SAN ANTONIO WATER SYSTEM
DSP WATER PRODUCTION FACILITY UPGRADES PROJECT

SAWS JOB NUMBER 12-6103

ADDENDUM NO. 2
September 26, 2013

To Respondent 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.

A. Modifications to the Specifications

1. TABLE OF CONTENTS
   Add Appendix A – Geotechnical Report

2. PRICE PROPOSAL
   Replace the entire Price Proposal pages 1 through 5 with the revised Price Proposal dated September 26, 2013.

3. SPECIAL CONDITIONS
   Add SC-4.4. The Edwards Aquifer Authority (EAA) requires inspection, testing and acceptance by their staff, representative and/or agent of all electromagnetic flow meters prior to the Substantial Completion inspection. The EAA and its agents shall have reasonable access to the facilities being modified as part of the project for the purposes of reviewing, inspecting and verifying the work being performed.

4. APPENDIX A
   Geotechnical report entitled "SAWS DSP Water Production Facility Upgrades", dated August 21, 2013, prepared by Arias and Associates, Inc. is incorporated into the specifications as Appendix A. Any references made to the "Somerset" Facility shall be disregarded.

ACKNOWLEDGMENT BY BIDDER

Each respondent is requested to acknowledge receipt of this Addendum No. 2 by his/her signature affixed hereto and to file same with and attach to his/her proposal.

Vicente J. Garza, P. E.
TXBPE 104973
San Antonio Water System
Project Engineer

The undersigned acknowledges receipt of this Addendum No. 2 and the proposal submitted herewith is in accordance with the information and stipulations set forth.

____
Date

____
Signature of Bidder

PRICE PROPOSAL

PROPOSAL OF ____a corporation

a partnership consisting of ____

an individual doing business as____

TO THE SAN ANTONIO WATER SYSTEM:

Pursuant to Invitation for Competitive Sealed Proposals and Instructions to Respondents, the undersigned proposes to furnish all labor, materials, equipment and supervision as specified and perform the work required for the construction of the **(DSP) Water Production Facility Upgrades Project**, San Antonio Water System Job Number 12-6103, in accordance with the Plans and Specifications for the following prices to wit:

1. BLACKHAWK PS (FACILITY #66)

ITEM NO	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (FIGURES)	TOTAL (FIGURES)
1A	Civil/Mechanical Demolition and Improvements at Blackhawk PS Complete in Place; ______________________________Dollars and __________________________Cents	LS	1	$XXXXXXX	$___________
1B	Electrical and Instrumentation and Controls Demolition and Improvements at Blackhawk PS Complete in Place; ______________________________Dollars and __________________________Cents	LS	1	$XXXXXXX	$___________
1C	Third Party Electrical Testing at Blackhawk PS Complete in Place; ______________________________Dollars and __________________________Cents	LS	1	$XXXXXXX	$___________
SUBTOTAL BLACKHAWK PS: ____________________________ Dollars and ________________ Cents					

2. MIDCROWN PS (FACILITY #36)

ITEM NO	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (FIGURES)	TOTAL (FIGURES)
2A	Civil/Mechanical Demolition and Improvements at Midcrown PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
2B	Electrical and Instrumentation and Controls Demolition and Improvements at Midcrown PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
2C	Third Party Electrical Testing at Midcrown PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
SUBTOTAL MIDCROWN PS: ____________________________ Dollars and ________________ Cents					

3. PITLUK PS (FACILITY #7)

ITEM NO	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (FIGURES)	TOTAL (FIGURES)
3A	Civil/Mechanical Demolition and Improvements at Pitluk PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
3B	Electrical and Instrumentation and Controls Demolition and Improvements at Pitluk PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
3C	Third Party Electrical Testing at Pitluk PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
SUBTOTAL PITLUK PS: ____________________________ Dollars and ________________ Cents					

4. WOTTLIN PS (FACILITY #24)

ITEM NO	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (FIGURES)	TOTAL (FIGURES)
4A	Civil/Mechanical Demolition and Improvements at Wottlin PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
4B	Electrical and Instrumentation and Controls Demolition and Improvements at Wottlin PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
4C	Third Party Electrical Testing at Wottlin PS Complete in Place; ______________________________Dollars and ___________________________Cents	LS	1	$XXXXXXX	$___________
SUBTOTAL WOTTLIN PS: ____________________________ Dollars and ________________ Cents					

5. ALLOWANCES

ITEM NO	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	UNIT PRICE (FIGURES)	TOTAL (FIGURES)
5A	Permit Allowance; Twenty Five Thousand Dollars and Zero Cents	Per Allowance	$XXXXXXX	$25,000.00
5B	CPS Energy Allowance; Forty Five Thousand Dollars and Zero Cents	Per Allowance	$XXXXXXX	$45,000.00
5C	Well Mudding Allowance; One Hundred Forty Thousand Dollars and Zero Cents	Per Allowance	$XXXXXXX	$140,000.00
SUBTOTAL ALLOWANCES: Two Hundred Ten **Dollars and** Zero **Cents**				

1.	**SUBTOTAL BLACKHAWK PS:**	**$**____________________
2.	**SUBTOTAL MIDCROWN PS:**	**$**____________________
3.	**SUBTOTAL PITLUK PS:**	**$**____________________
4.	**SUBTOTAL WOTTLIN PS:**	**$**____________________
5.	**SUBTOTAL ALLOWANCES:**	**$**____210,000.00__________
6.	**TOTAL PRICE AMOUNT**	**$** ____________________

____ **Dollars**

and ______________________________________ **Cents**

____
OFFEROR'S SIGNATURE & TITLE

____
FIRM'S PHONE NO. /FAX NO.

____
FIRM'S NAME (TYPE OR PRINT)

____
FIRM'S EMAIL ADDRESS

____
FIRM'S ADDRESS

The Contractor herein acknowledges receipt of the following Addendum Numbers.

ACKNOWLEDGEMENT OF ADDENDUM(s):

ADDENDUM No.____________________ **DATE:**______________

ADDENDUM No.____________________ **DATE:**______________

ADDENDUM No.____________________ **DATE:**______________

ADDENDUM No.____________________ **DATE:**______________

Owner Reserves the right to accept the overall most responsible Price Proposal.

1. Offeror acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Price. Final payment for all Unit Price Line Items will be based on actual quantities provided, determined as provided in the Contract Documents.

   Note: Complete the additional requirements of the proposal which are included on the following pages.

2. Any and all Addenda which are issued by the San Antonio Water System with appropriate signatures which acknowledge receipt shall be attached to and made a part of this Price Proposal.

3. The Offeror offers to construct the Project in accordance with the Contract Documents for the contract price and to complete the project within **360 calendar days** after the start date, as set forth in the Authorization to Proceed. The Offeror understands and accepts the provisions of the Contract Documents relating to liquidated damages of the Project if not completed on time.

4. The Undersigned agrees to commence work on a date to be specified in a written "Authorization to Proceed", and to substantially complete the work in **300 calendar days** and complete all the work in **360 calendar days** from that date.

Complete the additional requirements of the Proposal which are included on the following pages.

Geotechnical Engineering Study

SAWS DSP Water Production Facility Upgrades
San Antonio, Texas

Arias Job No. 2013-585

ARIAS & ASSOCIATES
Geotechnical • Environmental • Testing

Prepared For
SAN ANTONIO WATER SYSTEM

August 21, 2013

ARIAS & ASSOCIATES
Geotechnical • Environmental • Testing

August 21, 2013
Arias Job No. 2013-585

Vicente J. Garza, P.E., PMP
Production & Transmission Engineering
San Antonio Water System
2800 U.S. Hwy 281 North
San Antonio, TX 78212

RE: Geotechnical Engineering Study
SAWS DSP Water Production Facility Upgrades Project
San Antonio, Texas

Dear Mr. Garza:

The results of a Geotechnical Engineering Study for the proposed SAWS DSP Water Production Facility Upgrades Project in San Antonio, Texas are presented in this report. This project was authorized by Mr. .Jim Pedraza, P.E, by letter referencing the SAWS 2012 Geotechnical Engineering Design Services Contract between SAWS and Arias and Associates, Inc.

We understand that the proposed project will consist of installing a 50-foot tall antenna mast, concrete driveways, and shallow foundations for electrical equipment at five different SAWS Pump Station facilities. The purpose of this geotechnical engineering study was to establish foundation and pavement engineering properties for the subsurface conditions at each site. Our findings and recommendations should be incorporated into the design and construction documents for the proposed installations.

Thank you for the opportunity to be of service to you.

Sincerely,
Arias & Associates, Inc.
TBPE Registration No: F-32

STATE OF TEXAS
DEXTER BACON
54560
LICENSED
PROFESSIONAL ENGINEER
8/21/13

Dexter Bacon, P.E.
Senior Vice President

Marie Starich, P.E.
Senior Geotechnical Engineer

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5213 Davis Boulevard, Suite G
North Richland Hills, TX 76180
(817) 812-3500

REPORT FORMAT INFORMATION

To improve clarity in the intent of our geotechnical recommendations for this project, the report is organized into three sections. These sections are:

Section I – The *Scope and Findings* section contains the project and site description, an overview of our field exploration program, and the results of our subsurface exploration including a Vicinity Map, Boring Location Plan and the soil boring logs for all 5 sites.

Section II - The *Geotechnical Recommendations* section contains potential expansive soil related movement predictions for the various sites, subgrade preparation recommendations, an overview of applicable foundation systems, and design and construction considerations for the specific development items.

Section III - Section III contains Attachments.

SECTION I – SCOPE AND FINDINGS

PROJECT AND SITE DESCRIPTION

The proposed project will consist of the construction of a 50-foot tall antenna mast, concrete driveways, and concrete waffle slab foundations for electrical equipment at five SAWS Pump Station facilities. These facilities are located at:

Pump Station Facility	Address
Blackhawk	106 Blackhawk Trail, Hill Country Village, TX 78232
Midcrown	5825 Midcrown Dr., San Antonio, TX 78218
Pitluk	3040 Pitluk Ave., San Antonio, TX 78211
Wottlin	104 Wottlin Rd., Castle Hills, TX 78213
Somerset	19260 Somerset Rd., Somerset, TX 78069

The planned foundations at each site will consist of a stiffened beam and slab foundation (waffle slab) for electrical equipment and a drilled pier foundation for the antenna mast. Associated access drives at each site will consist of concrete pavement. *For the purpose of this geotechnical engineering study, we are assuming that the acceptable design PVR for the stiffened beam and slab (waffle) foundation for electrical equipment is on the order of 1 inch.*

During our field exploration performed between July 22 and 24, 2013, each site was developed and contained existing facilities. Existing facilities observed by Arias personnel at each location included:

Pump Station Facility	Observed Features
Blackhawk	Two (2) water wells, two maintenance buildings, electrical shelter, tank, concrete entrance and drive
Midcrown	A water well, maintenance building, electrical shelter, antenna mast, concrete entrance and asphalt drive. The area is non-paved within the site
Pitluk	Two (2) water wells, an abandoned diesel pump station, three buildings, electrical pad, in-ground shelter, antenna mast, concrete entrance and non-paved drives.
Wottlin	A water well, maintenance building, tank, antenna mast, asphalt entrance and drive which showed distress in areas with grass observed growing in the cracks
Somerset	Four (4) water wells, one diesel pump station, storage tank, maintenance building, in-ground shelter, antenna mast attached to the storage tank, concrete entrance and non-paved drives.

SOIL BORINGS AND LABORATORY TESTS

A total of 19 soil borings were drilled for the project. Four (4) borings drilled at the Blackhawk, Midcrown, Pitluk, and Somerset facilities, and three (3) borings drilled at the Wottlin facility. At each facility one 50-foot deep boring was drilled near the proposed antenna mast location, one 20-foot depth boring was located near the proposed electrical equipment foundation, and one or two 6-foot deep borings were located near proposed pavement areas. Because of size constraints and overhead power lines, only one pavement boring was drilled at the Wottlin facility. The approximate boring locations at each site are shown on the Boring Location Plans.

The soil borings were taken at existing site clearings in areas accessible to truck-mounted drilling equipment. Boring depths were measured from ground surface existing during our exploration. The borings were sampled in accordance with ASTM D 1587 for thin-walled tube and ASTM D 1586 for split spoon sampling techniques. A truck-mounted drill rig using continuous flight augers together with the sampling tool noted was used to secure the subsurface soil samples.

Material classifications and borehole logging were conducted during the exploration by our field representative. As a supplement to the field exploration, laboratory testing to aid in soil classification and evaluation of selected properties was conducted in accordance applicable ASTM procedures. The laboratory results are reported in the individual boring logs. Final soil classifications were determined by the Geotechnical Engineer based on laboratory and field test results and applicable ASTM procedures. Final classifications are shown on the boring logs .A key to the terms and symbols used on the logs is also included.

Remaining soil samples recovered from this exploration will be stored in our laboratory for a period of 30 days following submittal of this report. After this time period, the samples will be discarded unless requested otherwise.

SUBSURFACE CONDITIONS

Generalized stratigraphy and groundwater conditions encountered during this exploration are presented herein. The subsurface and groundwater conditions are based on conditions encountered at the boring locations to the depths explored. The Project Vicinity Map, the Boring Location Plan and the soil boring logs are shown on the following page.

Generalized Stratigraphy - Blackhawk Facility

Predominate Soil Type	Approx. Depth Range (ft)	Primary Consistency or Relative Density	USCS Class.	GW Observed Depth (ft)
Moderate to highly expansive CLAY with thin Gypsum and Gravel Seams	0 to 50	Stiff to Hard	CL or CH	47

Generalized Stratigraphy - Midcrown Facility

Predominate Soil Type	Approx. Depth Range (ft)	Primary Consistency or Relative Density	USCS Class.	GW Observed Depth (ft)
Clayey sand or clayey gravel (B-2 and B-3 only)	0 to (2-4)	Medium Dense	SC or GC	
Moderate to highly expansive CLAY with Gypsum Seams	0 to 50	Stiff to Hard	CL or CH	34

Generalized Stratigraphy - Pitluk Facility

Predominate Soil Type	Approx. Depth Range (ft)	Primary Consistency or Relative Density	USCS Class.	GW Observed Depth (ft)
Moderate to highly expansive sandy clay	0 to 4	Firm to very stiff	CL or CH	
Clayey gravel	0.5 to 15	Medium dense to dense	GC	
Moderate to highly expansive CLAY with calcareous deposits	10.5 to 50+	Very Stiff to Very Hard	CH	36

Generalized Stratigraphy - Wottlin Facility

Predominate Soil Type	Approx. Depth Range (ft)	Primary Consistency or Relative Density	USCS Classification	GW Observed Depth (ft)
Dark brown moderate to highly expansive CLAY	0 to 2	Stiff	CH	Not encountered during drilling
Clayey gravel with sand	0.5 to 4	Loose	GC	
Lean clay with calcareous deposits	2 to 16	Hard to very hard	CL	
MARL	16 to 50+	Very hard	MARL	

Generalized Stratigraphy - Somerset Facility

Predominate Soil Type	Approx. Depth Range (ft)	Consistency or Relative Density	USCS Classification	GW Observed Depth (ft)
Moderate to highly expansive CLAY	0-38	Stiff to hard	CL or CH	Not encountered during drilling
Sandy lean clay	38 to 50+	Very hard	CL	

BOREHOLE GROUNDWATER DATA

Groundwater was observed during drilling at the following boring locations.

Borehole Groundwater Data

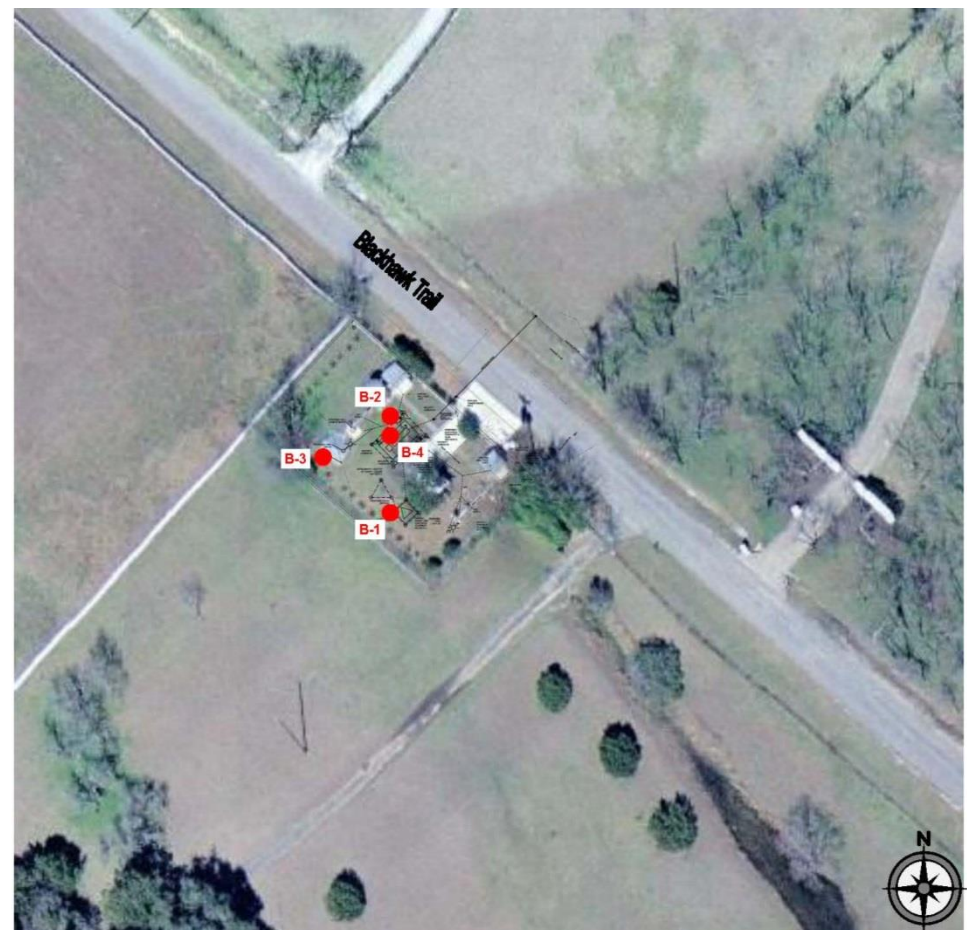
Site	Boring	Total Depth of Boring, feet	Depth to Groundwater (ft.)	
			During drilling	After completion
Blackhawk	B-1	49.0	47.0	47.0
Midcrown	B-1	47.5	35.0	34.0
Pitluk	B-1	50.0	36.0	36.0

Note:

1. Depth to groundwater is referenced from ground surface at the borehole location.
2. Water levels in open boreholes may require several hours to several days to stabilize depending on the permeability of the soils. Seasonal conditions or other factors such as recent rainfall, drought, or temperature variations may result in different groundwater conditions being present during construction.
3. Perched water conditions may develop after rain events or if inadequate drainage occurs in surface soils having lower PIs and/or higher sand and/or gravel content.
4. Groundwater levels will often change over time and should be verified immediately prior to construction. Pockets or seams of gravels, sands, silts or open fractures and joints can store and transmit “perched” groundwater flow or seepage.

VICINITY MAP

BORING LOCATION PLAN



EXISTING SITE CONDITIONS

Boring Log No. B-1

Project: **SAWS Pump Station - Blackhawk**
106 Blackhawk Trail
Hill Country Village, Texas

Sampling Date: 7/22/13
Coordinates: N29°34'32.4" W98 °29'23.4"
Location: Antenna mast: See Boring Location Plan
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200
SANDY FAT CLAY (CH), hard, dark brown		SS	34					30	
CLAYEY GRAVEL with Sand (GC), medium dense, light tan		SS	5	20	44	24		27	21
LEAN CLAY (CL), very stiff, brown, with trace of iron	5	SS	18					21	
LEAN CLAY (CL), stiff to very stiff, tan and gray to tan		SS	13	14	29	15		14	85
-with calcareous from 8' to 10' -with interbedded gypsum seams after 9'	10	SS	16					20	
-iron nodules between 10' to 11'		SS	15					23	
-hard below 13' -gravel at 14'	15	SS	12	16	39	23		41	90
	20	SS	14					38	
	25	T	12	17	47	30	5.75		87
	30	T	16				10.25		
	35	SS	13					65	
	40	T	17						
	45	T	14	16	39	23	7.5		89
		SS	21					**50/6"	

Borehole terminated at 49 feet

Groundwater Data:
First encountered during drilling: 47-ft depth
After completion: 47-ft depth
Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Air rotary: 0 - 49 ft

Nomenclature Used on Boring Log

Split Spoon (SS) | Thin-walled tube (T)
Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2013-585 BLACKHAWK.GPJ 8/26/13 (BORING LOG SA13-02 ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

Boring Log No. B-2

Project: **SAWS Pump Station - Blackhawk**
106 Blackhawk Trail
Hill Country Village, Texas

Sampling Date: 7/22/13
Coordinates: N29°34'32.9" W98 °29'23.4"
Location: Electrical equipment: See Boring Location Plan
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200	DD	Uc
SANDY FAT CLAY (CH), very hard, dark brown -gravel at 6"		SS	19					**50/6"			
-stiff after 2'		SS	15	22	54	32		11	73 (GSD)		
LEAN CLAY (CL) with sand, very stiff, tan and gray to tan	5	SS	11					16			
-hard at 7'		T	14				3.25		84 (GSD)		
-with calcareous from 8' to 10'	10	T	14	14	40	26	3.0		78	119	2.89
GRAVELLY FAT CLAY (CH), hard, tan -with interbedded gypsum seams below 10'		T	17				4.75			114	1.70
	15	T	17				6.0				
	20	T	18	22	60	38	7.0		63		

Borehole terminated at 20 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 20 ft

Nomenclature Used on Boring Log

Split Spoon (SS) | Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

2013-585 BLACKHAWK.GPJ 8/26/13 (BORING LOG SA13-02 ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

Boring Log No. B-3

Project: **SAWS Pump Station - Blackhawk**
106 Blackhawk Trail
Hill Country Village, Texas
Location: Pavement: See Boring Location Plan

Sampling Date: 7/22/13
Coordinates: N29°34'32.7" W98 °29'23.8"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
SANDY FAT CLAY (CH), firm, dark brown, with some gravel	0–1	SS	35	21	61	40	6	58
-stiff below 2'	2							
	3–4	SS	23				14	
	5–6	SS	8				10	

Borehole terminated at 6 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve

2013-585 BLACKHAWK.GPJ 8/21/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.
Job No.: 2013-585

Boring Log No. B-4

Project: **SAWS Pump Station - Blackhawk**
106 Blackhawk Trail
Hill Country Village, Texas
Location: Pavement: See Boring Location Plan

Sampling Date: 7/22/13
Coordinates: N29°34'32.8" W98 °29'23.4"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
SANDY FAT CLAY (CH), very stiff, dark brown	0–1	SS	11				17	
-with trace of gravel at 3'	3–4	SS	6				25	
FAT CLAY (CH) with sand, stiff, tan	5–6	SS	14	18	54	36	9	81

Borehole terminated at 6 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve

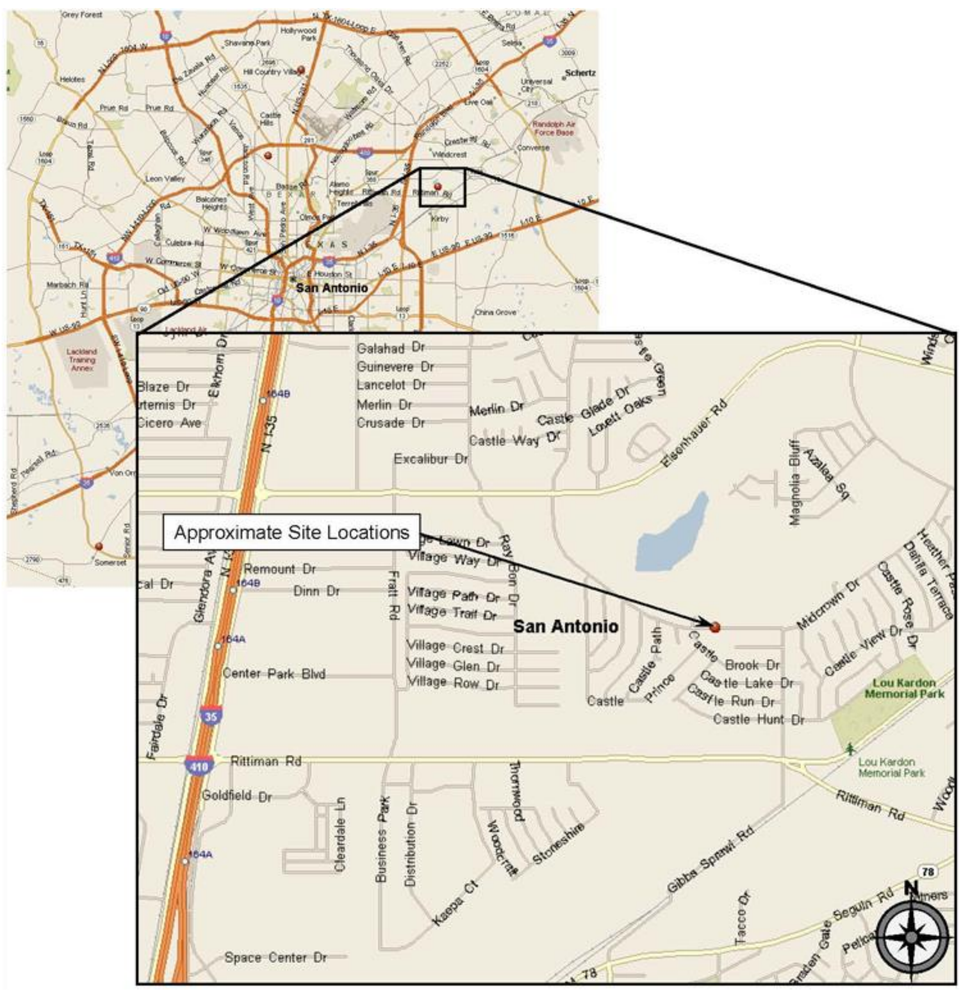
2013-585 BLACKHAWK.GPJ 8/21/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.
Job No.: 2013-585

VICINITY MAP

BORING LOCATION PLAN

EXISTING SITE CONDITIONS



Boring Log No. B-1

Project: **SAWS Pump Station - Midcrown**
5825 Midcrown Drive
San Antonio, Texas

Sampling Date: 7/23/13
Coordinates: N29°29'26.3" W98 °22'25.7"
Location: Antenna mast: See Boring Location Plan
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200	DD	Uc
FAT CLAY (CH) with sand, stiff, dark brown, (Possible Fill)		SS	14					9			
		SS	15					11			
-very stiff after 4'		SS	17	22	76	54		23	83		
FAT CLAY (CH), hard, tan and gray -with some gypsum from 6' to 10'		T	13				11.75				
		T	14	20	69	49	9.5		95		
		T	15				8.0			117	5.57
		T	15				9.0				
		T	14	19	55	36	8.75		97		
		T	17				7.25			114	3.63
		T	16				6.25				
		T	14								
-with gypsum seams below 38'		T	18	19	60	41	8.0		89		
		T	16								
		SS	22					35			
-very hard below 45'		SS	19					77			
		SS	21	21	69	48		71	94		

Borehole terminated at 47.5 feet

Groundwater Data:
First encountered during drilling: 35-ft depth
After 1 hour: 34-ft depth

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 47.5 ft

Nomenclature Used on Boring Log

Split Spoon (SS) — Thin-walled tube (T) — ▽ Water encountered during drilling — ▼ Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

2013-585 MIDCROWN.GPJ 8/26/13 (BORING LOG SA13-02.ARIAS SA12-01.GDT LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-2

Project: **SAWS Pump Station - Midcrown**
5825 Midcrown Drive
San Antonio, Texas

Sampling Date: 7/24/13
Coordinates: N29°29'26.4" W98 °22'26.3"
Location: Electrical equipment: See Boring Location Plan
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200
CLAYEY SAND (SC) with gravel and calcareous deposits, medium dense, dark brown, (Possible Fill) -chert at 1.5'		SS	13	20	69	49		12	48
FAT CLAY with Sand (CH), stiff, dark brown		SS	17					13	
		SS	16					13	88 (GSD)
FAT CLAY (CH), hard, tan and gray		SS	14					29	
		T	13	20	62	42	11.5		97
-with some iron nodules below 10'		T	14				8.25		98 (GSD)
		T	15				8.0		
		T	17	18	61	43	6.25		95

Borehole terminated at 20 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 20 ft

Nomenclature Used on Boring Log

Split Spoon (SS) — Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 MIDCROWN.GPJ 8/26/13 (BORING LOG SA13-02.ARIAS SA12-01.GDT LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-3

Project:	**SAWS Pump Station - Midcrown** **5825 Midcrown Drive** **San Antonio, Texas**
Location:	Pavement: See Boring Location Plan
Sampling Date:	7/23/13
Coordinates:	N29°29'25.4" W98 °22'27"
Backfill:	Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
3" ASPHALT								
5" BASE								
CLAYEY GRAVEL with Sand (GC), medium dense, dark brown	0–4	SS	14	18	60	42	11	36
		SS	21				8	
FAT CLAY (CH), stiff, dark brown	4–6	SS	24	19	74	55	13	85
Borehole terminated at 6 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 MIDCROWN.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-4

Project:	**SAWS Pump Station - Midcrown** **5825 Midcrown Drive** **San Antonio, Texas**
Location:	Pavement: See Boring Location Plan
Sampling Date:	7/23/13
Coordinates:	N29°29'26.1" W98 °22'26.4"
Backfill:	Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
FAT CLAY (CH) with sand, stiff, dark brown	0–4	SS	22	20	74	54	13	71
		SS	4				13	
FAT CLAY (CH), stiff, dark brown	4–6	SS	17				14	
Borehole terminated at 6 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

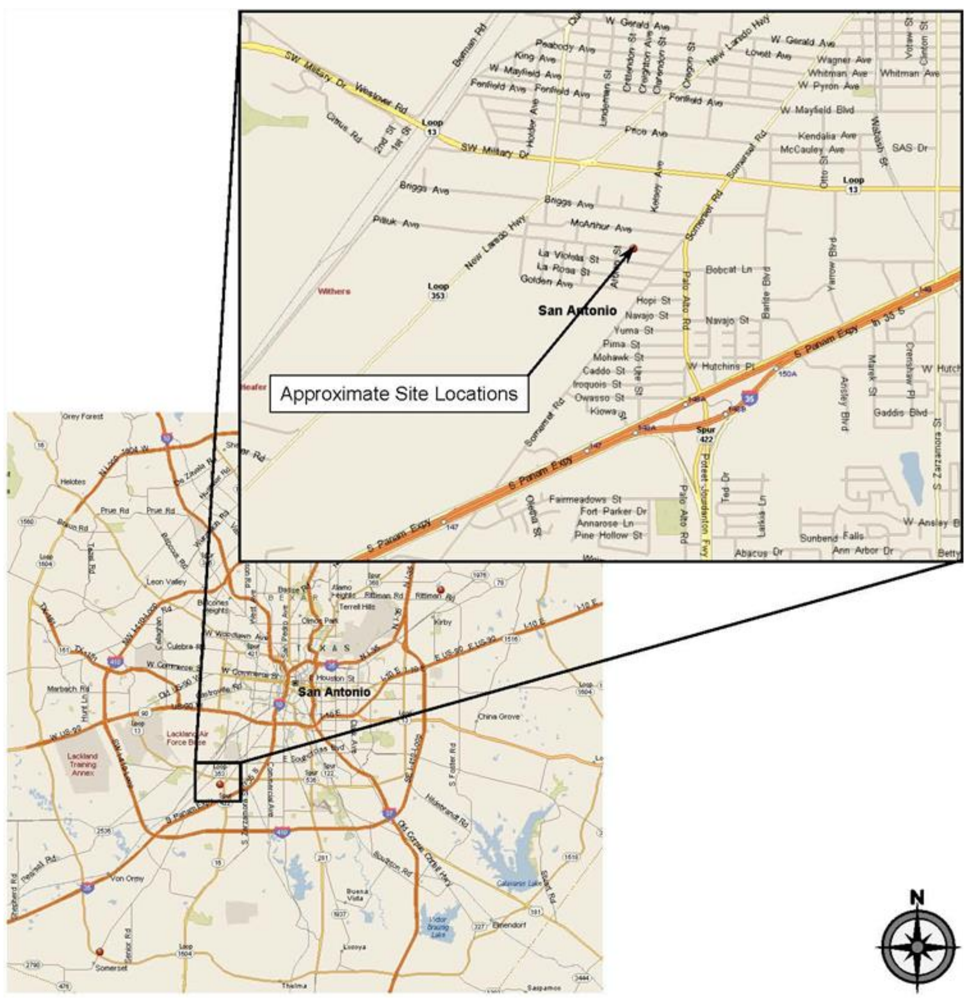
WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 MIDCROWN.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

VICINITY MAP



BORING LOCATION PLAN

EXISTING SITE CONDITIONS

Boring Log No. B-1

Project: **SAWS Pump Station - Pitluk**
3040 Pitluk Ave.
San Antonio, Texas
Location: Antenna mast: See Boring Location Plan

Sampling Date: 7/24/13
Coordinates: N29°21'9.8" W98 °33'25.3"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200
SANDY LEAN CLAY (CL), very stiff, dark brown		SS	15	16	43	27		19	66
CLAYEY GRAVEL with Sand (GC), dense, dark brown to tan		SS	13					39	
	5	SS	2					44	
		SS	11					30	
-with chert from 9' to 12'	10	SS	15	14	32	18		54	44
		SS	8					46	(GSD)
	15	SS	16					30	
FAT CLAY (CH), hard to very hard, tan and gray -with calcareous deposits below 15'									
-iron staining below 19'	20	T	24	25	62	37	6.75		98
	25	SS	18					44	
	30	SS	25					29	
	35	SS	22					54	
-iron nodules at 39'	40	SS	26					47	
	45	SS						72	
FAT CLAY (CH), very hard, bluish gray	50	SS	27	24	95	71		69	97
Borehole terminated at 50 feet									

Groundwater Data:
First encountered during drilling: 36-ft depth
After completion: 36-ft depth
Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Thin-walled tube (T)
Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 PITLUK.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-2

Project: **SAWS Pump Station - Pitluk**
3040 Pitluk Ave.
San Antonio, Texas
Location: Electrical equipment: See Boring Location Plan

Sampling Date: 7/24/13
Coordinates: N29°21'9.7" W98 °33'25.4"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
FAT CLAY with Sand (CH), very stiff, dark brown		SS	12				16	
		SS	16	22	62	40	19	76 (GSD)
CLAYEY GRAVEL with Sand (GC), medium dense, brown to tan	5	SS	9				26	
-dense at 7' -with calcareous deposits from 7.5' to 9.5'		SS	5	15	41	26	37	40
		SS	7				50/4"	
-chert seam from 9.5' to 10.5', very dense	10							
LEAN CLAY (CL) trace calcareous material, very stiff, tan and gray		SS	14	18	48	30	21	95
-very hard below 15'	15	SS	20				59	
FAT CLAY (CH), hard, tan and gray	20	SS	24	4	76	72	27	96
Borehole terminated at 20 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 20 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 PITLUK.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-3

Project: **SAWS Pump Station - Pitluk**
3040 Pitluk Ave.
San Antonio, Texas
Location: Pavement: See Boring Location Plan

Sampling Date: 7/24/13
Coordinates: N29°21'9.2" W98 °33'24.8"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
FAT CLAY (CH) with sand, stiff, dark brown	0–1	SS	14				14	
	3–4	SS	15	21	58	37	14	70
CLAYEY GRAVEL with Sand (GC), dense, dark brown	5–6	SS	6				41	

Borehole terminated at 6 feet

2013-585 PITLUK.GPJ 8/26/13 (BORING LOG SA13-02.ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-4

Project: **SAWS Pump Station - Pitluk**
3040 Pitluk Ave.
San Antonio, Texas
Location: Pavement: See Boring Location Plan

Sampling Date: 7/24/13
Coordinates: N29°21'10.3" W98 °33'24.6"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
SANDY LEAN CLAY (CL), firm, dark brown	0–0.5							
CLAYEY GRAVEL with Sand (GC), dense, brown and gray	0.5–1	SS	13	16	39	23	32	20
	3–4	SS	3				34	
	5–6	SS	5	17	38	21	29	23

Borehole terminated at 6 feet

2013-585 PITLUK.GPJ 8/26/13 (BORING LOG SA13-02.ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical
Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

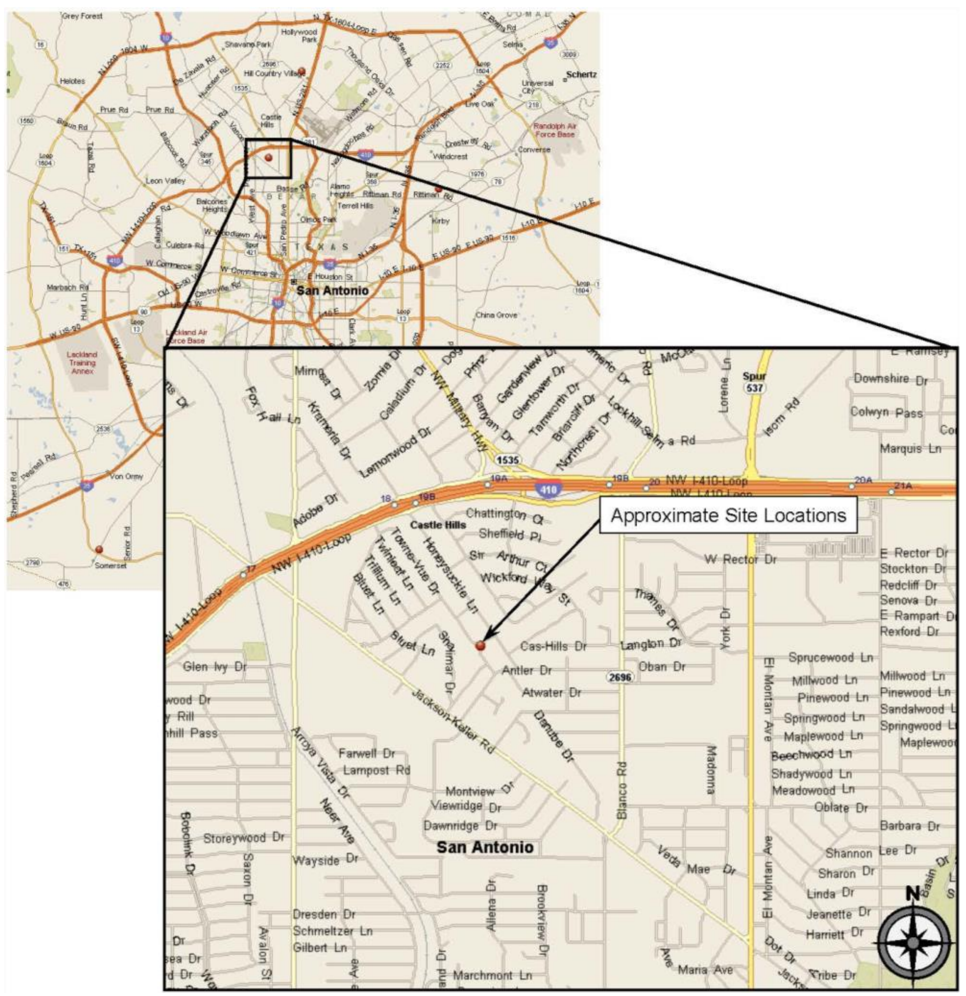
Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

Arias & Associates, Inc.

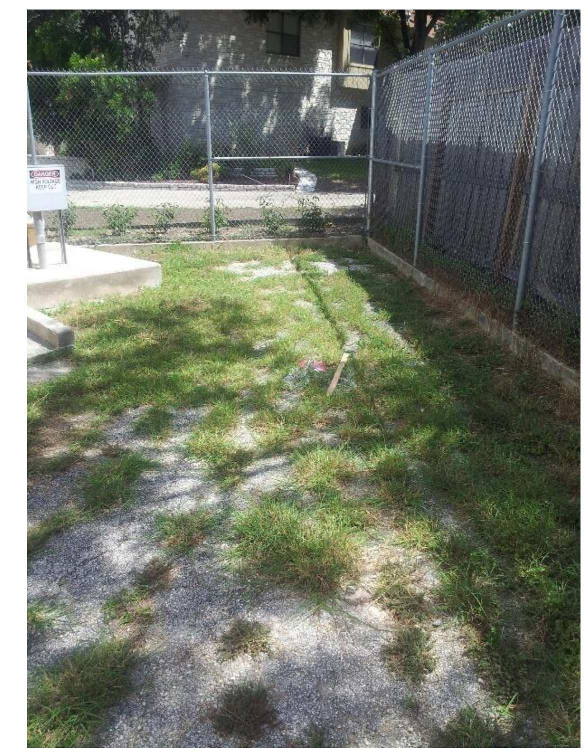
Job No.: 2013-585

VICINITY MAP



BORING LOCATION PLAN

EXISTING SITE CONDITIONS



Boring Log No. B-1

Project: **SAWS Pump Station - Wottlin**
104 Wottlin Road
Castle Hills, Texas

Location: Antenna mast: See Boring Location Plan

Sampling Date: 7/22/13

Coordinates: N29°30'42" W98 °30'52.4"

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
2" ASPHALT								
4" BASE		SS	12	18	58	40	12	85
FAT CLAY (CH), stiff, dark brown		SS	11	16	41	25	10	39
CLAYEY GRAVEL with Sand (GC), loose, light brown	5	SS	9				20	
LEAN CLAY (CL), very stiff, tan and gray, with calcareous nodules from 4' to 6'		SS	10				**50/5"	
-very hard below 6'	10	SS	10	16	40	24	53	89
		SS	10				51	
-iron nodules at 14'	15	SS	23				23	
MARL, hard, light gray with some tan	20	SS	11				87	
-very hard below 23'	25	SS	10				**50/5"	
	30	SS	9	16	40	24	**50/5"	78
	35	SS	10				**50/1"	
	40	SS	12				**50/5"	
	45	SS	15				**50/1"	
	50	SS	21	17	45	28	**50/3"	72
Borehole terminated at 50 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2013-585 WOTTLIN.GPJ 8/26/13 (BORING LOG SA13-02 ,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-2

Project: **SAWS Pump Station - Wottlin**
104 Wottlin Road
Castle Hills, Texas

Location: Electrical equipment: See Boring Location Plan

Sampling Date: 7/22/13

Coordinates: N29°30'41.8" W98 °30'52.4"

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
LEAN CLAY (CL), stiff, dark brown		SS	10				12	
-very stiff after 2'		SS	8	17	42	25	20	88
LEAN CLAY (CL) trace calcareous material, hard, tan and gray	5	SS	6				32	95 (GSD)
-very hard at 7'		SS	8				67	
-with some iron nodules from 9' to 15'	10	SS	10	19	42	23	41	92 (GSD)
	15	SS	10	18	49	31	53	87
MARL, hard, light gray with some tan								
-very hard below 18'		SS	8				**50/3"	
Borehole terminated at 18.75 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 18.75 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2013-585 WOTTLIN.GPJ 8/26/13 (BORING LOG SA13-02 ,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc.

Job No.: 2013-585

Boring Log No. B-3

Project: **SAWS Pump Station - Wottlin** **104 Wottlin Road** **Castle Hills, Texas**	Sampling Date: 7/23/13
	Coordinates: N29°30'42.3" W98 °30'52.2"
Location: Pavement: See Boring Location Plan	Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
1" ASPHALT								
5" BASE								
CLAYEY GRAVEL with Sand (GC), loose, tan	1							
		SS	7	17	48	31	9	41
	2							
LEAN CLAY (CL), stiff, tan and gray	3							
		SS	9				14	
-very stiff below 4'	4							
	5							
		SS	9	15	39	24	19	89
	6							
Borehole terminated at 6 feet								

2013-585 WOTTLIN.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve

Arias & Associates, Inc.

Job No.: 2013-585

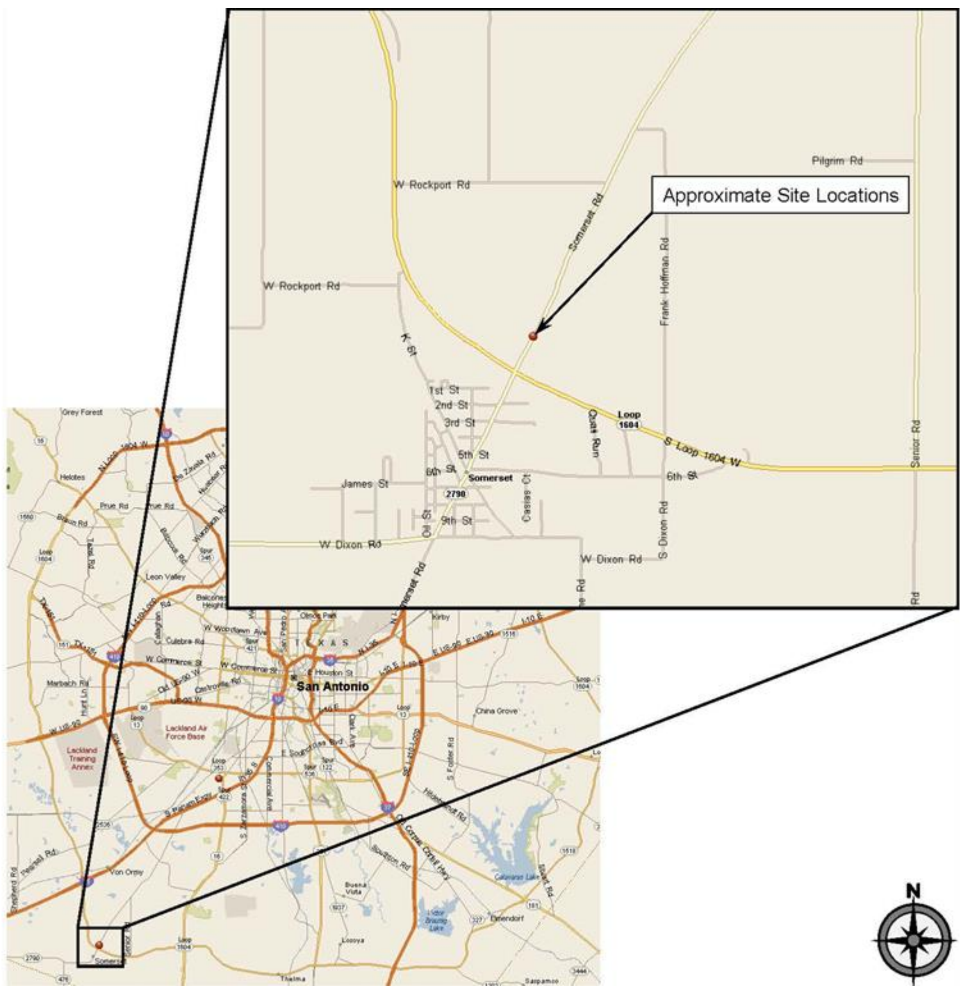
KEY TO CLASSIFICATION SYMBOLS USED ON BORING LOGS

MAJOR DIVISIONS			GROUP SYMBOLS	DESCRIPTIONS
COARSE-GRAINED SOILS (More Than Half of Material LARGER Than No. 200 Sieve size)	GRAVELS (More Than Half of Coarse Fraction is LARGER Than No. 4 Sieve Size)	Clean Gravels (Little or no Fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels With Fines (Appreciable Amount of Fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS (More Than Half of Coarse Fraction is SMALLER Than No. 4 Sieve Size)	Clean Sands (Little or no Fines)	SW	Well-Graded Sands, Gravelly Sands, Little or no Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or no Fines
		Sands With Fines (Appreciable Amount of Fines)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS (More Than Half of Material is SMALLER Than No. 200 Sieve Size)	SILTS & CLAYS	Liquid Limit Less Than 50	ML	Inorganic Silts & Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
	SILTS & CLAYS	Liquid Limit Greater Than 50	MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils, Elastic Silts
			CH	Inorganic Clays of High Plasticity, Fat Clays
FORMATIONAL MATERIALS	SANDSTONE			Massive Sandstones, Sandstones with Gravel Clasts
	MARLSTONE			Indurated Argillaceous Limestones
	LIMESTONE			Massive or Weakly Bedded Limestones
	CLAYSTONE			Mudstone or Massive Claystones
	CHALK			Massive or Poorly Bedded Chalk Deposits
	MARINE CLAYS			Cretaceous Clay Deposits
	GROUNDWATER		▼	Indicates Final Observed Groundwater Level
			▽	Indicates Initial Observed Groundwater Location

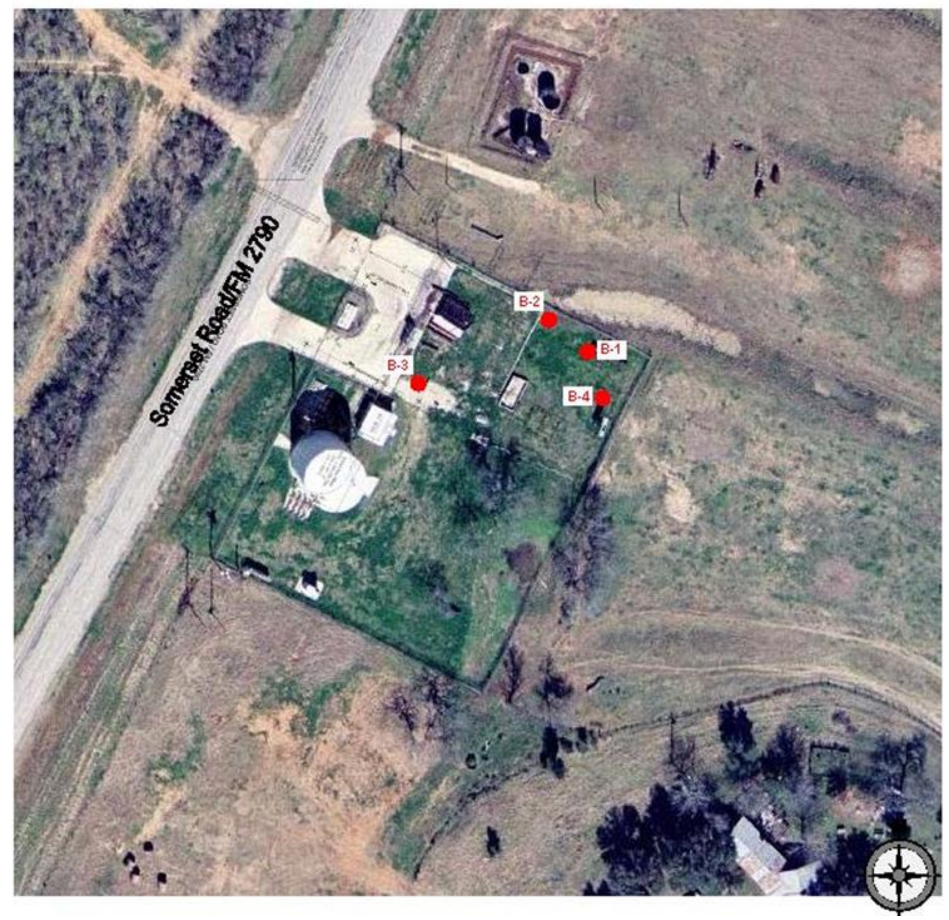
Arias & Associates, Inc.

Final soil classifications were determined by the Geotechnical Engineer based on laboratory and field test results and applicable ASTM procedures. Transition boundaries or contacts, noted on the boring logs to separate soil types, are approximate. Actual contacts may be gradual and vary at different locations. Stratigraphic and groundwater conditions shown on the boring logs reflect conditions at the explored location on the date explored.

VICINITY MAP



BORING LOCATION PLAN



EXISTING SITE CONDITIONS

Boring Log No. B-1

Project:	**SAWS Pump Stations - Somerset** **19260 Somerset Road** **Somerset, Texas**
Location:	Antenna mast: See Boring Location Plan
Sampling Date:	7/23/13
Coordinates:	N29°14'1.6" W98 °39'9.3"
Backfill:	Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200	DD	Uc
FAT CLAY with Sand (CH), stiff, light gray with reddish brown		SS	5					10			
		SS	10	18	55	37		14	80		
	5	SS	17					16			
		T	23				3.25				
	10	T	24	19	61	42	3.0		94		
		T	23				3.25			100	1.67
LEAN CLAY with Sand (CL), very stiff, reddish brown	15	SS	9					16			
FAT CLAY with Sand (CH), stiff, gray with reddish brown	20	T	21				1.25				
-very stiff below 23'	25	T	23	19	66	47	2.75		81		
	30	T	23				2.5				
	35	T	26								
SANDY LEAN CLAY (CL), very hard, dark gray	40	SS	23	23	44	21		55	62		
	45	T	20								
		SS	19	17	38	21		50/5"	64		

Borehole terminated at 49.5 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 49.5 ft

Nomenclature Used on Boring Log

Split Spoon (SS) — Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

2013-585 SOMERSET.GPJ 8/26/13 (BORING LOG SA13-02_ARIASSA12-01.GDT_LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

Boring Log No. B-2

Project:	**SAWS Pump Stations - Somerset** **19260 Somerset Road** **Somerset, Texas**
Location:	Electrical equipment: See Boring Location Plan
Sampling Date:	7/23/13
Coordinates:	N29°14'1.8" W98 °39'9.6"
Backfill:	Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	PP	N	-200
FAT CLAY with Sand (CH), stiff, reddish brown		SS	16	19	50	31		12	76
		SS	11	19	54	35		14	74 (GSD)
LEAN CLAY (CL) with sand, stiff, light gray, with some iron nodules	5	SS	22	18	48	30		12	87
-with yellow seams at 7'		T	24	22	33	11	1.75		81
FAT CLAY with Sand (CH), stiff, tan and gray		T	22				1.75		92 (GSD)
-hard below 10'	10								
		SS	25					31	
		T	24						
	15								
-stiff below 18'	20	T	20	20	58	38	1.5		84

Borehole terminated at 20 feet

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 20 ft

Nomenclature Used on Boring Log

Split Spoon (SS) — Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
PP = Pocket Penetrometer (tsf)
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 SOMERSET.GPJ 8/26/13 (BORING LOG SA13-02_ARIASSA12-01.GDT_LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

Boring Log No. B-3

Project: **SAWS Pump Stations - Somerset**
19260 Somerset Road
Somerset, Texas

Location: Pavement: See Boring Location Plan

Sampling Date: 7/23/13
Coordinates: N29°14'1.4" W98 °39'10.6"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
CLAYEY GRAVEL with Sand (GC), very stiff, reddish brown, (possible fill)	0–1.5	SS	2	17	31	14	24	32
FAT CLAY with Sand (CH), stiff, light gray	1.5–6	SS	11				9	
-with iron nodules from 4' to 6' -very stiff below 4'		SS	16	19	56	37	21	88
Borehole terminated at 6 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 SOMERSET.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

Boring Log No. B-4

Project: **SAWS Pump Stations - Somerset**
19260 Somerset Road
Somerset, Texas

Location: Pavement: See Boring Location Plan

Sampling Date: 7/23/13
Coordinates: N29°14'1.3" W98 °39'9.2"
Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
FAT CLAY with Sand (CH), stiff to hard, reddish brown to light gray	0–6	SS	5				13	
-very stiff below 2'		SS	6	21	53	32	18	81
-hard below 4'		SS	13				43	
Borehole terminated at 6 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: W. Persyn
Driller: Alpha & Omega Geotechnical Environmental Drilling
Equipment: Track-mounted drill rig

Single flight auger: 0 - 6 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve

2013-585 SOMERSET.GPJ 8/26/13 (BORING LOG SA13-02,ARIASSA12-01.GDT,LIBRARY2013-01.GLB)

Arias & Associates, Inc. Job No.: 2013-585

SECTION II – GEOTECHNICAL RECOMMENDATIONS

MOISTURE VARIATIONS AND ESTIMATED MOVEMENT

Structural damage can be caused by volume changes in clay soils. Clays can shrink when they lose water and swell (grow in volume) when they gain water. The potential for expansive clays to shrink and swell is typically related to the Plasticity Index (PI). Clays with a higher PI generally have a greater potential for soil volume changes due to moisture content variations. The soils found at these sites are capable of swelling and shrinking in volume dependent on potentially changing soil water content conditions during or after construction.

The encountered soils at each site have a high to very high potential for shrinking and swelling. Several methods exist to evaluate swell potential of expansive clay soils. We have estimated potential heave using the TXDOT method (Tex 124-E). we estimate that the PVR as shown on the attached table for each site.

Site	PVR (in.)
Blackhawk	2.25
Midcrown	5.5
Pitluk	2.5
Wottlin	2.25
Somerset	3.25

Soil moisture levels are relatively low and some are below the soil's plastic limit. Because of dry soil conditions (low soil moisture contents), it is our experience that the standard correlations incorporating the plasticity measurements of the soils typically underestimate the shrink/swell potential of soils in the San Antonio area. Consequently, fluctuations in the soil moisture content generated from extreme climatic conditions (i.e., droughts or floods) or as a result of development (e.g., irrigation of landscaping in the immediate vicinity of the building, poor surface drainage, leaking plumbing or water lines) may result in greater shrink/swell movements than calculated.

FOUNDATION DESIGN CONSIDERATIONS

Both shallow and deep foundation types are utilized in this area. Deep drilled piers will be utilized for the antenna supports. The equipment pad foundations will be based on a stiffened beam and slab (waffle slab) type foundation with the foundation site prepared for a maximum shrink/swell movement of a 1" PVR.

A "bathtub" condition can occur when excavating into low permeability, expansive soils and replacing these soils with a higher permeability, granular select fill. That is, surface water could infiltrate the more permeable select fill building pad material and pond on top of the underlying expansive clay, commonly referred to as a "bathtub" condition. This "bathtub" condition could result in expansive soil-related movements on the order of 3 to 5 times the design PVR. To aid in reducing the chances for a "bathtub condition" from developing at this site, we recommend the following:

1. Using a low permeability, clayey select fill to construct the building pad,
2. Installing a horizontal moisture barrier adjacent to the equipment foundation, and
3. Employing the recommendations provided herein for subgrade preparation and design measures to reduce changes in soil moisture.

Foundation Types

A criterion that is important in the selection of the type of foundation system to be used is the amount of movement and the consequences of movement that the Owner is willing to accept. The utilization of shallow foundations incurs higher risks for movement than use of drilled pier foundations with a structurally suspended floor slab. If the risk for movement cannot be tolerated and the potential for periodic maintenance is not acceptable, principal structural loads for the proposed equipment foundation should be supported on drilled piers founded adequately below the depth of anticipated seasonal moisture change (active zone) and the pier cap should be suspended above grade. Site improvements will be necessary for the slab-on-grade foundation system in order to reduce anticipated shrink/swell movement to an acceptable PVR magnitude. We are providing recommendations for a design PVR of about 1-inch. If project requirements dictate a different magnitude of PVR, we should be informed so that modifications to our recommendations can be made. We should note that a 1-inch design PVR is typically considered acceptable for movement-sensitive structures by local geotechnical and structural engineers practicing in South Texas. The 1-inch design PVR is generally selected where some foundation movement is considered acceptable.

Minimum Pier Depths

The selection of the minimum pier depth for the Antennae Supports is a function of axial and lateral capacity requirements. Additionally, the pier must be sufficiently deep such that the swelling of the upper clays does not excessively heave the pier. Uplift resistance is provided by skin friction for the soils below the active zone as well as the pier concrete pier weight and dead load. Through the Structural Engineer, we were provided the design loads from the antennae manufacturer and utilized the Ensoft "Lpile" program to evaluate the depth of pier requirements for each site location. The pier embedment depth as required from the lateral and axial loading was then compared to pier depth computed for uplift resistance. In each case, the pier depth requirement due to uplift resistance was the controlling case. The minimum embedment depth is provided within the Drilled Pier Foundation Design And Construction Recommendations table for each site shown subsequently.

IBC Site Classification and Seismic Design Coefficients

Section 1613 of the International Building Code (2012) requires that every structure be designed and constructed to resist the effects of earthquake motions, with the seismic design category to be determined in accordance with Section 1613 or ASCE 7. Site classification according to the International Building Code (2012) is based on the soil profile encountered to 100-foot depth. The stratigraphy at the site location was explored to a maximum 50-foot depth. Similar soils were extrapolated to the 100-foot depth. Seismic design parameters were evaluated by selecting the site classification based on the encountered materials and the on-line U.S. Seismic Design Map, v. 3.1.0, dated July 11, 2013 by the USGS; results are summarized as follows:

Seismic Design Parameters – 2012 IBC Code

Site	Site Classification	Risk Category	Site Latitude	Site Longitude	Ss	S1
Blackhawk	D	IV (essential facilities)	29.58858	98.48983	0.075	0.030
Midcrown	D	IV (essential facilities)	29.4915	98.37381	0.080	0.031
Pitluk	D	IV (essential facilities)	29.351333	98.55703	0.082	0.027
Wottlin	D	IV (essential facilities)	29.5	98.51455	0.078	0.030
Somerset	D	IV (essential facilities)	29.236833	98.652583	0.083	0.026

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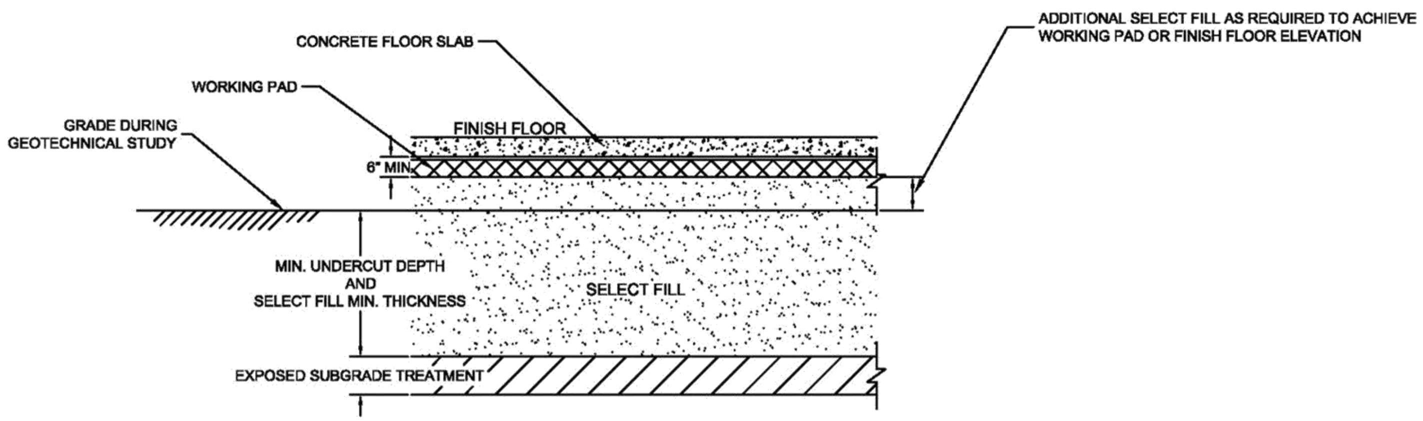
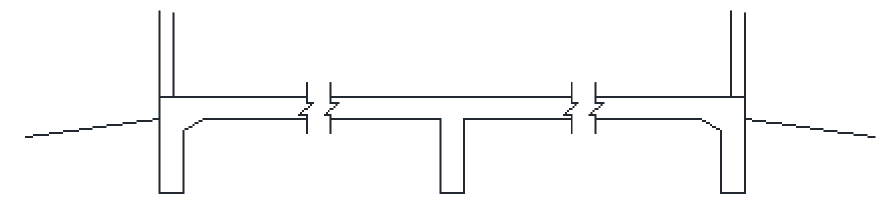
EQUIPMENT PAD DESIGN AND CONSTRUCTION RECOMMENDATIONS



Applicable for Foundation Type Options	Waffle Slab
Site Improvement Method	Undercut & Replace after Site Stripping
Improved Site Condition (PVR)	Approximate 1-inch Design PVR
Min. Undercut Depth - Somerset	**5 feet**
Minimum Undercut Depth - Blackhawk	**3 feet**
Minimum Undercut Depth – Mid Crown	**8 feet**
Minimum Undercut Depth - Pitluk	**4 feet**
Minimum Undercut Depth - Wottlin	**3 feet**
Undercut Extent	Below all slab areas and at least 5 feet beyond the slab perimeter and any features that may be sensitive to movement including but not limited to flatwork, canopy slabs, curbs, and other features adjacent to foundation
Exposed Subgrade Treatment	Scarify, moisture condition and compact existing materials to 12 inches below base of undercut depth
Select Fill Minimum Thickness	Same as Undercut Depth
Select Fill Material	LEAN CLAY (CL) with Liquid Limit <45%, PI = 12-20, -#200 > 50%, 3" maximum particle size
Working Pad Minimum Thickness	6 inches (optional)
Working Pad Material	Base meeting requirements of 2004 TxDOT Item 247, Type A, Grade 1 or 2
Vapor Retarder Material	Minimum 10-mil conforming to ASTM E1745, Class C or better and with a maximum water vapor permeance of 0.044 perms (ASTM E96) such as a 10 mil Stego Wrap by Stego Industries LLC or other similar product
Maximum Loose Lift Thickness (all materials)	8 inches
Maximum Elapsed Time Between Subgrade Preparation and Fill (select or reconditioned) Placement	48 hours

STIFFENED BEAM AND SLAB-ON-GROUND FOUNDATION RECOMMENDATIONS

TYPICAL WAFFLE SLAB CROSS-SECTION



A waffle slab type foundation is generally used to support relatively light structures where soil conditions are relatively uniform and where uplift and settlement can be tolerated. The intent of a stiffened beam and slab-on-grade foundation is to allow the structure and foundation to move with soil movements while providing sufficient stiffness to limit differential movements within the superstructure to an acceptable magnitude. The foundation may be designed using the Design of Slab-On-Ground Foundations published by the Wire Reinforcement Institute, Inc. (August 1981, updated March 1996). Alternately, the foundation may be designed using the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground published by the Post-Tensioning Institute (PTI DC10.1-08)

Arias is providing PTI design values for the Structural Engineer's consideration and possible use. These design values are estimated from the "Volflo" computer program in consideration of the soil conditions in the building area and local experience. The final design methodology for the planned foundations should be selected by the project Structural Engineer based on his knowledge and experience with similar foundation conditions in this area.

Slab Design Method	WRI
Applicability	Subgrade prepared in accordance with Building Pad Design and Construction Recommendations
Design PVR	About 1 inch
Climatic Rating (Cw) – San Antonio, Texas	17
Effective Plasticity Index	30
Support Index (C)	--
Soil/Climatic Rating Factor (1-C)	0.15
Unconfined Compressive Strength (tsf)	--

Slab Design Method	PTI
Applicability	Subgrade prepared in accordance with Equipment Pad Design and Construction Recommendations
Design PVR	About 1 inch
Depth to Constant Soil Suction	15 feet
Edge Moisture Variation Distance **Center Lift, e_m** **Edge Lift, e_m**	 9.0 feet 4.6 feet
Differential Soil Movement **Center Lift, y_m** **Edge Lift, y_m**	 0.8 inch 1.2 inches
Coefficient of Slab-Subgrade Friction, μ	0.75

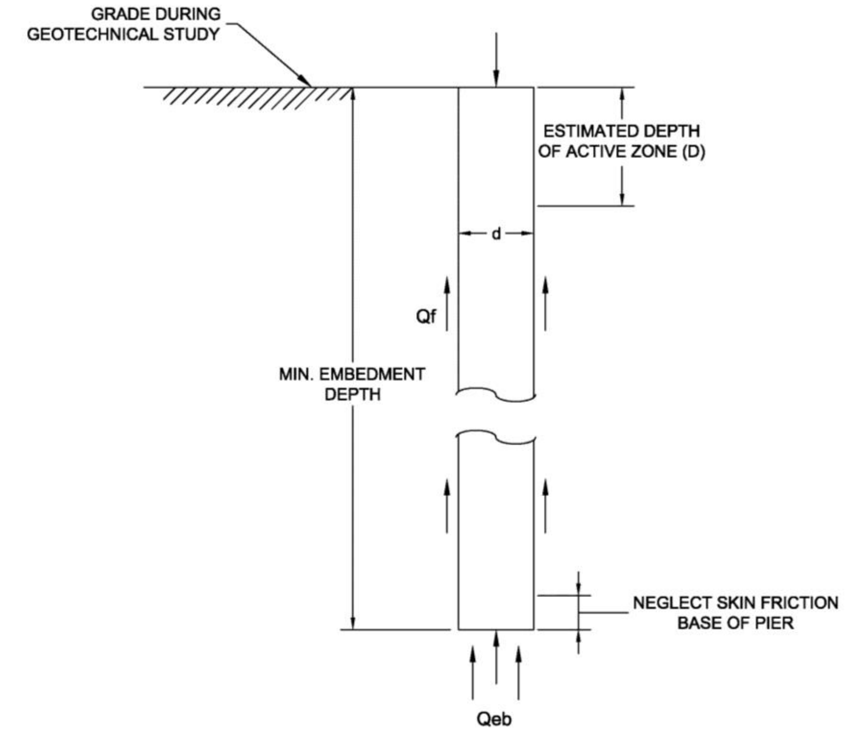
Allowable Bearing Pressure for Grade Beams	2,000 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Select Fill or Natural Clay
Minimum Penetration of Perimeter Grade Beams Below Final Exterior Grade	36 inches

DRILLED PIER FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS – BLACKHAWK SITE

Parameters for Axial Design				
Depth Interval, feet	Material	Allowable Skin Friction, Qf, psf (includes F.S. = 2)	Allowable End Bearing, Qeb, psf (includes F.S. = 3)	Uplift Force of Soil in Active Zone, kips
0 to 5	Clay and Gravel	--	--	30d with d in feet
5 to 15	CLAY (CL)	650	--	
15 to 50	CLAY (CL)	1,300	15,000	

Constraints to be Imposed During Shaft/Drilled Pier Design	
Minimum Embedment Depth	22 feet below final grade
Design Shaft Diameter, d	42 inches
Minimum Depth to Neglect Skin Friction Contribution to Base of Pier	3.5 feet
Uplift Resistance	Pier Weight + Dead load + skin friction below active zone
Estimated Depth of Active Zone from Ground Surface during Geotechnical Exploration, D	10 feet
Minimum Pier Spacing (center to center)	3 shaft diameters (3d)
Group Effects Due To Closely Spaced Piers	< 3d consult Arias
Pier Vertical Reinforcing Steel	As needed to resist uplift forces with a minimum of 1% of gross cross-sectional area
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement for Properly Installed Piles in Project Area	
Total Settlement	1 inch
Differential Settlement	0.5 inch
	Detailed settlement analyses based on encountered materials is outside of the project scope.

Parameters for Lateral Design using LPILE						
Depth Interval, feet	Material	Effective soil unit weight, pci γ_e	Undrained soil shear strength, psi C_u	Undrained angle of internal friction, degrees ϕ	Modulus of Subgrade Reaction, pci K (cyclic loading)	50% strain value e_{50}
0 to 3	Clay or Gravel	.072	3.47	0	100	0.007
3 to 15	CLAY (CL)	.069	17.4	0	400	0.005
15 to 50	CLAY (CL)	.072	34.7	0	800	0.004



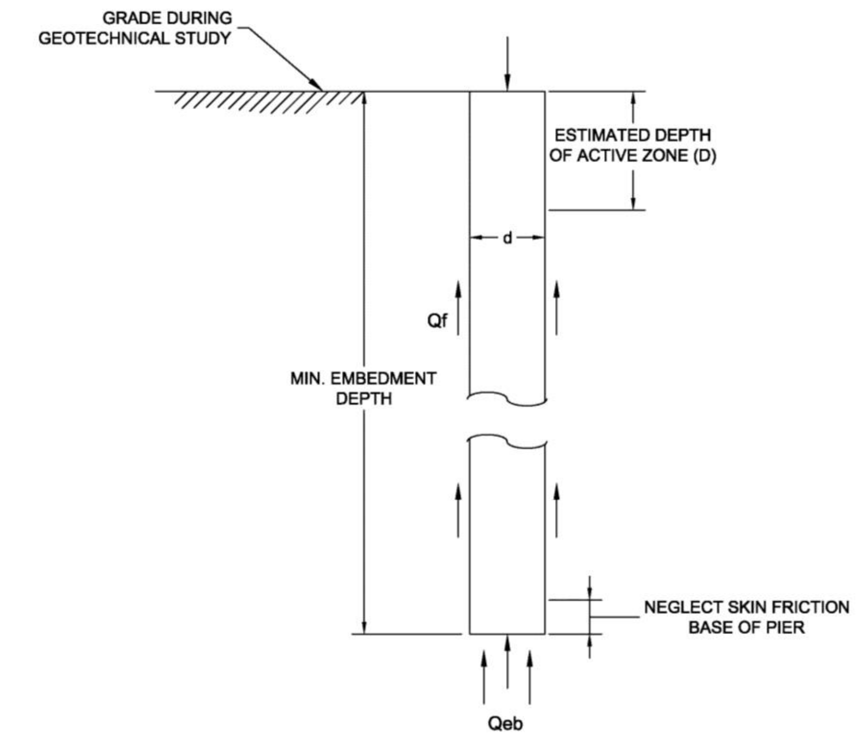
Drilled Shaft/Drilled Pier Installation Considerations	
Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-torque Drilling Equipment Anticipated	Yes
Groundwater Anticipated	No
Contractor Should Verify Groundwater Before Installation	Yes
Temporary Casing Anticipated	Possible depending upon groundwater
Concrete Placement After Drilling	Same day as drilling. If a pier excavation cannot be drilled and filled with concrete on the same day, temporary casing or slurry may be needed to maintain an open excavation. concrete should not be allowed to ricochet off the pier reinforcing steel nor off the pier side walls
Concrete Slump	7 inches ± 1 inch
Maximum Permissible Water Accumulation in Excavation	2 inches
Concrete Installation Method Needed if Water Accumulates	Tremie or pump to displace water
Spacing Between Reinforcing or Behind Reinforcing Cage	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcing Installation	Yes
Cross Bracing within Reinforcing Cage Within Installed Drilled Shaft	Not recommended
Quality Assurance Monitoring	Geotechnical engineer's representative should be present during drilling of all piers, should observe drilling and verify the installed depth, should verify material type at the base of excavation and cleanliness of base, should observe placement of reinforcing

DRILLED PIER FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS – MIDCROWN SITE

Parameters for Axial Design				
Depth Interval, feet	Material	Allowable Skin Friction, Qf, psf (includes F.S. = 2)	Allowable End Bearing, Qeb, psf (includes F.S. = 3)	Uplift Force of Soil in Active Zone, kips
0 to 5	CLAY (CH)	--	--	80d with d in feet
5 to 50	CLAY (CH)	1,350	15,000	

Constraints to be Imposed During Shaft/Drilled Pier Design	
Minimum Embedment Depth (considers estimated depth of seasonal moisture change)	30 feet below final grade
Design Shaft Diameter, d	42 inches
Minimum Depth to Neglect Skin Friction Contribution to Base of Pier	3.5 feet
Uplift Resistance	Pier Weight + Dead load + skin friction below active zone
Estimated Depth of Active Zone from Ground Surface during Geotechnical Exploration, D	10 feet
Minimum Pier Spacing (center to center)	3 shaft diameters (3d)
Group Effects Due To Closely Spaced Piers	< 3d consult Arias
Pier Vertical Reinforcing Steel	As needed to resist uplift forces with a minimum of 1% of gross cross-sectional area
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement for Properly Installed Piles in Project Area Total Settlement Differential Settlement	1 inch 0.5 inch Detailed settlement analyses based on encountered materials is outside of the project scope.

Parameters for Lateral Design using LPILE						
Depth Interval, feet	Material	Effective soil unit weight, pcf γ_e	Undrained soil shear strength, psf C_u	Undrained angle of internal friction, degrees ϕ	Modulus of Subgrade Reaction, pci K (cyclic loading)	50% strain value e_{50}
0 to 5	CLAY (CH)	.069	5.55	0	100	0.01
5 to 50	CLAY (CH)	.069	34.7	0	800	0.004



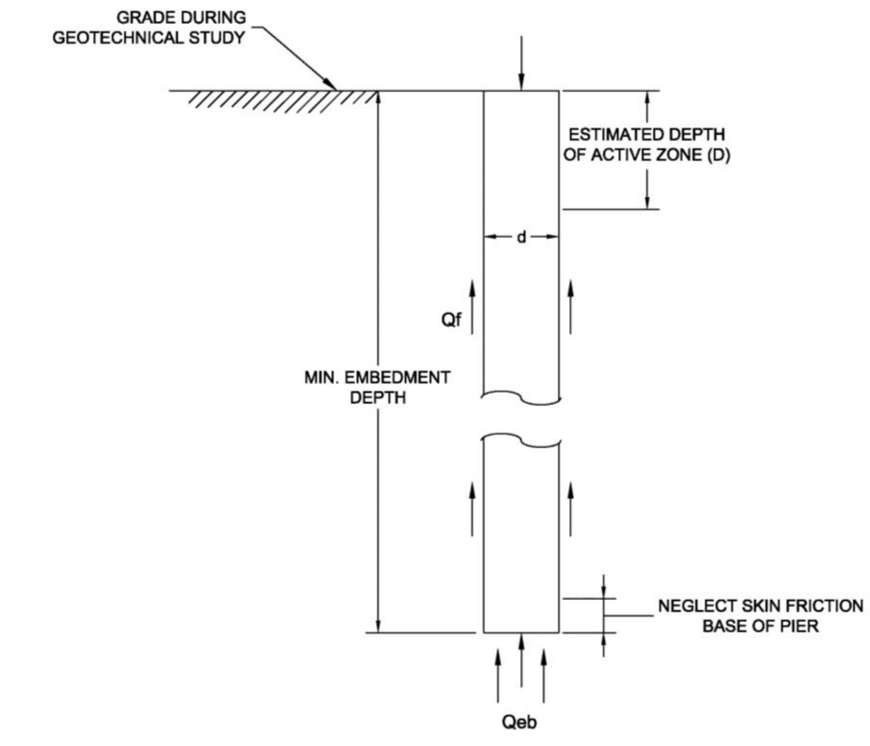
Drilled Shaft/Drilled Pier Installation Considerations	
Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-torque Drilling Equipment Anticipated	Yes
Groundwater Anticipated	Yes
Contractor Should Verify Groundwater Before Installation	Yes
Temporary Casing Anticipated	Possible depending upon groundwater
Concrete Placement After Drilling	Same day as drilling. If a pier excavation cannot be drilled and filled with concrete on the same day, temporary casing or slurry may be needed to maintain an open excavation. concrete should not be allowed to ricochet off the pier reinforcing steel nor off the pier side walls
Concrete Slump	7 inches ± 1 inch
Maximum Permissible Water Accumulation in Excavation	2 inches
Concrete Installation Method Needed if Water Accumulates	Tremie or pump to displace water
Spacing Between Reinforcing or Behind Reinforcing Cage	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcing Installation	Yes
Cross Bracing within Reinforcing Cage Within Installed Drilled Shaft	Not recommended
Quality Assurance Monitoring	Geotechnical engineer's representative should be present during drilling of all piers, should observe drilling and verify the installed depth, should verify material type at the base of excavation and cleanliness of base, should observe placement of reinforcing

DRILLED PIER FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS – PITLUK SITE

Parameters for Axial Design				
Depth Interval, feet	**Material**	**Allowable Skin Friction, Qf, psf (includes F.S. = 2)**	**Allowable End Bearing, Qeb, psf (includes F.S. = 3)**	**Uplift Force of Soil in Active Zone, kips**
0 to 5	CLAY (CH) and Clayey GRAVEL (GC)	--	--	25d with d in feet
5 to 15	Clayey GRAVEL (GC)	700	--	
15 to 50	CLAY (CH)	1,350	15,000	

Constraints to be Imposed During Shaft/Drilled Pier Design	
Minimum Embedment Depth **(considers estimated depth of seasonal moisture change)**	25 feet below finished floor elevation
Minimum Shaft Diameter, d	42 inches
Minimum Depth to Neglect Skin Friction Contribution to Base of Pier	3.5 feet
Uplift Resistance	Pier Weight + Dead load + skin friction below active zone
Estimated Depth of Active Zone from Ground Surface during Geotechnical Exploration, D	10 feet
Minimum Pier Spacing (center to center)	3 shaft diameters (3d)
Group Effects Due To Closely Spaced Piers	< 3d consult Arias
Pier Vertical Reinforcing Steel	As needed to resist uplift forces with a minimum of 1% of gross cross-sectional area
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement for Properly Installed Piles in Project Area **Total Settlement** **Differential Settlement**	1 inch 0.5 inch Detailed settlement analyses based on encountered materials is outside of the project scope.

Parameters for Lateral Design using LPILE						
Depth Interval, feet	**Material**	**Effective soil unit weight, pcf** γ_e	**Undrained soil shear strength, psf** C_u	**Undrained angle of internal friction, degrees** ϕ	**Modulus of Subgrade Reaction, pci K (cyclic loading)**	**50% strain value** e_{50}
0 to 3	CLAY (CL)	.069	5.55	0	100	--
3 to 15	Clayey GRAVEL (GC)	.072	0	32	200.075	--
15 to 50	CLAY (CH)	.072	34.72	0	800	0.004



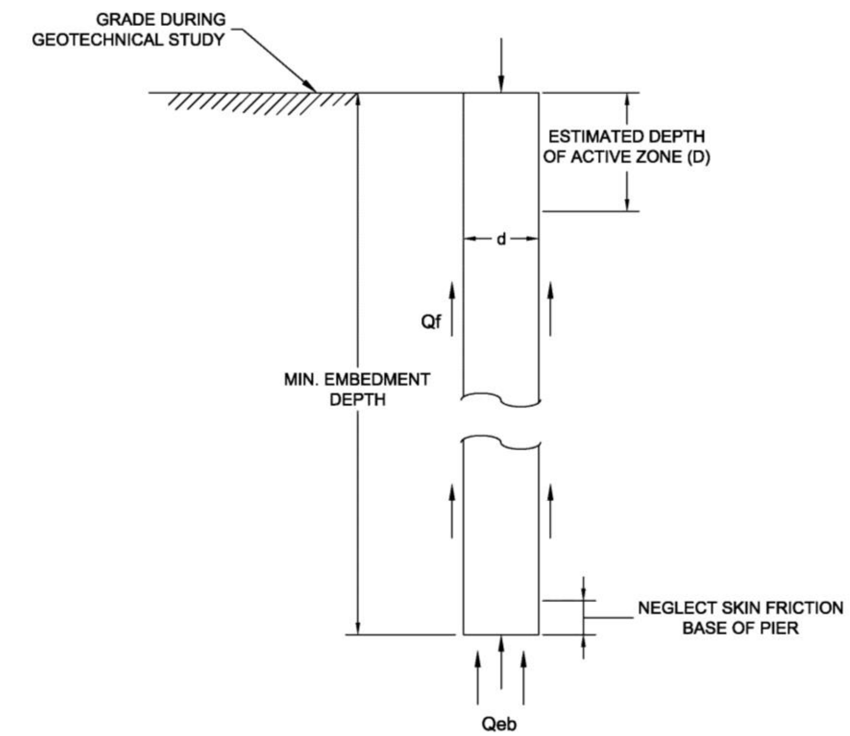
Drilled Shaft/Drilled Pier Installation Considerations	
Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-torque Drilling Equipment Anticipated	Yes
Groundwater Anticipated	Yes
Contractor Should Verify Groundwater Before Installation	Yes
Temporary Casing Anticipated	Possible depending upon permeability of gravel and depth of groundwater
Concrete Placement After Drilling	Same day as drilling. If a pier excavation cannot be drilled and filled with concrete on the same day, temporary casing or slurry may be needed to maintain an open excavation. concrete should not be allowed to ricochet off the pier reinforcing steel nor off the pier side walls
Concrete Slump	7 inches ± 1 inch
Maximum Permissible Water Accumulation in Excavation	2 inches
Concrete Installation Method Needed if Water Accumulates	Tremie or pump to displace water
Spacing Between Reinforcing or Behind Reinforcing Cage	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcing Installation	Yes
Cross Bracing within Reinforcing Cage Within Installed Drilled Shaft	Not recommended
Quality Assurance Monitoring	Geotechnical engineer's representative should be present during drilling of all piers, should observe drilling and verify the installed depth, should verify material type at the base of excavation and cleanliness of base, should observe placement of reinforcing

DRILLED PIER FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS – WOTTLIN SITE

Parameters for Axial Design				
Depth Interval, feet	Material	Allowable Skin Friction, Qf, psf (includes F.S. = 2)	Allowable End Bearing, Qeb, psf (includes F.S. = 3)	Uplift Force of Soil in Active Zone, kips
0 to 5	Clay and Gravel (CL)	--	--	35d with d in feet
5 to 16	CLAY (CL)	1,000	--	
16 to 50	Marl	2,000	30,000	

Constraints to be Imposed During Shaft/Drilled Pier Design	
Minimum Embedment Depth (considers estimated depth of seasonal moisture change)	20 feet and 2 feet into Marl Stratum
Minimum Shaft Diameter, d	42 inches
Minimum Depth to Neglect Skin Friction Contribution to Base of Pier	2 feet
Uplift Resistance	Pier Weight + Dead load + skin friction below active zone
Estimated Depth of Active Zone from Ground Surface during Geotechnical Exploration, D	12 feet
Minimum Pier Spacing (center to center)	3 shaft diameters (3d)
Group Effects Due To Closely Spaced Piers	< 3d consult Arias
Pier Vertical Reinforcing Steel	As needed to resist uplift forces with a minimum of 1% of gross cross-sectional area
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement for Properly Installed Piles in Project Area **Total Settlement** **Differential Settlement**	1 inch 0.5 inch Detailed settlement analyses based on encountered materials is outside of the project scope.

Parameters for Lateral Design using LPILE						
Depth Interval, feet	Material	Effective soil unit weight, pci γ_e	Undrained soil shear strength, psi C_u	Undrained angle of internal friction, degrees ϕ	Modulus of Subgrade Reaction, pci K (cyclic loading)	50% strain value e_{50}
0 to 5	Clay and Gravel (CL)	.069	5.55	0	100	0.01
5 to 16	CLAY (CL)	.072	24.30	0	400	0.005
16 to 50	Marl	.075	55.55	0	1,000	0.003



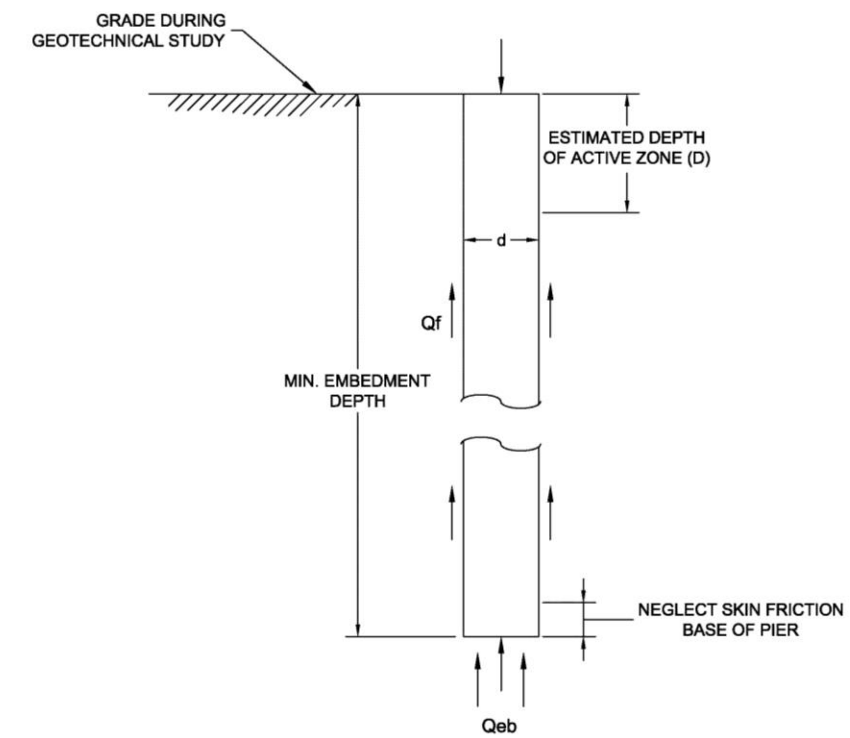
Drilled Shaft/Drilled Pier Installation Considerations	
Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-torque Drilling Equipment Anticipated	Yes
Groundwater Anticipated	No
Contractor Should Verify Groundwater Before Installation	Yes
Temporary Casing Anticipated	No
Concrete Placement After Drilling	Same day as drilling. If a pier excavation cannot be drilled and filled with concrete on the same day, temporary casing or slurry may be needed to maintain an open excavation. concrete should not be allowed to ricochet off the pier reinforcing steel nor off the pier side walls
Concrete Slump	7 inches ± 1 inch
Maximum Permissible Water Accumulation in Excavation	2 inches
Concrete Installation Method Needed if Water Accumulates	Tremie or pump to displace water
Spacing Between Reinforcing or Behind Reinforcing Cage	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcing Installation	Yes
Cross Bracing within Reinforcing Cage Within Installed Drilled Shaft	Not recommended
Quality Assurance Monitoring	Geotechnical engineer's representative should be present during drilling of all piers, should observe drilling and verify the installed depth, should verify material type at the base of excavation and cleanliness of base, should observe placement of reinforcing

DRILLED PIER FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS – SOMERSET SITE

Parameters for Axial Design				
Depth Interval, feet	**Material**	**Allowable Skin Friction, Qf, psf (includes F.S. = 2)**	**Allowable End Bearing, Qeb, psf (includes F.S. = 3)**	**Uplift Force of Soil in Active Zone, kips**
0 to 5	CLAY (CH)	--	--	50d with d in feet
5 to 38	CLAY (CH)	700	7,500	
38 to 50	CLAY (CL)	1,750	19,500	

Constraints to be Imposed During Shaft/Drilled Pier Design	
Minimum Embedment Depth (considers estimated depth of seasonal moisture change)	26 feet below final grade
Minimum Shaft Diameter, d	42 inches
Minimum Depth to Neglect Skin Friction Contribution to Base of Pier	3.5 feet
Uplift Resistance	Pier Weight + Dead load + skin friction below active zone
Estimated Depth of Active Zone from Ground Surface during Geotechnical Exploration, D	10 feet
Minimum Pier Spacing (center to center)	3 shaft diameters (3d)
Group Effects Due To Closely Spaced Piers	< 3d consult Arias
Pier Vertical Reinforcing Steel	As needed to resist uplift forces with a minimum of 1!% of gross cross-sectional area
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement for Properly Installed Piles in Project Area	
Total Settlement	1 inch
Differential Settlement	0.5 inch
	Detailed settlement analyses based on encountered materials is outside of the project scope.

Parameters for Lateral Design using LPILE						
Depth Interval, feet	**Material**	**Effective soil unit weight, pci γ_e**	**Undrained soil shear strength, psi C_u**	**Undrained angle of internal friction, degrees ϕ**	**Modulus of Subgrade Reaction, pci K (cyclic loading)**	**50% strain value e_{50}**
0 to 5	CLAY (CH)	.069	5.55	0	100	0.01
5 to 38	CLAY (CH or CL)	.072	17.36	0	400	0.005
38 to 50	CLAY (CL)	.072	45.13	0	800	0.004



Drilled Shaft/Drilled Pier Installation Considerations	
Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-torque Drilling Equipment Anticipated	Yes
Groundwater Anticipated	No
Contractor Should Verify Groundwater Before Installation	Yes
Temporary Casing Anticipated	Possible depending upon groundwater
Concrete Placement After Drilling	Same day as drilling. If a pier excavation cannot be drilled and filled with concrete on the same day, temporary casing or slurry may be needed to maintain an open excavation. concrete should not be allowed to ricochet off the pier reinforcing steel nor off the pier side walls
Concrete Slump	7 inches ± 1 inch
Maximum Permissible Water Accumulation in Excavation	2 inches
Concrete Installation Method Needed if Water Accumulates	Tremie or pump to displace water
Spacing Between Reinforcing or Behind Reinforcing Cage	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcing Installation	Yes
Cross Bracing within Reinforcing Cage Within Installed Drilled Shaft	Not recommended
Quality Assurance Monitoring	Geotechnical engineer's representative should be present during drilling of all piers, should observe drilling and verify the installed depth, should verify material type at the base of excavation and cleanliness of base, should observe placement of reinforcing

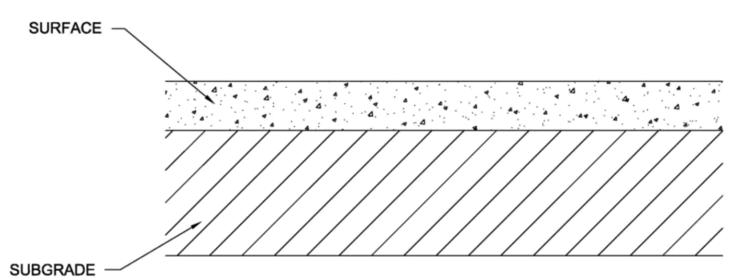
PAVEMENT SECTION DESIGN AND CONSTRUCTION RECOMMENDATIONS

Recommendations were prepared in accordance with the AASHTO *Guide for the Design of Pavement Structures* (1993) and the ACI *Design Guide 330R for Design and Construction of Concrete Parking Lots*. No specific design traffic information was received for this project.

Assumptions Used for Pavement Design

Design Life	20 years
Anticipated Maintenance	Periodic to repair/seal cracks resulting from movement and to maintain proper drainage
Drainage	Perimeter drainage should be controlled to reduce the influx of surface water from areas surrounding the paving.
Medium Duty Traffic Areas	Entrance aprons and drives into the site, areas with passenger vehicular traffic, and areas with occasional single-unit trucks
Medium Duty Traffic Load Estimate	50,000 equivalent single axle loads (ESALs); Average Daily Truck Traffic (ADTT) = 10
Average Daily Truck Traffic Vehicle with at least 6 Wheels	1
Concrete Compressive Strength	3,500 psi
California Bearing Ratio (CBR) for Raw Subgrade	At least 2
Modulus of Subgrade Reaction for Raw Subgrade, k	75 pci

CONCRETE PAVEMENT SECTION



Recommended Pavement Sections – All Sites

Layer	Material	Rigid Concrete					
		Light Duty		Medium Duty		Heavy Duty	
Surface	PCC	--	--	6"	7"	--	--
Subgrade	Lime Treatment	--	--	6"	--	--	--
	Moisture Conditioned	--	--	--	6"*	--	--
Additional Design Considerations							
Potential Estimated Movement Based on Existing Site Materials		1 to 3¼ inches					

* - Moisture Conditioned subgrade preparation option should not be used at Midcrown Site. Lime stabilization of subgrade should be used at this location.

Subgrade Preparation Prior to Concrete Paving Section Construction

Minimum Undercut Depth	4 inches or as needed to remove roots, organics and deleterious materials
Reuse Excavated Soils	Provided they are free of roots and debris and meet the material requirements for their intended use
Undercut Extent	2 feet beyond the paving limits
Exposed Subgrade Treatment (Before Stabilization or Moisture Conditioning)	Proof roll with rubber tired vehicle weighting at least 20 tons such as a loaded dump truck with Geotechnical Engineer's representative present during proof rolling
Pumping/Rutting Areas Discovered During Proof Rolling	Remove to firmer materials and replace with compacted general or select fill under direction of geotechnical engineer representative
General Fill Type	Material free of roots, debris and other deleterious material with a maximum rock size of 4 inches; on-site clays having CBR > 2 may be used
Minimum General Fill Thickness	As required to achieve grade
Maximum General Fill Loose Lift Thickness	8 inches
Stabilizer Application Rate (Estimated)	4 - 8% by dry weight
Soil Dry Unit Weight (Estimated)	105 pcf but may be variable
Determination Of Stabilizer Application Rate	The actual stabilizer application rate should be determined by laboratory testing of soil samples taken after the pavement subgrade elevation has been achieved. The quantity of lime should be sufficient to result in a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI. Alternately, the optimum lime content may be determined through Atterberg limits testing on treated samples with varying percentages of lime.
Stabilization Procedure	TxDOT Item 260 and 264
Minimum Concrete Compressive Strength At 28 Days	3500 psi
Desired concrete slump during placement	5 ± 1 inch
Reinforced section	Jointed not continuous
Expansion Joints	May be eliminated except at tie-ins with existing concrete and structures
Contraction Joints – transverse and longitudinal	Meet spacing and sawing requirements of ACI 330R (Guide for Design and Construction of Concrete Parking Lots)
Placement	In accordance with ACI 304R, ACI 305R, and ACI 306R

SUBGRADE PREPARATION SITE WORK (NON STRUCTURAL/GENERAL FILL)

Minimum Undercut Depth	4 inches or as needed to remove roots, organics and deleterious materials
Exposed Subgrade Treatment	Proof roll with rubber tired vehicle weighting at least 20 tons such as a loaded dump truck with Geotechnical Engineer's representative present during proof rolling
Pumping/Rutting Areas Discovered During Proof Rolling	Remove to firmer materials and replace with compacted general or select fill under direction of geotechnical engineer representative
General Fill Type	Material free of roots, debris and other deleterious material with a maximum rock size of 4 inches
Maximum General Fill Loose Lift Thickness	8 inches

COMPACTION AND TESTING REQUIREMENTS

Equipment Pad Materials

Location	Material	Percent Compaction	Optimum Moisture Content	Testing Requirement
		ASTM D 698 (Standard Proctor)		
Equipment Pad Area	Subgrade soil at base of excavation	93% to 98%	+1% to +5%	1 per 5,000 SF; min. 3 tests
	Reconditioned On-Site Soils	94% to -98%	+1% to +5%	1 per 5,000 SF; min. 3 per lift
	Select Fill	≥ 95%	-1% to +3%	1 per 5,000 SF; min. 3 per lift
	Crushed Limestone Base	≥ 98%	-2% to +3%	1 per 5,000 SF; min. 3 per lift

Pavement Materials

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Pavement Areas	Scarified On-site Soil (Subgrade)	ASTM D 698	≥ 95%	0 to +4%	1 per 5,000 SF; min. 3 tests
	General Fill (Onsite Material)	ASTM D 698	≥ 95%	0 to +4%	1 per 5,000 SF; min. 3 per lift
	Stabilized Materials	ASTM D 698	≥ 95%	0 to +4%	1 per 5,000 SF; min. 3 per lift
	Base Material	ASTM D 1557	≥ 95%	±3%	1 per 5,000 SF; min. 3 per lift
	Hot-mix asphaltic concrete	TEX 207 F	91% to 95% Theoretical Lab Density	Not applicable	1 per 5,000 SF; min. 3 per lift

General Site Work (Non Structural/General Fill) Materials

Location	Material	Percent Compaction	Optimum Moisture Content	Testing Requirement
		ASTM D 698 (Standard Proctor)		
General Fill Outside Building Pad and Pavement Area	On-site material free of vegetation and debris	≥ 95%	-2% to +3%	1 per 5,000 SF; min. 3 per lift

DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE

Measures to reduce future moisture fluctuations of the soils under the floor slab must be considered. Movements of foundation soil can be effectively reduced by providing horizontal and/or vertical moisture barriers around the edge of the slab. Typically the moisture barriers would consist of concrete flatwork or asphalt or concrete pavement placed adjacent to the edge of the foundation, a clay cap over plastic, or a deepened perimeter grade beam.

Although subgrade modification through excavation and replacement is recommended to reduce potential soil-related foundation movements, the design and construction of a grade-supported foundation should also include the following elements:

- Roof drainage should be controlled by gutters and carried well away from the structure. The ground surface adjacent to the building perimeter should be sloped and maintained a minimum of 5% grade away from the building for 10 feet to result in positive surface flow or drainage away from the building perimeter.
- Hose bibs, sprinkler heads, and other external water connections should be placed well away from the foundation perimeter such that surface leakage cannot readily infiltrate into the subsurface or compacted fills placed under the proposed foundations and slabs.
- No trees or other vegetation over 6 feet in height shall be planted within 15 feet of the structure unless specifically accounted for in the foundation design.
- Utility bedding should not include gravel within 4 feet of the perimeter of the foundation. Compacted clay or flowable fill trench backfill should be used in lieu of permeable bedding materials between 2 feet inside the building to a distance of 4 feet beyond the exterior of the building edge to reduce the potential for water to infiltrate within utility bedding and backfill material.
- Paved areas around the structure are helpful in maintaining equilibrium within the soil water content. Pavement and sidewalks should be located immediately adjacent to the building.
- Flower beds and planter boxes should be piped or water tight to prevent water infiltration under the building. Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress.
- Site work excavations should be protected and backfilled without delay to reduce changes in the natural moisture regime.
- In unpaved areas, the use of a clay cap over plastic sheeting or the use of a deepened perimeter grade beam should be performed.

FLATWORK CONSIDERATIONS

Minor differential movements between the planned structure(s) and abutting sidewalks may occur, particularly for the grade-supported foundation option. Flatwork supported on unimproved, natural site conditions will result in flatwork movements on the order of the magnitude or greater than reported in the PVR section which can result in significant cracking, joint separations, and a reversal in drainage.

We recommend that the flatwork and the structure be designed to include details that permit foundation movements without resulting in vertical separations and without distressing either element. Control joints should be included that include steel reinforcing to prevent vertical shear, but to allow bending.

The flatwork and abutting sidewalks that are supported on grade should be designed and constructed to allow for positive drainage to be maintained away from the structure foundations. The planned site grading should allow for potential future differential movements and should never be allowed to reach a level or negative slope that promotes drainage toward the foundation. This reversal in drainage can direct moisture to the structure becoming a constant nuisance and maintenance issue.

CONSTRUCTION CRITERIA NOTES

Initial Site Preparation for All Development Areas
Strip away any existing asphalt, concrete, topsoil, grass, organics, and deleterious debris as needed and dispose outside of the footprints of the building, pavement and other structural areas. Undercut to the required depth and extent as recommended for the proposed development features. Additional excavation may be required to remove existing utilities or foundations. Additional excavation may also be necessary if deleterious materials such as buried debris and/or rubble or if undesirable soft and wet subgrade conditions are encountered. The site representative of the geotechnical engineer should observe undercutting operations. Unless passing density reports are provided for a specific area, existing fill soils found during excavation should be considered as uncertified and removed to suitable natural soils.

Drainage
Good positive drainage during and after construction is very important to reduce expansive soil volume changes that can detrimentally affect the performance of the planned development. Proper attention to surface and subsurface drainage details during the design and construction phase of development can aid in preventing many potential soil shrink-swell related problems during and following the completion of the project.

Earthwork and Foundation Acceptance
Exposure to the environment may weaken the soils at the foundation bearing level if the excavation remains open for long periods of time. Therefore, it is recommended that all foundation excavations be extended to final grade and constructed as soon as possible in order to reduce potential damage to the bearing soils. If bearing soils are exposed to severe drying or wetting, the unsuitable soil must be re-conditioned or removed as appropriate and replaced with compacted fill, prior to concreting. The foundation bearing level should be free of loose soil, ponded water or debris and should be observed prior to concreting by the geotechnical engineer or his representative.

Foundation concrete should not be placed on soils that have been disturbed by rainfall or seepage. If the bearing soils are softened by surface water intrusion during exposure or by desiccation, the unsuitable soils must be removed from the foundation excavation and replaced with compacted select fill prior to placement of concrete.

Subgrade preparation and fill placement operations should be monitored by the soil engineer or his representative. Any areas not meeting the required compaction should be recompacted and retested until compliance is met.

Trench Excavations
Excavations should comply with OSHA Standard 29CFR, Part 1926, Subpart P and all State of Texas and local requirements. Trenches 20 feet deep or greater require that the protective system be designed by a registered professional engineer. A trench is defined as a narrow excavation in relation to its depth. In general, the depth is greater than the width, but the bottom width of the trench is not greater than 15 feet. Trenches greater than 5 feet in depth require a protective system such as trench shields, trench shoring, or sloping back the excavation side slopes.

The Contractor's "Competent Person" shall perform daily inspections of the trench to verify that the trench is properly constructed and that surcharge and vibratory loads are not excessive, that excavation spoils are sufficiently away from the edge of the trench, proper ingress and egress into the trench is provided and all other items are performed as outlined in these OSHA regulations. It is especially important for the inspector to observe the effects of changed weather conditions, surcharge loadings, and cuts into adjacent backfills of existing utilities. The flow of water into the base and sides of the excavation and the presence of any surface slope cracks should also be carefully monitored by the Trench Safety Engineer.

Although the geotechnical report provides an indication of soil types to be anticipated, actual soil and groundwater conditions will vary along the trench route. The "Competent Person" must evaluate the soils and groundwater in the trench excavation at the time of construction to verify that proper sloping or shoring measures are performed.

Appendix B to the OSHA regulations has sloping and benching requirements for short-term trench exposure for various soil types up to the maximum allowable 20-foot depth requirement.

GENERAL COMMENTS

The scope of this study is to provide geotechnical engineering criteria for use by design engineers in preparing designs for the features addressed in the Arias geotechnical report. Environmental studies of any kind were not a part of our scope of work or services even though we are capable of providing such services.

This report was prepared as an instrument of service for this project exclusively for the use of the Client and the project design team. If the development plans change relative to building or overall site layout, size, or anticipated loads or if different subsurface conditions are encountered, we should be informed and retained to ascertain the impact of these changes on our recommendations. We cannot be responsible for the potential impact of these changes if we are not informed.

Geotechnical Design Review
Arias should be given the opportunity to review the design and construction documents. The purpose of this review is to check to see if our geotechnical recommendations are properly interpreted into the project plans and specifications. Please note that design review was not included in the authorized scope and additional fees may apply.

Subsurface Variations
Soil and groundwater conditions may vary between the sample boring locations. Transition boundaries or contacts, noted on the boring logs to separate soil types, are approximate. Actual contacts may be gradual and vary at different locations. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions or highly variable subsurface conditions are encountered during construction, Arias should be contacted to evaluate the significance of the changed conditions relative to our recommendations.

Quality Assurance Testing
The long-term success of the project will be affected by the quality of materials used for construction and the adherence of the construction to the project plans and specifications. As Geotechnical Engineer of Record (GER), we should be engaged by the Owner to provide Quality Assurance (QA) testing. Our services will be to evaluate the degree to which constructors are achieving the specified conditions they're contractually obligated to achieve, and observe that the encountered materials during earthwork for foundation and pavement installation are consistent with those encountered during this study. In the event that Arias is not retained to provide QA testing, we should be immediately contacted if differing subsurface conditions are encountered during construction. Differing materials may require modification to the recommendations that we provided herein. A message to the Owner with regard to the project QA is included as an attachment to the Arias geotechnical report.

Arias has an established in-house laboratory that meets the standards of the American Standard Testing Materials (ASTM) specifications of ASTM E-329 defining requirements for Inspection and Testing Agencies for soil, concrete, steel and bituminous materials as used in construction. We maintain soils, concrete, asphalt, and aggregate testing equipment to provide the testing needs required by the project specifications. All of our equipment is calibrated by an independent testing agency in accordance with the National Bureau of Standards. In addition, Arias is accredited by the American Association of State Highway & Transportation Officials (AASHTO), the United States Army Corps of Engineers (USACE) and the Texas Department of Transportation (TxDOT), and also maintains AASHTO Materials Reference Laboratory (AMRL) and Cement and Concrete Reference Laboratory (CCRL) proficiency sampling, assessments and inspections.

Furthermore, Arias employs a technical staff certified through the following agencies: the National Institute for Certification in Engineering Technologies (NICET), the American Concrete Institute (ACI), the American Welding Society (AWS), the Precast/Prestressed Concrete Institute (PCI), the Mine & Safety Health Administration (MSHA), the Texas Asphalt Pavement Association (TXAPA) and the Texas Board of Professional Engineers (TBPE). Our services are conducted under the guidance and direction of a Professional Engineer (P.E.) licensed to work in the State of Texas, as required by law.

Standard of Care
Subject to the limitations inherent in the agreed scope of services as to the degree of care and amount of time and expenses to be incurred, and subject to any other limitations contained in the agreement for this work, Arias has performed its services consistent with that level of care and skill ordinarily exercised by other professional engineers practicing in the same locale and under similar circumstances at the time the services were performed.

Information about this geotechnical report is provided in the ASFE publication included as an attachment to the Arias geotechnical report.

SECTION III – ATTACHMENTS

Attachments to this report include:

- Supplement #1, dated August 26, 2013
- ASFE Document: Important Information about Your Geotechnical Report
- ASFE Document: Project Quality Assurance

ARIAS & ASSOCIATES
Geotechnical • Environmental • Testing

August 26, 2013
Arias Job No. 2013-585 VIA Email: vgarza@saws.org

Vicente J. Garza, P.E., PMP
Production & Transmission Engineering
San Antonio Water System
2800 U.S. Hwy 281 North
San Antonio, TX 78212

RE: Supplement #1 to Geotechnical Engineering Study
Proposed Antenna Masts, Electrical Equipment Foundations and Concrete Driveways at Five (5) SAWS Pump Station Locations
San Antonio, Texas

Dear Mr. Garza:

Arias & Associates, Inc. (Arias) performed a geotechnical study for this project in San Antonio, Texas. (Arias Job #2013-585 dated August 21, 2013).

We have been asked to provide foundation embedment recommendations for a 50' antennae monopole foundation. Based on provided design reactions at the top of pier and performance of the "Lpile" computer analysis, an embedment depth of 20 feet was computed for each site. (Results are attached to this letter). At this depth, upward movement of the pier due to expansive soils is estimated to be approximately 2 inches at the Midcrown site and 1 ½ inches at the other sites. If 1 ½ inches of movement is acceptable, we recommend the 20 foot embedment depth. If not, then the embedment depth shown in the original geotechnical report should be used. In any case, we recommend that the pier at Midcrown be extended to at least the 25 foot depth.

Each site will also have 20' high light poles installed. We understand that these light poles will be based on a 2 foot diameter drilled pier. It is our opinion that the pier embedment should be at least 15 feet at all of the sites except Midcrown. At Midcrown, a 20 foot deep pier is recommended.

We had originally provided equipment pad preparation recommendations in consideration of a potential vertical rise of one (1) inch. We have now been asked to provide recommendations for an allowable PVR of 1 ½ inch. The revised earthwork requirements for a 1 /12 inch PVR are shown in the table on the following page.

1295 Thompson Rd
Eagle Pass, Texas 78852
(830) 757-8891
(830) 757-8899 Fax

142 Chula Vista
San Antonio, Texas 78232
(210) 308-5884
(210) 308-5886 Fax

5233 IH 37, Suite B-12
Corpus Christi, Texas 78408
(361) 288-2670
(361) 288-4672 Fax

5213 Davis Boulevard, Suite G
North Richland Hills, TX 76180
(817) 812-3500

Applicable for Foundation Type Options	Waffle Slab
Site Improvement Method	Undercut & Replace after Site Stripping
Improved Site Condition (PVR)	Approximate 1 ½ -inch Design PVR
Min. Undercut Depth - Somerset	**3.5 feet**
Minimum Undercut Depth - Blackhawk	**1.5 feet**
Minimum Undercut Depth – Mid Crown	**6 feet**
Minimum Undercut Depth - Pitluk	**2.5 feet**
Minimum Undercut Depth - Wottlin	**1.5 feet**
Undercut Extent	Below all slab areas and at least 5 feet beyond the slab perimeter and any features that may be sensitive to movement including but not limited to flatwork, canopy slabs, curbs, and other features adjacent to foundation
Exposed Subgrade Treatment	Scarify, moisture condition and compact existing materials to 12 inches below base of undercut depth
Select Fill Minimum Thickness	Same as Undercut Depth
Select Fill Material	LEAN CLAY (CL) with Liquid Limit <45%, PI = 12-20, -#200 > 50%, 3" maximum particle size
Working Pad Minimum Thickness	6 inches (optional)
Working Pad Material	Base meeting requirements of 2004 TxDOT Item 247, Type A, Grade 1 or 2
Vapor Retarder Material	Minimum 10-mil conforming to ASTM E1745, Class C or better and with a maximum water vapor permeance of 0.044 perms (ASTM E96) such as a 10 mil Stego Wrap by Stego Industries LLC or other similar product
Maximum Loose Lift Thickness (all materials)	8 inches
Maximum Elapsed Time Between Subgrade Preparation and Fill (select or reconditioned) Placement	48 hours

All other recommendations contained within the original report not specifically addressed in this supplement should be followed. Please let us know if you have any questions.

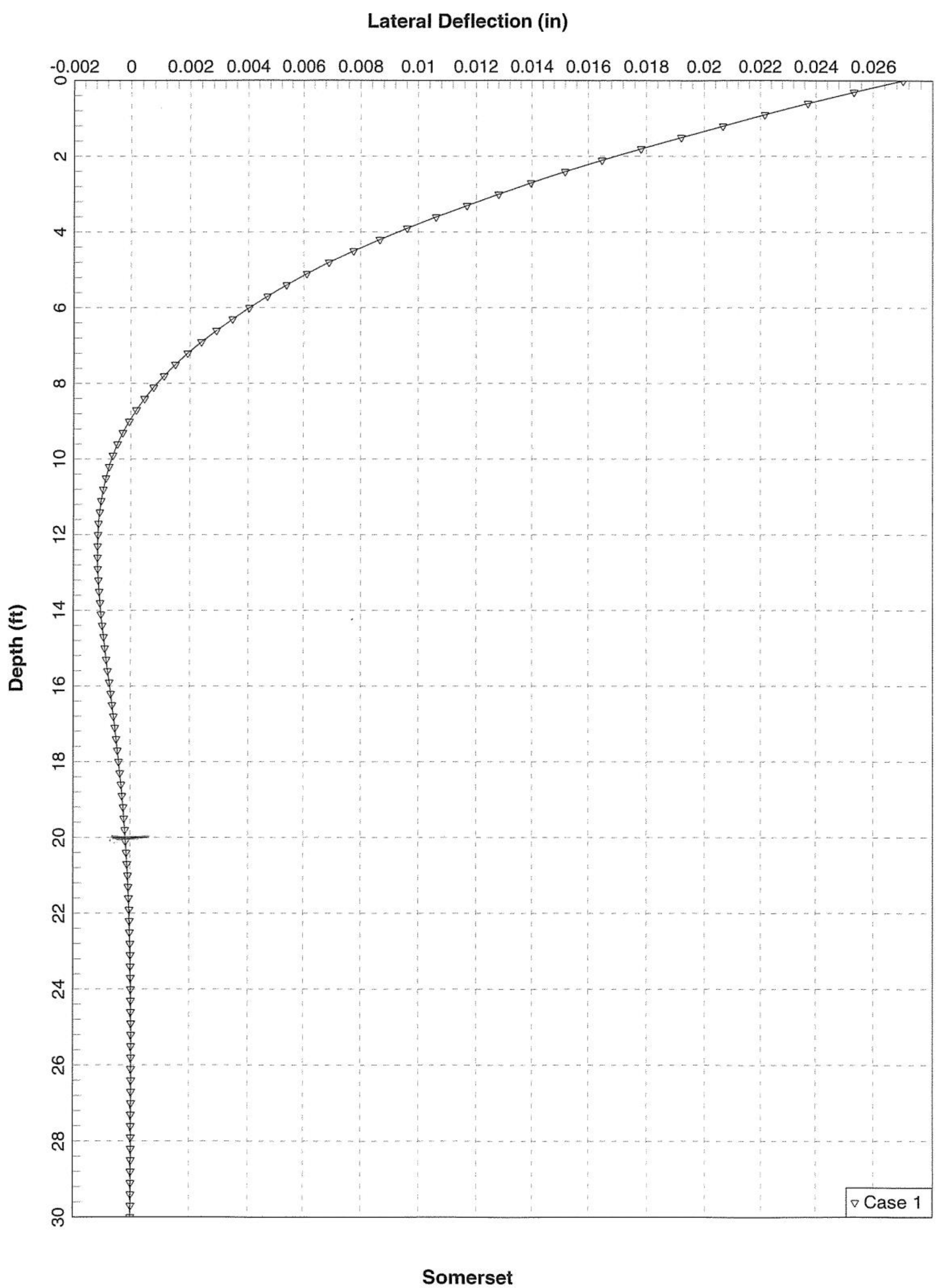
Cordially,

Arias & Associates, Inc.
TBPE Registration No. F-32

Dexter Bacon, P.E.
Senior Vice President

cc: Mr. Bill Reiffert, P.E. – Bill Reiffert and Associates, Inc.

Attachments: LPILE Output for Antennae Mast Foundations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0.026
Depth (ft)
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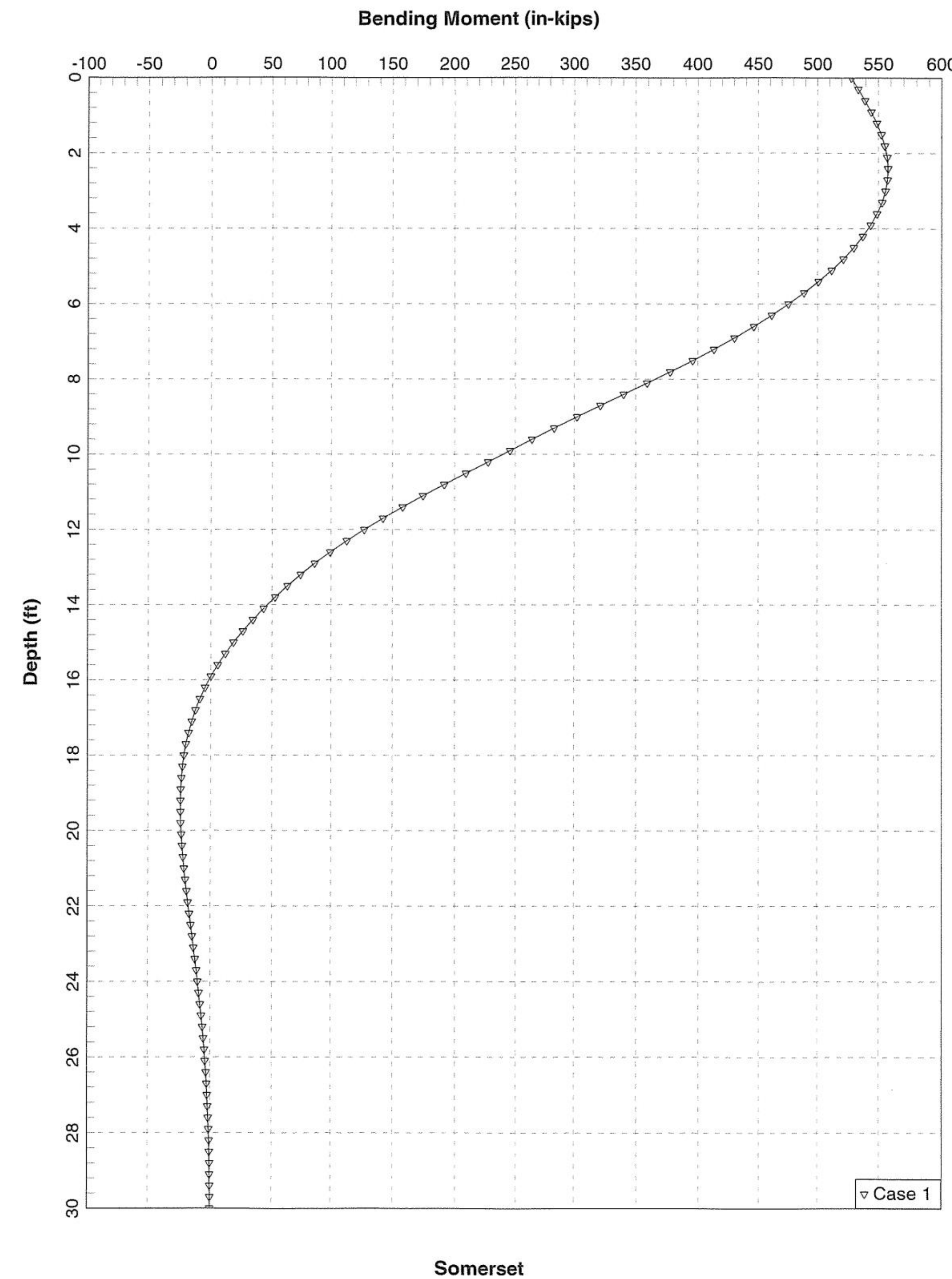
Case 1
Somerset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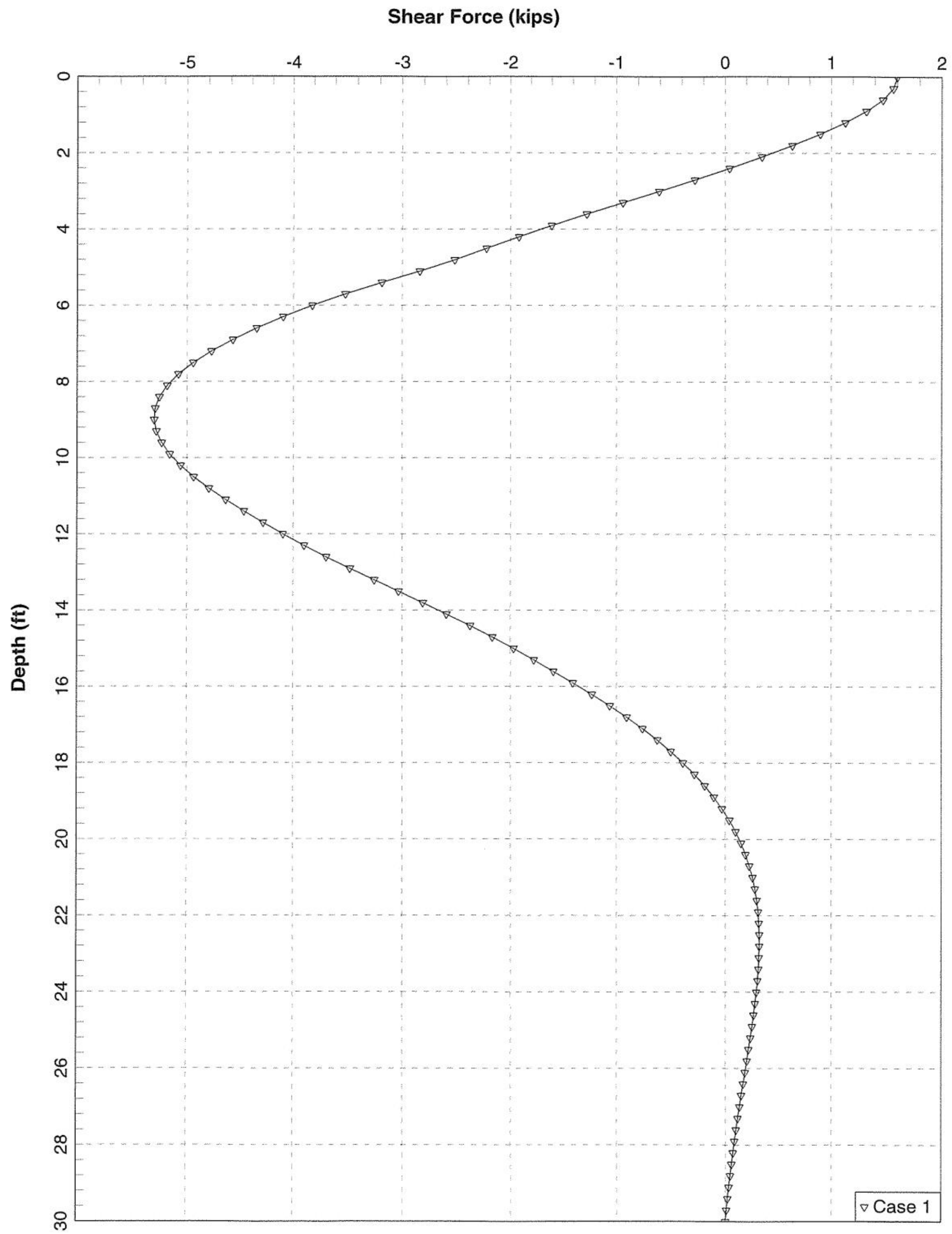

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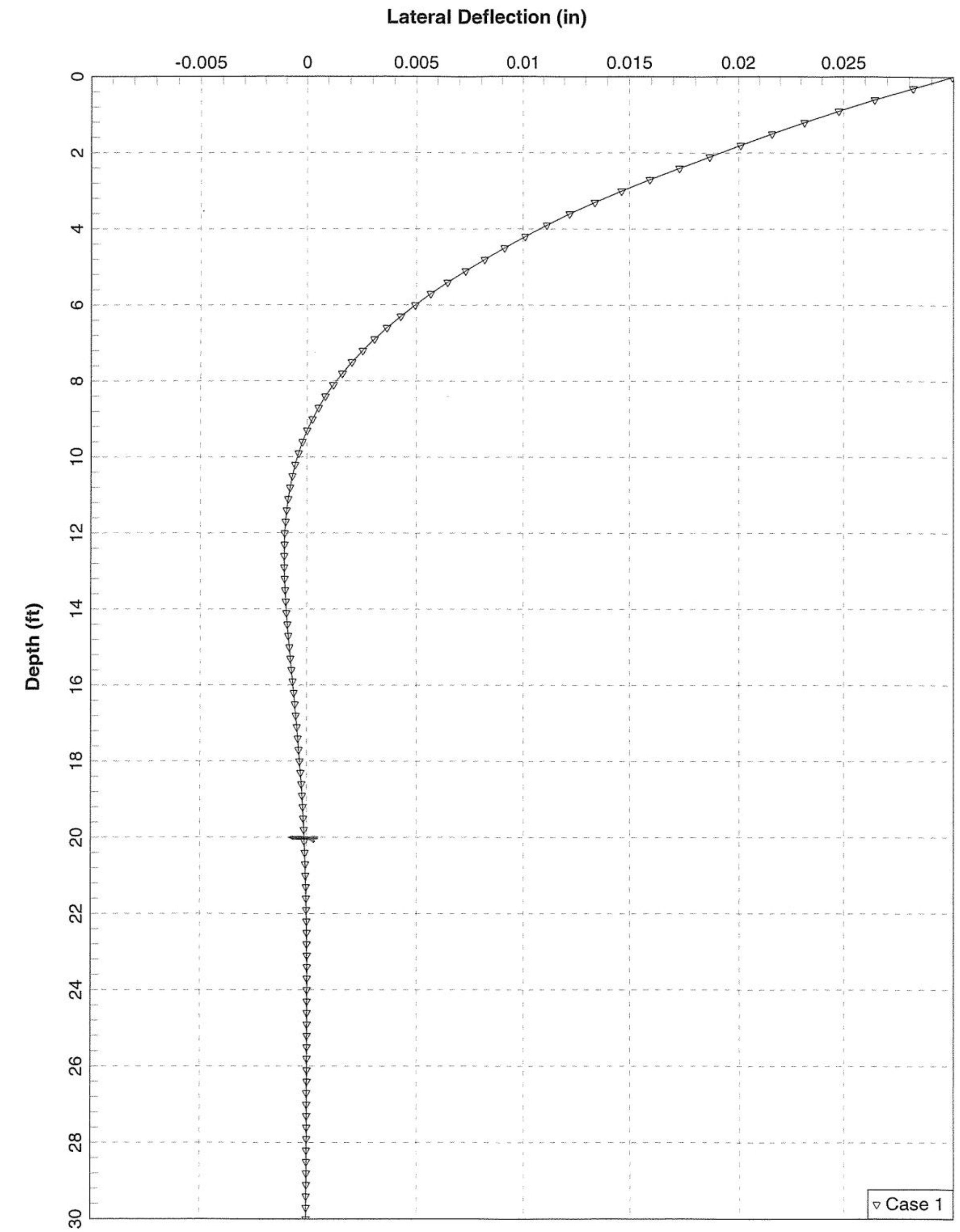
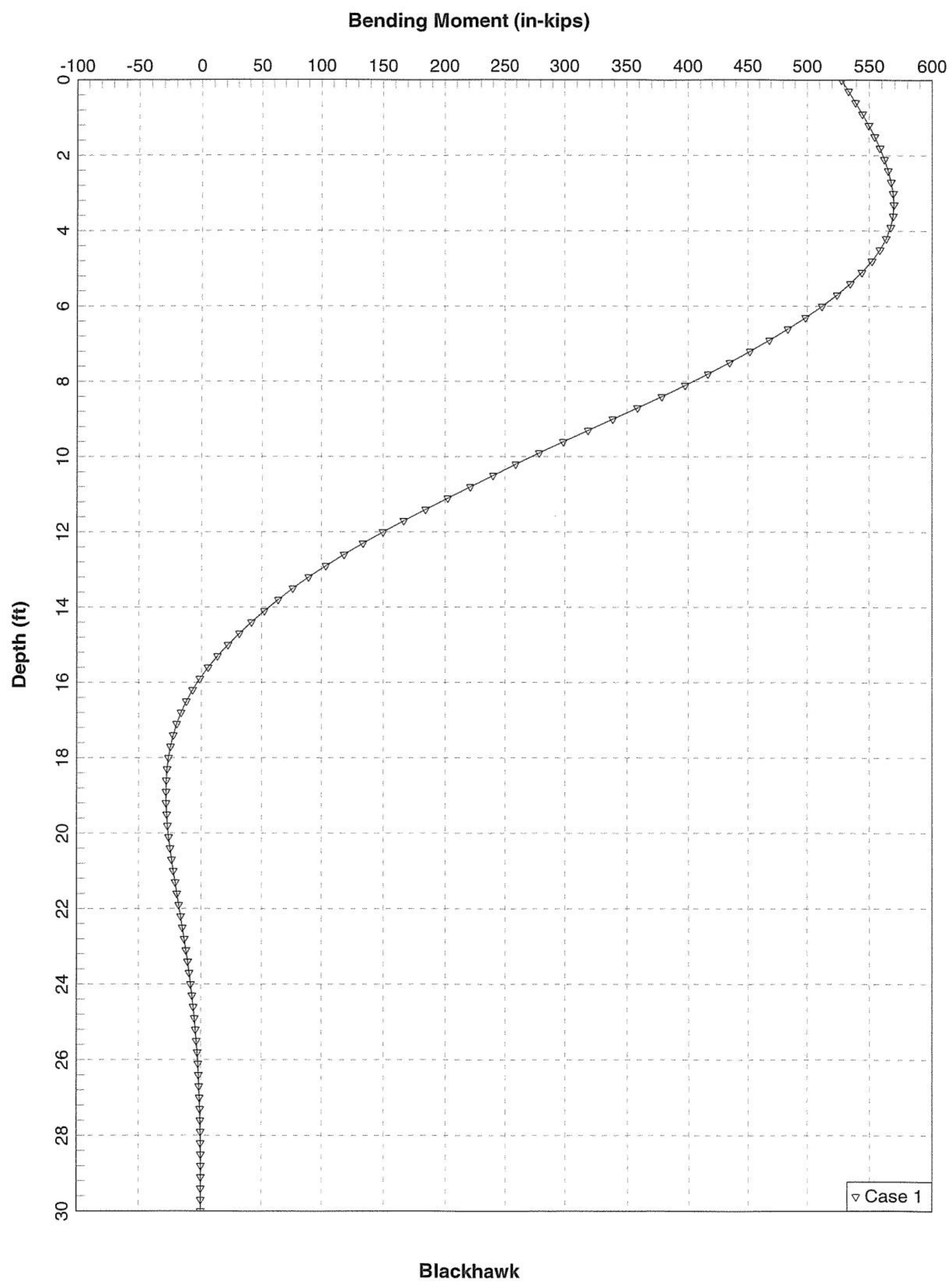


Blackhawk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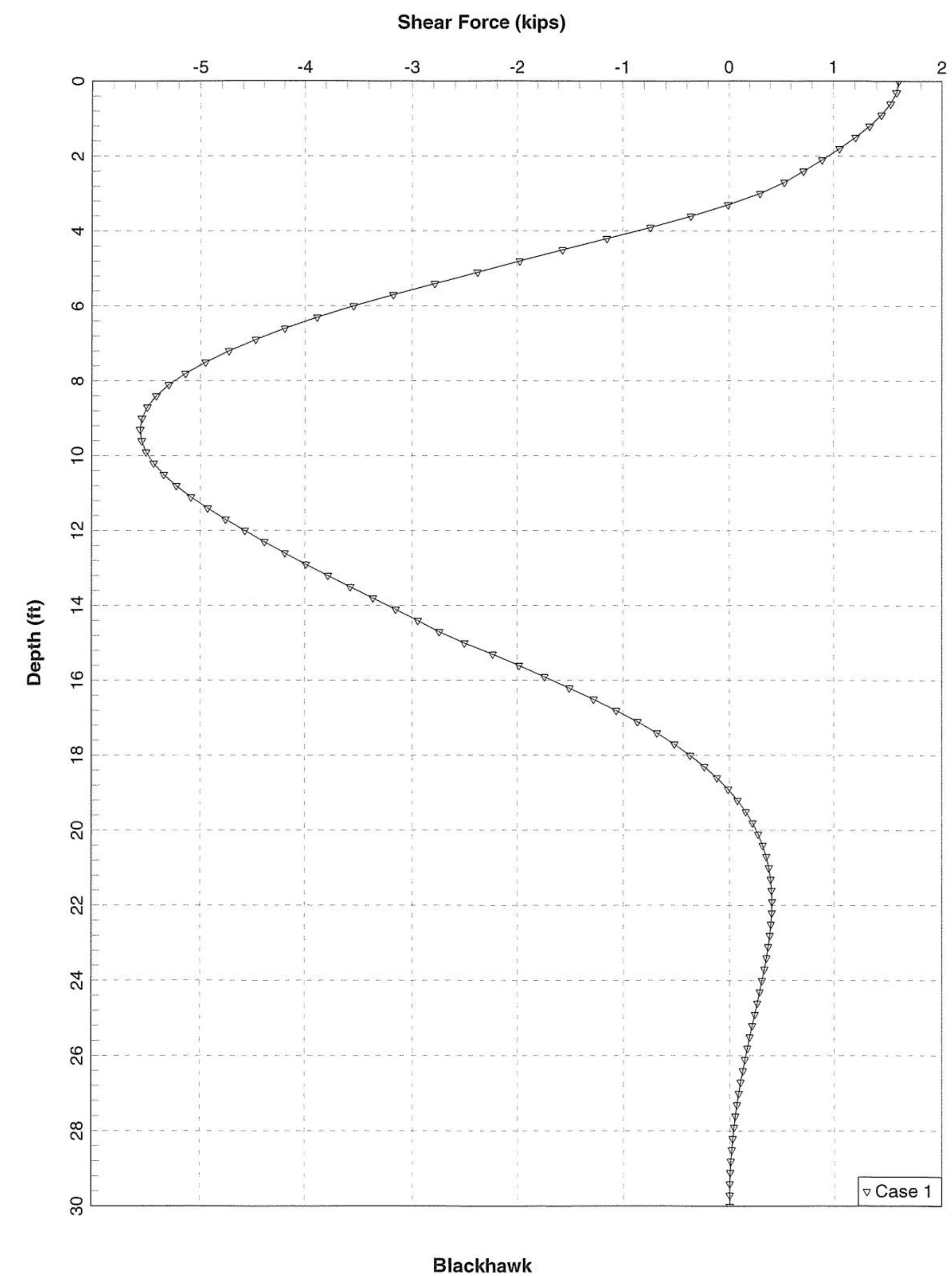
Blackhawk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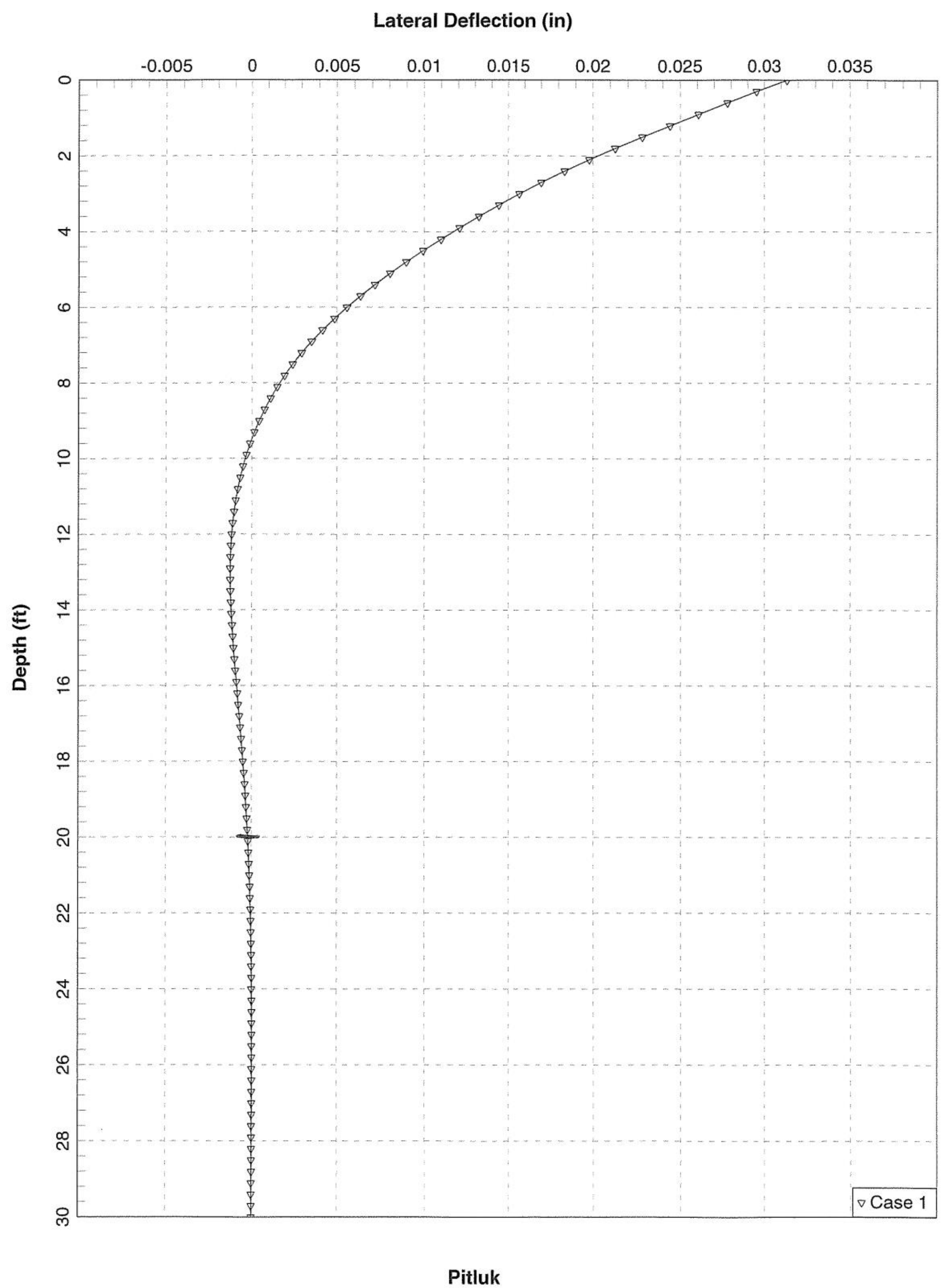
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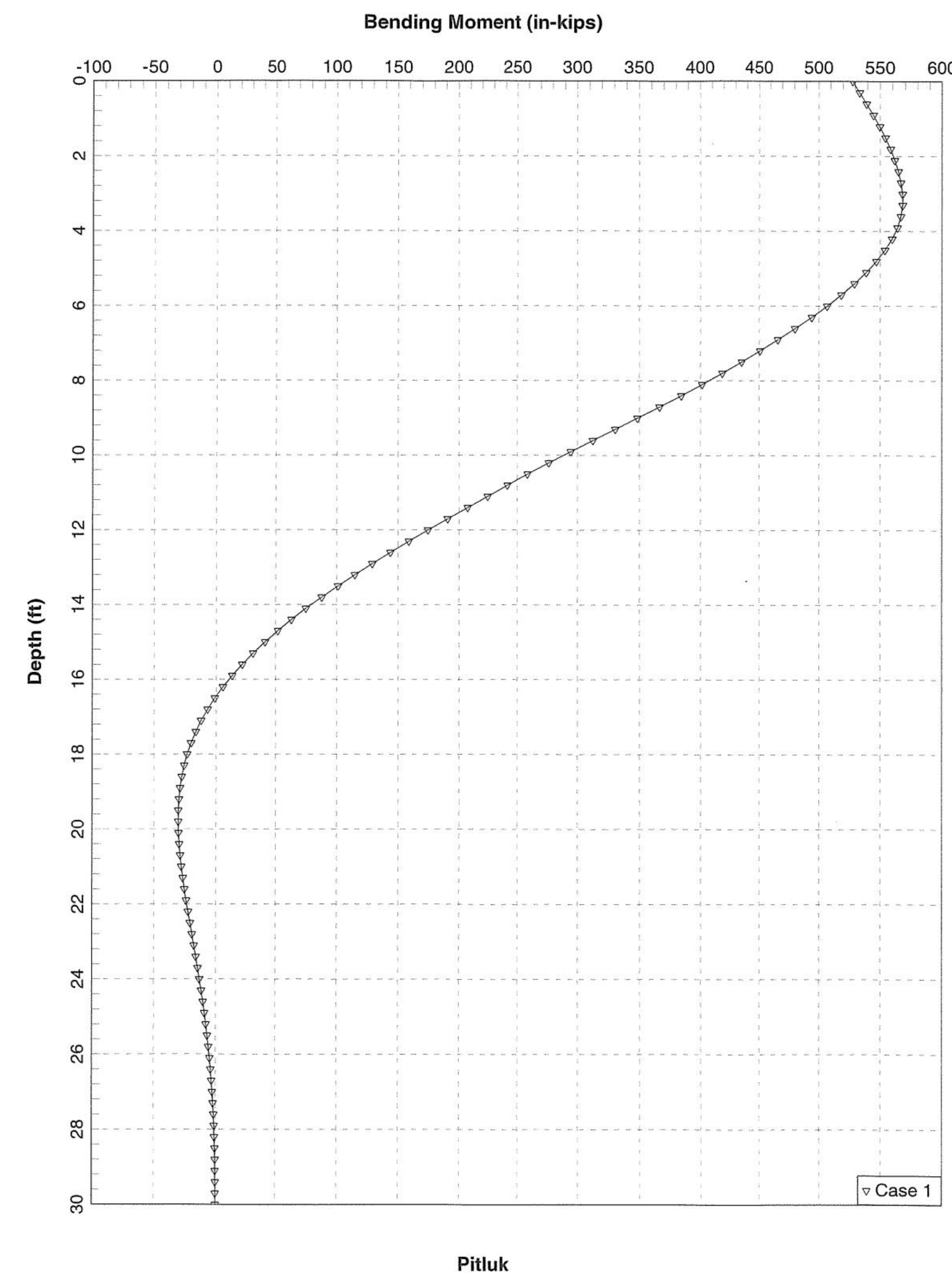
Case 1
Pitluk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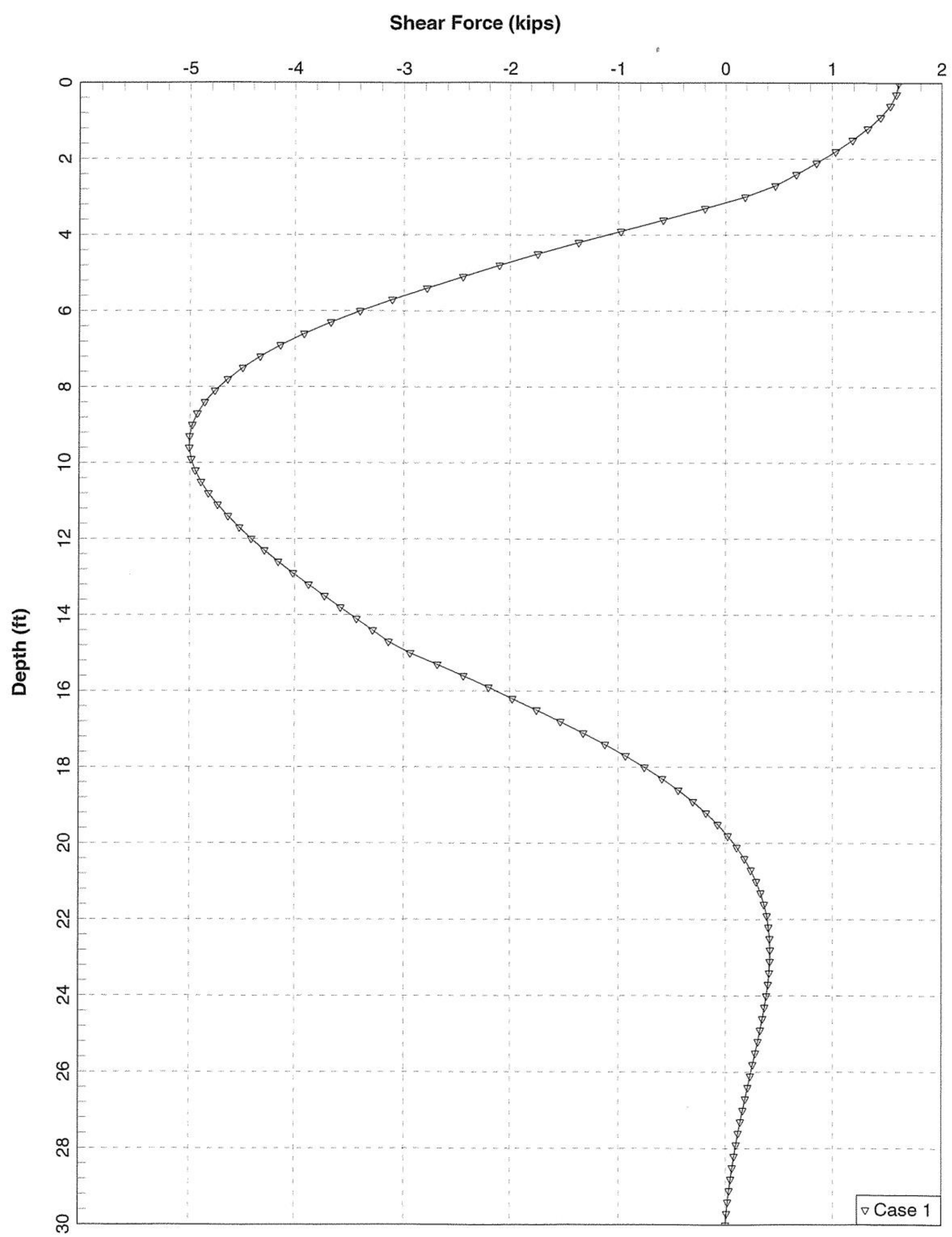
Pitluk



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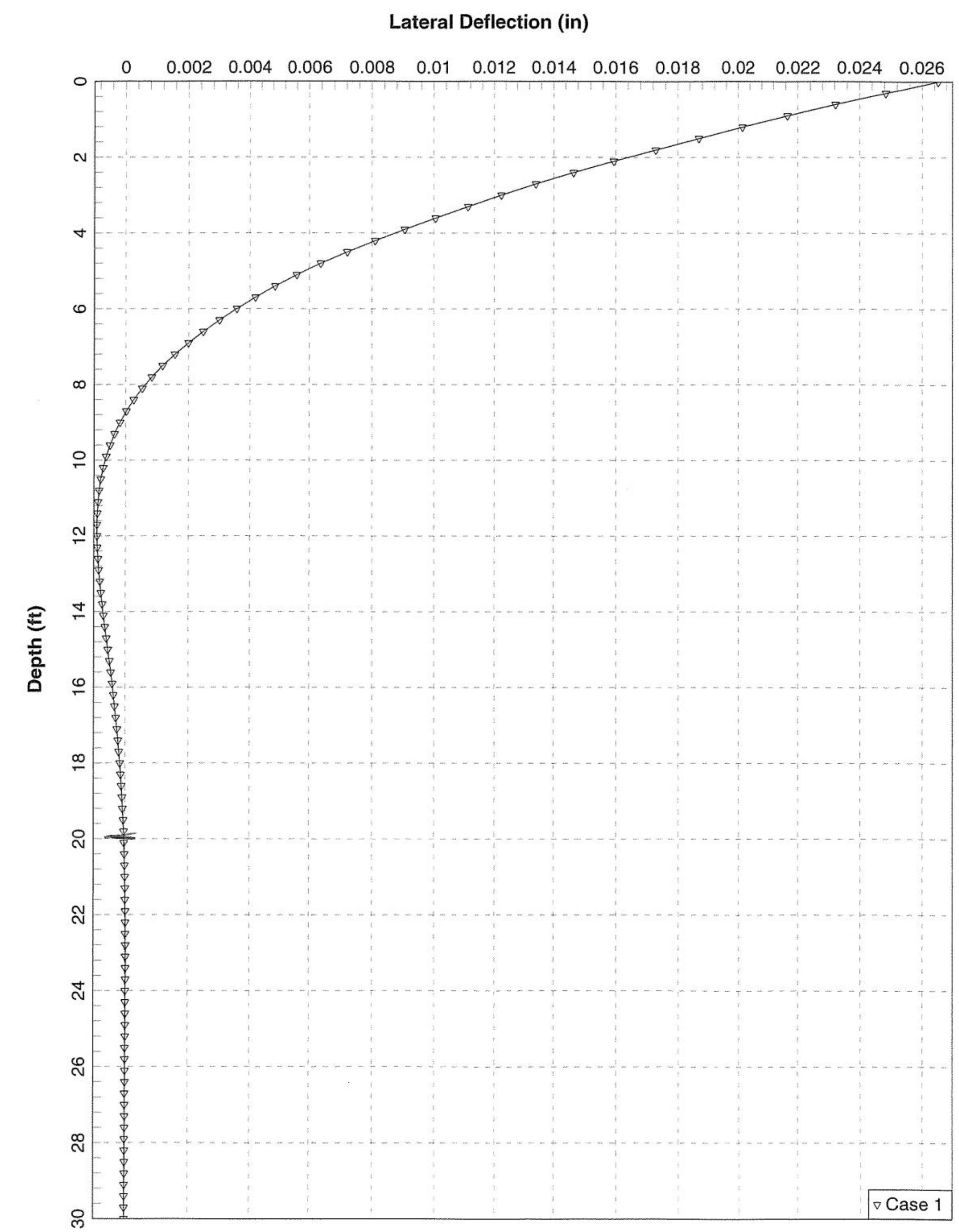
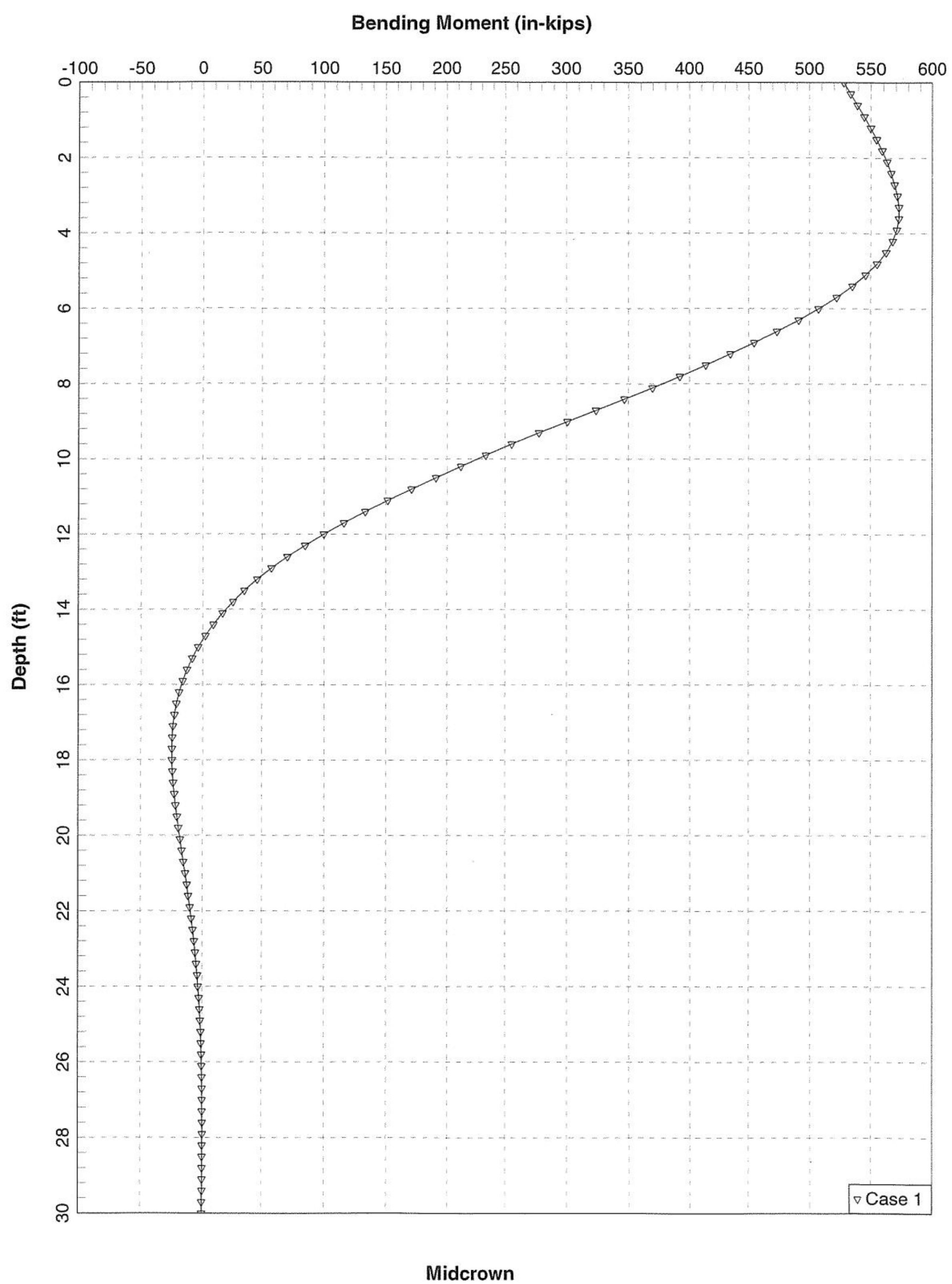


Midcrown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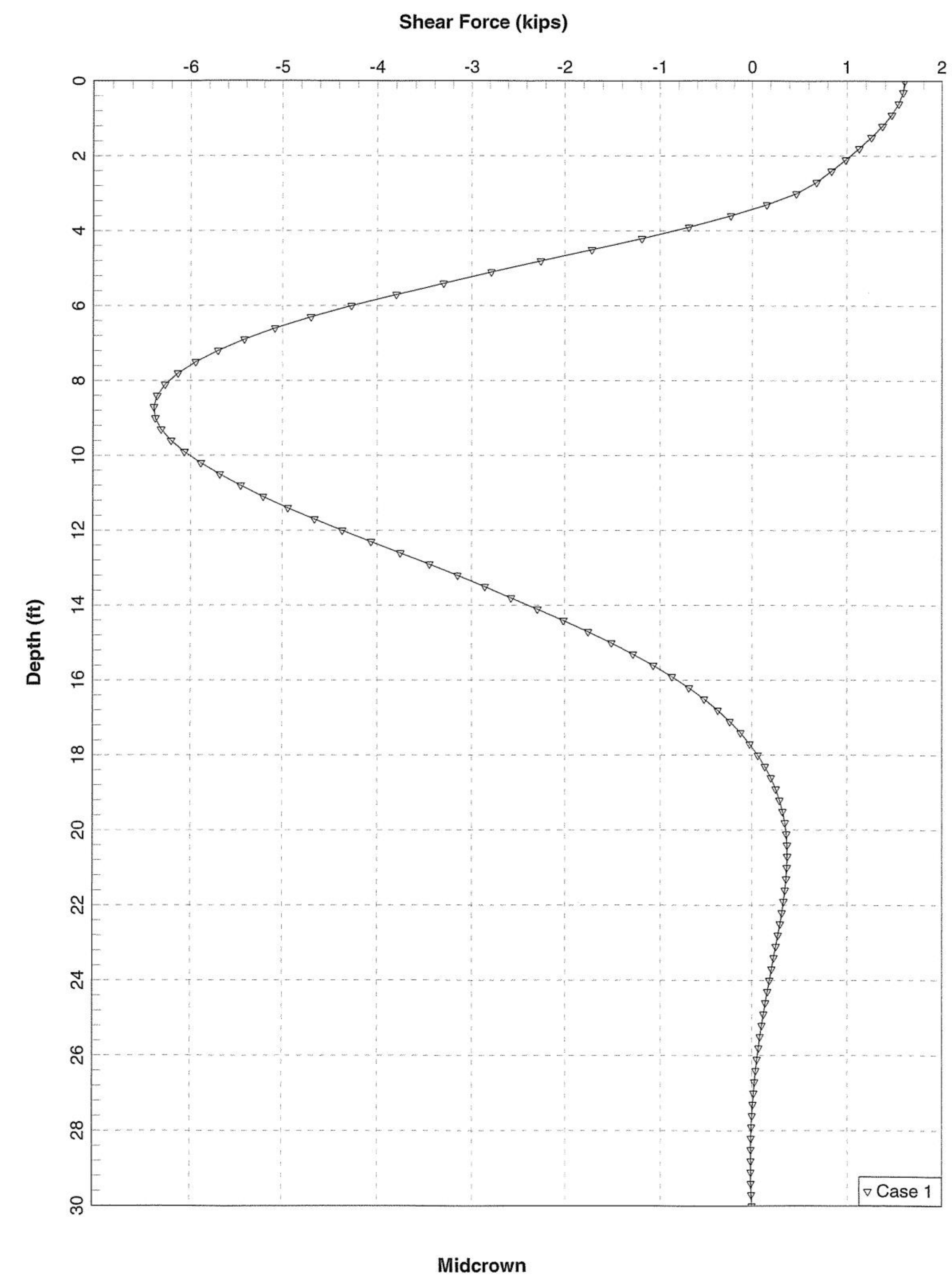
Case 1
Midcrown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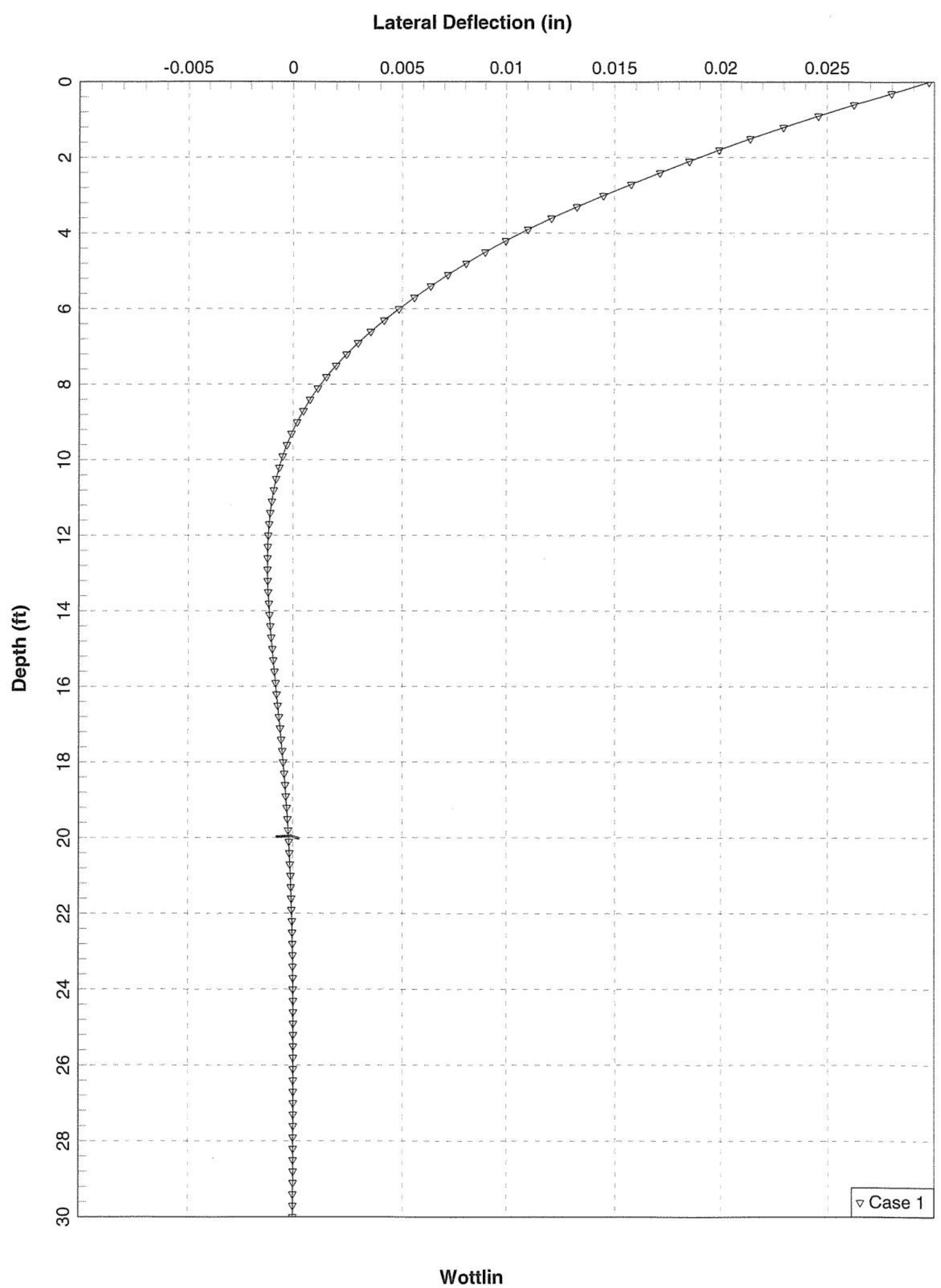
Case 1
Midcrown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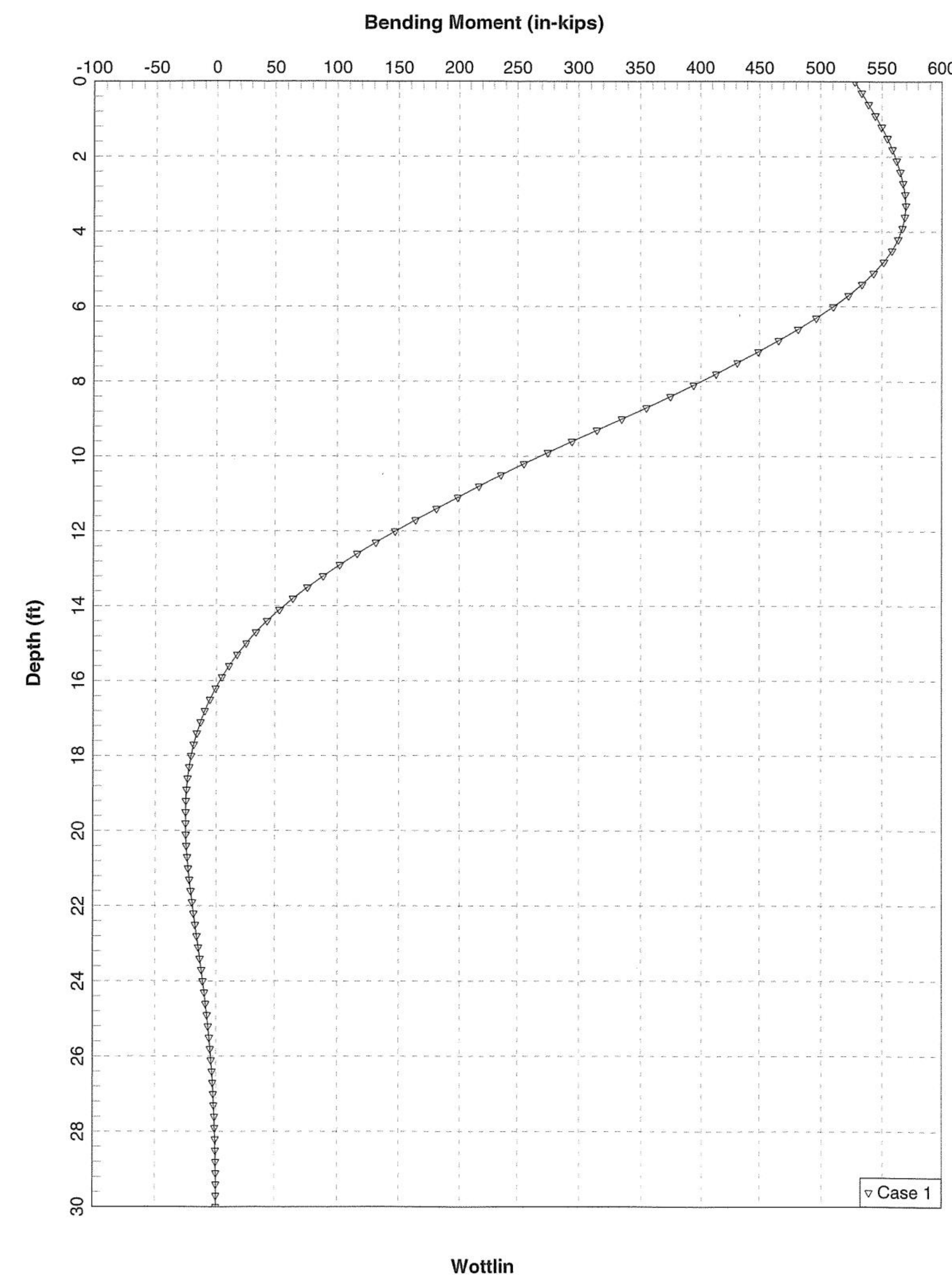
▿ Case 1
Wottlin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Depth (ft)
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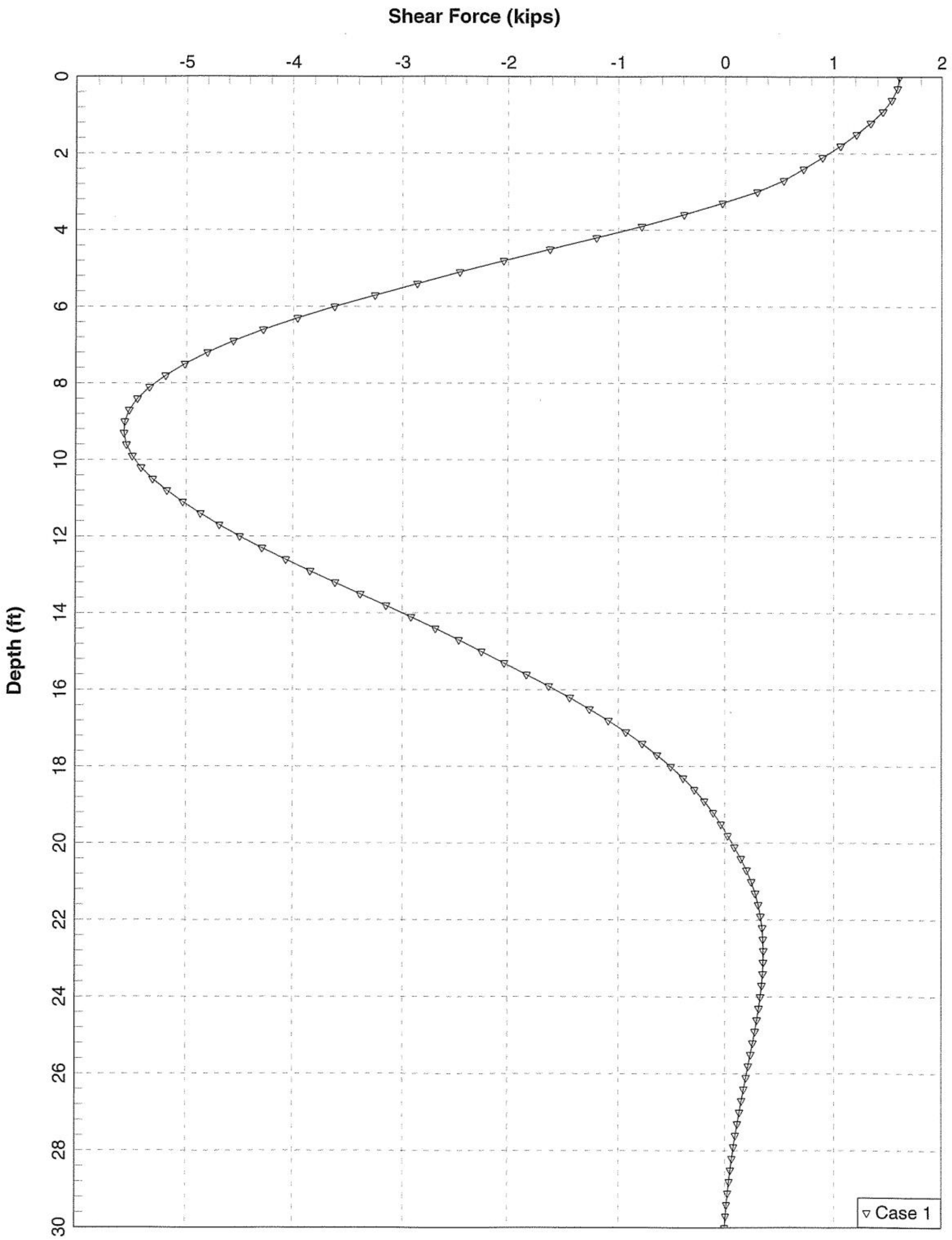
▿ Case 1
Wottlin



Wottlin

Important Information about Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

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PROJECT QUALITY ASSURANCE

A Message to Owners

Construction materials engineering and testing (CoMET) consultants perform quality-assurance (QA) services to evaluate the degree to which constructors are achieving the specified conditions they're contractually obligated to achieve. Done right, QA can save you time and money; prevent unanticipated-conditions claims, change orders, and disputes; and reduce short-term and long-term risks, especially by detecting molehills before they grow into mountains.

Done right, QA can save you time and money; prevent claims and disputes; and reduce risks. Many owners don't do QA right because they follow bad advice.

Many owners don't do QA right because they follow bad advice; e.g., "CoMET consultants are all the same. They all have accredited facilities and certified personnel. Go with the low bidder." But there's no such thing as a standard QA scope of service, meaning that – to bid low – each interested firms *must* propose the cheapest QA service it can live with, jeopardizing service quality and aggravating risk for the entire project team. Besides, the advice is based on misinformation.

Fact: ***Most CoMET firms are not accredited,*** and the quality of those that are varies significantly. Accreditation – which is important – nonetheless means that a facility met an accrediting body's minimum criteria. Some firms practice at a much higher level; others just barely scrape by. And what an accrediting body typically evaluates – management, staff, facilities, and equipment – can change substantially before the next review, two, three, or more years from now.

Most CoMET firms are not accredited. It's dangerous to assume CoMET personnel are certified.

Fact: ***It's dangerous to assume CoMET personnel are certified.*** Many have no credentials at all; some are certified by organizations of questionable merit, while others have a valid certification, but *not* for the services they're assigned.

Some CoMET firms – the "low-cost providers" – *want* you to believe that price is the only difference between QA providers. It's not, of course. Firms that sell low price typically lack the facilities, equipment, personnel, and insurance quality-oriented firms invest in to achieve the reliability concerned owners need to achieve quality in quality assurance.

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Firms that sell low price typically lack the facilities, equipment, personnel, and insurance quality-oriented firms invest in to achieve the reliability concerned owners need to achieve quality in quality assurance.

To derive maximum value from your investment in QA, require the CoMET firm's project manager to serve actively on the project team from beginning to end, a level of service that's relatively inexpensive and can pay huge dividends. During the project's planning and design stages, experienced CoMET professionals can help the design team develop uniform technical specifications and establish appropriate observation, testing, and instrumentation procedures and protocols. They can also analyze plans and specs much as constructors do, looking for the little errors, omissions, conflicts, and ambiguities that often become the basis for big extras and big claims. They can provide guidance about operations that need closer review than others, because of their criticality or potential for error or abuse. They can also relate their experience with the various constructors that have expressed interest in your project.

To derive maximum value, require the project manager to serve actively on the project team from beginning to end.

CoMET consultants' construction-phase QA services focus on two distinct issues: those that relate to geotechnical engineering and those that relate to the other elements of construction.

The geotechnical issues are critically important because they are essential to the "observational method" geotechnical engineers use to significantly reduce the amount of sampling they'd otherwise require. They apply the observational method by developing a sampling plan for a project, and then assigning field representatives to ensure samples are properly obtained, packaged, and transported. The engineers review the samples and, typically, have them tested in their own laboratories. They use the information they derive to characterize the site's subsurface and develop *preliminary* recommendations for the structure's foundations and for the specifications of various "geo" elements, like excavations, site grading, foundation-bearing grades, and roadway and parking-lot preparation and surfacing.

Geotechnical engineers cannot finalize their recommendations until they or their field representatives are on site to observe what's excavated to verify that the subsurface conditions the engineers predicted are those that actually exist.

When unanticipated conditions are observed, recommendations and/or specifications should be modified.

Responding to client requests, many geotechnical-engineering firms have expanded their field-services mix, so they're able to perform overall construction QA, encompassing – in addition to geotechnical issues – reinforced concrete, structural steel, welds, fireproofing, and so on. Unfortunately, that's caused some confusion. Believing that all CoMET consultants are alike, some owners take bids for the overall CoMET package, including the geotechnical field observation. *Entrusting geotechnical field observation to someone other than the geotechnical engineer of record (GER) creates a significant risk.*

PROJECT QUALITY ASSURANCE

Geotechnical engineers cannot finalize their recommendations until they are on site to verify that the subsurface conditions they predicted are those that actually exist. Entrusting geotechnical field observation to someone other than the geotechnical engineer of record (GER) creates a significant risk.

GERs have developed a variety of protocols to optimize the quality of their field-observation procedures. Quality-focused GERs meet with their field representatives before they leave for a project site, to brief them on what to look for and where, when, and how to look. (***No one can duplicate this briefing***, because no one else knows as much about a project's geotechnical issues.) And once they arrive at a project site, the field representatives know to maintain timely, effective communication with the GER, because that's what the GER has trained them to do. By contrast, it's extremely rare for a different firm's field personnel to contact the GER, even when they're concerned or confused about what they observe, because they regard the GER's firm as "the competition."

Divorcing the GER from geotechnical field operations is almost always penny-wise and pound-foolish. Still, because owners are given bad advice, it's commonly done, helping to explain why ***"geo" issues are the number-one source of construction-industry claims and disputes.***

Divorcing the GER from geotechnical field operations is almost always penny-wise and pound-foolish, helping to explain why "geo" issues are the number-one source of construction-industry claims and disputes.

To derive the biggest bang for the QA buck, identify three or even four quality-focused CoMET consultants. (If you don't know any, use the "Find a Geoprofessional" service available free at www.asfe.org.) Ask about the firms' ongoing and recent projects and the clients and client representatives involved; *insist upon receiving verification of all claimed accreditations, certifications, licenses, and insurance coverages.*

Insist upon receiving verification of all claimed accreditations, certifications, licenses, and insurance coverages.

Once you identify the two or three most qualified firms, meet with their representatives, preferably at their own facility, so you can inspect their laboratory, speak with management and technical staff, and form an opinion about the firm's capabilities and attitude.

Insist that each firm's designated project manager participate in the meeting. You will benefit when that individual is a seasoned QA professional familiar with construction's rough-and-tumble. Ask about others the firm will assign, too. There's no substitute for experienced personnel who are familiar with the codes and standards involved and know how to:

- read and interpret plans and specifications;
- perform the necessary observation, inspection, and testing;
- document their observations and findings;
- interact with constructors' personnel; and
- respond to the unexpected.

Important: Many of the services CoMET QA field representatives perform – like observing operations and outcomes – require the good judgment afforded by extensive training and experience, especially in situations where standard operating procedures do not apply. You need to know who will be exercising that judgment: a 15-year "veteran" or a rookie?

Many of the services CoMET QA field representatives perform require good judgment.

Also consider the tools CoMET personnel use. Some firms are passionate about proper calibration; others, less so. Passion is a good thing! Ask to see the firm's calibration records. If the firm doesn't have any, or if they are not current, be cautious. *You cannot trust test results derived using equipment that may be out of calibration.* Also ask a firm's representatives about their reporting practices, including report distribution, how they handle notifications of nonconformance, and how they resolve complaints.

Scope flexibility is needed to deal promptly with the unanticipated.

For financing purposes, some owners require the constructor to pay for CoMET services. ***Consider an alternative approach*** so you don't convert the constructor into the CoMET consultant's client. If it's essential for you to fund QA via the constructor, have the CoMET fee included as an allowance in the bid documents. This arrangement ensures that you remain the CoMET consultant's client, and it prevents the CoMET fee from becoming part of the constructor's bid-price competition. (Note that the International Building Code (IBC) *requires the owner to pay* for Special Inspection (SI) services commonly performed by the CoMET consultant as a service separate from QA, to help ensure the SI services' integrity. Because failure to comply could result in denial of an occupancy or use permit, having a contractual agreement that conforms to the IBC mandate is essential.)

If it's essential for you to fund QA via the constructor, have the CoMET fee included as an allowance in the bid documents. Note, too, that the International Building Code (IBC) requires the owner to pay for Special Inspection (SI) services.

CoMET consultants can usually quote their fees as unit fees, unit fees with estimated total (invoiced on a unit-fee basis), or lump-sum (invoiced on a percent-completion basis referenced to a schedule of values). No matter which method is used, estimated quantities need to be realistic. Some CoMET firms lower their total-fee estimates by using quantities they know are too low and then request change orders long before QA is complete.

Once you and the CoMET consultant settle on the scope of service and fee, enter into a written contract. Established CoMET firms have their own contracts; most owners sign them. Some owners prefer to use different contracts, but that can be a mistake when the contract was prepared for construction services. *Professional services are different.* Wholly avoidable problems occur when a contract includes provisions that don't apply to the services involved and fail to include those that do.

Some owners create wholly avoidable problems by using a contract prepared for construction services.

This final note: CoMET consultants perform QA for owners, not constructors. While constructors are commonly allowed to review QA reports as a *courtesy*, you need to make it clear that constructors do *not* have a legal right to rely on those reports; i.e., if constructors want to forgo their own observation and testing and rely on results derived from a scope created to meet *only* the needs of the owner, they *must do so at their own risk*. In all too many cases where owners have not made that clear, some constructors have alleged that they did have a legal right to rely on QA reports and, as a result, the CoMET consultant – not they – are responsible for their failure to deliver what they contractually promised to provide. The outcome can be delays and disputes that entangle you and all other principal project participants. Avoid that. Rely on a CoMET firm that possesses the resources and attitude needed to manage this and other risks as an element of a quality-focused service. Involve the firm early. Keep it engaged. And listen to what the CoMET consultant says. A good CoMET consultant can provide great value.

For more information, speak with your ASFE-Member CoMET consultant or contact ASFE directly.

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