



Geotechnical Engineering Report

**17-9SDP5002 WA2 – SH 6 Bridges at FM 2 and Beason Creek
Grimes County, Bryan District, Texas**

CSJ: 0050-03-096

April 2, 2021

Terracon Project No. A1205065

Prepared for:

Kimley-Horn & Associates Inc

Prepared by:

Terracon Consultants, Inc.

College Station, Texas



April 2, 2021

Kimley-Horn & Associates Inc
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Attn: Mr. Brian Boecker, P.E.
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Re: Geotechnical Engineering Report
17-9SDP5002 WA2 – SH 6 Bridges at FM 2 and Beason Creek
CSJ: 0050-03-096
Grimes County, Bryan District, Texas
Terracon Project No. A1205065

Dear Mr. Boecker:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with the Individual Project Order Number 069282702-TCI pursuant to the Master Agreement for Continuing Professional Services between Kimley-Horn and Associates, Inc. and Terracon Consultants, Inc. dated May 13, 2014. Our services were performed in general accordance with TxDOT Contract No. 17-9SDP5002, Work Authorization No. 2. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, subgrade preparation, the design and construction of bridge foundation elements, slopes, and site improvements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

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Environmental

Facilities

Geotechnical

Materials

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

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INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed bridges and slopes along SH 6 at its intersections with FM 2 and Beason Creek in Grimes County, Bryan District, Texas. The purpose of our services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Foundation design and construction for bridge structures
- Global stability analyses of the depressed section of SH 6 near FM 2 and SH 6 bridge abutments at Beason Creek
- Excavation considerations
- Site preparation and earthwork

The geotechnical engineering scope of services for this project included the advancement of four test borings for future bridge foundations, designated B-1 through B-4, to depths of approximately 100 feet below existing site grades, six borings for slopes, designated R-1 through R-3, R-4a, R-5, and R-6a, to depths ranging from approximately 40 to 60 feet below existing site grades, one test boring adjacent to an existing pond, designated P-1, to a depth of approximately 20 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

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Item	Description
Parcel Information	<p>The project limits extend along SH 6 from its intersection with Beason Creek to approximately 800 LF north of FM 2 (approximate SH 6 mainlane (ML) stations 1006+00 to 1040+00) and along FM 2 at its intersection with SH 6 (approximate FM 2 stations 405+00 to 408+00).</p> <p>See Site Location</p>
Existing Improvements	<p>The existing section of SH 6 along the project limits consists of a four-lane divided highway with a standard at-grade intersection at FM 2 and two bridges at Beason Creek.</p>
Current Ground Cover	<p>Existing asphalt pavements, grass, and weeds. Some areas of gravel driveways and private land with existing metal buildings in areas of planned future development.</p>
Existing Topography	<p>Ground elevation varies, generally sloping downward toward Beason Creek at the southern end of the project. Based on Google Earth imagery, ground elevations of the soil borings performed ranged from approximately 185 feet to 250 feet.</p>
Geology	<p>The site for the proposed construction is located on the Fleming formation, a deltaic non-marine Miocene deposit. The Fleming formation is a heterogeneous formation containing thick inter-bedded layers of clay and sandstone. The clay fraction is commonly calcareous and locally forms brownish-black soils. The sandstone formation consists of medium to coarse grained sands, calcareous, thick bedded, some cross-bedding, light yellowish gray to light gray and weathers light gray to medium gray.</p>

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	<p>The project is planned to include conversion of the at-grade standard intersection to a grade-separated intersection with FM 2 going over SH 6. SH 6 will be a four-lane divided highway with inside and outside shoulders and entrance and exit ramps to FM 2. The project also consists of the replacement of existing bridges crossing Beason Creek.</p>

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Item	Description
Proposed Structures	<p>Terracon's scope of work includes the following structures and locations:</p> <p>Bridges are planned at the following approximate locations:</p> <ul style="list-style-type: none">■ SH 6 Underpass at FM 2<ul style="list-style-type: none">■ FM 2 Station 405+03.28 to 407+58.28■ SH 6 NBML at Beason Creek<ul style="list-style-type: none">■ SH 6 NBML Station 3006+83.52 to 3009+13.52■ SH 6 SBML at Beason Creek<ul style="list-style-type: none">■ SH 6 SBML Station 2006+83.52 to 2009+13.52 <p>SH 6 is planned to be depressed below existing grade approaching and beneath the planned FM 2 bridge as follows:</p> <ul style="list-style-type: none">■ Depressed area extending from approximate ML Station 1017+00 to 1044+00;■ Sideslopes generally ranging from 4H:1V near the ends of the proposed depressed area to 2H:1V in the area of the FM 2 bridge; and■ Maximum slope height of approximately 27 feet.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation recommendations. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

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Boring Number ¹	Approximate Depth to Groundwater (feet) ²	Approximate Groundwater Elevation (feet) ³
B-1	4 ⁴	240
B-2	3.5 ⁴	236.5
B-3	10	175
B-4	20	166
R-3	23	214
R-4a	4.5 ⁴	242.5
R-5	4 ⁴	244
R-6a	10 ⁴	240

1. Groundwater was not observed in borings R-1, R-2, and P-1
2. Below ground surface.
3. Elevations presented are estimated based on Google Earth Imagery and the Schematic Plans previously provided to us.
4. Assumed to be perched water based on weather conditions around the time of our field investigation. Perched water may be encountered during construction and should be addressed through proper drainage measures to ensure that the slopes are not saturated and subjected to additional forces which could lead to instability, particularly for those slopes at inclinations of 2.5H:1V or greater.

Groundwater seepage is likely to be encountered at this site, particularly in the form of seepage traveling along pervious seams/fissures in the soil. Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Based on the relatively shallow short-term groundwater conditions observed in our borings, we strongly recommend long term observations through piezometers sealed from the influence of surface water to evaluate groundwater levels at the project site well before construction begins.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the

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state considered in our geotechnical engineering evaluation for foundations, slopes, and general site improvements.

Site Preparation

Construction areas should be stripped of all vegetation, existing pavements, loose soils, top soils, construction debris, and other unsuitable material currently present at the site. Roots of trees to be removed within construction areas, if any, should be grubbed to full depths, including the dry soil around the roots. We recommend that Terracon be retained to assist in evaluating exposed subgrades during earthwork so that unsuitable materials, if any, are removed at the time of construction.

Proof-Rolling

Once initial subgrade elevations have been achieved (i.e., after cuts but prior to fills), the exposed subgrade in all construction areas (except landscaping) should be carefully and thoroughly proof-rolled as per TxDOT Item 216 to detect weak zones in the subgrade. Weak areas detected during proof-rolling, zones containing debris or organics, and voids resulting from removal of tree roots, existing foundation elements, utilities, boulders, etc. should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils (or flowable fill). Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Moisture-Conditioned Subgrade

After proof-rolling, and just prior to placement of fill, the exposed soil subgrade in all construction areas (except landscaping) should be evaluated for moisture and density through field density testing. If the moisture and/or density requirements do not meet the moisture and density requirements below, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted as per the fill compaction requirements.

Excavations

The groundwater table could affect overexcavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

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Temporary Groundwater Control

As encountered during our drilling operations, groundwater seepage may be encountered during construction, especially after periods of wet weather. Temporary groundwater control is the responsibility of the General Contractor, however, temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of lateral drains could be required to remediate isolated water pockets.

Perched water may be encountered during construction and should be addressed through proper drainage measures to ensure that the slopes are not saturated and subjected to additional forces which could lead to instability, particularly for those slopes at inclinations of 2.5H:1V or greater.

Sand Drain Requirements

Vertically oriented sand drains should be installed longitudinally and at regular intervals along slopes of the depressed area that are steeper than 3H:1V to promote dewatering of the slope during and after construction. The sand drains should extend from the top of the slope to a minimum depth of 15 feet or an elevation near the bottom of the slope, whichever is shallower. A non-woven fabric meeting latest industry standards should be placed between the native soil and sand drains to prevent migration of fines from native soils into the sand drains, which could render them less effective long-term.

Fill Material Types

Fill required to achieve design grade should be classified as select/structural fill and general fill. Select/structural fill is material used below, or within 5 feet of structures. General fill is material used to achieve grade in paving, non-reinforced earthen slopes, landscape, or other general areas (non-structural areas). Earthen materials used for select fill and general fill should meet the following material property requirements:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
TxDOT Item 132 Type C1 Backfill	Sandy Clay or Clayey Sand ($8 \leq PI \leq 20$) with a friction angle of at least 30 degrees	Must be used within the areas of planned slopes and structures.
TxDOT Item 132 Type C2 Backfill	Varies	The on-site soils appear suitable for use as general fill, provided they are free of organics and debris.
TxDOT Item 400 Backfill	Sand	Must be used within sand drains.

¹. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. The samples should be tested for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing.

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Fill Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows.

Material Type	Minimum Compaction Requirements (%)	Moisture Content Range (%)	Maximum Loose Lift Thickness (in) ¹
TxDOT Item 132 Type C Backfill	98 - 101 ²	0 to +3	8 inches

1. Fill lift thickness must be reduced (typically 4 to 6 inches) if light compaction equipment is used, as is customary within a few feet of retaining walls.
2. Per TEX-114-E.

Construction Observation and Testing

The earthwork efforts should be documented under the direction of the Geotechnical Engineer. This should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation and density/moisture testing of subgrade and fills. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to evaluate the conditions.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Fill should be tested for density and water content at a frequency in accordance with TxDOT requirements.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

BRIDGE FOUNDATIONS

We understand that drilled shafts are planned to support the bridge abutments for this project. Based upon the field and laboratory data available, along with our previous experience, drilled shaft foundations are appropriate to support the proposed bridge structures. Recommendations and other geotechnical considerations for drilled shaft foundation systems are provided in the following sections. Capacity curves for each boring are provided in the **Supporting Information** section of this report.

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Drilled Shaft Design Considerations

Drilled shaft unit side friction, point bearing, and individual foundation capacity curves for wingwalls, abutments, and bents were generated using WinCore and are presented in **Supporting Information**. These curves were produced using the methodology presented in the TxDOT Geotechnical Design Manual, dated July 2020. We used Texas Cone Penetration (TCP) values in developing these capacity curves. Hand penetrometer values, modified SPT N-values, and compressive strength results, although indicated on the Drilling Logs, were not utilized for the capacity curves.

As recommended in the July 2020 TxDOT Geotechnical Manual, the allowable drilled shaft service loads should not exceed the maximum loads given in the following table.

Drilled Shaft Maximum Allowable Service Loads	
Shaft Diameter (inches)	Maximum Allowable Service Loads (tons)
24	175
36	400
48	700

As previously discussed, drilled shaft unit side friction and point bearing curves were generated for the proposed bridge foundations using WinCore and are presented in Appendix C as described in the following tables. The load capacities provided herein are based on the stresses induced in the supporting soil strata.

SH 6 at FM 2 Underpass			
Location	Drilled Shaft Diameter (inches)	Service Load (tons)	Referenced Boring(s)
Western Wing Wall	18	10	B-1
Abutment 1	36	75	B-1
Bent 2	36	145	B-1
Bent 3	36	145	B-2
Bent 4	36	145	B-2
Abutment 5	36	75	B-2
Eastern Wing Wall	18	10	B-2

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SH 6 NBML at Beason Creek Bridge			
Location	Drilled Shaft Diameter (inches)	Service Load (tons)	Referenced Boring(s)
Southern Wing Wall	18	10	B-4
Abutment 1	36	90	B-4
Bent 2	36	160	B-4
Bent 3	36	160	B-3
Abutment 4	36	90	B-3
Northern Wing Wall	18	10	B-3

SH 6 SBML at Beason Creek Bridge			
Location	Drilled Shaft Diameter (inches)	Service Load (tons)	Referenced Boring(s)
Southern Wing Wall	18	10	B-4
Abutment 1	36	95	B-4
Bent 2	36	180	B-4
Bent 3	36	180	B-3
Abutment 4	36	95	B-3
Northern Wing Wall	18	10	B-3

There are numerous factors which contribute to the behavior of groups subjected to axial load. Several of these factors are foundation type, size and length, spacing, overall group size, loading conditions, installation procedures and soil type and strength. We recommend a minimum spacing of three diameters, center-to-center, for shafts placed in groups beneath square or rectangular caps. Closer spacing than three diameters in groups could result in increased group settlement and a reduction of load-carrying capacity of individual foundation elements.

Settlement of a single, isolated shaft will depend on the elastic properties of the foundation, the applied load, and the interaction of the soil and foundation. Settlement is anticipated to be primarily elastic and will occur relatively soon as load is applied. Significant consolidation settlement due to applied load is not anticipated for the allowable capacities. Our experience indicates that a single, isolated foundation loaded to about one-half of its ultimate capacity will result in settlements of less than one inch. Groups generally undergo more settlement than single,

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isolated foundation elements for the same applied load. Based on the above recommended spacing, we anticipate that settlement of a group will be on the order of one inch under working loads with differential settlement between foundations to be one-half inch or less.

Drilled shaft foundations will provide resistance to structural uplift loads through the mobilization of the skin friction acting at the interface of the shaft sidewall and the adjacent soils. The allowable skin friction values may be used to calculate the uplift resistance for the shafts.

Drilled Shaft Lateral Loading

The drilled shaft foundations will provide resistance to lateral loads through the passive earth pressure acting on the side of the foundation. The following table lists input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on strength; however, non-default values of k_h should be used where provided. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the following lateral parameters.

SH 6 at FM 2 Underpass (Borings B-1 and B-2)							
Stratum ¹	Elevation (feet)	L-Pile Soil Model	S_u (psf) ²	ϕ ²	γ (pcf) ^{2,3}	ϵ_{50} ²	K (pci) ²
1	239 to 244	Sand (Reese)	---	30°	110	---	25
2	204 to 239	Stiff Clay w/o free water	2,500	---	126	0.005	1,000
3	192 to 204	Stiff Clay w/o free water	3,500	---	127	0.005	1,000
4	174 to 192	Sand (Reese)	---	38°	120	---	125
5	144 to 174	Stiff Clay w/o free water	3,000	---	120	0.005	1,000

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.

2. Definition of Terms:

S_u : Undrained shear strength

ϕ : Internal friction angle,

γ : Total unit weight

ϵ_{50} : Non-default E50 strain

K: Horizontal modulus of subgrade reaction

3. Buoyant unit weight values should be used below water table.

4. Lateral resistance should be neglected in the upper 2 feet in contact with the drilled shaft.

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SH 6 at Beason Creek Bridges (B-3)							
Stratum ¹	Elevation (feet)	L-Pile Soil Model	S _u (psf) ²	φ ²	γ (pcf) ^{2,3}	ε ₅₀ ²	K (pci) ²
1	178 to 185	Sand (Reese)	---	30°	115	---	25
2	155 to 178	Stiff clay w/ free water	800	---	120	0.009	375
3	148 to 155	Sand (Reese)	---	38°	125	---	125
4	135 to 148	Sand (Reese)	---	28°	120	---	20
5	125 to 135	Stiff clay w/o free water	1,750	---	120	0.007	500
6	103 to 125	Stiff clay w/o free water	4,000	---	123	0.005	1,000
7	85 to 103	Sand (Reese)	---	40°	130	---	125

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.

2. Definition of Terms:

S_u: Undrained shear strength

φ: Internal friction angle,

γ: Total unit weight

ε₅₀: Non-default E50 strain

K: Horizontal modulus of subgrade reaction

3. Buoyant unit weight values should be used below water table.

4. Lateral resistance should be neglected in the upper 2 feet in contact with the drilled shaft.

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SH 6 at Beason Creek Bridges (B-4)							
Stratum ¹	Elevation (feet)	L-Pile Soil Model	S _u (psf) ²	φ ²	γ (pcf) ^{2,3}	ε ₅₀ ²	K (pci) ²
1	178.5 to 186	Sand (Reese)	---	32°	115	---	25
2	154 to 178.5	Sand (Reese)	---	29°	115	---	25
3	139 to 154	Stiff clay w/ free water	1,400	---	120	0.007	500
4	116 to 139	Stiff clay w/o free water	3,000	---	120	0.005	1,000
5	86 to 116	Sand (Reese)	---	38°	125	---	125

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.

2. Definition of Terms:

S_u: Undrained shear strength

φ: Internal friction angle,

γ: Total unit weight

ε₅₀: Non-default E50 strain

K: Horizontal modulus of subgrade reaction

3. Buoyant unit weight values should be used below water table.

4. Lateral resistance should be neglected in the upper 2 feet in contact with the drilled shaft.

A detailed lateral load analysis of the proposed drilled shaft piers was beyond the scope of this project. If requested, a detailed lateral load analysis of the proposed drilled shaft foundations can be performed by Terracon. Lateral loads should not exceed the structural capacity of the individual drilled shaft.

Group action for lateral resistance of drilled shafts should be considered when spacing is less than six diameters (center to center). Group effects can be roughly estimated with the design parameters for allowable passive resistance in the direction of the load reduced in accordance with the table below; p-y multipliers can also be used in LPILE as a rough estimate for group load behavior. We can provide guidance for p-y multipliers if detailed analyses using LPILE are planned.

Drilled Shaft Spacing ¹	Reduction Factors
6D	1.0
4D	0.85
3D	0.65

1. Where D is the diameter of the drilled shaft

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The drilled shafts should be spaced at least three drilled shaft diameters apart (center-to-center; based on the larger drilled shaft diameter) if they will be used to resist lateral loads. Drilled shaft caps and/or grade beams could be subject to uplift loading due to expansive soils; thus, perimeter foundation elements should extend at least 4 feet below the lowest adjacent finished grade.

The structural capacity of the drilled shafts should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of drilled shafts should be evaluated using an appropriate analysis method, and will depend upon the drilled shaft's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of drilled shafts may be increased by increasing the diameter and/or length.

Drilled Shaft Construction Considerations

Drilled shafts should be constructed and installed in accordance with Item 416 of the 2014 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Drilled shaft foundations should be augered and constructed in a continuous matter. Concrete should be placed in the drilled shaft excavations following drilling and evaluation for proper bearing stratum, embedment, and cleanliness. The drilled shafts should not be allowed to remain open overnight before concrete placement. Surface runoff or groundwater seepage accumulating in the excavation should be pumped out and the condition of the bearing surface should be evaluated immediately prior to placing concrete. We anticipate difficulties in drilling may develop due to variations in soil consistency, silt/sand/gravel content, and the possible presence of cobbles and boulders within the soils.

As encountered during our field program, zones of groundwater inflow and/or sloughing soils are a possibility during drilled shaft construction at this site. Therefore, provisions should be incorporated into the plans and specifications to utilize casing to control sloughing and/or groundwater seepage during drilled shaft construction.

The use of casing should help to minimize groundwater inflow into the drilled shaft excavation. If soil sloughing or groundwater seepage is encountered at the proposed depth of a drilled shaft, it may be necessary to extend the excavation to a depth where the casing can control sloughing and/or seal off groundwater. If seepage persists even after casing installation and casing extension, the water should be pumped out of the excavation immediately prior to placing concrete. If groundwater inflow is too severe to be controlled by pumping, the concrete should be tremied to the full depth of the excavation to effectively displace the water. In this case, a "clean-out" bucket should be used to remove loose soil and/or rock fragments from the drilled shaft bottom before placing steel and concrete.

Care should be taken to not disturb the sides and bottom of the excavation during construction. The bottom of the shaft excavation should be free of loose material before concrete placement.

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Water or loose soil should be removed from the bottom of the drilled shafts prior to placement of the concrete. Concrete should be placed as soon as possible after the foundation excavation is completed, to reduce potential disturbance of the bearing surface.

Concrete should exhibit slump as designated in Structural Engineer's specifications. A design concrete slump of 6 to 8 inches helps to facilitate removal of casings and reduces the possibility of concrete arching/honeycombing. Under no circumstance should loose soil be placed in the space between the casing and the drilled shaft sidewalls. The concrete should be placed using a rigid tremie or by the free-fall method provided the concrete falls to its final position through air without striking the sides of the hole, the reinforcing steel cage, or any other obstruction. A drop chute should be used for this free-fall method.

While withdrawing casing, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures acting on the casing exterior. Arching of the concrete, loss of seal, mixing of the surrounding soil and water with fresh concrete, and other problems can occur during casing removal and result in contamination of the drilled shaft. These conditions should be considered during the design and construction phases. Placement of loose soil backfill should not be permitted around the casing prior to removal.

The drilled shaft installation process should be monitored under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil/rock and groundwater conditions encountered, consistency with expected conditions, and details of the installed shaft.

Foundation Construction Observation

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation installation be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation monitoring to be incorporated in the overall quality assurance program.

SLOPE STABILITY

Mechanics of Stability

Slope stability analyses take into consideration material strength, presence and orientation of weak layers, water (piezometric) pressures, surcharge loads, and the slope geometry. Mathematical computations are performed using computer-assisted simulations to calculate a Factor of Safety (FS). Minor changes to slope geometry, surface water flow and/or groundwater levels could result in slope instability. Reasonable FS values are dependent upon the confidence

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in the parameters utilized in the analyses performed, among other factors related to the project itself.

Soil Design Parameters for Evaluation of Slope Stability

Based on the field and laboratory test results and our past experience with similar soils, the strength parameters in the following tables were used in the slope stability analyses for the soil profiles developed.

Western Slope of Depressed Section along SH 6 (Borings B-1, R-1, R-3, and R-5)						
Stratum	Soil Description	Unit Weight	Short Term		Long Term	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
1	Clayey Sand	115	0	30	0	30
2	Fat Clay	120	2,000	0	150	21
3	Fat Clay	120	2,400	0	150	21
4	Fat Clay	120	3,000	0	150	21
5	Fat Clay	120	1,100	0	110	19
6	Fat Clay	120	4,000	0	150	23

Eastern Slope of Depressed Section along SH 6 (Borings B-2, R-2, R-4, and R-6)						
Stratum	Soil Description	Unit Weight	Short Term		Long Term	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
1	Clayey Sand	115	0	30	0	30
2	Fat Clay	120	1,500	0	150	20
3	Fat Clay	120	2,000	0	150	21
4	Fat Clay	120	2,400	0	150	21
5	Fat Clay	120	4,000	0	150	21

SH 6 at Beason Creek Southern Bank (Boring B-4)						
Stratum	Soil Description	Unit Weight	Short Term		Long Term	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
1	Silty Sand	120	0	32	0	32
2	Clayey Sand	115	50	29	50	29
3	Fat Clay	120	1,400	0	140	19

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SH 6 at Beason Creek Northern Bank (Boring B-3)						
Stratum	Soil Description	Unit Weight	Short Term		Long Term	
			c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
1	Silty Clayey Sand	115	0	31	0	31
2	Fat Clay	120	800	0	100	20
3	Silty Clayey Sand	115	0	28	0	28
4	Stone Riprap	135	0	40	0	40

Global Stability Analyses

Global stability analyses were performed utilizing a commercial slope stability software program, SLIDE 7.0 developed by Rocscience, Inc. This software calculates the factor of safety against slope failure using a two-dimensional limiting equilibrium method. The global stability analyses were performed for the short-term and long-term conditions. Rapid drawdown analyses using the B-bar method were also performed for the Beason Creek bridge abutments. Geometric models for the global stability analyses were developed considering the critical sections based on the cross sections and bridge layouts provided, generally those with the tallest slope height and steepest slopes.

The strength parameters that were used in the global stability analyses for the various soil profiles developed are presented in **Soil Design Parameters for Evaluation of Slope Stability**. The computer outputs of the stability analyses that include additional information are presented in **Supporting Information**.

The computed global stability factors of safety for the proposed slopes are summarized below.

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Summary of Global Stability Analyses for Proposed Slopes			
Location	Computed Factor of Safety		
	Short-Term	Long-Term	Rapid Drawdown
SH 6 at FM 2 Depressed Section Western Abutment	1.40	1.40	Not applicable
SH 6 at FM 2 Depressed Section Eastern Abutment	2.56	1.42	Not applicable
SH 6 over Beason Creek Southern Bank	1.99	1.80	1.16
SH 6 over Beason Creek Northern Bank	1.99	1.52	1.11
Minimum Factor of Safety	1.30	1.30	1.10

Shallow groundwater was encountered in some borings throughout the planned depressed section along SH 6. Based on the conditions observed, this appears to be perched water rather than a long-term groundwater surface; however, we recommend sand drains be installed as detailed in the **Sand Drain Requirements** and **Slope Protection and Drainage Requirements** sections of this report to ensure that slopes are properly drained during and after construction. Perched water may be encountered during construction and should be addressed through proper drainage measures to ensure that the slopes are not saturated and subjected to additional forces which would lead to instability, particularly for those slopes at inclinations of 2.5H:1V or greater.

Based on our evaluation, the proposed slopes of the planned depressed section of SH 6 may not be stable if groundwater is present within the planned excavation depth. If piezometers or other long-term groundwater observations indicate that shallow groundwater may be present, please contact us for additional analysis to evaluate steepest stable sideslope inclinations. Groundwater levels should be evaluated at the project site prior to construction.

Slope Protection and Drainage Requirements

Slopes steeper than 3H:1V should be protected through placement of concrete riprap constructed in accordance with TxDOT Item 432. Weepholes should be constructed through the concrete riprap to prevent buildup of hydrostatic pressures beneath the riprap and to promote proper drainage of the underlying slopes.

The planned concrete riprap will need to be designed to promote drainage behind and through the riprap to prevent buildup of hydrostatic pressures. This could consist of weepholes through the riprap and drainage material such as filter fabric wrapped no. 57 stone behind and at the toe of the slopes.

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Vertically oriented sand drains should be installed longitudinally and at regular intervals along slopes that are steeper than 3H:1V to promote dewatering of the slope during and after construction. The sand drains should extend from the top of the slope to a minimum depth of 15 feet or an elevation near the bottom of the slope, whichever is shallower. A non-woven fabric meeting latest industry standards should be placed between the native soil and sand drains to prevent migration of fines from native soils into the sand drains, which could render them less effective long-term.

An appropriate drainage system will need to be implemented during construction along the southern portion of the depressed area to promote drainage as excavation proceeds north into the areas where shallow groundwater is present.

Buffer Zones Adjacent to Cut Slopes

Excavation methods could result in decreased slope stability. To allow for some sloughing to occur, we recommend that a “buffer zone” at least 5 feet wide adjacent to pavement and other general areas be provided between the proposed construction areas and the permanent cut slopes (both at the toe and the crest). This should help reduce the possibility of sloughing soils from contacting the adjacent improvements on the downhill side and from undermining the improvements on the uphill side.

Erosion Considerations

The embankment slopes should be properly protected from erosion. The use of rock rip-rap, erosion control fabrics, and/or vegetation is common. In addition to initial erosion control measures, the embankments should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

Surficial Slope Stability

Surficial slope instability typically impacts the upper 3 to 5 feet of the subsurface profile, predominantly during extended wet periods. Regular maintenance should be anticipated to identify and address changes in natural drainage creating potential for soil creep or erosion near improvements. This includes replacing or replanting trees and grasses, as necessary, and grading the slope to reduce soil creep and erosion. If future surficial slope erosion occurs near the crest of slopes, we recommend the slope face be restored as soon as practical.

Fill slopes should be re-vegetated as soon as possible after grading and protected from erosion until vegetation is established. Slope planting should consist of ground cover, shrubs, and trees possessing deep, dense root structures that require minimum irrigation. It is the responsibility of the owner to maintain such planting.

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SULFATES

The table below lists the results of water-soluble sulfate testing.

Corrosivity Test Results Summary			
Boring	Sample Depth (feet)	Soil Description	Soluble Sulfate (ppm)
R-1	5 – 7	Fat clay	120
R-1	12 – 14	Fat clay	160
R-3	17 – 19	Fat clay	129
R-3	22 – 24	Fat clay	<100
R-4a	4 – 6	Clayey sand	<100
R-5	13 – 15	Lean clay	120
R-5	18 – 20	Fat clay	120
R-6a	7 – 9	Clayey sand	100

Results of water-soluble sulfate testing indicate that samples of the on-site soils have an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute (ACI) Design Manual.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with

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no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

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EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
4	100	Bridges (FM 2 and Beason Creek)
2	40	SH 6 Depressed Section
2	50	
2	60	
1	20	Pond

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 25 feet). Elevations were estimated based on Google Earth imagery. If elevations and a more precise boring layout are desired, we recommend boring locations be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using continuous flight augers (solid stem). Four to five samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube (shelby tubes) and split-barrel sampling procedures. The sampling procedure for split-barrel samplers (standard test method for standard penetration test (SPT) and split-barrel sampling of soils (ASTM D1586/D1886M-18)) was modified by the use of a 170-pound hammer and a 24-inch vertical drop. The Texas Cone Penetration (TCP) procedure was performed in accordance with TxDOT Method TEX-132-E.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below

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include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- Tex-103-E Determining Moisture Content in Soil Materials
- Tex-104-E Determining Liquid Limits of Soils
- Tex-105-E Determining Plastic Limit of Soils
- Tex-106-E Determining Plasticity Index of Soils
- Tex-110-E Particle-Size Analysis of Soils
- Tex-111-E Determining the Amount of Material in Soils Finer than the No. 200 Sieve
- Tex-118-E Triaxial Compression Test for Undisturbed Soils
- Tex-131-E Consolidated-Undrained Triaxial Compression Test on Cohesive Soils
- Tex-145-E Determining Sulfate Content in Soils – Colorimetric Method
- ASTM D3080 Direct Shear Test of Soils Under Consolidated Drained Conditions

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan (2 pages)

Note: All attachments are one page unless noted above.

SITE LOCATION

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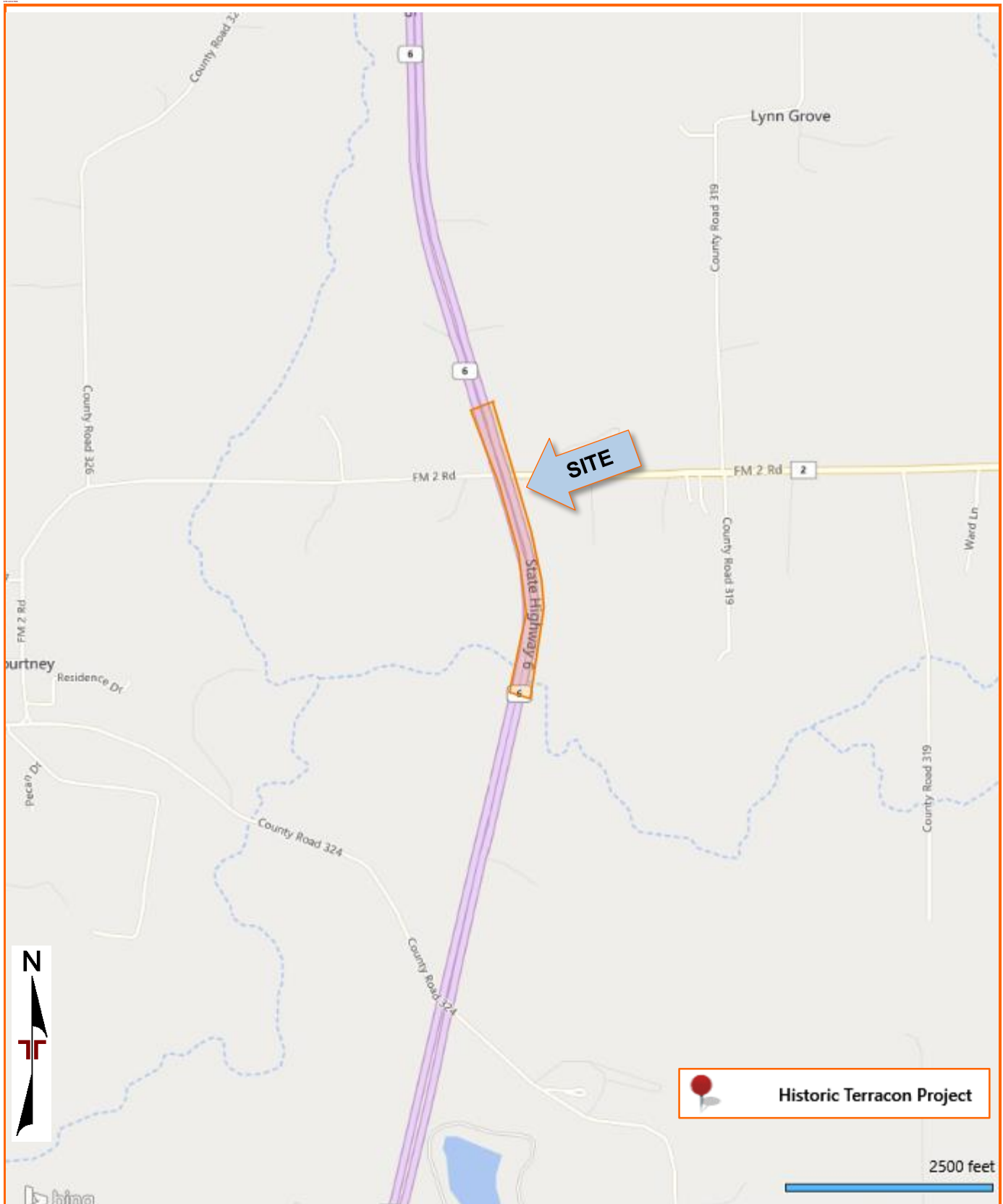


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

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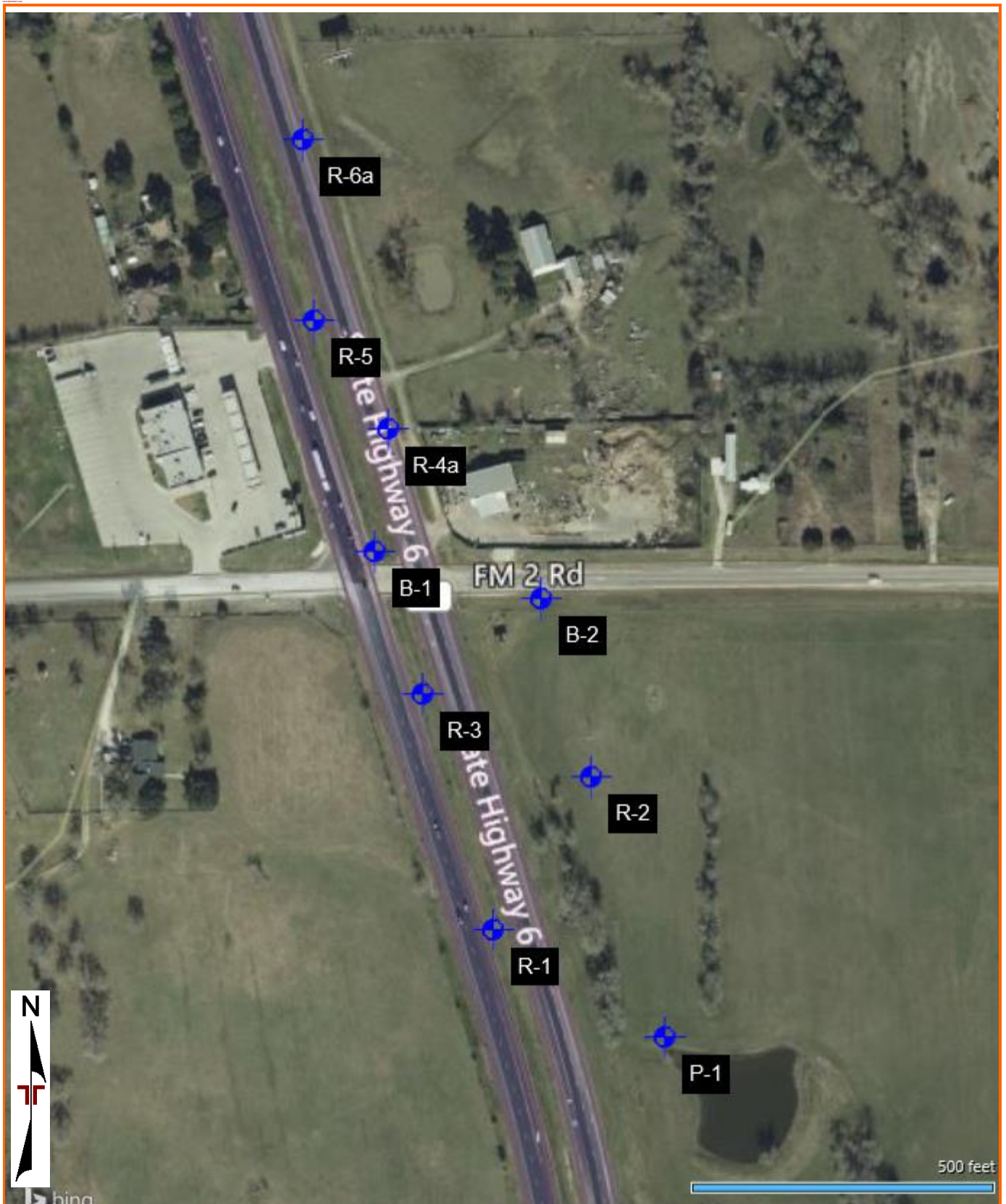


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MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

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DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-1
Structure FM 2 Bridge
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
239.5		10 (6) 10 (6)	SAND, clayey, loose, tan and reddish brown (SC)			20	27	10		-w/ scattered calc nods to 7ft HP-2.0 HP-1.0; #200(%)-27
										Initial GW: 4ft
10		11 (6) 15 (6)	CLAY, fat, soft to hard, tan, w/ferric stains, jointed (CH)			24	61	39		3-5-6; N=11 HP-4.5; #200(%)-94
										HP-4.5
15		10 (6) 14 (6)								HP-4.5
20		16 (6) 17 (6)				0	34.17	22	131	HP-4.5
25		22 (6) 21 (6)								HP-4.5
30		48 (6) 50 (4)								HP-4.5

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27359, -96.04209). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.



DRILLING LOG

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District Bryan District
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Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, soft to hard, tan, w/ferric stains, jointed (CH)	0	47.92	24			126	HP-4.5
35		8 (6) 7 (6)								HP-4.5
40		7 (6) 6 (6)								
202.			CLAY, fat, sandy, hard, tan, w/ ferric stains (SC)							8-10-16; N=26
45		50 (3) 32 (6)								22-50/5"; #200(%)-69
50		50 (4) 50 (4)								
192.			SAND, clayey, dense to very dense, tan, w/clay laminations (SC)							26-23-25; N=48
55		50 (3) 50 (2)								
						23.8				24-50/5"
60		50 (2) 50 (1.5)								

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27359, -96.04209). Elevations estimated from Google Earth Imagery.

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Hole B-1
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District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SAND, clayey, dense to very dense, tan, w/clay laminations (SC)							16-20-33; N=53
65		50 (2) 50 (2)								39-44-50/5.5
70		50 (1) 50 (1)								9-12-17; N=29
75		50 (4) 50 (6)								15-15-24; N=39
167.			CLAY, fat, very stiff to hard, gray and tan, with slickensides (CH)							-no recovery
80		50 (5.5) 50 (5.5)								-jointed below 85ft
85		22 (6) 22 (6)								
				73	40.9	27			123	HP-4.5
90		30 (6) 36 (6)								

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27359, -96.04209). Elevations estimated from Google Earth Imagery.

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DRILLING LOG



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 CSJ 0050-03-096

Hole B-1
 Structure FM 2 Bridge
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District Bryan District
 Date 7/31/2020
 Grnd. Elev. 244.00 ft
 GW Elev. 240.00 ft

WinCore
 Version 3.3

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
95		34 (6) 41 (6)	CLAY, fat, very stiff to hard, gray and tan, with slickensides (CH)							HP-4.5
100		50 (5) 50 (6)								HP-4.5
105										
110										
115										
120										

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27359, -96.04209). Elevations estimated from Google Earth Imagery.

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County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-2
Structure FM 2 Bridge
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, soft to very stiff, tan, reddish-brown and gray, some jointed areas (CH)							HP-2.5 -w/ scattered roots to 2ft HP-2.0
5		4 (6) 5 (6)				18	52	33		HP-3.5; #200(%)-78
										-w/sand to 7 feet HP-4.0
10		7 (6) 7 (6)								-w/ scattered calc nods to 9ft
						23	69	47		8-9-10; N=19
15		10 (6) 10 (6)								HP-4.5
20		18 (6) 20 (6)								
				0	17.36	23			126	HP-4.5
25		19 (6) 40 (6)								
										HP-4.5
30		13 (6) 17 (6)								

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27337, -96.04121). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

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Hole B-2
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Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, soft to very stiff, tan, reddish-brown and gray, some jointed areas (CH)	0	39.45	25			126	HP-4.5
35		6 (6) 10 (6)								HP-4.5
203.			CLAY, fat, very stiff to hard, tan, reddish-brown and gray, some jointed areas (CH)							HP-4.5
40		50 (4) 50 (4)								10-30-36; N=66 -w/sand below 43 ft
45		30 (6) 33 (6)								
				0	45.28	24			127	HP-4.5
50		50 (4) 28 (6)								20-50/6"
186.			SAND, clayey. dense to very dense, tan, reddish-brown and gray (SC)							
55		50 (4) 50 (1.5)				18	22	8		15-27-36; N=63; #200(%)-34
60		50 (1.5) 50 (1)								

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27337, -96.04121). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

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Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-2
Structure FM 2 Bridge
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks	
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)		
65		50 (0) 50 (0.5)	SAND, clayey. dense to very dense, tan, reddish-brown and gray (SC)							33-50/5"	
											50/3"
170. 70		50 (5.5) 50 (5)	CLAY, fat, stiff to hard, tan and gray, jointed, with slickensides (CH)							12-17-22; N=39	
75		36 (6) 45 (6)									HP-4.5
80											
					70	15.61	31			120	HP-2.0
85		50 (6) 50 (6)									
90		22 (6) 35 (6)									

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27337, -96.04121). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.

DRILLING LOG



County Grimes County
 Highway HWY 6 & FM 2
 CSJ 0050-03-096

Hole B-2
 Structure FM 2 Bridge
 Station
 Offset

District Bryan District
 Date 8/4/2020
 Grnd. Elev. 240.00 ft
 GW Elev. 236.50 ft

WinCore
 Version 3.3

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
95		24 (6) 40 (6)	CLAY, fat, stiff to hard, tan and gray, jointed, with slickensides (CH)							HP-4.5
100		26 (6) 50 (5.5)								HP-4.5
105										
110										
115										
120										

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27337, -96.04121). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-3
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
183.			CLAY, lean, stiff, with sand, reddish-brown and gray (CL)							HP-4.0
			SAND, silty, clayey, slightly compact, tan and reddish-brown			15	18	4		#200(%)-29 -w/ferric stains and nodules
5		14 (6) 19 (6)								4-6-6; N=12
178.			CLAY, fat, very soft to stiff, with sand, dark gray (CH)							HP-2.0
10		10 (6) 13 (6)								Initial GW: 10ft
				0	10.69	37	71	46	116	HP-2.0
15		2 (6) 2 (6)								HP-3.0; #200(%)-72
20		2 (6) 2 (6)								HP-2.5
				0	16.53	31			121	-w/ferric stains
25		2 (6) 2 (6)								HP-2.5
155		3 (6) 3 (6)								

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26736, -96.04117). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-3
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
35		10 (6) 12 (6)	SAND, silty, clayey, very loose to slightly compact, light gray			23			127	5-6-12; N=18
40		6 (6) 6 (6)								1-4-3; N=7 HP-2.5
45		0 (6) 0 (6)								2-3-4; N=7
135.50		3 (6) 3 (6)		CLAY, fat, stiff to very hard, light gray and tan (CH)						
55		7 (6) 14 (6)	43		24.24	27			121	HP-4.5 -w/sand seams to 70ft
60		15 (6) 50 (4.5)								HP-4.5

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26736, -96.04117). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-3
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
65		50 (4.5) 50 (3)	CLAY, fat, stiff to very hard, light gray and tan (CH)							HP-3.25
70		50 (5) 46 (6)								HP-4.0
75		50 (5.5) 50 (3)	CLAY, fat, sandy, hard, light gray (SC)			18				HP-2.0; #200(%)-59
80		50 (3) 50 (3)								50/5"
85		50 (2.5) 50 (1.5)	SAND, clayey, dense to very dense, light gray, with clay pockets (SC)							38-50/5"
90		50 (4) 50 (3)								15-27-30; N=57

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26736, -96.04117). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-3
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
95	[Dotted pattern]	50 (4) 50 (4)	SAND, clayey, dense to very dense, light gray, with clay pockets (SC)							50/5.5"
100		50 (0.5) 50 (0.5)								35-50/4"
105										
110										
115										
120										

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26736, -96.04117). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-4
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
5		27 (6) 26 (6)	SAND, silty, compact, reddish-brown and tan			6				HP-1.5
										#200(%)-27; 9-11-12; N=23 -w/ferric stains -w/scattered calc nods
178.5			SAND, clayey, loose, gray and tan, with silt throughout (SC)							7-8-5; N=13
10		5 (6) 7 (6)								1-3-5; N=8
						16	27	13		HP-2.5; #200(%)-35
15		8 (6) 9 (6)								
				0	15.42	16			132	HP-3.75; w/ferric stains -w/scattered calc nods
20		5 (6) 6 (6)								Initial GW: 20ft
						19	25	10		#200(%)-35; 2-2-3; N=5
25		5 (6) 5 (6)								2-2-3; N=5
30		7 (6) 11 (6)								

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26659, -96.04130). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-4
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
154.			SAND, clayey, loose, gray and tan, with silt throughout (SC)							4-5-7; N=12
35		8 (6) 8 (6)	CLAY, fat, very soft to soft, gray and tan, some jointed areas (CH)							7-11-15; N=26
				0	27.09	28	77	52	123	HP-4.5; #200(%) -100
40		7 (6) 9 (6)								-w/sand pockets HP-4.5; w/ scattered calc nods
45		3 (6) 4 (6)								
139.			CLAY, fat, stiff to hard, gray and tan, some jointed areas (CH)							HP-3.0
50		19 (6) 22 (6)								HP-3.25
55		12 (6) 16 (6)								
				46	59.03	25	66	46	124	HP-3.75
60		12 (6) 29 (6)								

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26659, -96.04130). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole B-4
Structure SH 6 Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
65		36 (6) 50 (4)	CLAY, fat, stiff to hard, gray and tan, some jointed areas (CH)							HP-3.75
70		50 (3) 50 (3)								HP-3.5
75		50 (4) 50 (3)	SAND, silty, clayey, very dense, gray and tan							
75		50 (3) 50 (2)				22	23	5		31-41-50/2"; #200(%)-29
80		50 (2) 50 (1)								34-35-33; N=68
85		50 (1) 50 (0.5)								33-36-50/5"
96		50 (1) 50 (0.5)								50/5.5"

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26659, -96.04130). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.

DRILLING LOG



County Grimes County
 Highway HWY 6 & FM 2
 CSJ 0050-03-096

Hole B-4
 Structure SH 6 Bridge
 Station
 Offset

District Bryan District
 Date 8/8/2020
 Grnd. Elev. 186.00 ft
 GW Elev. 166.00 ft

WinCore
 Version 3.3

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SAND, silty, dense, gray							
						18				#200(%)-20; 17-37-36; N=73
95		50 (3) 50 (3)								
										27-33-28; N=61
86. 100		50 (4) 50 (3)								
105										
110										
115										
120										

Remarks: Advance Method: Dry augered to 20 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.26659, -96.04130). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-1
Structure Slope
Station
Offset

District Bryan District
Date 8/7/2020
Grnd. Elev. 225.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
220.5		3 (6) 3 (6)	SAND, silty, clayey, very loose, gray, tan and reddish-brown			9	20	6		HP-2.0; #200(%) -39 HP-2.5 HP-2.5
10		0 (6) 0 (6)	CLAY, fat, very soft to stiff, gray, tan and reddish-brown, with sand seams and scattered calc nods (CH)	0	24.58	23	63	44	126	HP-3.0 w/scattered ferric nods to 9ft HP-1.75
15		19 (6) 13 (6)								
20		13 (6) 15 (6)				27	74	50		HP-4.0; #200(%) -97 HP-3.25
201.25		50 (4) 50 (1)	CLAY, fat, hard to very hard, gray, tan and reddish-brown (CH)							
30		50 (0.5) 50 (0.5)								

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27187, -96.04147). Elevations estimated from Google Earth Imagery.

The ground water elevation was not determined during the course of this boring.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.

DRILLING LOG



County Grimes County
 Highway HWY 6 & FM 2
 CSJ 0050-03-096

Hole R-1
 Structure Slope
 Station
 Offset

District Bryan District
 Date 8/7/2020
 Grnd. Elev. 225.00 ft
 GW Elev. N/A

WinCore
 Version 3.3

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
190.35		35 (6) 50 (3)	CLAY, fat, hard to very hard, gray, tan and reddish-brown (CH)			23	69	48		20-22-24; N=46 HP-4.5
			CLAY, lean, hard, gray, tan and reddish-brown (CL)	31	105.48	19	47	30	130	HP-4.5
185.40		50 (3) 50 (4)								
45										
50										
55										
60										

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27187, -96.04147). Elevations estimated from Google Earth Imagery.

The ground water elevation was not determined during the course of this boring.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.

DRILLING LOG



WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-04-096

Hole R-2
Structure Slope
Station
Offset

District Bryan District
Date 9/30/2020
Grnd. Elev. 237.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, soft to very stiff, tan and dark tan (CH)							-w/silt lams, calc nods to 35ft
		12 (6) 31 (6)		0	66.25	22	71	49	128	HP-4.5
35										
		12 (6) 30 (6)								HP-4.5
40										
195.			CLAY, lean, sandy, very stiff to hard (SC)			17	29	15		#200(%)-54; HP-4.5
		50 (3)								
45										
190.			SAND, clayey, dense, reddish brown (SC)							42-42-42; N=84
		50 (1.5)								
187.										
50										
55										
60										

Remarks: Advance Method: Dry augered to 25 feet, wet rotary thereafter. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = (30.27257, -96.04095). Elevations estimated from Google Earth Imagery.

The ground water elevation was not determined during the course of this boring.

Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.

DRILLING LOG



WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-3
Structure Slope
Station
Offset

District Bryan District
Date 8/6/2020
Grnd. Elev. 237.00 ft
GW Elev. 214.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks	
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)		
			CLAY, fat, very soft to stiff, gray and tan, with sand seams and some jointed areas (CH)							HP-3.25 -w/scattered gravel to 2 ft HP-3.0	
5		3 (6) 4 (6)				20	58	39		HP-4.25; #200(%) -94	
										HP-4.5 -w/calc nods to 9ft	
10		11 (6) 11 (6)								HP-4.5	
										HP-4.5	
15		10 (6) 13 (6)								HP-4.5	
										HP-4.5	
20		16 (6) 19 (6)							HP-4.5		
									HP-4.5		
25		12 (6) 15 (6)							Initial GW: 26ft 15min: 23ft		
					0	25.7	24	72	51	126	HP-4.25; #200(%) -95
30		5 (6) 6 (6)									

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27294, -96.04184). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-3
Structure Slope
Station
Offset

District Bryan District
Date 8/6/2020
Grnd. Elev. 237.00 ft
GW Elev. 214.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
205.			CLAY, fat, very soft to stiff, gray and tan, with sand seams and some jointed areas (CH)							HP-2.25
		10 (6) 47 (6)	CLAY, lean, very stiff to very hard, gray and tan, with sand seams (CL)							
35										
		50 (3) 50 (2)								50/3"
40										
		50 (2) 50 (2)		35	21.53	19	40	23	123	HP-3.75
45										
		50 (3) 50 (4)								-no recovery
50										
		50 (3) 50 (2)								10-16-22; N=38
184.			CLAY, fat, hard to very hard, gray and tan (CH)							HP-4.5
55										
		50 (3) 50 (2)								
180.			SAND, silty, dense, tan, with scattered gravel							
		50 (3) 50 (2)				26				#200%-29; 24-27-38; N=65
177	60									

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27294, -96.04184). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.

DRILLING LOG



WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-4a
Structure Slope
Station
Offset

District Bryan District
Date 11/30/2020
Grnd. Elev. 247.00 ft
GW Elev. 242.50 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks	
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)		
			SAND, clayey, loose to compact, dark tan (SC)			17				#200(%)-33	
5		7 (6) 8 (6)				20	24	10		HP-2.5 -w/ calc nodules below 4ft	
10		24 (6) 18 (6)							#200(%)-31; 4-4-5; N=9		
235.			CLAY, fat, soft to stiff, tan (CH)							4-4-13; N=17	
15		9 (6) 12 (6)			0	19.86	45	55	35	126	#200(%)-96; HP-4.5
20		5 (6) 9 (6)									HP-4.5
25		17 (6) 17 (6)									HP-4.5 -slickensided to 25ft
30		7 (6) 13 (6)				16	64	43	127	HP-4.5	

Remarks: Advance Method: Dry augered to 10 feet, wet rotary thereafter. SPT N-values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = (30.27414, -96.04202). Elevations estimated from Google Earth Imagery.

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Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-4a
Structure Slope
Station
Offset

District Bryan District
Date 11/30/2020
Grnd. Elev. 247.00 ft
GW Elev. 242.50 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
214.			CLAY, fat, soft to stiff, tan (CH)							
35		50 (1) 50 (1)	CLAY, fat, reddish brown, very stiff to very hard (CH)							20-13-13; N=26
										-w/ ferric stains to 45ft
40		25 (6) 23 (6)								8-11-16; N=27
45		15 (6) 35 (6)								8-12-15; N=27
50		30 (6) 35 (6)								6-11-16; N=27
										50/0.25
						19	62	42		#200(%)-87
55		50 (0) 50 (0)								10-15-19 N=34, slickensided
187 60		29 (6) 32 (6)								

Remarks: Advance Method: Dry augered to 10 feet, wet rotary thereafter. SPT N-values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = (30.27414, -96.04202). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-5
Structure Slope
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 248.00 ft
GW Elev. 244.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties			Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	
5			SAND, silty, clayey, slightly compact, reddish-brown, tan and gray, with ferric stains and nodules						HP-1.25
		10 (6) 10 (6)							
				0	26.67	19		132	Initial GW: 7ft 15min: 4ft
		10 (6) 11 (6)							HP-3.25
238.10			CLAY, lean, sandy, soft, gray and tan, with slickensides (SC)						HP-3.0
		5 (6) 7 (6)				27	45	25	#200(%)-62; 3-5-7; N=12
									HP-4.5
230.15			CLAY, fat, soft to very hard, gray and tan, with slickensides (CH)						
		6 (6) 11 (6)							
		10 (6) 14 (6)				21	58	39	HP-3.75
25									HP-4.5
		34 (6) 24 (6)							
30									

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27463, -96.04240). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-5
Structure Slope
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 248.00 ft
GW Elev. 244.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
35		21 (6) 24 (6)	CLAY, fat, soft to very hard, gray and tan, with slickensides (CH)							8-13-16; N=29
40		28 (6) 26 (6)				24	70	50		5-11-12; N=23
45		50 (2) 50 (0.5)								HP-4.5
50		21 (6) 35 (6)								HP-4.5
55										
60										

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat,Lon) = (30.27463, -96.04240). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Patrick Moore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-6a
Structure Slope
Station
Offset

District Bryan District
Date 12/1/2020
Grnd. Elev. 250.00 ft
GW Elev. 240.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
246.			CLAY, lean, sandy, soft, dark tan (SC)			22	48	30		-with scat roots to 2ft -gray to 13ft #200(%)-57; HP-1.5
5		7 (6) 11 (6)	SAND, clayey, loose, gray, with ferric stains and nodules (SC)			20	36	16		HP-3.0 -w/ ferric stains and nodules #200(%)-38; 4-5-6; N=11
240.		4 (6) 7 (6)	CLAY, fat, stiff to very stiff, gray (CH)							HP-4.5
15		13 (6) 13 (6)								HP-4.5
				0	29.58	21	56	34	132	HP-4.5
20		11 (6) 17 (6)								HP-4.5
25		16 (6) 19 (6)								HP-4.5
30		29 (6) 40 (6)								HP-4.5

Remarks: Advance Method: Dry augered to 10 feet, wet rotary thereafter. SPT N-values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = (30.27545, -96.04246). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Jonathan Whitmore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-03-096

Hole R-6a
Structure Slope
Station
Offset

District Bryan District
Date 12/1/2020
Grnd. Elev. 250.00 ft
GW Elev. 240.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, stiff to very stiff, gray (CH)							HP-4.5
35		39 (6) 21 (6)								
				33 111.94	22	62	42	129	#200(%)-100; HP-4.5	
210. 40		20 (6) 20 (6)							-slickensided	
45										
50										
55										
60										

Remarks: Advance Method: Dry augered to 10 feet, wet rotary thereafter. SPT N-values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = (30.27545, -96.04246). Elevations estimated from Google Earth Imagery.

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: Justin Lovelace

Logger: Jonathan Whitmore

Organization: Terracon Consultants, Inc.



DRILLING LOG

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
CSJ 0050-04-096

Hole P-1
Structure Pond
Station
Offset

District Bryan District
Date 9/30/2020
Grnd. Elev. 208.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Deviator Press. (psi)	Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, fat, soft to very stiff, tan and dark tan, w/ calcareous nodules (CH)			16				-w/scat roots to 7ft HP-2.0
						21				HP-3.0
5		3 (6) 5 (6)				21				HP-3.5
						21				-w/ferric stains,silt lams HP-4.0
10		8 (6) 10 (6)				21				-w/silt lenses to 17ft HP-4.5
15		4 (6) 8 (6)				17				-w/sand below 17ft HP-4.5
188.20		26 (6) 22 (6)								
25										
30										

Remarks: Advance Method: Dry augered to termination depth. SPT N-Values are not standard (170-lb hammer and 24 inch drop). (Lat, Lon) = 30.27137, -96.040578). Elevations estimated from Google Earth Imagery.

The ground water elevation was not determined during the course of this boring.

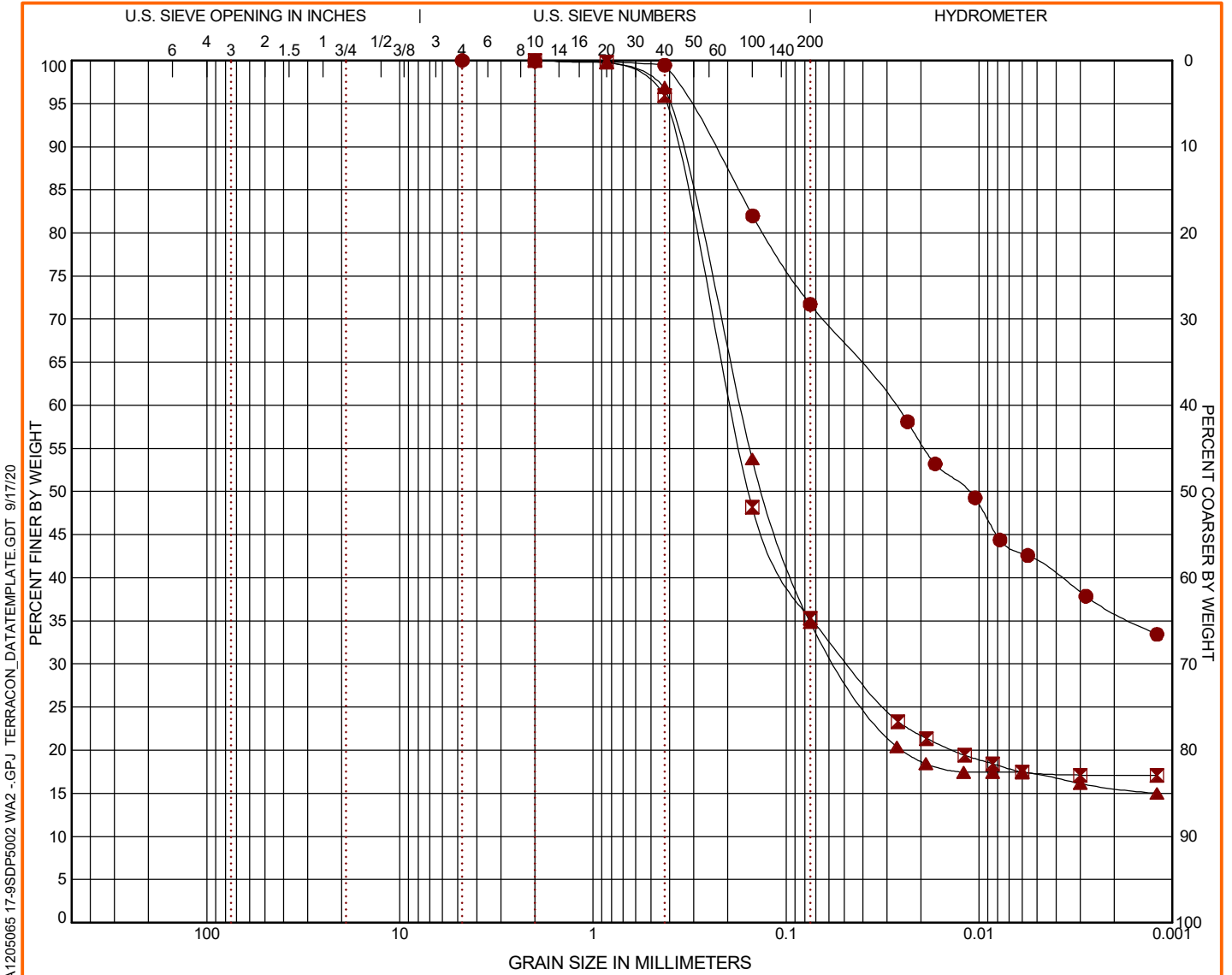
Driller: Justin Lovelace

Logger: Derek Barosh

Organization: Terracon Consultants, Inc.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
● B-3	18 - 20	0.0	0.0	28.3	29.9		41.8	
☒ B-4	12 - 14	0.0	0.0	64.6	18.0		17.4	SC
▲ B-4	23.5 - 25	0.0	0.0	65.2	17.7		17.1	SC

GRAIN SIZE			
	●	☒	▲
D ₉₅	0.325	0.416	0.407
D ₅₀	0.011	0.156	0.131
D ₁₀			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	#10	100.0	#10	100.0
#10	99.94	#20	99.84	#20	99.78
#40	99.46	#40	95.96	#40	96.84
#100	81.98	#100	48.2	#100	53.78
#200	71.72	#200	35.32	#200	34.82

SOIL DESCRIPTION	
●	
☒	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)
REMARKS	
●	
☒	
▲	

COEFFICIENTS			
	●	☒	▲
C _c			
C _u			

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. TXDOT-GRAIN SIZE A1205065 17-9SDP5002 WA2 - GPJ TERRACON DATATEMPLATE.GDT 9/17/20

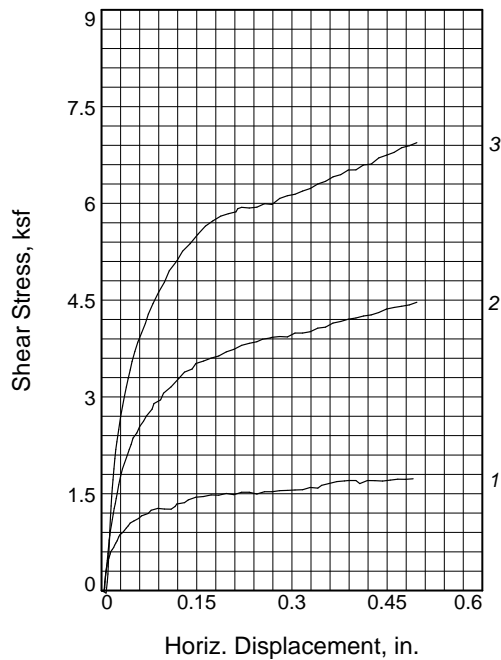
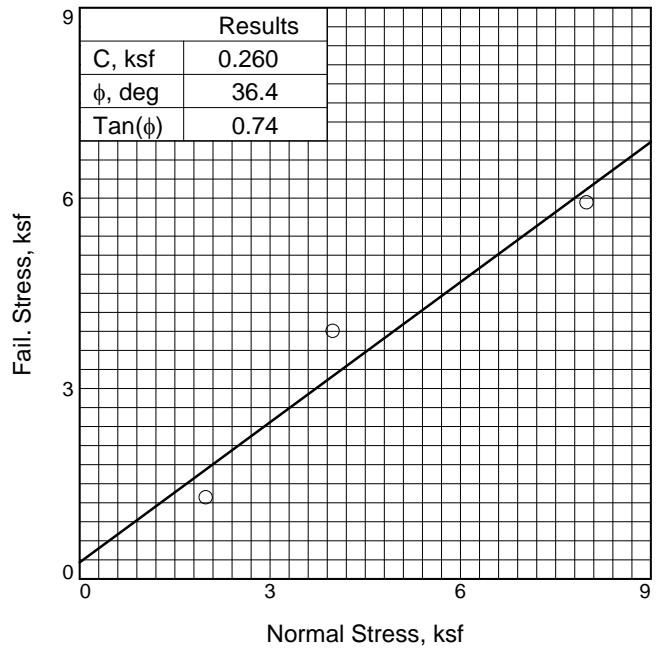
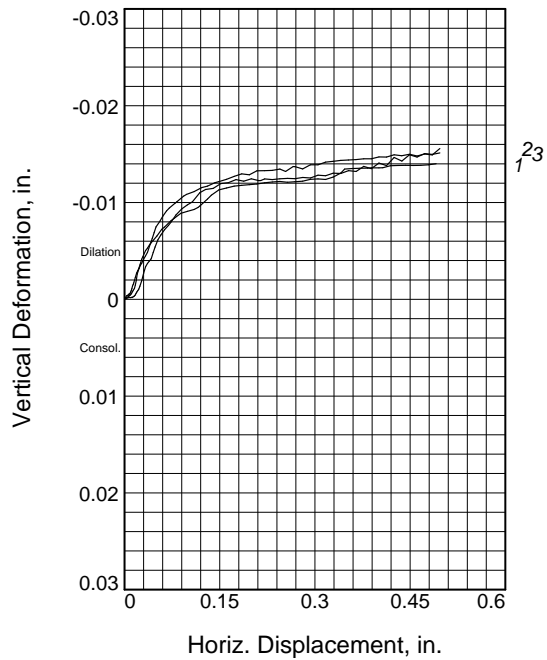
PROJECT: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

SITE: SH 6 at FM 2 Navasota, TX



PROJECT NUMBER: A1205065

CLIENT: Kimley-Horn & Associates Inc Austin, TX



Sample No.	1	2	3	
Initial	Water Content, %	23.8	23.8	23.8
	Dry Density, pcf	99.0	99.0	99.4
	Saturation, %	91.4	91.5	92.2
	Void Ratio	0.7024	0.7019	0.6962
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	25.9	25.4	25.2
	Dry Density, pcf	99.0	99.0	99.4
	Saturation, %	99.7	97.6	97.7
	Void Ratio	0.7024	0.7019	0.6962
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf	2.000	4.000	8.000	
Fail. Stress, ksf	1.272	3.895	5.918	
Displacement, in.	0.089	0.254	0.215	
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.	0.001	0.001	0.001	

Sample Type: Undisturbed

Description: Clayey sand

Assumed Specific Gravity= 2.70

Remarks: ASTM D3080

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

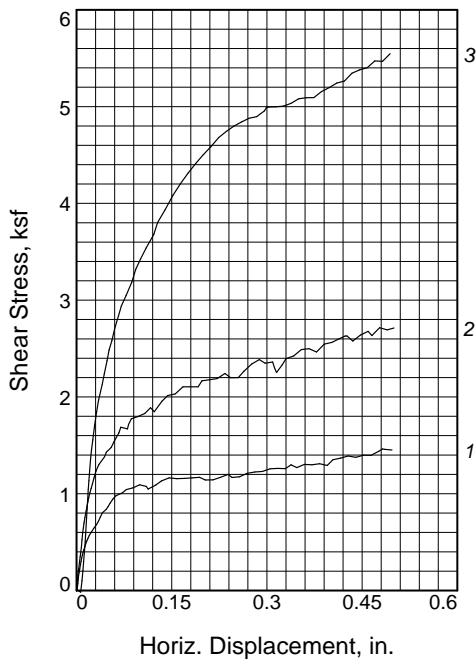
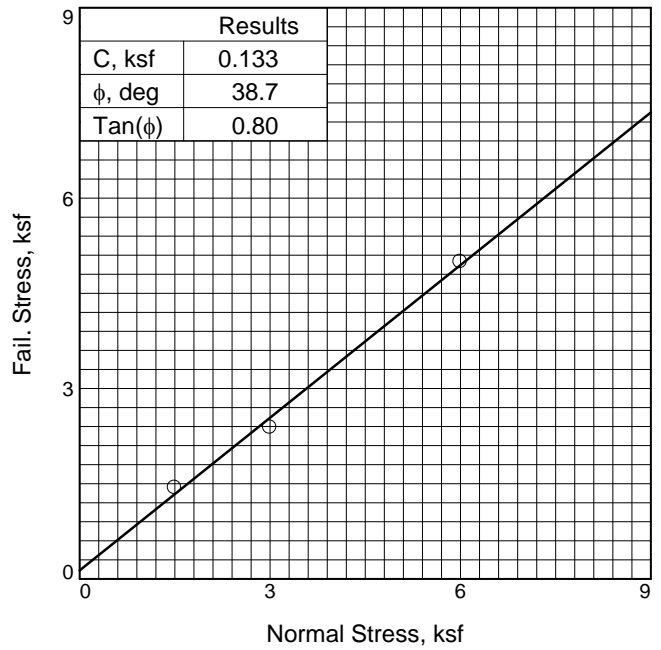
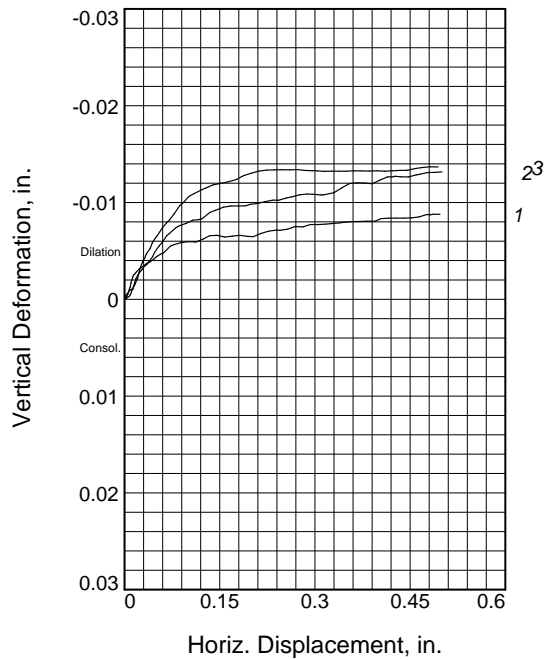
Location: B-1

Depth: 57-59 ft.

Proj. No.: A1205065

Date Sampled:

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Houston, TX

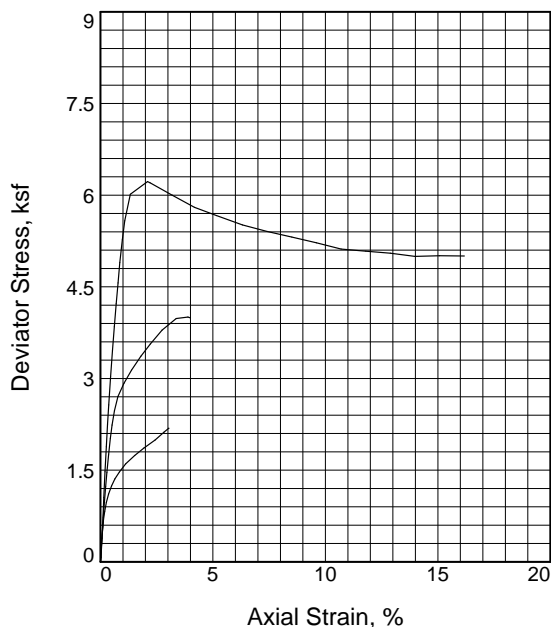
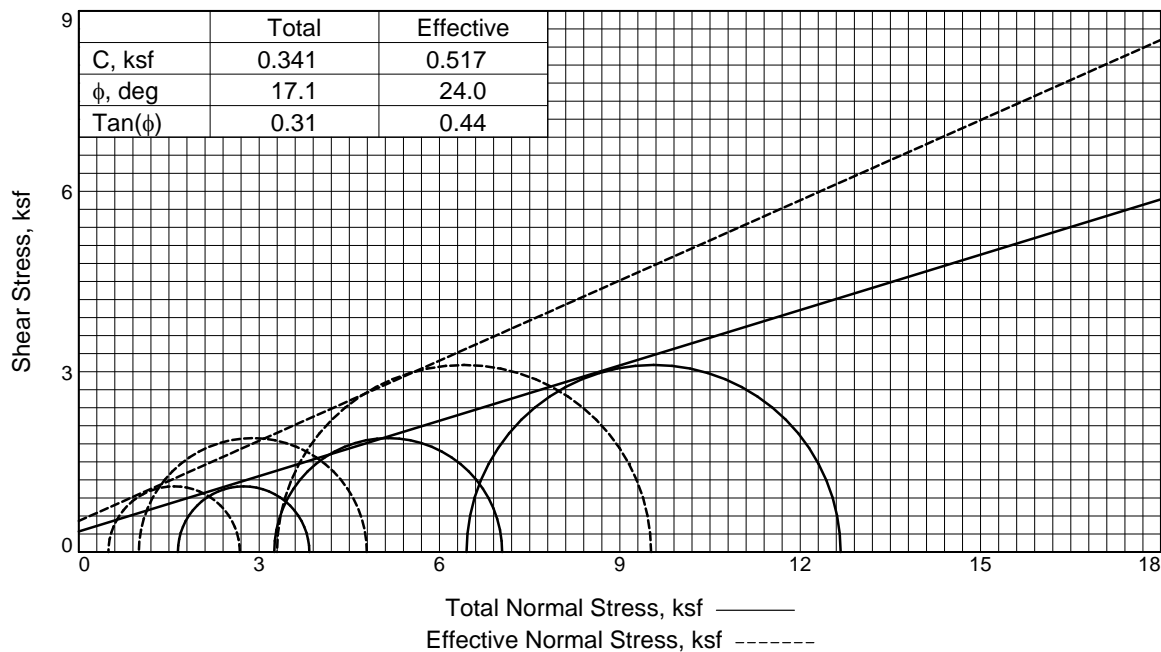


Sample No.	1	2	3	
Initial	Water Content, %	22.6	22.6	22.6
	Dry Density, pcf	103.4	104.4	102.9
	Saturation, %	96.5	99.2	95.4
	Void Ratio	0.6308	0.6138	0.6385
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	22.8	22.5	22.9
	Dry Density, pcf	103.4	104.4	102.9
	Saturation, %	97.7	99.1	97.0
	Void Ratio	0.6308	0.6138	0.6385
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf	1.500	3.000	6.000	
Fail. Stress, ksf	1.438	2.386	4.995	
Displacement, in.	0.476	0.288	0.302	
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.	0.002	0.002	0.002	

Sample Type: Undisturbed
Description: Dark gray silty clayey sand
Assumed Specific Gravity= 2.70
Remarks: ASTM D3080

Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: B-3
Depth: 35-37 ft.
Proj. No.: A1205065 **Date Sampled:**

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Houston, TX



Sample No.		1	2	3
Initial	Water Content, %	15.6	15.6	15.6
	Dry Density, pcf	110.2	110.2	110.2
	Saturation, %	77.7	77.7	77.7
	Void Ratio	0.5471	0.5471	0.5471
	Diameter, in.	2.783	2.783	2.783
	Height, in.	6.000	6.000	6.000
At Test	Water Content, %	19.1	18.4	17.2
	Dry Density, pcf	111.9	113.5	115.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5227	0.5011	0.4706
	Diameter, in.	2.768	2.798	2.836
	Height, in.	5.968	5.760	5.492
Strain rate, in./min.		0.000	0.000	0.000
Back Pressure, psi		60.000	60.000	60.000
Cell Pressure, psi		71.450	82.580	104.790
Fail. Stress, ksf		2.186	3.791	6.223
Excess Pore Pr., ksf		1.156	2.252	3.153
Ult. Stress, ksf		2.186	3.791	6.223
Excess Pore Pr., ksf		1.156	2.252	3.153
$\bar{\sigma}_1$ Failure, ksf		2.679	4.790	9.519
$\bar{\sigma}_3$ Failure, ksf		0.493	1.000	3.297

Type of Test:

CU with Pore Pressures

Sample Type:

Description: Tan Fat Clay

Assumed Specific Gravity= 2.73

Remarks:

Liquid Limit, 64
Plastic Limit, 21
Plasticity Index, 43

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

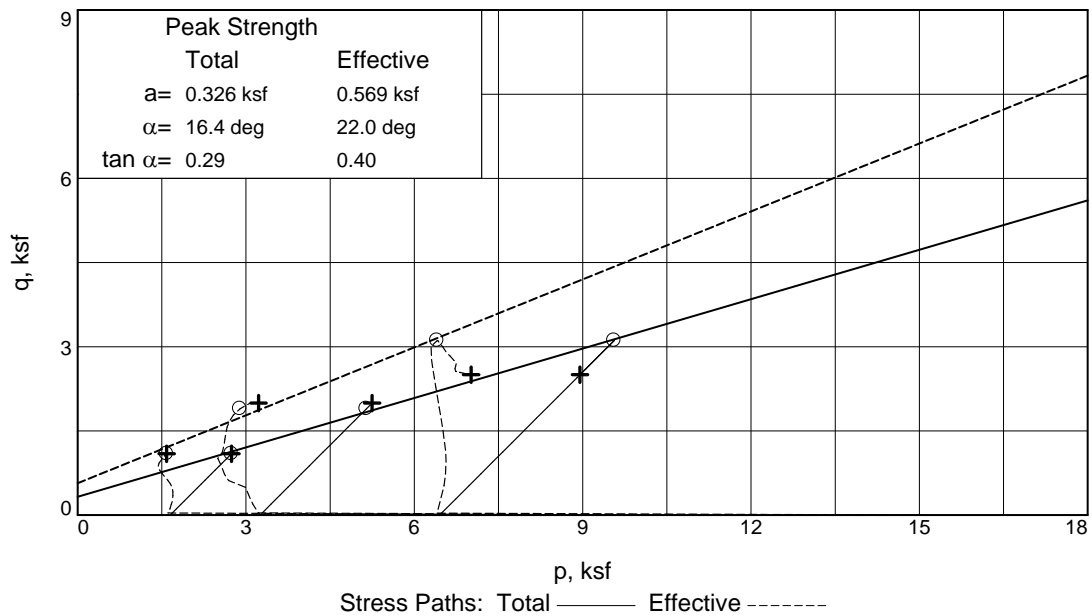
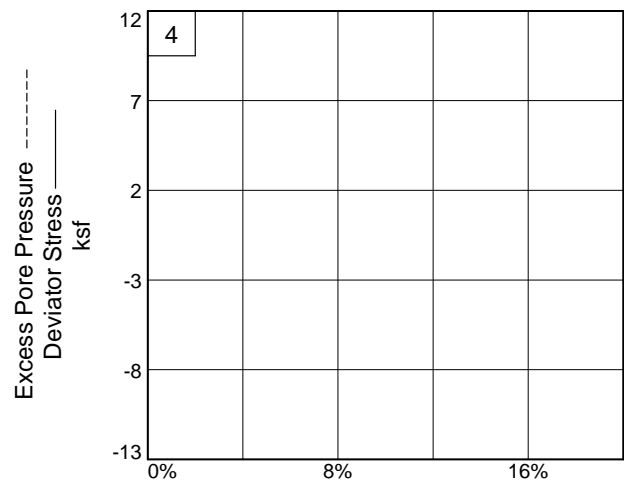
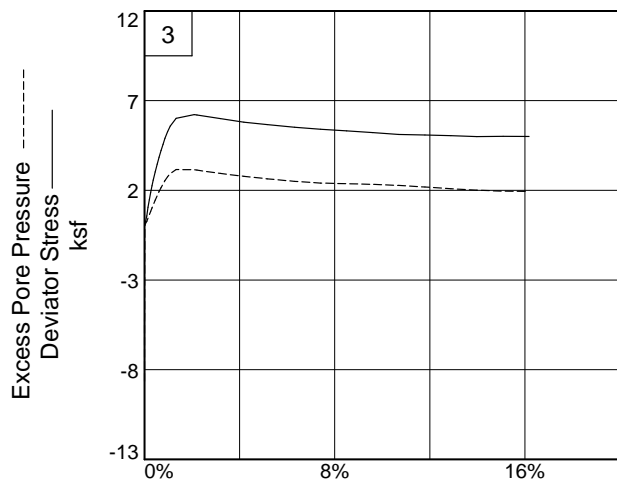
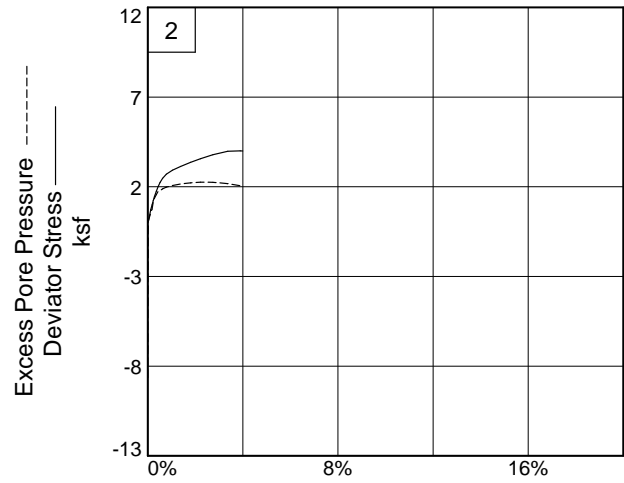
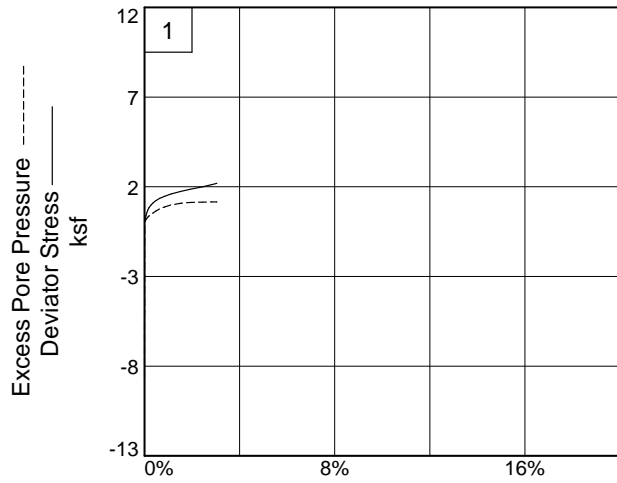
Location: R-4a

Depth: 27-29 ft.

Proj. No.: A1205065

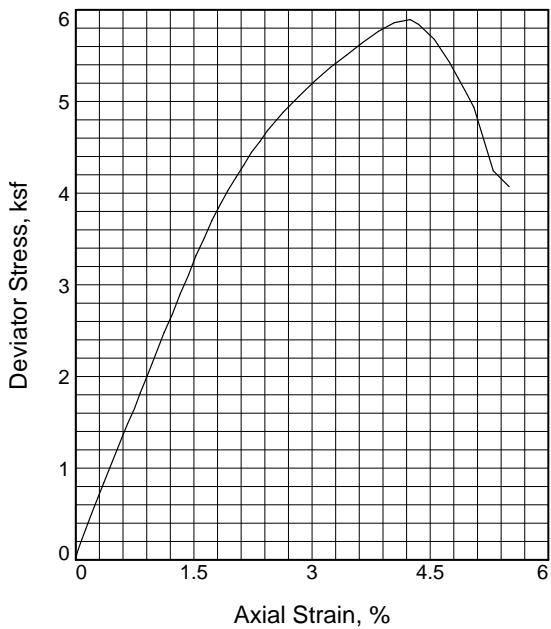
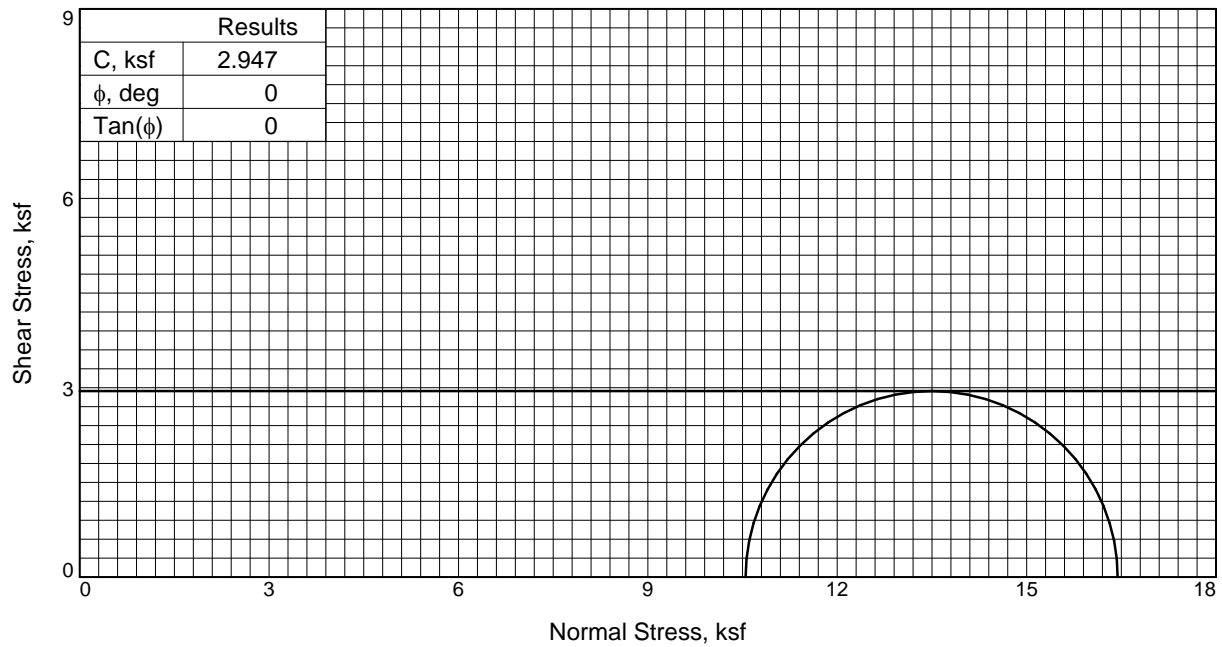
Date Sampled:

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: R-4a **Depth:** 27-29 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	27.1
	Dry Density, pcf	96.7
	Saturation, %	96.1
	Void Ratio	0.7749
	Diameter, in.	2.770
	Height, in.	5.640
At Test	Water Content, %	27.1
	Dry Density, pcf	96.7
	Saturation, %	96.1
	Void Ratio	0.7749
	Diameter, in.	2.770
	Height, in.	5.640
Strain rate, in./min.	0.055	
Back Pressure, psi	0.000	
Cell Pressure, psi	73.250	
Fail. Stress, ksf	5.89	
Ult. Stress, ksf		
σ_1 Failure, ksf	16.44	
σ_3 Failure, ksf	10.55	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Fat Clay

Assumed Specific Gravity= 2.75

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

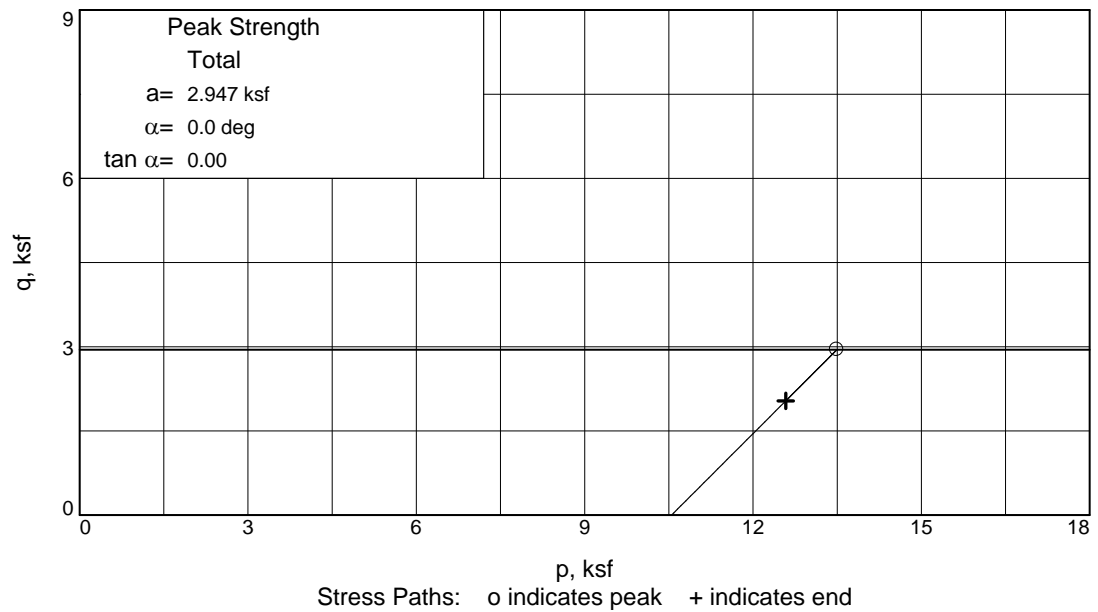
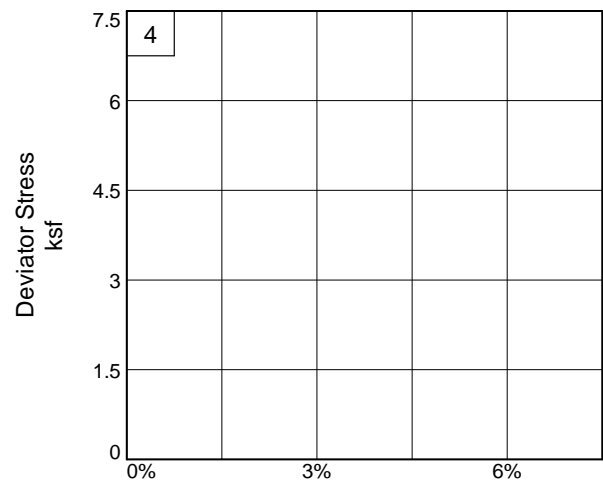
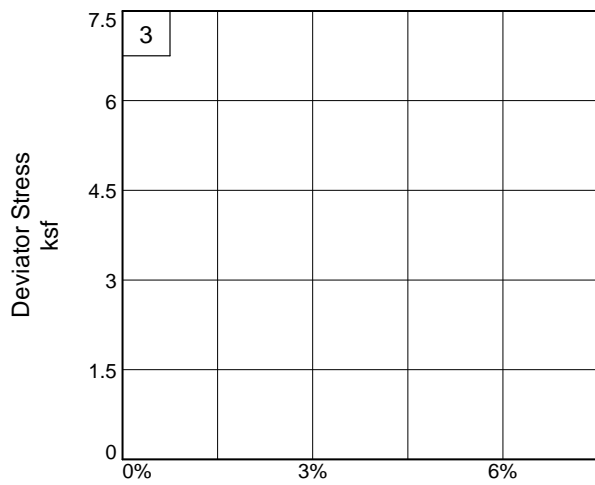
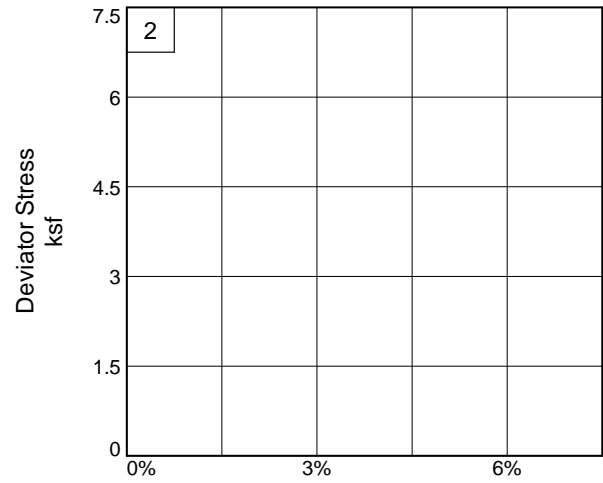
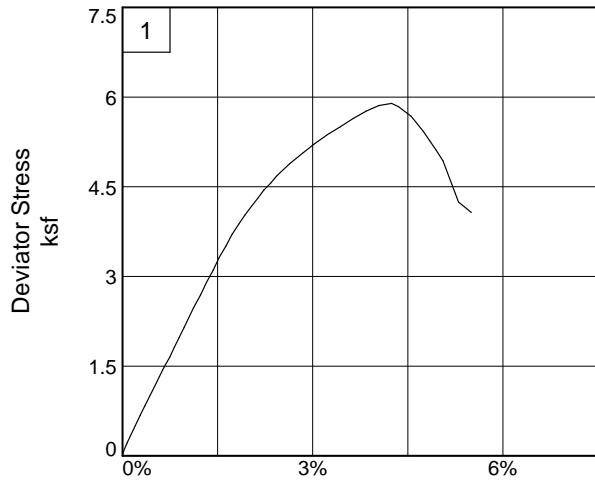
Location: B-1

Depth: 87-89 ft.

Proj. No.: A1205065

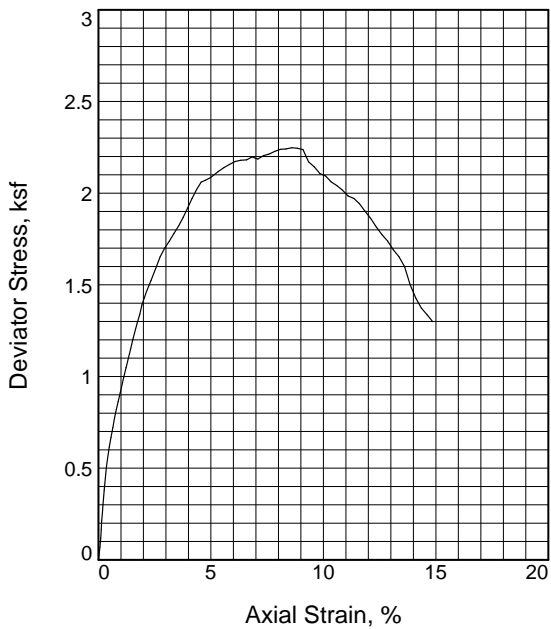
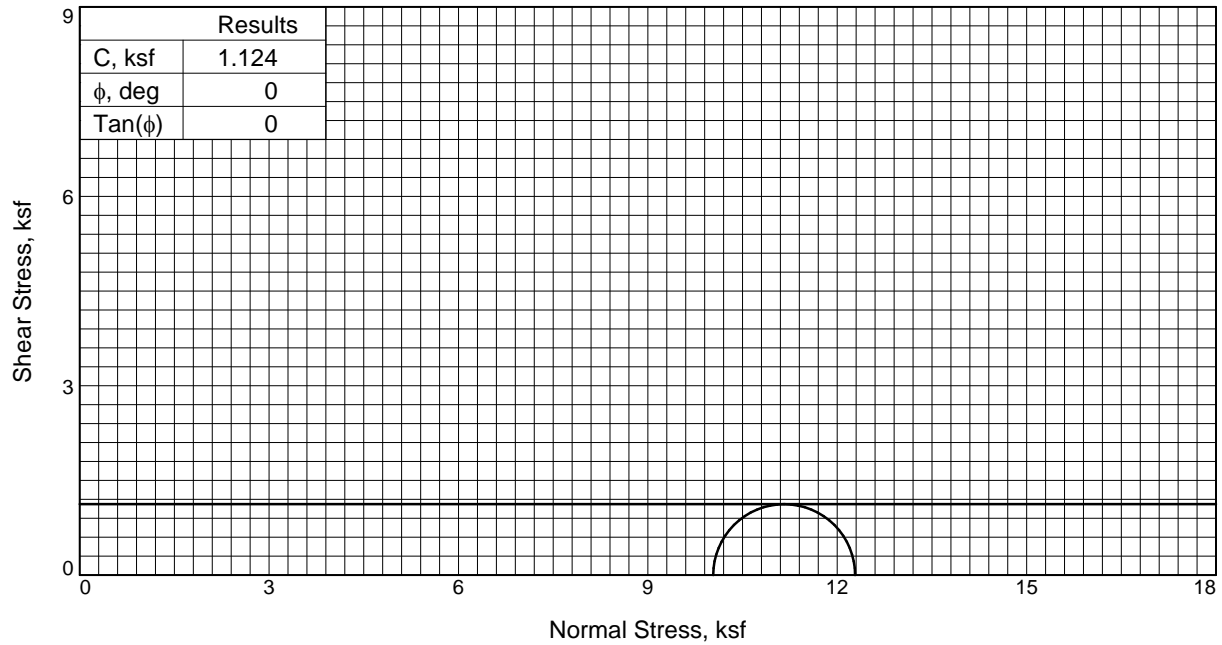
Date Sampled:

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: B-1 **Depth:** 87-89 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	31.2
	Dry Density, pcf	92.1
	Saturation, %	99.2
	Void Ratio	0.8646
	Diameter, in.	2.760
	Height, in.	5.640
At Test	Water Content, %	31.2
	Dry Density, pcf	92.1
	Saturation, %	99.2
	Void Ratio	0.8646
	Diameter, in.	2.760
	Height, in.	5.640
Strain rate, in./min.	0.055	
Back Pressure, psi	0.000	
Cell Pressure, psi	69.690	
Fail. Stress, ksf	2.25	
Ult. Stress, ksf		
σ_1 Failure, ksf	12.28	
σ_3 Failure, ksf	10.04	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Fat Clay

Assumed Specific Gravity= 2.75

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

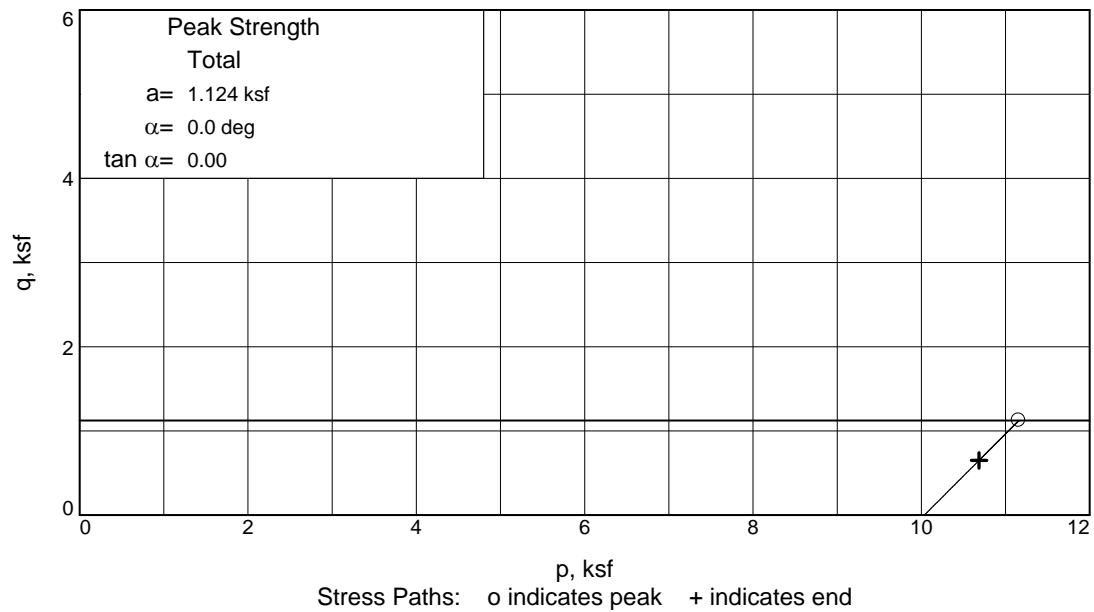
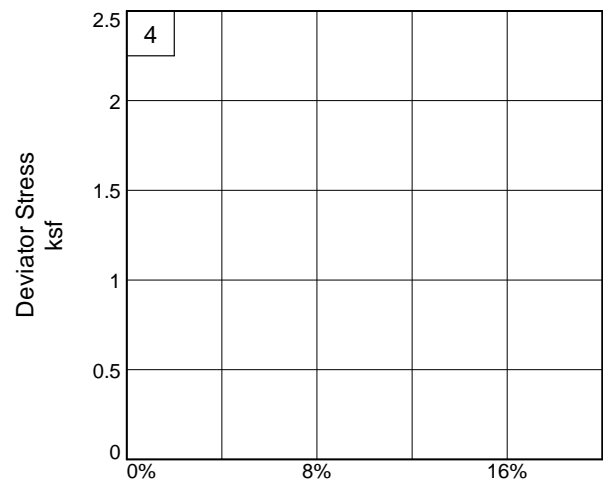
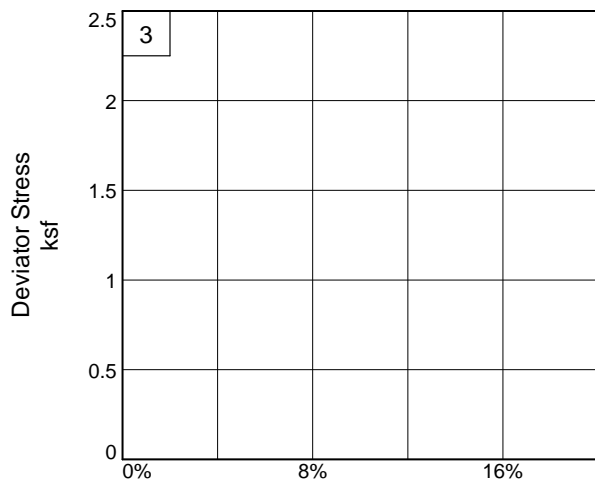
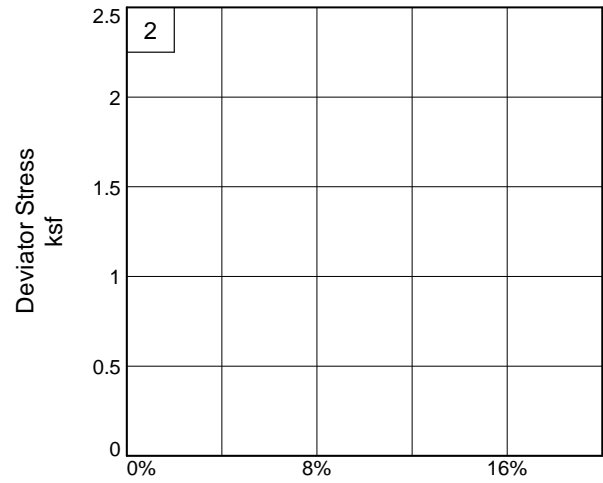
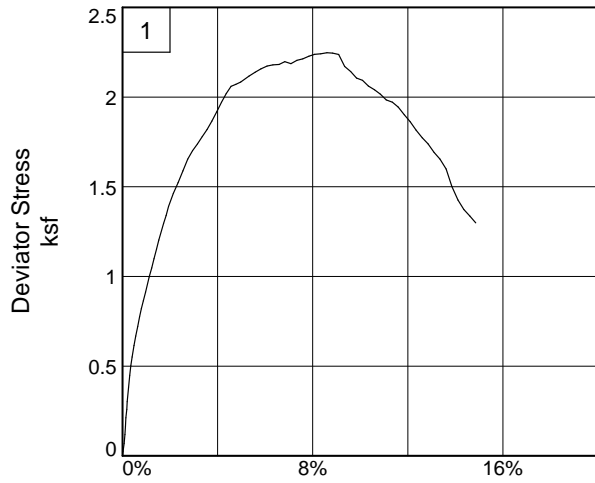
Location: B-2

Depth: 83-85 ft.

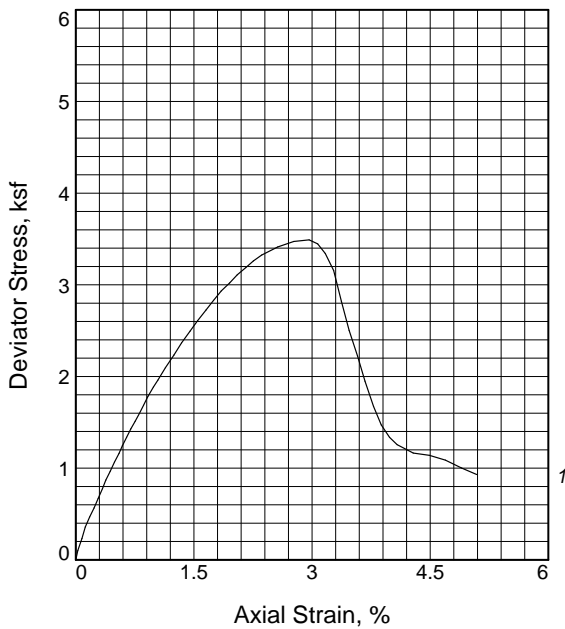
Proj. No.: A1205065

Date Sampled:

TRIAXIAL SHEAR TEST REPORT
 Terracon Consultants, Inc.
 Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: B-2 **Depth:** 83-85 ft.
Project No.: A1205065



Sample No.	1	
Initial	Water Content, %	27.3
	Dry Density, pcf	95.3
	Saturation, %	95.8
	Void Ratio	0.7690
	Diameter, in.	2.760
At Test	Height, in.	5.600
	Water Content, %	27.3
	Dry Density, pcf	95.3
	Saturation, %	95.8
	Void Ratio	0.7690
Diameter, in.	2.760	
	Height, in.	5.600
Strain rate, in./min.	0.055	
Back Pressure, psi	0.000	
Cell Pressure, psi	42.620	
Fail. Stress, ksf	3.490	
Ult. Stress, ksf		
σ_1 Failure, ksf	9.627	
σ_3 Failure, ksf	6.137	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Light Gray and Tan Fat Clay

Assumed Specific Gravity= 2.70

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

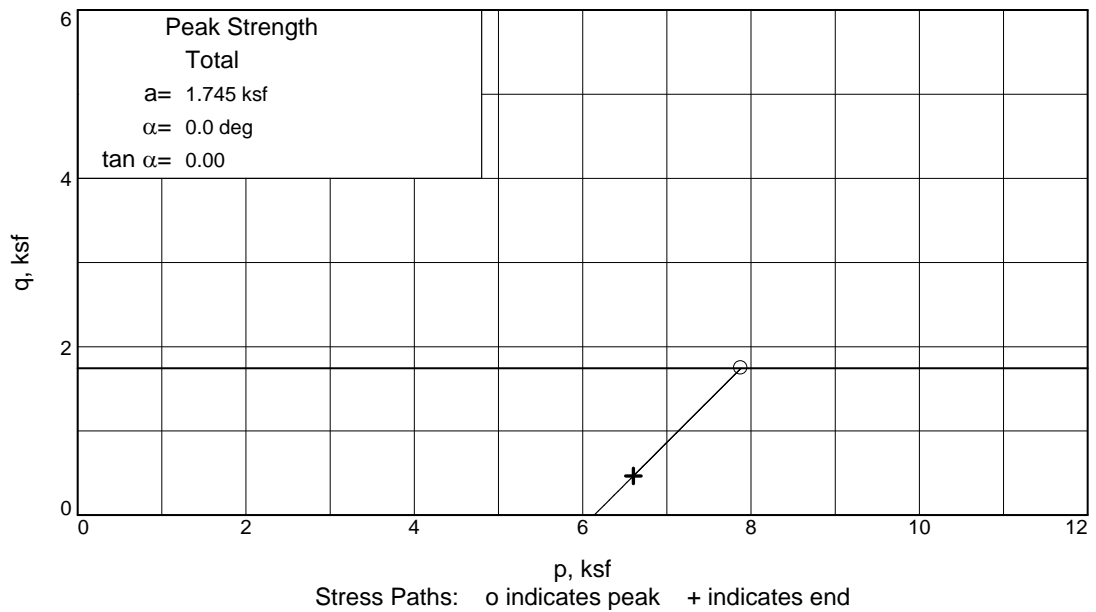
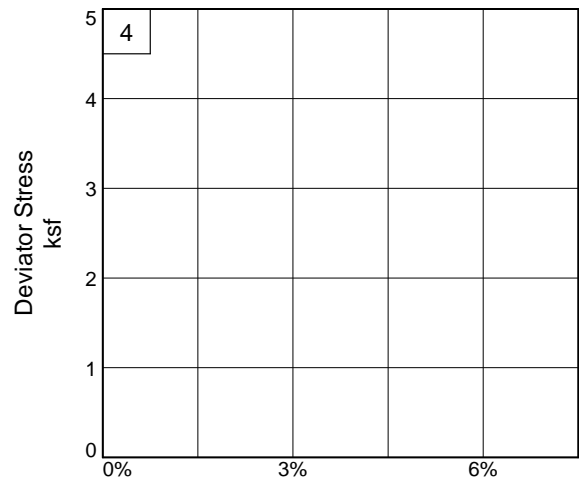
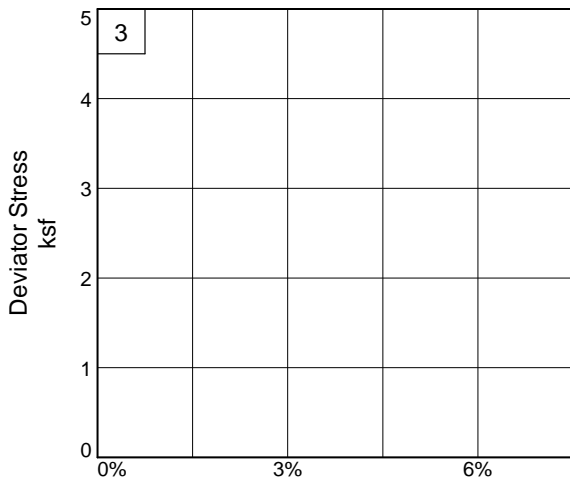
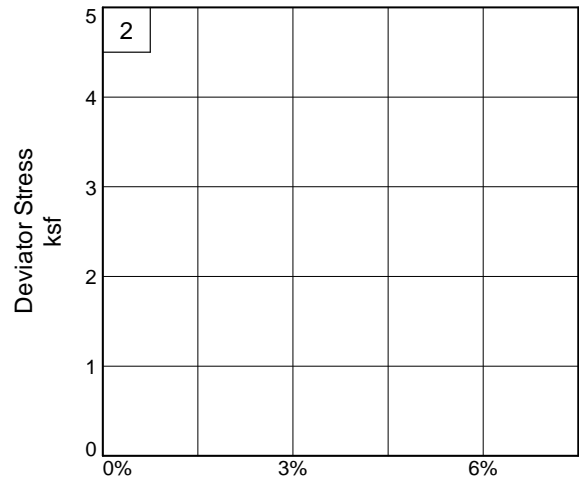
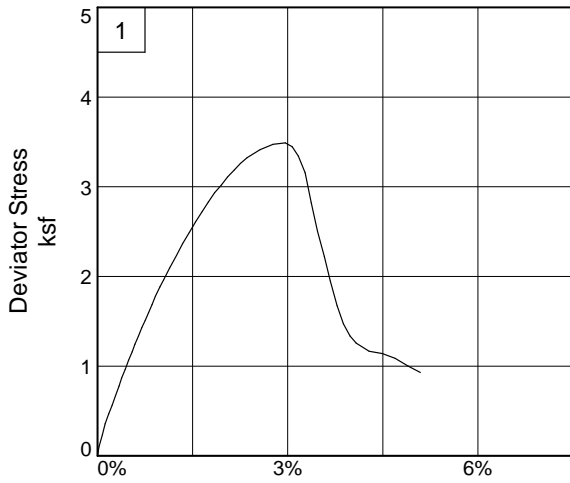
Location: B-3

Depth: 53-55 ft.

Proj. No.: A1205065

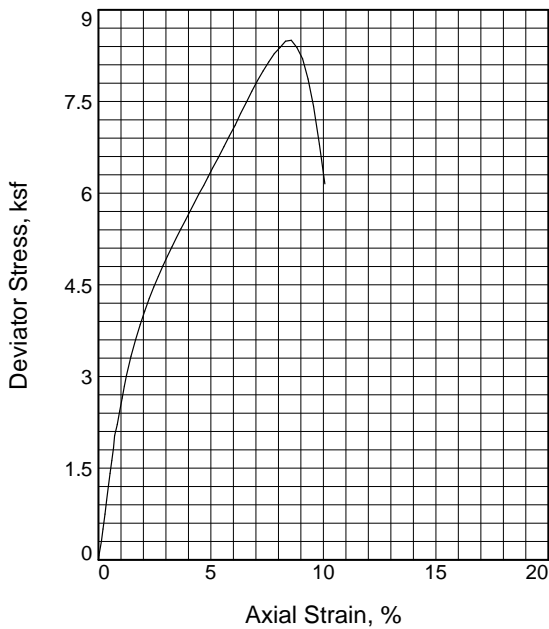
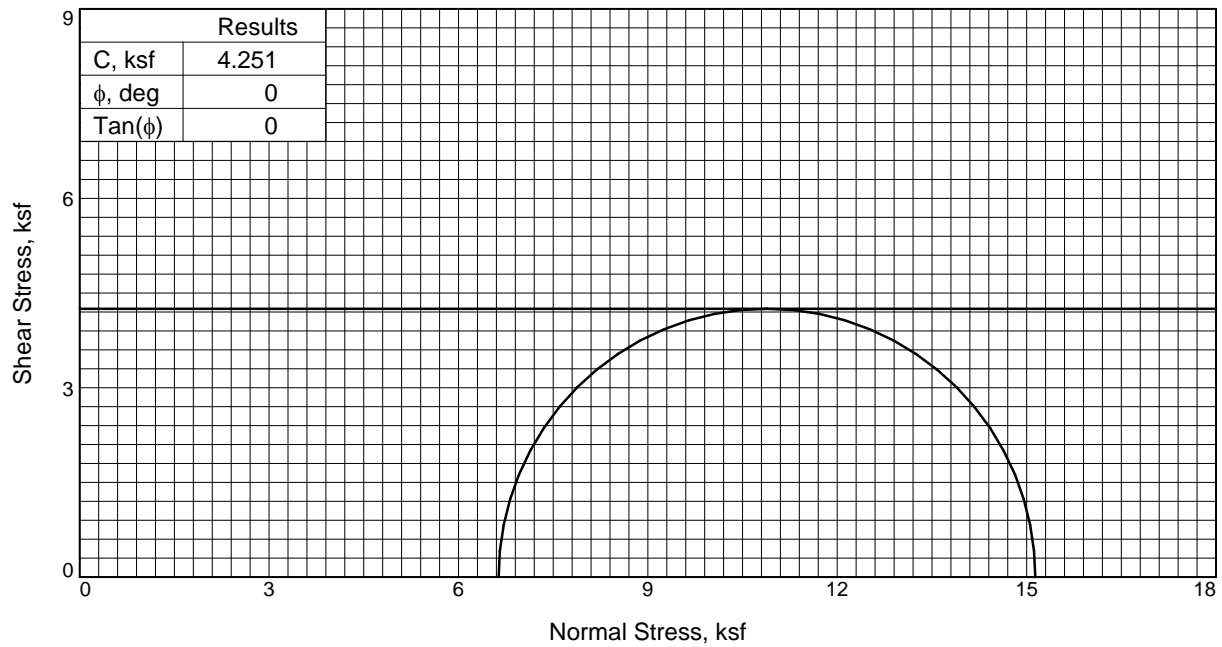
Date Sampled:

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 Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: B-3 **Depth:** 53-55 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	24.5
	Dry Density, pcf	99.0
	Saturation, %	92.9
	Void Ratio	0.7211
	Diameter, in.	2.770
	Height, in.	5.660
At Test	Water Content, %	24.5
	Dry Density, pcf	99.0
	Saturation, %	92.9
	Void Ratio	0.7211
	Diameter, in.	2.770
	Height, in.	5.660
Strain rate, in./min.	0.055	
Back Pressure, psi	0.000	
Cell Pressure, psi	46.080	
Fail. Stress, ksf	8.50	
Ult. Stress, ksf		
σ_1 Failure, ksf	15.14	
σ_3 Failure, ksf	6.64	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Fat Clay

Assumed Specific Gravity= 2.73

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

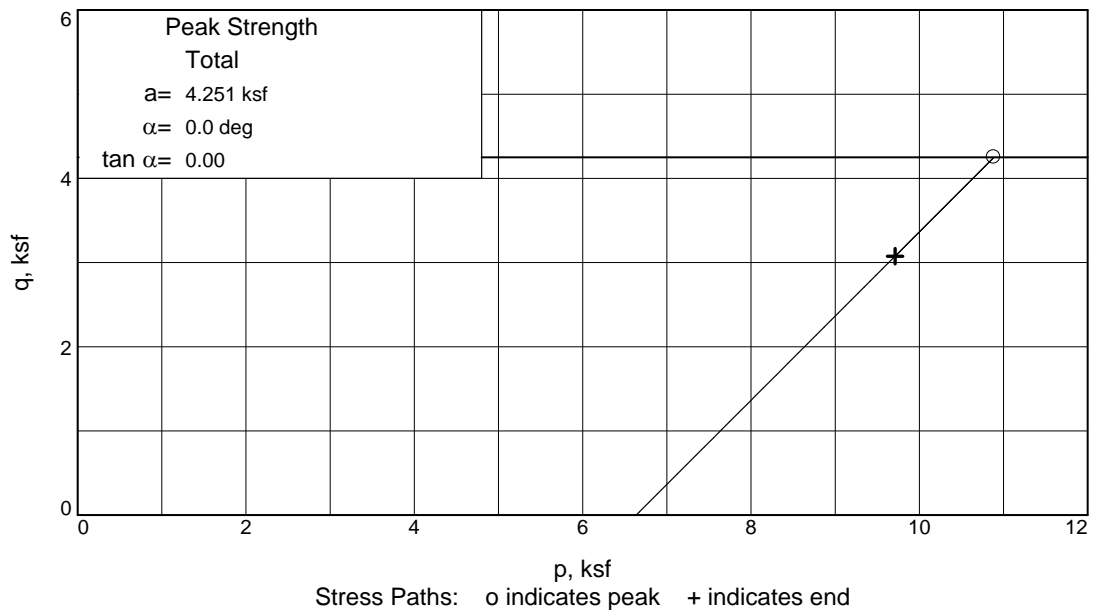
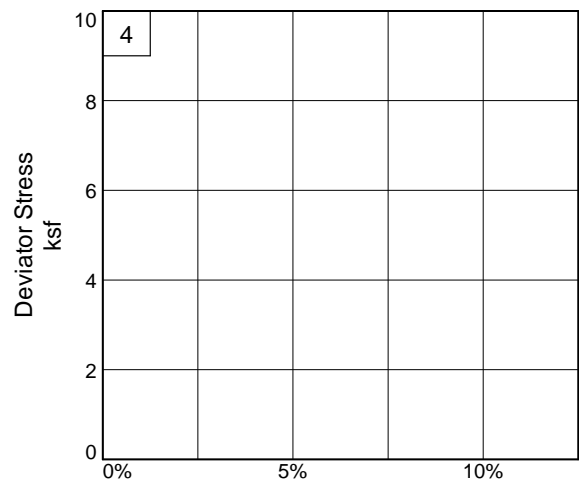
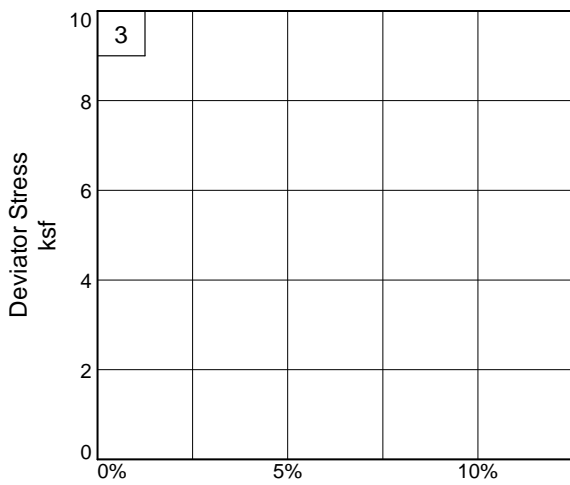
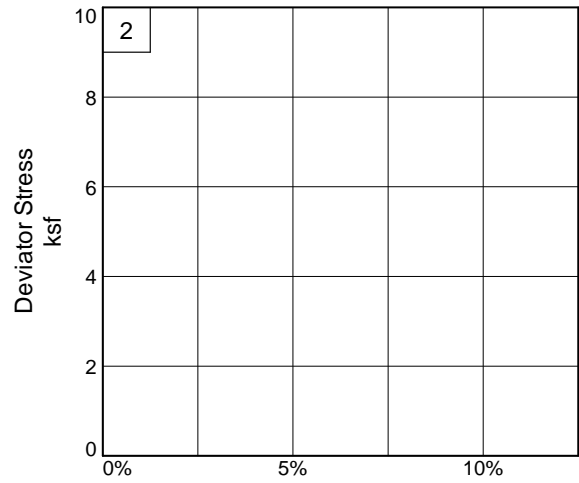
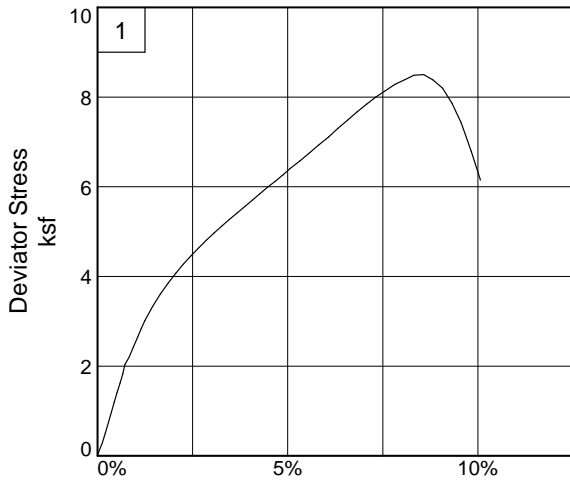
Location: B-4

Depth: 58-60 ft.

Proj. No.: A1205065

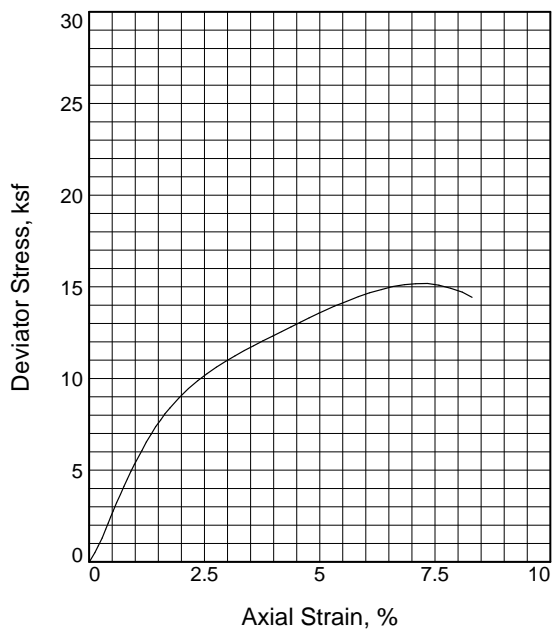
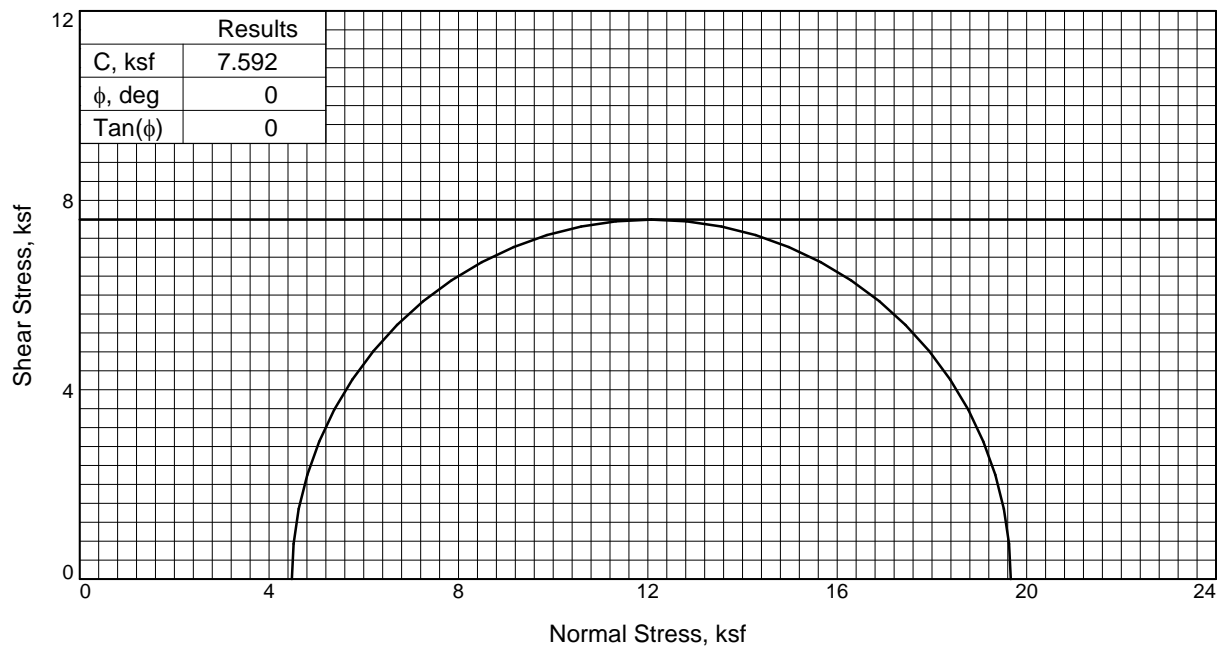
Date Sampled:

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: B-4 **Depth:** 58-60 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	18.5
	Dry Density, pcf	110.9
	Saturation, %	96.1
	Void Ratio	0.5203
	Diameter, in.	2.860
At Test	Height, in.	5.640
	Water Content, %	18.5
	Dry Density, pcf	110.9
	Saturation, %	96.1
	Void Ratio	0.5203
Strain rate, in./min.	Diameter, in.	2.860
	Height, in.	5.640
	Back Pressure, psi	0.000
	Cell Pressure, psi	31.110
	Fail. Stress, ksf	15.18
Ult. Stress, ksf		
σ_1 Failure, ksf	19.66	
σ_3 Failure, ksf	4.48	

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed
Description: Gray Lean Clay

Assumed Specific Gravity= 2.70

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

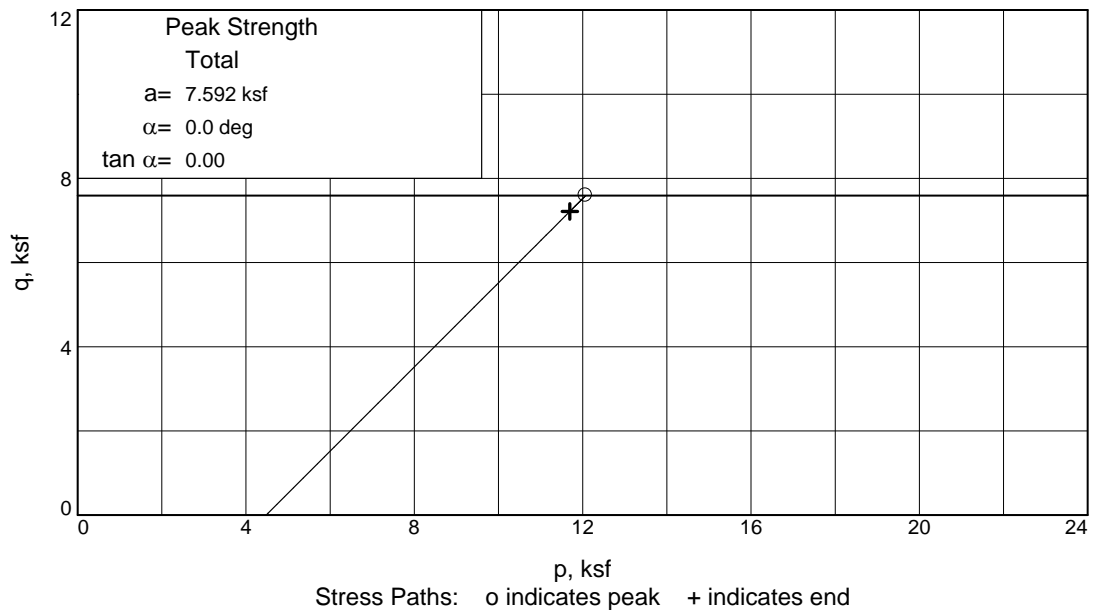
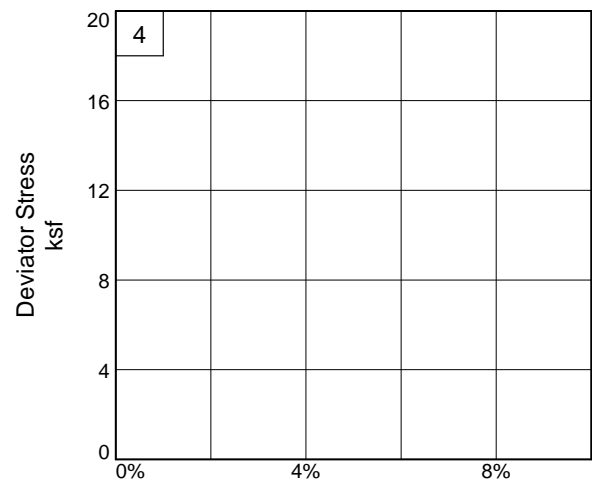
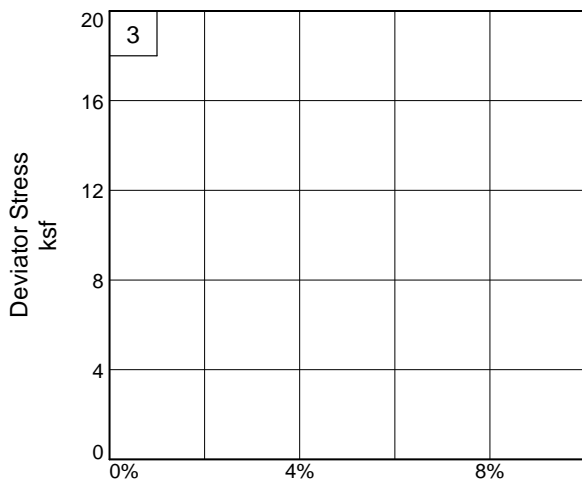
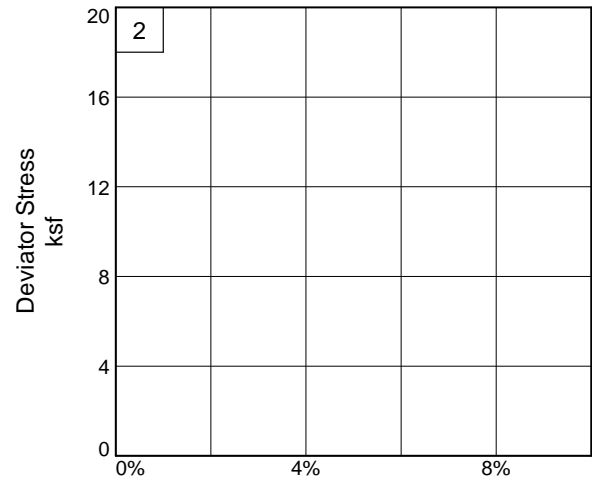
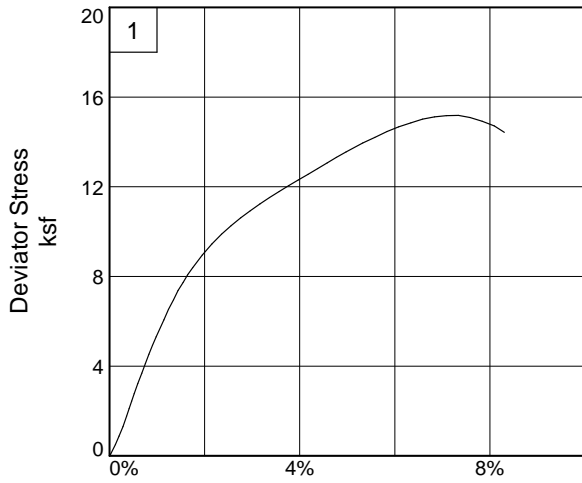
Location: R-1

Depth: 37-39 ft.

Proj. No.: A1205065

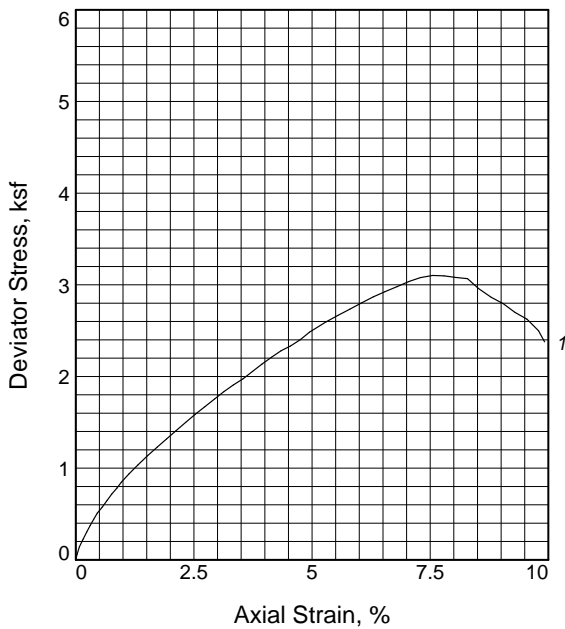
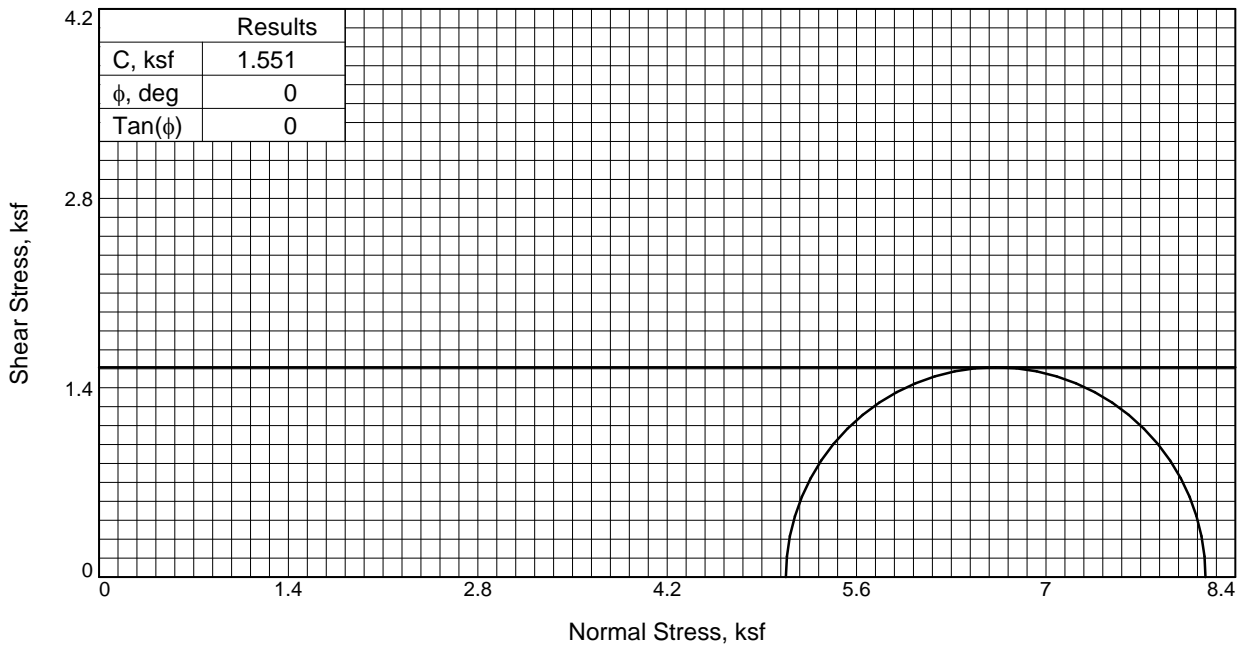
Date Sampled:

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 Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: R-1 **Depth:** 37-39 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	18.7
	Dry Density, pcf	103.9
	Saturation, %	81.4
	Void Ratio	0.6215
	Diameter, in.	2.770
At Test	Height, in.	5.660
	Water Content, %	18.7
	Dry Density, pcf	103.9
	Saturation, %	81.4
	Void Ratio	0.6215
Diameter, in.	2.770	
Height, in.	5.660	
Strain rate, in./min.	0.055	
Back Pressure, psi	0.000	
Cell Pressure, psi	35.260	
Fail. Stress, ksf	3.102	
Ult. Stress, ksf		
σ_1 Failure, ksf	8.179	
σ_3 Failure, ksf	5.077	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Lean Clay

Assumed Specific Gravity= 2.70

Remarks: ASTM D2850

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

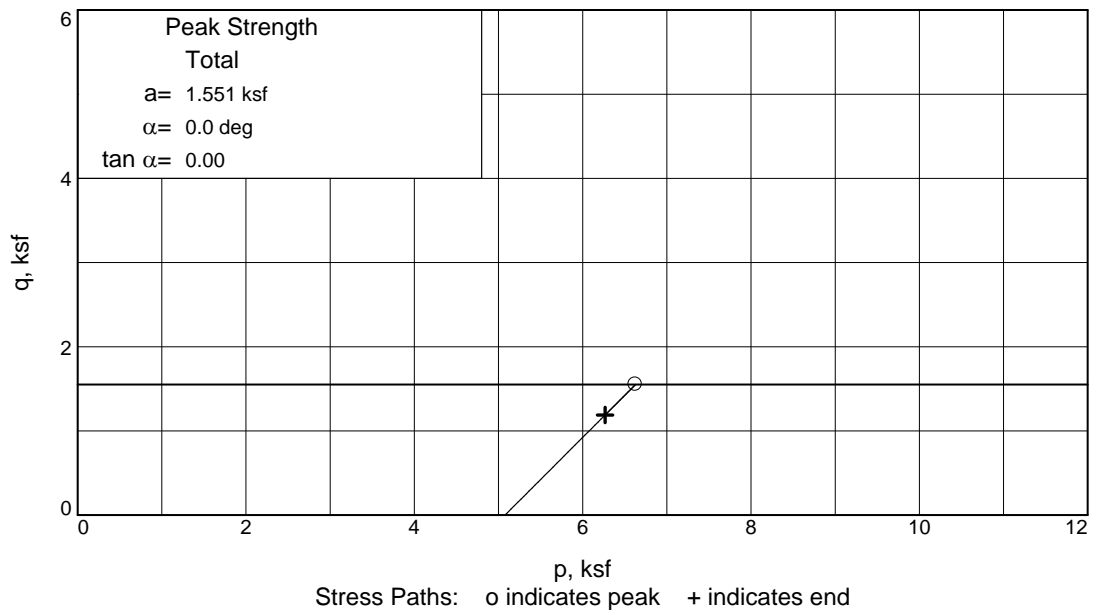
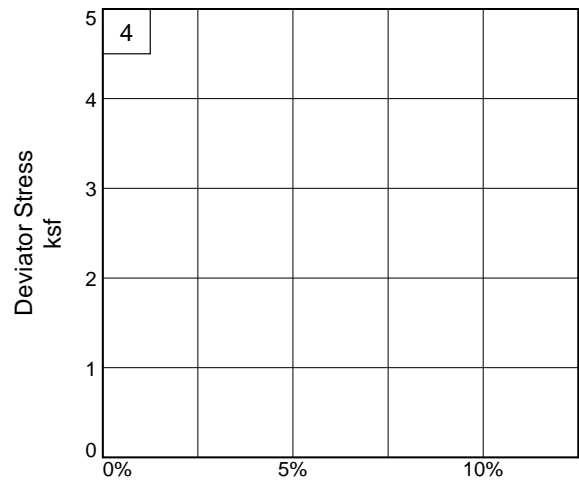
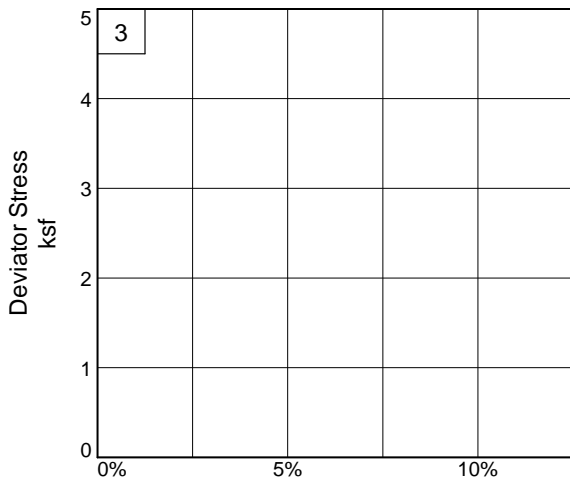
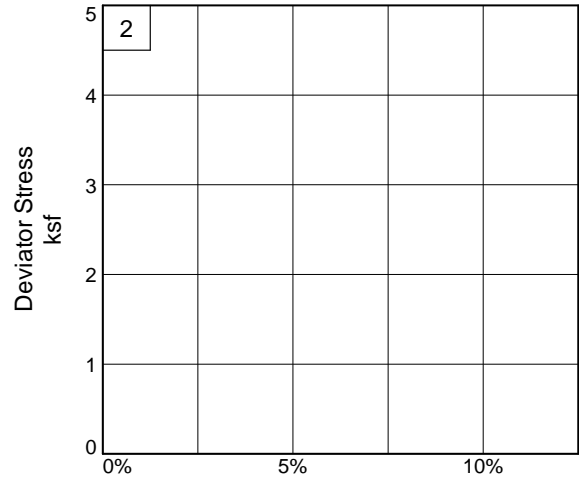
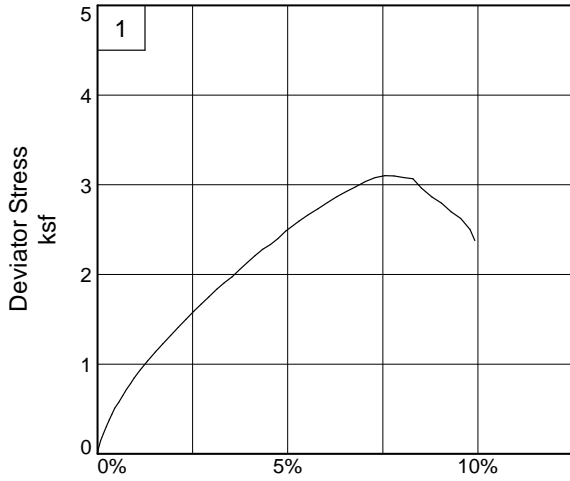
Location: R-3

Depth: 42-44 ft.

Proj. No.: A1205065

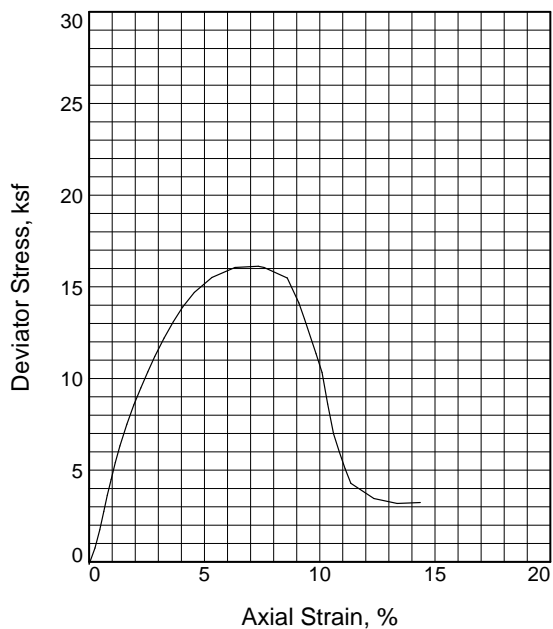
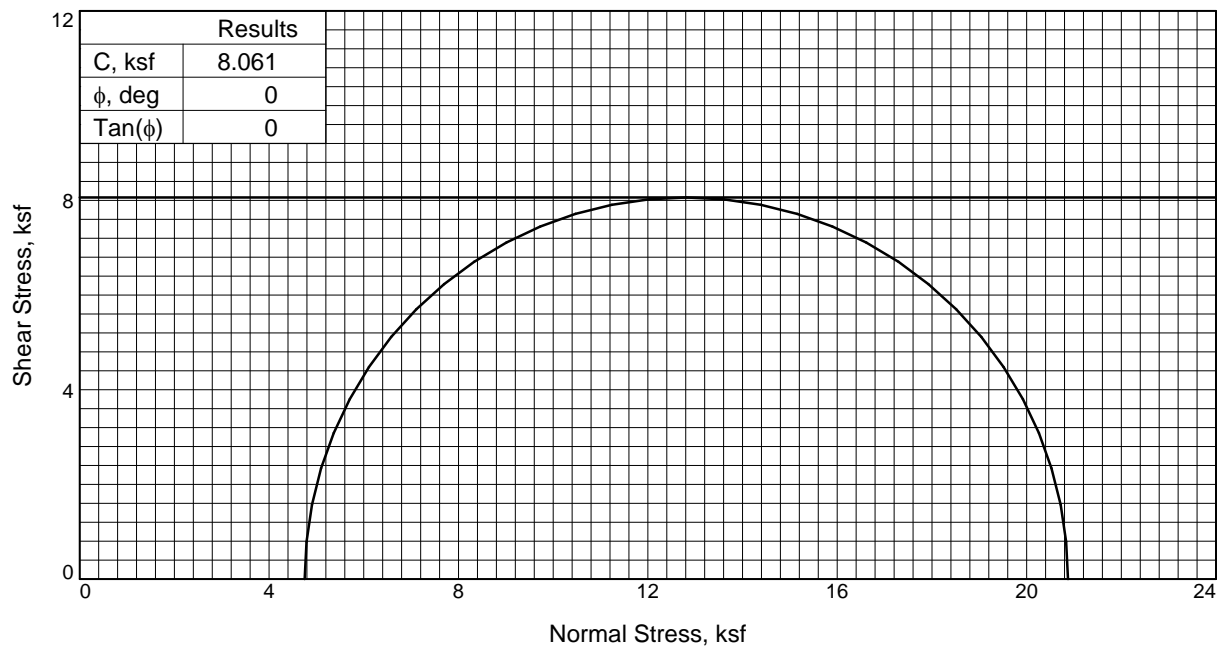
Date Sampled:

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Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: R-3 **Depth:** 42-44 ft.
Project No.: A1205065

Terracon Consultants, Inc.



Sample No.	1	
Initial	Water Content, %	22.3
	Dry Density, pcf	105.4
	Saturation, %	98.9
	Void Ratio	0.6167
	Diameter, in.	2.875
At Test	Height, in.	5.620
	Water Content, %	22.3
	Dry Density, pcf	105.4
	Saturation, %	98.9
	Void Ratio	0.6167
Strain rate, in./min.	Diameter, in.	2.875
	Height, in.	5.620
	Back Pressure, psi	0.000
	Cell Pressure, psi	32.990
	Fail. Stress, ksf	16.12
Ult. Stress, ksf		
σ_1 Failure, ksf		20.87
σ_3 Failure, ksf		4.75

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Fat Clay

Assumed Specific Gravity= 2.73

Remarks:

Client: Kimley-Horn & Associates Inc. Austin, Texas.

Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek

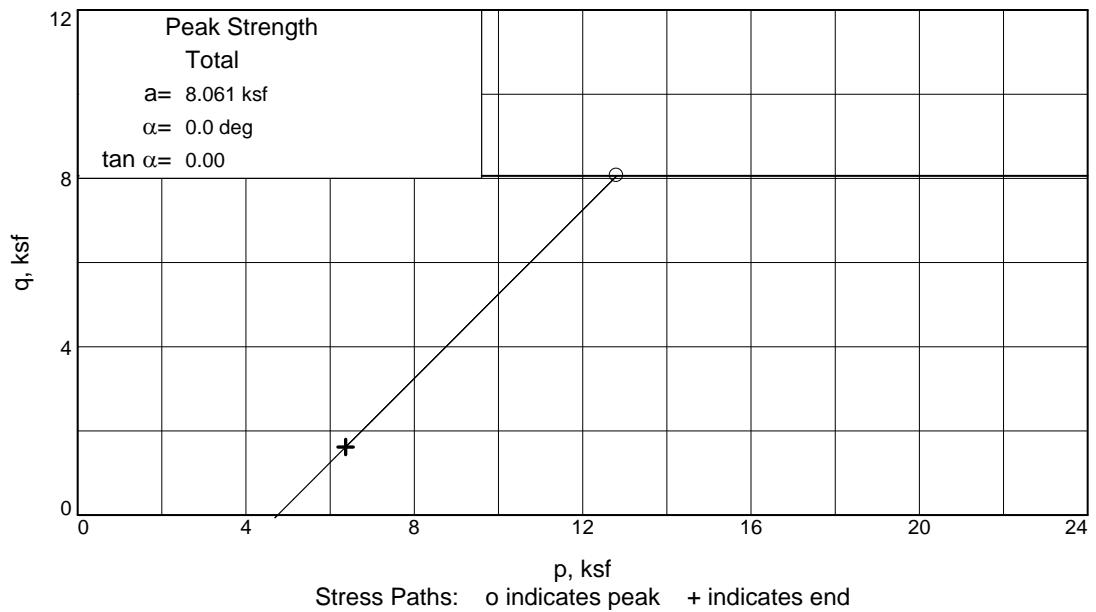
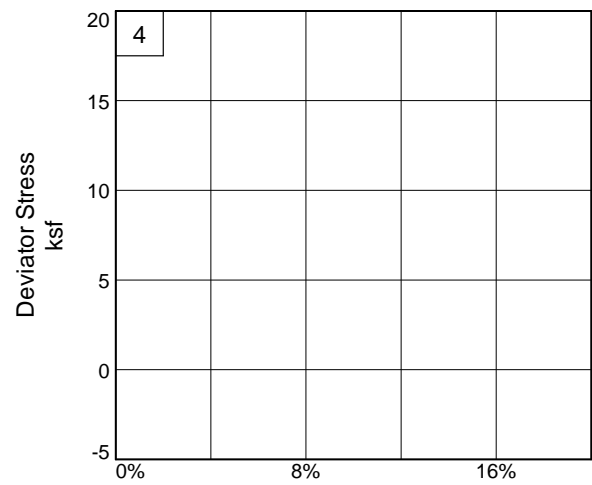
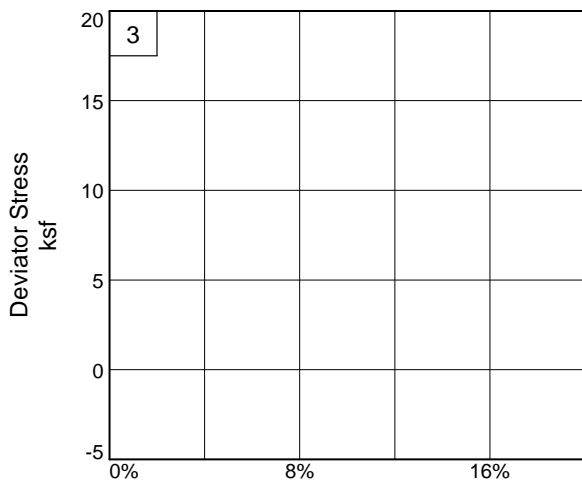
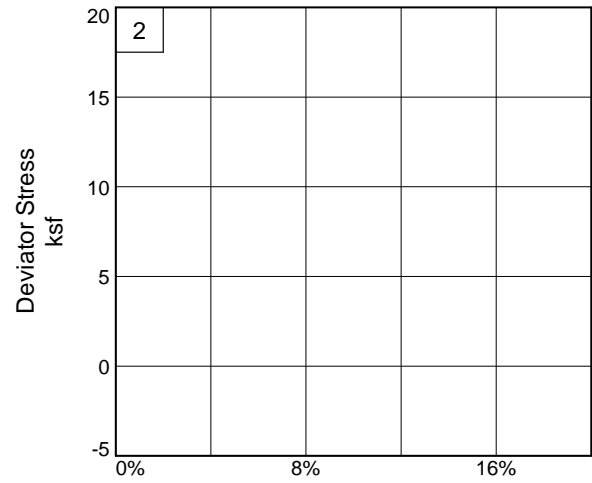
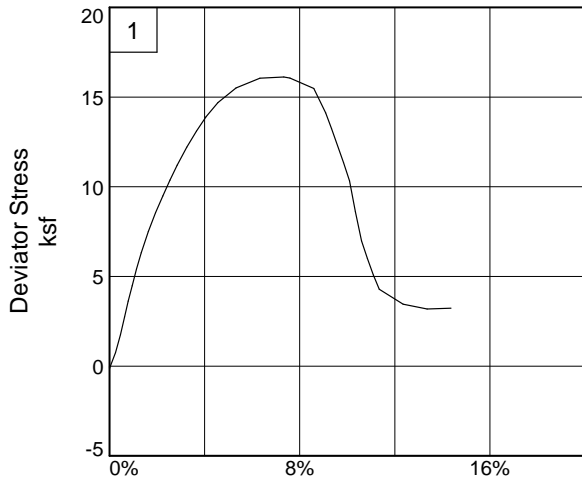
Location: R-6a

Depth: 37-39 ft.

Proj. No.: A1205065

Date Sampled:

TRIAXIAL SHEAR TEST REPORT
 Terracon Consultants, Inc.
 Houston, TX



Client: Kimley-Horn & Associates Inc. Austin, Texas.
Project: 17-9SDP5002 WA2 - SH 6 Bridges at FM 2 and Beason Creek
Location: R-6a **Depth:** 37-39 ft.
Project No.: A1205065

Terracon Consultants, Inc.

SUPPORTING INFORMATION

Contents:

Unified Soil Classification System

Capacity Curves (36 pages)

Global Stability Analyses (10 pages)

SH 6 at FM 2 Critical Cross Sections and Beason Creek Bridge Layouts (4 pages)

Note: All attachments are one page unless noted above.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

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

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

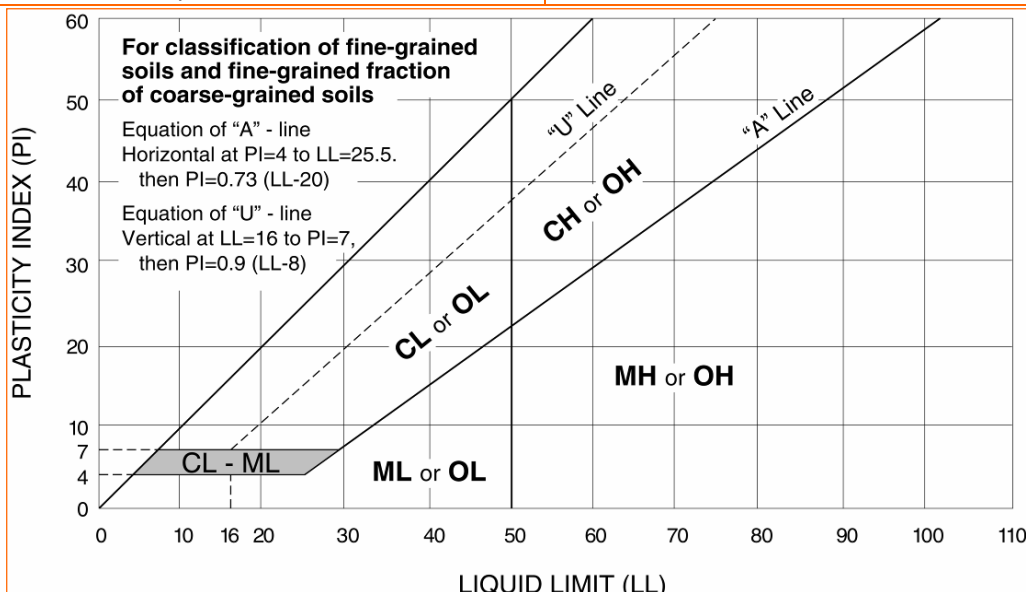
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



Capacity Curves: SH 6 Underpass at FM 2



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County	Grimes County	Hole	B-1	District	Bryan District
Highway	HWY 6 & FM 2	Structure	Bridge	Date	7/31/2020
Control	0050-03-096	Station		Grnd. Elev.	244.00 ft
		Offset		GW Elev.	240.00 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	244.0	239.0	OTHER	80	0	0.00	0.00
2	239.0	236.0	CH	50	20	0.28	0.84
2	236.0	231.0	CH	50	26	0.36	2.66
2	231.0	226.0	CH	50	24	0.34	4.34
2	226.0	221.0	CH	50	33	0.46	6.65
2	221.0	216.0	CH	50	43	0.60	9.66
2	216.0	211.0	CH	50	123	0.85	13.91
2	211.0	206.0	CH	50	15	0.21	14.96
2	206.0	202.0	CH	50	13	0.18	15.69
3	202.0	196.0	SC	70	132	0.85	20.79
3	196.0	192.0	SC	70	150	0.85	24.19
4	192.0	186.0	SC	70	240	1.35	32.29
4	186.0	181.0	SC	70	343	1.93	41.92
4	181.0	176.0	SC	70	300	1.69	50.36
4	176.0	171.0	SC	70	600	3.25	66.61
4	171.0	167.0	SC	70	120	0.85	70.01
5	167.0	161.0	CH	50	109	0.85	75.11
5	161.0	156.0	CH	50	44	0.62	78.19
5	156.0	151.0	CH	50	66	0.92	82.81
5	151.0	146.5	CH	50	75	1.05	87.53
5	146.5	144.0	CH	50	109	0.85	89.66



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-2
Structure Bridge
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	240.0	232.0	CH	50	9	0.13	1.01
1	232.0	227.0	CH	50	14	0.20	1.99
1	227.0	222.0	CH	50	20	0.28	3.39
1	222.0	217.0	CH	50	38	0.53	6.05
1	217.0	212.0	CH	50	59	0.83	10.18
1	212.0	207.0	CH	50	30	0.42	12.28
1	207.0	203.0	CH	50	16	0.22	13.17
2	203.0	197.0	CH	50	150	0.85	18.27
2	197.0	192.0	CH	50	63	0.88	22.68
2	192.0	186.0	CH	50	103	0.85	27.78
3	186.0	182.0	SC	70	218	1.23	32.69
3	182.0	177.0	SC	70	480	2.70	46.19
3	177.0	170.0	SC	70	2400	3.25	68.94
4	170.0	167.0	CH	50	114	0.85	71.49
4	167.0	159.5	CH	50	81	1.13	79.99
4	159.5	152.0	CH	50	100	1.40	90.49
4	152.0	147.0	CH	50	57	0.80	94.48
4	147.0	142.5	CH	50	64	0.90	98.51
4	142.5	140.0	CH	50	81	1.13	101.33



POINT BEARING DESIGN

WinCore
Version 3.3

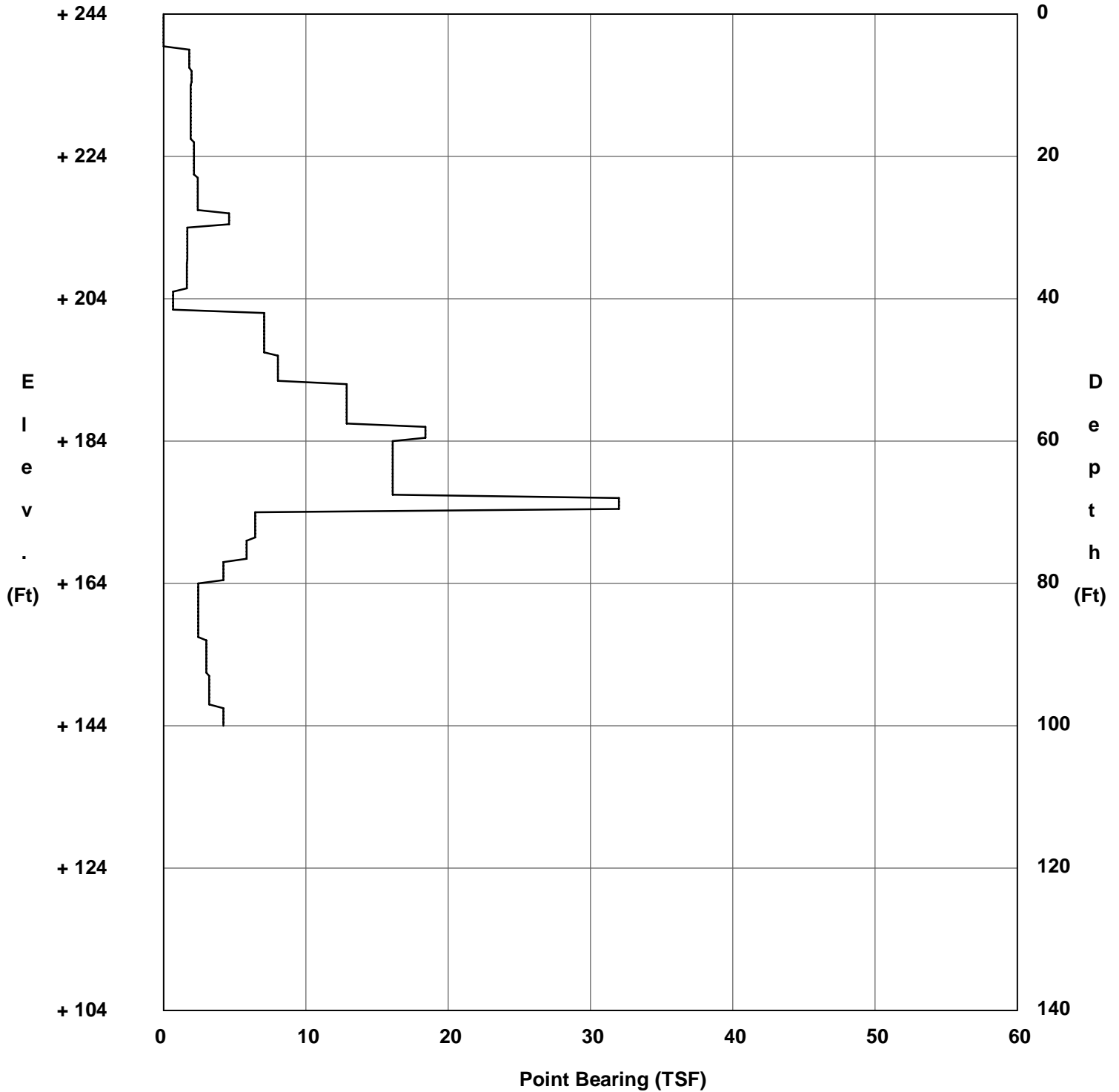
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-1
Structure Bridge
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





POINT BEARING DESIGN

WinCore
Version 3.3

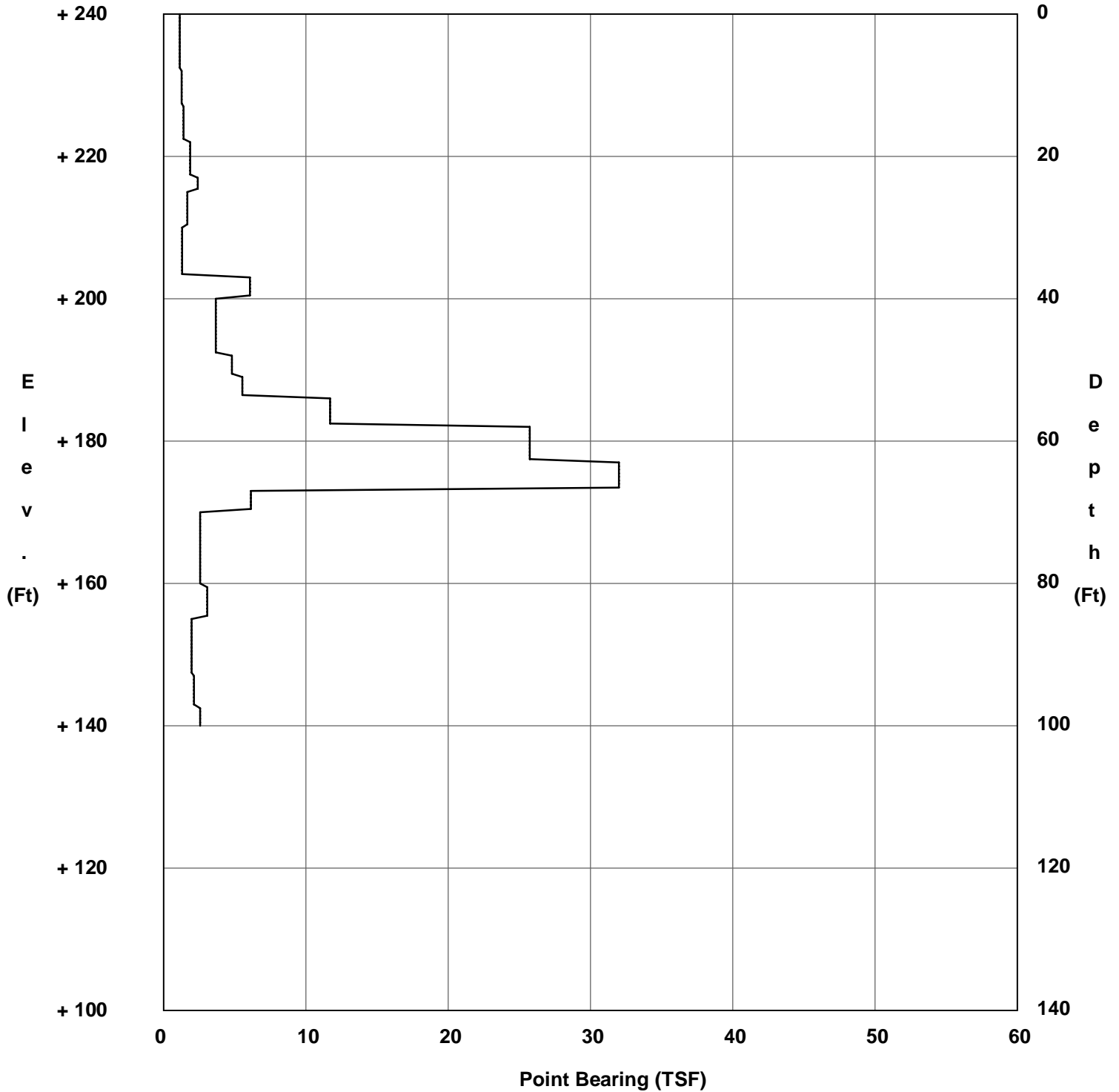
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-2
Structure Bridge
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

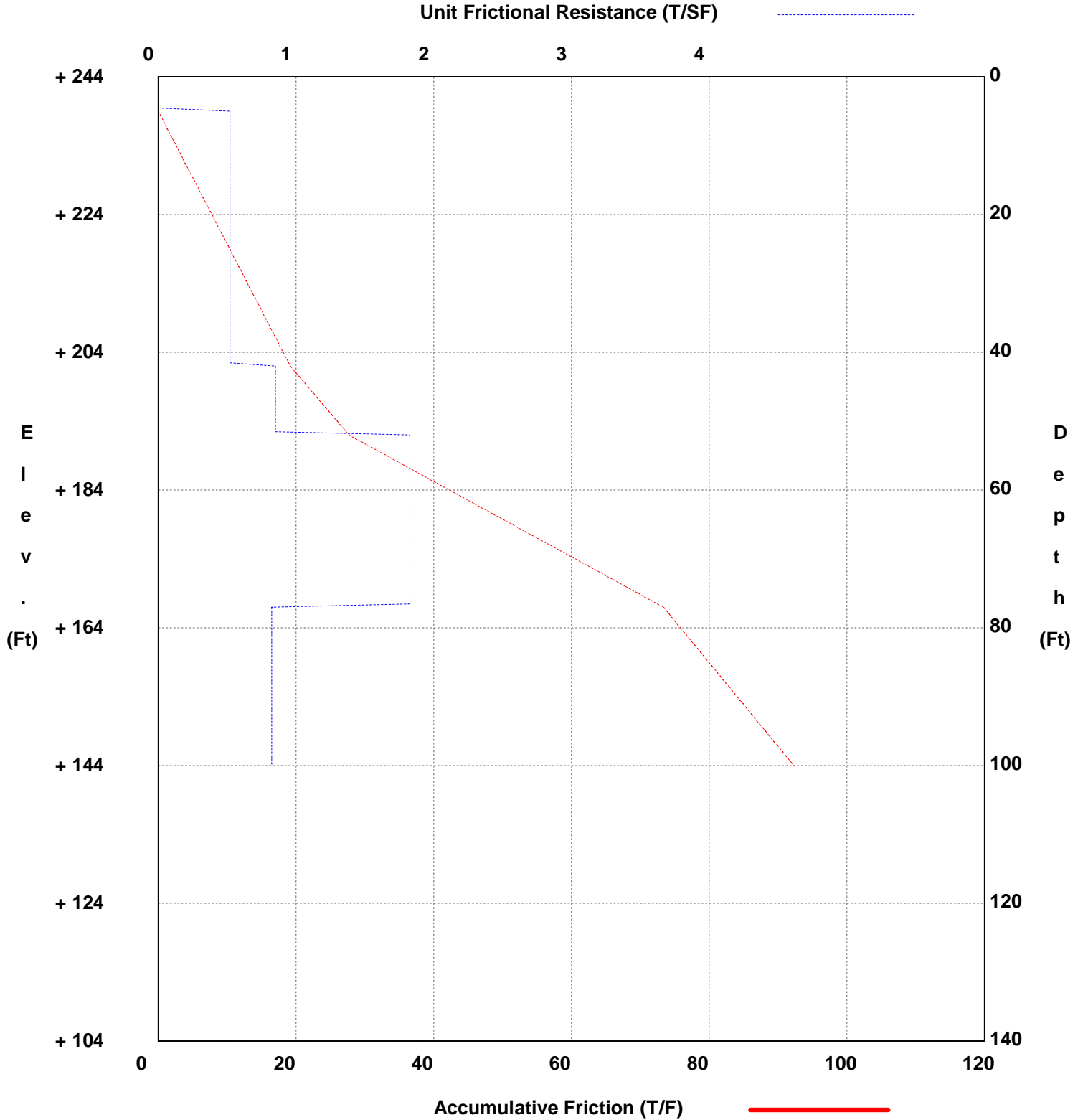
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-1
Structure Bridge
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

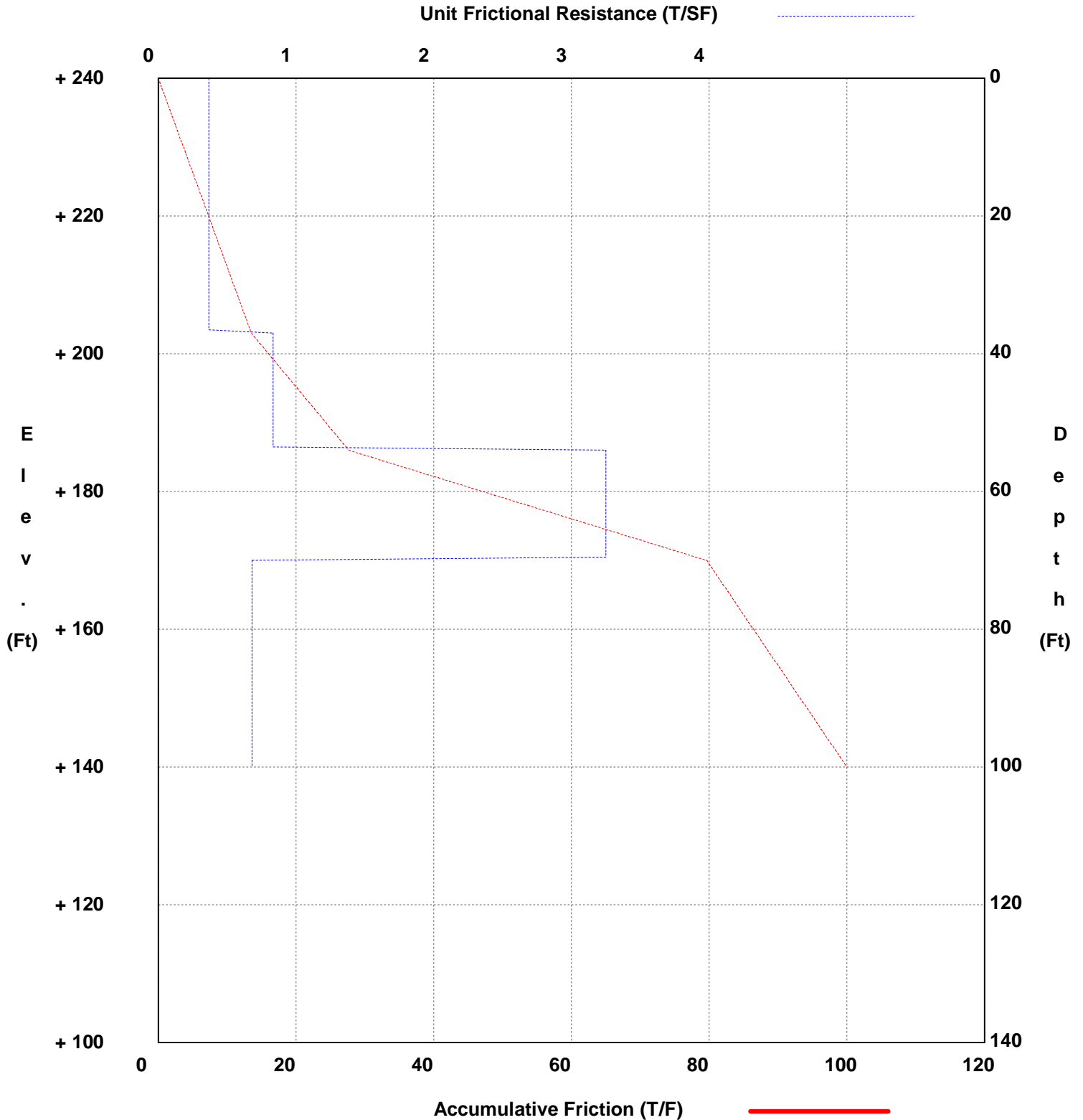
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-2
Structure Bridge
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

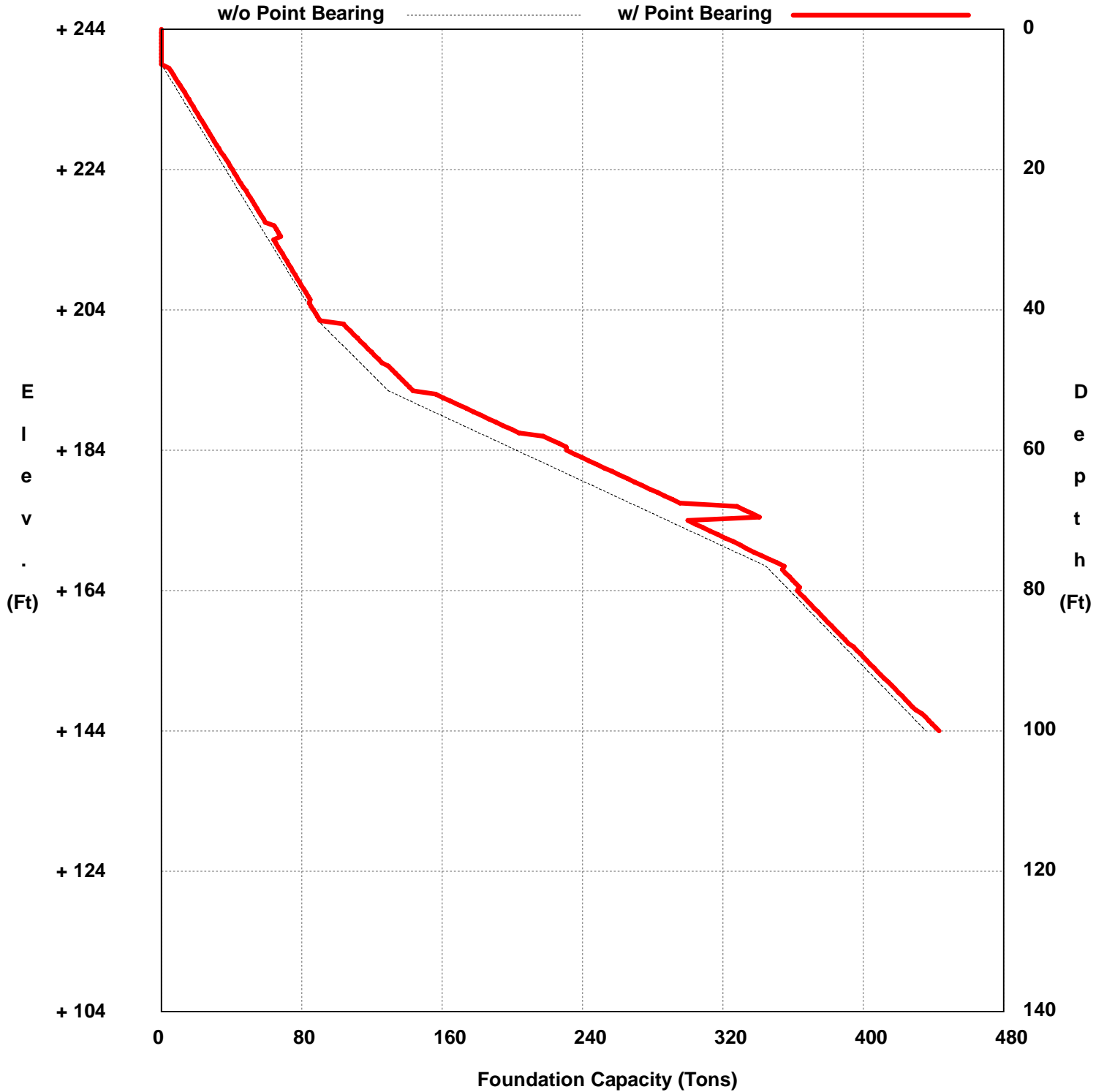
Hole B-1
Structure Wing Wall
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 236

+244 Top Hole Elevation
+239 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

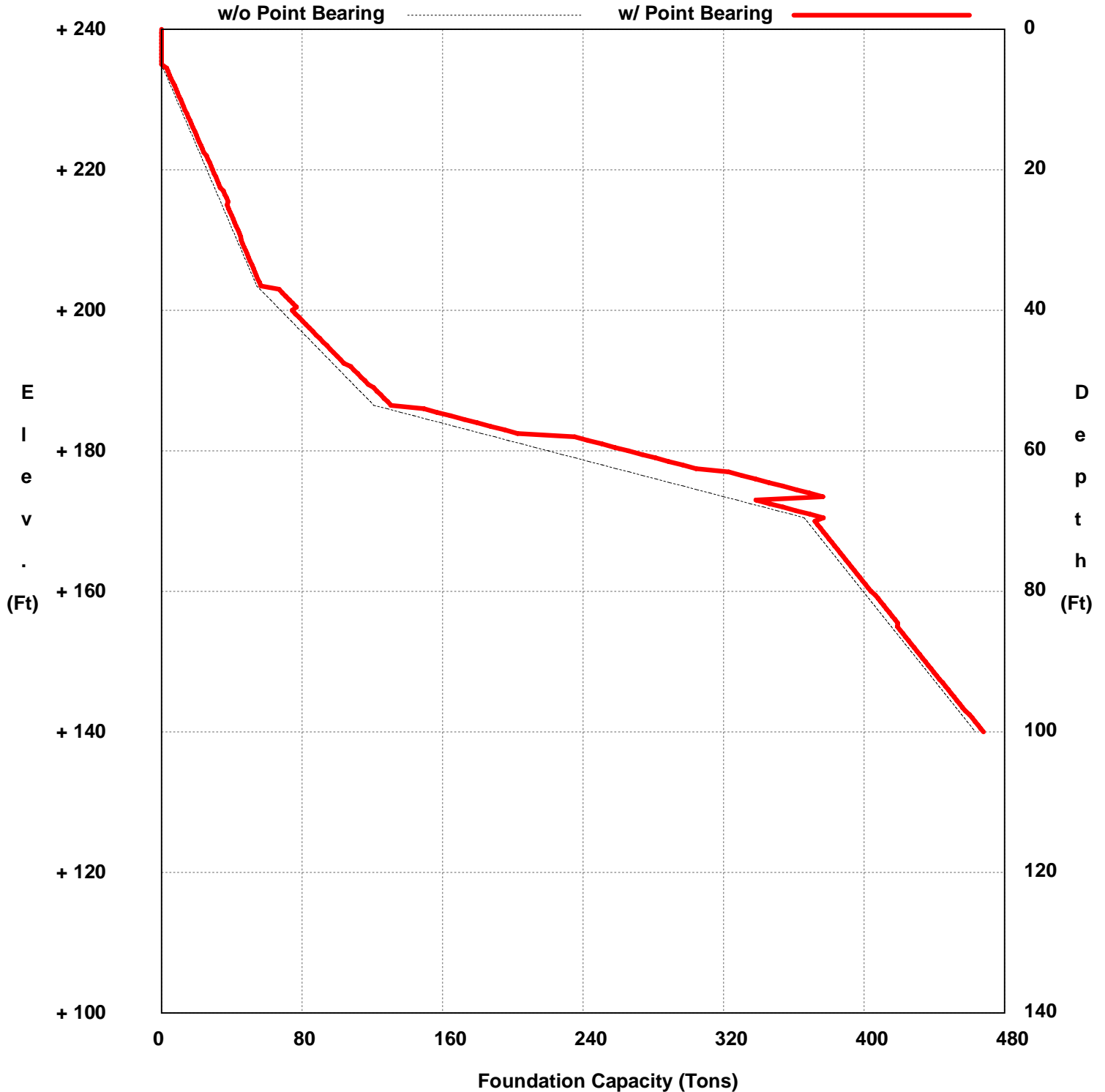
Hole B-2
Structure Wing Wall
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 230

+240 Top Hole Elevation
+235 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

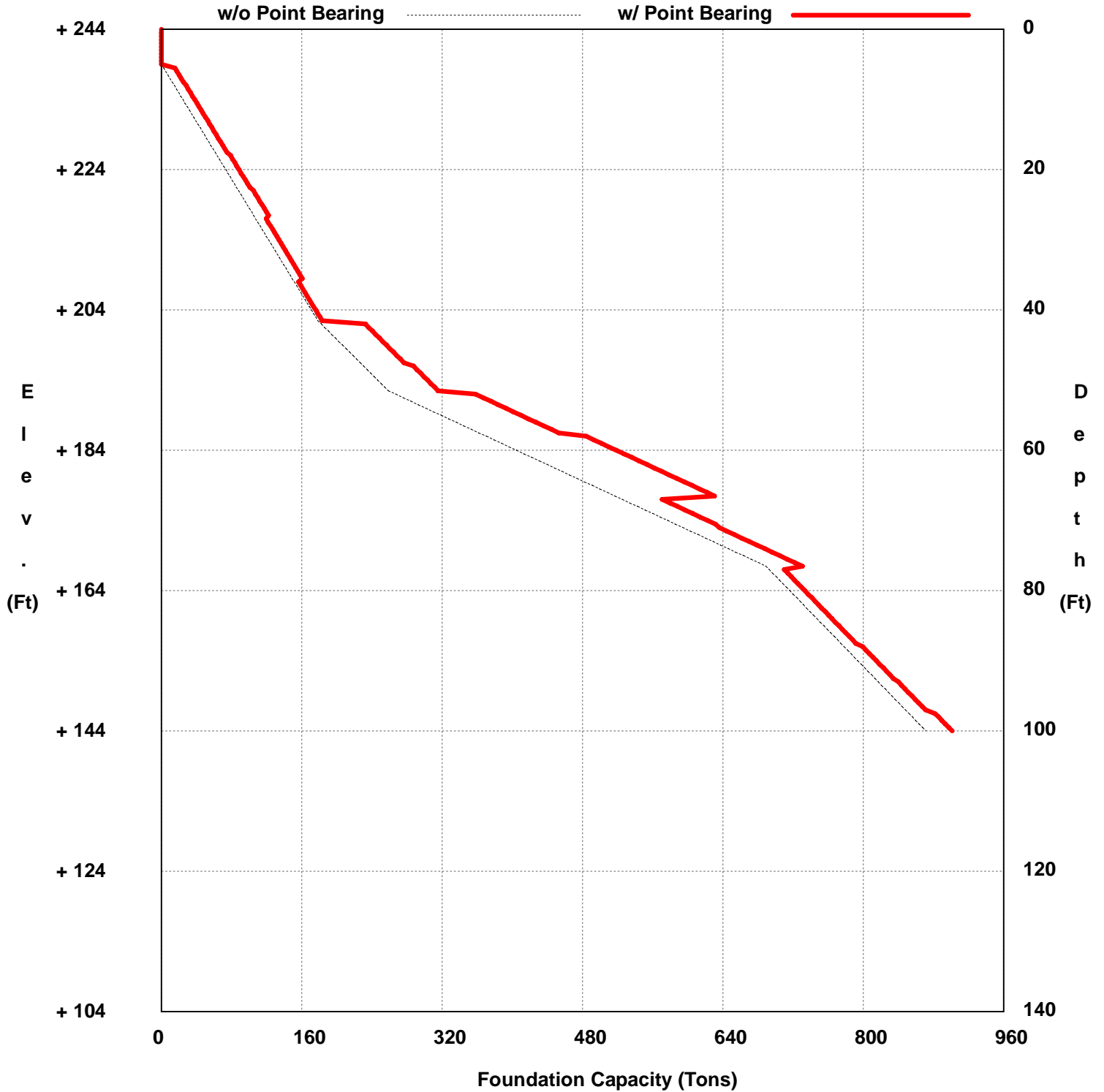
Hole B-1
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

36 inch Drilled Shaft
75 ton Design Load
Tip Elevation = + 226

+244 Top Hole Elevation
+239 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

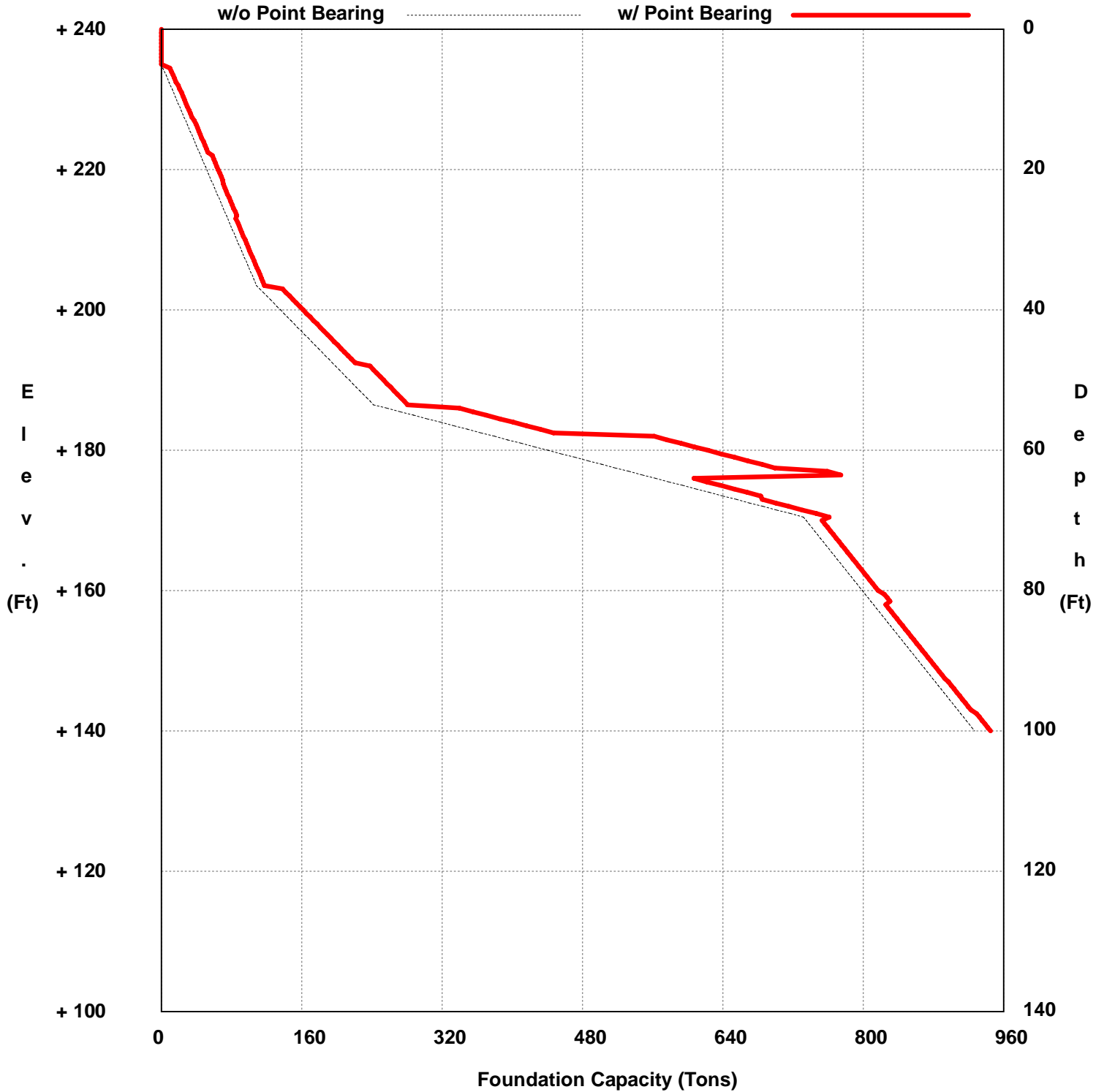
Hole B-2
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

36 inch Drilled Shaft
75 ton Design Load
Tip Elevation = + 216.5

+240 Top Hole Elevation
+235 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

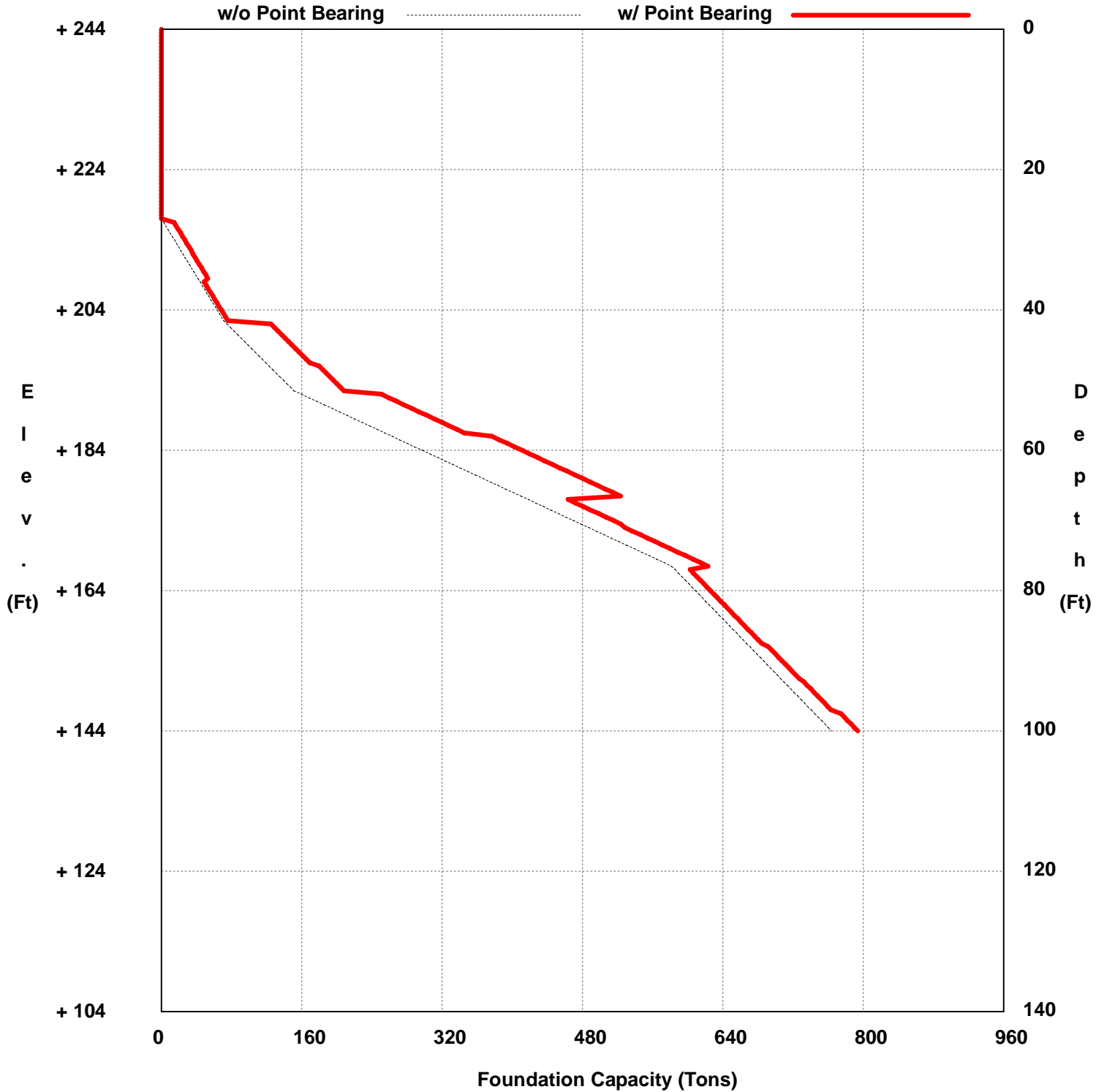
Hole B-1
Structure Bridge Bents
Station
Offset

District Bryan District
Date 7/31/2020
Grnd. Elev. 244.00 ft
GW Elev. 240.00 ft

36 inch Drilled Shaft
145 ton Design Load
Tip Elevation = + 199

+244 Top Hole Elevation
+217 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

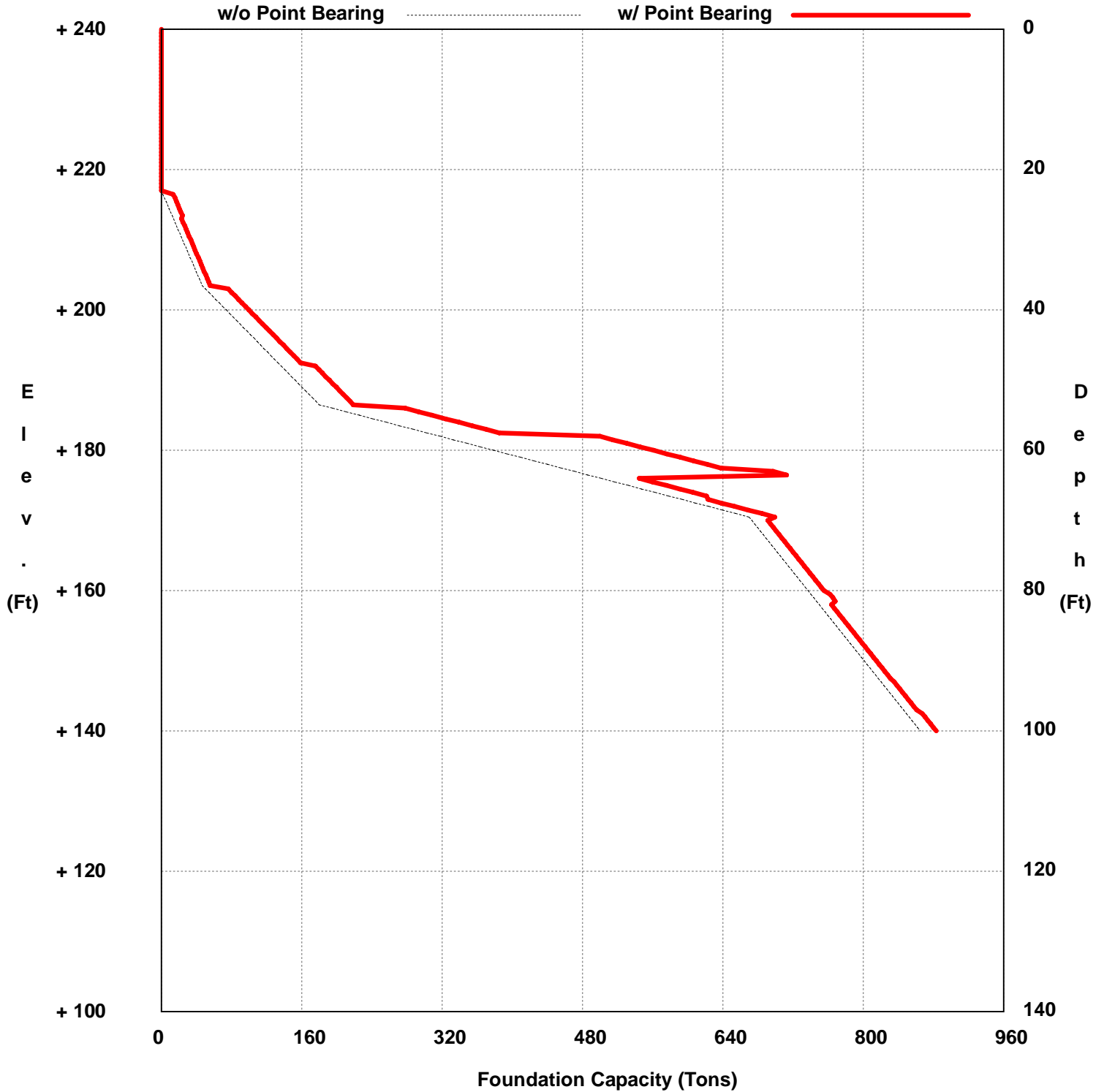
Hole B-2
Structure Bridge Bents
Station
Offset

District Bryan District
Date 8/4/2020
Grnd. Elev. 240.00 ft
GW Elev. 236.50 ft

36 inch Drilled Shaft
145 ton Design Load
Tip Elevation = + 194

+240 Top Hole Elevation
+217 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used



Capacity Curves: SH 6 NBML Beason Creek Bridge



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	185.0	183.0	CL	60	0	0.00	0.00
2	183.0	178.0	SC-SM	80	33	0.29	1.44
3	178.0	172.0	CH	50	23	0.32	3.38
3	172.0	167.0	CH	50	4	0.06	3.66
3	167.0	162.0	CH	50	4	0.06	3.94
3	162.0	155.0	CH	50	4	0.06	4.33
4	155.0	152.0	SC-SM	80	6	0.05	4.49
4	152.0	147.0	SC-SM	80	22	0.19	5.45
4	147.0	142.0	SC-SM	80	12	0.11	5.97
4	142.0	135.0	SC-SM	80	0	0.00	5.97
5	135.0	132.0	CH	50	6	0.08	6.22
5	132.0	127.0	CH	50	21	0.29	7.69
5	127.0	122.0	CH	50	82	1.14	13.41
5	122.0	115.0	CH	50	160	0.90	19.71
6	115.0	112.0	SC	70	106	0.85	22.26
6	112.0	107.0	SC	70	141	0.85	26.51
6	107.0	103.0	SC	70	200	1.12	31.01
7	103.0	97.0	SC	70	300	1.69	41.13
7	97.0	92.0	SC	70	171	0.96	45.95
7	92.0	87.5	SC	70	150	0.85	49.77
7	87.5	85.0	SC	70	1200	3.25	57.90



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	186.0	178.5	SM	80	53	0.46	3.48
2	178.5	173.0	SC	70	12	0.12	4.14
2	173.0	168.0	SC	70	17	0.17	4.99
2	168.0	163.0	SC	70	11	0.11	5.54
2	163.0	158.0	SC	70	10	0.10	6.04
2	158.0	154.0	SC	70	18	0.18	6.76
3	154.0	148.0	CH	50	16	0.22	8.10
3	148.0	143.0	CH	50	16	0.22	9.22
3	143.0	139.0	CH	50	7	0.10	9.61
4	139.0	133.0	CH	50	41	0.57	13.06
4	133.0	128.0	CH	50	28	0.39	15.02
4	128.0	123.0	CH	50	41	0.57	17.89
4	123.0	116.0	CH	50	111	0.85	23.84
5	116.0	114.5	SC-SM	80	200	1.12	25.53
5	114.5	111.0	SC-SM	80	171	0.96	28.90
5	111.0	106.0	SC-SM	80	240	1.35	35.65
5	106.0	96.0	SC-SM	80	400	2.25	58.14
6	96.0	93.0	SM	80	800	3.25	67.89
6	93.0	88.5	SM	80	200	1.12	72.95
6	88.5	86.0	SM	80	171	0.96	75.36



POINT BEARING DESIGN

WinCore
Version 3.3

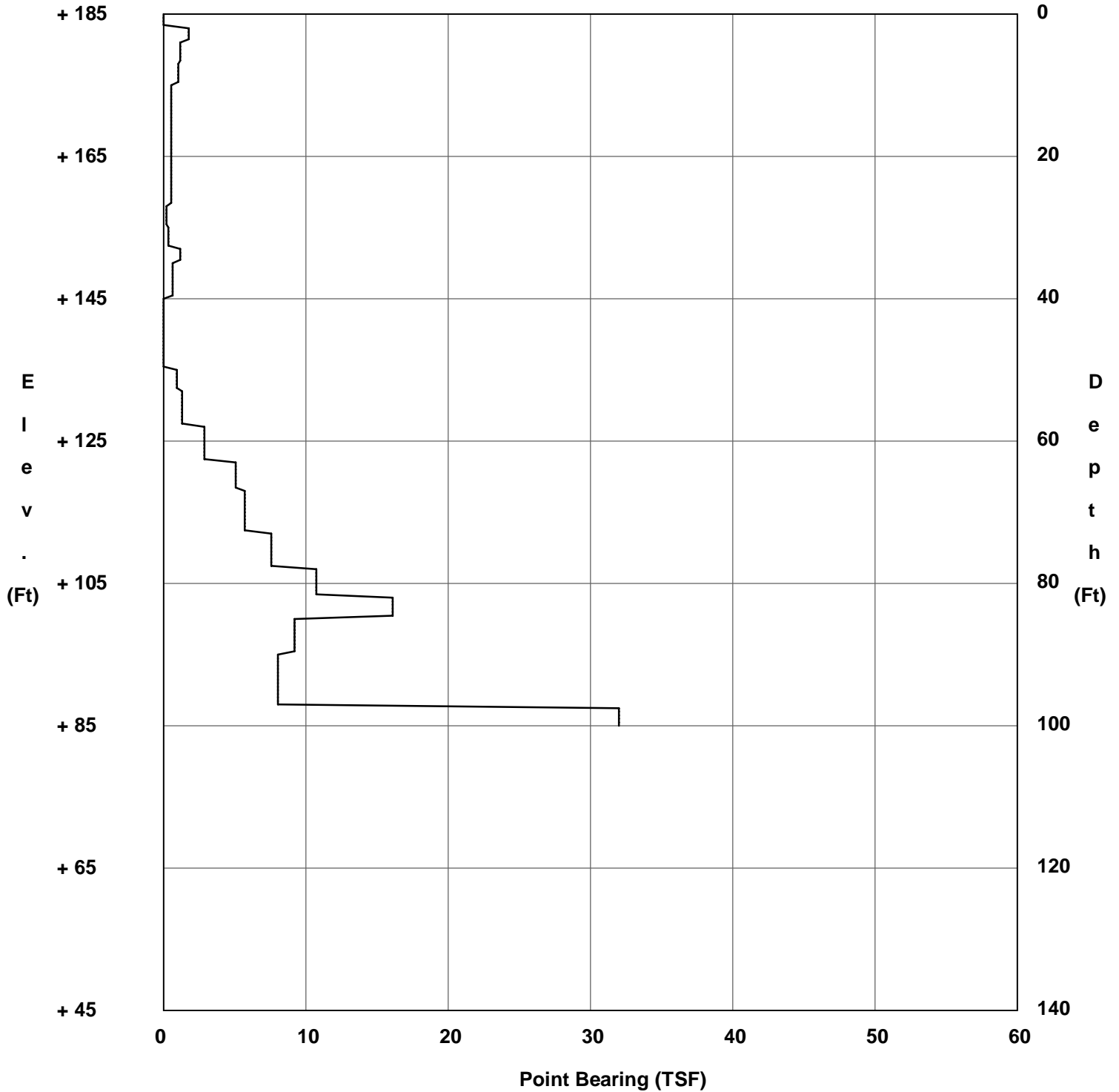
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





POINT BEARING DESIGN

WinCore
Version 3.3

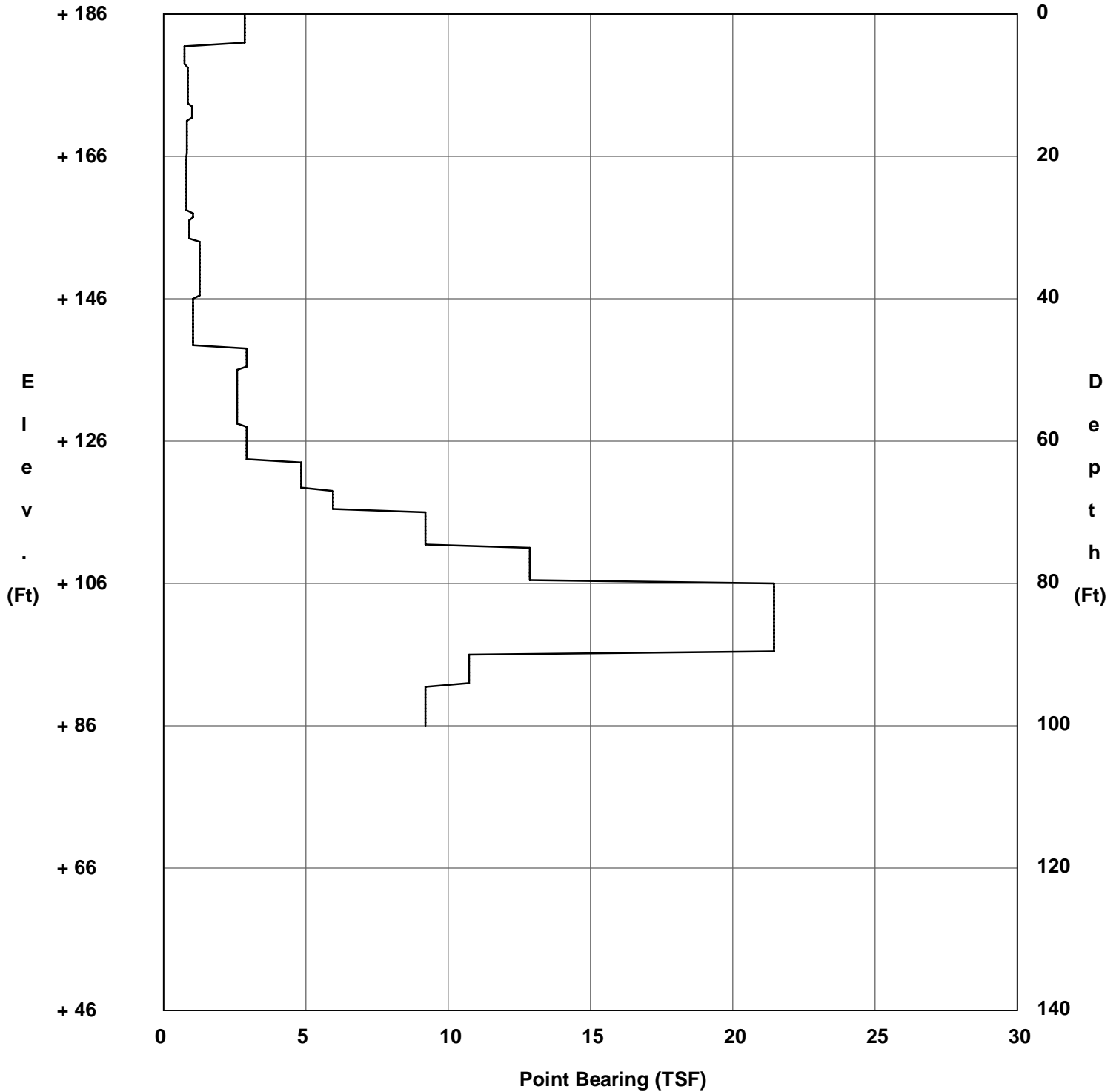
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

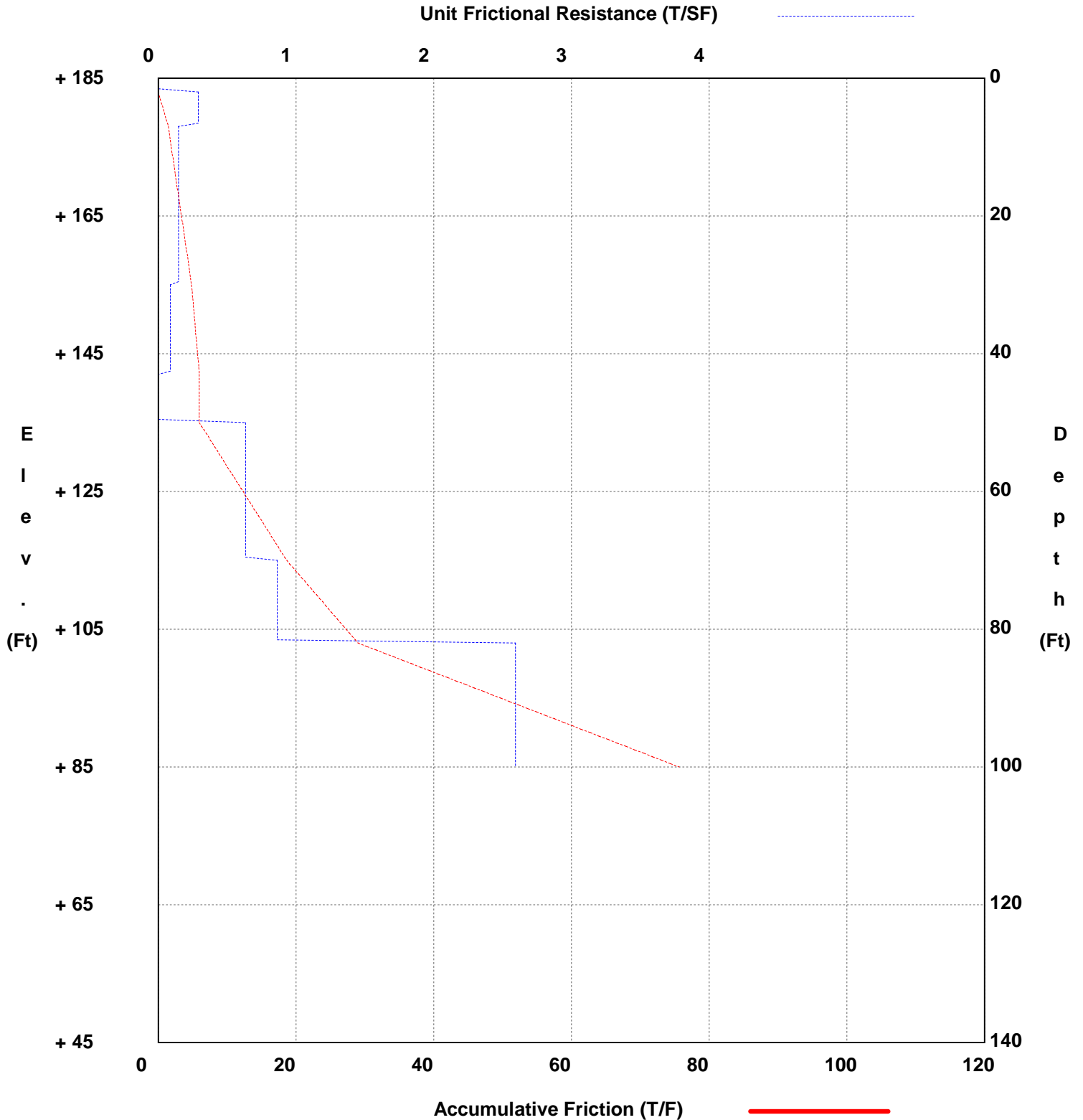
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

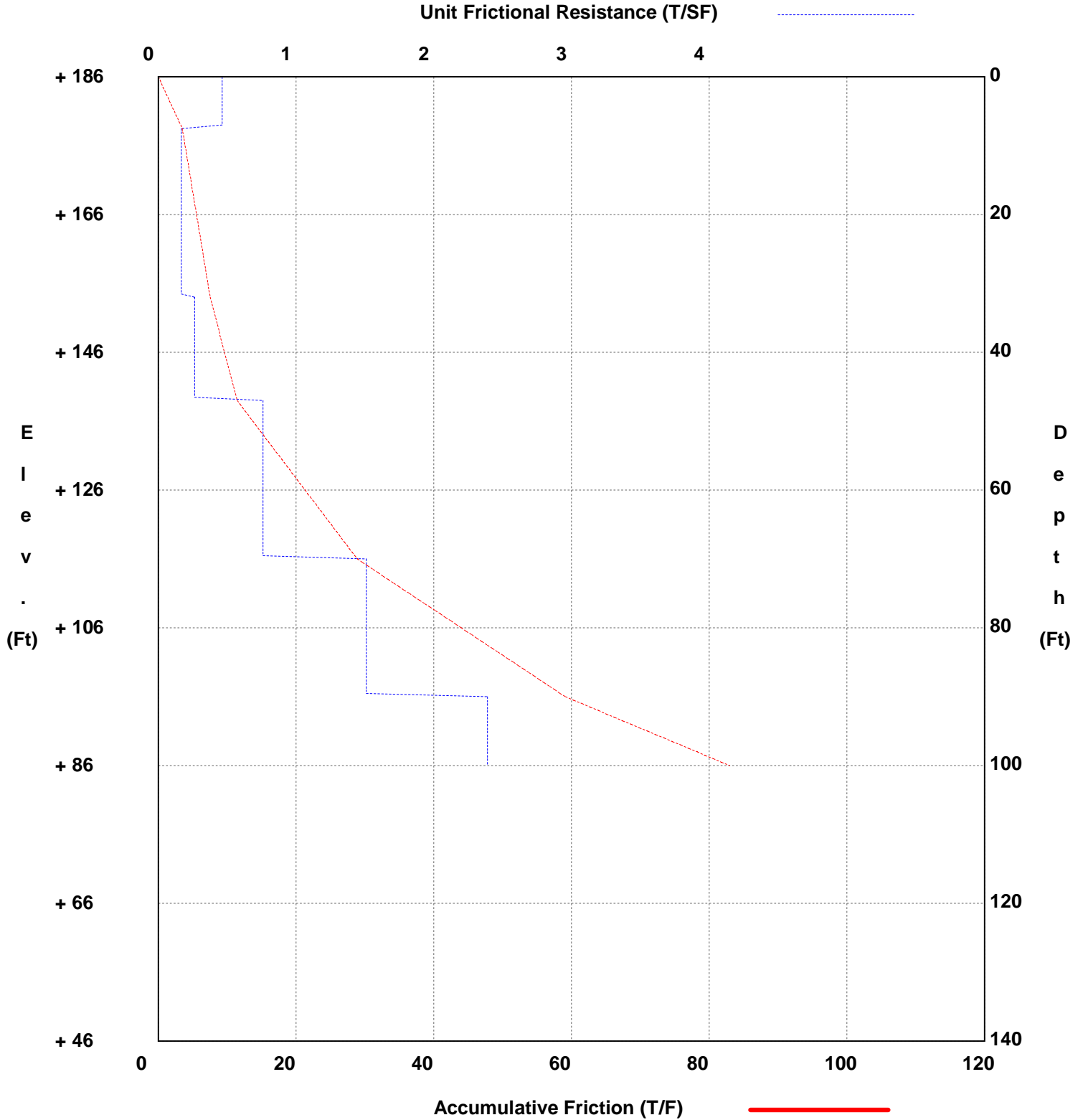
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

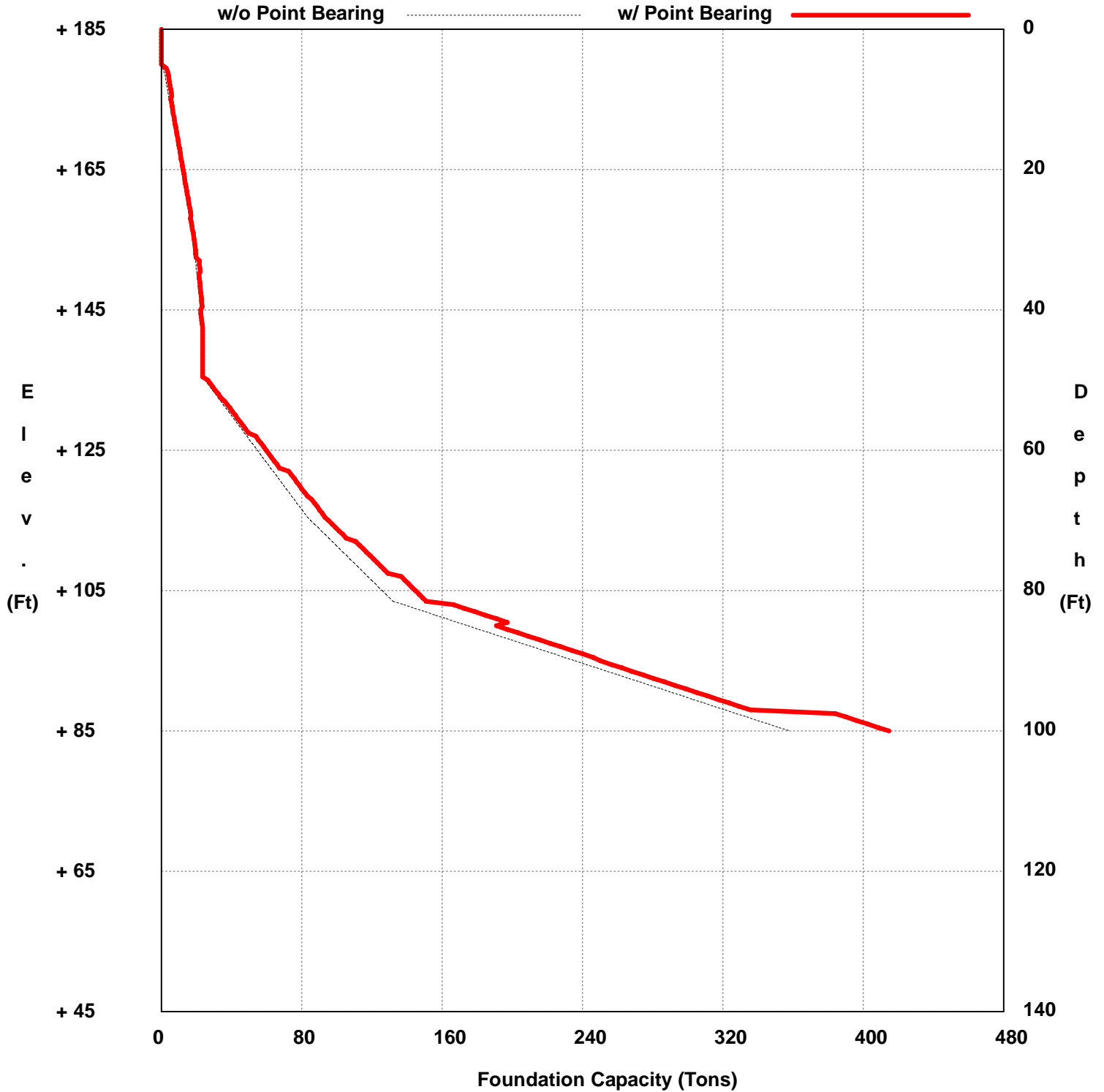
Hole B-3
Structure Wing Wall
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 168

+185 Top Hole Elevation
+180 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

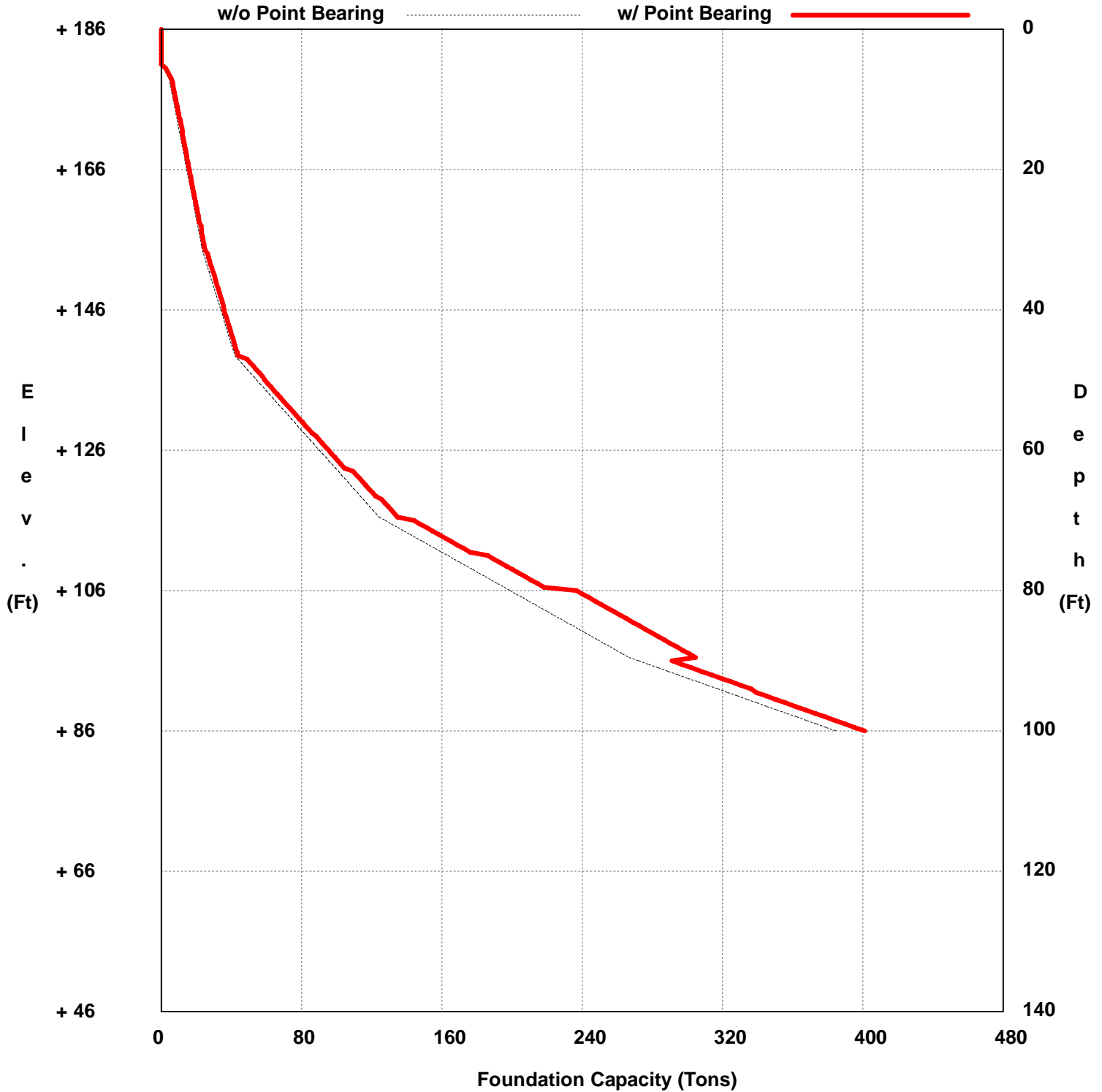
Hole B-4
Structure Wing Wall
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 173.5

+186 Top Hole Elevation
+181 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

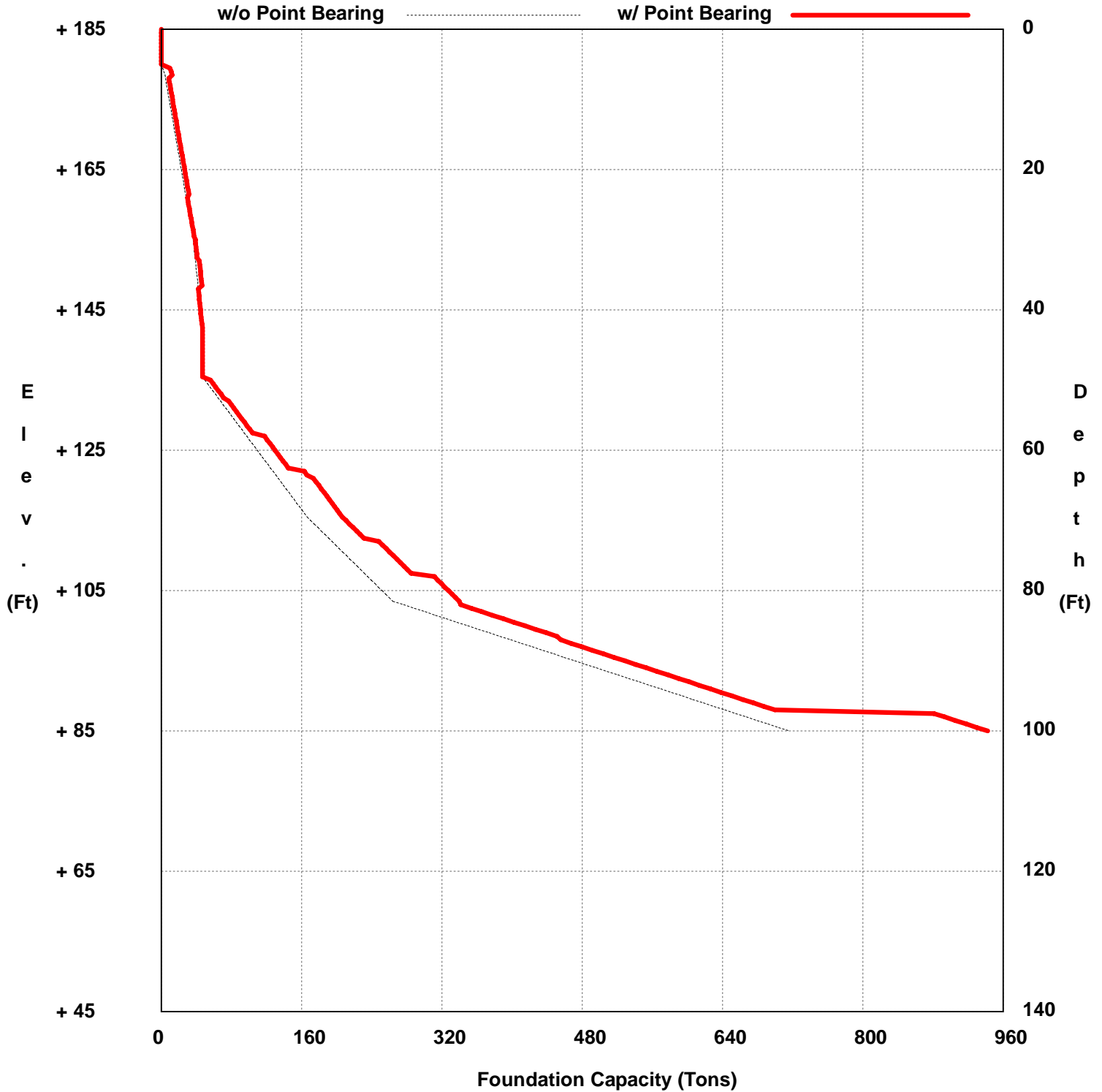
Hole B-3
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

36 inch Drilled Shaft
90 ton Design Load
Tip Elevation = + 129.5

+185 Top Hole Elevation
+180 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

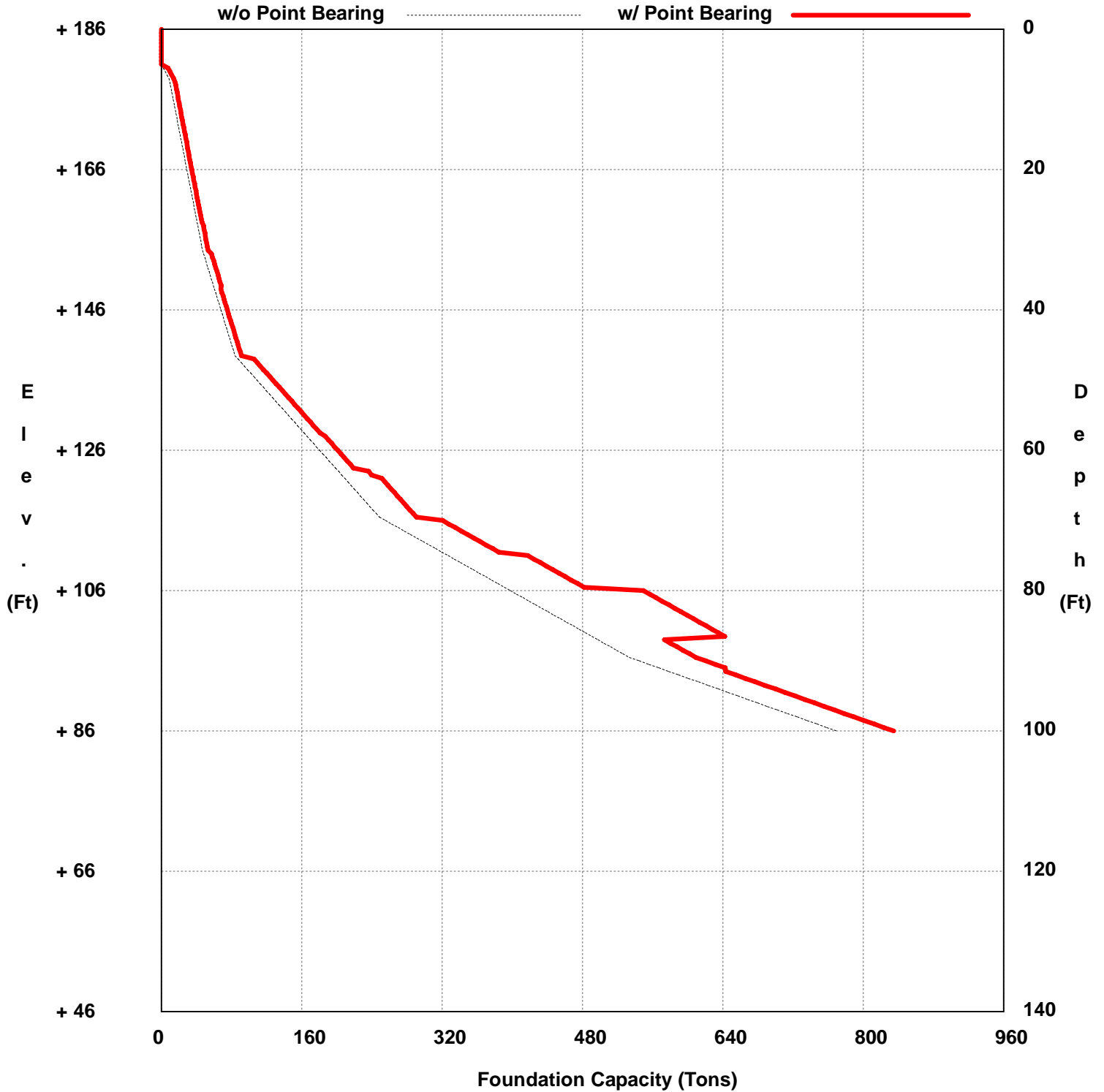
Hole B-4
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

36 inch Drilled Shaft
90 ton Design Load
Tip Elevation = + 139.5

+186 Top Hole Elevation
+181 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

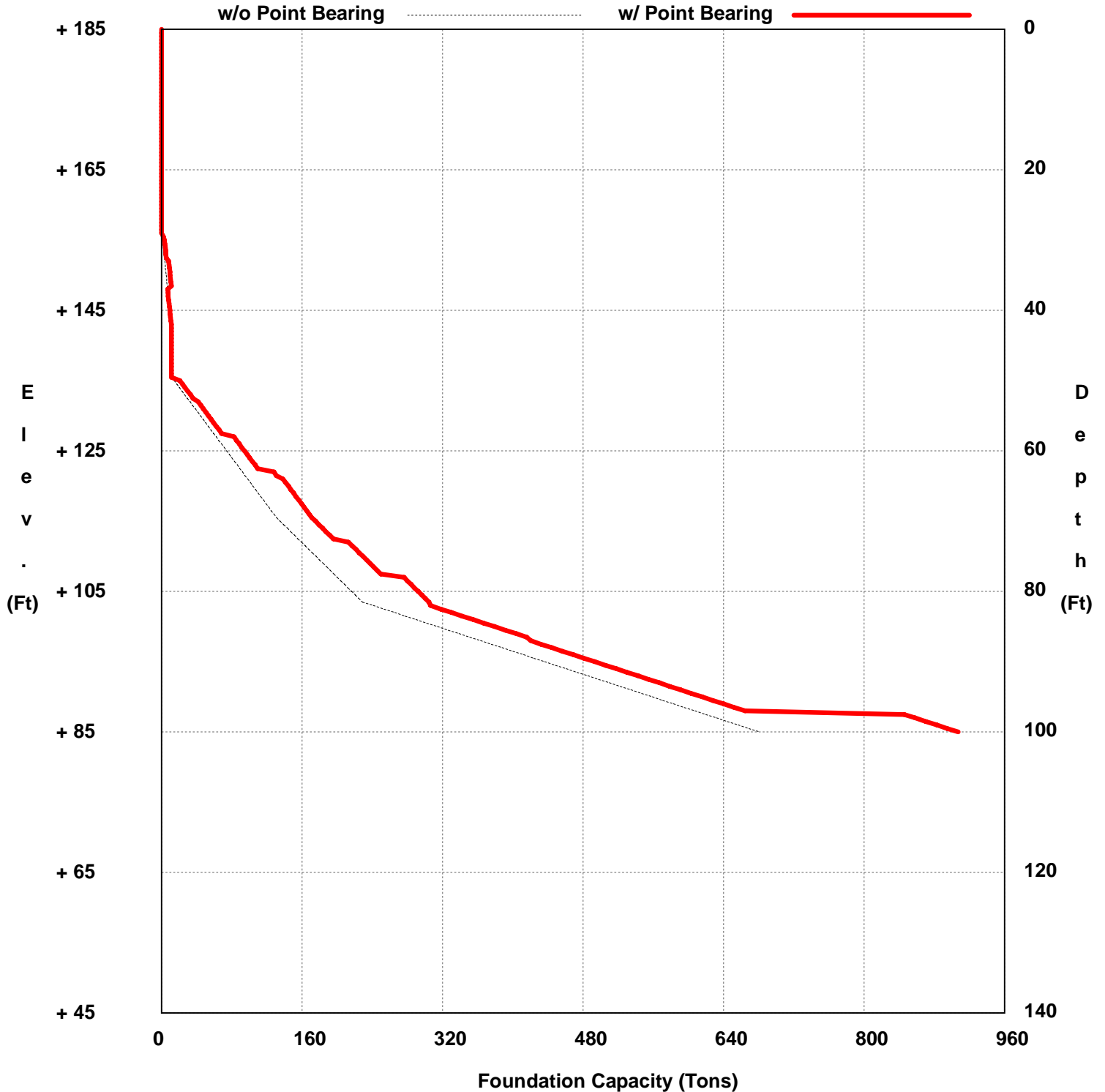
Hole B-3
Structure Bridge Bents
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

36 inch Drilled Shaft
160 ton Design Load
Tip Elevation = + 117

+185 Top Hole Elevation
+156 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

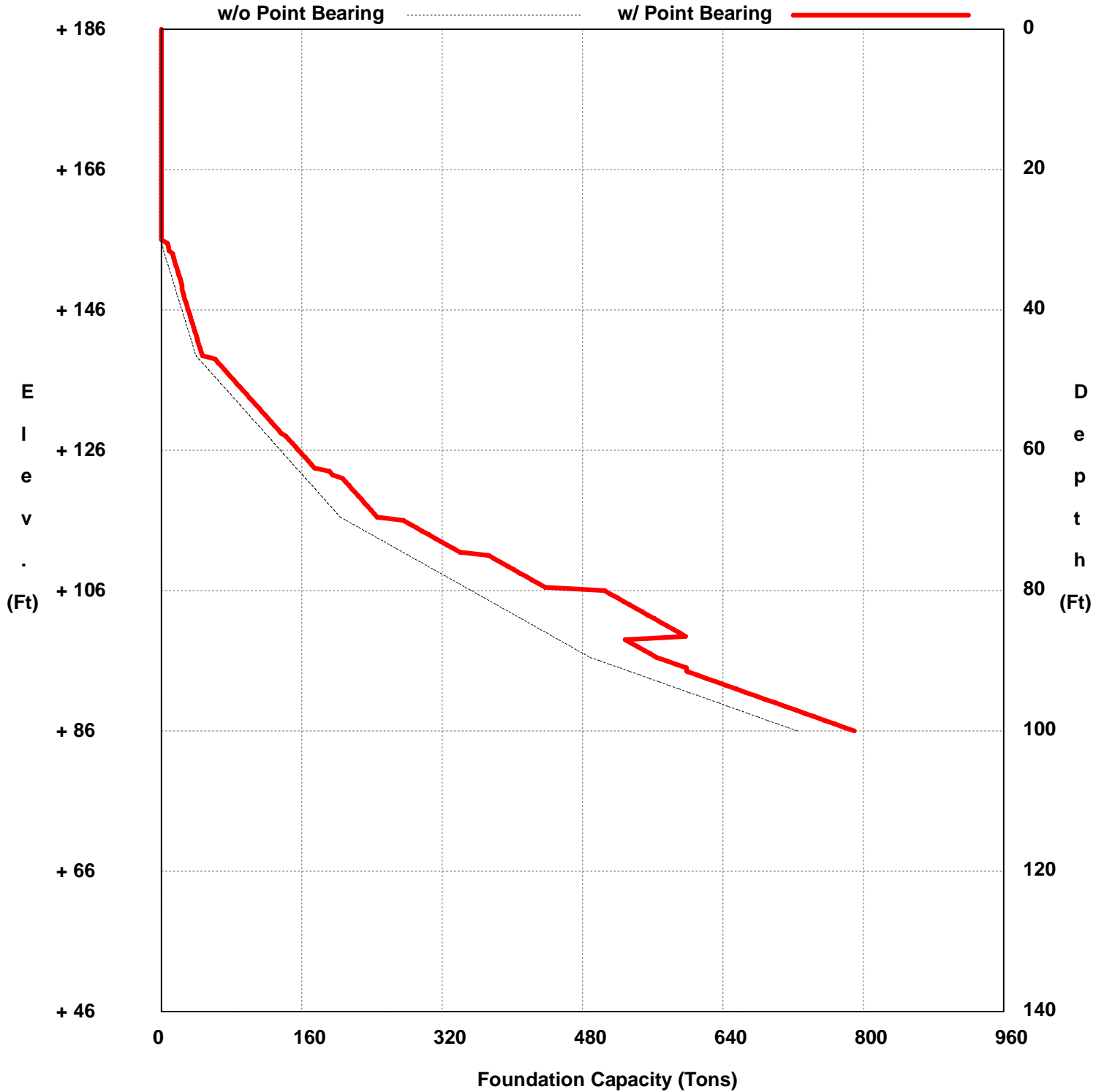
Hole B-4
Structure Bridge Bents
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

36 inch Drilled Shaft
160 ton Design Load
Tip Elevation = + 125.5

+186 Top Hole Elevation
+156 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used



Capacity Curves: SH 6 SBML Beason Creek Bridge



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	185.0	183.0	CL	60	0	0.00	0.00
2	183.0	178.0	SC-SM	80	33	0.29	1.44
3	178.0	172.0	CH	50	23	0.32	3.38
3	172.0	167.0	CH	50	4	0.06	3.66
3	167.0	162.0	CH	50	4	0.06	3.94
3	162.0	155.0	CH	50	4	0.06	4.33
4	155.0	152.0	SC-SM	80	6	0.05	4.49
4	152.0	147.0	SC-SM	80	22	0.19	5.45
4	147.0	142.0	SC-SM	80	12	0.11	5.97
4	142.0	135.0	SC-SM	80	0	0.00	5.97
5	135.0	132.0	CH	50	6	0.08	6.22
5	132.0	127.0	CH	50	21	0.29	7.69
5	127.0	122.0	CH	50	82	1.14	13.41
5	122.0	115.0	CH	50	160	0.90	19.71
6	115.0	112.0	SC	70	106	0.85	22.26
6	112.0	107.0	SC	70	141	0.85	26.51
6	107.0	103.0	SC	70	200	1.12	31.01
7	103.0	97.0	SC	70	300	1.69	41.13
7	97.0	92.0	SC	70	171	0.96	45.95
7	92.0	87.5	SC	70	150	0.85	49.77
7	87.5	85.0	SC	70	1200	3.25	57.90



SOIL STRENGTH ANALYSIS

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet)		Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
	From	To					
1	186.0	178.5	SM	80	53	0.46	3.48
2	178.5	173.0	SC	70	12	0.12	4.14
2	173.0	168.0	SC	70	17	0.17	4.99
2	168.0	163.0	SC	70	11	0.11	5.54
2	163.0	158.0	SC	70	10	0.10	6.04
2	158.0	154.0	SC	70	18	0.18	6.76
3	154.0	148.0	CH	50	16	0.22	8.10
3	148.0	143.0	CH	50	16	0.22	9.22
3	143.0	139.0	CH	50	7	0.10	9.61
4	139.0	133.0	CH	50	41	0.57	13.06
4	133.0	128.0	CH	50	28	0.39	15.02
4	128.0	123.0	CH	50	41	0.57	17.89
4	123.0	116.0	CH	50	111	0.85	23.84
5	116.0	114.5	SC-SM	80	200	1.12	25.53
5	114.5	111.0	SC-SM	80	171	0.96	28.90
5	111.0	106.0	SC-SM	80	240	1.35	35.65
5	106.0	96.0	SC-SM	80	400	2.25	58.14
6	96.0	93.0	SM	80	800	3.25	67.89
6	93.0	88.5	SM	80	200	1.12	72.95
6	88.5	86.0	SM	80	171	0.96	75.36



POINT BEARING DESIGN

WinCore
Version 3.3

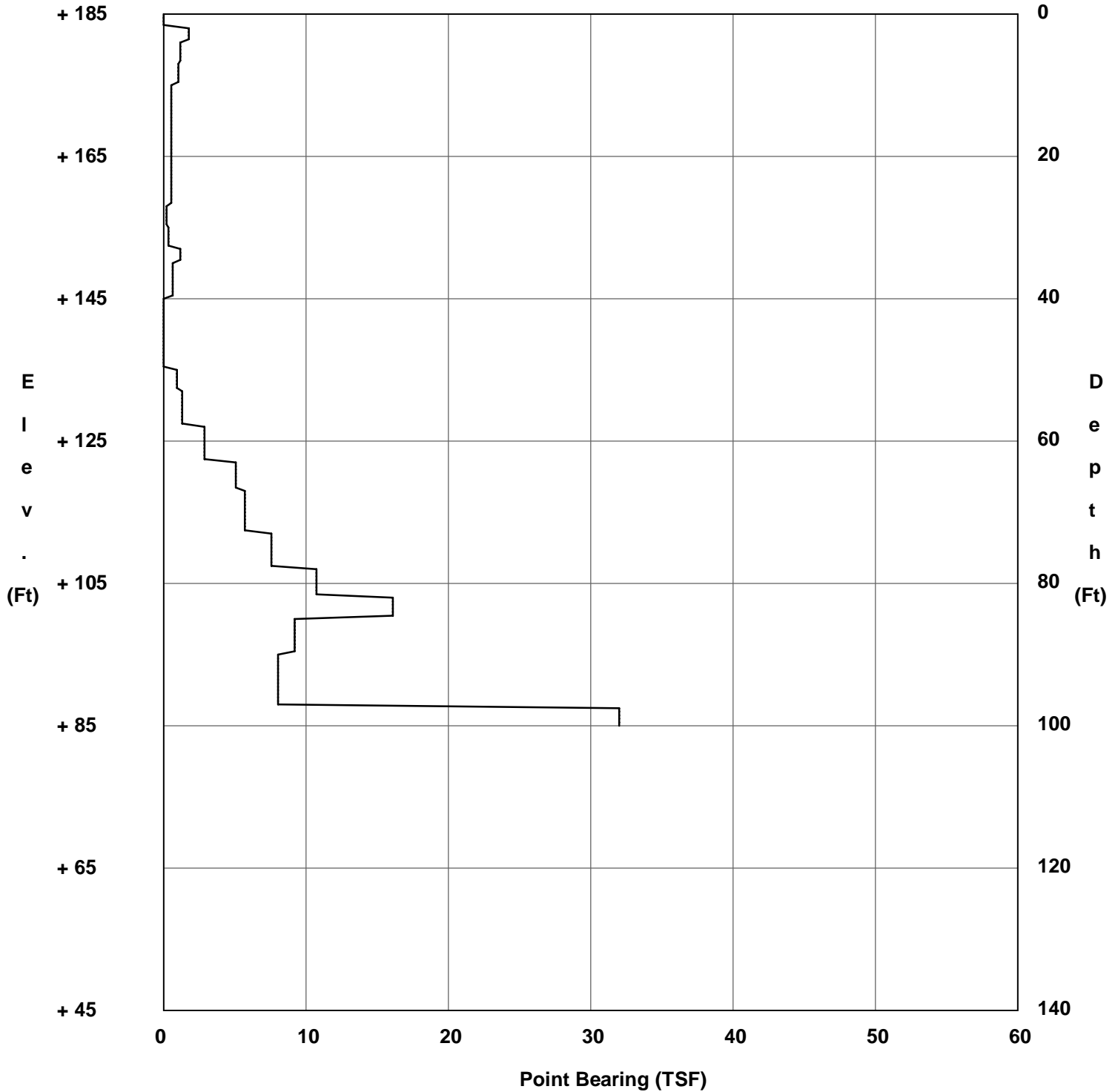
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





POINT BEARING DESIGN

WinCore
Version 3.3

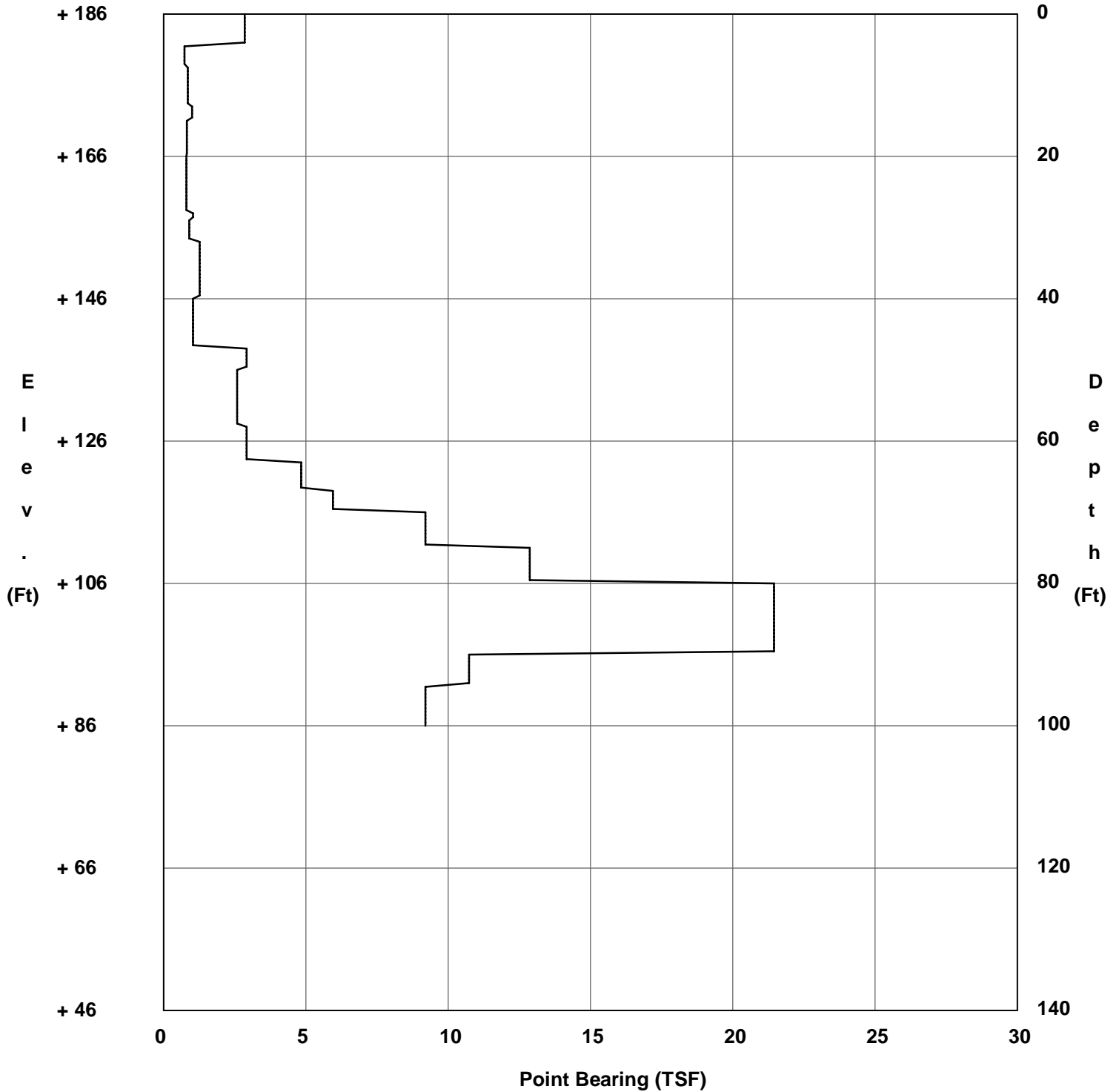
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Diameters Below Tip Checked = 2

Average Bearing Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

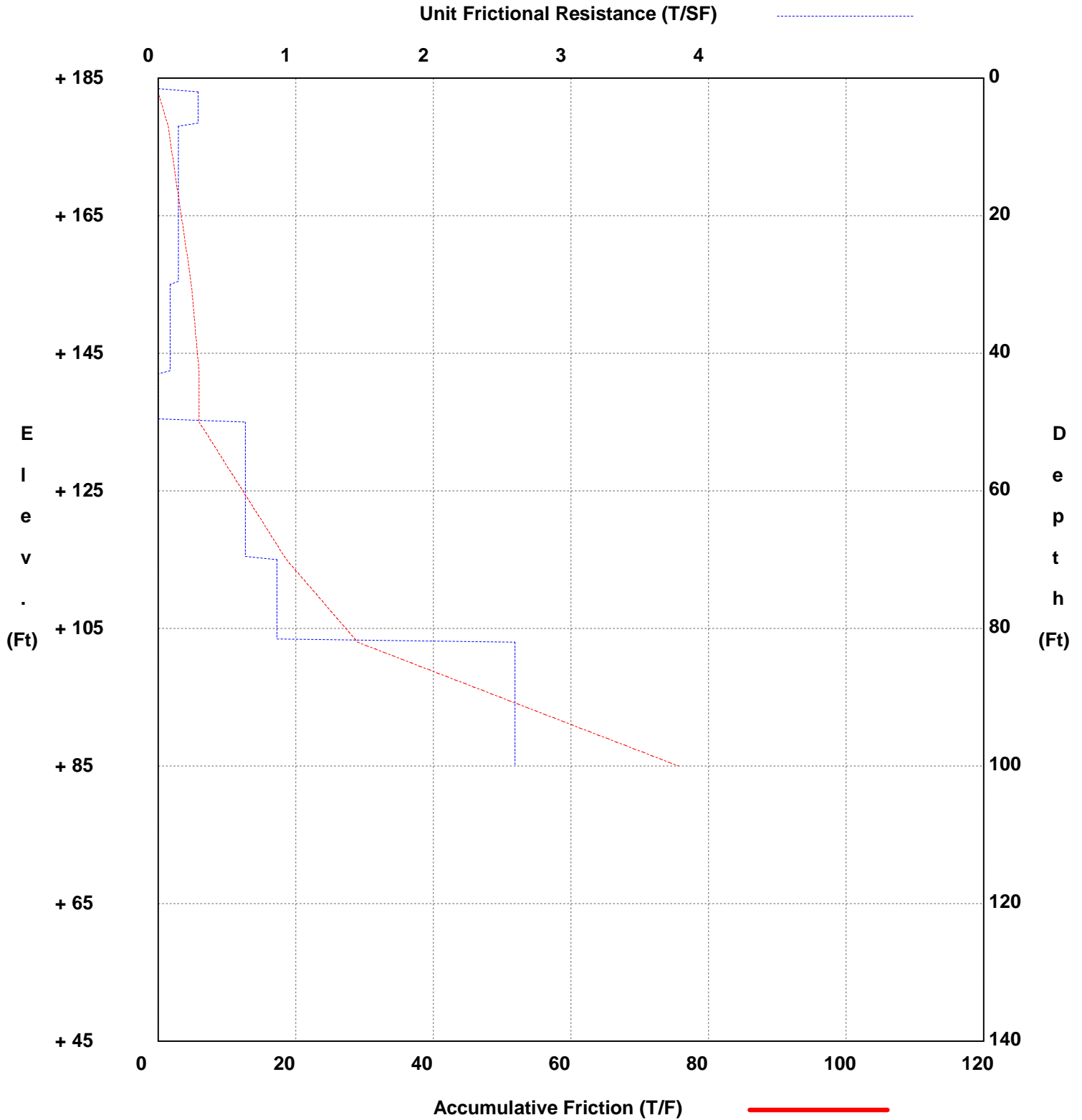
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-3
Structure Bridge
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





SKIN FRICTION DESIGN

WinCore
Version 3.3

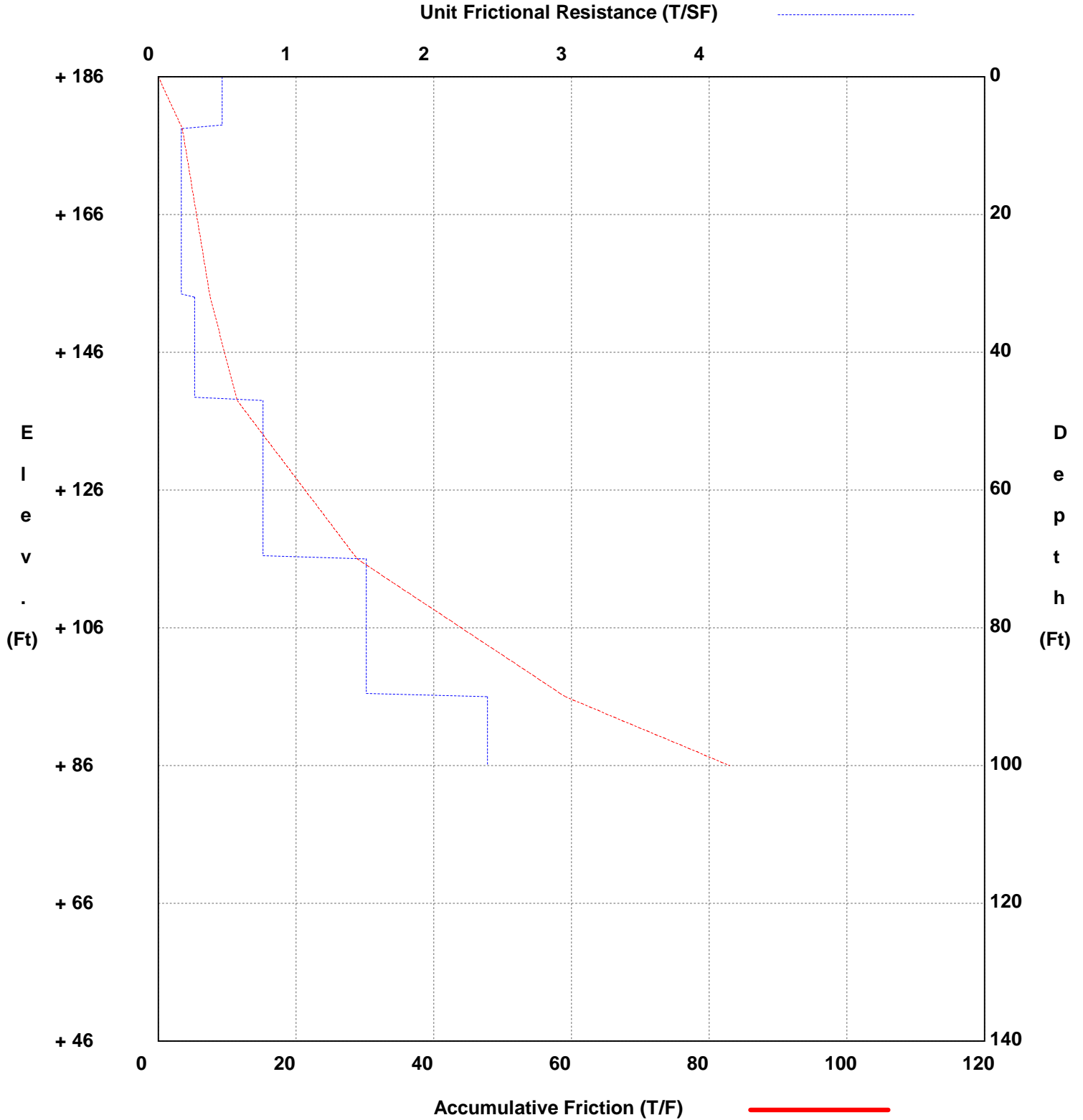
County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

Hole B-4
Structure Bridge
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

Drilled Shaft Design: Soil Reduction Factor = 0.7

Average Friction Values Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

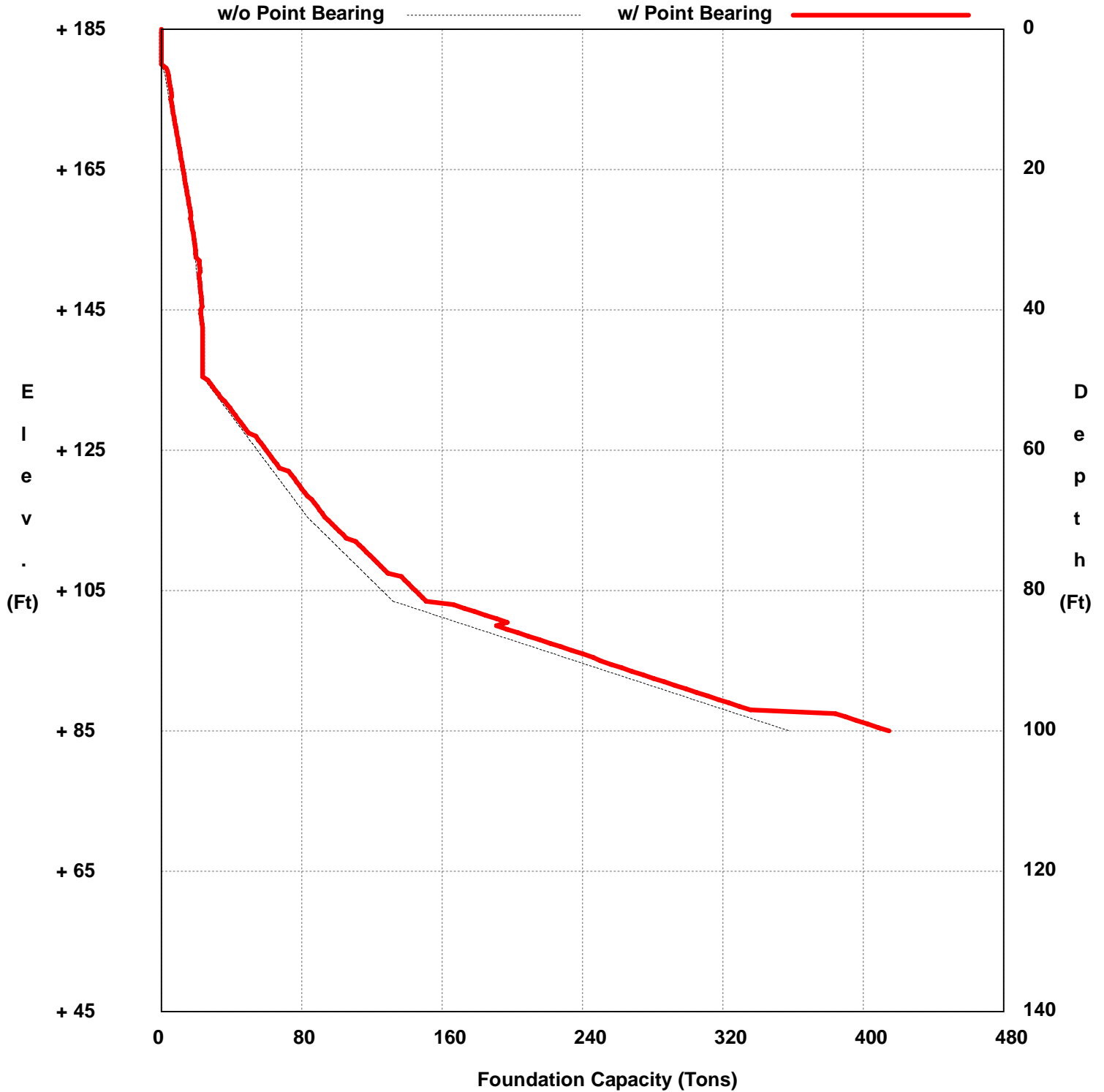
Hole B-3
Structure Wing Wall
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 168

+185 Top Hole Elevation
+180 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

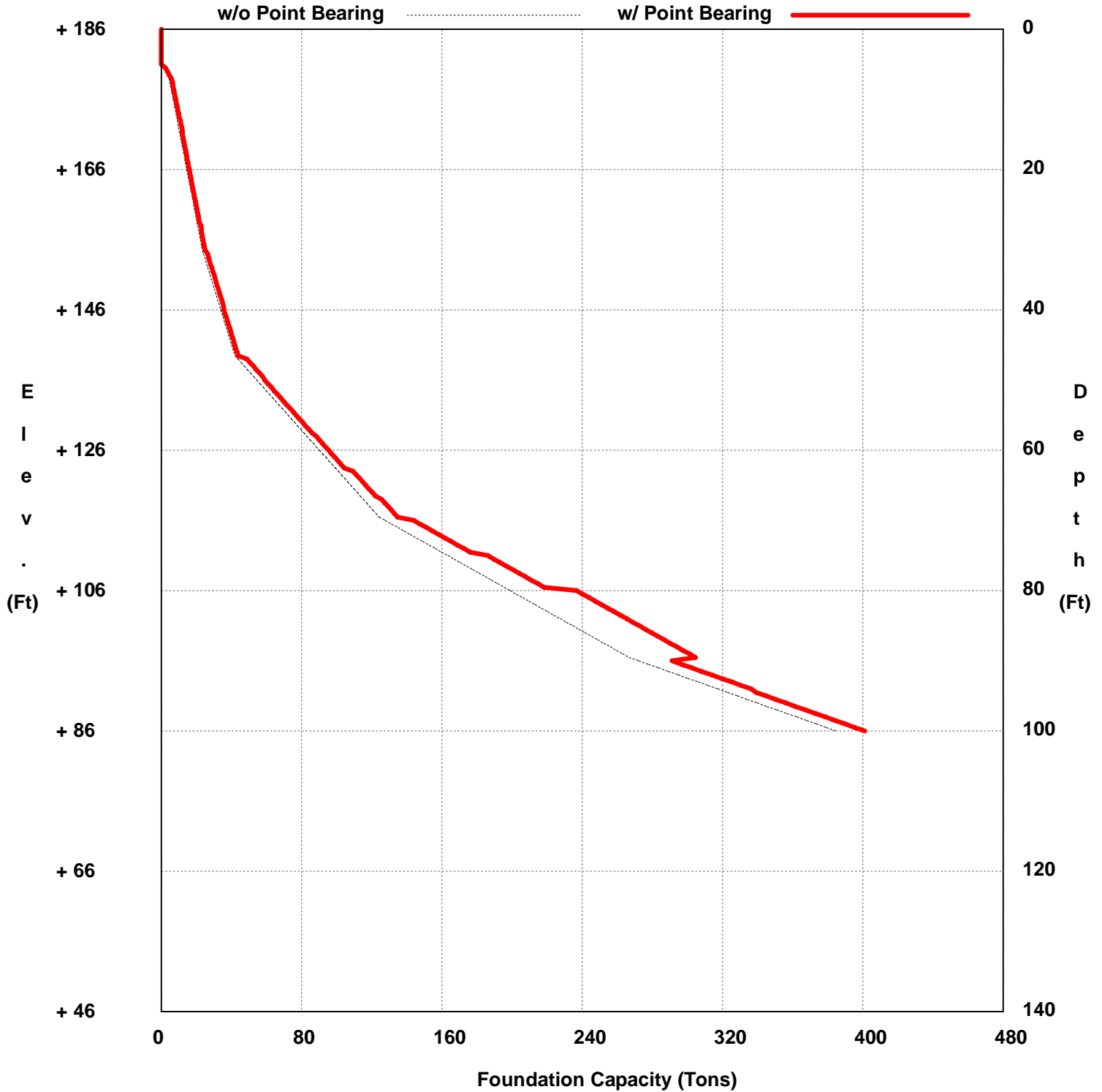
Hole B-4
Structure Wing Wall
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

18 inch Drilled Shaft
10 ton Design Load
Tip Elevation = + 173.5

+186 Top Hole Elevation
+181 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

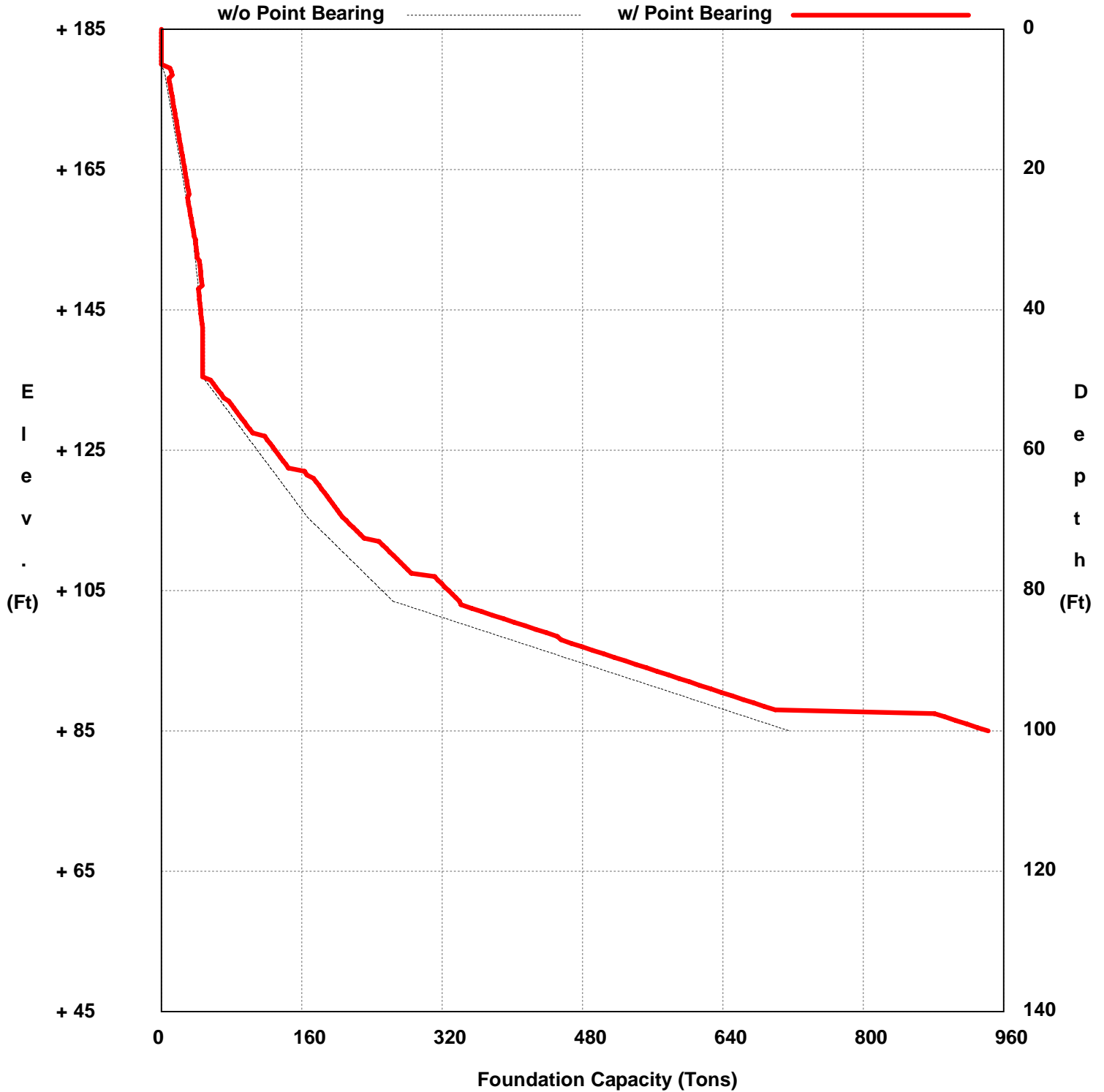
Hole B-3
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

36 inch Drilled Shaft
95 ton Design Load
Tip Elevation = + 128.5

+185 Top Hole Elevation
+180 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

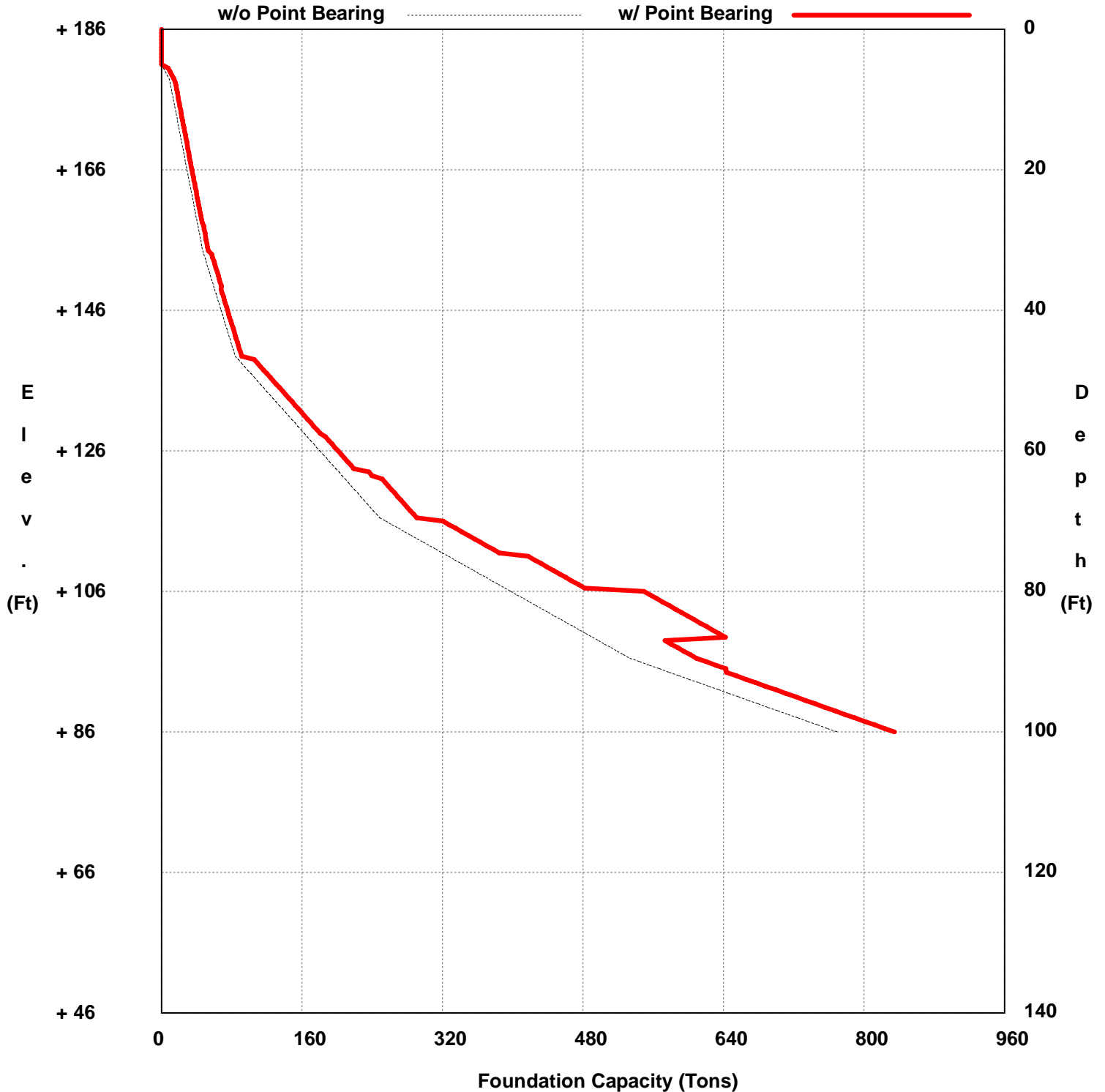
Hole B-4
Structure Bridge Abutments
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

36 inch Drilled Shaft
95 ton Design Load
Tip Elevation = + 139

+186 Top Hole Elevation
+181 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

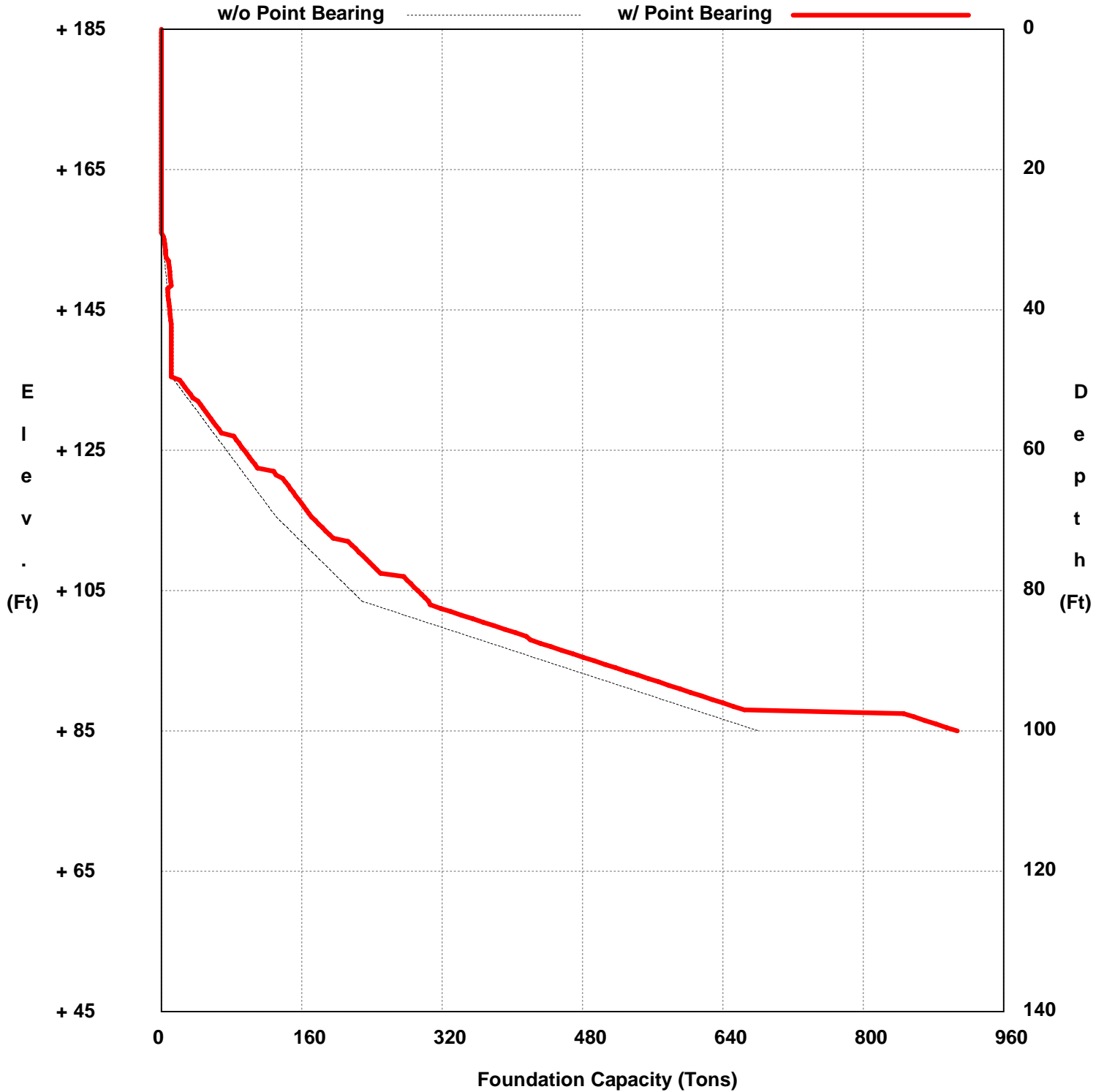
Hole B-3
Structure Bridge Bents
Station
Offset

District Bryan District
Date 8/5/2020
Grnd. Elev. 185.00 ft
GW Elev. 175.00 ft

36 inch Drilled Shaft
180 ton Design Load
Tip Elevation = + 114

+185 Top Hole Elevation
+156 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used





FOUNDATION CAPACITY

WinCore
Version 3.3

County Grimes County
Highway HWY 6 & FM 2
Control 0050-03-096

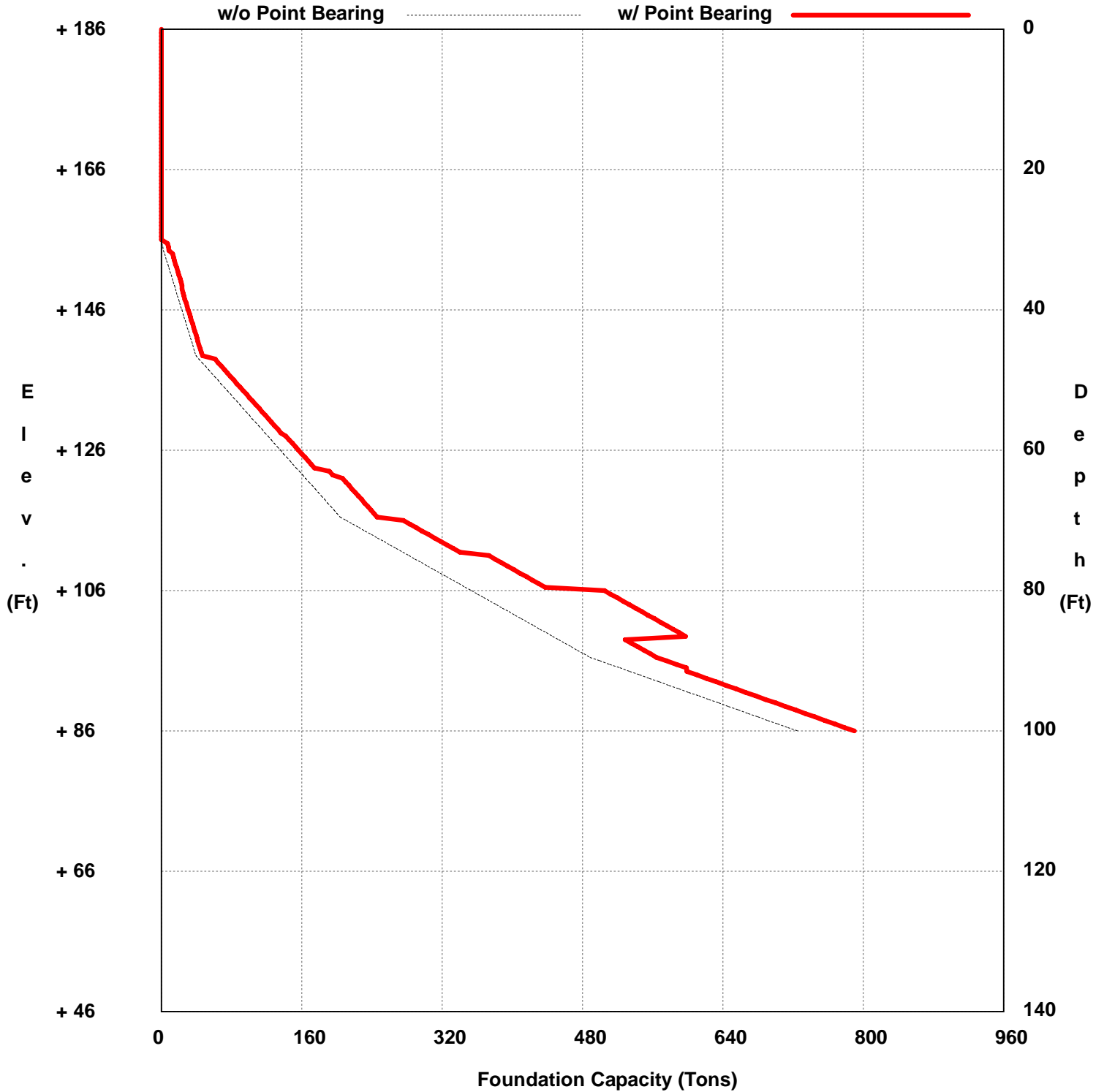
Hole B-4
Structure Bridge Bents
Station
Offset

District Bryan District
Date 8/8/2020
Grnd. Elev. 186.00 ft
GW Elev. 166.00 ft

36 inch Drilled Shaft
180 ton Design Load
Tip Elevation = + 123

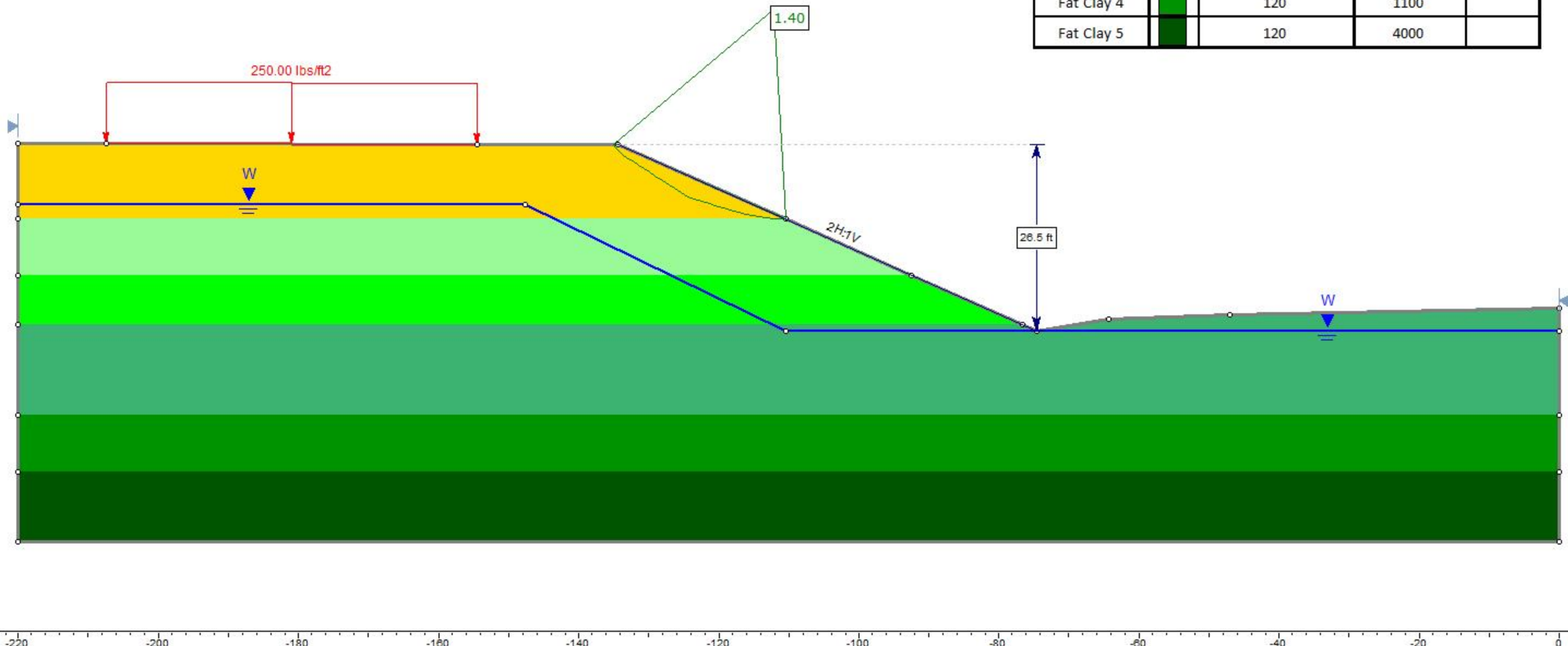
+186 Top Hole Elevation
+156 Disregard Elevation

Disregard above hard strata disabled
Pb: 2 Diameters Below Tip Checked
Average Capacity Values Used
0.7 Soil Reduction Factor Used



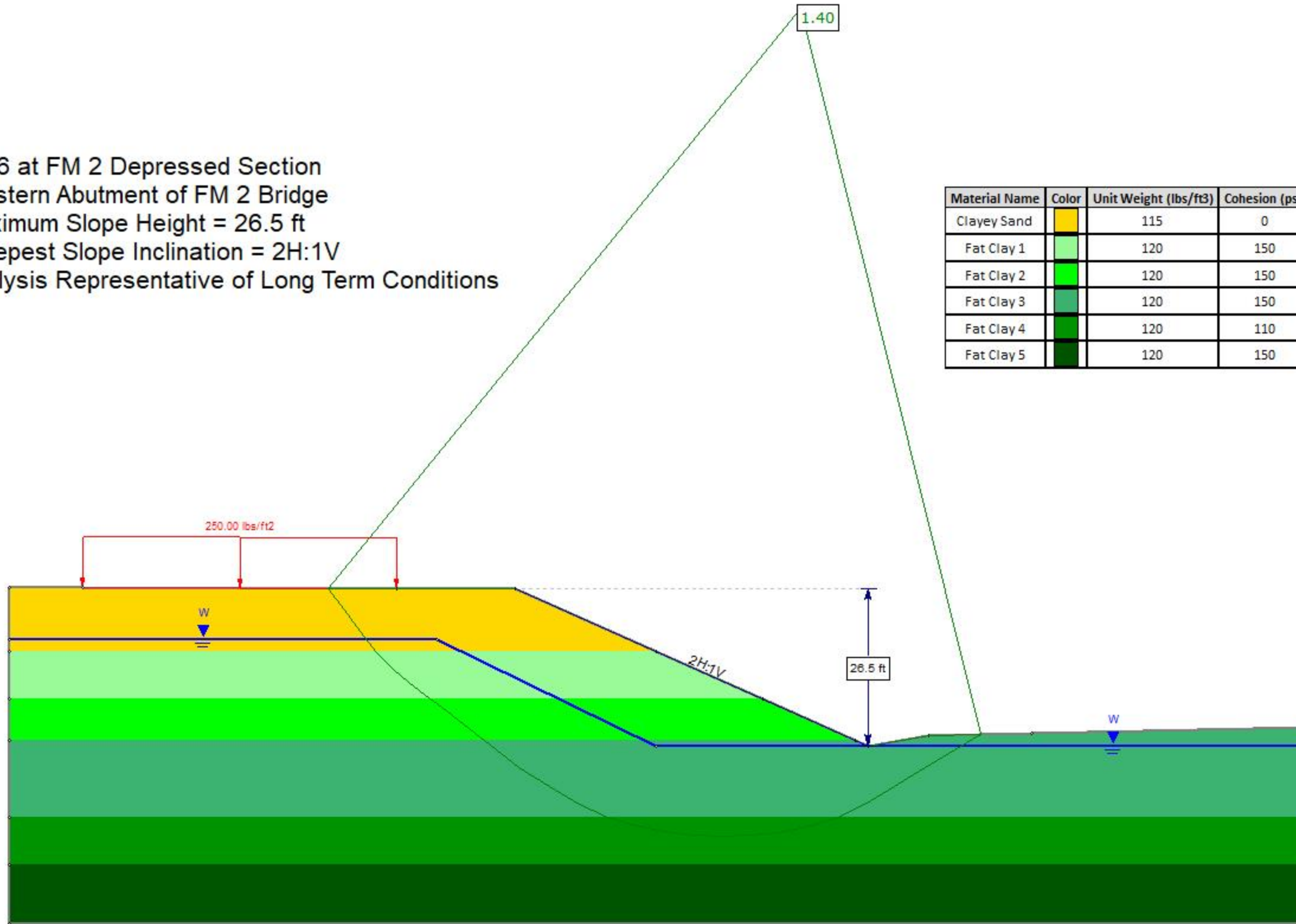
SH 6 at FM 2 Depressed Section
 Western Abutment of FM 2 Bridge
 Maximum Slope Height = 26.5 ft
 Steepest Slope Inclination = 2H:1V
 Analysis Representative of Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Clayey Sand	Yellow	115	0	30
Fat Clay 1	Light Green	120	2000	
Fat Clay 2	Bright Green	120	2400	
Fat Clay 3	Medium Green	120	3000	
Fat Clay 4	Dark Green	120	1100	
Fat Clay 5	Very Dark Green	120	4000	



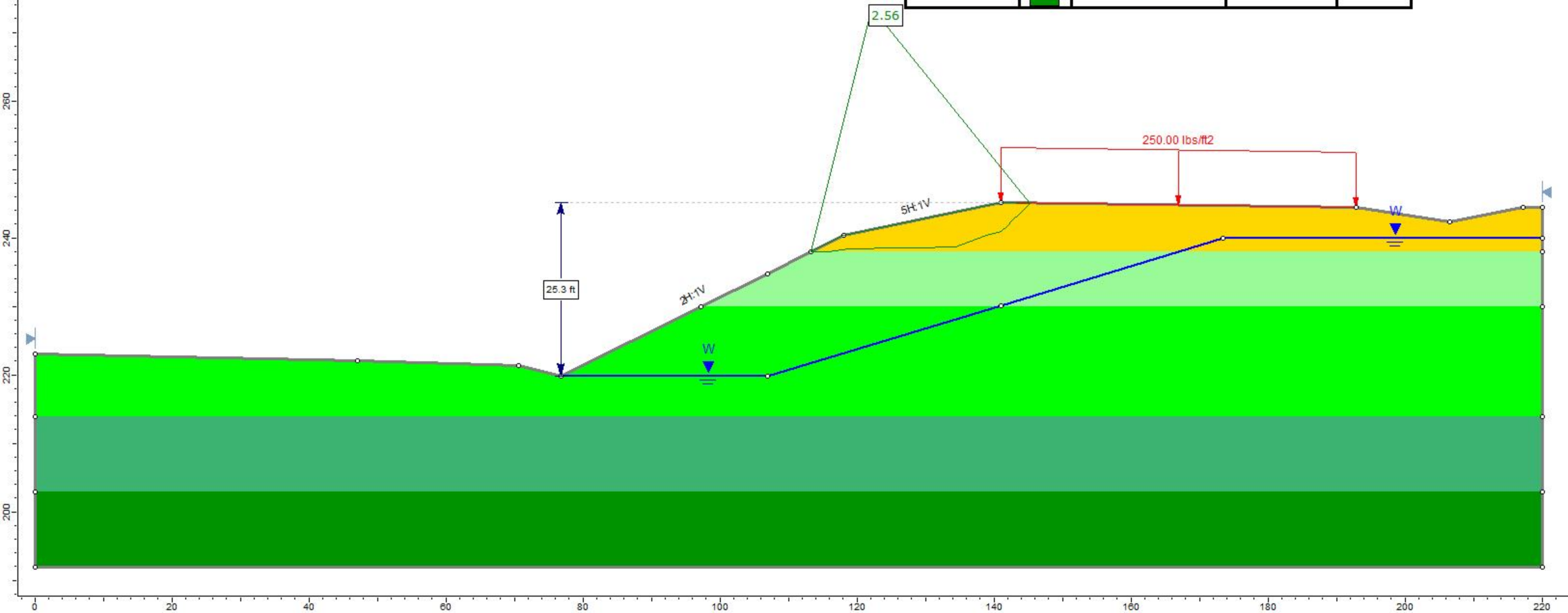
SH 6 at FM 2 Depressed Section
 Western Abutment of FM 2 Bridge
 Maximum Slope Height = 26.5 ft
 Steepest Slope Inclination = 2H:1V
 Analysis Representative of Long Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Clayey Sand	Yellow	115	0	30
Fat Clay 1	Light Green	120	150	21
Fat Clay 2	Bright Green	120	150	21
Fat Clay 3	Medium Green	120	150	21
Fat Clay 4	Dark Green	120	110	19
Fat Clay 5	Very Dark Green	120	150	23



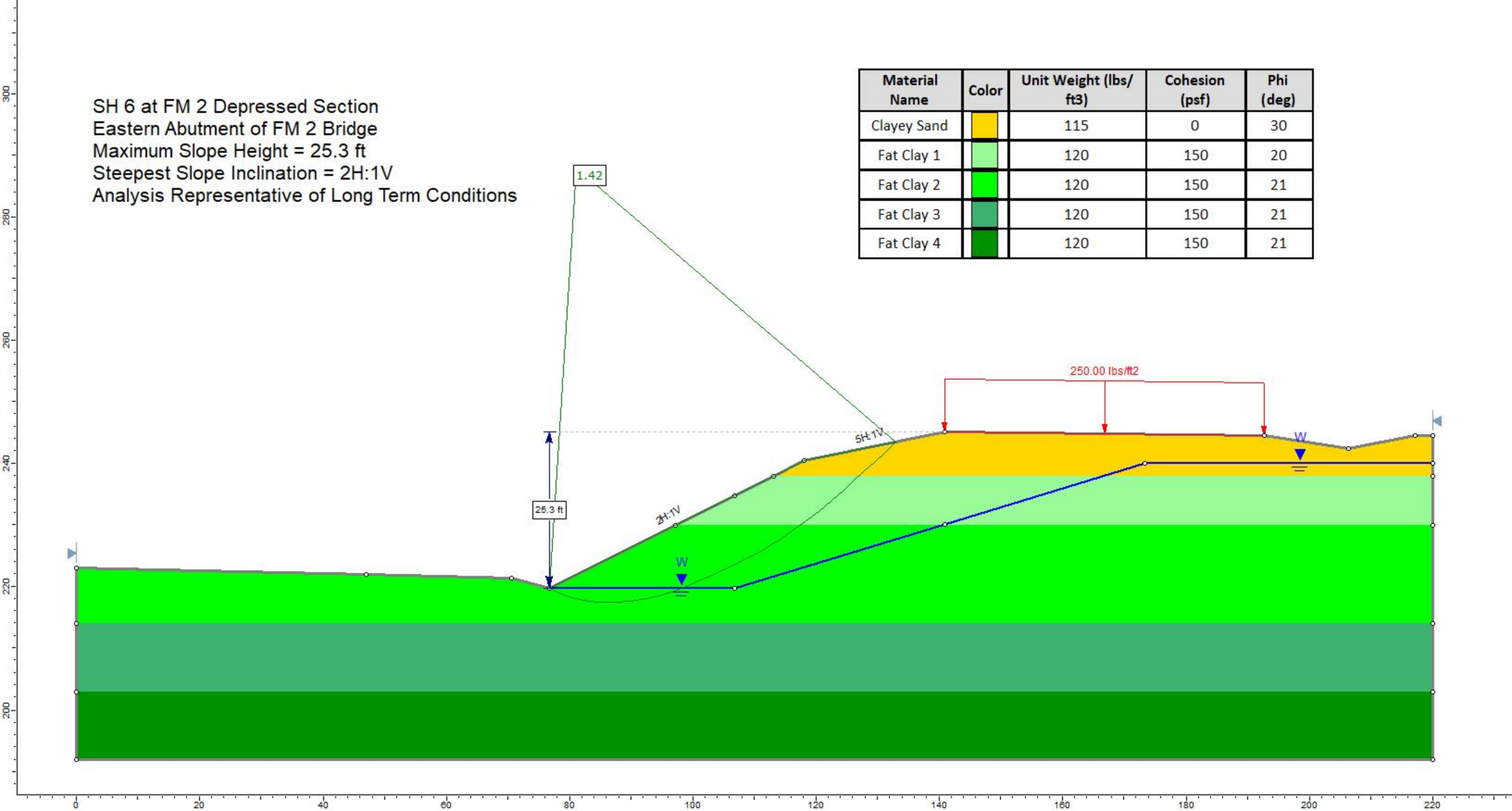
SH 6 at FM 2 Depressed Section
 Eastern Abutment of FM 2 Bridge
 Maximum Slope Height = 25.3 ft
 Steepest Slope Inclination = 2H:1V
 Analysis Representative of Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Clayey Sand	Yellow	115	0	30
Fat Clay 1	Light Green	120	1500	
Fat Clay 2	Bright Green	120	2000	
Fat Clay 3	Medium Green	120	2400	
Fat Clay 4	Dark Green	120	4000	



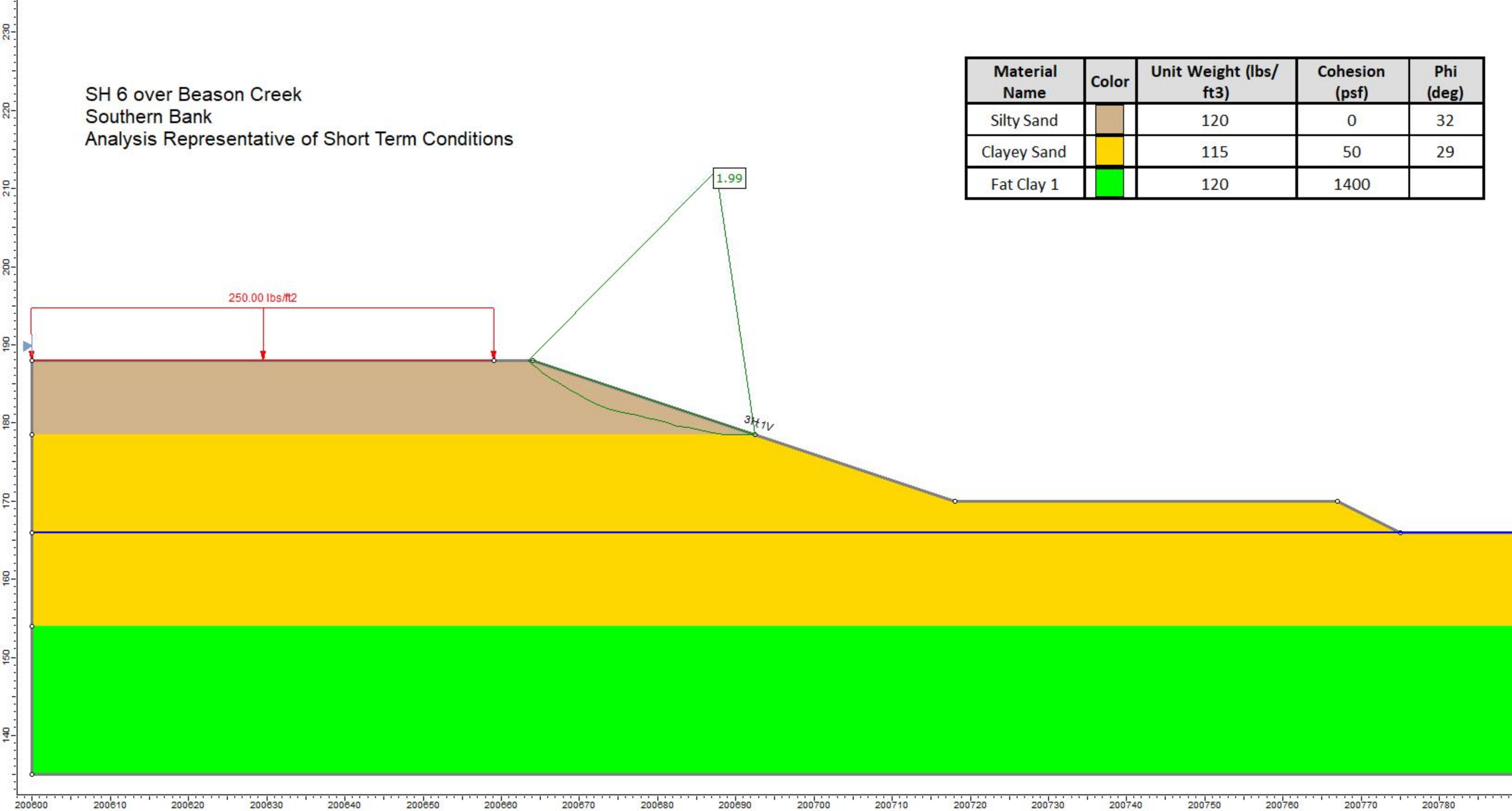
SH 6 at FM 2 Depressed Section
 Eastern Abutment of FM 2 Bridge
 Maximum Slope Height = 25.3 ft
 Steepest Slope Inclination = 2H:1V
 Analysis Representative of Long Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Clayey Sand	Yellow	115	0	30
Fat Clay 1	Light Green	120	150	20
Fat Clay 2	Bright Green	120	150	21
Fat Clay 3	Medium Green	120	150	21
Fat Clay 4	Dark Green	120	150	21






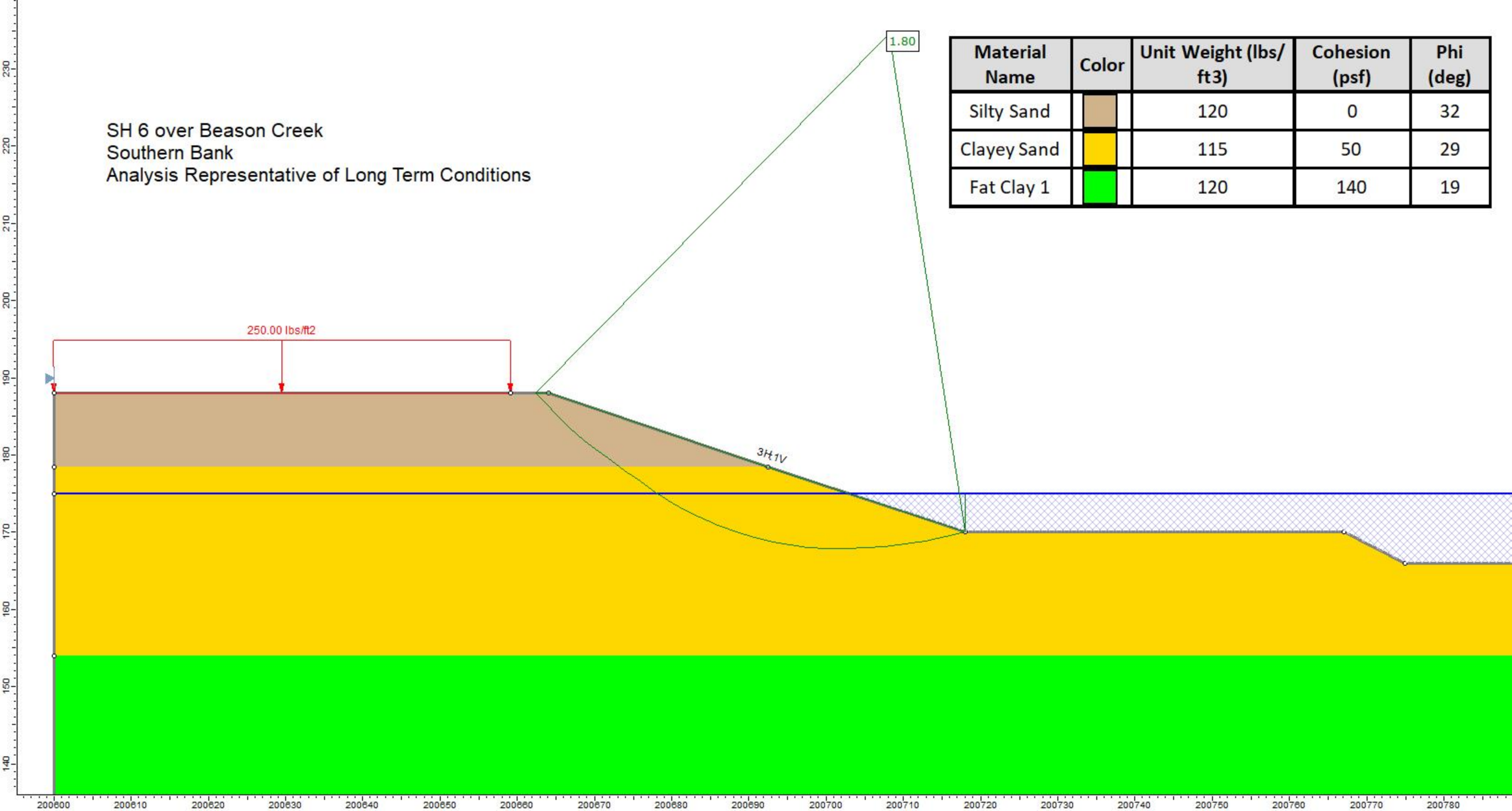
SH 6 over Beason Creek
 Southern Bank
 Analysis Representative of Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Silty Sand		120	0	32
Clayey Sand		115	50	29
Fat Clay 1		120	1400	






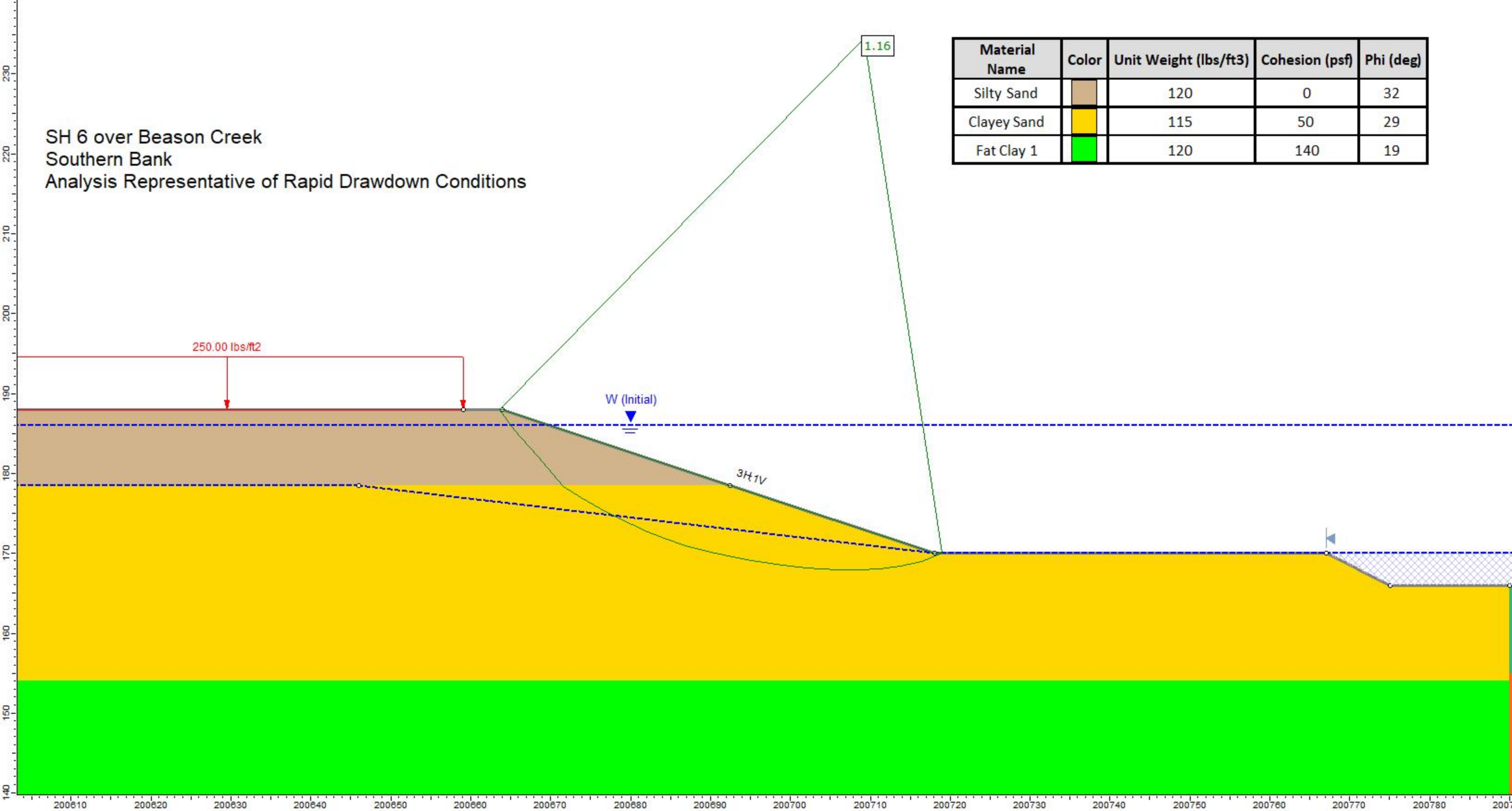
SH 6 over Beason Creek
 Southern Bank
 Analysis Representative of Long Term Conditions

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Silty Sand		120	0	32
Clayey Sand		115	50	29
Fat Clay 1		120	140	19



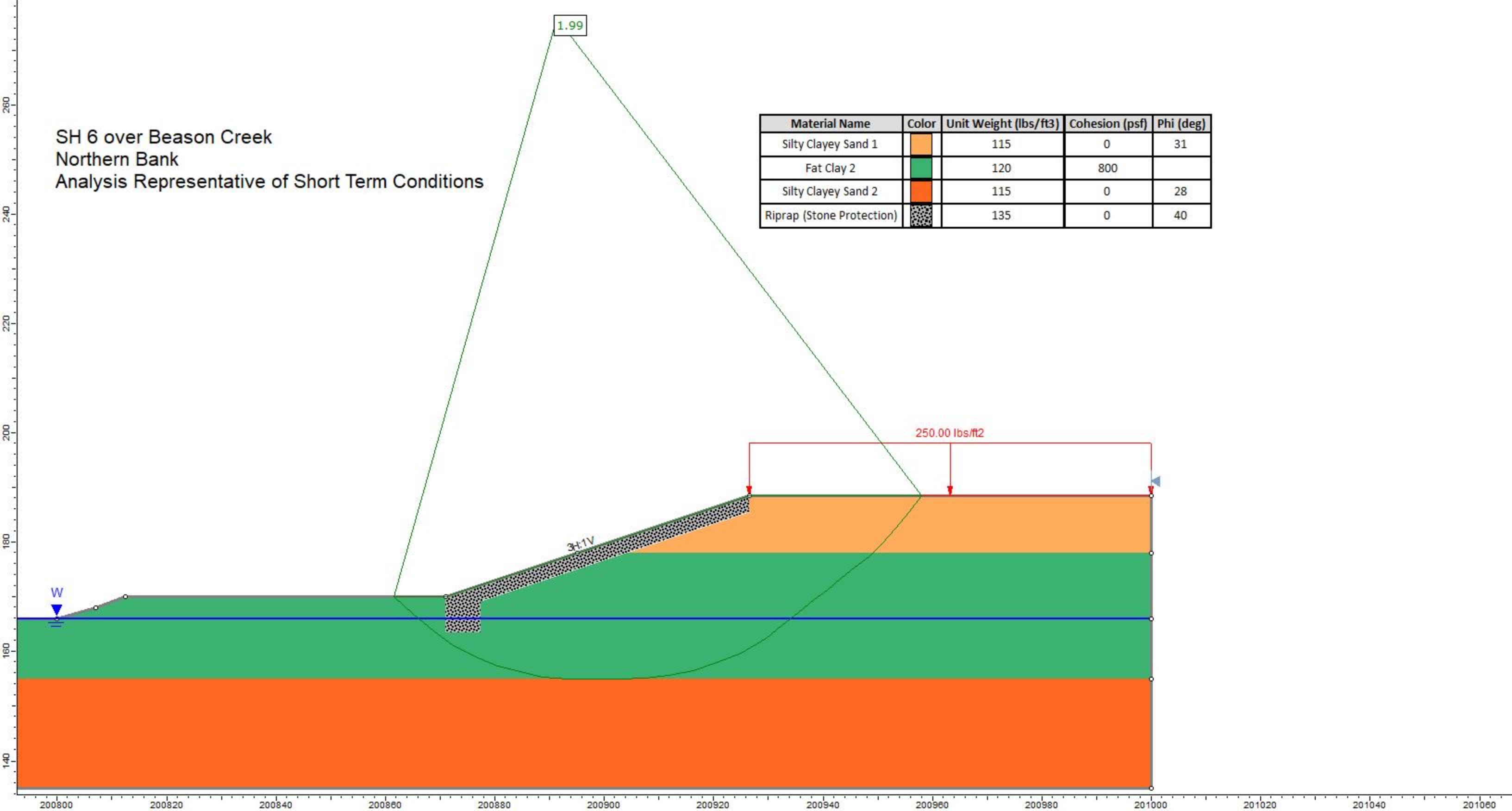
SH 6 over Beason Creek
 Southern Bank
 Analysis Representative of Rapid Drawdown Conditions

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Silty Sand		120	0	32
Clayey Sand		115	50	29
Fat Clay 1		120	140	19







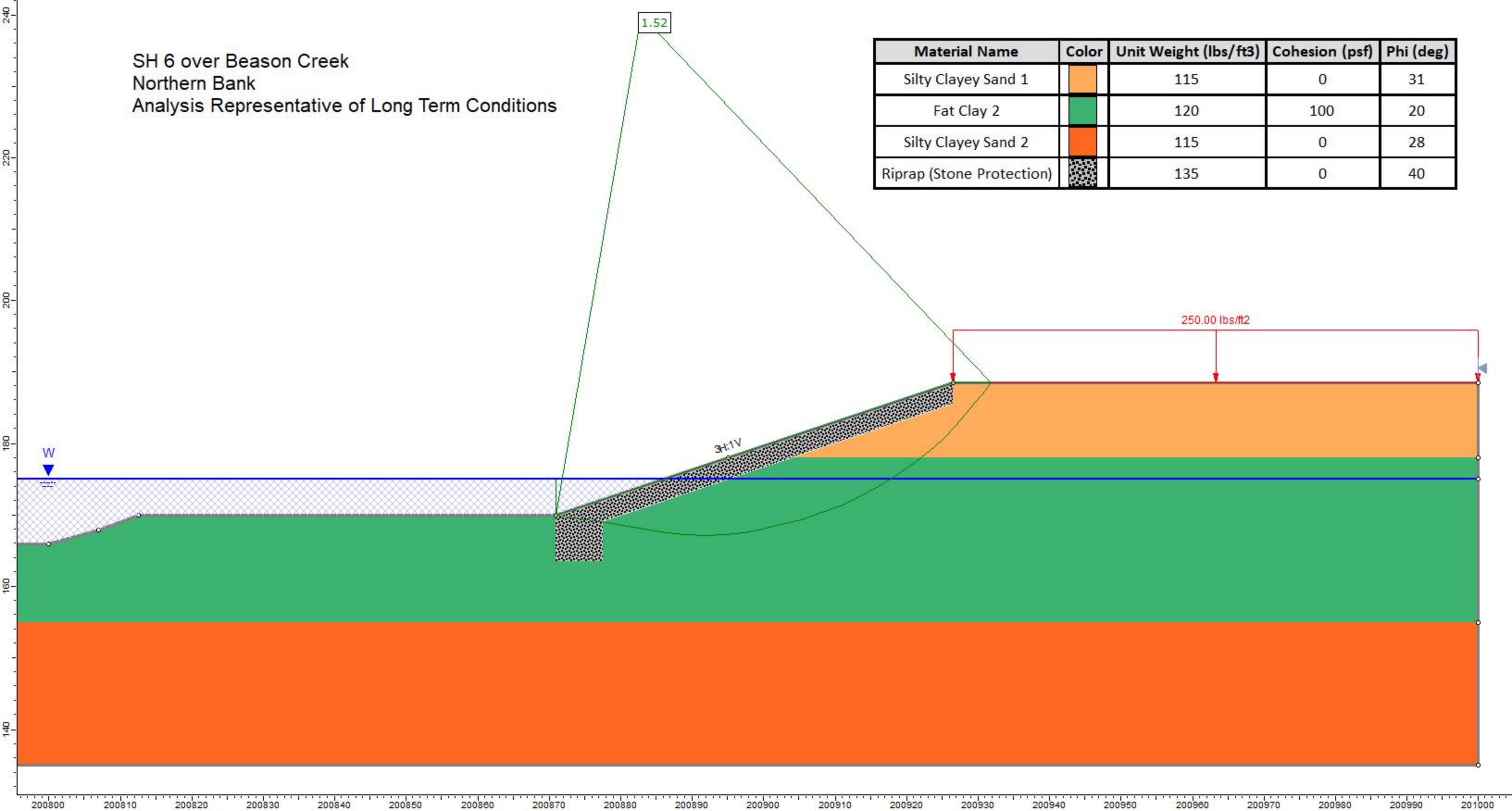
SH 6 over Beason Creek
 Northern Bank
 Analysis Representative of Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Silty Clayey Sand 1	Orange	115	0	31
Fat Clay 2	Green	120	800	
Silty Clayey Sand 2	Red-Orange	115	0	28
Riprap (Stone Protection)	Black Dotted	135	0	40







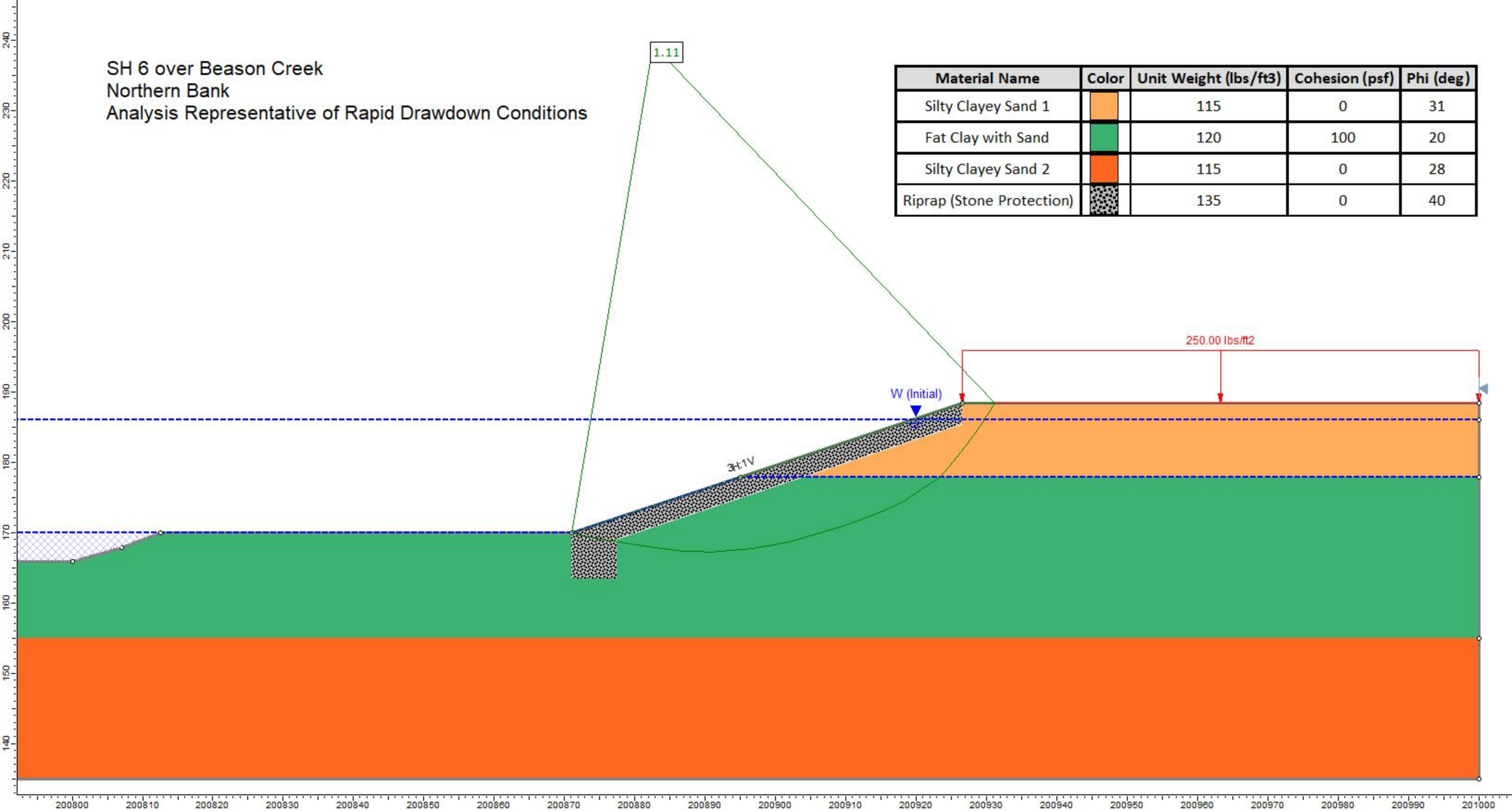
SH 6 over Beason Creek
 Northern Bank
 Analysis Representative of Long Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Silty Clayey Sand 1		115	0	31
Fat Clay 2		120	100	20
Silty Clayey Sand 2		115	0	28
Riprap (Stone Protection)		135	0	40

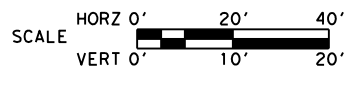
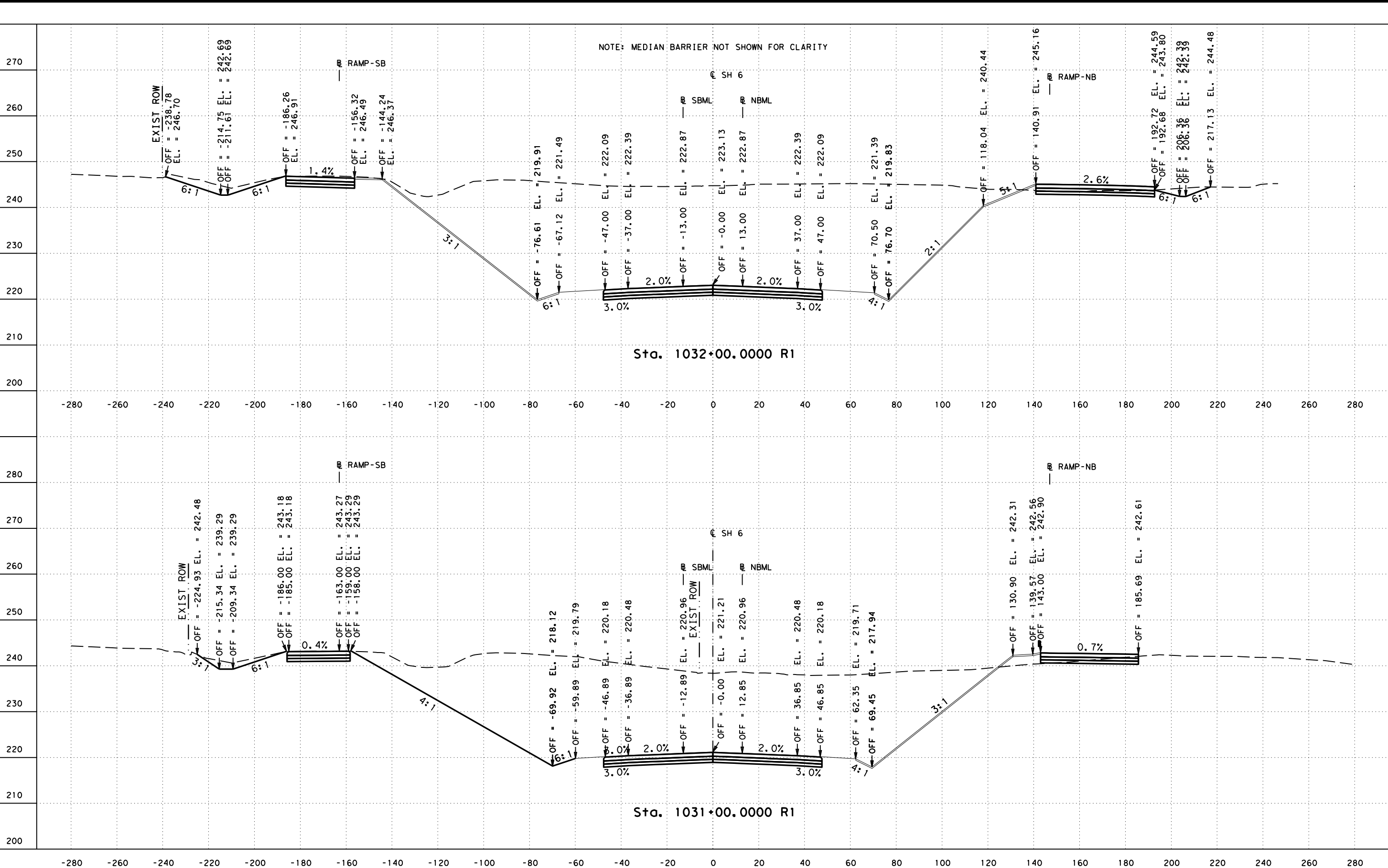


SH 6 over Beason Creek
 Northern Bank
 Analysis Representative of Rapid Drawdown Conditions

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Silty Clayey Sand 1		115	0	31
Fat Clay with Sand		120	100	20
Silty Clayey Sand 2		115	0	28
Riprap (Stone Protection)		135	0	40



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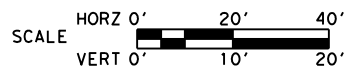
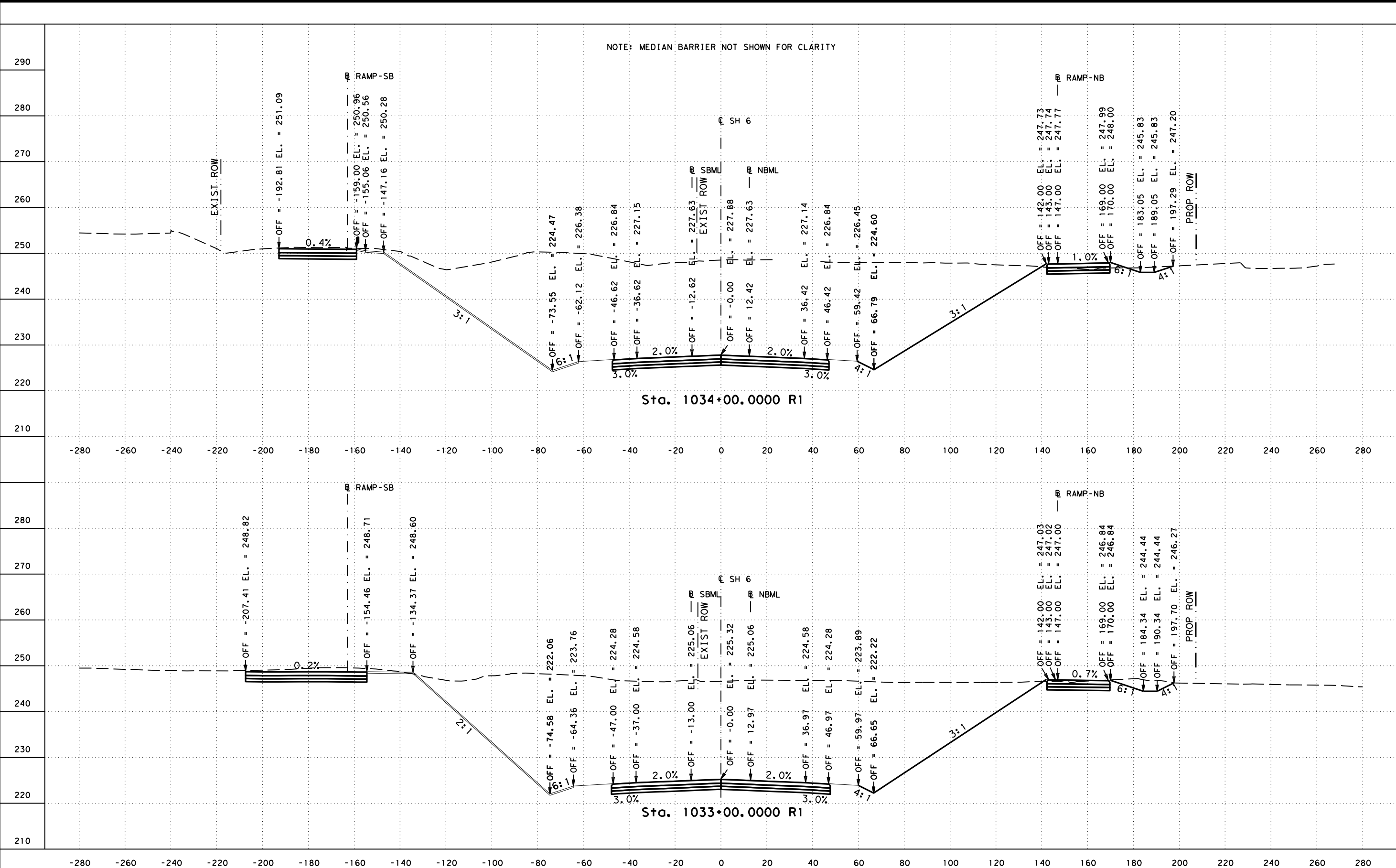


SH 6
 CROSS SECTIONS
 STA 1031+00.0000 R1 STA 1032+00.0000 R1

FED. RD. DIV. NO. 6	FEDERAL AID PROJECT NO.		HIGHWAY NO. SH 6
STATE TEXAS	DISTRICT BRY	COUNTY GRIMES	SHEET NO. 17
CONTROL 0050	SECTION 03	JOB 096	

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 DRAWING DATE: 2/12/2021

NOTE: MEDIAN BARRIER NOT SHOWN FOR CLARITY

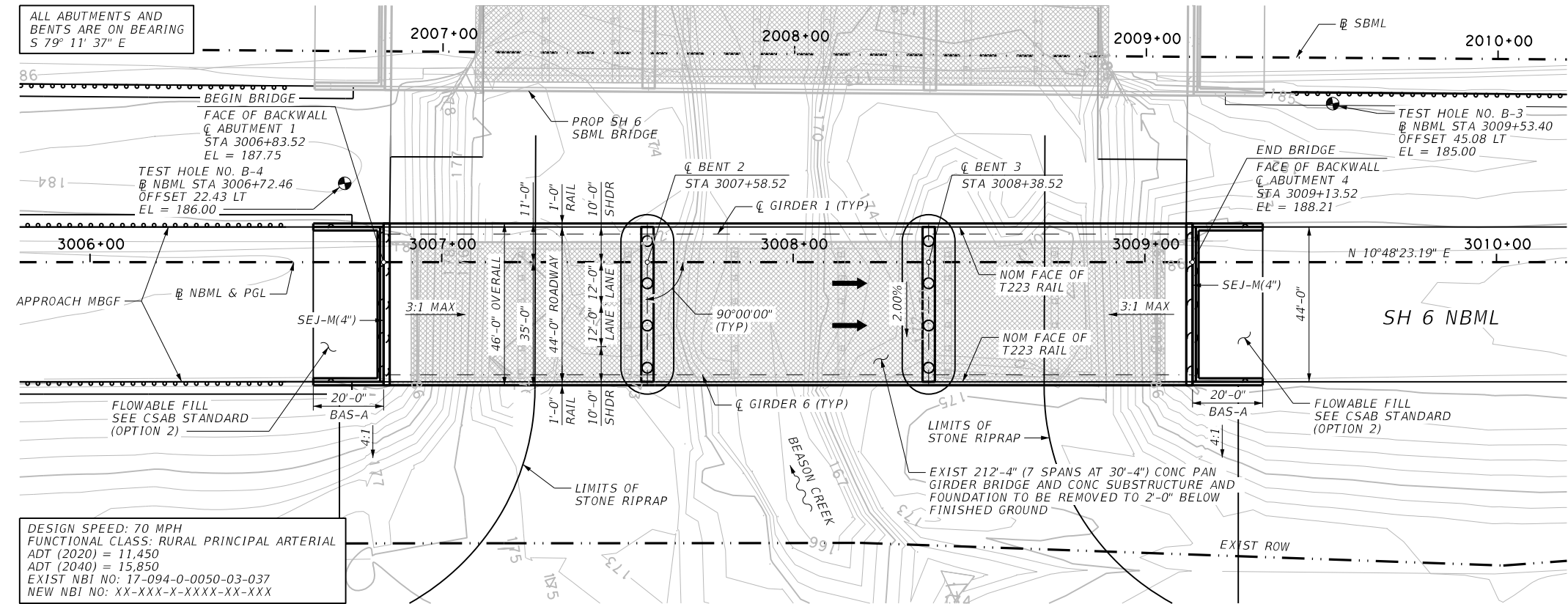


SH 6
 CROSS SECTIONS
 STA 1033-00.0000 R1 STA 1034-00.0000 R1

FED. RD. DIV. NO.	FEDERAL AID PROJECT NO.		HIGHWAY NO.
6			SH 6
STATE	DISTRICT	COUNTY	SHEET NO.
TEXAS	BRY	GRIMES	18
CONTROL	SECTION	JOB	
0050	03	096	



ALL ABUTMENTS AND BENTS ARE ON BEARING S 79° 11' 37" E



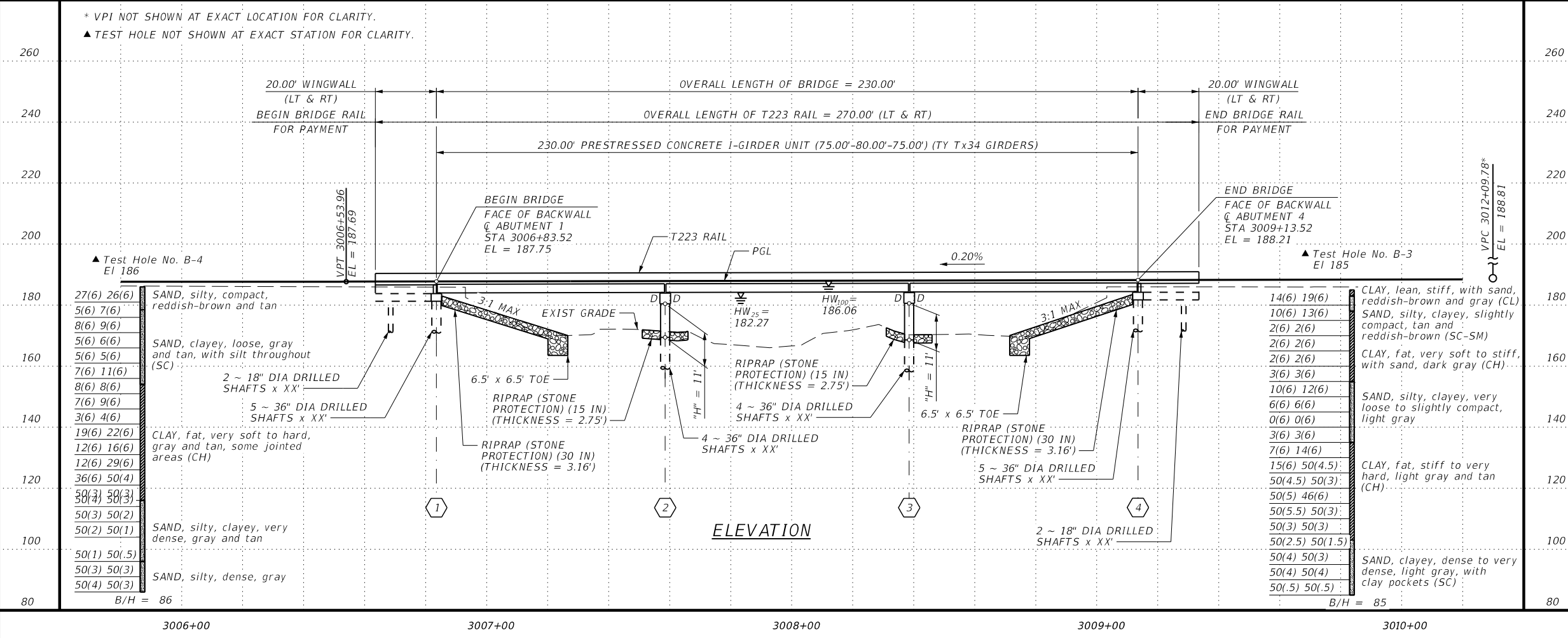
DESIGN SPEED: 70 MPH
 FUNCTIONAL CLASS: RURAL PRINCIPAL ARTERIAL
 ADT (2020) = 11,450
 ADT (2040) = 15,850
 EXIST NBI NO: 17-094-0-0050-03-037
 NEW NBI NO: XX-XXX-X-XXXX-XX-XXX

- GENERAL NOTES:**
- DESIGNED IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION (2017).
 - ALL DIMENSIONS ARE EITHER HORIZONTAL OR VERTICAL AND MUST BE CORRECTED FOR GRADE AND SUPERELEVATION.
 - "H" VALUES SHOWN ARE ESTIMATED COLUMN HEIGHTS. CONTRACTOR IS RESPONSIBLE FOR CALCULATING ACTUAL COLUMN HEIGHTS BASED ON FIELD CONDITIONS.
 - CONTRACTOR SHALL VERIFY LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.
 - SEE "BORING LOGS" SHEETS FOR BORING LOG INFORMATION.
 - FOR ADDITIONAL GEOTECHNICAL INFORMATION, REFERENCE GEOTECHNICAL ENGINEERING REPORT NO. XXXX PREPARED BY XXXXX.
 - "D" DENOTES BENTS WITH DOWELED END CONDITION. SEE BENT DETAILS FOR LOCATIONS OF DOWELS D.
 - SEE "TYPICAL SECTION" SHEET FOR BRIDGE TYPICAL SECTION.
 - USE CASING AS NECESSARY FOR DRILLED SHAFT CONSTRUCTION IF WATER IS ENCOUNTERED AT SHAFT LOCATION.

PLAN

HL93 LOADING

* VPI NOT SHOWN AT EXACT LOCATION FOR CLARITY.
 ▲ TEST HOLE NOT SHOWN AT EXACT STATION FOR CLARITY.



ELEVATION

DESIGN INTERIM REVIEW
 DOCUMENT INCOMPLETE. NOT INTENDED FOR PERMIT, BIDDING OR CONSTRUCTION.
 ENGINEER: RYAN J. WILLIAMS
 P.E. SERIAL NO: 110418
 DATE: 11/19/2020

60% PLANS

AGUIRRE & FIELDS
 ENGINEERING INNOVATORS
 TBPE FIRM REGISTRATION #739

Texas Department of Transportation

SH 6 AT FM 2
 SH 6 NBML BEASON CREEK BRIDGE

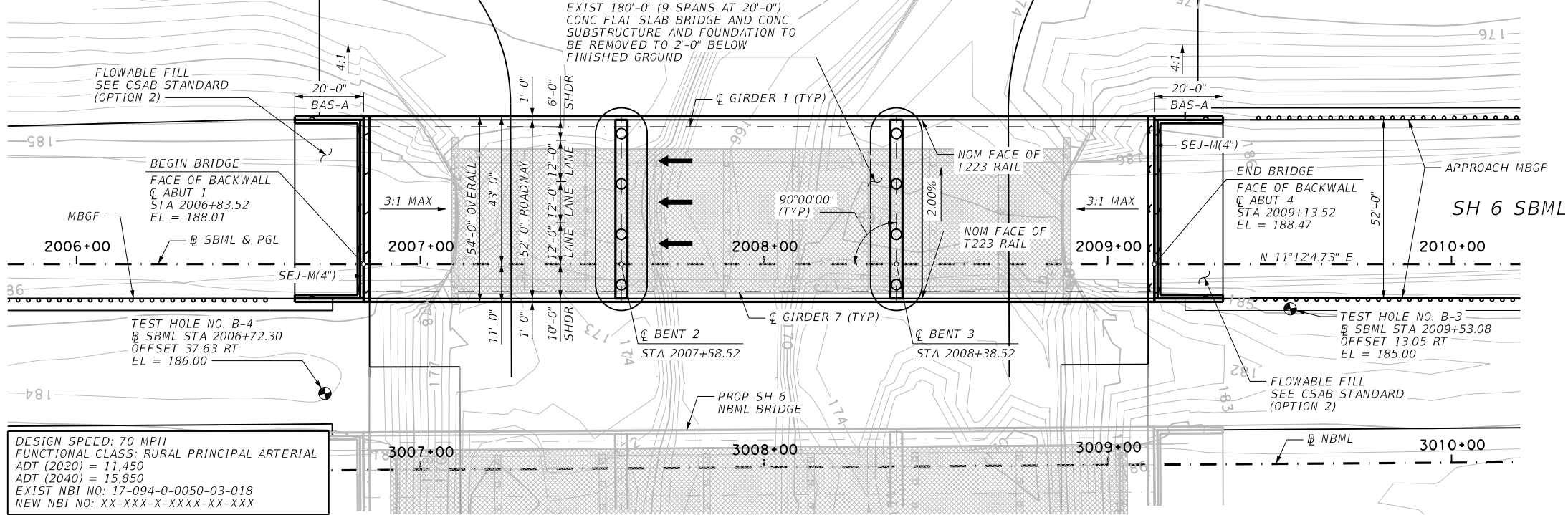
BRIDGE LAYOUT

SHEET 1 OF 1

FED. RD. DIV. NO.	FEDERAL AID PROJECT NO.	HIGHWAY NO.	SHEET NO.
6		SH 6	
STATE	DIST.	COUNTY	
TEXAS	BRY	GRIMES	
CONT.	SECT.	JOB	263
0050	03	096	

FILENAME: \$DGN\$SPEC\$
 PLOTTED: 11/19/2020 \$SYTIME\$

ALL ABUTMENTS AND BENTS ARE ON BEARING N 78° 47' 55" W



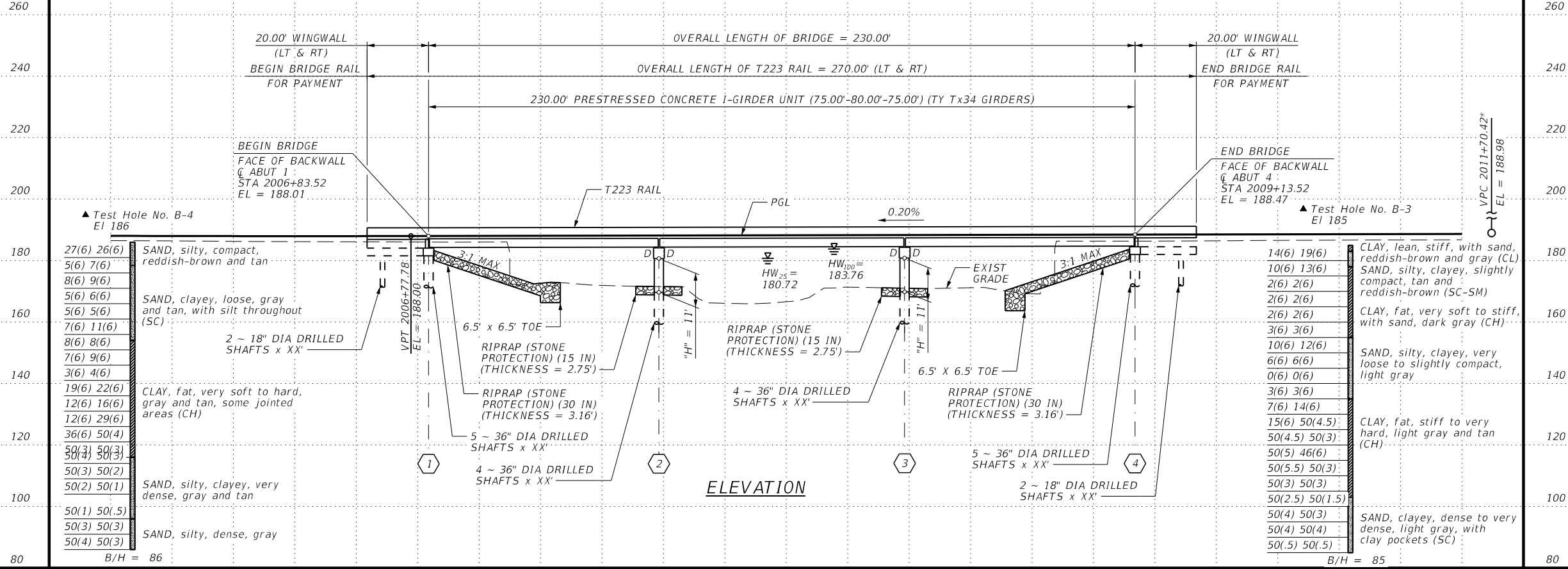
DESIGN SPEED: 70 MPH
 FUNCTIONAL CLASS: RURAL PRINCIPAL ARTERIAL
 ADT (2020) = 11,450
 ADT (2040) = 15,850
 EXIST NBI NO: 17-094-0-0050-03-018
 NEW NBI NO: XX-XXX-X-XXXX-XX-XXX

- GENERAL NOTES:**
- DESIGNED IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION (2017).
 - ALL DIMENSIONS ARE EITHER HORIZONTAL OR VERTICAL AND MUST BE CORRECTED FOR GRADE AND SUPERELEVATION.
 - "H" VALUES SHOWN ARE ESTIMATED COLUMN HEIGHTS. CONTRACTOR IS RESPONSIBLE FOR CALCULATING ACTUAL COLUMN HEIGHTS BASED ON FIELD CONDITIONS.
 - CONTRACTOR SHALL VERIFY LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.
 - SEE "BORING LOGS" SHEETS FOR BORING LOG INFORMATION.
 - FOR ADDITIONAL GEOTECHNICAL INFORMATION, REFERENCE GEOTECHNICAL ENGINEERING REPORT NO. XXXX PREPARED BY XXXXX.
 - "D" DENOTES BENTS WITH DOWELED END CONDITION. SEE BENT DETAILS FOR LOCATIONS OF DOWELS D.
 - SEE "TYPICAL SECTION" SHEET FOR BRIDGE TYPICAL SECTION.
 - USE CASING AS NECESSARY FOR DRILLED SHAFT CONSTRUCTION IF WATER IS ENCOUNTERED AT SHAFT LOCATION.

PLAN

HL93 LOADING

* VPI NOT SHOWN AT EXACT LOCATION FOR CLARITY.
 ▲ TEST HOLE NOT SHOWN AT EXACT STATION FOR CLARITY.



ELEVATION

DESIGN INTERIM REVIEW
 DOCUMENT INCOMPLETE. NOT INTENDED FOR PERMIT, BIDDING OR CONSTRUCTION.
 ENGINEER: RYAN J. WILLIAMS
 P.E. SERIAL NO: 110418
 DATE: 11/19/2020

60% PLANS

AGUIRRE & FIELDS
 ENGINEERING INNOVATORS
 TBPE FIRM REGISTRATION #739

Texas Department of Transportation

SH 6 AT FM 2
 SH 6 SBML BEASON CREEK BRIDGE

BRIDGE LAYOUT

SHEET 1 OF 1

FED. RD. DIV. NO.	FEDERAL AID PROJECT NO.	HIGHWAY NO.	SHEET NO.
6		SH 6	266
STATE	DIST.	COUNTY	
TEXAS	BRY	GRIMES	
CONT.	SECT.	JOB	
0050	03	096	

FILENAME: \$DGN\$SPEC\$ PLOTTED: 11/19/2020 \$SYTIME\$