APPENDIX G

FOUNDATION REPORT

FOUNDATION REPORT

Replacement of County Road R Bridge over Glenn Colusa Irrigation District Canal, Caltrans Bridge No. 11C-0011
Glenn County, California

Dist	Co	Rte	PM	EA
XX	Glenn	R	N/A	N/A

Report Prepared By:

WILLDAN ENGINEERING
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Project No. 106453-4000
October 15, 2019

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October 15, 2019

Mr. Gary Gordon
Willdan Engineering
2400 Washington Avenue, Suite 101
Redding, CA 96001

Subject: Foundation Report
Replacement of County Road R Bridge over Glenn Colusa Irrigation District Canal, Caltrans Bridge No. 11C-0011, Glenn County, California
Willdan Geotechnical Project No. 106453-4000

Dear Mr. Gordon,

Willdan Engineering Geotechnical Group (Willdan Geotechnical) is pleased to submit this Foundation Report (FR) for the proposed replacement of County Road R Bridge over Glenn Colusa Irrigation District (GCID) Canal (Caltrans Bridge No. 11C-0011) in Glenn County, California. This report has been written to meet the requirements for a FR per "Caltrans Foundation Report Preparation for Bridges", February 2017 Edition.

Should you have any questions regarding the contents of this report, or should you require additional information, please contact us.

Respectfully Submitted,
WILLDAN ENGINEERING
GEOTECHNICAL GROUP

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Sr. Engineering Geologist

Distribution: Addressee

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1. SCOPE OF WORK

This Foundation Report (FR) is presented to assist in the structure type selection for the proposed replacement of the County Road R Bridge over GCID Canal, Caltrans Bridge No. 11C-0011, in Glenn County, California.

This FR documents existing foundation conditions, provides preliminary structure-specific seismic recommendations, and makes preliminary foundation recommendations. The site geology and subsurface conditions discussed in this FR are based on review of available published data and the findings from the field exploration.

We have performed the following tasks as the scope of work for this FR:

- Provide site geology and subsurface conditions based on review of published data and the findings from the field exploration;

- Provide preliminary seismic recommendations, including addressing seismic hazards such as liquefaction potential, surface fault rupture potential, seismically induced settlement, and seismic slope instability, as applicable;

- Provide preliminary design recommendations for foundation, retaining walls, earthwork, and construction considerations.

No scour evaluation is included in this FR. Scour evaluation will be done as part of the hydraulics report prepared by others.

2. PROJECT DESCRIPTION AND SITE LOCATION

The existing bridge crosses GCID Canal and is located on County Road R, approximately 0.3 miles north of the intersection of County Roads R and 39. The latitude and longitude at the approximate center of the proposed new bridge are 39.5869° N and 122.1169° W, respectively. The location of the project site is shown on Figure 1, Site Location Map.

The existing bridge is a six-span bridge comprised of corrugated steel deck filled with asphalt concrete (AC) on steel stringers, reinforced concrete cap and four (4) driven steel shell piles. According to the Caltrans Bridge Inspection Report dated 1/16/2013, the bridge was built in 1950. The project entails replacement of the existing bridge with a new bridge on a slightly modified alignment to improve the roadway geometrics and eliminate the kink in the existing alignment.

3. FIELD INVESTIGATION AND TESTING PROGRAM

Willdan Geotechnical drilled and sampled three (3) soil borings. Borings R-18-001 and R-18-002 were drilled on April 23, 2018 along the approach roadways and advanced to the maximum depth of 50.5 feet below ground surface (bgs). Also, an additional Boring R-19-001 was drilled on January 22, 2019 close to Boring R-18-001 to the maximum depth of 101.5 feet bgs. Underground Service Alert of Northern California and Nevada (USA North) was notified for clearance of underground utilities in the vicinity of the borings. Approximate boring locations are shown on Figure 2, Boring Location Plan.

Borings were advanced using a truck-mounted rig equipped with 8-inch diameter solid flight auger/mud rotary. Disturbed and relatively undisturbed drive samples were collected at select depth intervals from each soil boring. Bulk samples were collected from auger cuttings obtained from within the near-surface soils. Relatively undisturbed samples were collected by driving a three-inch outside diameter Modified California Sampler lined with brass rings/steel tubes, and disturbed samples were collected by driving a 1⅜-inch inside diameter Standard Penetration split-spoon sampler. The samplers were driven into the underlying soil for 18-inch interval with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler was recorded for each 6-inch penetration interval. The blow count for the final 12 inches, or for a lesser distance if the sampler could not be driven 12 inches, is shown on the Log of Test Borings in Appendix A. The number of blows required to drive the sampler the last 12 inches was used to estimate the in-situ relative density of granular soils. Pocket penetrometer was also used to evaluate consistency of cohesive soils. All soil samples were retained for laboratory testing. Upon completion of the borings, the boreholes were backfilled with soil cuttings.

Classification of the soils encountered in the exploratory borings was made in general accordance with the Unified Soil Classification System (USCS), using visual-manual procedure (ASTM D2488) and/or based on laboratory testing (ASTM D2487). A Log of Test Borings (LOTB) is included as Appendix A. The soil and rock descriptions in the LOTB are per Appendix A of Caltrans "Soil and Rock Logging, Classification, and Presentation Manual, 2010 Edition".

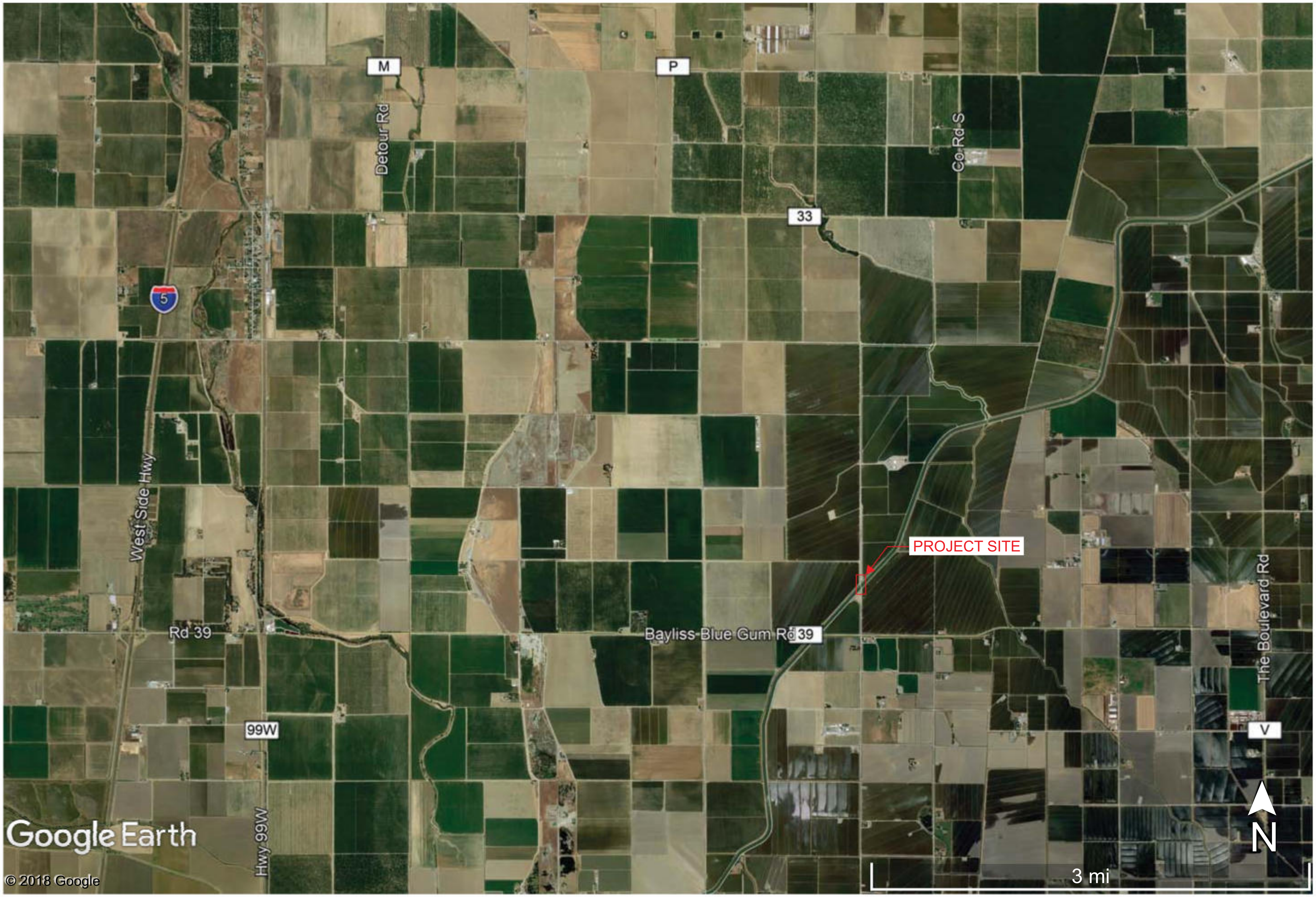

FIGURE 1. SITE LOCATION MAP

REPLACEMENT OF COUNTY ROAD R BRIDGE OVER GCID CANAL
GLENN COUNTY, CALIFORNIA

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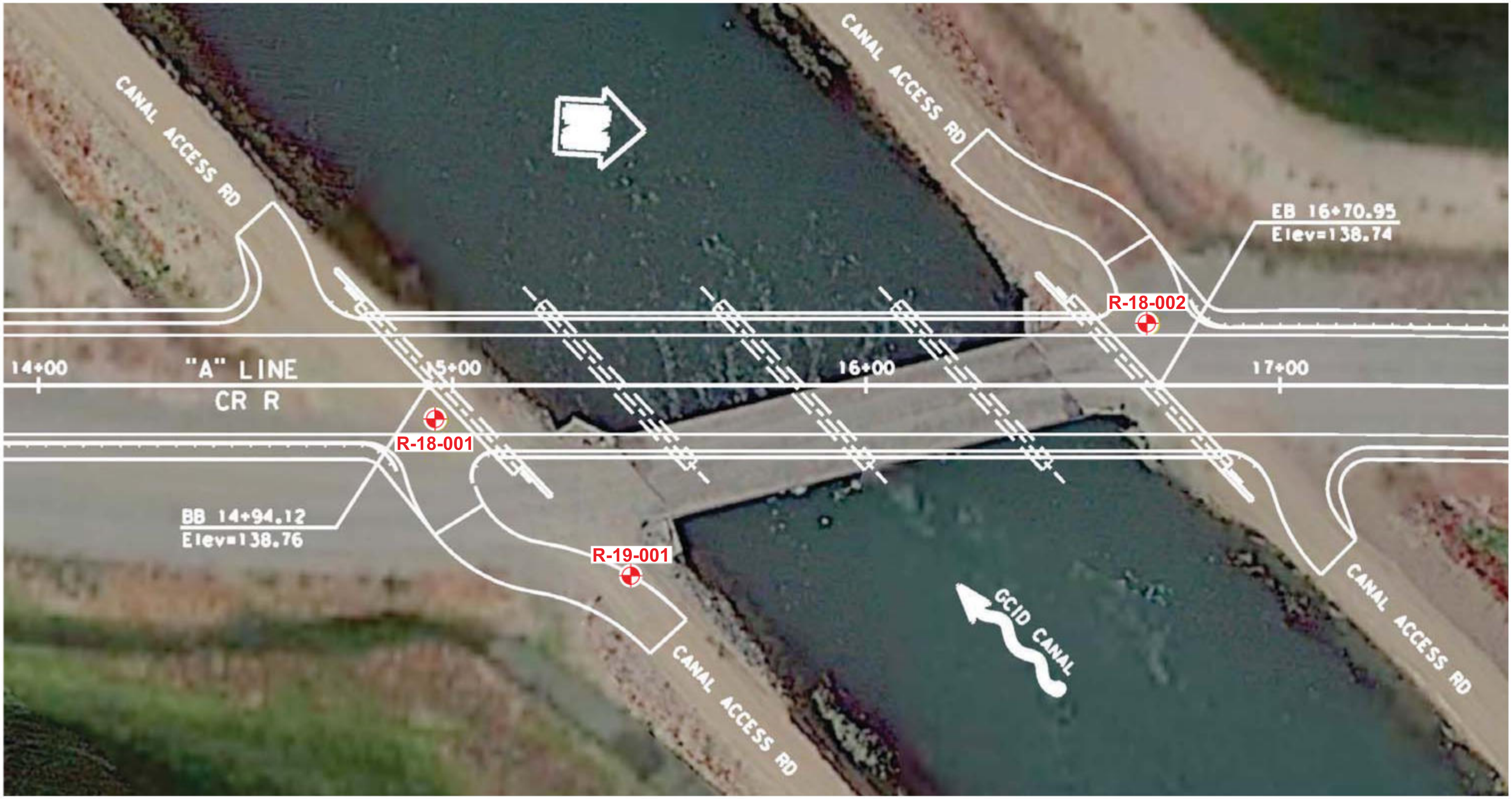
Drawn By: MR	Date: 07-17-2018
Approved By: MR	Project No.: 106453-4000



Approximate Boring Location
R-19-001

FIGURE 2. BORING LOCATION PLAN

REPLACEMENT OF COUNTY ROAD R BRIDGE OVER GCID CANAL
GLENN COUNTY, CALIFORNIA

WILLDAN Geotechnical | extending your reach

Drawn By: MR	Date: 02-06-2019
Approved By: MR	Project No.: 106453-4000

4. LABORATORY TESTING PROGRAM

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. Laboratory testing included determination of in-situ moisture and density, pocket penetrometer, passing #200 sieve, Atterberg limits, direct shear, consolidation, R-value and corrosion potential for soil samples. Laboratory tests were conducted in general accordance with American Society for Testing of Materials (ASTM) Standards or California Test Methods. The in-situ dry density and moisture content test results are shown on the LOTB. The remaining laboratory test results are presented in Appendix B, Laboratory Test Results.

Groundwater observations were made in the borings during drilling operations. Upon completion of the borings, the boreholes were backfilled with soil cuttings. Soil samples were delivered to Willdan's laboratory for testing.

5. SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1. REGIONAL GEOLOGY

The project site lies on the floor of Sacramento Valley, north of the Great Valley geomorphic province in the east-central California. The Great Valley is a large northwestward trending, asymmetric structural trough that has been filled with as much as six vertical miles of sediment. The trough is situated between the Sierra Mountains on the east and the Coast Range Mountains on the west (Kleinfelder, 2009). Most of the localized drainage in the area is generally trending south toward downhill.

According to a geologic map of the area, the site is underlain by Quaternary non-marine terrace deposits (USGS, 2015). Geology in the vicinity of the site is dominated by sedimentary features associated with the Stony Creek fan alluvium which extends from around the Glenn Tehama County line southward about 15 miles from Orland Buttes eastward to the Sacramento River. Stony Creek fan alluvium have also been mapped as Riverbank formation on various regional geologic maps. These deposits are composed of sand gravel with clay and silt. The alluvial fan deposits in the vicinity of the project site are underlain by the Tehama formation. The Tehama formation consists of semi-consolidated and erosion-resistant fluvial deposits derived from the Coast Range. These deposits were laid down by the ancestral Sacramento River and its tributaries. The Tehama Formation consists of predominantly silt and clay deposits, with discontinuous layers of sand and gravel.

Borings drilled within the limits of the project site during our investigation on April 23, 2018 and January 22, 2019 encountered mainly alluvium consisting of lean clay, sandy lean clay and sandy clay to the maximum drilled depth of 101.5 feet bgs.

5.2. GROUNDWATER

The approximate elevation at the subject site is 135 feet based on NAVD88. There is currently no map or data published by the Department of Conservation or the United States Geological Survey (USGS) to provide historical groundwater information at the site vicinity. Groundwater was encountered at about 18 feet bgs in all of our exploratory borings which corresponds to approximate elevation of 117 feet. The elevation of the canal bed is approximately 124 feet and therefore, it is our opinion that the highest groundwater level is expected to be higher than the canal bed. Due to the type of the proposed bridge and expected depth of grading/excavation, it is likely that groundwater would be encountered during the course of construction for the proposed bridge.

5.3. SUBSURFACE INFORMATION

The subsurface soils encountered in the borings to the maximum drilled depth of 50.5 feet bgs predominantly consist of layers of medium stiff to very stiff lean clay. Table 1 summarizes the estimated soil strength properties for the generalized subsurface strata profile for the subject project site.

Table 1. Idealized Soils Properties

Depth (ft)	Material	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degree)	N_{SPT}
0 - 75	Lean CLAY (CL)	120	200	27.0	14
75 - 120	Silty, Clayey SAND with Gravel	120	--	--	62

6. SCOUR EVALUATION

An evaluation of the scour potential is not included as part of this FR. Scour evaluation will be done as part of the hydraulics report prepared by others.

7. CORROSION EVALUATION

The available test results for pH, minimum resistivity, soluble chloride content and soluble sulfate content on samples for the bridge site vicinity shows pH value of 8.32, minimum resistivity of 2151 ohm-cm, soluble chloride content of 90 parts per million (ppm), and soluble sulfate content of 45 ppm.

The Caltrans Corrosion Guidelines (Caltrans, 2012) classifies soil as corrosive if the soluble chloride content is 500 ppm or greater, if the soluble sulfate content is 2,000 ppm or greater, or if the pH is 5.5 or less. Based on the above test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete. Further interpretation of the corrosivity test results and providing corrosion design and construction recommendations are referred to corrosion specialists.

8. SEISMIC CONSIDERATIONS

8.1. SEISMIC GROUND MOTION INFORMATION

According to current data from Caltrans, the controlling fault for a deterministic scenario is the Great Valley 01 fault, located approximately 16.9 km east of the site. Table 2 summarizes the fault parameters.

Table 2. Controlling Fault for Deterministic Seismic Scenario

Name	Type	Dip	PGA	Maximum Moment Magnitude
Great Valley 01 Fault	Reverse	15°	0.257g	6.70

There is currently no map or data published by the USGS to provide information with respect to the special studies zones at the site vicinity, however the site lies in a seismically active zone and will be subject to strong ground shaking.

8.2. DESIGN RESPONSE SPECTRUM

Figure 3, Design Acceleration Response Spectra, shows a plot of the acceleration response spectrum (ARS) curve considering near-fault effects. The corrections for near-fault effects were done as per recommendations contained in Appendix B of the Caltrans Seismic Design Criteria.

The design spectral acceleration values are the envelope of the probabilistic and deterministic spectra and are controlled by probabilistic criteria. The deterministic and probabilistic spectra have been determined using version 2.3.09 of the Caltrans ARS Online tool. Also, the probabilistic spectrum has been determined using edition v3.3.1 of the USGS Unified Hazard Tool website. We estimated a deaggregated moment magnitude of 6.72 for a return period of 975 years (5% probability of exceedance in 50 years) using edition v3.3.1 of the USGS Unified Hazard Tool website. Based on the soils encountered during current subsurface investigations by Willdan within the project site and consideration of the geologic units mapped in the area, it is our opinion that the site soil profile corresponds to Soil Profile D in accordance with Figure B.12 in Appendix B of Caltrans Seismic Design Criteria (SDC 2017). The shear wave velocity at a depth of 30 meters ($V_{S,30}$) used for the analyses is 270 m/s, estimated based on the NEHRP classification (FEMA, 1994 & 1997) and the data collected.

8.3. LIQUEFACTION

Liquefaction is the loss of strength that can occur in saturated coarse-grained soils during earthquake seismic shaking. The susceptibility of a granular soil to liquefaction is a function of the gradation, relative density, and fines content of the soil. Susceptibility to liquefaction generally decreases with increasing mean grain size, relative density, fines content and clay-size fraction of the fines, and the age of the deposit.

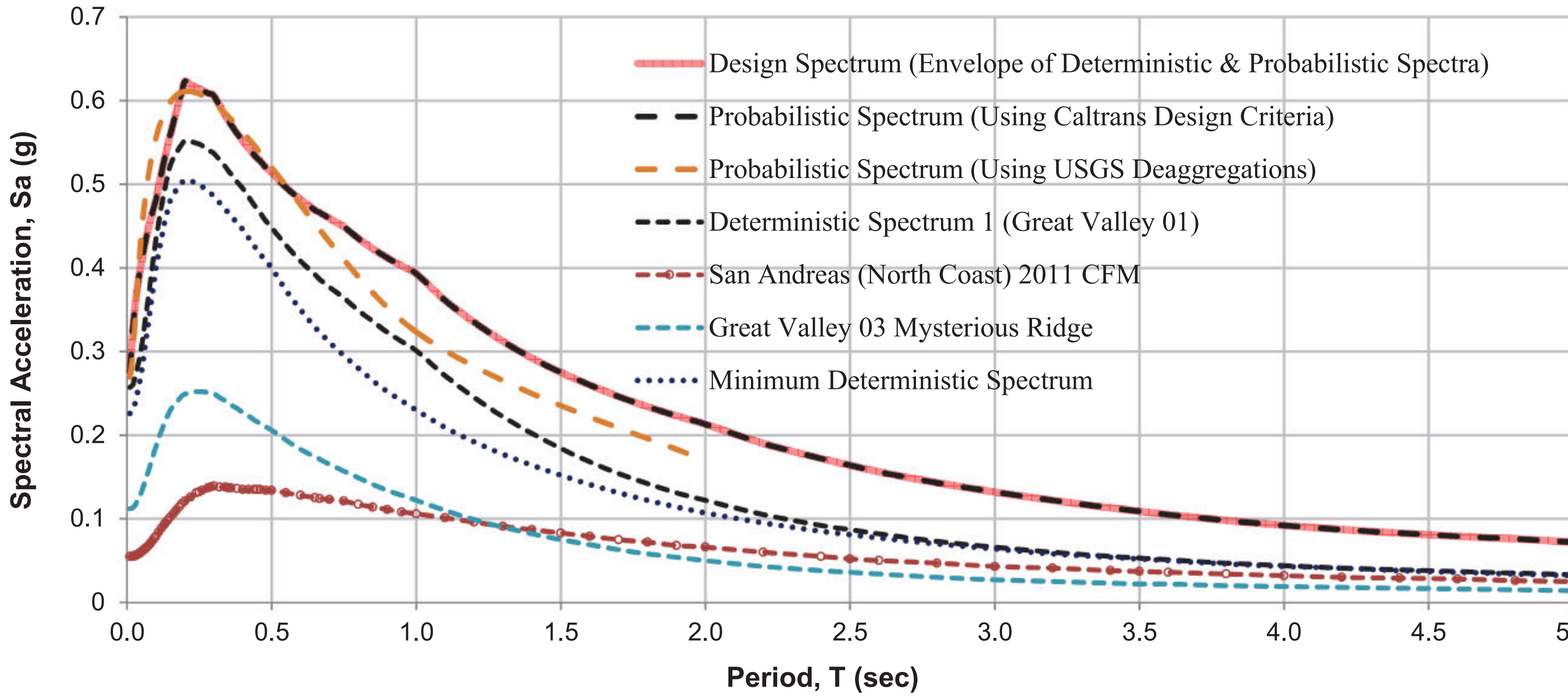
The subsurface soils at the bridge site are classified as lean clay. As such, it is our professional opinion that the project site is not susceptible to liquefaction under the design seismic scenario.

8.4. SURFACE FAULT RUPTURE POTENTIAL

No known faults project through the site. As such, it is our professional opinion that surface fault rupture is not likely to occur at the project site during the design seismic scenario.

9. SLOPE STABILITY

The embankment slopes at a slope ratio of 2H:1V or flatter are expected to be stable under both static and design seismic loads.



Design Curve	Design Criteria	Probability of Exceedence	Return Period	Moment Magnitude	PGA (g)
	Envelope of Deterministic & Probabilistic Spectra with Near-Fault Effect Included [1, 2]	5 percent in 50 years	975 years	6.72	0.276

Notes:

1 - Based on Caltrans Seismic Design Criteria, Version 2.3.09, April 26, 2017

2 - Design spectrum is controlled by probabilistic criteria. Probabilistic spectral accelerations for small periods are also obtained using the United State Geological Survey (USGS) Unified Hazard Tool website at https://earthquake.usgs.gov/hazards/interactive/, Edition Conterminous U.S. 2008 (v3.3.1)

FIGURE 3. DESIGN ACCELERATION RESPONSE SPECTRUM

Replacement of County Road R Bridge over GCID Canal
Caltrans Bridge No. 11C-0011,Glenn County, California

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Drawn By: AM	Date: 23-Jul-18
Approved By: MR	Project No.: 106453-4000

10. FOUNDATION RECOMMENDATIONS

10.1. GENERAL

It is our opinion that the proposed new bridge may be supported on driven steel shell piles. The following sections of this report contain our geotechnical recommendations for design and construction of the piles.

10.2. DRIVEN STEEL SHELL PILES

General: The recommended steel shell pile consists of a steel pipe that will be driven into the ground. It is assumed that after driving, the soils within the top 15 feet of the pile will be removed and replaced with cast-in-place concrete.

Axial Capacity: Ultimate downward and uplift capacities for an 18-inch diameter pile were evaluated using APILE 2015 program and are presented in Appendix C. Similar graphs for different diameters other than above will be provided upon request. Uplift capacity of the pile may be assumed as half of the downward capacity of the pile. It is recommended that the piles have a minimum embedment length of 10 feet. The actual length of the piles shall be calculated by the structural engineer for the project, considering recommendations provided herein. The provided capacities are based on the strength of the soils, not the pile section, which should be designed and checked by the project structural engineer.

Lateral Capacity: Lateral loads can be resisted by passive pressure developed against the vertical shafts. The lateral capacity of the pile depends on the permissible deflection and the degree of fixity at the top of the pile. For this project, lateral resistance of a free-head and a fixed-head single pile were evaluated using LPILE 2016 program.

A lateral deflection of 0.5 inch has been applied to the top of the pile, and the lateral capacity graphs of lateral deflection, bending moment and shear force vs. depth, for an 80-foot long and 18 inches diameter pile with 150 kips axial load are presented within Appendix C. The provided capacities are based on the strength of the soils, not the pile section, which should be designed and checked by the project structural engineer.

Settlements: The pile settlement vs. axial load were evaluated using APILE 2015 program and the graphs are presented in Appendix C.

11. ABUTMENT, WING AND RETAINING WALLS

11.1. ABUTMENT WALLS

The lateral earth pressure behind the abutment walls, which are restrained at the top, may be estimated using the recommendations of Section 5.5.5.11 of the Caltrans Bridge Design

Specifications (2004). The walls may be designed using the pressure that is developed by an equivalent fluid with density of 65 pounds per cubic foot (pcf) and 45 pcf for at-rest and active pressure, respectively.

The abutment walls shall also be designed in accordance to the recommendations of Section 7.8 of the Caltrans Seismic Design Criteria (Caltrans SDC 1.7, 2013). The walls may be designed for a passive resistance force calculated using Equation 7.8.1-3 from the SDC to resist movement at the abutment walls.

11.2. WING AND RETAINING WALLS LATERAL EARTH PRESSURES

Lateral earth pressures for the design of wing walls and retaining walls may be assumed to be equal to the pressure developed by an equivalent fluid with density presented in Table 3.

Table 3. Summary of Lateral Earth Pressures

Lateral Earth Pressure Condition	Equivalent Fluid Density
Active Pressure	45 pcf
At-Rest Pressure	65 pcf
Passive Pressure	320 pcf

In addition to the above active earth pressure, the walls more than 12 feet high, should be designed to support a seismic active pressure. The seismic active lateral earth pressure may be assumed to be an inverted triangular pressure distribution equal to 24H psf at the top of the retaining wall and decreasing linearly to zero at the bottom of retaining wall, where H is the height of retaining wall in feet.

11.3. WALLS FOUNDATIONS

11.3.1. General

The walls may be supported on shallow foundation including spread and/or strip footing, or on deep foundation. Deep foundation may be used at any depth, while the shallow foundation may be used where the footing's subgrade and underlying compacted fill are located above the groundwater table. Below are our recommendations for deep and shallow foundations.

11.3.2. Deep Foundation

The walls may be supported on deep foundations designed in accordance with the recommendations provided in Section 10.0 of this report.

11.3.3. Spread/Strip Footings

Bearing Capacity: The footings shall have a minimum width of 24 inches and be embedded at least 24 inches below the lowest adjacent grade, supported on at least 2 feet of engineered fill compacted to at least 90% relative compaction of the maximum density as determined by the ASTM D1557 test procedure. The bottom of excavation to receive the compacted fill, shall be scarified to a minimum depth of 8 inches and compacted to at least 90% relative compaction of the maximum density as determined by the ASTM D1557 test procedure. The footings may be designed using a maximum allowable bearing value of 2,500 pounds per square foot (psf). A one-third increase in the bearing value may be used when considering wind or seismic loads.

Lateral Resistance: Lateral soil resistance will be provided by a combination of frictional resistance between the bottom of the footings and the underlying soils, and by passive soil resistance acting against side of the footing. For frictional resistance between concrete and soil, a frictional coefficient of 0.35 may be used. For passive resistance, an allowable pressure developed by a fluid with density of 300 pound per cubic foot (pcf), to a maximum pressure of 3000 psf, may be used for a level ground surface condition in front of the footing. When combining both frictional and passive resistance, the passive resistance should be reduced by one-third.

Settlement: Our preliminary computations indicate that the total settlement of the footings due to the anticipated loads, for footings designed as recommended here, will be less than one inch, and the differential settlements are expected to be less than 0.5 inch over a 50-foot span.

11.4. SUBDRAIN INSTALLATION

Subdrain systems shall be installed to prevent hydrostatic pressure build-up acting as an additional lateral load. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. Retaining wall backfill and typical subdrain details for conditions of native soil, imported sand, or crushed rock are provided in Appendix D.

12. PAVEMENT DESIGN

Laboratory testing of a bulk sample from the shallow subsurface soil of the approach roadway of the subject bridge indicates a minimum R-value of 14. A flexible section consisting of asphalt concrete (AC) over aggregate base (AB), or a full-depth AC section may be used. The pavement sections listed in Table 4 have been developed in accordance with the procedure presented in the Caltrans Highway Design Manual for a range of traffic index (TI) values.

Table 4. Flexible Pavement Design

TI	AC/AB (in/in)	Full Depth AC (in)
6	3.5/11.0	8.5
8	5.0/15.0	11.5
10	6.5/20.0	14.5

The pavement section shall be supported on the subgrade prepared per recommendations of Section 13.0 of this report. The base material shall consist of AB-Class 2 as specified in the Caltrans Standard Specifications (2010) and compacted to a minimum of 95% of maximum dry density.

13. EARTHWORK RECOMMENDATIONS

All earthwork and grading should be performed in accordance with the recommendations of this report and requirements of Section 19 of the Caltrans Standard Specifications (2015). Within the approach roads, any existing fills or soils disturbed during construction and associated site clearing operations should be removed down to a minimum of 24 inches and replaced with engineered fill. As an alternative option where there is an unstable saturated subgrade, the road subgrade may be over-excavated to 12 inches, a layer of geo-fabric be placed at the bottom of over-excavation and then backfilled to the grade. All the fills shall be compacted to at least 90% relative compaction of the maximum density as determined by the ASTM D1557 test procedure

The exposed subgrade to receive fill or pavement section should be scarified to a minimum of 8 inches and compacted to minimum of 90% relative compaction. The fill materials under the roadways and behind the retaining walls shall be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned and compacted to minimum 90% of relative compaction. The onsite soil free of debris and deleterious material or import granular material may be used as backfill material.

14. CONSTRUCTION CONSIDERATIONS

14.1. TEMPORARY EXCAVATION

Temporary excavations shall be properly sloped or shored. Based on the earth materials encountered in our borings, excavation of 5 feet or less in depth may be performed with vertical sidewalls. Deeper excavation up to a depth of 15 feet can be accomplished in accordance with the Occupational Safety and Health Administration (OSHA) requirements for Type B soils. The contractor is responsible for maintaining the stability of the cuts and personnel safety in the field during construction. All excavations shall be performed in accordance with applicable requirements established by the State, County, or local government. The regulatory requirement may supersede the recommendations presented in this section. A representative of the geotechnical engineer of record should be present during all excavations.

15. LIMITATIONS

This report is based on the available information for the project and obtained from the current subsurface investigations. The materials data available from the current investigation are believed to be representative of the subject project site, and the conclusions and recommendations contained in this report are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. Any changes noted during construction should be brought to the attention of the Geotechnical Engineer so that any changes to these recommendations can be made as appropriate.

This Foundation Report (FR) has been prepared consistent with the level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty.

The information contained herein has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

16. REFERENCES

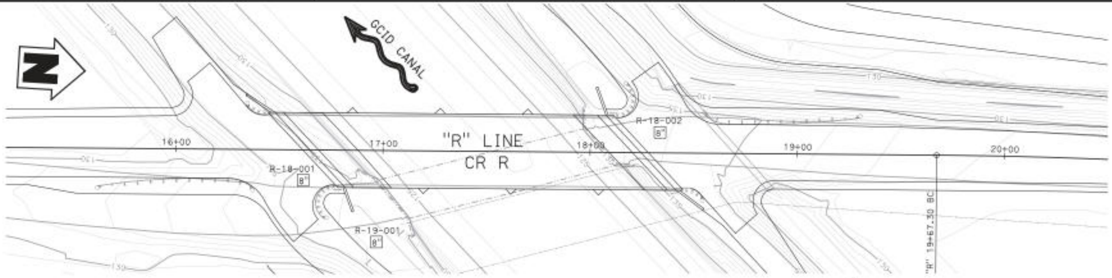
- Caltrans, 2010a. Soil and Rock Logging, Classification, and Presentation Manual, 2010 Edition.
- Caltrans, 2015. Standard Specifications, 2015.
- Caltrans, 2010c. Standard Plans, 2010 Edition.
- Caltrans, 2017. Foundation Report Preparation for Bridges, February 2017.
- Caltrans, 2013. Seismic Design Criteria, Version 1.7, April 2013.
- Caltrans, 2013. ARS Online Tool, version 2.3.09, at http://dap3.dot.ca.gov/ARS_Online/index.php
- Caltrans, 2008a. Memo to Designers 4-1, April 2008.
- Caltrans, 2012. Highway Design Manual, May 2012.
- Caltrans, 2003. Bridge Design Specifications, Section 4 – Foundations, November 2003.
- Caltrans, 2012. Corrosion Guidelines, Version 2.0, November 2012.
- United States Geological Survey (USGS) Unified Hazard Tool, at https://earthquake.usgs.gov/hazards/interactive
- USGS (2015), Geology of California, Ukiah Sheet, available at https://ngmdb.usgs.gov/Prodesc/proddesc_336.htm
- Kleinfelder, 2009, Geological Investigation & Geologic Hazard Report, Proposed Fire Station, Fish Camp, California, Submitted to Mariposa County, Department of Public Works, File No: 105105-GEO/GEOL

APPENDIX A: LOGS OF TEST BORINGS

BENCH MARK

Horizontal Datum is NAD83 (2011) epoch 2010.0000. Coordinates are California State Plane Coordinate System, Zone 2 Scaled to Ground about Control Point #101. To Obtain Grid Distances Scale Coordinates 0.99995102 about Control Point #101.

Vertical Datum is NAVD88 based on NGS OPUS Solution FOR THE Project Taken from Control Point #101, Elevation=130.085'



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	Gle	CR R	NA	X	X

GEOTECHNICAL PROFESSIONAL — XX/XX/XX DATE

MM/DD/YYYY
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Mohsen Rahimian — No. GE3059 — Exp. 12/31/18 — GEOTECHNICAL — STATE OF CALIFORNIA

Prepared by:
WILLDAN ENGINEERING
1515 SOUTH SUNKIST STREET, SUITE E
ANAHEIM, CALIFORNIA 92806

R-18-001

14' RT STA:16+61 C/L County Rd. R

8" ELEV: 135.38'

8" (R)

Blows	Length	Sample	Density	Moisture	Tests	Description
		1			(CR)	Lean CLAY (CL), stiff, grayish brown, moist PP= 1.75 tsf
7	2.0	2	126	19.8		
18	2.0	3	129	19.4	(W)(PI)	very stiff PP= 2.5 tsf
5	2.0	4	125	25.2	(DS)	medium stiff PP= 0.5 tsf
						117.38' GWS Elev — Groundwater at 18 feet
11	2.0	5	119	27.5	(C)	stiff, brown, wet PP= 1.5 tsf
7	2.0	6	129	20.3		PP= 2.0 tsf
9	2.0	7	---	---		
27	1.4	8	---	---		
12	2.0	9	125	28.3		PP= 1.5 tsf
15	2.0	10	121	29.1		PP= 1.0 tsf
20	2.0	11	135	15.1		Lean CLAY/Clayey SAND (CL/SC), stiff/medium dense, brown, wet PP= 1.75 tsf

BOH 50.5' ON 4/23/18

ER_i=80%

R-18-002

10' LT STA:18+33 C/L County Rd. R

8" ELEV: 136.17'

8" (R)

Blows	Length	Sample	Density	Moisture	Tests	Description
		1			(R)	Lean CLAY (CL), very stiff, dark brown, moist PP= 2.5 tsf
7	2.0	2	126	17.1		
20	2.0	3	134	17.9		hard PP= >4.5 tsf
9	2.0	4	123	23.9	(W)	Sandy Lean CLAY (CL), medium stiff, grayish brown, moist PP= 0.75 tsf
						117.67' GWS Elev — Groundwater at 18.5 feet
14	2.0	5	124	26.7	(DS)(PI)	Lean CLAY (CL), stiff, grayish brown, wet PP= 1.5 tsf
13	2.0	6	---	---		
15	2.0	7	130	22.8		very stiff PP= 2.5 tsf
17	2.0	8	126	27.6		PP= 2.5 tsf
17	2.0	9	118	29.8	(W)(PI)(C)	stiff PP= 1.75 tsf
19	2.0	10	126	25.5	(DS)	PP= 1.75 tsf
26	2.0	11	130	20.7		PP= 1.5 tsf

BOH 50.5' ON 4/23/18

ER_i=80%

Elevation: 140, 130, 120, 110, 100, 90, 80

Station: 16.00, 17.00, 18.00

Horiz SCALE: 1" = 30'
Vert SCALE: 1" = 10'

DRAWN	BY AM	M.T.Hall and Associates FIELD INVESTIGATOR	
CHECKED	BY MR	04/23/2018 & 01/22/2019 DATE	

PREPARED FOR
COUNTY OF GLENN
PUBLIC WORKS AGENCY

G. GORDON
PROJECT ENGINEER

BRIDGE No. 11C0011
POST MILE NA

GCID CANAL BRIDGE (REPLACE)
LOG OF TEST BORINGS (1 of 2)

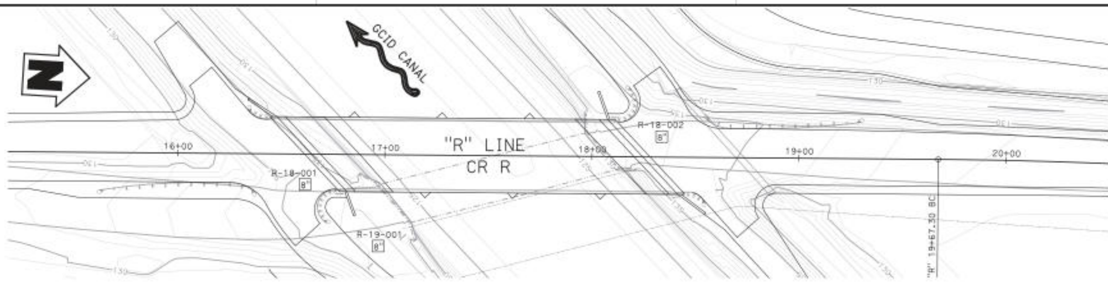
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES — SHEET X OF X

BENCH MARK

Horizontal Datum is NAD83 (2011) epoch 2010.0000. Coordinates are California State Plane Coordinate System, Zone 2 Scaled to Ground about Control Point #101. To Obtain Grid Distances Scale Coordinates 0.99995102 about Control Point #101.

Vertical Datum is NAVD88 based on NGS OPUS Solution FOR THE Project Taken from Control Point #101, Elevation=130.085'



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	Gle	CR R	NA	X	X

GEOTECHNICAL PROFESSIONAL XX/XX/XX DATE

MM/DD/YYYY
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Mohsen Rahimian
No. GE3059
Exp. 12/31/18
GEOTECHNICAL
STATE OF CALIFORNIA

Prepared by:
WILLDAN ENGINEERING
1515 SOUTH SUNKIST STREET, SUITE E
ANAHEIM, CALIFORNIA 92806

Horiz SCALE: 1" = 30'
Vert SCALE: 1" = 20'

DRAWN	BY AM	M.T.Hall and Associates FIELD INVESTIGATOR	
CHECKED	BY MR	04/23/2018 & 01/22/2019 DATE	

PREPARED FOR
COUNTY OF GLENN
PUBLIC WORKS AGENCY

G. GORDON
PROJECT ENGINEER

BRIDGE No.	11C0011
POST MILE	NA

GCID CANAL BRIDGE (REPLACE)

LOG OF TEST BORINGS (2 of 2)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET	OF
X	X

APPENDIX B: LABORATORY TEST RESULTS

TABLE B-1. SUMMARY OF LABORATORY TEST RESULTS

REPLACEMENT OF COUNTY ROAD R BRIDGE OVER GCID CANAL, GLENN COUNTY, CALIFORNIA

WILLDAN GEOTECHNICAL PROJECT NO. 106453-4000

Sample		USCS Soil Description	Passing #200 Sieve (ASTM D1140)	Atterberg Limits (ASTM D4318)		R-Value (CTM 301)	Direct Shear (ASTM D3080)				Consolidation (ASTM D2435)			Corrosivity (CTM 422, 417, 643)			
							Peak		Ultimate								
Boring No.	Depth (ft)		(% F)	Liquid Limit	Plasticity Index		c (psf)	ϕ (°)	c (psf)	ϕ (°)	P_C (ksf)	C_C	C_S	pH	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Minimum Resistivity (ohm-cm)
A-18-001	0 to 2.5	Lean CLAY (CL)												8.32	45	90	2151
	10.0	Lean CLAY (CL)	92	30	12												
	15.0	Lean CLAY (CL)					175	29.5	180	27.0							
	20.0	Lean CLAY (CL)									2.40	0.074	0.010				
A-18-002	0 to 2.5	Lean CLAY (CL)				14											
	15.0	Sandy Lean CLAY(CL)	61														
	20.0	Lean CLAY(CL)		33	13		390	27.5	200	27.5							
	39.0	Lean CLAY(CL)	95	37	15						3.00	0.080	0.009				
	44.0	Lean CLAY (CL)					220	26.5	185	26.0							

Project Name : County Rd. R Bridge over GCID Canal		Project No.: 106453-4000	
Sample Location / Source :		Tested by : RMC	Date: 6/7/2018
Sample Depth / No. : A-18-001 @ 10'		Sampled by:	Date:
Sample Description / Classification : Lean CLAY (CL)			

PLASTIC LIMIT

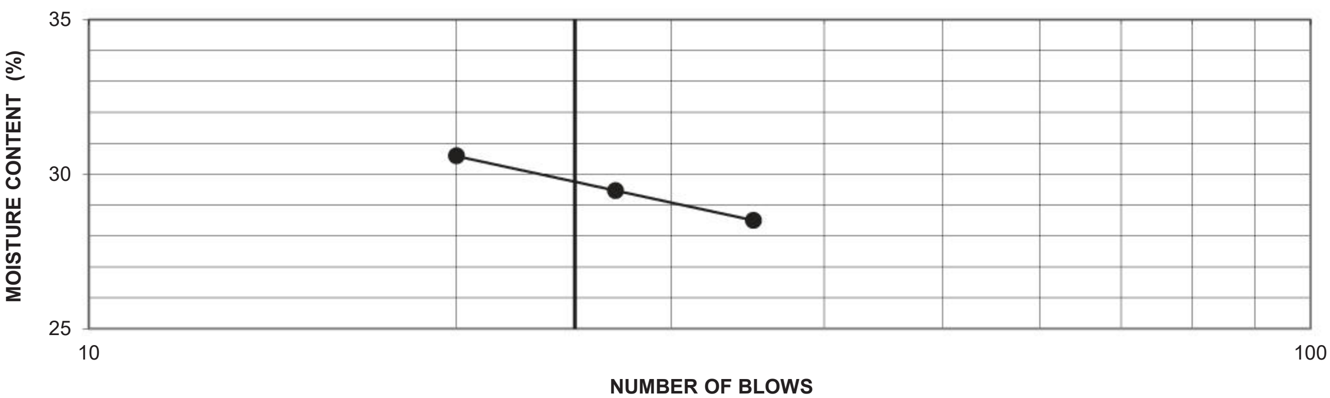
DETERMINATION NO.	1	
DISH NO.	14	
MASS, DISH + WET SOIL (g)	41.85	
MASS, DISH + DRY SOIL (g)	39.49	
MASS OF WATER (g)	2.36	
MASS OF DISH (g)	26.39	
MASS OF DRY SOIL (g)	13.1	
MOISTURE CONTENT (%)	18.0	

LIQUID LIMIT

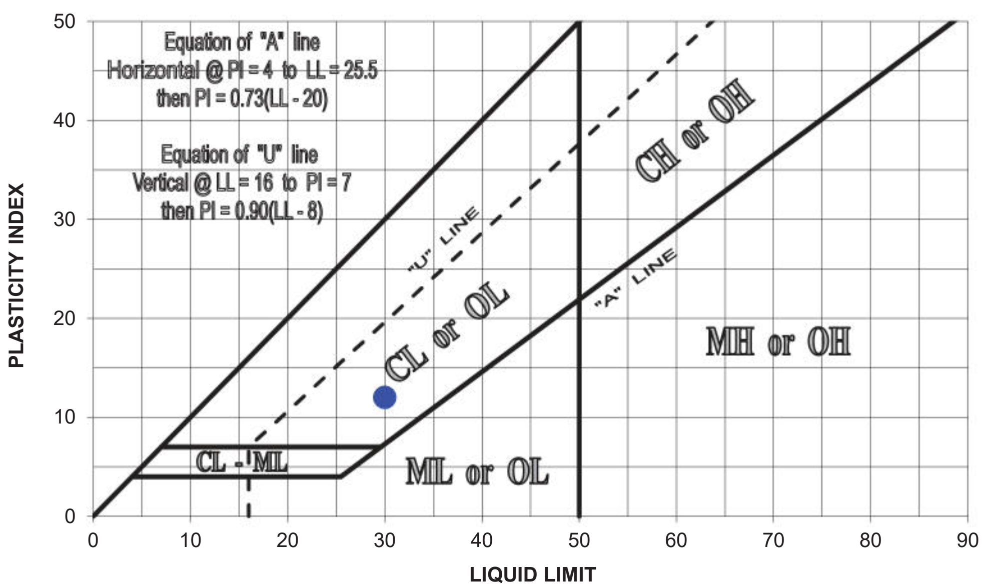
DETERMINATION NO.	1	2	3
DISH NO.	24	8	2
MASS, DISH + WET SOIL (g)	35.36	35.37	38.28
MASS, DISH + DRY SOIL (g)	32.88	31.92	34.09
MASS OF WATER (g)	2.48	3.45	4.19
MASS OF DISH (g)	24.18	20.21	20.39
MOISTURE CONTENT (%)	28.5	29.5	30.6
NUMBER OF BLOWS	35	27	20

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	30
PLASTIC LIMIT (PL)	18
PLASTICITY INDEX (PI)	12
SYMBOL FROM PLASTICITY CHART	CL

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

WILLDAN Geotechnical | extending your reach

Project Name :	County Rd.R Bridge over GCID Canal	Project No.:	106453-4000		
Sample Location / Source :		Tested by :	RMC	Date:	6/8/2018
Sample Depth / No. :	A-18-002 @ 20'	Sampled by:		Date:	
Sample Description / Classification :	Lean CLAY (CL)				

PLASTIC LIMIT

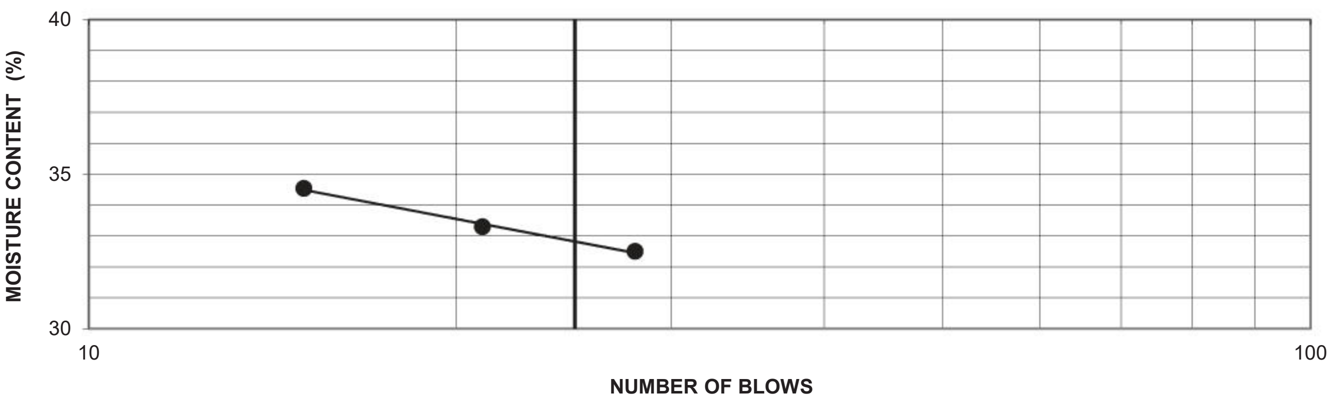
DETERMINATION NO.		1	
DISH NO.		20	
MASS, DISH + WET SOIL	(g)	39.01	
MASS, DISH + DRY SOIL	(g)	36.76	
MASS OF WATER	(g)	2.25	
MASS OF DISH	(g)	25.59	
MASS OF DRY SOIL	(g)	11.17	
MOISTURE CONTENT	(%)	20.1	

LIQUID LIMIT

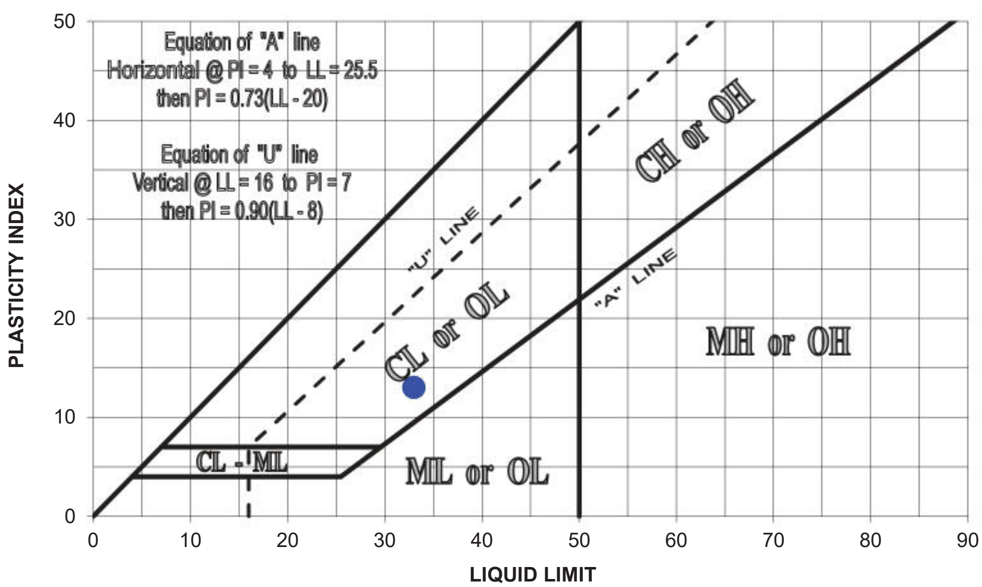
DETERMINATION NO.		1	2	3
DISH NO.		13	11	12
MASS, DISH + WET SOIL	(g)	34.13	37.53	36.31
MASS, DISH + DRY SOIL	(g)	31.73	34.83	33.31
MASS OF WATER	(g)	2.40	2.70	3.00
MASS OF DISH	(g)	24.78	26.72	24.08
MOISTURE CONTENT	(%)	34.5	33.3	32.5
NUMBER OF BLOWS		15	21	28

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	33
PLASTIC LIMIT (PL)	20
PLASTICITY INDEX (PI)	13
SYMBOL FROM PLASTICITY CHART	CL

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

WILLDAN Geotechnical | extending your reach

Project Name :	County Rd.R Bridge over GCID Canal	Project No.:	106453-4000		
Sample Location / Source :		Tested by :	RMC	Date:	6/7/2018
Sample Depth / No. :	A-18-002 @ 39'	Sampled by:		Date:	
Sample Description / Classification :	Lean CLAY (CL)				

PLASTIC LIMIT

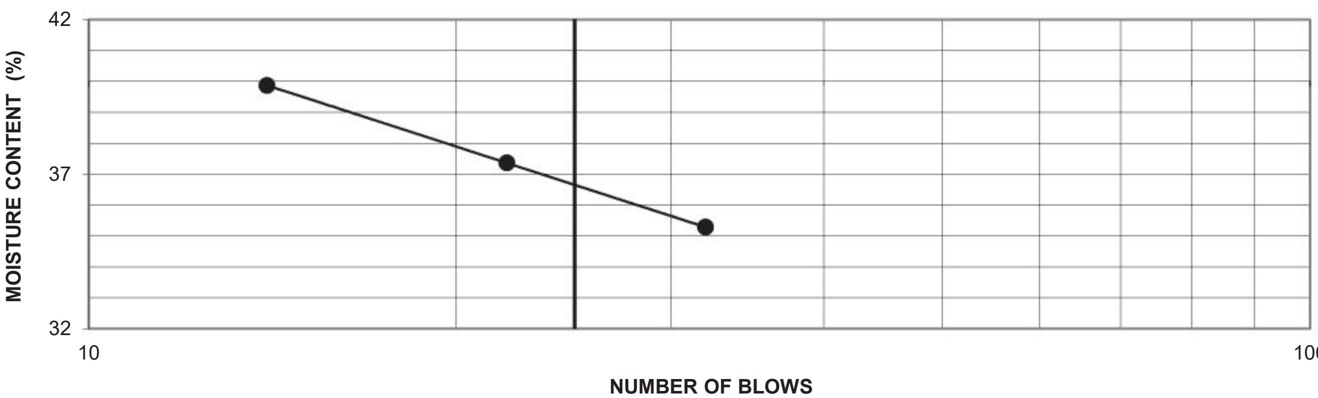
DETERMINATION NO.		1	
DISH NO.		4	
MASS, DISH + WET SOIL	(g)	36.41	
MASS, DISH + DRY SOIL	(g)	33.85	
MASS OF WATER	(g)	2.56	
MASS OF DISH	(g)	22.22	
MASS OF DRY SOIL	(g)	11.63	
MOISTURE CONTENT	(%)	22.0	

LIQUID LIMIT

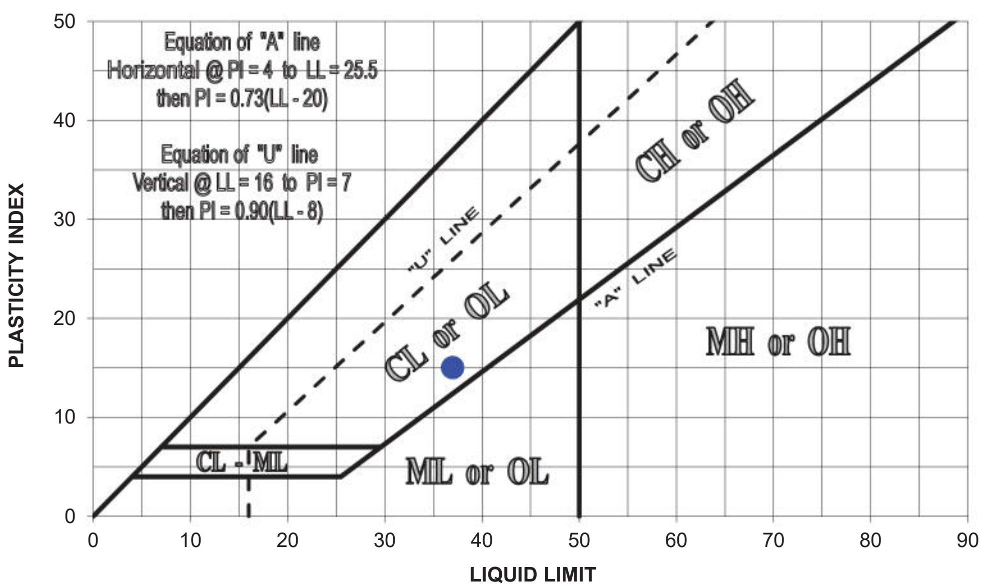
DETERMINATION NO.		1	2	3
DISH NO.		19	8	2
MASS, DISH + WET SOIL	(g)	32.32	31.11	32.49
MASS, DISH + DRY SOIL	(g)	29.94	28.39	30.56
MASS OF WATER	(g)	2.38	2.72	1.93
MASS OF DISH	(g)	23.97	21.11	25.09
MOISTURE CONTENT	(%)	39.9	37.4	35.3
NUMBER OF BLOWS		14	22	32

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	37
PLASTIC LIMIT (PL)	22
PLASTICITY INDEX (PI)	15
SYMBOL FROM PLASTICITY CHART	CL

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

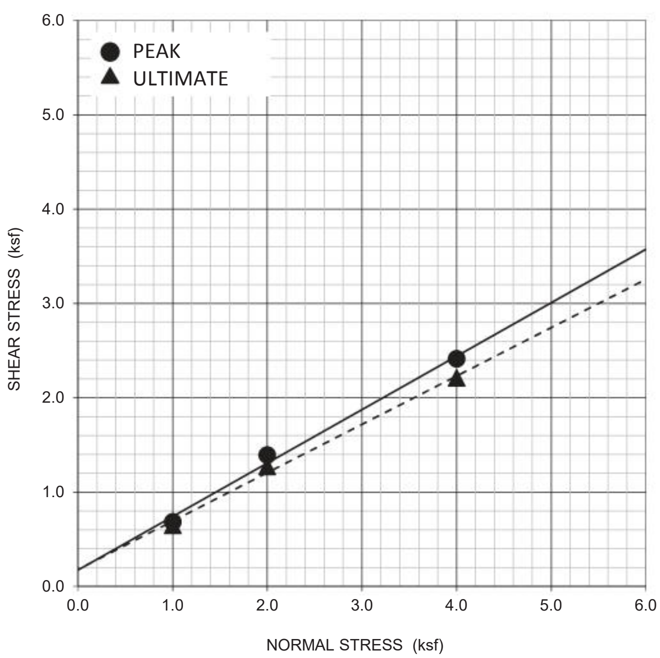
WILLDAN Geotechnical | extending your reach

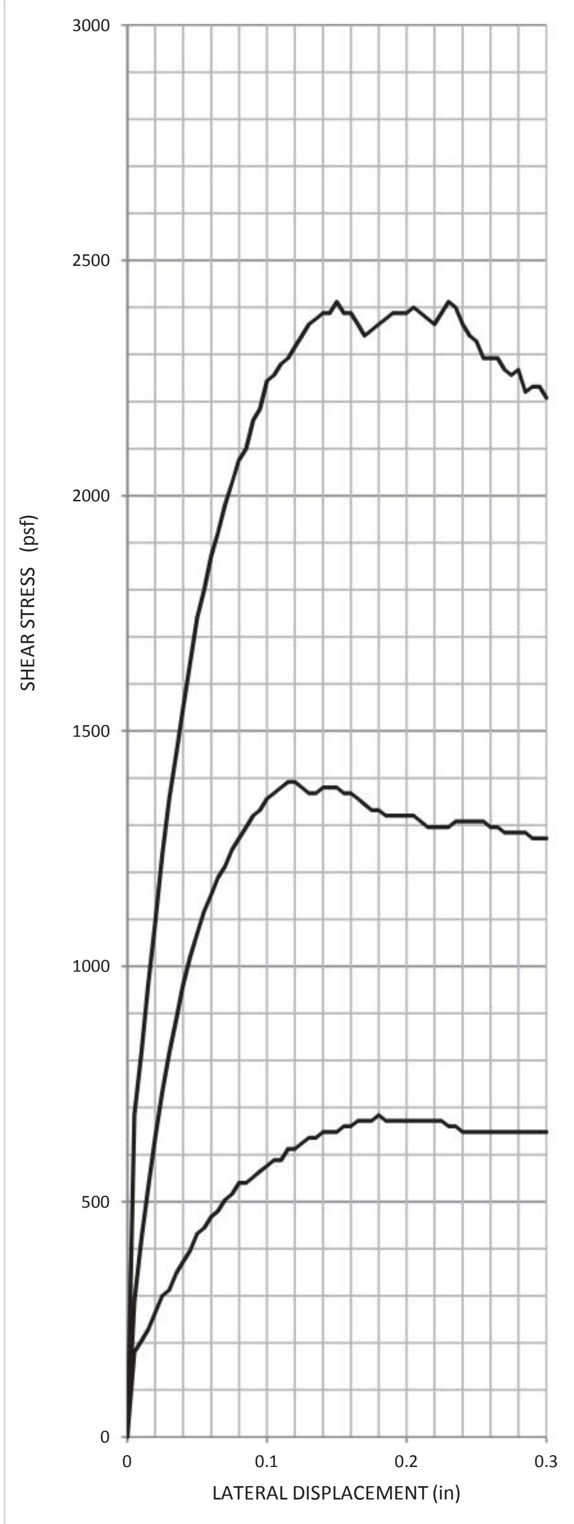
Project Name :	County RD. R Bridge over GCID Canal	Project No. :	106453-4000
Boring / Sample No :	A-18-001 Depth : 15 ft	Tested By :	RMC Date: 5-Jun-18
Sample Descriptions / Classification :	Lean Clay (CL)	Sampled By :	Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.684		1.392		2.412	
Shear Stress,Ultimate(ksf)	0.648		1.272		2.208	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	195.19	195.6	197.9	198.6	199.7	200.3
Dry Wt. of Soil + Ring (g)		164.8		167.3		168.7
Weight of Water (g)	30.4	30.9	30.6	31.3	30.9	31.5
Weight of Ring (g)		44.1		46.0		46.1
Weight of Dry Soil (g)		120.7		121.3		122.6
Moisture Content (%)	25.2	25.6	25.2	25.8	25.2	25.7
Wet Density (pcf)	125.5	125.8	126.0	126.6	127.5	128.0
Dry Density (pcf)		100.2		100.7		101.8
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	100.0	100.0	100.0	100.0	100.0	100.0
Void Ratio		0.669		0.661		0.643

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	175	180
Friction Angle, ϕ (degree)	29.5	27.0





Remarks : ____________________

DIRECT SHEAR TEST

(ASTM D3080)

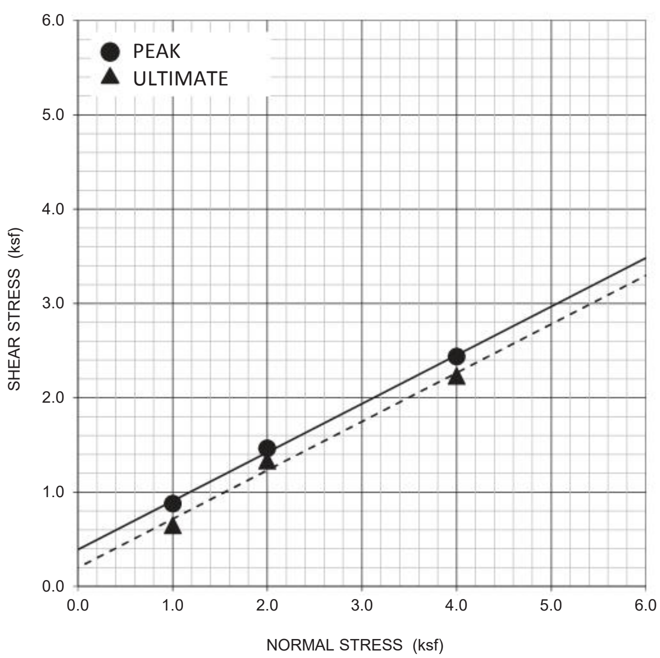
WILLDAN Geotechnical | extending your reach

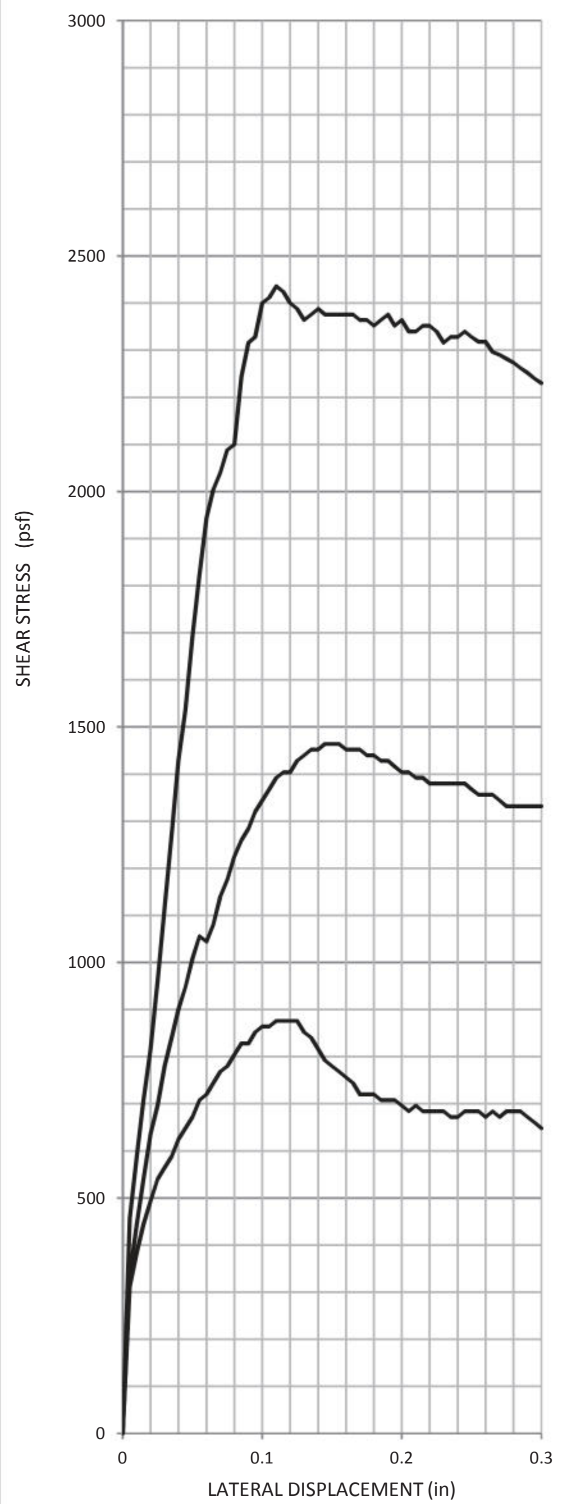
Project Name :	County Rd. R Bridge over GCID Canal	Project No. :	106453-4000
Boring / Sample No :	A-18-002 Depth : 20 ft	Tested By :	RMC Date: 5-Jun-18
Sample Descriptions / Classification :	Lean Clay (CL)	Sampled By :	Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.876		1.464		2.436	
Shear Stress,Ultimate(ksf)	0.648		1.332		2.230	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	189.4	191.9	186.1	189.6	188.4	191.6
Dry Wt. of Soil + Ring (g)		158.6		155.8		157.8
Weight of Water (g)	30.8	33.3	30.3	33.8	30.5	33.8
Weight of Ring (g)		43.1		42.3		43.6
Weight of Dry Soil (g)		115.5		113.4		114.3
Moisture Content (%)	26.7	28.8	26.7	29.8	26.7	29.6
Wet Density (pcf)	121.5	123.5	119.3	122.2	120.2	122.9
Dry Density (pcf)		95.9		94.2		94.9
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	96.1	100.0	92.2	100.0	93.8	100.0
Void Ratio		0.744		0.776		0.763

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	390	200
Friction Angle, ϕ (degree)	27.5	27.5





Remarks : ______

DIRECT SHEAR TEST

(ASTM D3080)

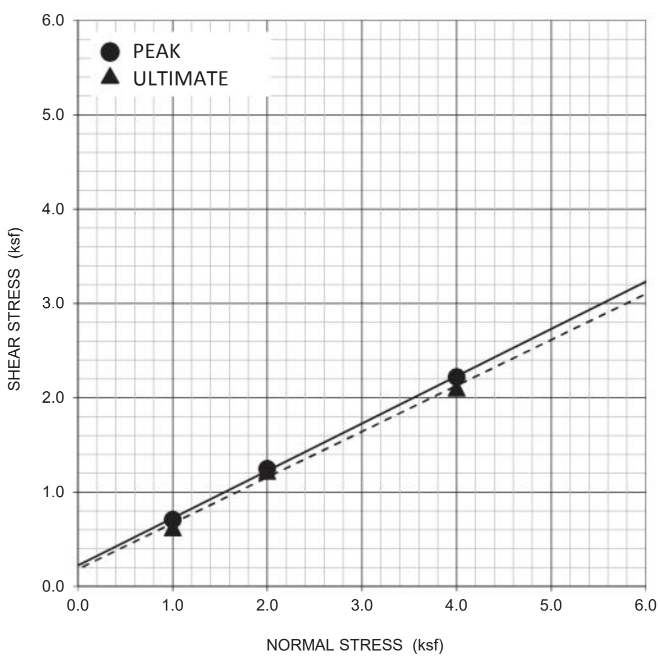
WILLDAN Geotechnical | extending your reach

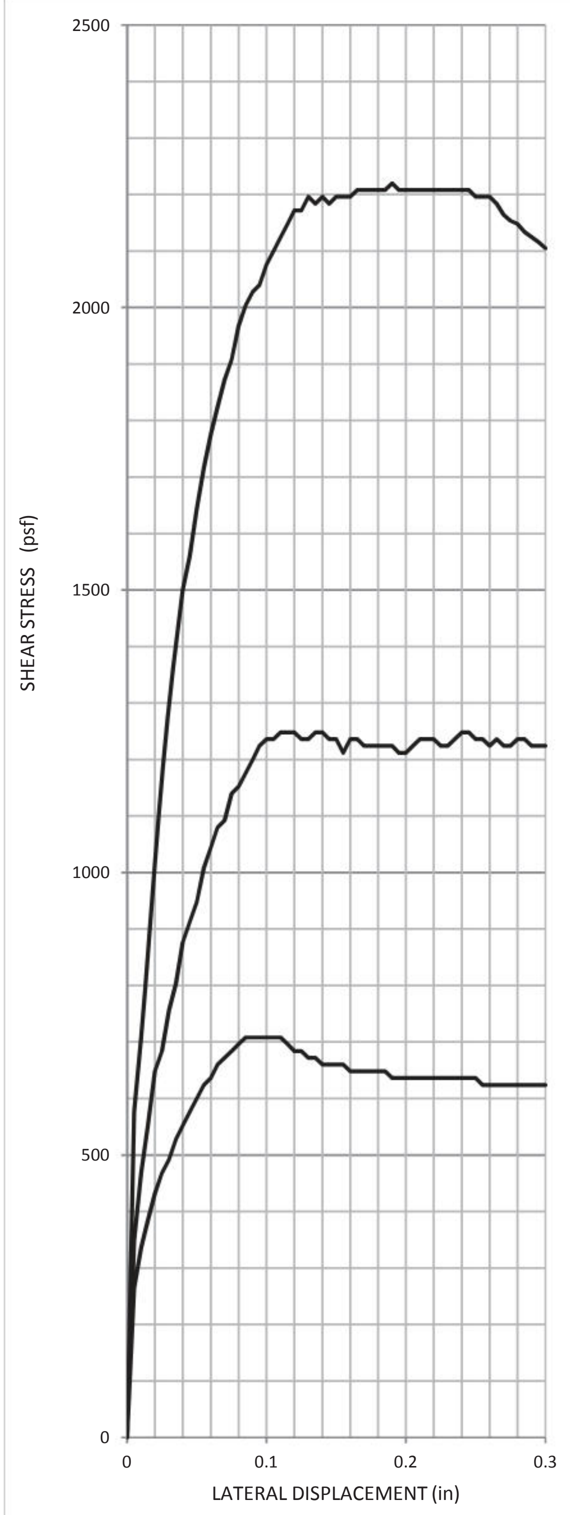
Project Name :	County Rd. R Bridge over GCID Canal	Project No. :	106453-4000
Boring / Sample No :	A-18-002 Depth : 44 ft	Tested By :	RMC Date: 5-Jun-18
Sample Descriptions / Classification :	Lean Clay (CL)	Sampled By :	Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.708		1.248		2.220	
Shear Stress,Ultimate(ksf)	0.624		1.224		2.105	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	192.35	192.4	199.6	199.8	194.5	195.4
Dry Wt. of Soil + Ring (g)		161.9		168.4		164.0
Weight of Water (g)	30.5	30.6	31.2	31.4	30.5	31.4
Weight of Ring (g)		42.4		46.0		44.4
Weight of Dry Soil (g)		119.5		122.4		119.5
Moisture Content (%)	25.5	25.6	25.5	25.7	25.5	26.3
Wet Density (pcf)	124.5	124.6	127.5	127.7	124.6	125.3
Dry Density (pcf)		99.2		101.6		99.3
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	99.7	100.0	100.0	100.0	99.8	100.0
Void Ratio		0.685		0.646		0.685

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	220	185
Friction Angle, ϕ (degree)	26.5	26.0



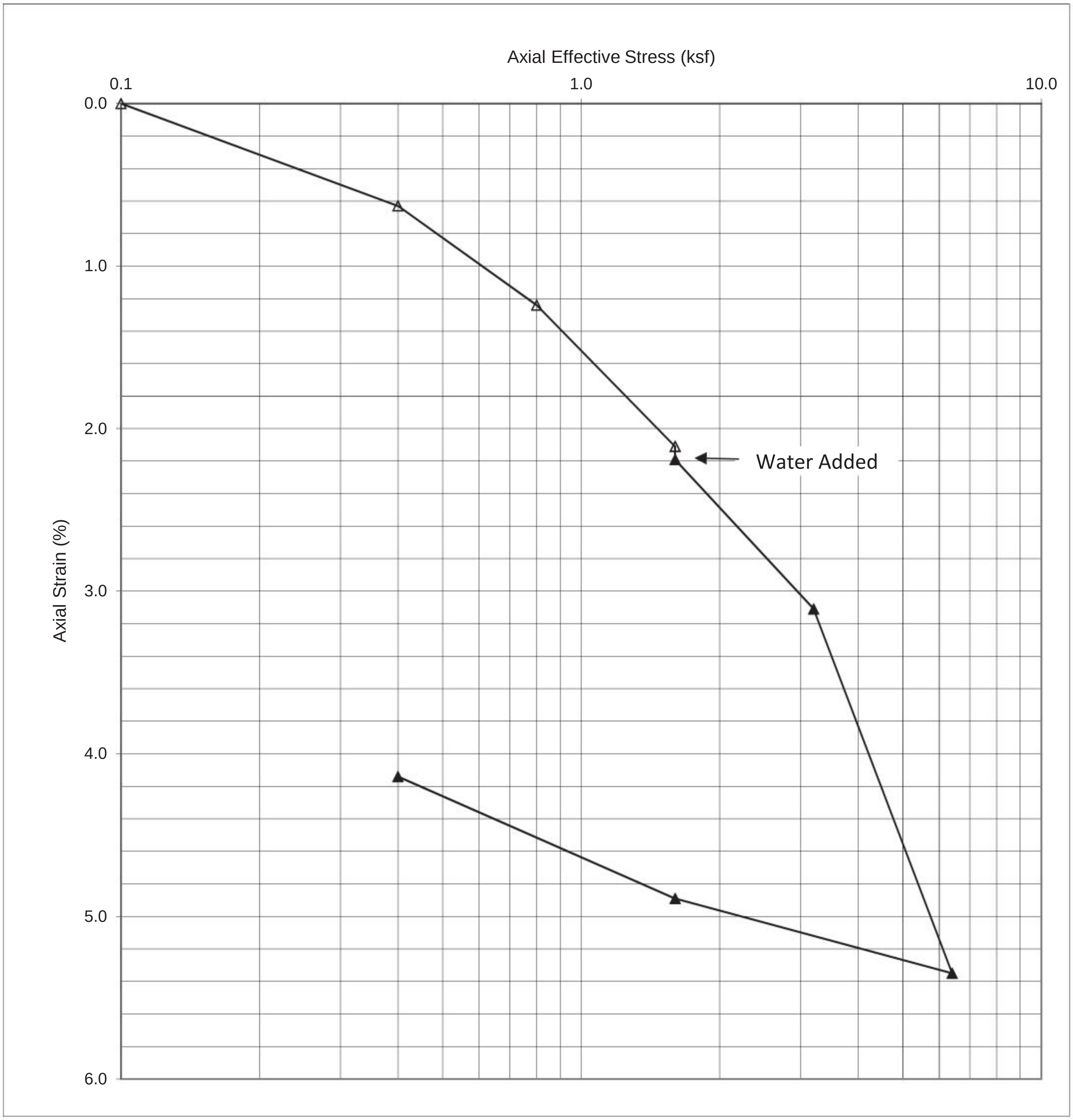


Remarks : ______________________

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical | extending your reach



Boring No. : A-18-001 Depth (ft) : 20 Pre-Consolidation Pressure, P_c (ksf) : 2.40

Sample Descriptions/Classification : Lean CLAY (CL) Overburden Pressure, P_o (ksf) : 2.40

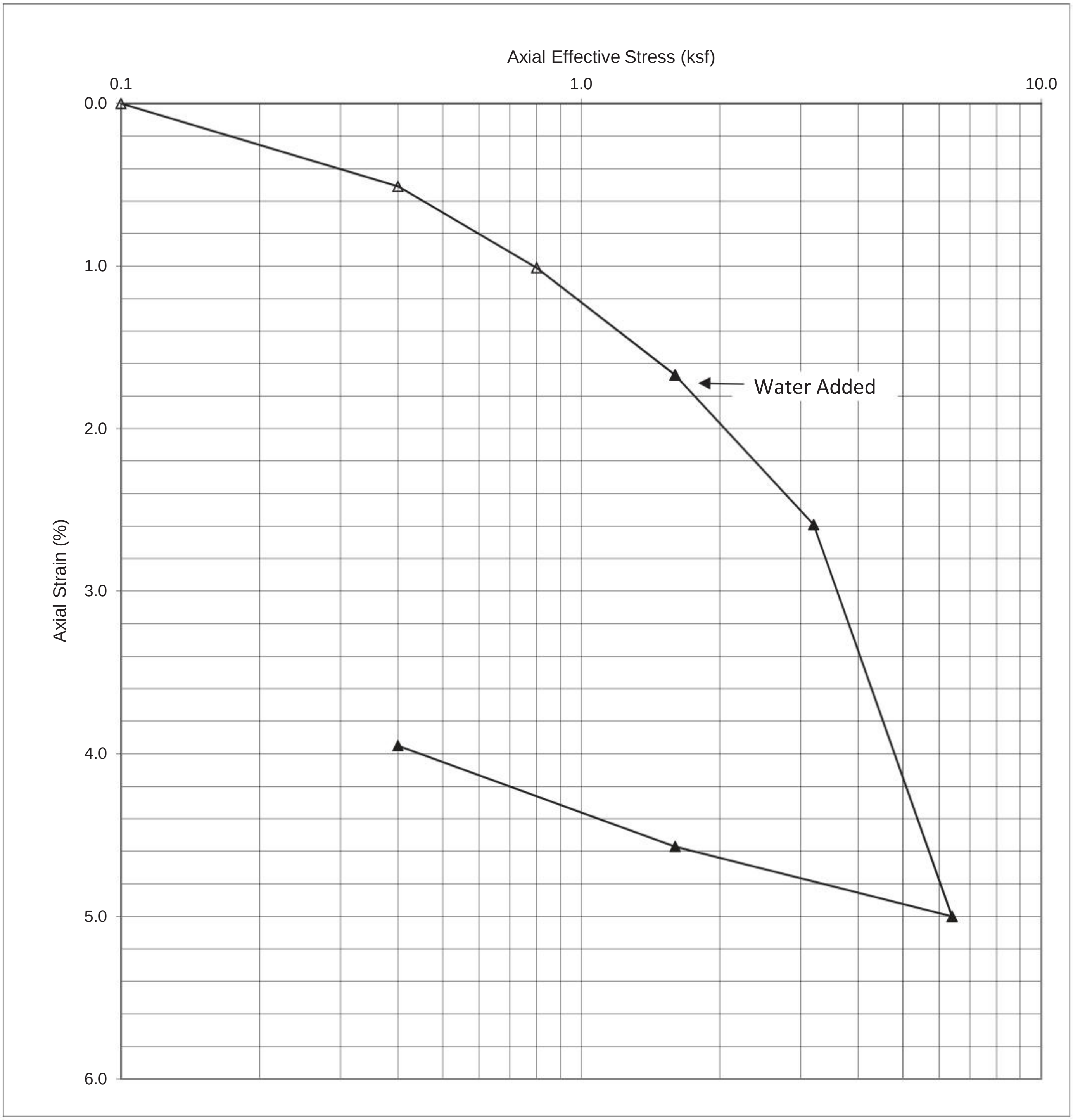
Sp. Gravity : 2.68 (Assumed) Compression Ratio, $C_{c\varepsilon}$: 0.074 Swell Ratio, $C_{s\varepsilon}$: 0.010

Specimen Height (in)		Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	1.000	25.2	93.4	85.5	0.790
Final	0.959	26.7	97.5	100.0	0.716

Consolidation Test
(ASTM D2435)

WILLDAN Geotechnical | extending your reach

County Rd. R Brisge over GCID Canal	**Project No. 106453-4000**	**6-Jun-18**



Boring No. : A-18-002 Depth (ft) : 39 Pre-Consolidation Pressure, P_c (ksf) : 3.00

Sample Descriptions/Classification : Lean CLAY (CL) Overburden Pressure, P_o (ksf) : 4.70

Sp. Gravity : 2.68 (Assumed) Compression Ratio, $C_{c\varepsilon}$: 0.080 Swell Ratio, $C_{s\varepsilon}$: 0.009

Specimen Height (in)		Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	1.000	29.9	92.0	98.0	0.817
Final	0.961	29.2	95.8	105.0	0.745

Consolidation Test
(ASTM D2435)

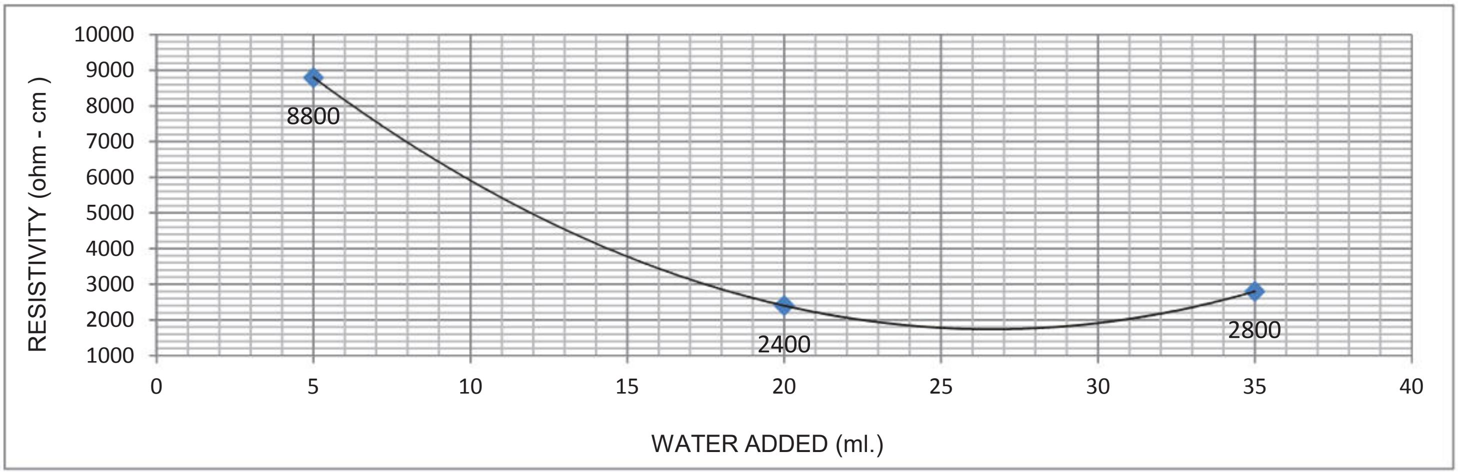
WILLDAN Geotechnical — extending your reach

County Rd. R Bridge over GCID Canal | **Project No. 106453-4000** | **6-Jun-18**

Project Name :	County Rd. R Bridge over GCID Canal	Project No.:	106453-4000		
Sample Location / Source :	A-18-001	Tested by :	RMC	Date:	6/7/2018
Sample Depth / No. :	0.0' - 2.5'	Sampled by:		Date:	
Sample Description / Classification :	Lean CLAY (CL)				

A. MINIMUM RESISTIVITY (CTM 643)

WATER ADDED, (ml)	5	20	35	
RESISTIVITY MEASURED, (ohm-cm)	8800	2400	2800	
TEMPERATURE MEASURED, (^{0}C)	23.9			
MINIMUM RESISTIVITY (ohm-cm)	1800			
MIN. RESISTIVITY CORRECTED , $R_{min\ -15.5}$ (ohm-cm)	2151			



B. SULFATE CONTENT OF SOILS (CTM 417)

SOIL - WATER RATIO	100 : 300
SO_4 DILUTION (ALIQUOT : DISTILLED H_2O)	5 : 20
FACTOR	15
SULFATE READING (ppm)	3
WATER SOLUBLE SULFATES, (ppm)	45

C. CHLORIDE CONTENT OF SOILS (CTM 422, SILVER NITRATE METHOD)

CHLORIDE DILUTION (ALIQUOT:DISTILLED H_2O)	50 : 50
NUMBER OF DIGITS REQUIRED	30
WATER SOLUBLE CHLORIDES, (ppm)	90

D. pH OF SOILS (CTM 643)

pH VALUE	8.32

REMARKS :

CORROSION TESTS

(CTM 417, 422, 643)

WILLDAN Geotechnical | extending your reach

Project Name: County Rd. R Bridge at GCID Canal   Willdan Project No.: 106453-4000

'R' VALUE CA 301

US STD. SIEVE OPENING IN INCHES   US STD. SIEVE NUMBERS   HYDROMETER

COBBLES | G R A V E L (COARSE, FINE) | S A N D (COARSE, MEDIUM, FINE) | SILT OR CLAY

1-1/2" 3/4" 3/8" #4 #10 #40 #200

Client: Willdan Geotechnical   Date: 6/7/18   By: LD

Client's Job No.: 106453-4000   Sample No.: A-18-002 @ 0 - 2.5'

GLA Reference: 2005-224   Soil Type: Lean Clay (CL)

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	**65**	**50**	**125**	
Initial Moisture Content	%	**6.4**	**6.4**	**6.4**	
Water Added	ml	**80**	**100**	**60**	
Moisture at Compaction	%	13.5	15.3	11.8	
Sample & Mold Weight	gms	**3241**	**3206**	**3218**	
Mold Weight	gms	**2102**	**2109**	**2096**	
Net Sample Weight	gms	1139	1097	1122	
Sample Height	in.	**2.515**	**2.479**	**2.462**	
Dry Density	pcf	120.9	116.3	123.6	
Pressure	lbs	**4665**	**3425**	**6680**	
Exudation Pressure	psi	371	273	532	
Expansion Dial	x 0.0001	**48**	**28**	**88**	
Expansion Pressure	psf	208	121	381	
Ph at 1000lbs	psi	**50**	**60**	**40**	
Ph at 2000lbs	psi	**117**	**128**	**88**	
Displacement	turns	**3.57**	**3.91**	**3.49**	
R' Value		20	14	37	
Corrected 'R' Value		**20**	**14**	**37**	

FINAL 'R' VALUE	
By Exudation Pressure (@ 300 psi):	**16**
By Expansion Pressure:	**14**
TI =	5

PERCENT FINER BY WEIGHT: 100.0, 90.0, 80.0, 70.0, 60.0, 50.0, 40.0, 30.0, 20.0, 10.0, 0.0

100.00   10.00   1.00   0.10   0.01

GRAIN SIZE IN MILLIMETERS

Project No. : 102357-2000   Project Name : MORENO VALLEY

Boring No.	Sample No.	Depth	Symbol	Classification	Nat.W %	LL	PL	PI
B-1	S-2	5' - 6'	SM	Weathered GRANITE/ Silty SAND		-	-	-

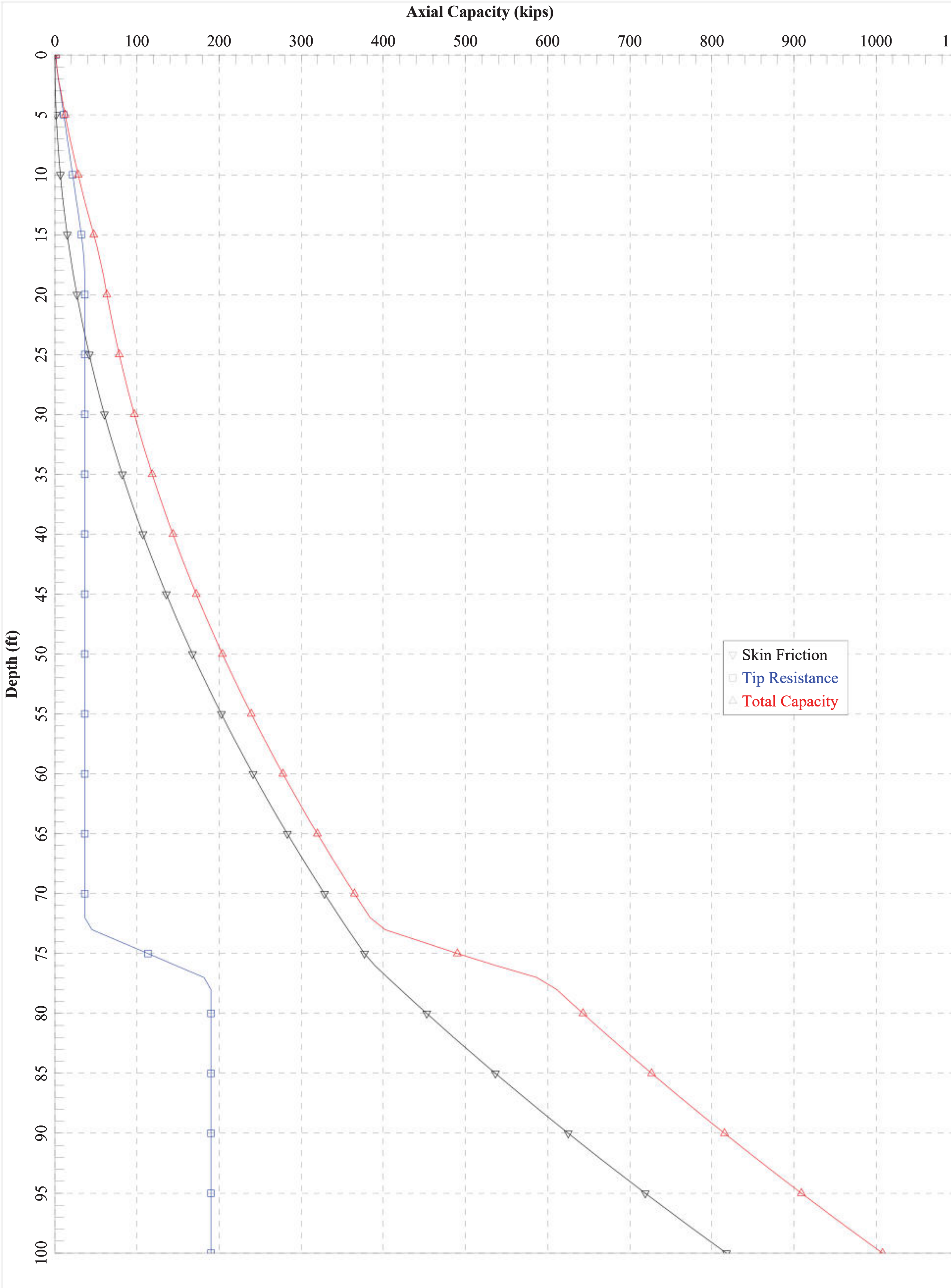
Geo-Logic ASSOCIATES

R-VALUE TEST (CTM 301)

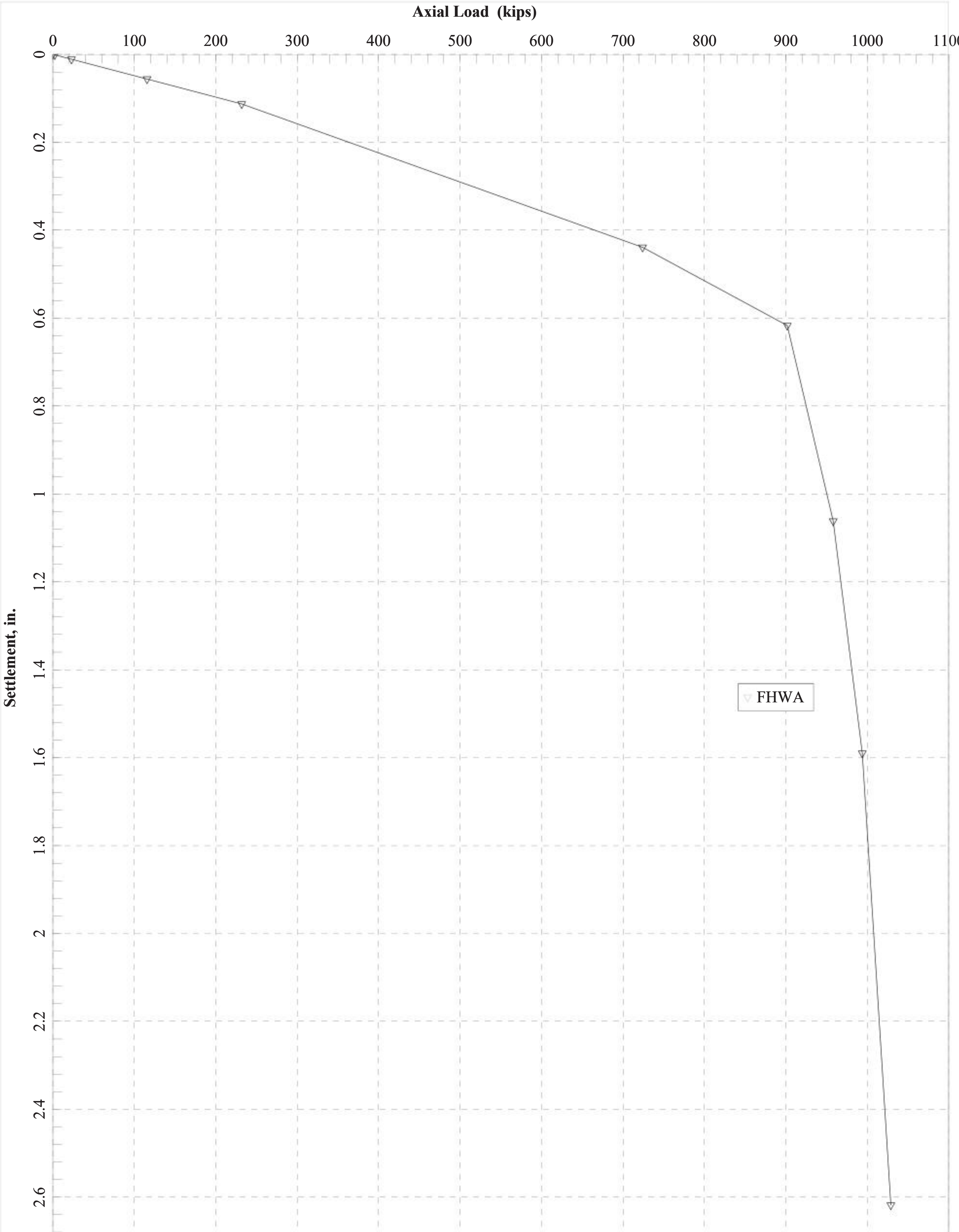
GRAIN SIZE CURVE

WILLDAN Geotechnical | extending your reach

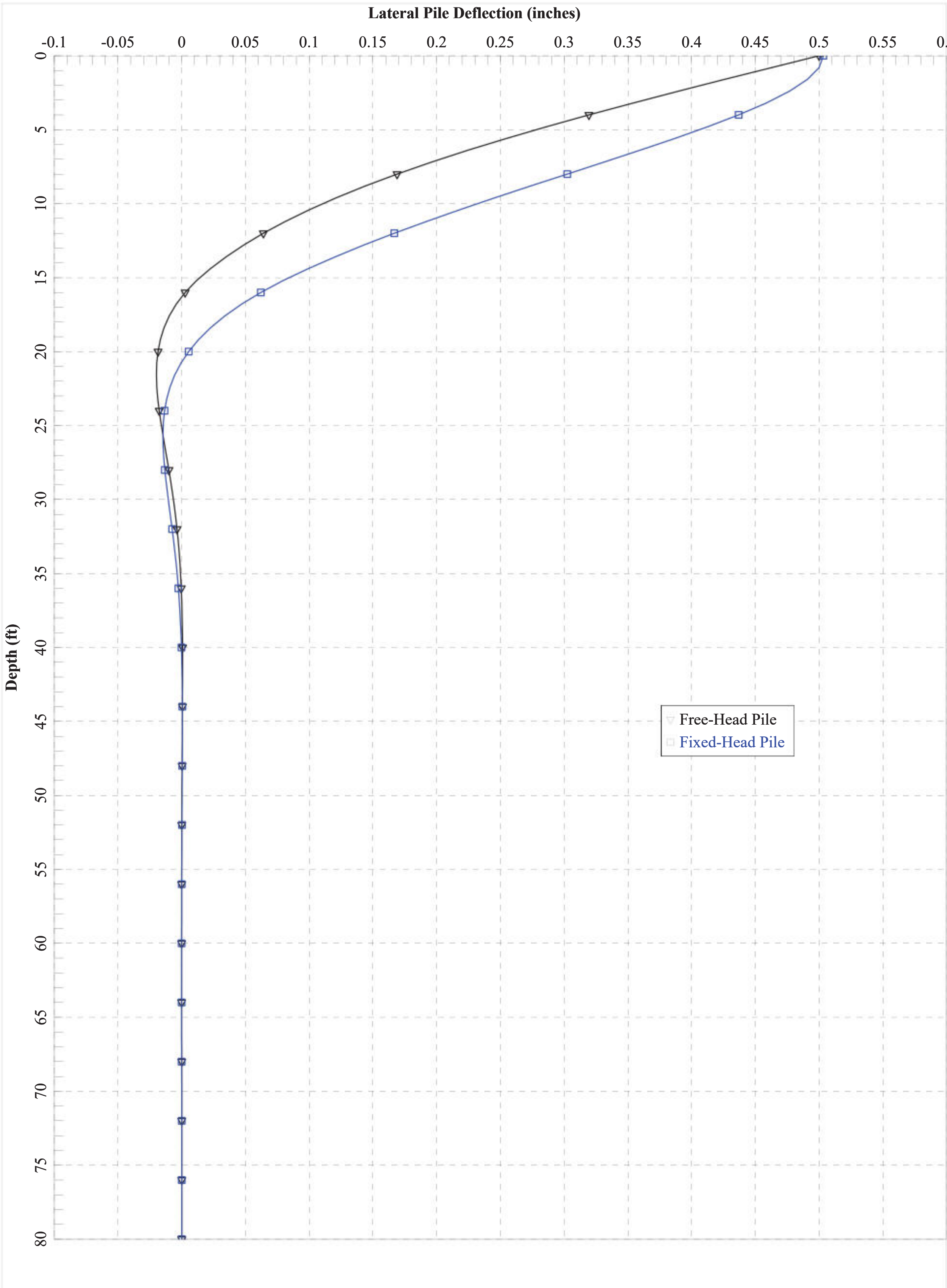
APPENDIX C: PILE CAPACITY GRAPHS



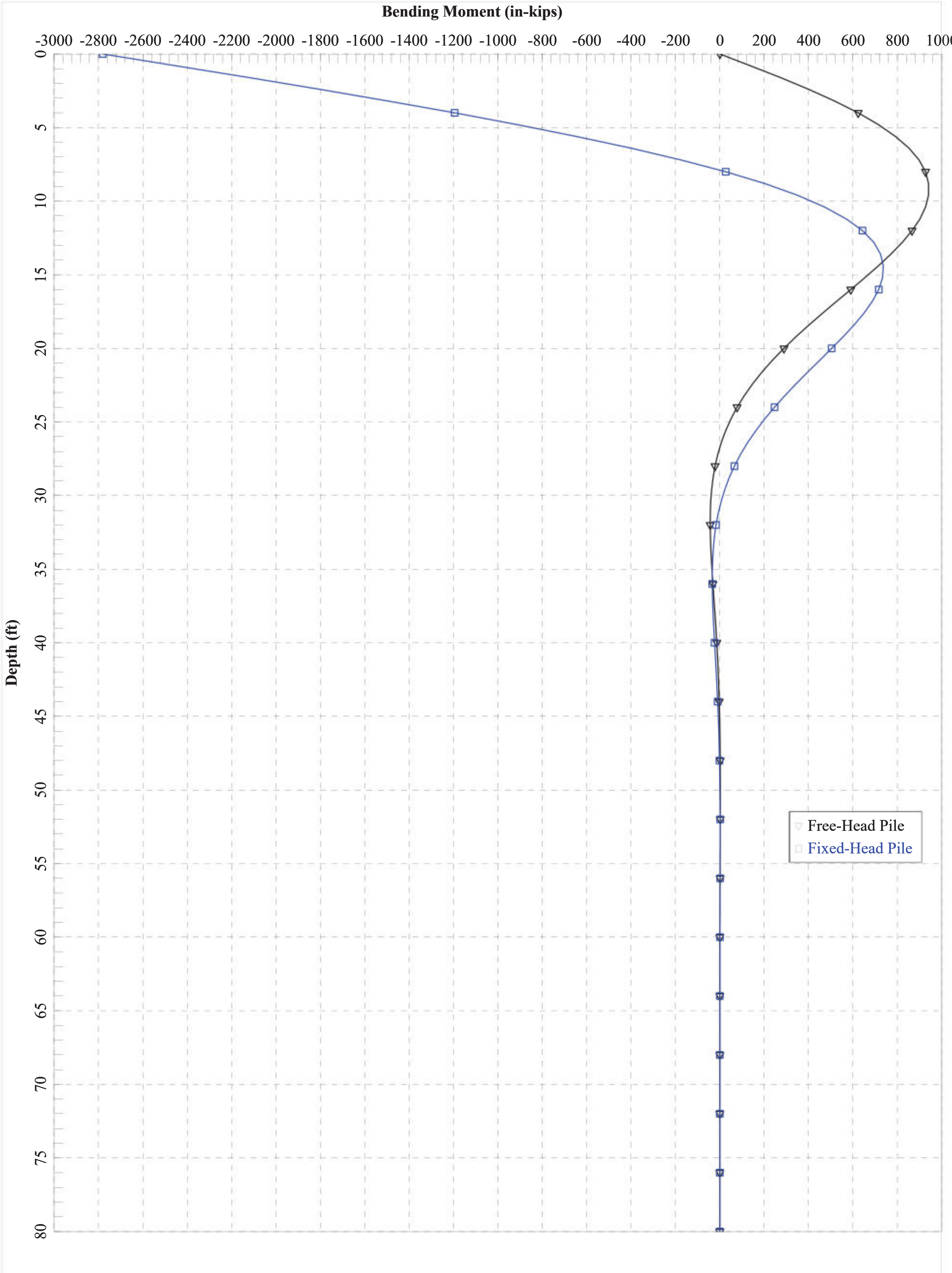
18-inch Diameter Pile - Ultimate Axial Compression Capacity



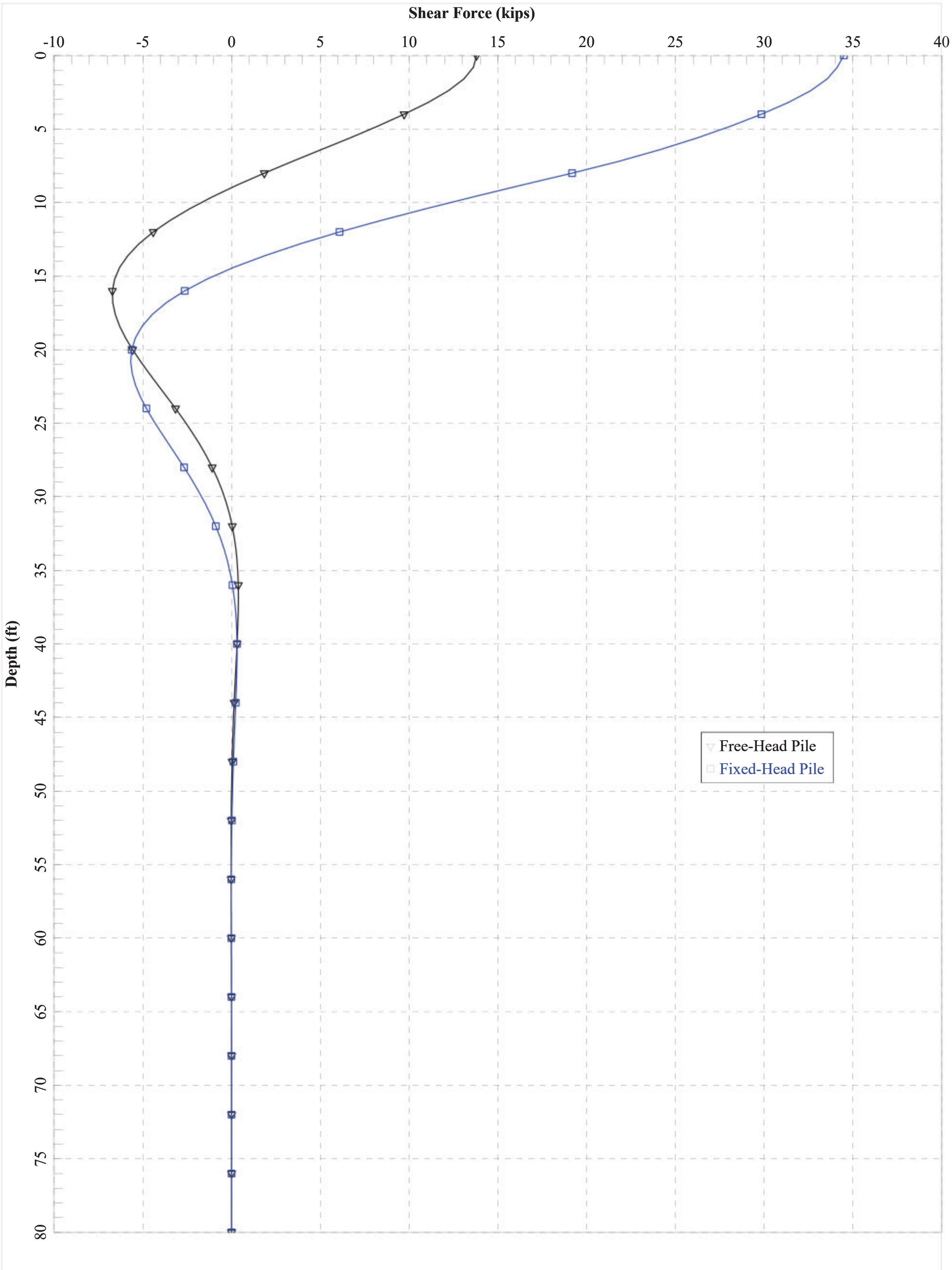
18-inch Diameter Pile - Settlement vs. Axial Load



18-inch Diameter Pile - Lateral Deflection vs. Depth



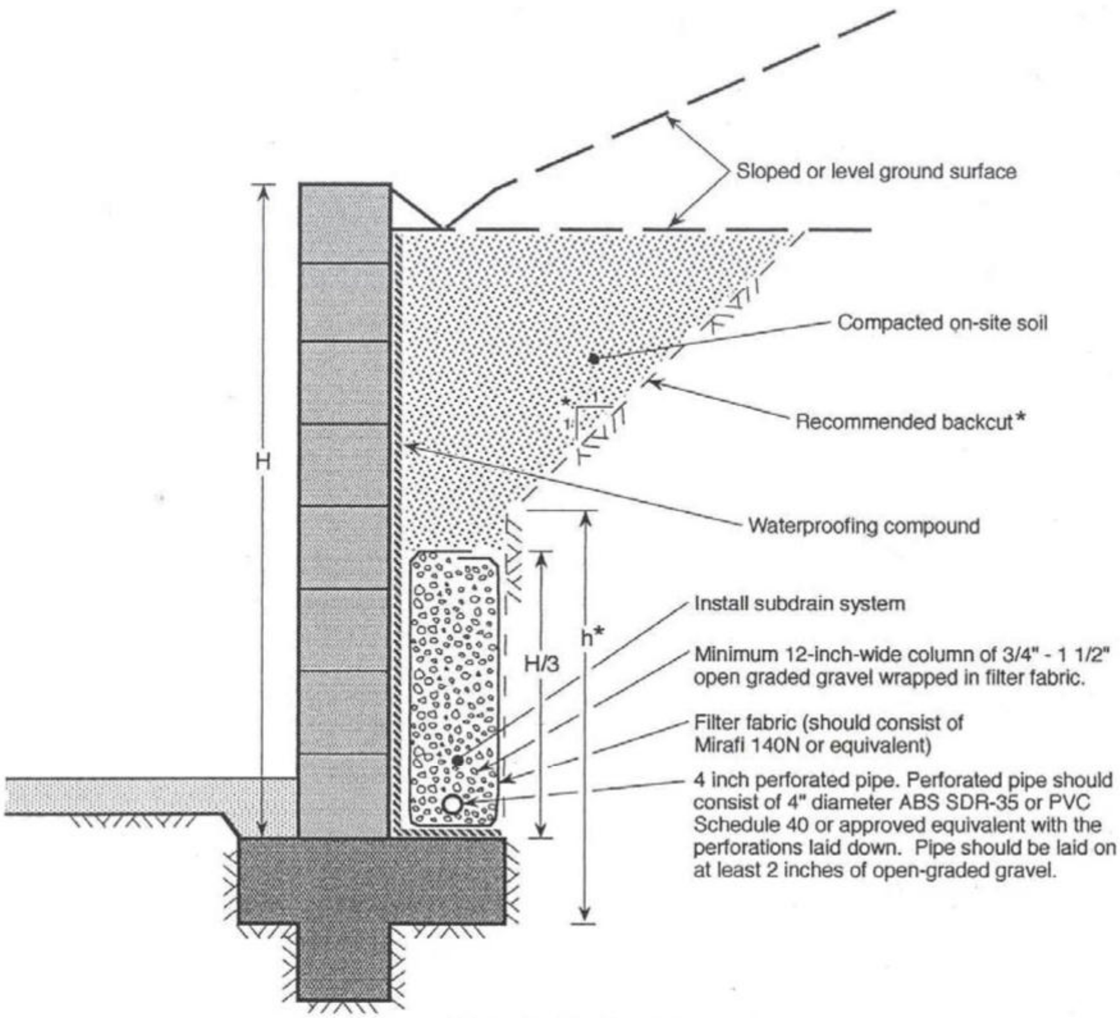
18-inch Diameter Pile - Bending Moment vs. Depth



18-inch Diameter Pile - Shear Force vs. Depth

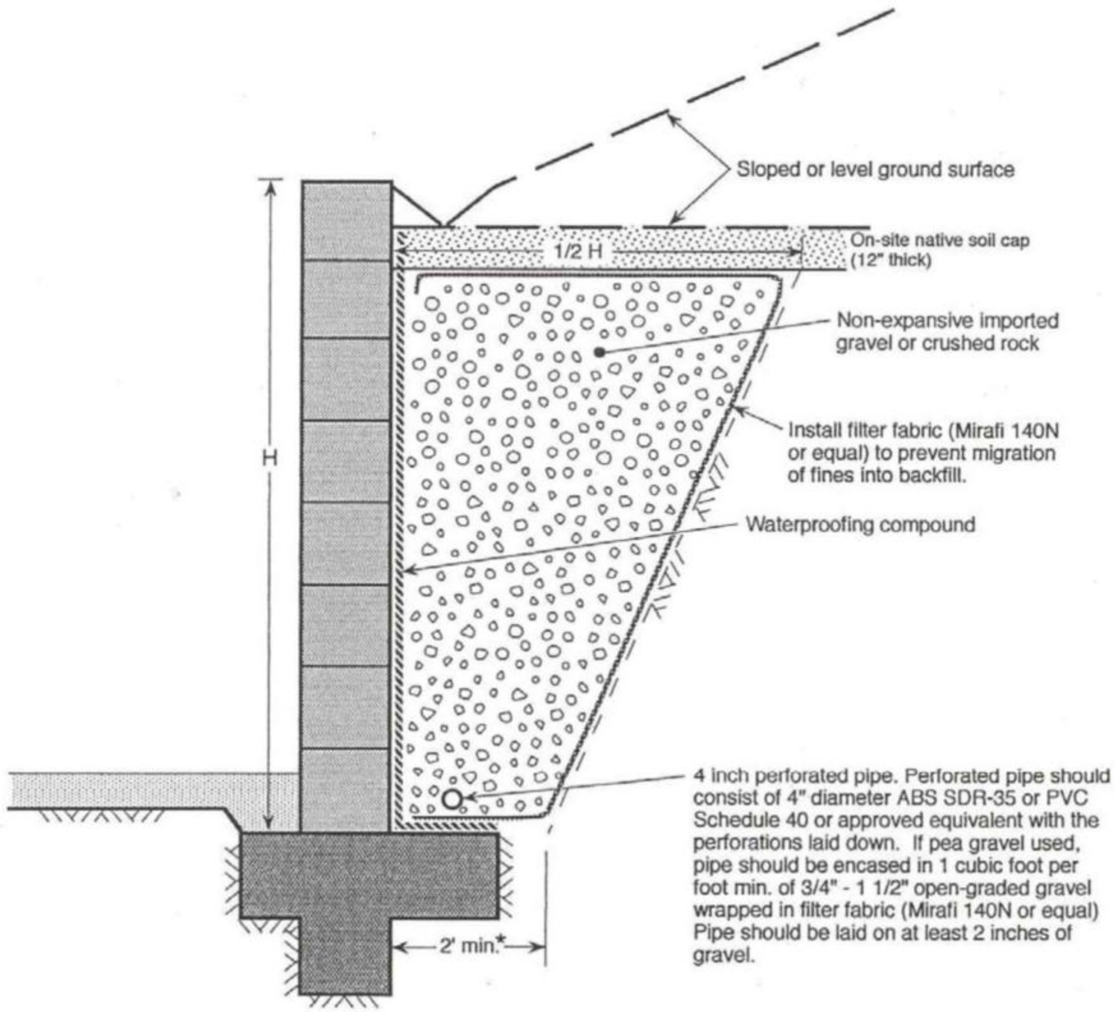
APPENDIX D: TYPICAL RETAINING WALL BACKFILL DETAILS

NATIVE SOIL BACKFILL



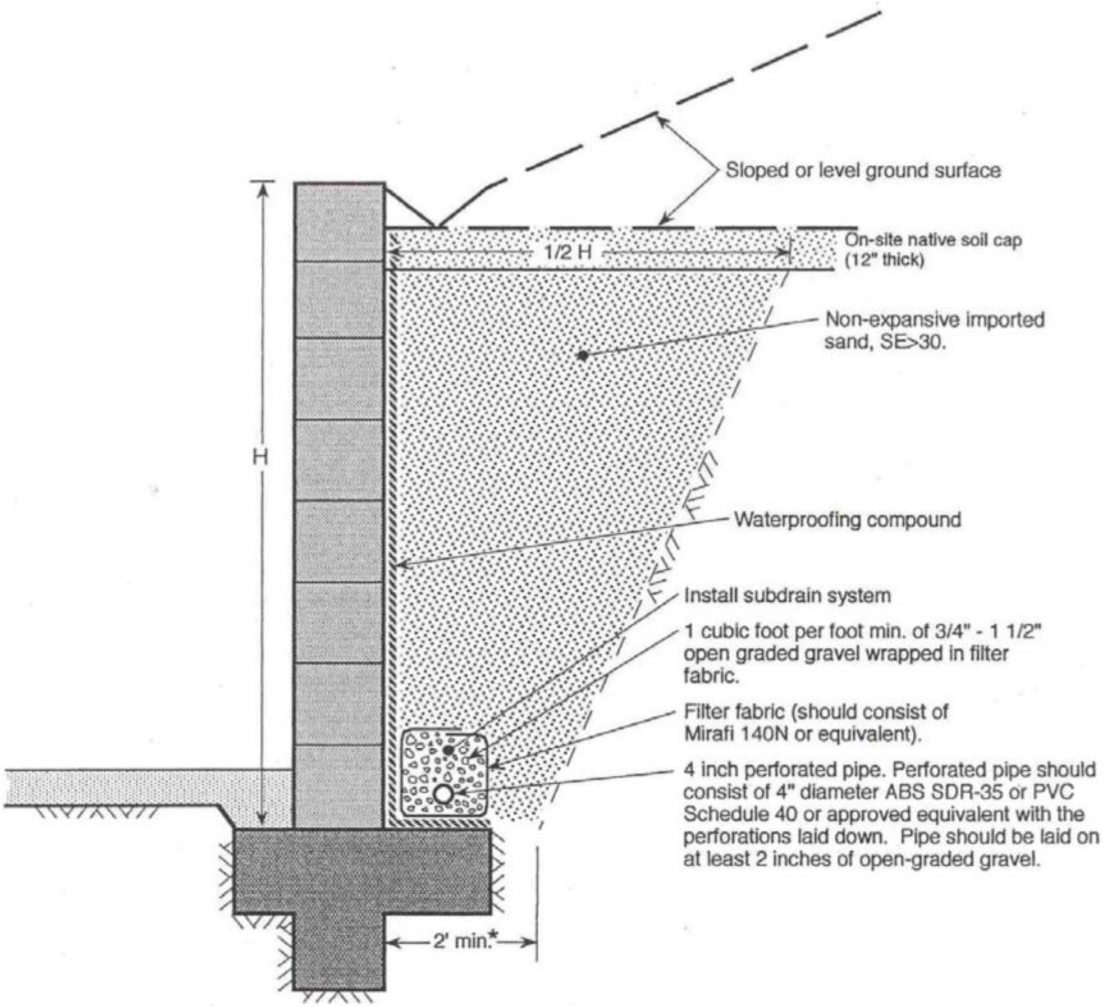
* Vertical height (h) and slope angle of backcut per soils report. Based on geologic conditions, configuration of backcut may require revisions (i.e. reduced vertical height, revised slope angle, etc.)

IMPORTED GRAVEL OR CRUSHED ROCK BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

IMPORTED SAND BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.