DRAFT FOUNDATION REPORT

Pole Line Road/Olive Drive Connection

Davis, California
CAInc File No. 18-438.1

Prepared by:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
Sacramento | Modesto | Pleasanton | Rocklin | Ukiah

Crawford & Associates, Inc.

1100 Corporate Way, Suite 230

Sacramento, CA 95831

February 14, 2020

Prepared for:

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Wood Rodgers, Inc.

701 University Ave, Ste 200

Sacramento, CA 95825

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
Sacramento | Modesto | Pleasanton | Rocklin | Ukiah

Corporate Office: 1100 Corporate Drive, Suite 230 | Sacramento, CA 95831 | (916) 455-4225
Modesto: 1165 Scenic Drive, Suite B | Modesto, CA 95350 | (209) 312-7668
Pleasanton: 6200 Stoneridge Mall Road, Suite 330 | Pleasanton, CA 94588 | (925) 401-3515
Rocklin: 4220 Rocklin Road, Suite 1 | Rocklin, CA 95677 | (916) 455-4225
Ukiah: 100 North Pine Street | Ukiah, CA 95482 | (707) 240-4400

February 14, 2020
CAInc File No. 18-438.1

Mr. Dennis Pecchia
Wood Rodgers, Inc.
3301 C Street, Bldg. 100-B
Sacramento, CA 95816

Subject: **DRAFT FOUNDATION REPORT**
Pole Line Road/Olive Drive Connection
Davis, California

Dear Mr. Pecchia,

Crawford & Associates, Inc. (CAInc) prepared this DRAFT Foundation Report for the Pole Line Road/Olive Drive Bike and Pedestrian Connection Project located in Davis, California. CAInc prepared this report in accordance with our August 7, 2017 scope of services and agreement. We will issue a Final Foundation Report once we review the Caltrans and your comments on this draft report.

Thank you for the opportunity to be part of your design team. Please call if you have questions or require additional information.

Sincerely,

Crawford & Associates, Inc.,

Hailey Wagenman
Project Engineer

Benjamin D. Crawford, PE, GE
Principal Geotechnical Engineer

Taber
Since 1954

TABLE OF CONTENTS

LIST OF FIGURES:

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX E

APPENDIX F

1 INTRODUCTION

1.1 PURPOSE

Crawford & Associates, Inc. (CAInc) prepared this **DRAFT** Foundation Report for the Pole Line Road/Olive Drive Bike and Pedestrian Connection Project in Davis, California. This report presents the results of our subsurface exploration and testing, engineering analysis, conclusions and recommendations for use in design for new bridge foundations and associated grading. CAInc will prepare a Final Foundation Report after receiving comments on this draft report.

1.2 SCOPE OF SERVICES

To prepare this report, CAInc:

- Discussed the project with Dennis Pecchia and Gerard Murdock from Wood Rogers, Inc. (WR),
- Reviewed the "General Plan No. 1" and "Column & Footing Details" As-Built plan sheets for the Pole Line Road Overcrossing project prepared by Greiner, Inc., dated January 26, 1995,
- Reviewed "Log of Test Borings No. 1, No. 2 and No. 3" As-Built plan sheets for the Pole Line Road Overcrossing project prepared by Taber Consultants, dated January 26, 1995 and,
- Reviewed the Olive Drive Bike Path/ Poleline Rd OC Ramp Connection General Plan prepared by WR, dated January 2020,
- Reviewed available published geologic and seismic mapping of the site,
- Performed subsurface exploration between May 3-4, 2018,
- Performed laboratory testing on soil samples obtained during our subsurface exploration, and
- Performed geotechnical engineering evaluation and analysis.

Limitations of this study are discussed in the final section of this report.

1.3 PROJECT DATUM

All elevations referenced within this report are based on the topographic survey completed by Radman Aerial Surveys, dated June 2017.

1.4 SITE DESCRIPTION

The project is located along the Olive Drive Trail located at the east end of Olive Drive in Davis, California. The proposed structure will follow the same general alignment as Olive Drive Trail and will connect to the Pole Line Road Overcrossing. Olive Drive Trail is an existing paved bike path that crosses under the Pole Line Road Overcrossing. Westbound I-80 is located directly south of the project site, and Union Pacific Railroad train tracks and 2nd street are located directly north of the project site. Site coordinates are approximately latitude 38.54593°N and longitude 121.72686°W. The site location is shown on Figure 1.

The site is within gently-rolling topography at about elevation 40 feet. Currently nearby land use is primarily commercial and residential. The bike path is primarily used for pedestrians and bikes.

1.5 PROJECT DESCRIPTION

Based on the most recent General Plan provided by WR, dated January 2020, the project will consist of a new ramp bridge structure that is about 542 ft long and 14 ft wide. The new ramp structure will require an approach embankment about 1133 ft in long near the connection point to the Olive Drive Trail. The bridge and embankment will slope down from the Pole Line Overcrossing towards Olive Drive Trail at a slope of 8%. Abutment 1 is currently planned to be supported by ten 24-inch CIDH piles, and Bents 2 through 5 are currently planned to be supported by a single, 72-inch diameter CIDH pile at each bent location.

2 AS-BUILT FOUNDATION DATA FOR POLE LINE ROAD OVERCROSSING

The Pole Line Road Overcrossing (Bridge No. 22-0193) was originally constructed in 1996 and is a seven-span-bridge that is 810±ft long. The bridge is 87±ft wide for spans 1 and 2, and 78±ft for spans 3 through 7. The existing bridge deck is depicted at elev. 53.34±ft at Begin Bridge ("BB", Station line "A" 15+33.93) and at elev. 66.30±ft at the End Bridge ("EB", Station line "A" 21+44.00).

The substructure of the bridge includes abutments with wingwalls, and six reinforced concrete column-bents. All supports are skewed 12±degrees from the normal line to the centerline of the bridge. Bent 5 support is the closest existing bridge support to our project area. The "General Plan No. 1" and "Column & Footing Details" As-Built plan sheets show the below information in Table 1 for Bent 5 support.

Table 1: As-Built Elevation Data

Bridge Supports	Pile Type	Specified/Probable Pile Tip Elevation (ft)
Bent 5	Class 70 Concrete Piles	-25.0/-30.0

The As-Built plan sheets do not specify whether the pile types are drilled (i.e. CIDH) or driven (i.e. precast, prestressed concrete). However, the "Column & Footing Details" As-Built plan sheet shows a pile was broken during driving on Bent 3, therefore the piles were most likely precast, prestressed concrete piles.

We show select As-Built plan sheets in Appendix A.

3 GEOLOGIC SETTING

The project is located within the Great Valley geomorphic province of California, at the very southwestern edge of the Sacramento Valley. Published geologic mapping[1] indicates the immediate project vicinity is underlain by Holocene age fan levee deposits (described as natural levees deposited as long, low ridges oriented down-fan, containing coarser material than the adjoining interlevee areas). The fan levee deposits are surrounded by Holocene age alluvial fan deposits that are described as alluvial fan sediment deposited by streams emanating from mountains a debris flows, hyper-concentrated mudflows, or braided steam flows. Sediments for levee deposits and alluvial fan deposits

[1] Gutierrez, C.I., 2011, Preliminary Geologic Map of the Sacramento 30' x 60' Quadrangle, California: California Geological Survey, 1:100,000 scale.

include sand, gravel, silt and clay that are moderately to poorly sorted, and moderately to poorly bedded. We show a Geologic Map as Figure 3.

4 SUBSURFACE EXPLORATION

4.1 FIELD EXPLORATION

CAInc retained Geo-Ex Subsurface Exploration (Geo-Ex) to drill and sample a total of two test borings on May 3-4, 2018. Boring depths ranged from 81.5 to 85.5 feet below ground surface (bgs).

Geo-Ex used a CME 55 truck-mounted drill rig to complete the borings with 4-inch solid-stem auger drilling equipment and 4-inch rotary wash techniques. Soil samples were recovered by means of a 2.0-inch O.D. “Standard Penetration” (SPT) split-spoon sampler with liners and a 3.0-inch O.D. “Standard California” spilt-spoon sampler with liners. Both samplers were advanced with standard 350 ft-lb striking force using an auto-hammer. An energy hammer analysis was not performed specific to this project/site, however Geo-Ex reports an efficiency of 77.3%. The field recorded (uncorrected) blow counts are shown on the “Log of Test Borings” (LOTB), provided in Appendix A.

CAInc’s Project Engineers, Hailey Wagenman and Gabriela Lopez, logged the test borings consistent with the Unified Soil Classification System (USCS) and the Caltrans 2010 Logging Manual. Consistency of cohesive soils were obtained in the field by means of pocket penetrometer. Selected portions of recovered soil drive samples were retained in sealed containers for laboratory testing and reference. Bulk soil samples were retained in sealed bags for laboratory testing and reference. Groundwater observations were recorded during drilling operations when encountered. At completion, test borings were backfilled with lean cement grout per the county boring permit requirements.

Taber Consultants (acquired by CAInc in 2016) completed borings B-1, B-2, B-4, B-5 and B-7 in 1990, and B-1(93) and B-2(93) in 1993 for the Pole Line Road Overcrossing Bridge Project. They also completed CPT locations B-3, B-6 and B-8 in 1990. Taber’s boring B-5 was located near proposed Bent 5 support location.

The boring locations were measured in the field with respect to existing site features and then referenced to project stationing. The boring elevations are referenced to project datum provided by Wood Rodgers, Inc. The details and locations of test borings are shown on the “Log of Test Borings” (LOTB) drawing, provided in Appendix A.

4.2 SUBSURFACE CONDITIONS

The soils encountered CAInc R-18-001 and R-18-002 are generally soft to hard lean clay to sandy lean clay with localized layers of medium dense clayey sand. The soils encountered in Taber B-5 are generally soft to stiff lean clay, silt, clayey silt to silty clay with interbedded layers of dense silty-sand and sandy silts. We interpret the encountered materials as consistent with Holocene age fan levee deposits identified in the geologic mapping.

Taber’s LOTBs are attached as Appendix A.

4.3 GROUNDWATER

During the Taber field exploration, Taber Borings B-1(1990), B-2(1990), B-4(1990), B-1(1993) and B-2 (1993) encountered groundwater at elevations varying from 1 to 10 ft. We encountered groundwater during our fieldwork at elevations ranging from 16-20 ft. We present the encountered groundwater depths in in Table 2 below.

Table 2: Groundwater Data

Well Location/ Boring ID	Date	Groundwater Surface in Feet (Elevation)
CAInc R-18-001	5/3/18	16.9
CAInc R-18-002	5/4/18	20.9
Taber B1	1/4/90	9.7
Taber B2	1/5/90	6.8
Taber B4	1/19/90	5.3
Taber B-1 (93)	9/21/93	1.6
Taber B-2 (93)	9/22/93	1.8

Groundwater depth was not shown for Taber Boring B-5 on the Taber LOTBs.

5 LABORATORY TESTING

CAInc completed the following laboratory tests on representative soil samples from the borings:

- Moisture Content/Unit Weight (ASTM D2216/2937)
- No. 200 Sieve (ASTM D1140)
- Atterberg Limits (ASTM D4318)
- Unconfined Compression (ASTM D2166)
- Consolidation (ASTM D2435)
- Sulfate/Chloride Content (CTM 417/422)
- pH/Minimum Resistivity (CTM 643)

CAInc laboratory test results are provided in Appendix B. Laboratory testing performed by Taber Consultants is shown on the "Log of Test Borings No. 1, No.2 and No.3" As-Built plan sheets, provided in Appendix A.

6 SCOUR CONSIDERATIONS

There are no scour considerations for the Pole Line Road/Olive Drive Bike and Pedestrian Connection Bridge due to the lack of surface water.

7 CORROSION EVALUATION

Based on the test results summarized below in Table 3 and current Caltrans guidelines, the site is considered non-corrosive to structural concrete/steel foundation elements. The test results are only an indicator of soil corrosivity. Section 12 of Caltrans' March 2018 Corrosion Guidelines (Version 3.0) provides information regarding corrosion mitigation measures for structural elements and lists additional Caltrans guideline documents regarding corrosion mitigation.

Table 3: Soil Corrosivity Test Results

Boring / Sample No.	Depth (ft)	Elevation (ft)	pH	Minimum Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
R-18-001-9A	41.5	-1.5	7.62	1,142	1.7	32.9
R-18-002-5A	21.5	18.8	7.69	1,100	0.4	7.9

Caltrans currently defines a corrosive environment as an area where the soil has either a chloride concentration of 500 ppm or greater, a sulfate concentration of 1500 ppm or greater, or has a pH of 5.5 or less.

8 SEISMIC DATA AND EVALUATION

8.1 SURFACE FAULT RUPTURE

The site does not lie within an Alquist–Priolo Earthquake Fault Zone and no known active faults are mapped within or through the project area. The California Geologic Survey[2] (CGS) considers a fault to be active if it has shown evidence of surface displacement within Holocene time (about the last 11,000 years). According to the United States Geologic Survey (USGS)[3], the closest active fault is the Dunnigan Hills Fault at about 16.4± miles to the northwest of the site. Based on this mapping, we consider the potential for fault rupture at the site to be low.

We show nearby faults in Figure 2.

8.2 SEISMIC GROUND MOTIONS

CAInc used the Caltrans ARS Online (web-based) tool (V2.3.09)[4] to calculate deterministic and probabilistic acceleration response spectra for the site based on criteria provided in Appendix B of the April 2013 Caltrans' Seismic Design Criteria (SDC) Version 1.7.

The deterministic spectrum is defined as the average of median response spectra calculated using ground motion prediction equations developed under the "Next Generation Attenuation" (NGA) project.

[2] http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps

[3] https://earthquake.usgs.gov/hazards/qfaults/

[4] http://dap3.dot.ca.gov/ARS_Online/index.php, accessed June 27, 2018.

These equations are applied to all faults considered active in the last 750,000 years (late-Quaternary age) that are capable of producing a moment magnitude earthquake of 6.0 or greater.

Based on Caltrans ARS Online (v2.3.09) and the 2012 Caltrans Fault Database v2b, the nearest deterministic seismic sources are the Great Valley 03a Dunnigan Hills, Great Valley 03 Mysterious Ridge, and the Great Valley 04b Gordon Valley, assigned the parameters shown in Table 4.

Table 4: Fault Data

Fault Parameters	Great Valley 03a Dunnigan Hills	Great Valley 03 Mysterious Ridge	Great Valley 04b Gordon Valley
Fault Identification Number (FID)	95	82	104
Maximum Moment Magnitude (M_{max})	6.4	7.0	6.7
Site-to-Fault (R_{RUP}) Distance (km/mi)	13.3/8.3	33.4/20.8	29.3/18.2
Style of Faulting	Reverse	Reverse	Reverse
Fault Dip (degrees)	20	20	20
Dip Direction	East	West	West

The deterministic response spectra for the controlling seismic sources identified above was compared to the Caltrans minimum deterministic response spectrum that assumes a maximum moment magnitude 6.5, reverse slip event occurring at a distance of 8.3 miles. We also compared the deterministic results with the Caltrans probabilistic response spectrum based on data from the 2008 United States Geological Survey (USGS) National Seismic Hazard Map for a 5% in 50 year probability of exceedance (975 year return period).

Caltrans structure design practice also requires an increase to spectra due to fault proximity (near-fault factor) and when the site is located over a deep sedimentary basin (basin factor). The near-fault adjustment factor is applied for locations with a site-to-rupture plane distance (Rrup) of 25 km (15.5 miles) or less to the causative fault. The near-fault factor increase applies to this site. The basin factor increase does not apply to this site.

Based on our boring data and the above information, we recommend that structure design be based on the following Caltrans SDC parameters:

- Shear Wave Velocity, Vs_{30}: 220 meters per second (879 ft per second);
- Soil Profile Type D;
- Maximum Moment Magnitude (M_{max}): 6.4;
- Peak Ground Acceleration (PGA): 0.36 g; and
- Controlling Spectra: Caltrans ARS Online Probabilistic Spectrum (2008 USGS seismic hazard map with 975-year return period).

We include the "ARS Curve" as Figure 4.

8.3 LIQUEFACTION EVALUATION

Liquefaction is a secondary effect associated with seismic loading. It can occur when very loose to medium dense, granular, saturated soils (generally within 50 feet of the surface), or specifically defined cohesive soils, are subjected to ground shaking. Based on the soil encountered in the field, the potential for liquefaction at this site is considered low.

8.4 SEISMICALLY INDUCED SETTLEMENT

During a seismic event, ground shaking can cause densification of granular soil above the water table that can result in settlement of the ground surface. Based on the soils encountered in CAInc borings R-18-001 and R-18-002, and Taber B-5, the potential for seismically induced ground settlement at this site is considered low.

9 CONCLUSIONS

The site is considered adequately stable with support available for proposed CIDH bridge foundations within the Holocene alluvial fan sediment deposits. Driven piles are not considered suitable due to the close proximity to existing Pole Line Road Bridge and rail road structures. Spread footings are not considered suitable due to the lack of space for excavation. No other over-riding geologic hazards (e.g. faulting, volcanoes, settlement, landslides, etc.) were identified in either published geologic mapping or field exploration/ reconnaissance performed for this study. We provide the results of our analysis below.

9.1 SOIL PARAMETERS

Soil profiles were developed for this project based on the subsurface data provided in CAInc borings R-18-001 and R-18-002, and Taber boring B-5. The generalized engineering parameters for this project are based on the following:

- Average unit weights based on laboratory test results.
- Average cohesion values based on unconfined compressive strength.
- Friction angles based on published blow count correlations.
- Engineering experience and judgment.
- A groundwater elevation of 16 ft obtained from CAInc boring R-18-001.

The generalized soil parameters used in our analysis are shown in Tables 5, 6 and 7.

Table 5: Generalized Soil Parameters based on CAInc R-18-001

Elevation (feet)	Soil Description	Total Unit Weight (lb/ft^3)	Friction Angle, Phi (degrees)	Cohesion, c (psf)
36 to 19	Lean Clay	118	0	750
19 to -30	Lean Clay	130	0	2500
-30 to -45	Lean Clay	124	0	1000

Table 6: Generalized Soil Parameters based on CAInc R-18-002

Elevation (feet)	Soil Description	Total Unit Weight (lb/ft^3)	Friction Angle, Phi (degrees)	Cohesion, c (psf)
40 to 25	Lean Clay	118	0	1250
25 to 10	Lean Clay	134	0	3250
10 to -15	Lean Clay	124	0	1500
-15 to -35	Lean Clay	122	0	2000
-35 to -45	Lean Clay	122	0	750

Table 7: Generalized Soil Parameters based on Taber B5

Elevation (feet)	Soil Description	Total Unit Weight (lb/ft^3)	Friction Angle, Phi (degrees)	Cohesion, c (psf)
40.5 to 39	Poorly Graded Sand	123	35	0
39 to 34	Lean Clay	124	0	400
34 to 11.5	Lean Clay	133	0	3,600
11.5 to 0	Silt	129	0	1,700
0 to -6	Poorly Graded Sand with Silt	134	35	0
-6 to -36	Lean Clay	130	0	2,900
-36 to -40	Silt	129	31	0

9.2 FOUNDATION DATA AND LOADING

Foundation information and Pile Foundation Design Loads provided by WR are shown in Table 8 and Table 9 below.

Abutment 1, Bent 2, Bent 3, Bent 4 and Bent 5 are all being modeled with 17 feet of permanent casing. The permanent casing was modeled with grout backfill in the annular spacing between the casing and soil; therefore, the pile was modeled with 50% capacity in this section.

Table 8: Foundation Design Data Sheet

Support No.	Design Method	Pile Type	Finished Grade Elevation(ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement – Service Load (in)[1]	Number of Piles per Support
					B	L		
Abut 1	LRFD	24" CIDH	--[2]	36.11	9	24	1	10
Bent 2	LRFD	72" CIDH	--[2]	17.97	N/A	N/A	1	1
Bent 3	LRFD	72" CIDH	--[2]	25.40	N/A	N/A	1	1
Bent 4	LRFD	72" CIDH	--[2]	32.55	N/A	N/A	1	1
Bent 5	LRFD	72" CIDH	--[2]	39.69	N/A	N/A	1	1

[1] Based on CALTRANS' current practice, the total permissible settlement is one inch for multi-span structures with continuous spans or multi-column bents, one inch for single span structures with diaphragm abutments, and two inches for single span structures with seat type abutments. Different permissible settlement under service loads may be allowed if a structural analysis verifies that required level of serviceability is met.

[2] Finished Grade Elevations were not available at the time of this report.

Table 9: Foundation Design Loads

Support No.	Service-I Limit State (kips)			Strength/Construction Limit State (Controlling Group, kips) (Does not include ϕ)				Extreme Limit State (Controlling Group, kips) (Does not include ϕ)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	189	65	132	264	65	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	553	553	437	748	748	0	0	475	475	0	0
Bent 3	579	579	465	781	781	0	0	507	507	0	0
Bent 4	633	633	504	856	856	0	0	563	563	0	0
Bent 5	388	388	311	523	523	0	0	378	378	0	0

10 FOUNDATION RECOMMENDATIONS

10.1 ABUTMENT AND BENT FOUNDATION DESIGN RECOMMENDATIONS

The foundation design recommendations for 24-inch-diameter CIDH piles at the abutment and 72-inch diameter CIDH piles at the bents are summarized in Table 10 and Table 11 below.

Table 10: Abutment and Bents Foundation Design Recommendations

Support Location	Pile Type	Cut-off Elev. (ft)	Service-I Limit State Load Per Support (kips)		Total Permissible Support Settlement (inches)	Nominal Resistance[1] (kips)				Design Tip Elev. [3] (ft)
						Strength/Const.		Extreme		
			Total	Perm.		Comp. φ_{qs}= 0.7	Tens. φ_{qs}= 0.7	Comp. φ_{qs}= 1.0	Tens. φ_{qs}= 1.0	
Abut 1	24" CIDH	36.11	189	132	1	100	N/A	N/A	N/A	10 (a) -- (d)
Bent 2	72" CIDH	17.97	553	437	1	1070	0	475	0	-30 (a) -- (d)
Bent 3	72" CIDH	25.40	579	465	1	1120	0	507	0	-25 (a) -- (d)
Bent 4	72" CIDH	32.55	633	504	1	1230	0	563	0	-37 (a) -- (d)
Bent 5	72" CIDH	39.69	388	311	1	750	0	378	0	-12 (a) -- (d)

Notes:
1) Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, (d) Lateral Load.
2) The Specified Tip Elevation shall not be raised above the design tip elevation.
3) The Lateral Load will be determined by WR.

10.2 PILE DATA TABLE

Table 11: Pile Data Table

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations[3] (ft)	Specified Tip Elevations[4] (ft)
		Compression	Tension		
Abut 1	24" CIDH	100	0	10 (a) -- (d)	--
Bent 2	72" CIDH	1070	0	-30 (a) -- (d)	--
Bent 3	72" CIDH	1120	0	-25 (a) -- (d)	--
Bent 4	72" CIDH	1230	0	-37 (a) -- (d)	--
Bent 5	72" CIDH	750	0	-12 (a) -- (d)	--

Notes:
1) Design tip elevations are controlled by: (a) Compression and (d) Lateral Load, respectively.
2) The Specified Tip Elevation shall not be raised above the design tip elevation.
3) The Lateral Load will be determined by WR.
4) Specified Tip Elevations will be determined by WR after completing Lateral Load analysis.

10.3 CAST-IN-DRILLED-HOLE PILES

10.3.1 COMPRESSIVE/TENSION RESISTANCE AND SETTLEMENT

The side (compressive) resistance for the CIDH pile foundations was evaluated using Load and Resistance Factor Design (LRFD) methods and factors from AASHTO LRFD Bridge Design Specifications (6th Edition) with Caltrans amendments. End bearing contributions to axial resistance were neglected, consistent with current Caltrans guidelines for CIDH pile design. Skin friction contributions are only considered in our compressive resistance analysis. Where permanent casing is shown 50% of the capacity was utilized in determining the skin friction of the pile. Actual contributions to skin friction vary depending on load transfer along the pile shaft.

A geotechnical resistance factor (φ) of 0.7 was used to evaluate compressive resistance at the Strength Limit State consistent with Load and Resistance Factor Design (LRFD) method for the abutment piles. The required factored nominal resistance was determined by comparing the highest Factored Strength Limit Load (φ = 0.7) with the highest Extreme Event Load (φ = 1.0). The higher value was then used as the required factored nominal resistance. The Controlling Strength Limit State for the 24-inch CIDH piles for Abutment 1 is 100 kips. The Controlling Strength Limit State for the 72-inch CIDH piles (1070 kips, 1120 kips, 1230 kips and 750 kips) control at Bent 2, Bent 3, Bent 4 and Bent 5, respectively.

Consistent with AASHTO LRFD BDS 10.8.3.5.1b and C10.8.3.4.1b (Side Resistance), the top 5 ft of the pile and the bottom length of pile equivalent to the shaft diameter are excluded from contributing to geotechnical capacity.

For individual pile analysis, an immediate settlement (including axial pile compression) of less than 1-inch was calculated. No significant long-term pile settlement is anticipated at this site.

We present the CIDH Pile Nominal Resistance in Appendix C.

10.3.2 LATERAL RESISTANCE

The LPILE parameters for use in lateral pile capacity analysis are provided in Appendix D. WR will be performing their own lateral pile design for this project.

10.3.3 NEGATIVE SKIN FRICTION

We do not anticipate negative skin friction at the abutment or bents.

10.3.4 PILE GROUP REDUCTION

The foundation soils predominately consist of stiff cohesive and medium dense and dense/very dense granular layers. The pile center-to-center spacing is greater than 2.5 times the pile diameter and there are no scour considerations for the structure.

According to the AASHTO LRFD BDS 6th Edition (Section10.7.3.9 – Resistance of Pile Groups in Compression) with California amendments:

- *For Cohesive Soil - If the cap is in firm contact with the ground, no reduction in efficiency shall be required. If the cap is not in firm contact with the ground and if the soil is stiff, no reduction in efficiency shall be required.*

- *For Granular Soil - The efficiency factor, η, shall be 1.0 where the pile cap is or is not in contact with the ground for a center to center pile spacing of 2.5 diameters or greater.*

Therefore, a group efficiency factor (η) of 1.0 was used in our compressive resistance pile analysis

10.3.5 CONSTRUCTION CONSIDERATIONS - CIDH

Construct CIDH piles in conformance with Section 49-3 of the 2015 Caltrans Standard Specifications, Revised Standard Specifications, and Standard Special Provisions. If groundwater is anticipated within foundation depths, we recommend that the CIDH piles be installed by the "wet" method, including slurry drilling and concrete placed under slurry using tremie pipe to avoid construction delays should groundwater be present during construction. The slurry construction method ("wet" method) requires placement of inspection tubes to permit Gamma-Gamma Logging (GGL) and Cross-hole Sonic Logging (CSL) of the CIDH pile.

The contractor is responsible for the design and installation of temporary casing, including actual length(s) and diameter(s), to install CIDH piles according to the above specifications without defects or damage to existing utilities/ facilities. Temporary casing (if used), must be noncorrugated steel with smooth surfaces and the casing diameter should be at least 8-inches greater than the CIDH pile to help prevent binding of the drilling tool. Installing temporary casing below the specified pile tip elevation is not permissible.

The project specifications should explicitly exclude vibration and impact installation methods if noise or vibrations are of concern or otherwise not allowed due to environmental constraints, proximity of nearby residences or to protect the existing railroad tracks and other facilities (e.g., underground utilities potentially susceptible to vibration damage).

For a Type II Shaft, the bottom of the permanent casing must extend to 5 ft below the construction joint. The permanent steel casing must be placed in drilled hole, and annular space backfilled with grout (SS 49-3.02B(5), 49-3.02C(6). It is also permissible to drill/oscillate/rotate the permanent casing into place. Installation by driving or vibration is not permissible.

If an oscillator or rotator is used to construct the CIDH piles, the following is required:

- The contractor should be prepared for subsurface soil conditions that include layers of soft to hard cohesive soils and medium dense sandy layers.
- The contractor must maintain a positive fluid head within the drill road at all times. The fluid must be mineral or polymer slurry; water is not permitted.
- The contractor is to maintain a minimum 10 foot soil plug within the drill rod. The 10 foot plug is to be maintained until the drill rod reaches the specified tip elevation. At no time is the contractor to have less than the minimum 10 foot soil plug until the specified tip elevation has been reached.
- The contractor must provide access to the top of the oscillator/rotator drill rod, as requested by the Engineer, to verify the positive head and minimum soil plug are being maintained.

Prior to mobilization to the site, the foundation contractor should prepare and submit a detailed work plan for the engineer's review and approval. The work plan should state explicitly all assumptions the contractor has made regarding earth materials and foundation construction conditions. The work plan should include details of proposed equipment, personnel, materials, methods and order or work.

The plans show pea gravel and filter fabric being utilized around the column between the finished grade and top of the footing with a 2-foot minimum. Pea gravel has the potential to settle which may cause future maintenance considerations. Where spacing is planned to be greater than 5 feet isolator casing should be utilized.

11 EARTHWORK

Site grading and earthwork should be performed in accordance with Section 17 and Section 19 of Caltrans 2015 Standard Specifications, respectively.

11.1 FILL MATERIAL

Construct embankment and place new fill in accordance with Caltrans "Standard Specifications", including at least 95% relative compaction (CTM 216) on all fill within 150 ft of bridge abutments.
Any imported fill should be approved by the soils engineer, should have 100% passing 3-inch sieve and have low expansion potential [Expansion Index (EI) < 50 and Sand Equivalent (SE) > 20]. In general, all fill material should be free of debris and organic material.

11.2 SLOPE GEOMETRY AND STABILITY

The near-surface soils are capable of providing adequate support for proposed fill heights. We expect that new embankment constructed as above, and with exterior slopes at 2:1 (horizontal:vertical), or flatter, will be stable.

Based on our experience in Davis additional embankment fills can cause long term consolidation settlement on the order of 2 to 4 inches. Settlement monitoring during and after construction is recommended through established monuments. A minimum “waiting period” of 90-days between placing embankment fill and driving piling and/or placing wall backfill is recommended. The design team should consider placing approach slabs to minimize the eventual uneven surface that will develop between the abutment and the bridge.

12 CONSTRUCTION CONSIDERATIONS

This section is provided to help identify relevant Standard Specifications and subsurface conditions that may be encountered in the field during construction. For the project described herein, we recommend that the foundation report, LOTB, and any subsequent addenda be included with project documents during the bidding process for reference purposes.

12.1 EXISTING UTILITIES

We understand that an overhead utility line exists north of the existing bike path and runs from east to west. These utilities will most likely not adversely affect pile installation. Locations of any other utilities, if present, are unknown.

12.2 EXISTING FOUNDATIONS

The proposed foundation elements for the bridge are not expected to encounter existing foundations, however the existing Pole Line Overcrossing structure foundation should be protected during construction.

12.3 EXISTING CONCRETE SECTION

The existing bike path is underlain with a concrete section approximately 3 inches thick. Contractor should expect difficult drilling and/or excavation within the concrete section. The 3-inch concrete section must be removed 5 ft laterally around the proposed Abutment 1 pile cap and embankment area.

The existing concrete section may cause adverse draining conditions at the project site. The design team should consider if it is necessary to remove or punch holes through the concrete section to assist with drainage.

See Figure 1 for approximate location of the underlying concrete.

12.4 EXCAVATION AND SHORING

Based on the subsurface conditions at this site, we expect that excavation to the indicated pile cut-off depths can be achieved using typical heavy-duty construction equipment. Soils encountered in the borings completed at this site are considered consistent with Cal/OSHA Type B soil classification. The CIDH pile excavations are expected to encounter groundwater within the depth of pile excavation. The contractor is responsible for design and construction of excavation sloping and shoring in accordance with Cal/OSHA requirements, including verifying soil type in open excavations, and to protect existing structures, utilities and other facilities during construction.

12.5 VIBRATION

Train tracks are directly north, the Poleline Road Overpass is directly east and Highway 80 is directly south of the proposed Olive Drive bike path. Vibration is expected to occur during construction. If impact or vibratory hammers are utilized for temporary casing the vibration can be calculated using the following. Vibration criteria is discussed in Chapter 6 of the "Transportation and Construction Vibration Guidance Manual," dated September 2013, published by Caltrans Department of Transportation. According to AASHTO the maximum vibration level for preventing damage to engineered structures is between 1.0-1.5 (in/sec). Vibration amplitudes produced by vibratory pile drivers can be calculated using equation 10 in Section 7.1.2 of the manual.

$$PPV_{Vibratory\ Pile\ Driver} = PPV_{Ref}\left(\frac{25}{D}\right)^{n} \text{ (in/sec)}$$

Where:

$$PPV_{Ref} = 0.65\ in/\sec\ for\ a\ reference\ pile\ driver\ at\ 25\ ft$$
$$D = distance\ from\ pile\ driver\ to\ the\ receiver\ in\ ft$$
$$n = 1.1\ (the\ value\ related\ to\ the\ attenuation\ rate\ through\ ground)$$

If necessary vibration monitoring should be the responsibility of the contractor.

13 RISK MANAGEMENT

Our experience, and that of our profession, clearly indicates the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the Geotechnical Engineer of Record to provide additional services during design and construction. For this project, CAInc should be retained as the Geotechnical Engineer of Record to:

- Review and provide comments on the final plans and specifications, insofar as they rely upon this report, prior to construction bidding to verify consistency with the recommendations contained herein;
- Review pile installation during construction in order to confirm anticipated bearing materials and provide additional or alternate recommendations if necessary; and,
- Update this report if design changes occur, 2 years or more lapse between this report and construction, and/or site conditions have changed.

Should there be significant change in the project or should soil conditions different from those described in this report be encountered during construction, this office should be contacted/notified for evaluation and supplemental recommendations as necessary or appropriate.

CAInc cannot be responsible for any other parties' interpretation of our report and recommendations contained herein, as well as subsequent addendums, letters, and discussions. If others perform the construction observation, they should review this report and either accept the conclusions and recommendations herein as their own or provide alternative recommendations.

14 LIMITATIONS

The conclusions and recommendations of this study are professional opinion based upon the indicated project criteria and the limited data described herein. It is recognized there is potential for variation in subsurface conditions and modification of conclusions and recommendations might emerge from further, more detailed study. This report is intended only for the purpose, site location, and project description indicated and construction in accordance with Caltrans practice.
As changes in appropriate standards, site conditions and technical knowledge cannot be adequately predicted; review of recommendations by this office for use after a period of two years is a condition of this report.

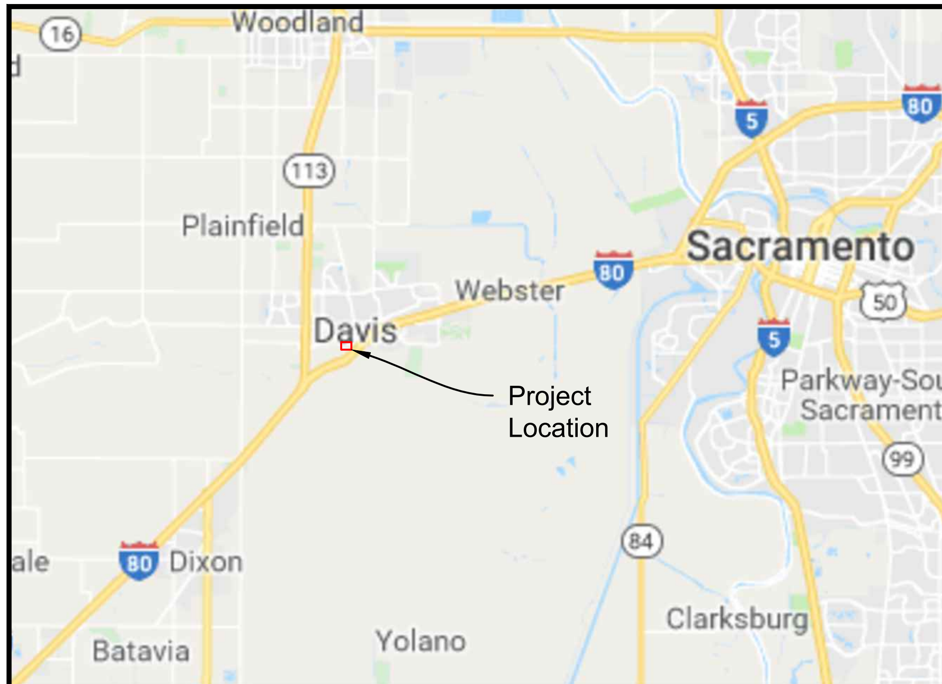
A review by this office of any foundation and/or grading plans and specifications or other work product insofar as they rely upon or implement the content of this report, together with the opportunity to make supplemental recommendations as indicated therefrom is considered an integral part of this study and a condition of recommendations.

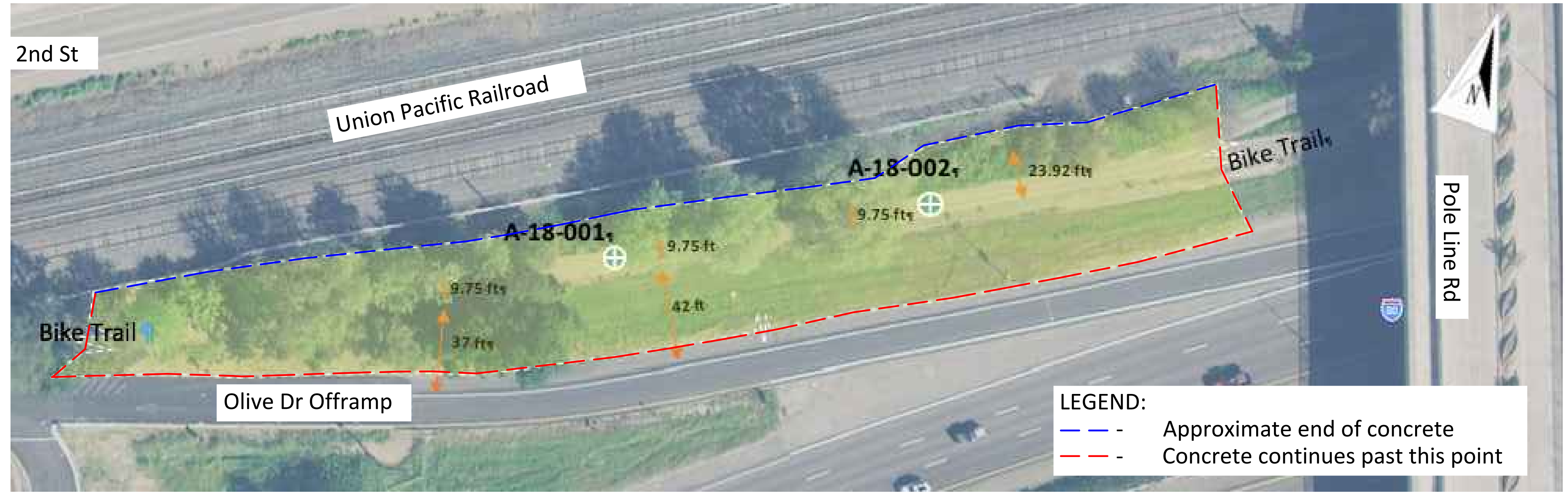
Subsequently defined construction observation procedures and/or agencies are an element of work, which may affect supplementary recommendations.

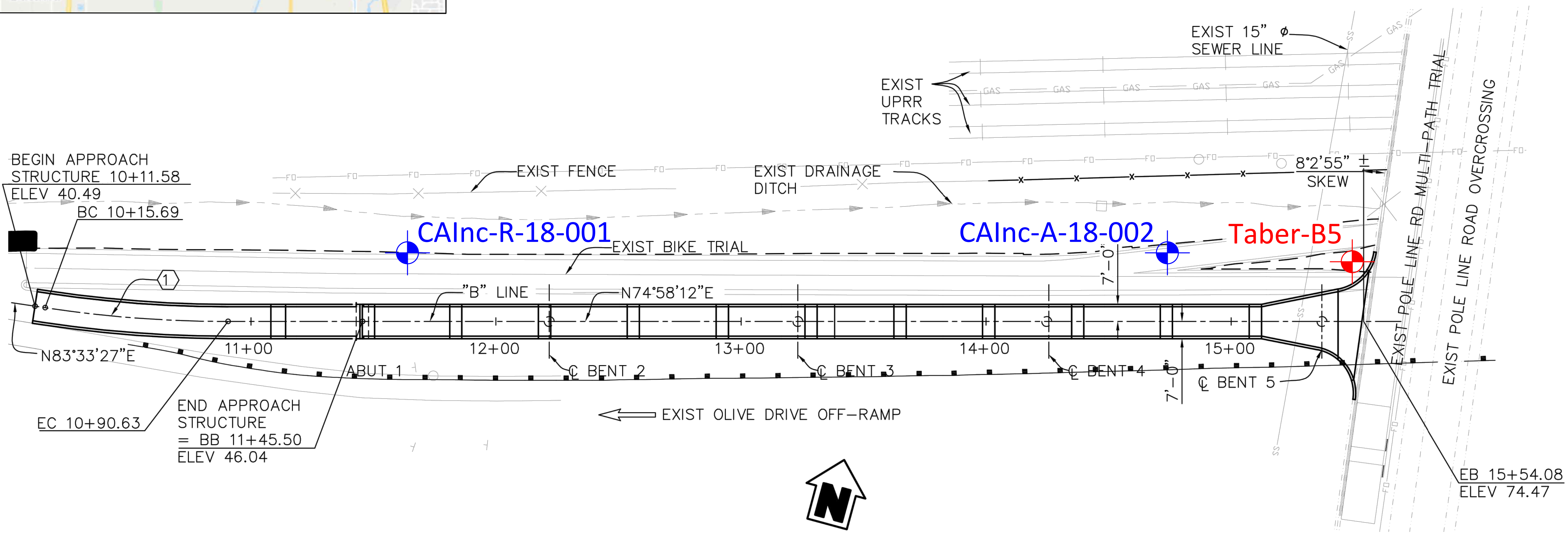
Opinions and recommendations apply to current site conditions and those reasonably foreseeable for the described development--which includes appropriate operation and maintenance thereof. They cannot apply to site changes occurring, made, or induced, of which this office is not aware and has not had opportunity to evaluate.

The scope of this study specifically excluded sampling and/or testing for, or evaluation of the occurrence and distribution of, hazardous substances. No opinion is intended regarding the presence or distribution of any hazardous substances at this or nearby site.

FIGURES







LEGEND

Taber-B5 approximate boring location

CAInc-A-18-001 approximate boring location

Reference:
"Ped_Bridge2-dims Alt 5A.pdf," Wood Rogers, April 21, 2018.

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Taber Since 1954

1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

	By	Date
Project Mgr.	JJW	03/16/18
Project Eng.	HFW	03/16/18
Designer		
Checked By	JJW	04/03/18
Drawn By	HFW	03/16/18

Pole Line/Olive Drive Connection

Davis, California

Figure 1
Vicinity and Exploration Location Map

Project No. 18-438.1
Scale 1" = 40'
Date 1/23/20

LEGEND

Quaternary Fault (Age)	Quaternary Fault (Age)	Location
<150 years	<750,000 years	Well Constrained
<15,000 years	<1.6 million years	Moderately Constrained
<130,000 years		Inferred

Project Mgr.	JJW	03/16/18
Project Eng.	HFW	03/16/18
Designer		
Checked By	JJW	04/03/18
Drawn By	HFW	03/16/18
	By	Date

Source: USGS Google Earth Fault Overlay Map

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
Taber Since 1954
1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

Pole Line/Olive Drive Connection
Davis, California

Figure 2
Fault Activity Map

Project No.	18-438.1
Scale	1":35,000'
Date	03/16/18

Qa Quaternary Levee & Channel deposits

Qb Quaternary Basin Depositis (Alluvium)

Qmr Quaternary Modesto-Riverbank Formations (Arkosic alluvium)

Qr Quaternary Riverbank Formations (Alluvium)

Qm Quaternary Modesto Formation (Alluvium)

	By	Date
Project Mgr.	JJW	03/16/18
Project Eng.	HFW	03/16/18
Designer		
Checked By	JJW	04/03/18
Drawn By	HFW	03/16/18

Source: Wagner, D.L, Jennings, C.W., Bedrossian, T.L., Bortugno, E.J., Geologic Map of the Sacramento Quadrangle, 1:250,000, California Divisions of Mines & Geology, 1981.

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
Taber Since 1954
1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

Pole Line/Olive Drive Connection
Davis, California

Figure 3
Geologic Map

Project No.	18-438.1
Scale	1":62,500'
Date	03/16/18

SEISMIC DESIGN DATA

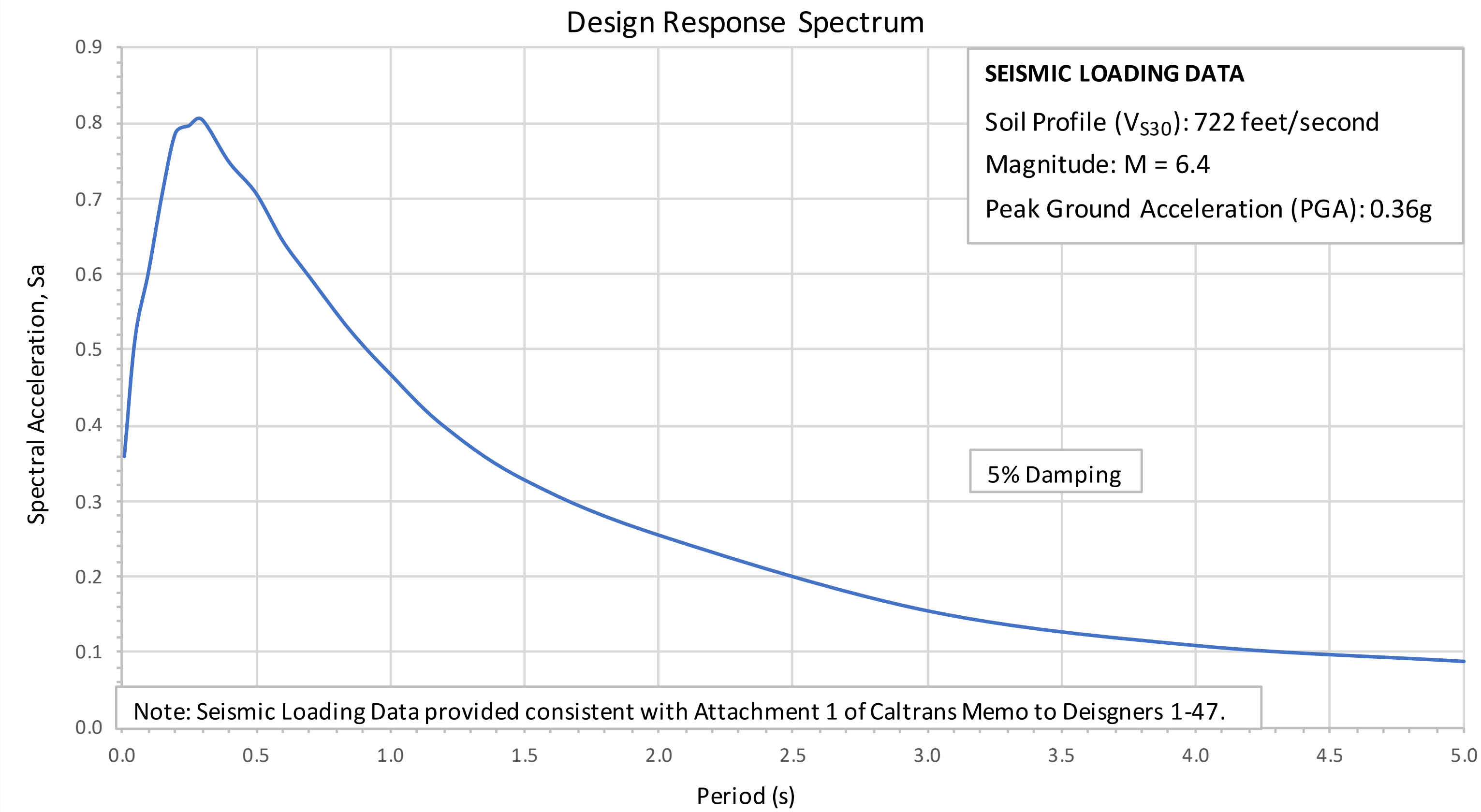
Pole Line/Olive Drive Connection

Davis, California

Caltrans ARS Online Version: V2.3.09

Date Accessed: 6/27/2018

Period (s)	Spectral Acceleration, Sa (g)
0.010	0.359
0.050	0.515
0.100	0.603
0.150	0.704
0.200	0.786
0.250	0.796
0.300	0.804
0.400	0.748
0.500	0.707
0.600	0.644
0.700	0.596
0.850	0.526
1.000	0.468
1.200	0.399
1.500	0.328
2.000	0.255
3.000	0.155
4.000	0.109
5.000	0.088



The Design Response Spectrum is the upper envelope of the deterministic and probabilistic repsonse spectrum, but not less than the Minimum Deterministic Spectrum for California. The deterministic spectrum is obtained by using the average of the 2008 Campbell-Bozorgnia and the 2008 Chiou-Youngs ground motion prediction equations. Probabilistic response spectrum is

Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services

Taber Since 1954

Site Latitude: 38.54593

Site Longitude: -121.72686

FIGURE 4

APPENDIX A

Log of Test Borings
Pole Line Road Overcrossing 1995 As-Built Plans

Map and Data Source
Topographic Survey provided by Wood Rogers via electronic transfer on January 9, 2020. Survey completed by Radman Aerial Surveys, dated June 2017.

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET NO	TOTAL SHEETS
3	YOL				3

REGISTERED CIVIL ENGINEER — DATE 2/11/2020

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

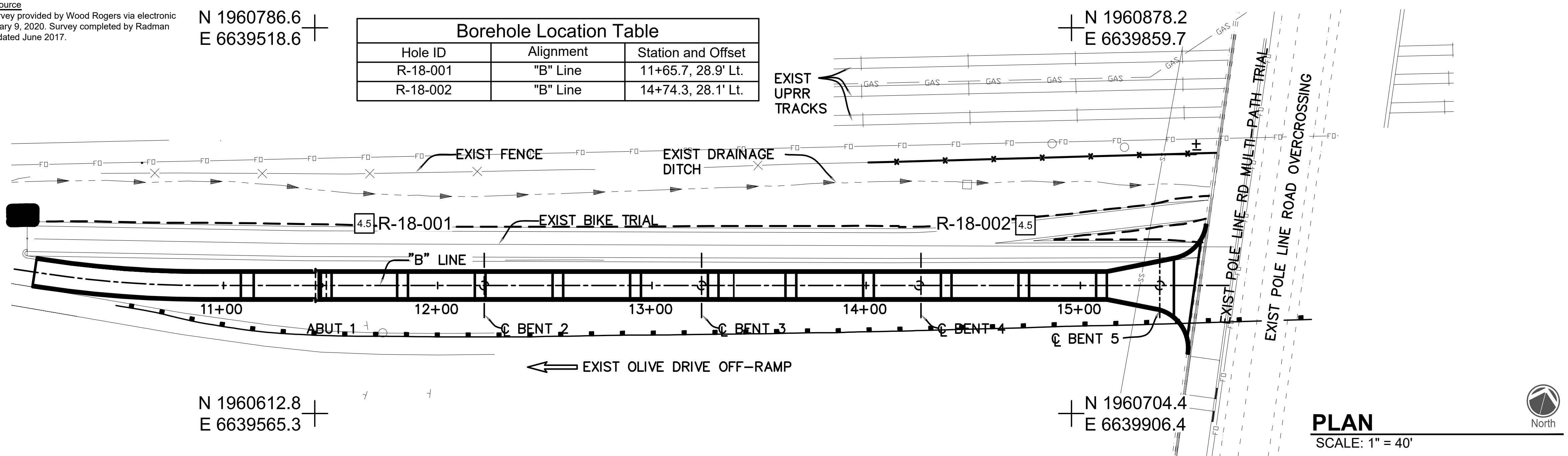
REGISTERED PROFESSIONAL ENGINEER — BENJAMIN D. CRAWFORD — No. 68457 — CIVIL — STATE OF CALIFORNIA

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831 (916) 455-4225

18-438.1
Project Number

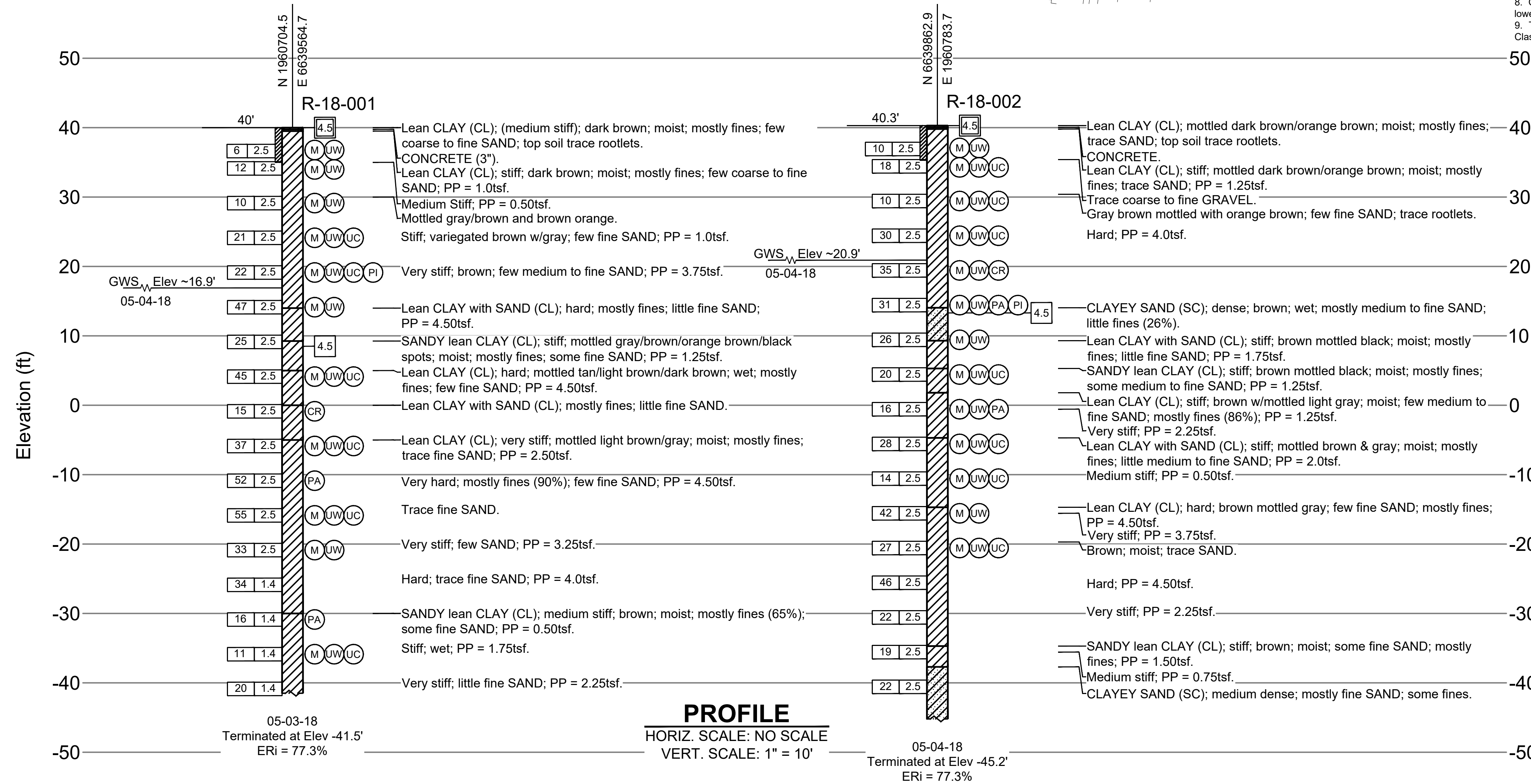
Borehole Location Table

Hole ID	Alignment	Station and Offset
R-18-001	"B" Line	11+65.7, 28.9' Lt.
R-18-002	"B" Line	14+74.3, 28.1' Lt.



PLAN
SCALE: 1" = 40'

NOTES:
1. Field classification of soils was in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010). See Log of Test Borings No. 2, "Soil Legend".
2. Standard Penetration tests were performed in accordance with ASTM D 1586-99 using a hammer operated with an automated drop system. Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.
3. "2.5 inch sampler": ID=2.5 inch, OD=2.9 inch. Driven in same manner as SPT ("1.4 inch") sampler.
4. If laboratory tests are not shown as being performed, the soil descriptions presented on the LOTB are based solely on the visual practices described in this Manual.
5. The length of each sampled interval is shown graphically on the boring log. Whole number blow counts ("N") represent the "standard penetration resistance" interval in accordance with the Caltrans Soil & Logging, Classification, and Presentation Manual (June 2010). Where less than 0.5 feet of penetration is achieved, the blow count shown is for that fraction of the "standard penetration resistance" interval actually penetrated.
6. Consistency of soils shown in ( ) where estimated.
7. Groundwater surface (GWS) elevations in the borings indicated on the Log of Test Boring Sheets reflect the fluid level in the borings on the specified date.
8. Groundwater elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
9. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010)



PROFILE
HORIZ. SCALE: NO SCALE
VERT. SCALE: 1" = 10'

REV.	DATE	DESCRIPTION	BY

OLIVE DR BIKE PATH / POLE LINE RD OC RAMP CONNECTION
LOG OF TEST BORINGS NO. 1
C.I.P. No. 8313

WOOD RODGERS — DEVELOPING INNOVATIVE DESIGN SOLUTIONS — 3301 C St. Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

Davis California

CITY OF DAVIS
PUBLIC WORKS DEPARTMENT

FIELD WORK BY: H.F.W. — DATE: MAY 2018
CHECKED BY: S.M.L. — DATE: JANUARY 2020
DRAWN BY: B.J.U. — DATE: JANUARY 2020

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET NO	TOTAL SHEETS
3	YOL				3

REGISTERED CIVIL ENGINEER — DATE 2/11/2020

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER BENJAMIN D. CRAWFORD No. 68457 CIVIL STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831 (916) 455-4225

18-438.1
Project Number

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

LEGEND – SOIL (SHEET 1 OF 2)

CEMENTATION

DESCRIPTION	CRITERIA
WEAK	CRUMBLES OR BREAKS WITH HANDLING OR LITTLE FINGER PRESSURE.
MODERATE	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE.
STRONG	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE.

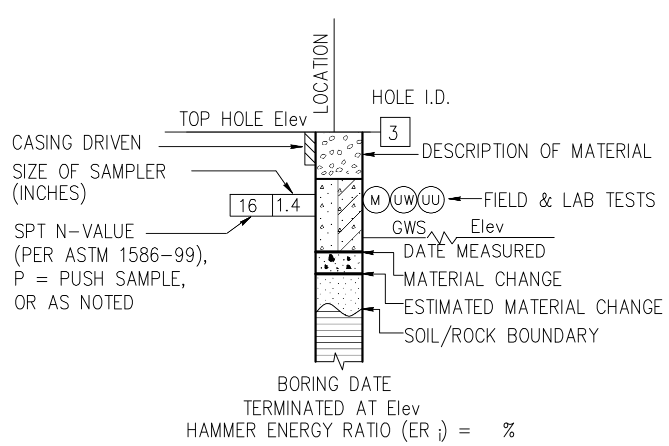
BOREHOLE IDENTIFICATION

SYMBOL	HOLE TYPE	DESCRIPTION
Size (square)	A	AUGER BORING (HOLLOW OR SOLID STEM BUCKET)
Size (square)	R RW P	ROTARY DRILLED BORING (CONVENTIONAL) ROTARY DRILLED WITH SELF-CASING WIRE-LINE ROTARY PERCUSSION BORING (AIR)
Size (diamond)	R RC	ROTARY DRILLED DIAMOND CORE ROTARY CORE WITH CONTINUOUSLY-SAMPLED, SELF-CASING WIRE-LINE
Size (rectangle)	HD HA	HAND DRIVEN (1-INCH SOIL TUBE) HAND AUGER
●	D	DYNAMIC CONE PENETRATION BORING
▲	CPT	CONE PENETRATION TEST (ASTM D 5778)
□	O	OTHER (NOTE ON LOTB)

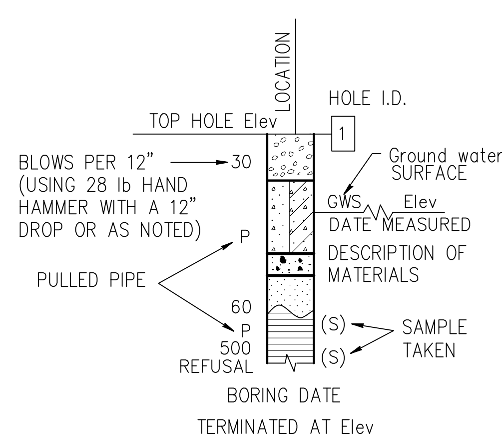
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

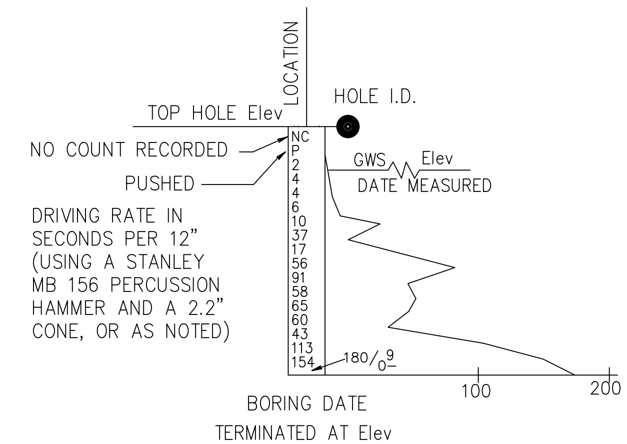
DESCRIPTION	SHEAR STRENGTH (tsf)	POCKET PENETROMETER MEASUREMENT, PP, (tsf)	TORVANE MEASUREMENT, TV, (tsf)	VANE SHEAR MEASUREMENT, VS, (tsf)
VERY SOFT	LESS THAN 0.12	LESS THAN 0.25	LESS THAN 0.12	LESS THAN 0.12
SOFT	0.12 – 0.25	0.25 – 0.5	0.12 – 0.25	0.12 – 0.25
MEDIUM STIFF	0.25 – 0.5	0.5 – 1	0.25 – 0.5	0.25 – 0.5
STIFF	0.5 – 1	1 – 2	0.5 – 1	0.5 – 1
VERY STIFF	1 – 2	2 – 4	1 – 2	1 – 2
HARD	GREATER THAN 2	GREATER THAN 4	GREATER THAN 2	GREATER THAN 2



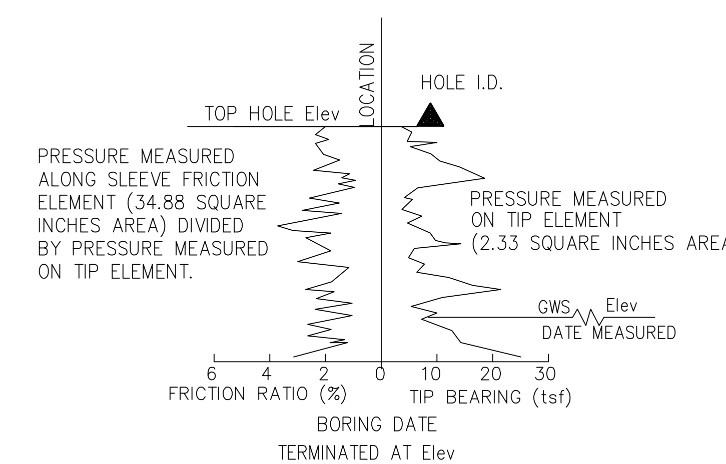
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

REV.	DATE	DESCRIPTION	BY

OLIVE DR BIKE PATH / POLE LINE RD OC RAMP CONNECTION

LOG OF TEST BORINGS NO. 2
C.I.P. No. 8313

WOOD RODGERS — DEVELOPING INNOVATIVE DESIGN SOLUTIONS
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

Davis California

CITY OF DAVIS
PUBLIC WORKS DEPARTMENT

FIELD WORK BY: H.F.W.		DATE: MAY 2018
CHECKED BY:	S.M.L.	DATE: JANUARY 2020
DRAWN BY:	B.J.U.	DATE: JANUARY 2020

SHEET 45 OF 46 SHEETS — DWG. NO. S31 of 32

GROUP SYMBOLS AND NAMES

GRAPHIC/SYMBOL	GROUP NAMES	GRAPHIC/SYMBOL	GROUP NAMES
GW	WELL-GRADED GRAVEL WELL-GRADED GRAVEL WITH SAND	CL	LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL SANDY LEAN CLAY SANDY LEAN CLAY WITH GRAVEL GRAVELLY LEAN CLAY GRAVELLY LEAN CLAY WITH SAND
GP	POORLY-GRADED GRAVEL POORLY-GRADED GRAVEL WITH SAND		
GW-GM	WELL-GRADED GRAVEL WITH SILT WELL-GRADED GRAVEL WITH SILT AND SAND	CL-ML	SILTY CLAY SILTY CLAY WITH SAND SILTY CLAY WITH GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY WITH GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY WITH SAND
GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY) WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILTY CLAY AND SAND)		
GP-GM	POORLY-GRADED GRAVEL WITH SILT POORLY-GRADED GRAVEL WITH SILT AND SAND	ML	SILT SILT WITH SAND SILT WITH GRAVEL SANDY SILT SANDY SILT WITH GRAVEL GRAVELLY SILT GRAVELLY SILT WITH SAND
GP-GC	POORLY-GRADED GRAVEL WITH CLAY (OR SILTY CLAY) POORLY-GRADED GRAVEL WITH CLAY AND SAND (OR SILTY CLAY AND SAND)		
GM	SILTY GRAVEL SILTY GRAVEL WITH SAND	OL	ORGANIC LEAN CLAY ORGANIC LEAN CLAY WITH SAND ORGANIC LEAN CLAY WITH GRAVEL SANDY ORGANIC LEAN CLAY SANDY ORGANIC LEAN CLAY WITH GRAVEL GRAVELLY ORGANIC LEAN CLAY GRAVELLY ORGANIC LEAN CLAY WITH SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND	OL	ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT WITH GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT WITH SAND
SW	WELL-GRADED SAND WELL-GRADED SAND WITH GRAVEL		
SP	POORLY-GRADED SAND POORLY-GRADED SAND WITH GRAVEL	CH	FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL SANDY FAT CLAY SANDY FAT CLAY WITH GRAVEL GRAVELLY FAT CLAY GRAVELLY FAT CLAY WITH SAND
SW-SM	WELL-GRADED SAND WITH SILT WELL-GRADED SAND WITH SILT AND GRAVEL		
SW-SC	WELL-GRADED SAND WITH CLAY (OR SILTY CLAY) WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)	MH	ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL SANDY ELASTIC SILT SANDY ELASTIC SILT WITH GRAVEL GRAVELLY ELASTIC SILT GRAVELLY ELASTIC SILT WITH SAND
SP-SM	POORLY-GRADED SAND WITH SILT POORLY-GRADED SAND WITH SILT AND GRAVEL		
SP-SC	POORLY-GRADED SAND WITH CLAY (OR SILTY CLAY) POORLY-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)	OH	ORGANIC FAT CLAY ORGANIC FAT CLAY WITH SAND ORGANIC FAT CLAY WITH GRAVEL SANDY ORGANIC FAT CLAY SANDY ORGANIC FAT CLAY WITH GRAVEL GRAVELLY ORGANIC FAT CLAY GRAVELLY ORGANIC FAT CLAY WITH SAND
SM	SILTY SAND SILTY SAND WITH GRAVEL		
SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL	OH	ORGANIC ELASTIC SILT ORGANIC ELASTIC SILT WITH SAND ORGANIC ELASTIC SILT WITH GRAVEL SANDY ORGANIC ELASTIC SILT SANDY ORGANIC ELASTIC SILT WITH GRAVEL GRAVELLY ORGANIC ELASTIC SILT GRAVELLY ORGANIC ELASTIC SILT WITH SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND WITH GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL WITH SAND ORGANIC SOIL WITH GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL WITH GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL WITH SAND
	COBBLES COBBLES AND BOULDERS BOULDERS		

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

FIELD AND LABORATORY TESTING

- (C) CONSOLIDATION (ASTM D 2435)
- (CL) COLLAPSE POTENTIAL (ASTM D 4546)
- (CP) COMPACTION CURVE (CTM 216)
- (CR) CORROSIVITY TESTING (CTM 643, CTM 422, CTM 417)
- (CU) CONSOLIDATED UNDRAINED TRIAXIAL (ASTM D 4767)
- (DR) DRAINED RESIDUAL SHEAR STRENGTH (ASTM D 6467)
- (DS) DIRECT SHEAR (ASTM D 3080)
- (EI) EXPANSION INDEX (ASTM D 4829)
- (M) MOISTURE CONTENT (ASTM D 2216)
- (OC) ORGANIC CONTENT-% (ASTM D 2974)
- (P) PERMEABILITY (CTM 220)
- (PA) PARTICLE SIZE ANALYSIS (ASTM D 422)
- (PI) PLASTICITY INDEX (AASHTO T 90) LIQUID LIMIT (AASHTO T 89)
- (PL) POINT LOAD INDEX (ASTM D 5731)
- (PM) PRESSURE METER
- (R) R-VALUE (CTM 301)
- (SE) SAND EQUIVALENT (CTM 217)
- (SG) SPECIFIC GRAVITY (AASHTO T 100)
- (SW) SWELL POTENTIAL (ASTM D 4546)
- (UC) UNCONFINED COMPRESSION-SOIL (ASTM D 2166) UNCONFINED COMPRESSION-ROCK (ASTM D 7012 METHOD C)
- (UU) UNCONSOLIDATED UNDRAINED TRIAXIAL (ASTM D 2850)
- (UW) UNIT WEIGHT (ASTM D 7263)

LEGEND – SOIL (SHEET 2 OF 2)

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET NO	TOTAL SHEETS
3	YOL				3

REGISTERED CIVIL ENGINEER — DATE 2/11/2020

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER BENJAMIN D. CRAWFORD No. 68457 CIVIL STATE OF CALIFORNIA

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831 (916) 455-4225

18-438.1
Project Number

APPARENT DENSITY OF COHESIONLESS SOILS

DESCRIPTION	SPT N_{60} (BLOWS / 12 INCHES)
VERY LOOSE	0 – 5
LOOSE	5 – 10
MEDIUM DENSE	10 – 30
DENSE	30 – 50
VERY DENSE	GREATER THAN 50

MOISTURE

DESCRIPTION	CRITERIA
DRY	NO DISCERNABLE MOISTURE
MOIST	MOISTURE PRESENT, BUT NO FREE WATER
WET	VISIBLE FREE WATER

PERCENT OR PROPORTION OF SOILS

DESCRIPTION	CRITERIA
TRACE	PARTICLES ARE PRESENT BUT ESTIMATED TO BE LESS THAN 5%
FEW	5% – 10%
LITTLE	15% – 25%
SOME	30% – 45%
MOSTLY	50% – 100%

PARTICLE SIZE

DESCRIPTION		SIZE
BOULDER		GREATER THAN 12"
COBBLE		3" – 12"
GRAVEL	COARSE	3/4" – 3"
	FINE	1/5" – 3/4"
SAND	COARSE	1/16" – 1/5"
	MEDIUM	1/64" – 1/16"
	FINE	1/300" – 1/64"
SILT AND CLAY		LESS THAN 1/300"

REV.	DATE	DESCRIPTION	BY

OLIVE DR BIKE PATH / POLE LINE RD OC RAMP CONNECTION
LOG OF TEST BORINGS NO. 3
C.I.P. No. 8313

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

Davis California

CITY OF DAVIS
PUBLIC WORKS DEPARTMENT

FIELD WORK BY: H.F.W.	DATE: MAY 2018
CHECKED BY: S.M.L.	DATE: JANUARY 2020
DRAWN BY: B.J.U.	DATE: JANUARY 2020
SHEET 46 OF 46 SHEETS	DWG. NO. S32 of 32

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	Yol	80	0.90	76	108

Richard A. Pratt
REGISTERED CIVIL ENGINEER
1-26-95
PLANS APPROVAL DATE

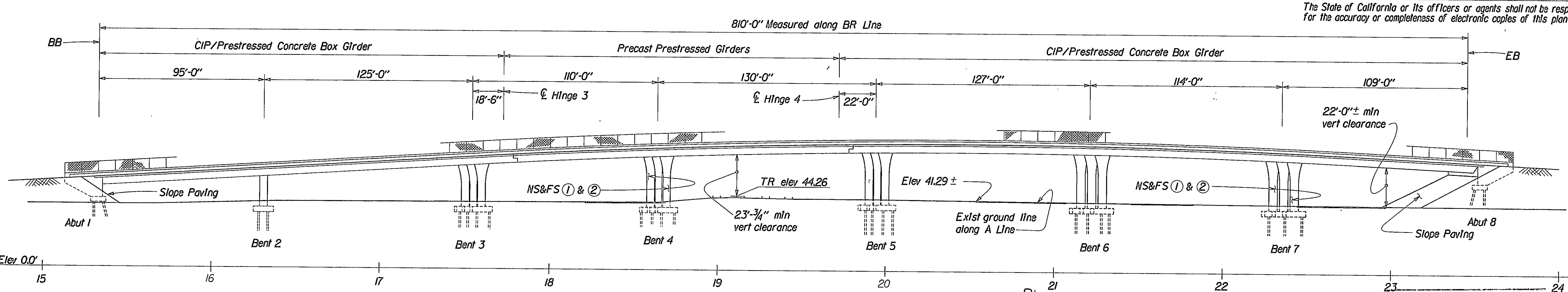
REGISTERED PROFESSIONAL ENGINEER
Richard A. Pratt
No. C41047
Exp. 3/31/95
CIVIL
STATE OF CALIFORNIA

GREINER, INC.
1380 LEAD HILL ROAD, STE. 100
ROSEVILLE, CA 95661-2941

CITY OF DAVIS
23 RUSSELL BOULEVARD
DAVIS, CALIFORNIA 95616

A LINE PROFILE GRADE

No Scale



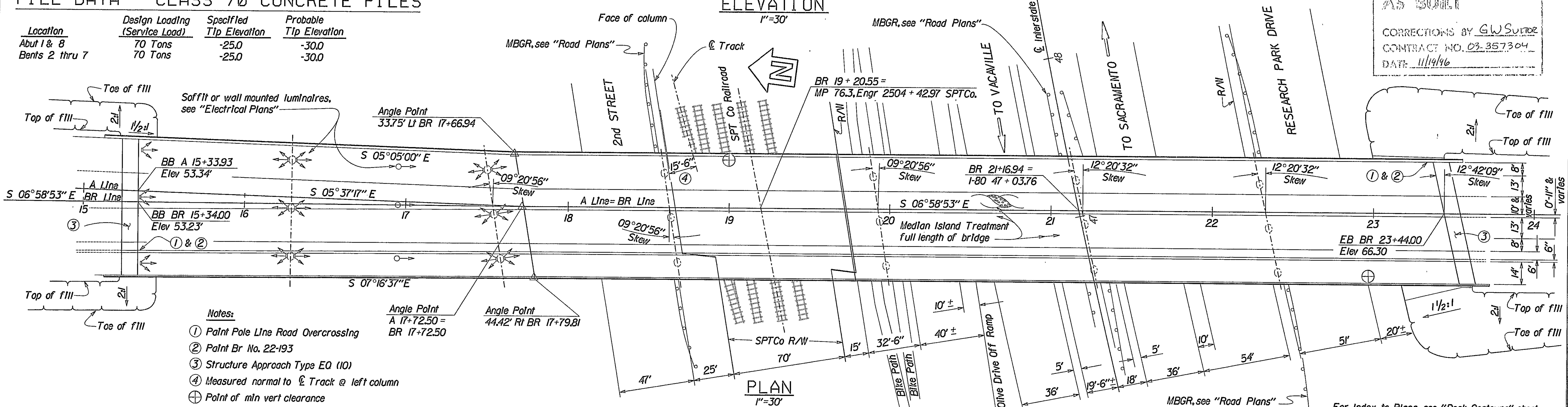
ELEVATION

1"=30'

PILE DATA - CLASS 70 CONCRETE PILES

Location	Design Loading (Service Load)	Specified Tip Elevation	Probable Tip Elevation
Abut 1 & 8	70 Tons	-25.0	-30.0
Bents 2 thru 7	70 Tons	-25.0	-30.0

AS BUILT
CORRECTIONS BY G W Sutton
CONTRACT NO. 03-357304
DATE 11/19/96



PLAN

1"=30'

Notes:

① Paint Pole Line Road Overcrossing
② Paint Br No. 22-193
③ Structure Approach Type EQ (10)
④ Measured normal to ℄ Track @ left column
⊕ Point of min vert clearance

For Index to Plans, see "Deck Contours" sheet
For General Notes, see "General Plan No. 2" sheet

DESIGN OVERSIGHT 12-7-94 SIGNOFF DATE	DESIGN	BY R Pratt	CHECKED CK Ball/R Rivet	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD	
	DETAILS	BY Gene Brown	CHECKED CK Ball/R Rivet	LAYOUT	BY M Howell/R Pratt	CHECKED GW Horton
	QUANTITIES	BY CK Ball	CHECKED YN	SPECIFICATIONS	BY R Pratt/CK Ball	PLANS AND SPECS COMPARED W LaFranchi

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Richard A Pratt
PROJECT ENGINEER

BRIDGE NO. 22-193
POST MILE 0.90

POLE LINE ROAD OVERCROSSING
GENERAL PLAN NO. 1

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03-101
EA 357301

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 8-23-93, 11-18-93, 2-8-94, 2-18-94, 4-20-94, 7-8-94, 10-28-94, 11-11-94, 11-30-94

SHEET 1 OF 33

/usr/projects/pole/plgpl.dgn   Job # 22110.05

303-225

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	Yol	80	0.90	86	108

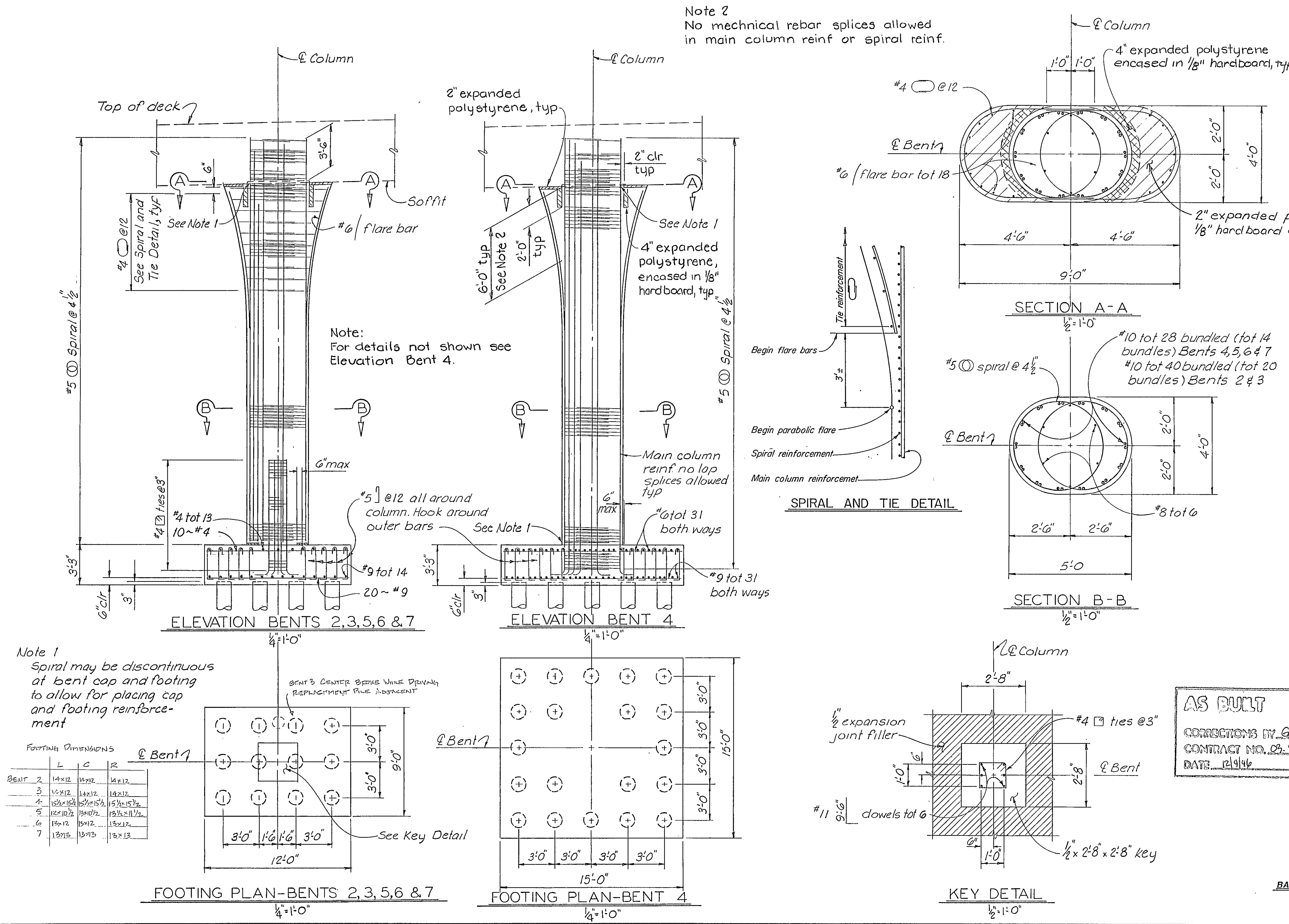
REGISTERED CIVIL ENGINEER
1-26-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
R.A. Pratt
No. C041047
Exp. 3-31-95
CIVIL
STATE OF CALIFORNIA

Greiner, Inc.
1380 Lead Hill Rd., Ste. 100
Roseville, CA 95661-2941

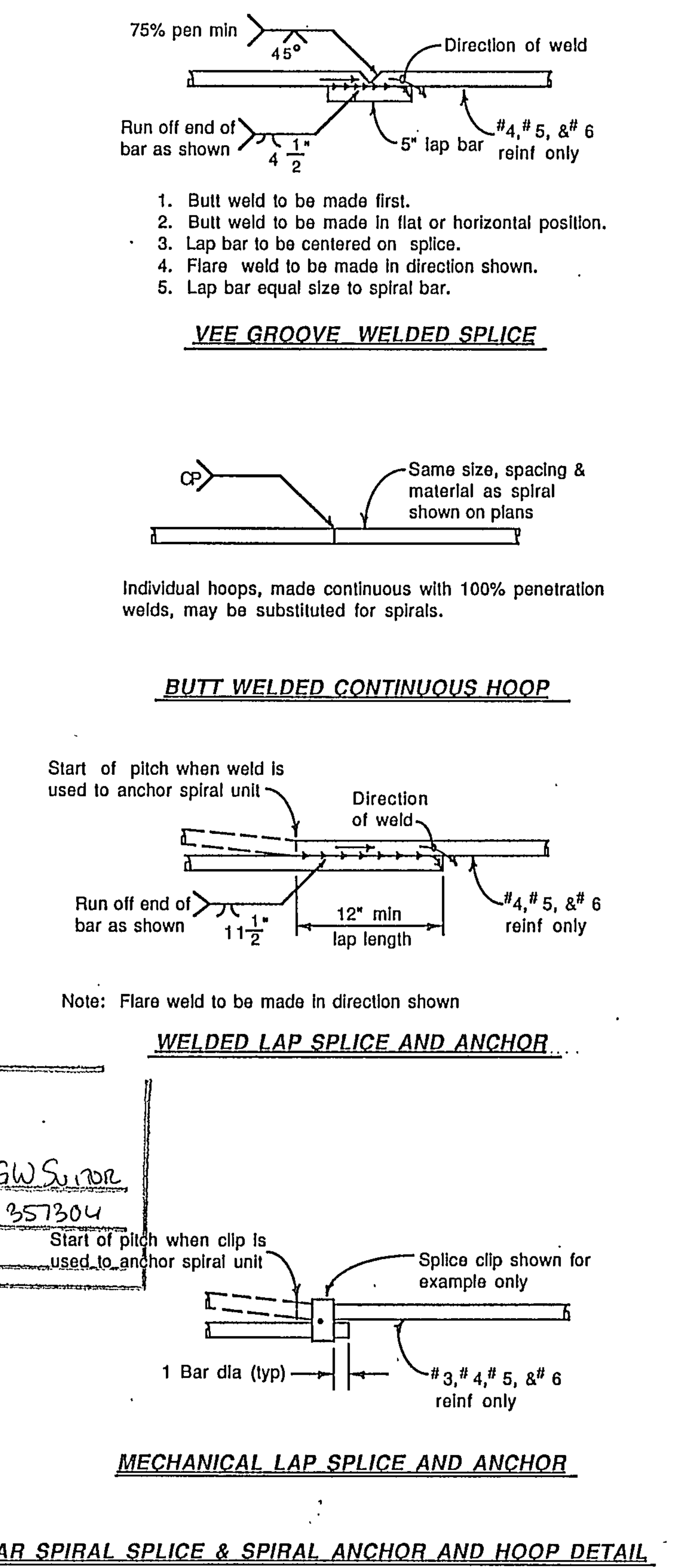
City of Davis
23 Russell Boulevard
Davis, California 95616

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



FOOTING DIMENSIONS

	L	C	R
BENT 2	14×12	14×12	14×12
3	14×12	14×12	14×12
4	15½×15½	15½×15½	15½×15½
5	12×10½	13×10½	13½×11½
6	13×12	13×12	13×12
7	13×13	13×13	13×13



DESIGN OVERSIGHT 12-7-94 SIGN OFF DATE	DESIGN BY R Pratt	CHECKED C. Chen	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	DETAILS BY YN	CHECKED C.Chen	
	QUANTITIES BY CK Ball	CHECKED YN	

Richard A Pratt
PROJECT ENGINEER

BRIDGE NO. 22-193
POST MILE 0.90

POLE LINE ROAD OVERCROSSING
COLUMN & FOOTING DETAILS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03-101
EA 357301

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 11 OF 33

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	YOL	80	0.90	106	108

GEOTECHNICAL PROFESSIONAL 5-29-90

1-26-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER FRANKLIN P. TABER No. 816 EXP. 3-31-96 GEOTECHNICAL STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

TABER CONSULTANTS
536 Galveston Street
West Sacramento, CA 95691
JOB No. 1P2/389/12

Brent Massey DESIGN OVERSIGHT 12-7-94 SIGN OFF DATE	DRAWN BY J.O.D. 2-90 CHECKED BY T.A.K. 3-90	T. A. Krause FIELD INVESTIGATOR DATE Jan. & Feb. 1990	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Richard A Pratt PROJECT ENGINEER

BRIDGE NO. 22-193
POST MILE 0.90

POLE LINE ROAD OVERCROSSING
LOG OF TEST BORINGS NO.1

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03-101
EA 357301

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) 7-26-94 10/26/94

SHEET 31 OF 33

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	YOL	80	0.90	107	108

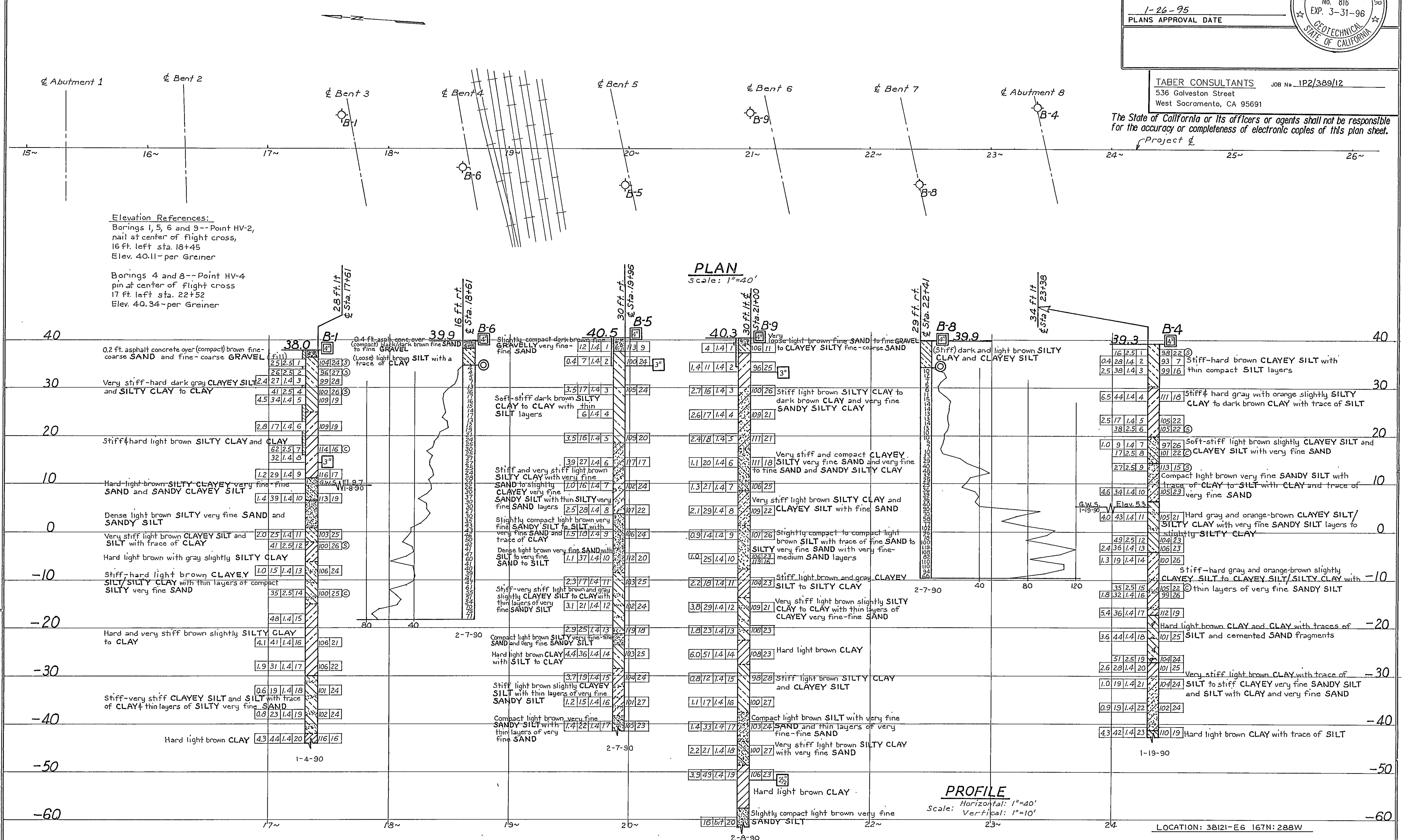
4-3-90
GEOTECHNICAL PROFESSIONAL

1-26-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER FRANKLIN P. TABER No. 816 EXP. 3-31-96 GEOTECHNICAL STATE OF CALIFORNIA

TABER CONSULTANTS JOB No. 1P2/389/12
536 Galveston Street
West Sacramento, CA 95691

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



CONSISTENCY CLASSIFICATION FOR SOILS According to the Standard Penetration Test		
Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

LEGEND OF EARTH MATERIALS: GRAVEL, SAND, SILT, CLAY, SANDY CLAY or CLAYEY SAND, SANDY SILT or SILTY SAND, SILTY CLAY, CLAYEY SILT, PEAT and/or ORGANIC MATTER, FILL MATERIAL, IGNEOUS ROCK, SEDIMENTARY ROCK, METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

Brent Massey DESIGN OVERSIGHT 12-7-94 SIGN OFF DATE	DRAWN BY J.O.D. 2-90 CHECKED BY T.A.K. 3-90	T. A. Krause FIELD INVESTIGATOR DATE Jan. & Feb. 1990	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Richard A Pratt PROJECT ENGINEER	BRIDGE NO. 22-193 POST MILE 0.90	POLE LINE ROAD OVERCROSSING LOG OF TEST BORINGS NO.2

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03-101
EA 357301

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY) 1-26-94 10/26/94

SHEET 32 OF 33

303-225

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	Yol	80	0.90	108	108

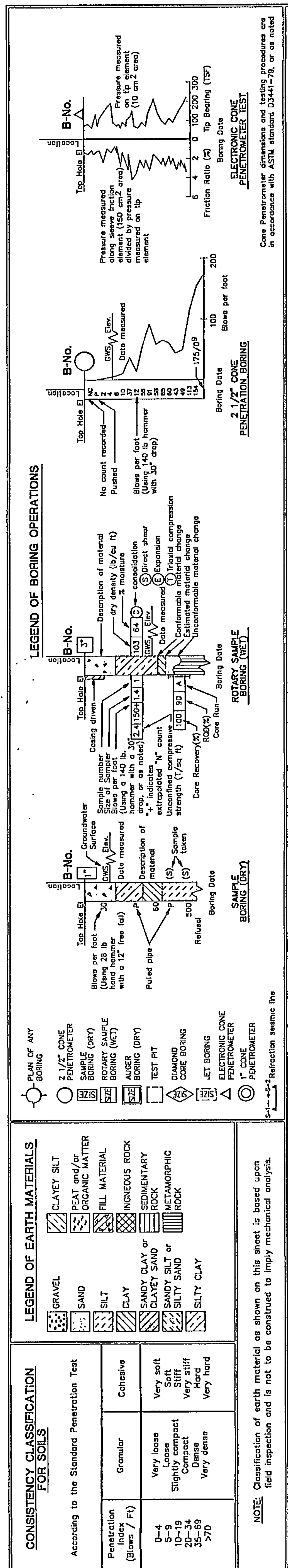
1-26-94
GEOTECHNICAL PROFESSIONAL

1-26-95
PLANS APPROVAL DATE

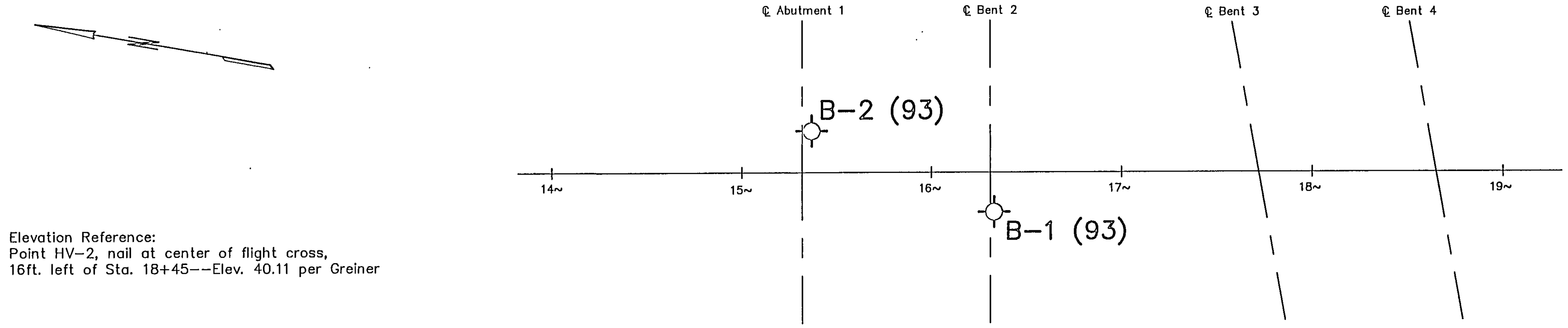
REGISTERED PROFESSIONAL ENGINEER FRANKLIN P. TABER No. 816 EXP. 3-31-96 GEOTECHNICAL STATE OF CALIFORNIA

TABER CONSULTANTS JOB No. 1P2/389/12
536 Galveston Street
West Sacramento, CA 95691

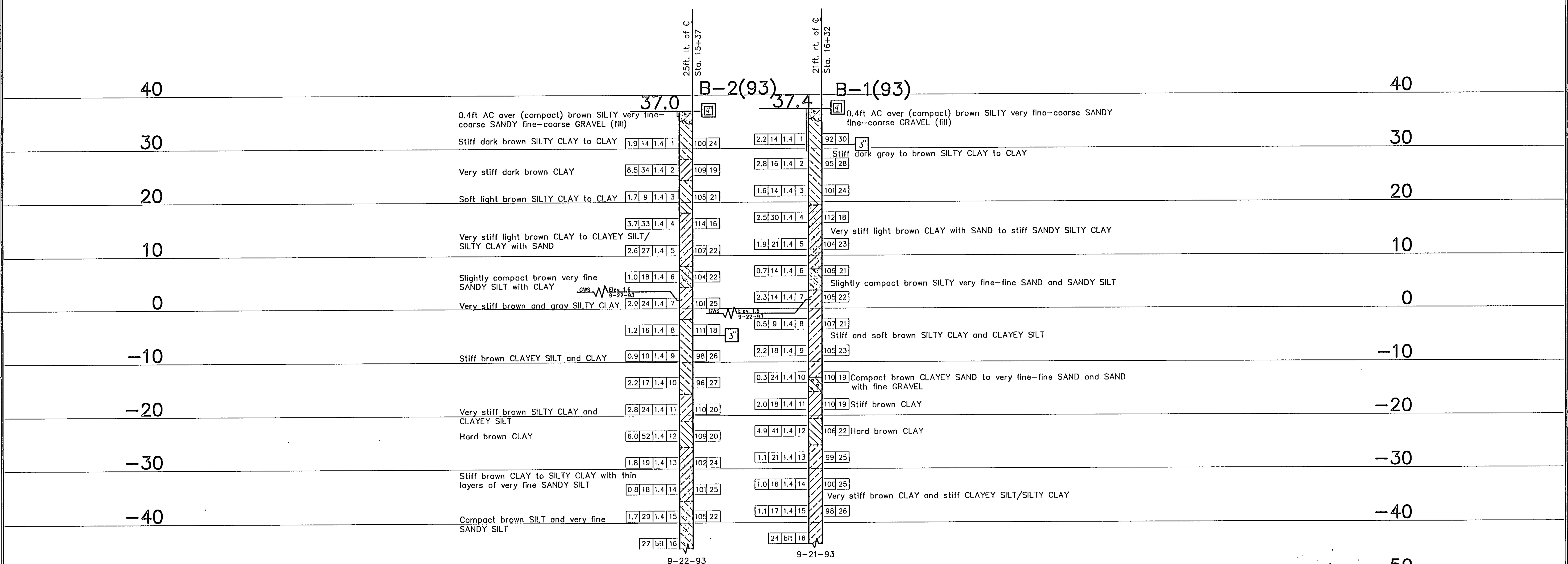
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



Elevation Reference:
Point HV-2, nail at center of flight cross,
16ft. left of Sta. 18+45--Elev. 40.11 per Greiner



PLAN
1" = 40'



PROFILE
Scale: Horizontal 1"=40'
Vertical 1" = 10'

LOCATION: 38121-E6:167N:288W

Brent Massey DESIGN OVERSIGHT 12-7-94 SIGN OFF DATE	DRAWN BY	M.D.R. 9/93	T.A. Krause FIELD INVESTIGATOR	Prepared for the State of CALIFORNIA DEPARTMENT OF TRANSPORTATION	Richard A Pratt PROJECT ENGINEER
	CHECKED BY	W.E.N. 10/93	DATE Sept. 1993		

BRIDGE NO. 22-193
POST MILE 0.90

POLE LINE ROAD OVERCROSSING
LOG OF TEST BORINGS NO.3

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03-101
EA 357301

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 33 OF 33

IL 6052 REV. 4/89

303-225

APPENDIX B

Laboratory Test Results

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-18-001-1A	R-18-001-2A	R-18-001-3A	R-18-001-4A	R-18-001-5A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	3.5	6	11	16	21
Sample Length (in.)	5.454	5.081	5.959	6.025	6.029
Diameter (in.)	2.381	2.378	2.390	2.415	2.393
Sample Volume (ft^3)	0.01406	0.01305	0.01547	0.01597	0.01569
Total Mass Soil+Tube (g)	1008.8	961.7	1093.1	901.7	928.9
Mass of Tube (g)	276.2	280.1	278.4	0.0	0.0
Tare No.	E3	H4	G9	C4	B3
Tare (g)	13.9	13.4	13.6	13.6	13.7
Wet Soil + Tare (g)	76.6	63.6	66.3	64.4	55.0
Dry Soil + Tare (g)	61.2	51.7	52.6	53.5	48.2
Dry Soil (g)	47.3	38.3	39.0	39.9	34.5
Water (g)	15.4	12.0	13.8	10.9	6.8
Moisture (%)	**32.5**	**31.3**	**35.2**	**27.4**	**19.8**
Dry Density (pcf)	**86.7**	**87.7**	**85.8**	**97.7**	**109.0**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-18-001-6A	R-18-001-8A	R-18-001-10A	R-18-001-12A	R-18-001-13A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	26	36	46	56	61
Sample Length (in.)	5.713	5.653	5.647	5.290	5.978
Diameter (in.)	2.381	2.412	2.390	2.406	2.404
Sample Volume (ft^3)	0.01472	0.01495	0.01466	0.01392	0.01570
Total Mass Soil+Tube (g)	1182.0	870.6	844.5	828.5	1168.9
Mass of Tube (g)	275.1	0.0	0.0	0.0	273.9
Tare No.	B1	C18	A19	A18	C7
Tare (g)	13.9	13.6	13.7	13.6	13.7
Wet Soil + Tare (g)	65.2	71.8	55.5	67.4	76.1
Dry Soil + Tare (g)	57.0	60.2	47.4	58.2	63.4
Dry Soil (g)	43.1	46.6	33.8	44.6	49.6
Water (g)	8.2	11.6	8.1	9.2	12.7
Moisture (%)	**19.1**	**24.8**	**23.8**	**20.5**	**25.6**
Dry Density (pcf)	**114.0**	**102.9**	**102.5**	**108.9**	**100.0**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-18-001-16A	R-18-002-1A	R-18-002-2A	R-18-002-3A	R-18-002-4A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	75.5	3.5	6	11	16
Sample Length (in.)	3.330	5.663	5.744	5.626	6.001
Diameter (in.)	1.395	2.426	2.381	2.373	2.403
Sample Volume (ft^3)	0.00295	0.01515	0.01480	0.01440	0.01575
Total Mass Soil+Tube (g)	169.8	976.4	797.3	753.9	929.3
Mass of Tube (g)	0.0	226.3	0.0	0.0	0.0
Tare No.	G6	F6	A8	B15	G2
Tare (g)	13.4	13.6	13.7	13.8	13.4
Wet Soil + Tare (g)	62.8	70.0	52.9	72.0	86.4
Dry Soil + Tare (g)	52.5	58.4	44.4	57.4	74.1
Dry Soil (g)	39.1	44.8	30.7	43.7	60.7
Water (g)	10.3	11.6	8.5	14.6	12.3
Moisture (%)	**26.4**	**25.9**	**27.7**	**33.4**	**20.3**
Dry Density (pcf)	**100.5**	**86.7**	**93.0**	**86.5**	**108.1**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-18-002-5A	R-18-002-6A	R-18-002-7A	R-18-002-8A	R-18-002-9B
USCS Symbol	CL	SC	CL	CL	CL
Depth (ft.)	21	26	31	36	40.5
Sample Length (in.)	5.992	5.974	5.667	5.948	5.887
Diameter (in.)	2.373	2.384	2.376	2.469	2.426
Sample Volume (ft^3)	0.01533	0.01543	0.01454	0.01648	0.01575
Total Mass Soil+Tube (g)	1201.5	1216.3	1139.0	881.6	1114.0
Mass of Tube (g)	272.9	279.7	276.2	0.0	231.6
Tare No.	G24	R5	G22	H20	R17
Tare (g)	13.7	126.6	13.6	13.4	130.3
Wet Soil + Tare (g)	83.3	378.2	81.1	53.4	496.7
Dry Soil + Tare (g)	71.5	342.8	68.2	45.3	417.4
Dry Soil (g)	57.9	216.2	54.7	31.9	287.1
Water (g)	11.8	35.4	12.9	8.1	79.3
Moisture (%)	**20.4**	**16.4**	**23.6**	**25.3**	**27.6**
Dry Density (pcf)	**110.9**	**115.0**	**105.8**	**94.1**	**96.8**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL

MOISTURE-DENSITY TESTS - D2216

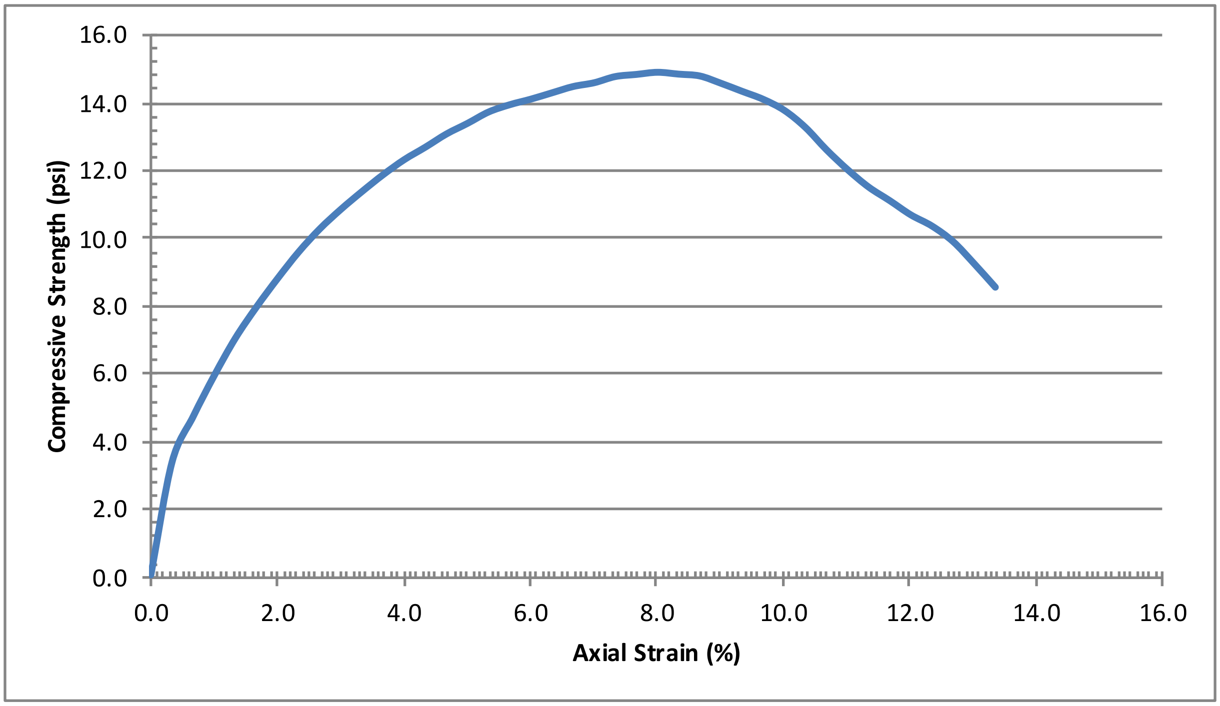
	1	2	3	4	5
Sample No.	R-18-002-10A	R-18-002-11A	R-18-002-12A	R-18-002-13A	
USCS Symbol	CL	CL	CL	CL	
Depth (ft.)	46	51	56	61	
Sample Length (in.)	5.849	6.003	5.425	6.002	
Diameter (in.)	2.442	2.396	2.416	2.412	
Sample Volume (ft^3)	0.01585	0.01566	0.01439	0.01587	
Total Mass Soil+Tube (g)	881.2	872.3	1035.6	887.8	
Mass of Tube (g)	0.0	0.0	203.4	0.0	
Tare No.	C19	B5	H3	F3	
Tare (g)	13.9	13.7	13.4	13.6	
Wet Soil + Tare (g)	45.6	61.1	62.4	59.1	
Dry Soil + Tare (g)	40.1	50.8	53.6	50.2	
Dry Soil (g)	26.2	37.1	40.2	36.6	
Water (g)	5.5	10.3	8.8	8.9	
Moisture (%)	**21.0**	**27.7**	**22.0**	**24.4**	
Dry Density (pcf)	**101.3**	**96.2**	**104.5**	**99.1**	

Notes:

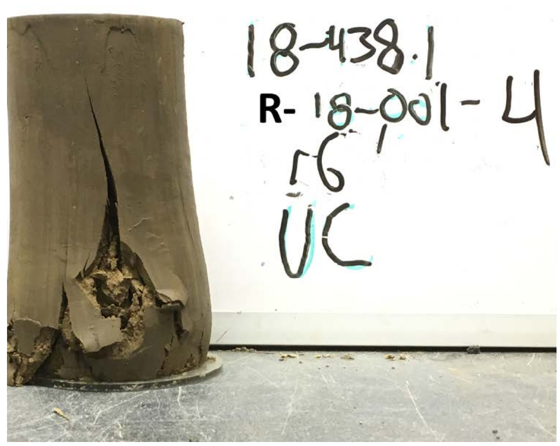
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/25/18
Technician: CAP
Sample ID: R-18-001-4A Depth (ft): 16.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**97.7**
Water Content (%)	**27.4**
Unconfined Compressive Strength (psi)	**14.9**
Unconfined Compressive Strength (psf)	**2146**
Shear Strength (psf)	**1072.8**
Average Height (in)	6.025
Average Diameter (in)	2.415
Rate of strain (%)	1.0
Strain at Failure (%)	8.0

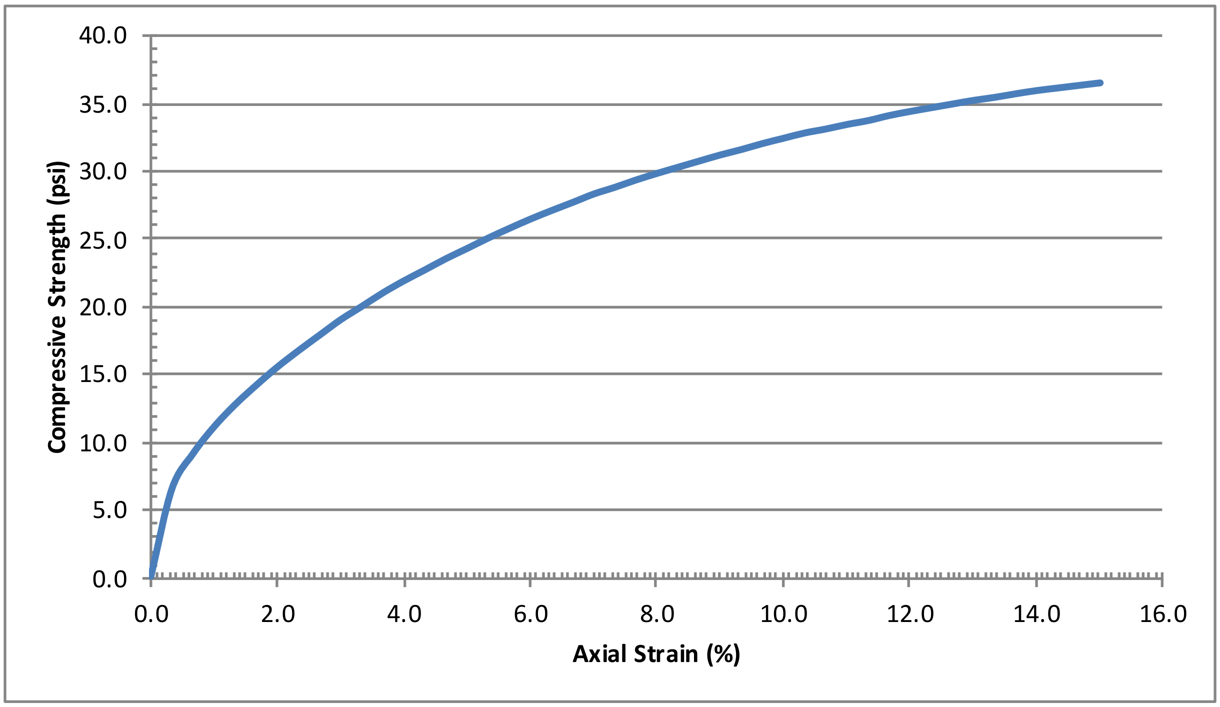


Notes:

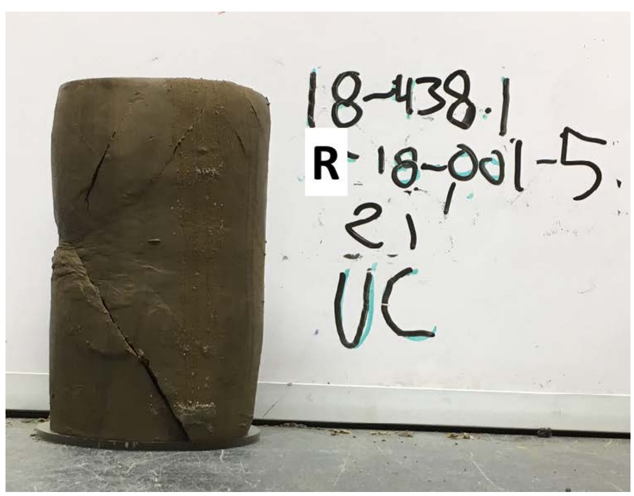
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/25/18
Technician: CAP
Sample ID: R-18-001-5A Depth (ft): 21.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**109.0**
Water Content (%)	**19.8**
Unconfined Compressive Strength (psi)	**36.5**
Unconfined Compressive Strength (psf)	**5256**
Shear Strength (psf)	**2628**
Average Height (in)	6.029
Average Diameter (in)	2.393
Rate of strain (%)	1.0
Strain at 15%	

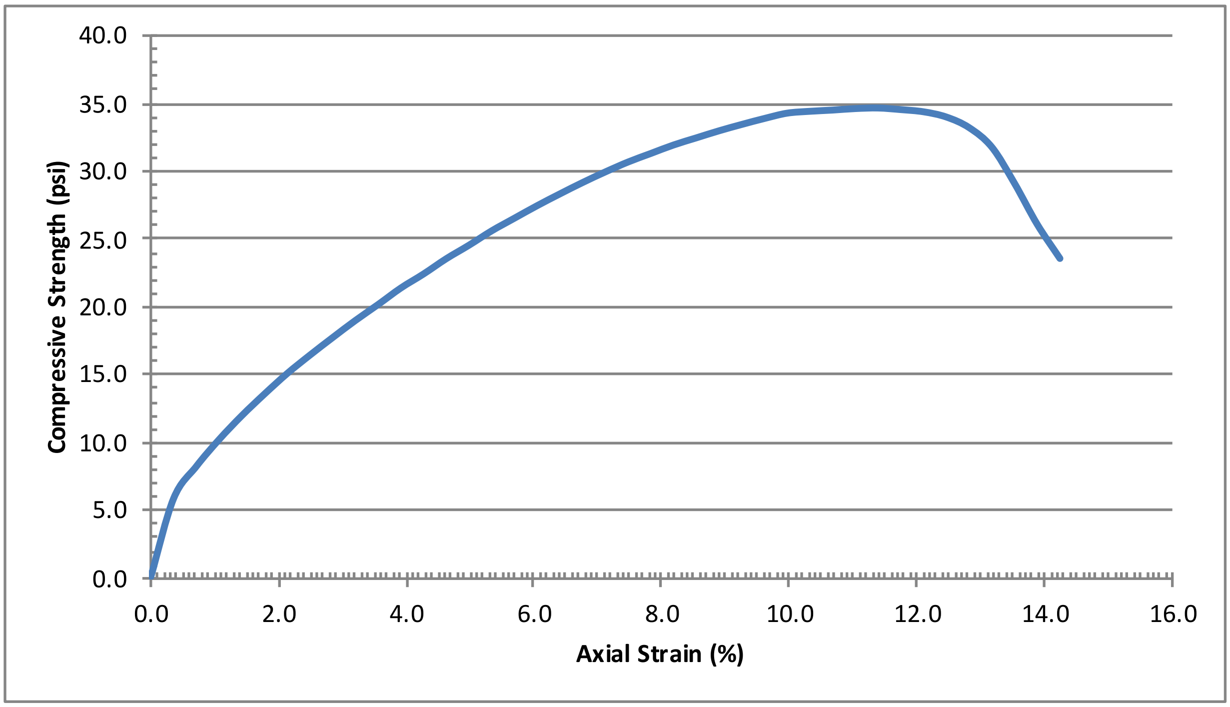


Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/29/18
Technician: GL
Sample ID: R-18-001-8A Depth (ft): 36.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



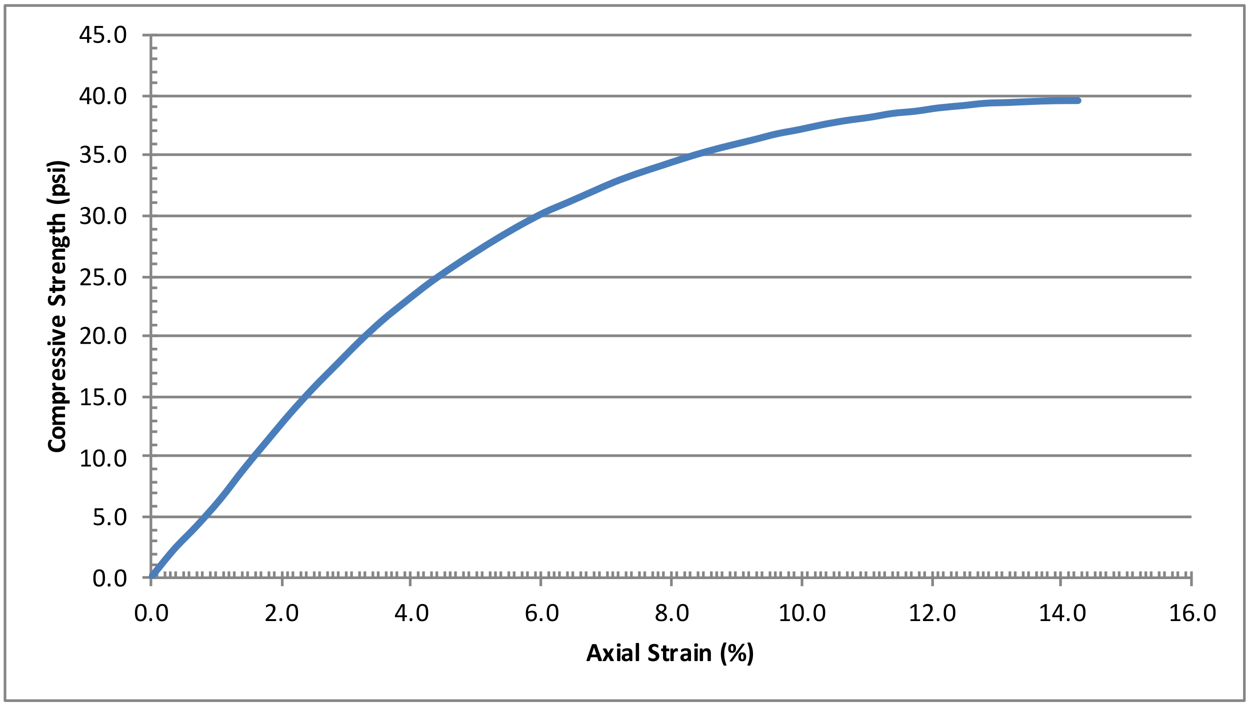
Dry Density (pcf)	**102.9**
Water Content (%)	**24.8**
Unconfined Compressive Strength (psi)	**34.7**
Unconfined Compressive Strength (psf)	**4997**
Shear Strength (psf)	**2498.4**
Average Height (in)	5.653
Average Diameter (in)	2.412
Rate of strain (%)	1.0
Strain at Failure (%)	11.4

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-001-10A Depth (ft): 46.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166

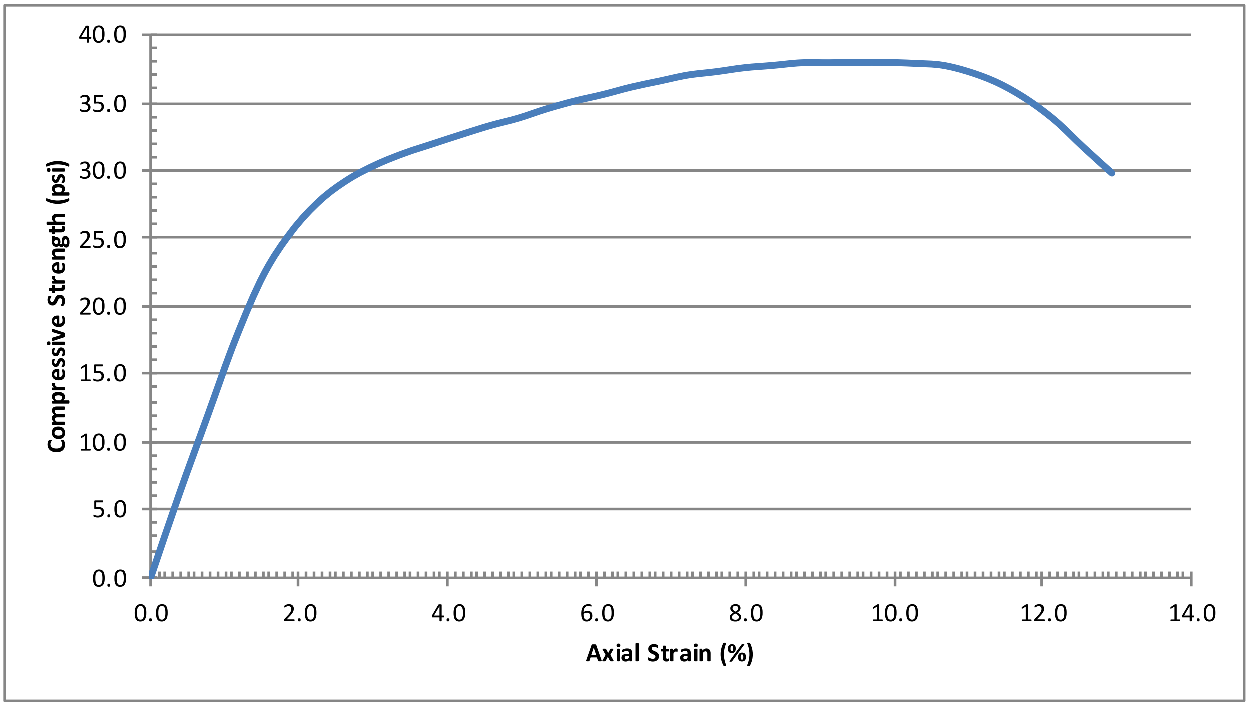


Dry Density (pcf)	**102.6**
Water Content (%)	**23.8**
Unconfined Compressive Strength (psi)	**39.6**
Unconfined Compressive Strength (psf)	**5702**
Shear Strength (psf)	**2851.2**
Average Height (in)	5.647
Average Diameter (in)	2.390
Rate of strain (%)	2.0
Strain at 15%	

Notes:

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-001-12A Depth (ft): 56.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



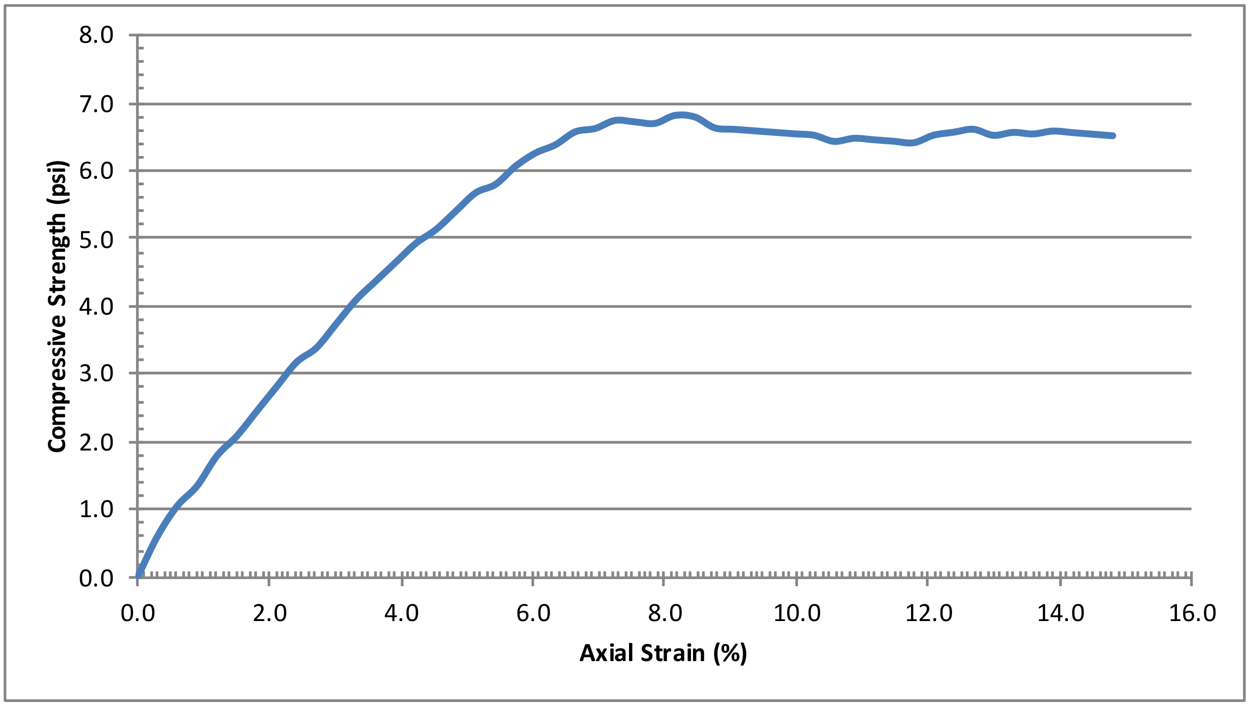
Dry Density (pcf)	**108.9**
Water Content (%)	**20.5**
Unconfined Compressive Strength (psi)	**38.0**
Unconfined Compressive Strength (psf)	**5472**
Shear Strength (psf)	**2736**
Average Height (in)	5.290
Average Diameter (in)	2.406
Rate of strain (%)	2.0
Strain at Failure (%)	9.9

Notes:

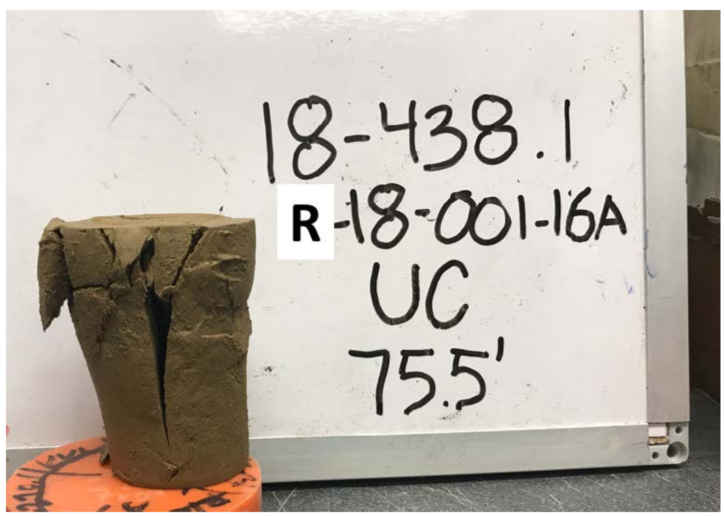
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-001-16A Depth (ft): 75.5
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**100.5**
Water Content (%)	**26.4**
Unconfined Compressive Strength (psi)	**6.8**
Unconfined Compressive Strength (psf)	**979**
Shear Strength (psf)	**489.6**
Average Height (in)	3.330
Average Diameter (in)	1.395
Rate of strain (%)	1.0
Strain at Failure (%)	8.2

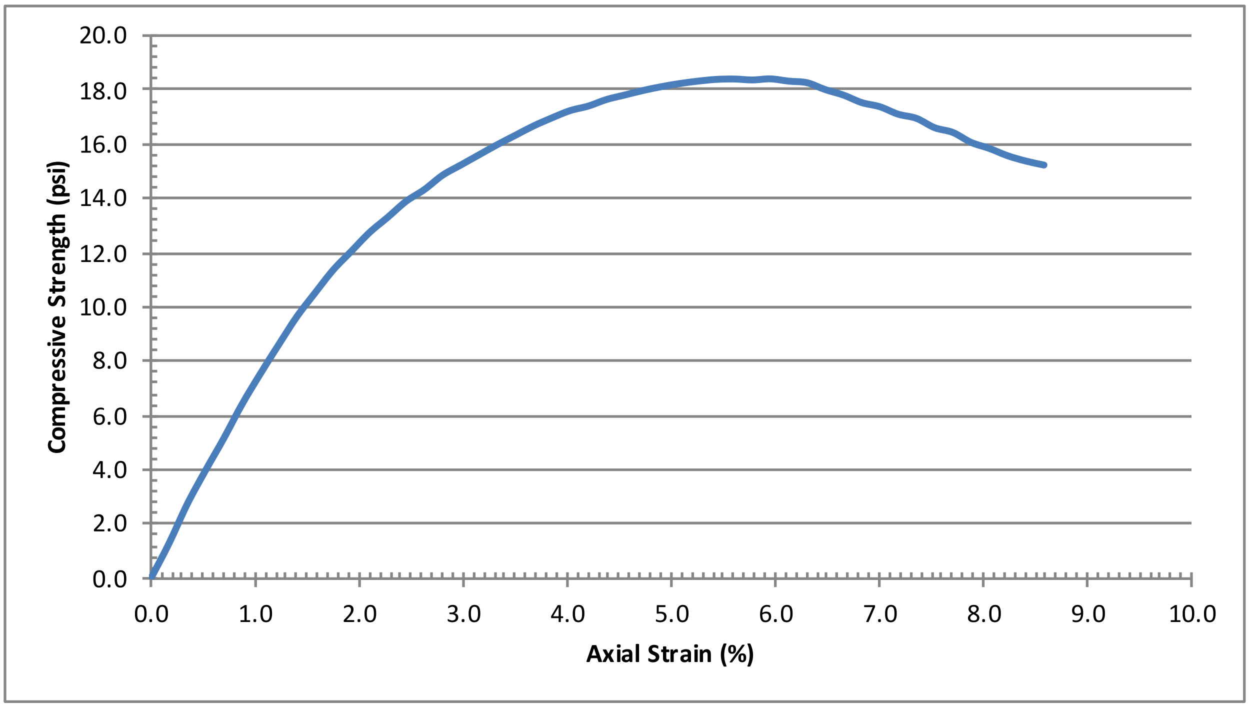


Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-002-2A Depth (ft): 6.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



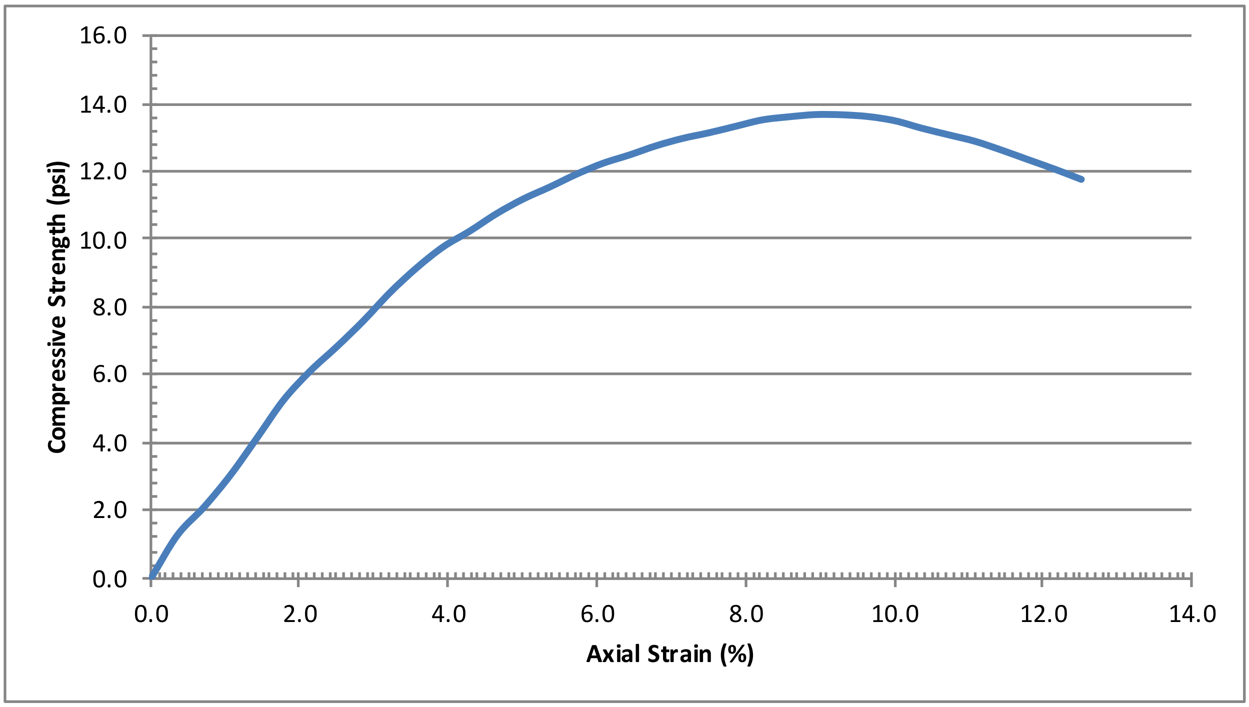
Dry Density (pcf)	**93.0**
Water Content (%)	**27.7**
Unconfined Compressive Strength (psi)	**18.4**
Unconfined Compressive Strength (psf)	**2650**
Shear Strength (psf)	**1324.8**
Average Height (in)	5.744
Average Diameter (in)	2.381
Rate of strain (%)	1.0
Strain at Failure (%)	6.0

Notes:

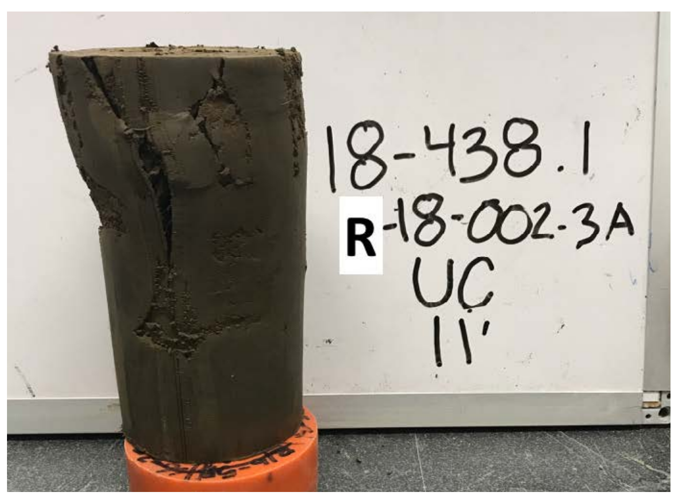
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-002-3A Depth (ft): 11.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**86.5**
Water Content (%)	**33.4**
Unconfined Compressive Strength (psi)	**13.7**
Unconfined Compressive Strength (psf)	**1973**
Shear Strength (psf)	**986.4**
Average Height (in)	5.626
Average Diameter (in)	2.373
Rate of strain (%)	2.0
Strain at Failure (%)	8.9

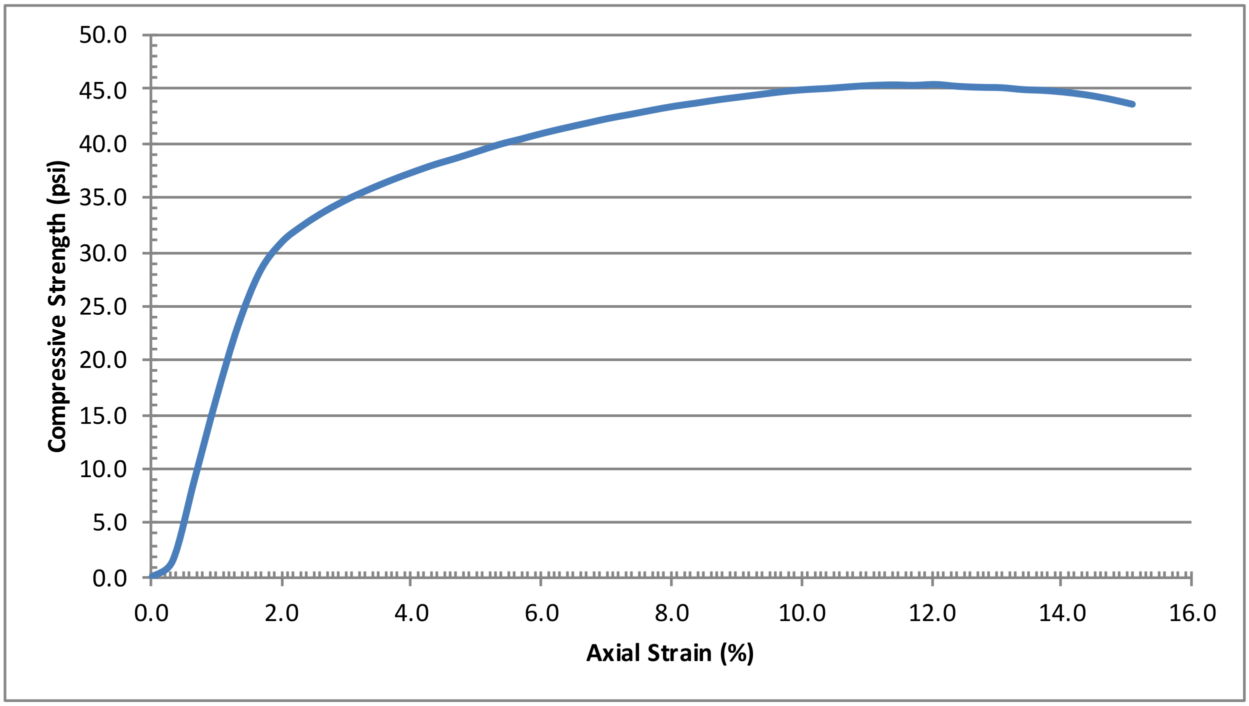


Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/30/18
Technician: HFW
Sample ID: R-18-002-4A Depth (ft): 16.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166

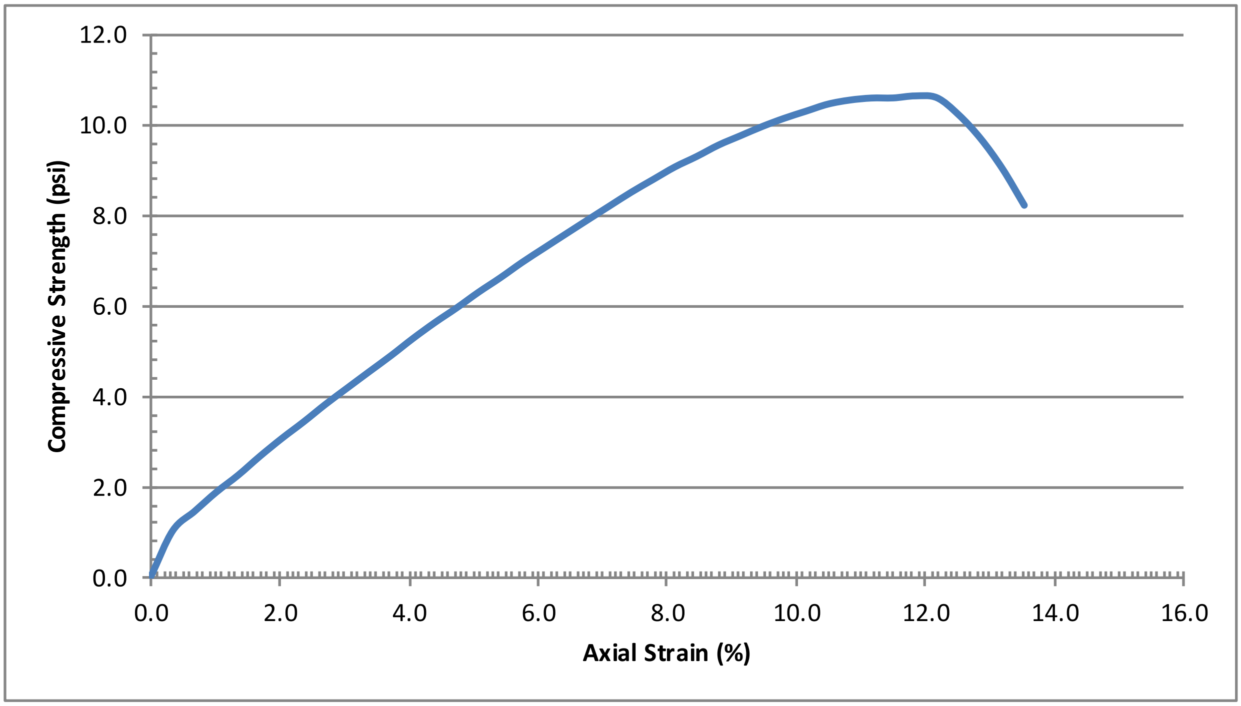


Dry Density (pcf)	**108.2**
Water Content (%)	**20.3**
Unconfined Compressive Strength (psi)	**45.4**
Unconfined Compressive Strength (psf)	**6538**
Shear Strength (psf)	**3268.8**
Average Height (in)	6.001
Average Diameter (in)	2.403
Rate of strain (%)	2.0
Strain at Failure (%)	12.1

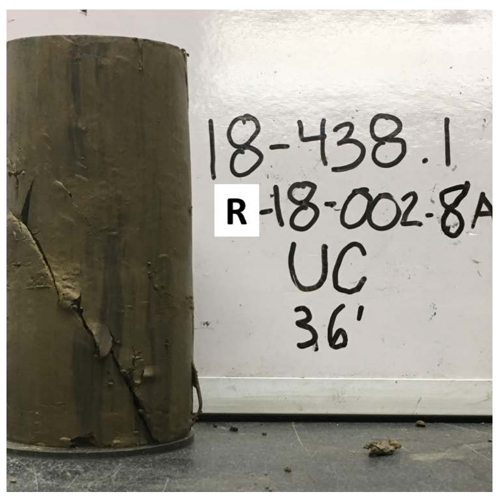
Notes:

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/31/18
Technician: CAP
Sample ID: R-18-002-8A Depth (ft): 36.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**94.1**
Water Content (%)	**25.3**
Unconfined Compressive Strength (psi)	**10.7**
Unconfined Compressive Strength (psf)	**1541**
Shear Strength (psf)	**770.4**
Average Height (in)	5.948
Average Diameter (in)	2.469
Rate of strain (%)	2.0
Strain at Failure (%)	11.8

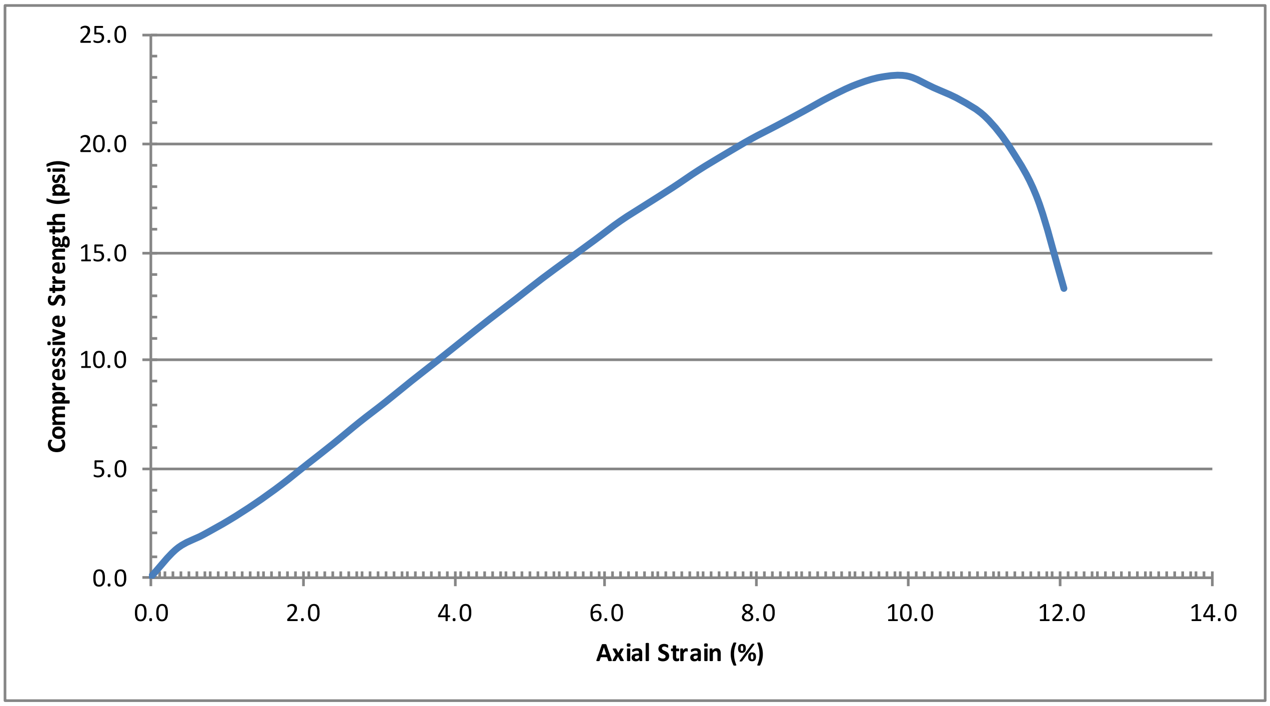


Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/31/18
Technician: CAP
Sample ID: R-18-002-10A Depth (ft): 46.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



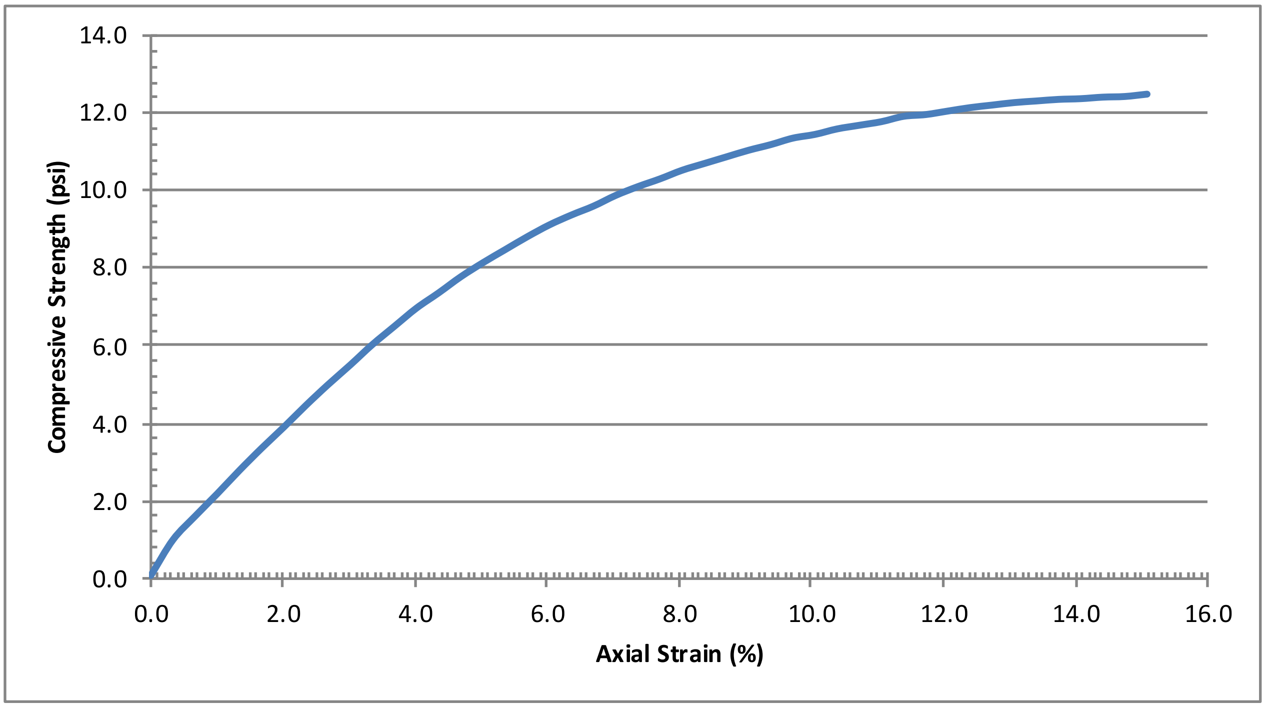
Dry Density (pcf)	**101.3**
Water Content (%)	**21.0**
Unconfined Compressive Strength (psi)	**23.1**
Unconfined Compressive Strength (psf)	**3326**
Shear Strength (psf)	**1663.2**
Average Height (in)	5.849
Average Diameter (in)	2.442
Rate of strain (%)	2.0
Strain at Failure (%)	10.0

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/31/18
Technician: CAP
Sample ID: R-18-002-11A Depth (ft): 51.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



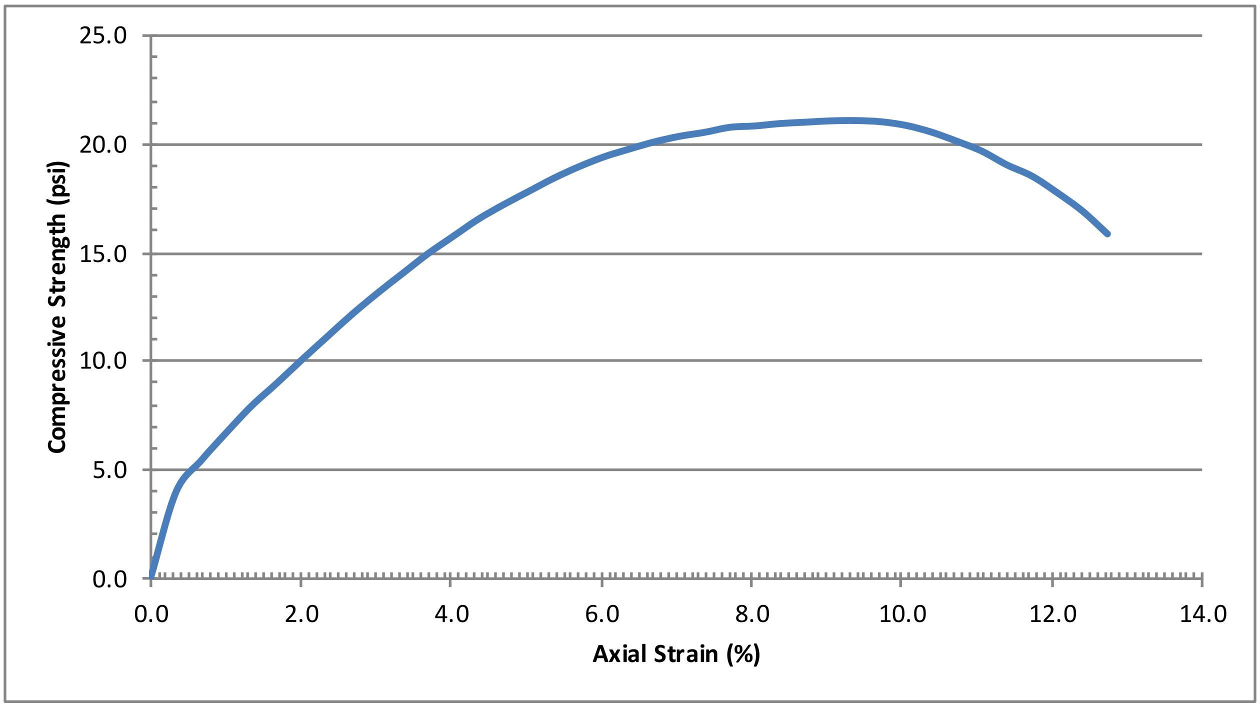
Dry Density (pcf)	**96.2**
Water Content (%)	**27.7**
Unconfined Compressive Strength (psi)	**12.5**
Unconfined Compressive Strength (psf)	**1800**
Shear Strength (psf)	**900**
Average Height (in)	6.003
Average Diameter (in)	2.396
Rate of strain (%)	2.0

Strain at 15%

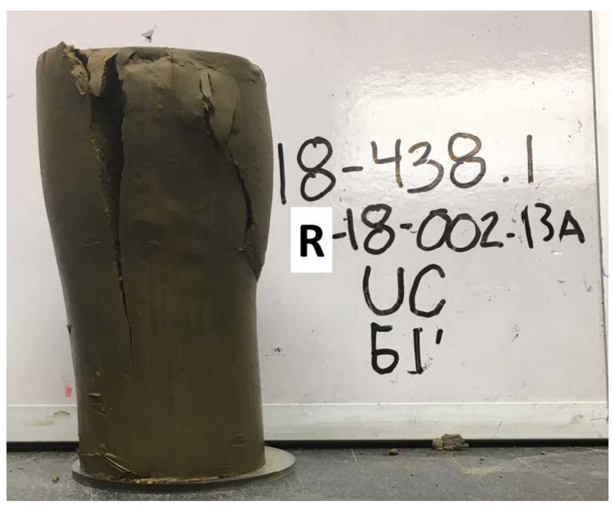
Notes:

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/31/18
Technician: CAP
Sample ID: R-18-002-13A Depth (ft): 61.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**99.1**
Water Content (%)	**24.4**
Unconfined Compressive Strength (psi)	**21.1**
Unconfined Compressive Strength (psf)	**3038**
Shear Strength (psf)	**1519.2**
Average Height (in)	6.002
Average Diameter (in)	2.412
Rate of strain (%)	2.0
Strain at Failure (%)	9.4



Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 5/25/18
Technician: GL

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	R-18-001-11A	R-18-001-15A	R-18-002-6A	R-18-002-9B	
USCS Symbol	CL	CL	SC	CL	
Depth (ft.)	51	71	26	40.5	
Tare No.	R8	P5	R5	R17	
Tare (g)	130.8	131.8	126.6	130.3	
Dry Soil + Tare (g)	393.5	297.3	342.8	419.4	
Dry Mass before (g)	262.7	165.5	216.2	289.1	
Dry Mass after (g)	25.3	58.1	160.8	41.7	
Percent Fines (%)	90	65	26	86	

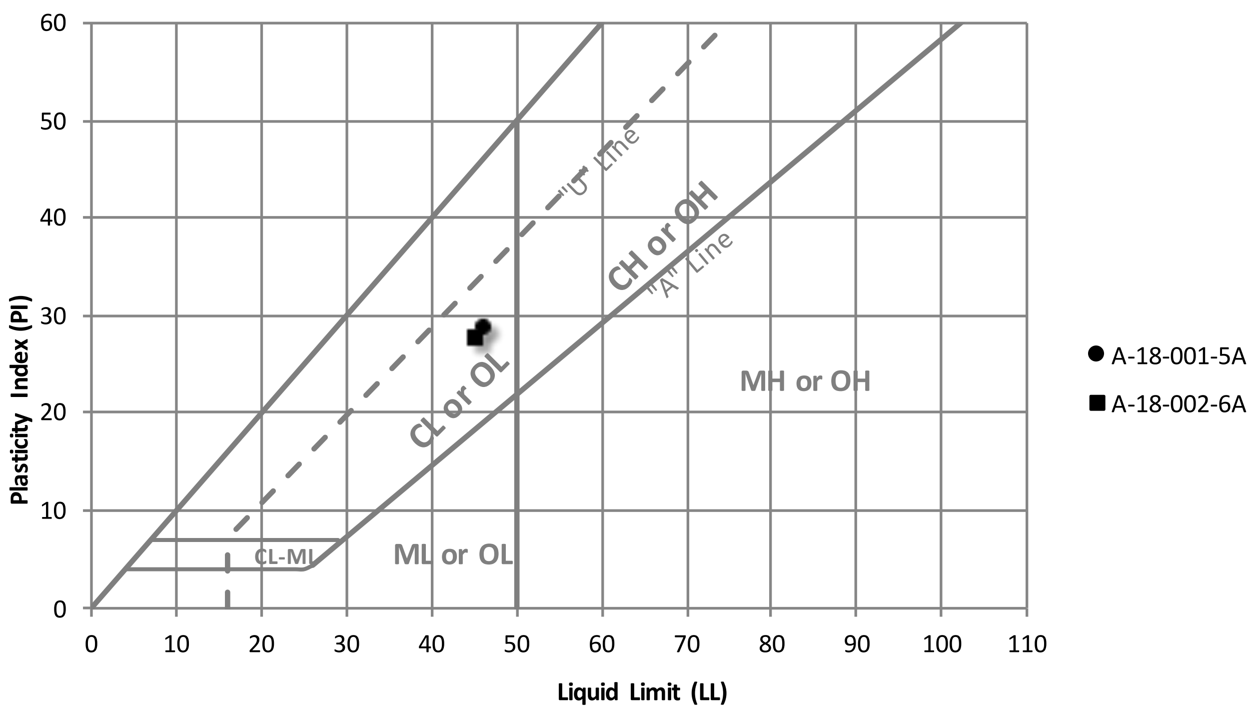
Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Olive Drive Bike and Ped Connection Davis
CAInc File No: 18-438.1
Date: 6/4/18
Technician: CAP

Plastic Index - ASTM D4318

Sample ID	Depth (ft)	Liquid Limit	Plastic Limit	PI
R-18-001-5A	21	46	17	29
R-18-002-6A	26	45	17	28



Plasticity Chart

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 06/01/2018
Date Submitted 05/29/2018

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 18-438.1 OLIVE DR. Site ID : R-18-001-9A.
Thank you for your business.

* For future reference to this analysis please use SUN # 77100-160932.

EVALUATION FOR SOIL CORROSION

Soil pH	7.62		
Minimum Resistivity	1.42	ohm-cm (x1000)	
Chloride	1.7 ppm	00.00017	%
Sulfate	32.9 ppm	00.00329	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 06/01/2018
Date Submitted 05/29/2018

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 18-438.1 OLIVE DR. Site ID : R-18-002-5A.
Thank you for your business.

* For future reference to this analysis please use SUN # 77100-160933.

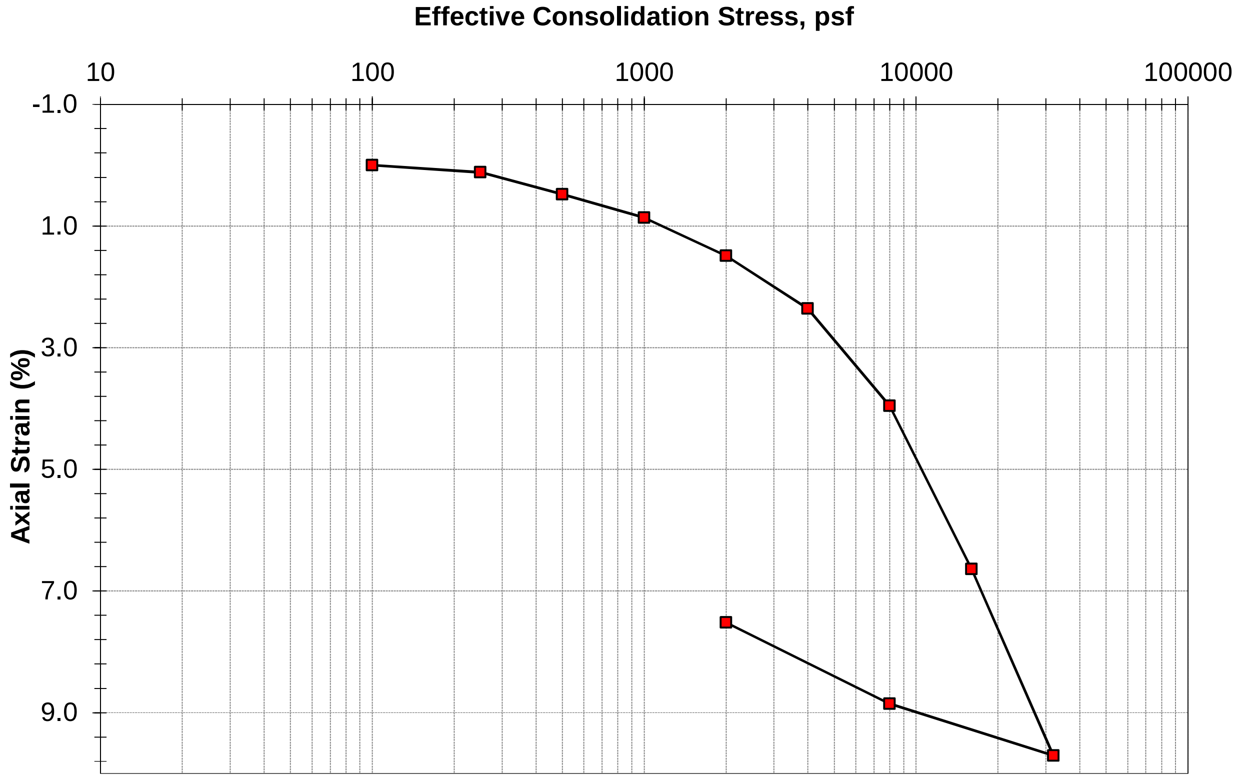
EVALUATION FOR SOIL CORROSION

Soil pH	7.69		
Minimum Resistivity	1.10	ohm-cm (x1000)	
Chloride	0.4 ppm	00.00004	%
Sulfate	7.9 ppm	00.00079	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

CONSOLIDATION TEST - ASTM D2435
STRESS VERSUS STRAIN

Project Name	Crawford 18-438.1
Geocon Project Number	S9763-05-128
Boring Number	R-18-001
Sample Number	R-18-001-7A
Sample Description	Olive Sandy lean CLAY



Axial Load, psf	Void Ratio	Axial Strain, %
initial	0.717	0.00
100	0.717	0.00
250	0.715	0.12
500	0.709	0.48
1000	0.702	0.87
2000	0.691	1.49
4000	0.676	2.36
8000	0.649	3.96
16000	0.603	6.64
32000	0.550	9.71
8000	0.565	8.85
2000	0.588	7.52

Measurement	Initial	Final
Height (in.)	0.750	0.694
Moisture Content (%)	24.4	21.2
Dry Density (pcf)	100.4	108.5
Saturation (%)	94	100

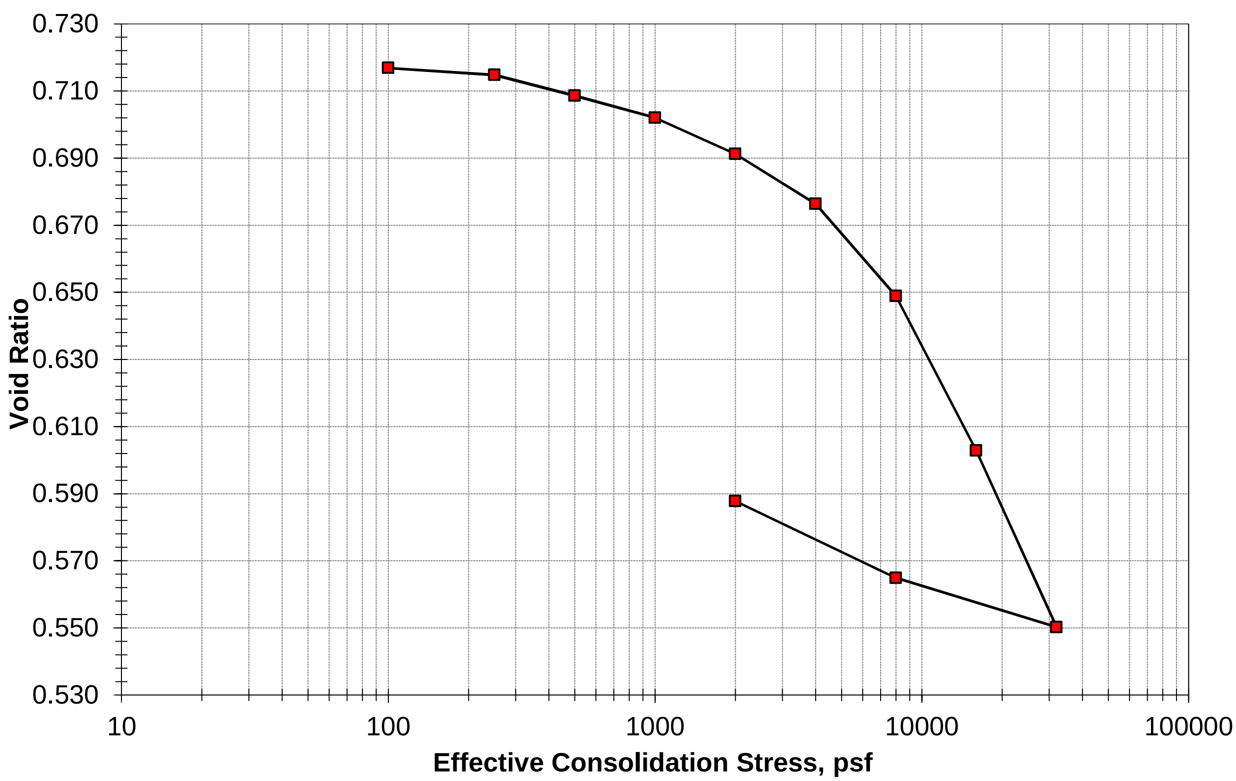
Note:
Gs = 2.76 (assumed)

GEOCON CONSULTANTS, INC.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, CA 95742
tel. 916.852-9118 fax. 916.852.9132

CONSOLIDATION TEST - ASTM D2435

STRESS VERSUS VOID RATIO

Project Name	Crawford 18-438.1
Geocon Project Number	S9763-05-128
Boring Number	R-18-001
Sample Number	R-18-001-7A
Sample Description	Olive Sandy lean CLAY



Axial Load, psf	Void Ratio	Axial Strain, %
initial	0.717	0.00
100	0.717	0.00
250	0.715	0.12
500	0.709	0.48
1000	0.702	0.87
2000	0.691	1.49
4000	0.676	2.36
8000	0.649	3.96
16000	0.603	6.64
32000	0.550	9.71
8000	0.565	8.85
2000	0.588	7.52

Measurement	Initial	Final
Height (in.)	0.750	0.694
Moisture Content (%)	24.4	21.2
Dry Density (pcf)	100.4	108.5
Saturation (%)	94	100

Note:
Gs = 2.76 (assumed)

GEOCON CONSULTANTS, INC.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, CA 95742
tel. 916.852-9118 fax. 916.852.9132

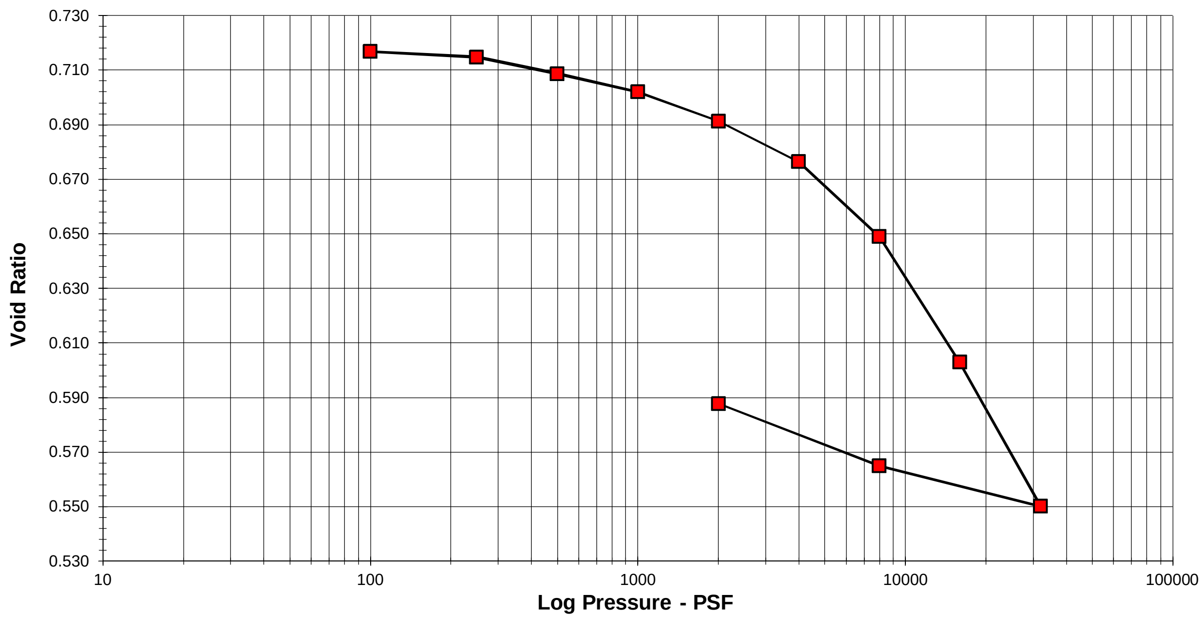
CONSOLIDATION TEST - ASTM D2435

Project Name: Crawford 18-438.1

Project Number: S9763-05-128 Sample Number: R-18-001 R-18-001-7A

CONSOLIDATION TEST RESULTS

JOB S9763-05-128, BORING R-18-001, R-18-001-7A



Axial Load (psf)	Void Ratio	Axial Strain (%)	m_V, coef of vol Compres (in^2/lb)	$c_{C,}$ Comp Index	50% Consolidation: t_{50}, Time to Consol (min)	50% Consolidation: C_V, Coeff of Consol (ft^2/yr)	90% Consolidation: t_{90}, Time to Consol (min)	90% Consolidation: C_V, Coeff of Consol (ft^2/yr)
initial	0.717	0.00						
100	0.717	0.00						
250	0.715	0.12						
500	0.709	0.48						
1000	0.702	0.87	0.0011	0.022	1.57	63.47	6.73	63.84
2000	0.691	1.49	0.0009	0.036	0.24	406.21	1.04	408.56
4000	0.676	2.36						
8000	0.649	3.96						
16000	0.603	6.64						
32000	0.550	9.71						
8000	0.565	8.85						
2000	0.588	7.52						

G_s = 2.76 (assumed)	COND AT START OF TEST	COND AT END OF TEST
HEIGHT (in.)	0.7500	0.6936
MOISTURE CONTENT (%)	24.4	21.2
DRY DENSITY (pcf):	100.4	108.5
SATURATION (%)	94.2	99.9

GEOCON CONSULTANTS, INC.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, CA 95742
tel. 916.852-9118 fax. 916.852.9132

APPENDIX C

CIDH Pile Nominal Resistance

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE

Pole Line Road/ Olive Drive Connection

Davis, CA

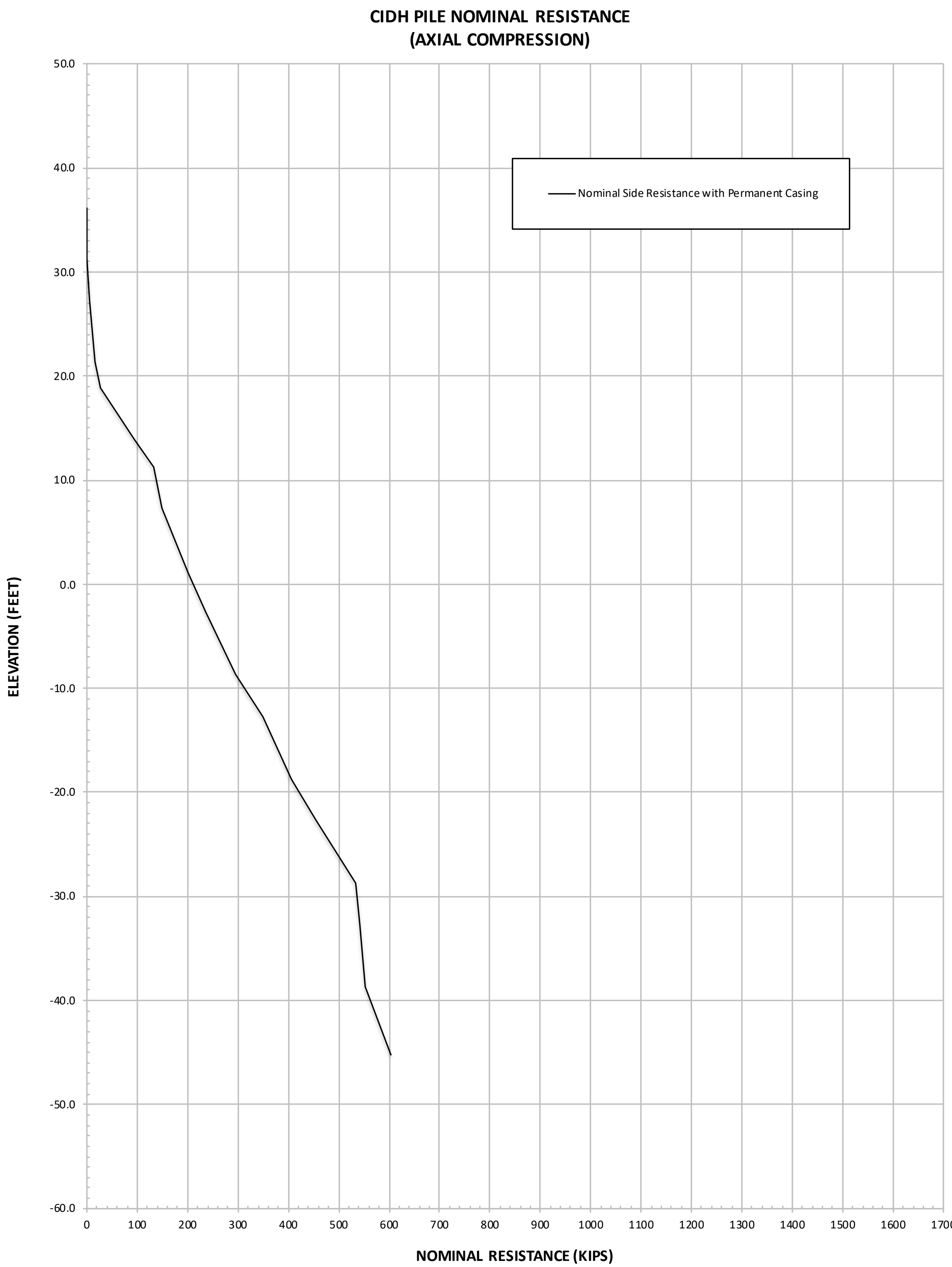
CAInc Project Number: 18-438.1

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

February 6, 2020

Support Location(s): Abutment 1	Pile Diameter = 24 inches	Pile Cut-Off Elevation = 36.11 feet
	Socket Diameter = NA	Permanent Casing Tip Elevation = 19.11 feet

SERVICE LIMIT			STRENGTH LIMIT			EXTREME LIMIT		
REQUIRED NOMINAL RESISTANCE =	70	kips	REQUIRED NOMINAL RESISTANCE =	100	kips	REQUIRED NOMINAL RESISTANCE =	N/A	kips
SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	12.0	feet	DESIGN PILE TIP ELEVATION =	10.0	feet	DESIGN PILE TIP ELEVATION =	N/A	feet



CIDH Pile Nominal Resistance calculated consistent with 2012 Sixth Edition AASHTO LRFD Bridge Design Specifications and California Amendments.

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE

Pole Line Road/ Olive Drive Connection

Davis, CA

CAInc Project Number: 18-438.1

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

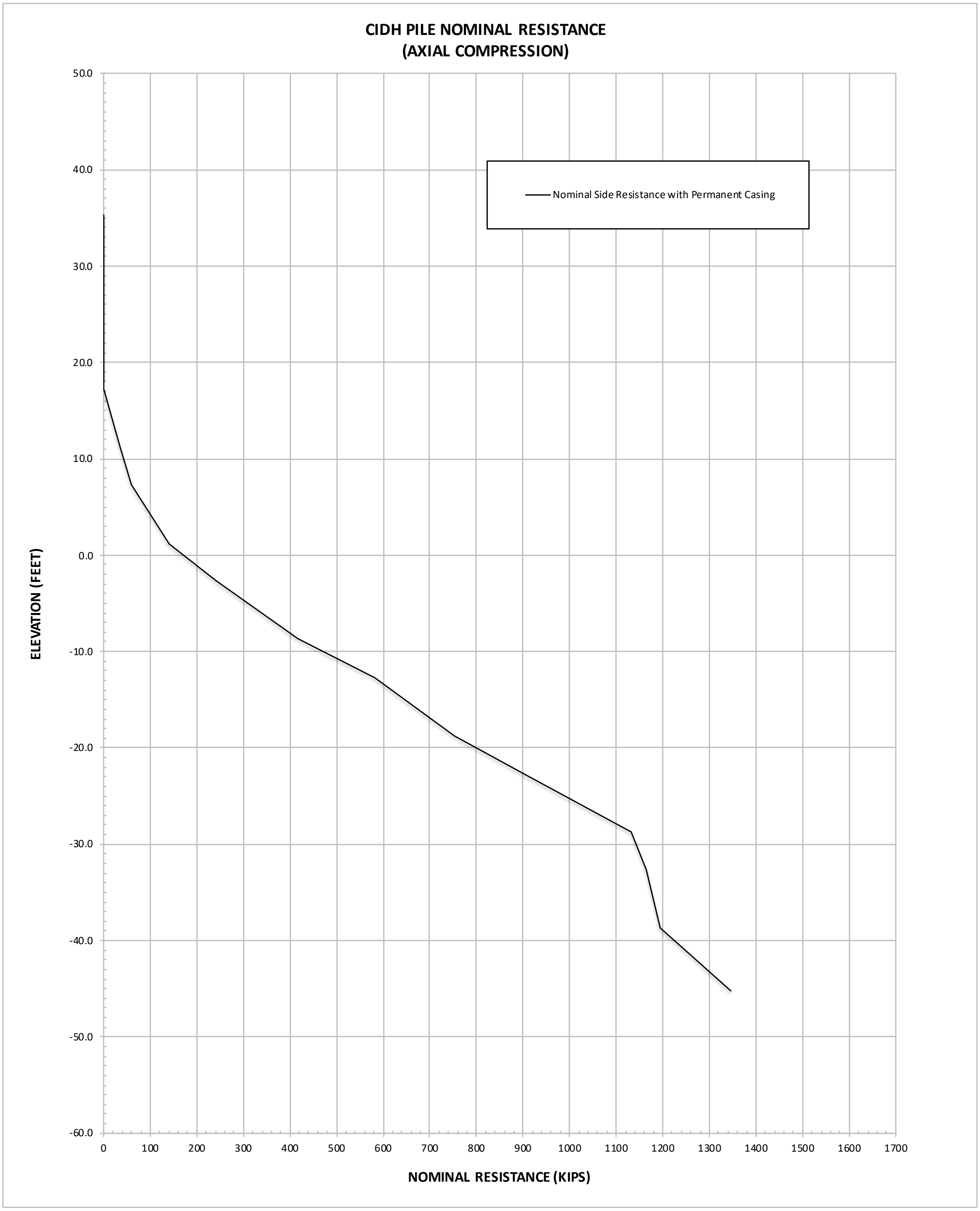
February 6, 2020

Support Location(s): Bent 2	**Pile Diameter = 72 inches**	**Pile Cut-Off Elevation = 17.97 feet**
	Socket Diameter = NA	**Permanent Casing Tip Elevation =** 0.97 feet

SERVICE LIMIT		
REQUIRED NOMINAL RESISTANCE =	560	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-16.0	feet

STRENGTH LIMIT		
REQUIRED NOMINAL RESISTANCE =	1070	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-30.0	feet

EXTREME LIMIT		
REQUIRED NOMINAL RESISTANCE =	480	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-14.0	feet



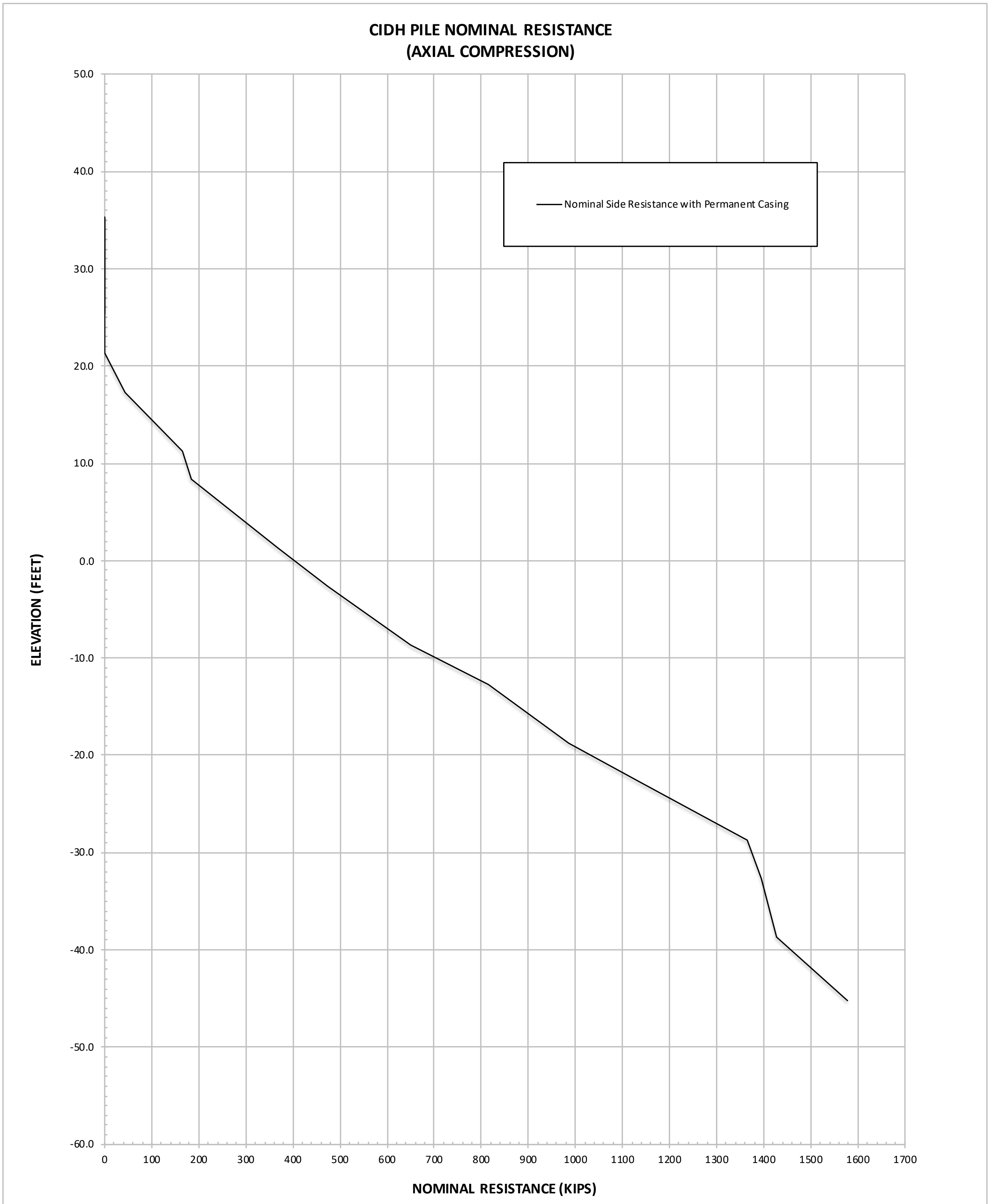
CIDH Pile Nominal Resistance calculated consistent with 2012 Sixth Edition AASHTO LRFD Bridge Design Specifications and California Amendments.

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE
Pole Line Road/ Olive Drive Connection
Davis, CA
CAInc Project Number: 18-438.1

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
January 21, 2020

Support Location(s): Bent 3	**Pile Diameter = 72 inches**	**Pile Cut-Off Elevation = 25.4 feet**
	Socket Diameter = NA	**Permanent Casing Tip Elevation =** 8.4 feet

SERVICE LIMIT			STRENGTH LIMIT			EXTREME LIMIT		
REQUIRED NOMINAL RESISTANCE =	580	kips	REQUIRED NOMINAL RESISTANCE =	1120	kips	REQUIRED NOMINAL RESISTANCE =	510	kips
SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-10.0	feet	DESIGN PILE TIP ELEVATION =	-25.0	feet	DESIGN PILE TIP ELEVATION =	-7.0	feet



CIDH Pile Nominal Resistance calculated consistent with 2012 Sixth Edition AASHTO LRFD Bridge Design Specifications and California Amendments.

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE

Pole Line Road/ Olive Drive Connection

Davis, CA

CAInc Project Number: 18-438.1

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

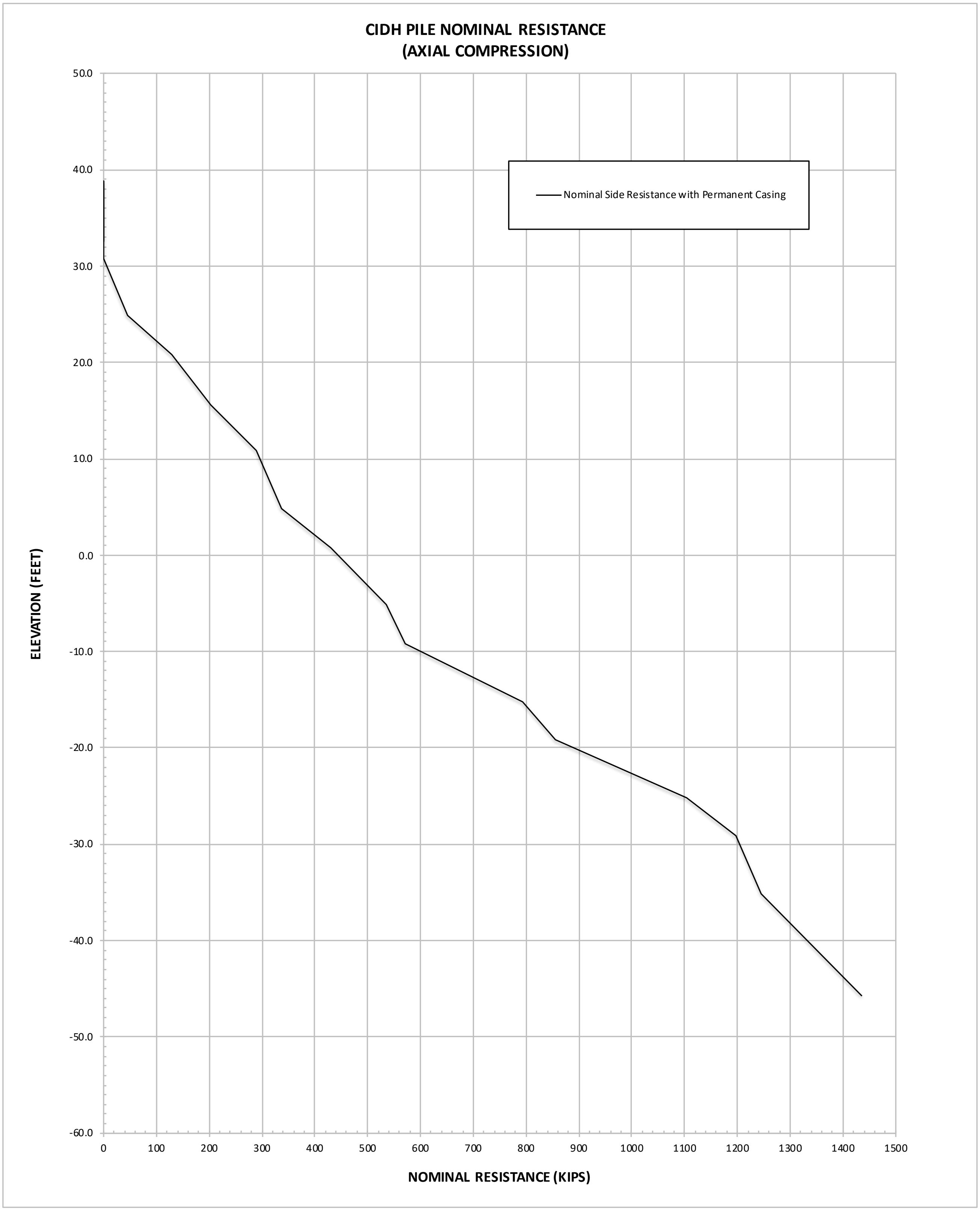
January 21, 2020

Support Location(s): Bent 4	**Pile Diameter = 72 inches**	**Pile Cut-Off Elevation = 32.55 feet**
	Socket Diameter = NA	**Permanent Casing Tip Elevation =** 15.55 feet

SERVICE LIMIT		
REQUIRED NOMINAL RESISTANCE =	640	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-14.0	feet

STRENGTH LIMIT		
REQUIRED NOMINAL RESISTANCE =	1230	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-37.0	feet

EXTREME LIMIT		
REQUIRED NOMINAL RESISTANCE =	570	kips
SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	-12.0	feet



CIDH Pile Nominal Resistance calculated consistent with 2012 Sixth Edition AASHTO LRFD Bridge Design Specifications and California Amendments.

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE

Pole Line Road/ Olive Drive Connection

Davis, CA

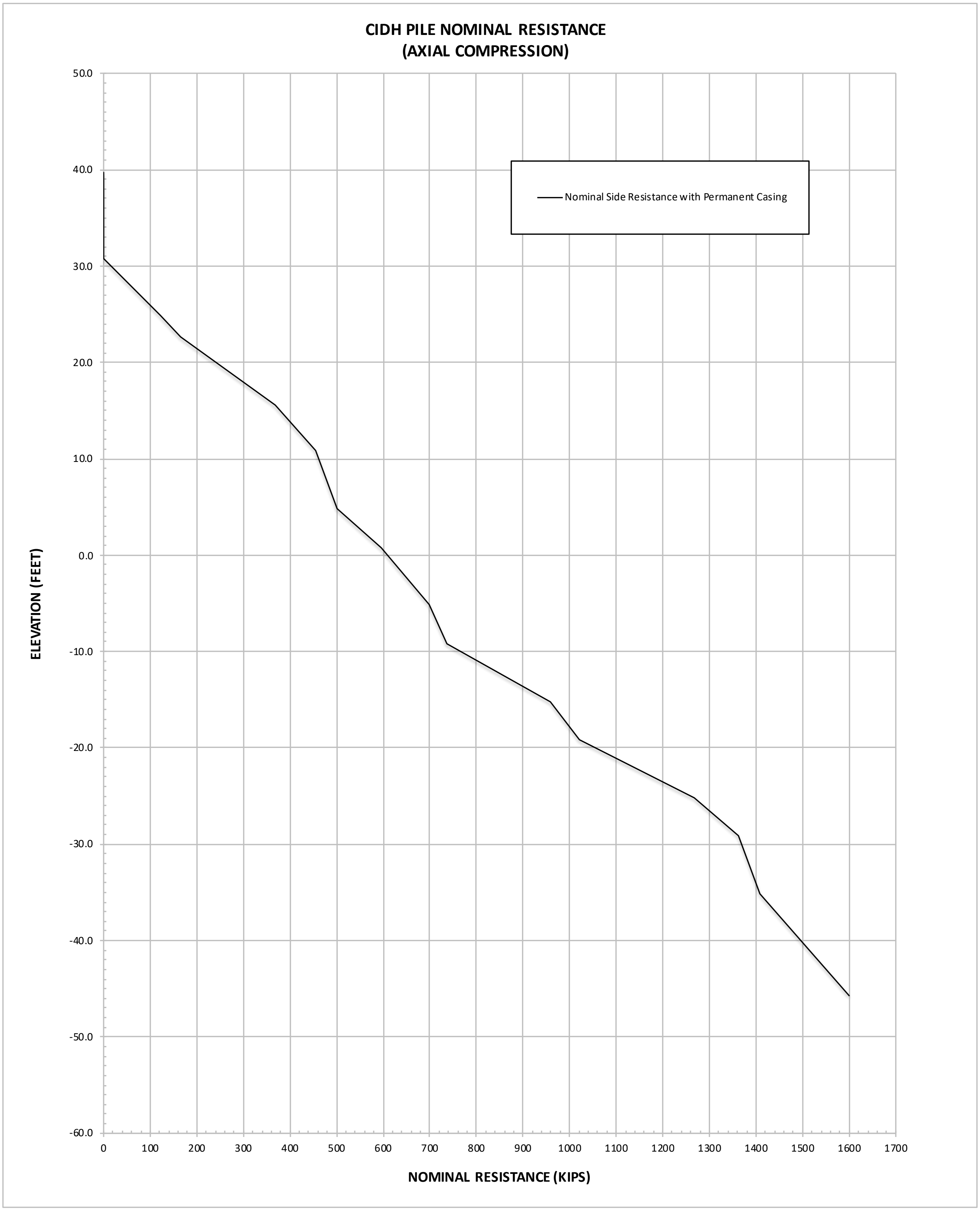
CAInc Project Number: 18-438.1

Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services

January 21, 2020

Support Location(s): Bent 5	**Pile Diameter = 72 inches**	**Pile Cut-Off Elevation = 39.69 feet**
	Socket Diameter = NA	**Permanent Casing Tip Elevation =** 22.69 feet

SERVICE LIMIT			**STRENGTH LIMIT**			**EXTREME LIMIT**		
REQUIRED NOMINAL RESISTANCE =	390	kips	REQUIRED NOMINAL RESISTANCE =	750	kips	REQUIRED NOMINAL RESISTANCE =	380	kips
SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet	SCOUR ELEVATION =	NA	feet
DESIGN PILE TIP ELEVATION =	9.0	feet	DESIGN PILE TIP ELEVATION =	-12.0	feet	DESIGN PILE TIP ELEVATION =	9.0	feet



CIDH Pile Nominal Resistance calculated consistent with 2012 Sixth Edition AASHTO LRFD Bridge Design Specifications and California Amendments.

APPENDIX D

LPile Parameters

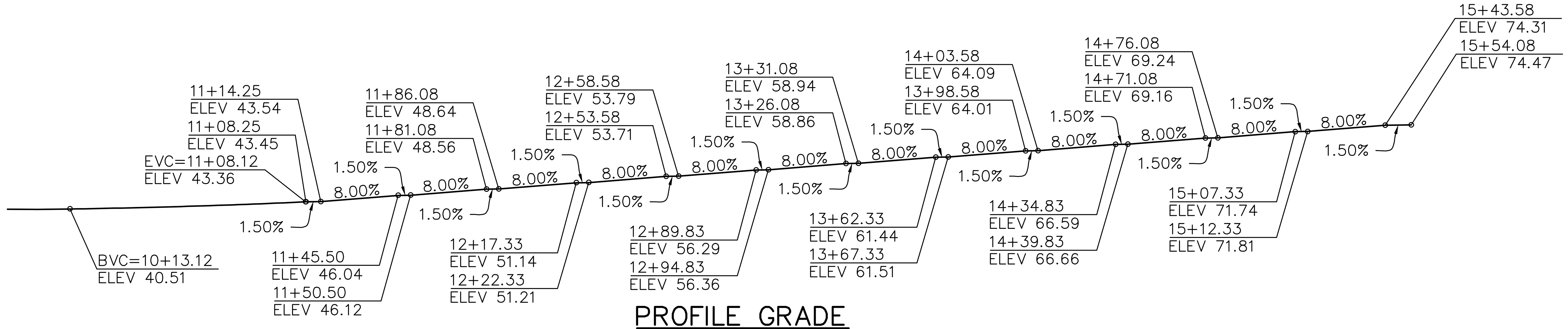
LPile Parameters - Abut 1 & Bent 2 (CAInc R-18-001)							
Elevation	Soil Type	Total Unit Weight (lb/ft³)	Buoyant Unit Weight (lb/ft³)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)	Strain Factor, E50 (dim.)	p-y Modulus, K (lb/in³)
36 to 19	Soft Clay (Reese)	118	56	xx	750	0.010	500
19 to -30	Stiff Clay w/o free water (Reese)	130	68	xx	2500	0.005	1000
-30 to -45	Stiff Clay w/o free water (Reese)	124	62	xx	1000	0.007	500

LPile Parameters - Bent 3 & Bent 4 (CAInc R-18-002)							
Elevation	Soil Type	Total Unit Weight (lb/ft³)	Buoyant Unit Weight (lb/ft³)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)	Strain Factor, E50 (dim.)	p-y Modulus, K (lb/in³)
40 to 25	Stiff Clay w/o free water (Reese)	118	56	xx	1250	0.007	500
25 to 10	Stiff Clay w/o free water (Reese)	134	72	xx	3250	0.005	1000
10 to -15	Stiff Clay w/o free water (Reese)	124	62	xx	1500	0.007	500
-15 to -35	Stiff Clay w/o free water (Reese)	122	60	xx	2000	0.007	500
-35 to -45	Soft Clay (Reese)	122	60	xx	750	0.010	500

LPile Parameters - Bent 5 (Taber B5)							
Elevation	Soil Type	Total Unit Weight (lb/ft^3)	Buoyant Unit Weight (lb/ft^3)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)	Strain Factor, E50 (dim.)	p-y Modulus, K (lb/in^3)
40.5 to 39	Sand (Reese)	123	61	35	xx	xx	60
39 to 34	Soft Clay (Reese)	124	62	xx	400	0.020	200
34 to 11.5	Stiff Clay w/o free water (Reese)	133	71	xx	3600	0.005	1000
11.5 to 0	Stiff Clay w/o free water (Reese)	129	67	xx	1700	0.070	500
0 to -6	Sand (Reese)	134	72	35	xx	xx	60
-6 to -36	Stiff Clay w/o free water (Reese)	130	68	xx	2900	0.005	1000
-36 to -40	Sand (Reese)	129	67	31	xx	xx	20

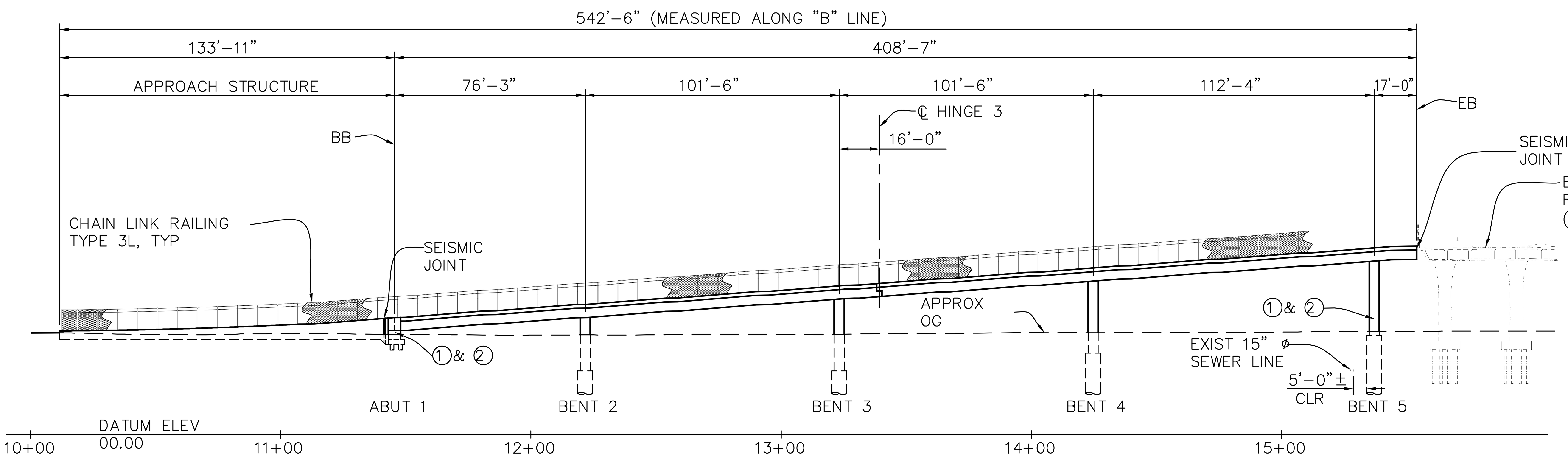
APPENDIX E

General Plan



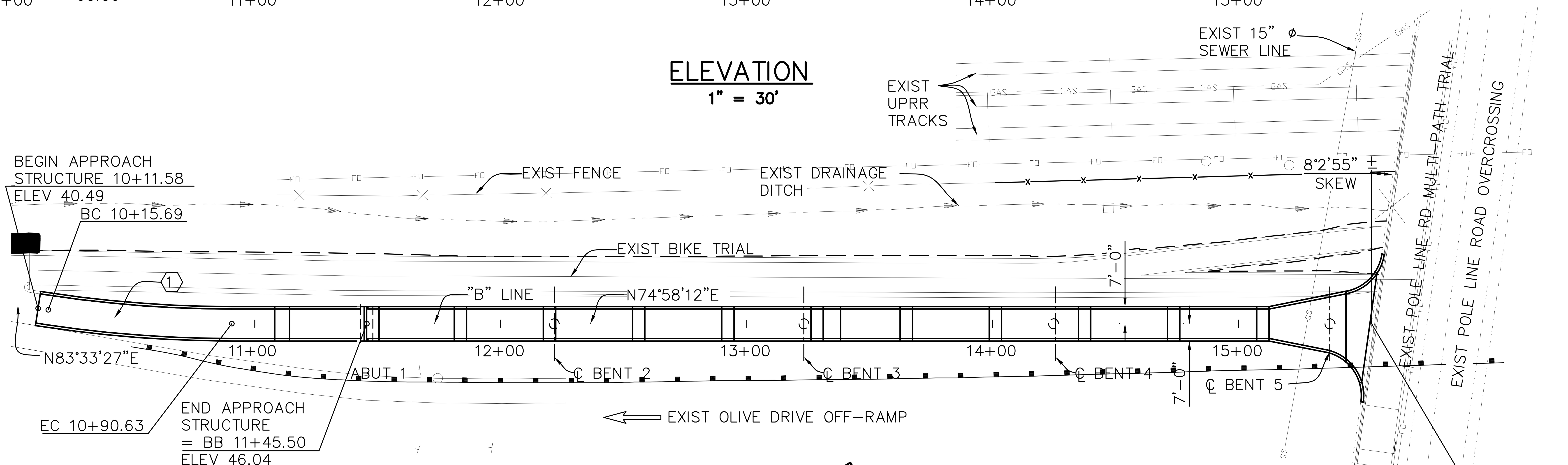
PROFILE GRADE

N.T.S.



ELEVATION

1" = 30'



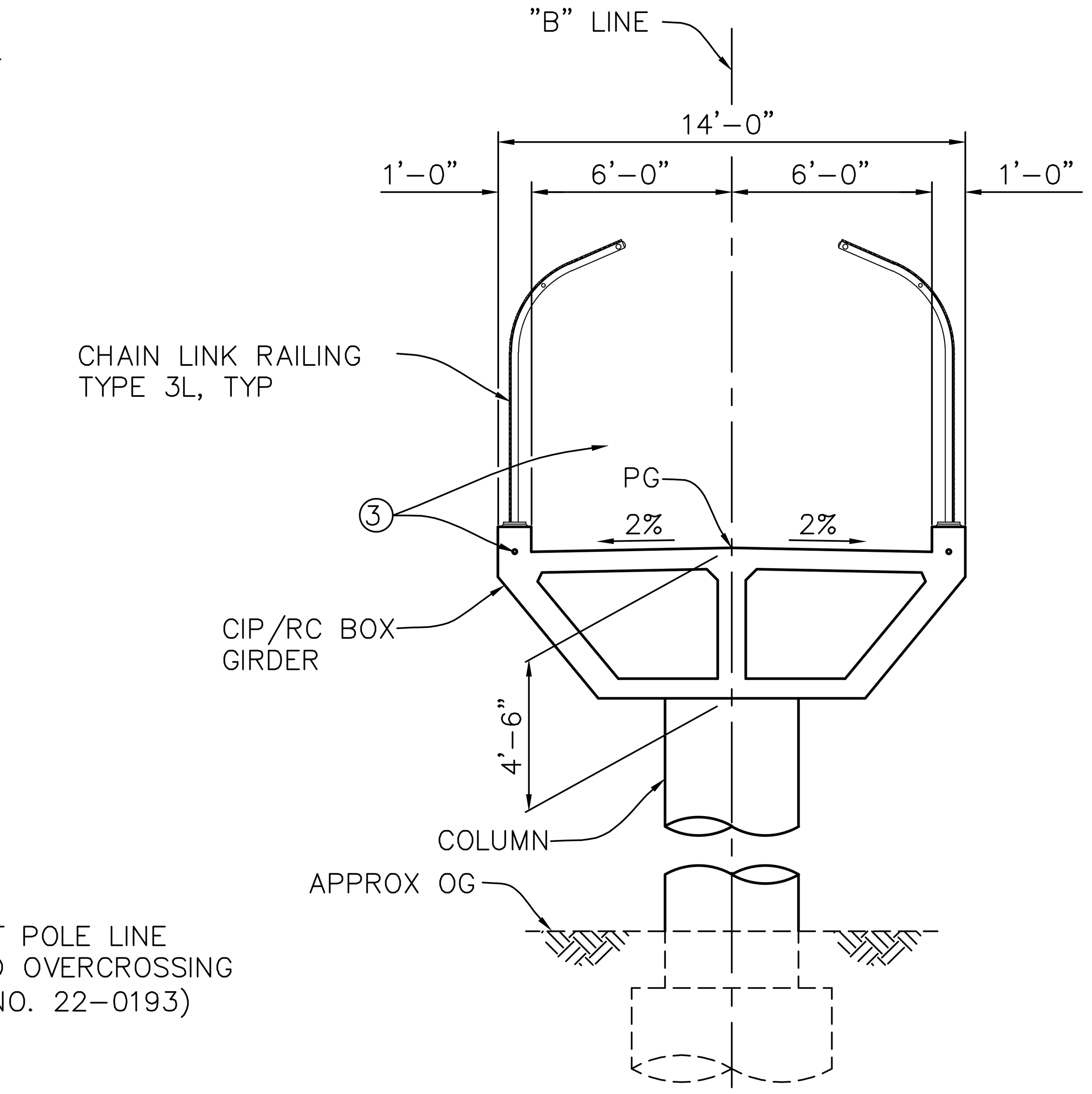
NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

PLAN

1" = 30'

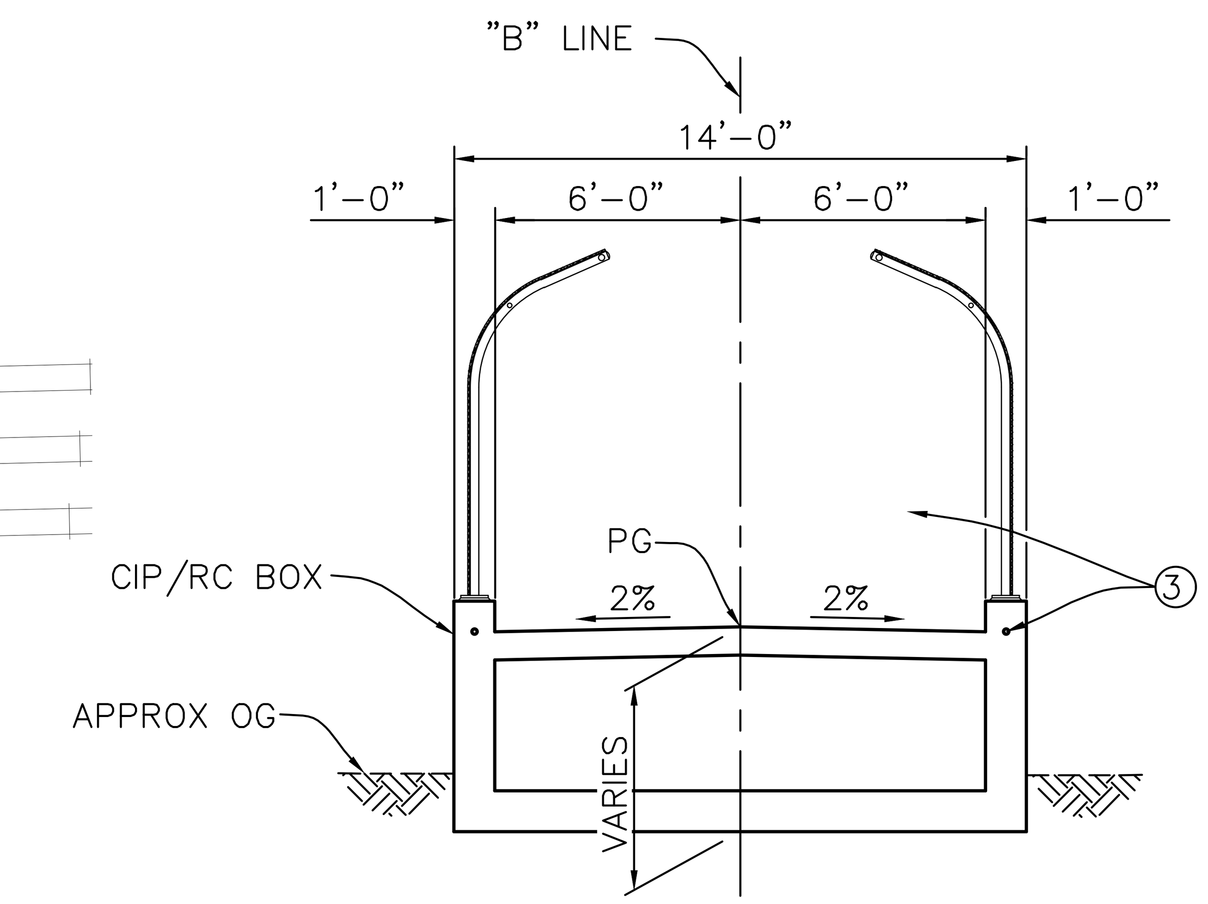
CURVE DATA

NO.	R	▽	T	L
⟨1⟩	500.00'	8°35'14"	37.54'	74.94'



TYPICAL SECTION

¼" = 1'-0"



APPROACH STRUCTURE TYPICAL SECTION

¼" = 1'-0"

NOTES:
1. Paint "Br No. XX-XXXX"
2. Paint "OLIVE DRIVE BIKE PATH RAMP BRIDGE"
3. Indicates 1 ½"ϕ electrical conduit for future utilities

---- Indicates existing structure

WOOD RODGERS

REGISTERED PROFESSIONAL ENGINEER Gerardo V Calvillo Jr. No. 2920 Exp. 6-30-20 STRUCTURAL STATE OF CALIFORNIA

DATE:

REV.	DATE	DESCRIPTION	BY

OLIVE DR BIKE PATH / POLE LINE RD OC RAMP CONNECTION
GENERAL PLAN
C.I.P. No. 8313

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

Davis California

CITY OF DAVIS
PUBLIC WORKS DEPARTMENT

DESIGNED BY: G.D.M.	DATE: JANUARY 2020
CHECKED BY: G.V.C.	DATE: JANUARY 2020
DRAWN BY: J.F.M.	DATE: JANUARY 2020
SHEET 15 OF 46 SHEETS	DWG. NO. S1 of 32

APPENDIX F

Caltrans Review Comments
Responses to Caltrans Review Comments

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 03 EA: 03-4H260 Project # : 0318000232 Project :03-SAC-80-PM 0.90 OSFP Liaison: Saygunn Low Telephone: (916) 227-8868 e-mail: Low, Saygunn@DOT <saygunn.low@dot.ca.gov>	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No._1) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☐ PS&E (Review No.) ☐ Construction Support ☒ Other: DRAFT	Reviewer Name: Asef Wardak Phone Number: (916)-227-1091 e-mail: asef_wardak@dot.ca.gov Supervisor: Reza Mahallati Phone Number: (916) 227-1033 Functional Unit: Geotechnical Design North A. Date of Review: 12/27/2019
	Structure Information Olive Dr. Bike Path / Pole Line Road OC Ramp Connection Bridge No: 22-(New)		

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
_____.	_____.	_____	_____	_____

#	Doc. See Note 1	Section Page #	Section Name	Review Comments	Consultant Responses	✓
1	Cover Sheet			-Please include Bridge number along with EA and Project numbers, on the cover sheet of the Foundation Report.		
2	FR	4.1 3	Field Explorat-ion	-Please provide explanation that why only two borings were drilled for a five (5) support locations of the proposed structure? Caltrans usually recommends one borehole per support location for new structure for CIDH pile. -On what was the consistency of cohesive soil based on in the field classification? Please explain. -The exploration borings drilled by Taber Consultants in 1990s are okay for general study of the site geology but may not be a substitute for a new boring for the proposed structure. Please exclude.		
3	FR	4.3 4	4.3 Ground	-Because of the large (7.2 feet) difference in Groundwater elevation, why piezometer was not installed?		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

		Cont.	**Water**	-What is the design Groundwater elevation (depth)? Please provide.		
4	FR	7.1 Surface Fault Rupture 5	**7 Seismic Data and evaluation**	Per Caltrans Memo To Designer 20-10, Fault Rupture studies should include both Alquist-Priolo Fault Zones and analysis of unzoned fault(s) that is Holocene or younger in age. Also, Caltrans online map is not to be used to obtain fault distances for fault rupture study.		
5	FR	8.1 7	**Soil Paramet-ers**	The design soil parameters provided in Table 5 thru 7 do not match with the laboratory test results as shown in appendix B. Please explain.		
6	FR	8.2 Table 9 9	**8.2 Foundation Data and Loading**	-Please provide units for the given loads.		
7	FR	9.1 Table 10 10	**Abut. Fnd. Design Recoms.**	-Table 10 represents both Abutment and Bents so it should be "Abutment and Bents Foundation Design Recommendations". Please revise. -The resistance factors should be 0.7 for all cases? Please check.		
8	FR	9.3.2 11	**9.3 Pile Group Reduction**	Please provide reference(s) to validate the sentence you mentioned "Also, the pile cap at Abutment 1 is expected to be in firm contact with the ground. Therefore, no pile group reduction is applied to the bent piles."		
9	FR	9.3.3 11	**9.3.3 SETTLEMENT**	What did you mean by significant long-term settlement at this site (even for cohesive soil)? Please explain.		
10	FR	9.3.4 12	**10.3.4 LATERAL LOAD ANALYSES**	-The lateral resistance analyses of the proposed pile are not included in Appendix D. Please include. -The Pile p-Multipliers, pm should be based on California Amendments to ASSHTO 10-7-2.4.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

				-Please provide elevations along the designed depth of the proposed pile (graphical representation) piles. -Please provide calculation.		
11	FR	9.3.6 12	**Construction Consideratio CIDH**	-Please discuss in the foundation report any adverse effect of the installation of the proposed CIDH piles to the existing Pole Line Road and the rail road structures.		
12	FR	**Appendix A**		Please ensure that the LOTB sheets conform to Caltrans' Soil & Rock Logging, Classification, and Presentation Manual (SRLCPM), currently dated 2010. The LOTB attached to this report are not acceptable.		
13	Plan	**4**	**ARS-Curve**	Please specify the methodology (deterministic or probabilistic) used to develop design response spectra.		
14	FR	**Additional**		-Please discus alternative foundation types. -All required loads and geotechnical data should be provided according to LRFD Memo to Designer 3-1. -All responses to Caltrans review comments should be addressed in the report and be included as attachments.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

Caltrans Review Comments – Sections are updated to reflect current report (Sections in parentheses reflect Caltrans reviewed report – 2018)

1) No Bridge number reported on general plan (GP)
EA number not specified on GP
Included Crawford & Associates, Inc. (CAInc) project number on cover page

2) - 2 borings combined with the available information in the area are sufficient for evaluation of the project.
-The consistency of cohesive soil is based on the pocket penetrometer test. A sentence was added in Section 4.1: Field Exploration to address this.

3) -A piezometer was not installed.
-A design groundwater elevation of 16 feet (obtained from boring A-18-001) is being utilized as stated in Section 9.1 (Section 8.1): Soil Parameters.

4) -All faults in the project vicinity can be seen on Figure 2: Fault Activity Map; attached in the appendices. The closest fault <150 years in age, the Green Valley fault zone (Green Valley fault), is approximately 35.5 miles away and therefore not in the image.
-The Caltrans online map was not utilized to obtain fault distance. In Section 8.1 (Section 7.1): the United States Geologic Survey (USGS) Google Earth kmz file was utilized to obtain the closest active fault.
[https://earthquake.usgs.gov/hazards/qfaults/].

5) -Soil parameters were based off the LOTB and Laboratory results completed for the Pole Line/ Olive Drive Connection Project.

6) -Units for the given loads are provided on the graph at the top.

7) -The title of Table 10 was updated to read "Abutment and Bents Foundation Design Recommendations."
-Per Caltrans LRFD Memo to Designers, dated June 2014, Section 3-1: Deep Foundations Attachment 1 Design Procedure and Examples, Table 3-6 Foundation Recommendations on page 5 a resistance factor of 0.7 is used for the Strength and a resistance factor of 1.0 is used for the Extreme Event. [https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/memotodesigner/f0003026-3-1-a-1.pdf].

8) -Section 10.3.4 (Section 9.3.2) Pile Group Reduction was revised.

9) -Significant long term settlement for cohesive soils refers to the consolidation analysis. This portion was moved to Section 10.3.1. Long-term settlement of the embankments is also discussed in Section 11.2 (Section 10.2) Slope Geometry and Stability.

10) -Per Section 10.3.2 (Section 9.3.4) LPILE analysis results were not provided because Wood Rogers (bridge engineer) is performing their own LPile analysis for this project.
-P-multipliers could not be calculated due to the lack of pile layout. This information was since provided on the Olive Drive Path/Pole Line Rd OC Ramp Connection – Abutment Details No. 1 dated October 2019 and the report was updated.
-Pile Cut-off elevations were added to the titles of the CIDH output graphs. Pile Cut-off elevations can also be found in Section 10.1 (Section 9.1), Table 10.

11) -Section 12.5 (Section 11.5) Vibration was added to the report to address the potential adverse effects of the proposed CIDH installation on the existing structures. If temporary casing cannot be installed using impact or vibratory hammers rotator /oscillator methods may be utilized instead.

12) -The LOTB was edited to conform to Caltrans current requirements.

13) -The probabilistic methodology was utilized to develop the design response spectra as discussed in Section 8.2 (Section 7.2) Seismic Ground Motions.

14) -Discussion of alternative foundation types were added to Section 9 (Section 8) conclusions.
-Scour data as required per LRFD Memo to Designers 3-1 Attachment 1 Table 3-3 was missing from this report. A section was added to address that there are no scour considerations due to the lack of surface water. Subsequently all section after 6 were increased by one number.
-All Caltrans review comments are reported as an attachment in Appendix F.