FOR CONTRACT NO.: 06-0K8004

INFORMATION HANDOUT
MATERIALS INFORMATION

1. Water Source
2. Alternative Flared Terminal System
3. Final hydraulic report for Br No. 42-0134, dated August 17, 2015
4. Final hydraulic report for Br No. 45-0007 dated August 18, 2015
5. Final hydraulic report for Br No. 45-0064 dated August 15, 2015
6. Foundation report for Br No. 45-0064, dated September 21, 2015
7. Foundation report for Br No. 45-0007, dated September 15, 2015
8. Foundation report for Br No. 42-0216F, dated September 15, 2015
9. Foundation report for Br No. 42-0134, dated September 15 2015

PERMITS

10. California Regional Water Quality Control Board 401 Permit for Br No. 45-0064, Dated November 20, 2015
11. Department of Fish and Game 1600 Permit for Br No. 45-0064, Dated September 23, 2015
12. Department of Fish and Game 1600 Permit for Br No. 42-0134, Dated March 2, 2016
13. Department of Fish and Game 1600 Permit for Br No. 45-0007, Dated January 21, 2016
14. Central Valley Flood Protection Board Encroach Permit for Br No. 45-0064, Dated September 1, 2015
15. Central Valley Flood Protection Board Encroach Permit for Br No. 45-0007, Dated September 1, 2015
16. U.S. Army Corps of Engineers, Non-reporting Nationwide 14 Permit for Br No. 45-0064, Dated March 19, 2012
17. U.S. Department of the Interior Fish and Wildlife Service Letter of Concurrence, Dated January 26, 2015
18. Department of the Interior Fish and Wildlife Service Revision Letter of Concurrence, Dated October 8, 2015

ROUTE: 06-Fre, Kin-31, 41, 43, PM Var

Lian, Joe@DOT

From: Lisa Koehn <lisak@ci.clovis.ca.us>
Sent: Wednesday, December 23, 2015 4:19 PM
To: Nijhawan, Amit@DOT
Cc: Lian, Joe@DOT; Hanif, Shakila@DOT; Ramirez, Arthur A@DOT
Subject: RE: Water Source for EA 06-0K8001

Hi,

Yes, that amount of water will be available. The current price is $0.74/1,000 gallons.

Lisa Koehn
Assistant Public Utilities Director
155 N. Sunnyside Avenue
Clovis, CA 93611
(559) 324-2607
Fax (559) 324-2862

From: Nijhawan, Amit@DOT [mailto:amit.nijhawan@dot.ca.gov]
Sent: Wednesday, December 23, 2015 4:10 PM
To: Lisa Koehn
Cc: Lian, Joe@DOT; Hanif, Shakila@DOT; Ramirez, Arthur A@DOT
Subject: Water Source for EA 06-0K8001

Lisa,

It was good taking to you. As I mentioned on the phone I have project in Fresno. We estimate the project will requires 3,125 gallon to construct. Please provide you concurrence, if contractor can use recycled water source off of 168 and Temperance Ave.

Thanks for your help with project.

Have a good Holidays..

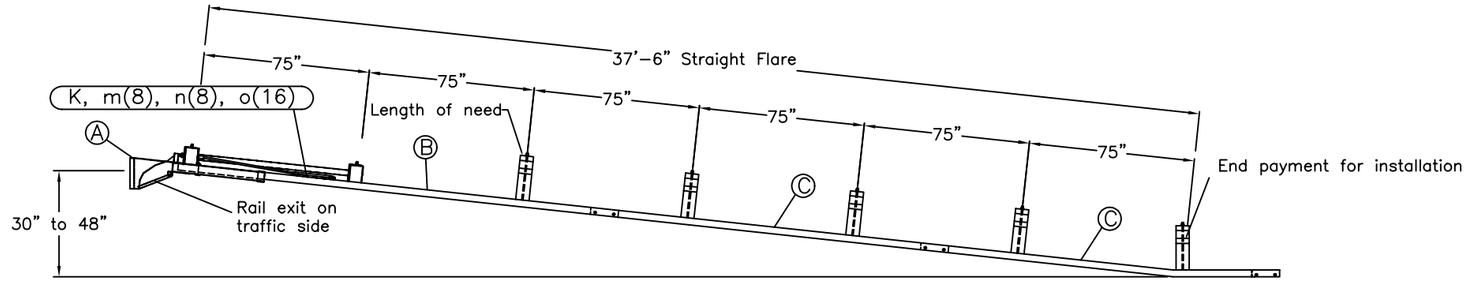
Amit Nijhawan, PE
Design 1, Branch M
Ph. (559) 243-3811
Fax. (559) 243-3840

From: Lian, Joe@DOT
Sent: Wednesday, December 23, 2015 3:14 PM
To: Nijhawan, Amit@DOT <amit.nijhawan@dot.ca.gov>
Cc: Hanif, Shakila@DOT <shakila.hanif@dot.ca.gov>
Subject: Water Source for EA 06-0K8001

Hi,

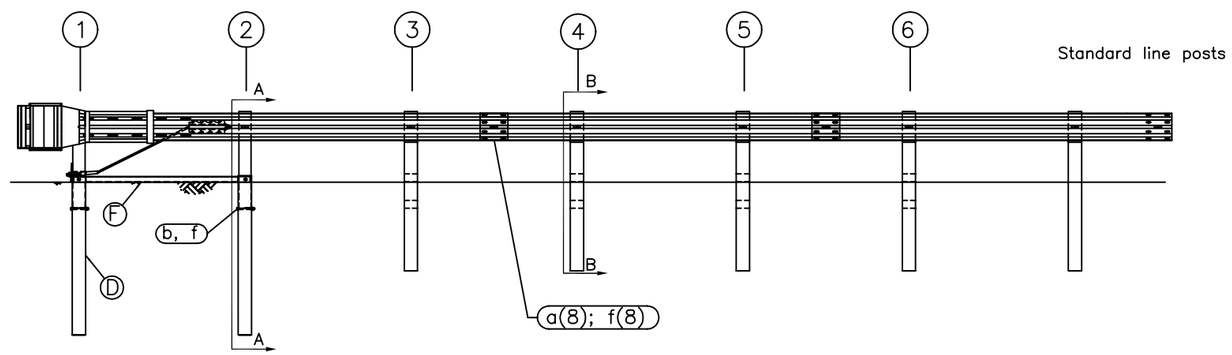
Please provide the water source for this project.

Joe Lian

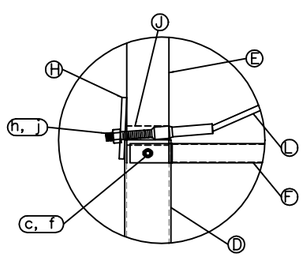


TRAFFIC

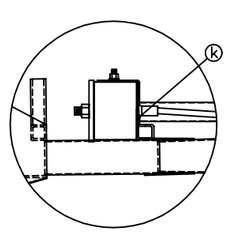
PLAN



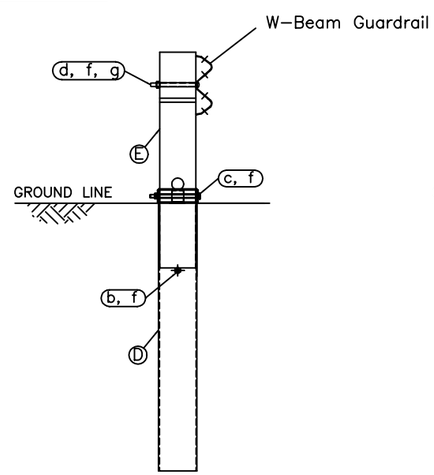
ELEVATION



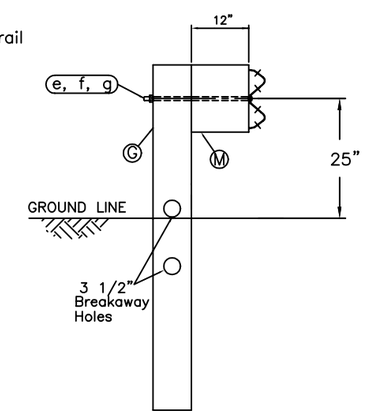
POST #1 CONNECTION DETAILS



IMPACT HEAD CONNECTION DETAIL



SECTION A-A
Post #2



SECTION B-B
Posts 3 thru 6

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	F3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	F1303 MGS
C	2	W-BEAM GUARDRAIL, 12 Ga.	G1203 MGS
D	2	FOUNDATION TUBE	E731
E	2	BCT WOOD POST	P650 MGS
F	1	GROUND STRUT	E780
G	4	CRT WOOD POST	P671 MGS
H	1	BEARING PLATE	E750
J	1	PIPE SLEEVE	E740
K	1	CABLE ANCHOR BOX	S760
L	1	BCT CABLE ANCHOR ASSEMBLY	E770
M	4	MGS TIMBER BLOCKOUT OR RECYC. EQUIV.	P618
		HARDWARE (ALL DIMENSIONS IN INCHES)	
a	16	5/8ø x 1 1/4 SPLICE BOLT	B580122
b	2	5/8ø x 7 1/2 HEX BOLT	B580754
c	2	5/8ø x 10 HEX BOLT	B581004
d	1	5/8ø x 10 H.G.R. BOLT	B581002
e	4	5/8ø x 22 H.G.R. BOLT	B582202
f	25	5/8ø H.G.R. NUT	N050
g	5	H.G.R. WASHER	W050
h	2	1 ANCHOR CABLE HEX NUT	N100
j	2	1 ANCHOR CABLE WASHER	W100
k	2	3/8 x 3 LAG SCREW	E350
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A

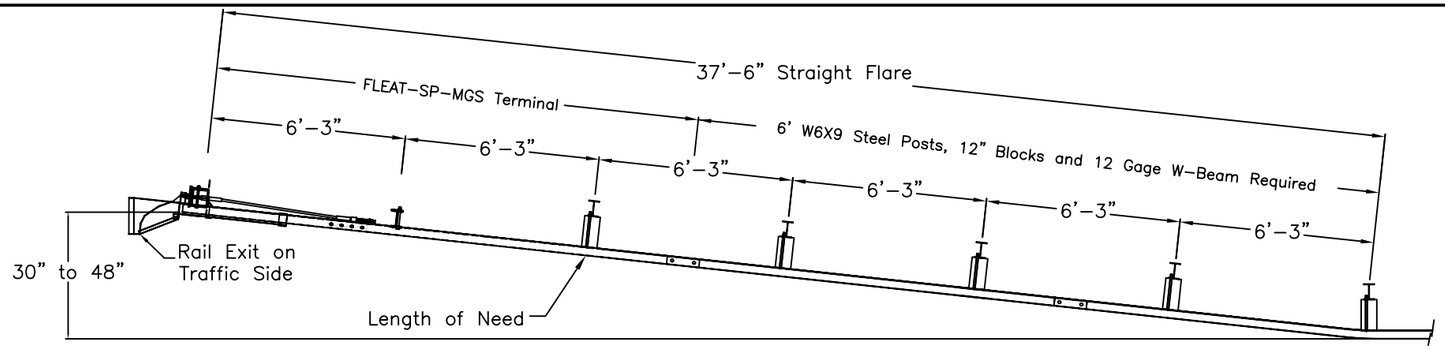
GENERAL NOTES:
1. Breakaway posts are required with the FLEAT.
2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
3. The foundation tubes shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
4. When rock is encountered, a 12" Ø post hole, 20 in into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
5. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
6. The soil tubes may be driven with an approved driving head. They shall not be driven with the post in the tube.
7. The wood blockouts should be "toe-nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.

RSI
Road Systems, Inc.
Big Spring, TX
Phone: 432-263-2435
or Phone: 330-346-0721

Flared Energy Absorbing Terminal - FLEAT Assembly
Midwest Guardrail System

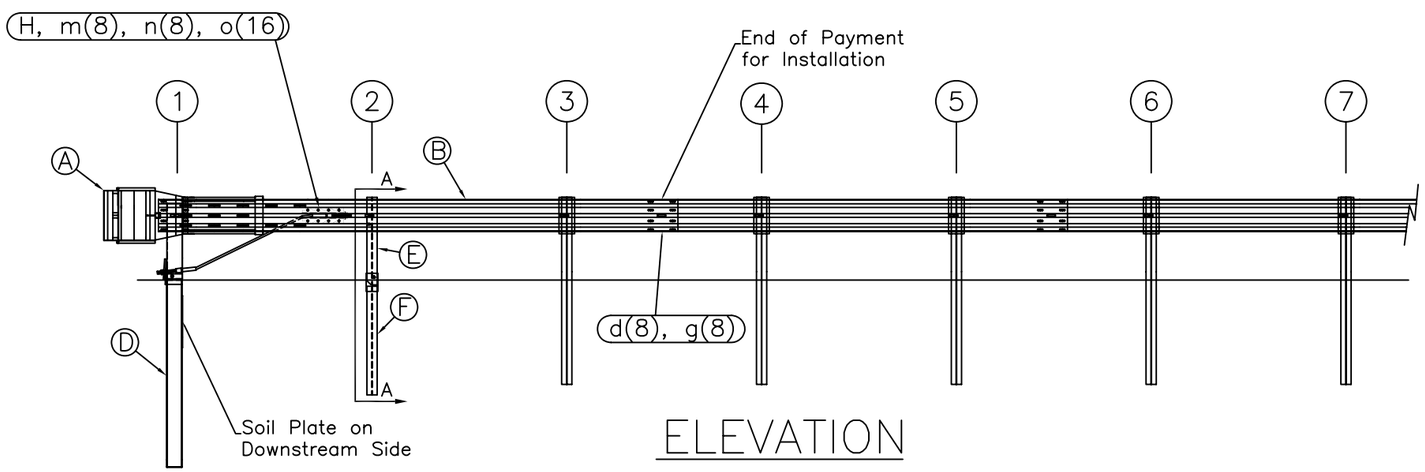
Wood Post System

Sheet: A1
Date: 12/01/2004
By: JRR
Drawing Name: FLT-MGS-W-US
Scale: None
Rev: 0



PLAN

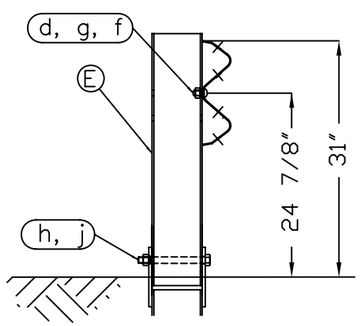
TRAFFIC



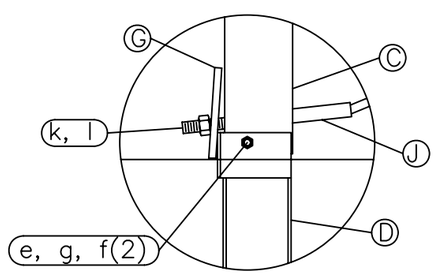
ELEVATION

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	F3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	MGS-SF1303
C	1	FIRST POST TOP (6X6X$\frac{1}{8}$" Tube)	TPHP1A
D	1	FIRST POST BOTTOM (6' W6X15)	TPHP1B
E	1	SECOND POST ASSEMBLY TOP	UHP2A
F	1	SECOND POST ASSEMBLY BOTTOM	HP3B
G	1	BEARING PLATE	E750
H	1	CABLE ANCHOR BOX	S760
J	1	BCT CABLE ANCHOR ASSEMBLY	E770
		HARDWARE (ALL DIMENSIONS IN INCHES)	
a	2	5/16 x 1 HEX BOLT GRD 5	B5160104A
b	4	5/16 WASHER	W0516
c	2	5/16 HEX NUT	N0516
d	9	5/8 Dia. x 1 1/4 SPLICE BOLT (POST #2)	B580122
e	1	5/8 Dia. x 9 HEX BOLT GRD 5	B580904A
f	3	5/8 WASHER	W050
g	10	5/8 Dia. H.G.R NUT	N050
h	1	3/4 Dia. x 8 1/2 HEX BOLT GRD A449	B340854A
j	1	3/4 Dia. HEX NUT	N030
k	2	1 ANCHOR CABLE HEX NUT	N100
l	2	1 ANCHOR CABLE WASHER	W100
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A

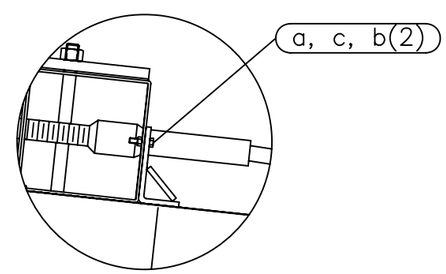
GENERAL NOTES:
1. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
2. The lower sections of the Posts 1&2 shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
3. The lower sections of the hinged posts should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
4. When competent rock is encountered, a 12" Ø post hole, 20 in. deep cored into the rock surface may be used if approved by the engineer for post 1. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first post can be field cut to length, placed in the hole and backfilled with suitable backfill. The soil plate may be trimmed if required.
5. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.



SECTION A-A
Post #2



Post #1 Connection Detail



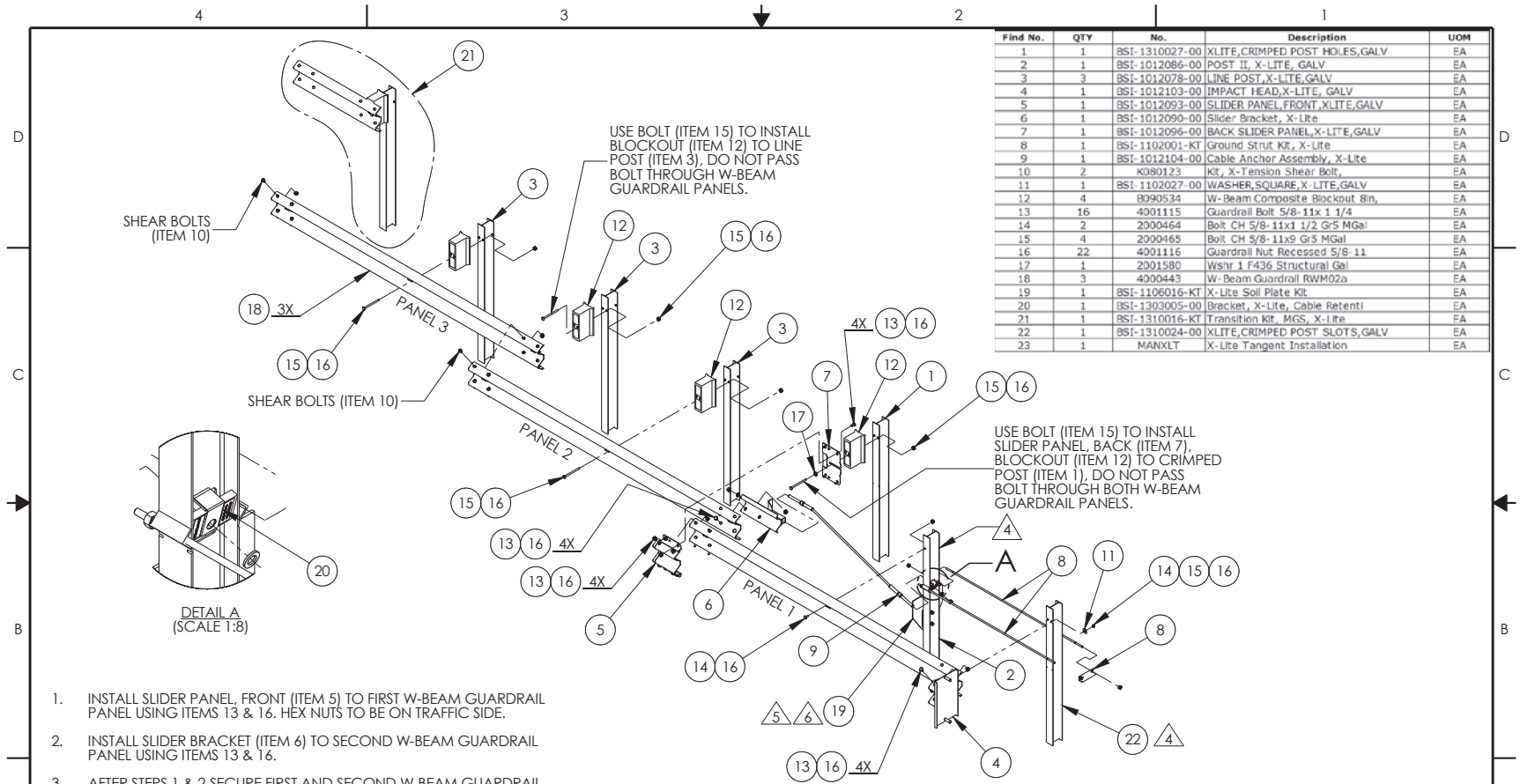
Impact Head Connection Detail

Road Systems, Inc.
Big Spring, TX
Phone: 432-263-2435
or Phone: 330-346-0721

FLEAT-SP-MGS Terminal
Midwest Guardrail System
31" Top of Rail

Sheet: 1
Date: 02/24/10
By: JRR
Drawing Name: FLT-SP-S-MGS
Scale: None
Rev: 0

Appendix A - System Configuration, 37' 6" MGS



Find No.	QTY	No.	Description	UOM
1	1	BSI-1310027-00	XLITE,CRIMPED POST HOLES,GALV	EA
2	1	BSI-1012086-00	POST II, X-LITE, GALV	EA
3	3	BSI-1012078-00	LINE POST,X-LITE,GALV	EA
4	1	BSI-1012103-00	IMPACT HEAD,X-LITE, GALV	EA
5	1	BSI-1012093-00	SLIDER PANEL,FRONT,XLITE,GALV	EA
6	1	BSI-1012090-00	Slider Bracket, X-Lite	EA
7	1	BSI-1012096-00	BACK SLIDER PANEL,X-LITE,GALV	EA
8	1	BSI-1102001-KT	Ground Strut Kit, X-Lite	EA
9	1	BSI-1012104-00	Cable Anchor Assembly, X-Lite	EA
10	2	K080123	Kit, X-Tension Shear Bolt,	EA
11	1	BSI-1102027-00	WASHER,SQUARE,X-LITE,GALV	EA
12	4	B090534	W-Beam Composite Blockout 8in,	EA
13	16	4001115	Guardrail Bolt 5/8-11x 1 1/4	EA
14	2	2000464	Bolt CH 5/8-11x1 1/2 Gr5 MGal	EA
15	4	2000465	Bolt CH 5/8-11x9 Gr5 MGal	EA
16	22	4001116	Guardrail Nut Recessed 5/8-11	EA
17	1	2001580	Wshr 1 F436 Structural Gal	EA
18	3	4000443	W-Beam Guardrail RWM02a	EA
19	1	BSI-1106016-KT	X-Lite Soil Plate Kit	EA
20	1	BSI-1303005-00	Bracket, X-Lite, Cable Retentl	EA
21	1	BSI-1310016-KT	Transition Kit, MGS, X-Lite	EA
22	1	BSI-1310024-00	XLITE,CRIMPED POST SLOTS,GALV	EA
23	1	MANXLT	X-Lite Tangent Installation	EA

1. INSTALL SLIDER PANEL, FRONT (ITEM 5) TO FIRST W-BEAM GUARDRAIL PANEL USING ITEMS 13 & 16. HEX NUTS TO BE ON TRAFFIC SIDE.
2. INSTALL SLIDER BRACKET (ITEM 6) TO SECOND W-BEAM GUARDRAIL PANEL USING ITEMS 13 & 16.
3. AFTER STEPS 1 & 2 SECURE FIRST AND SECOND W-BEAM GUARDRAIL PANEL USING ITEMS 7, 13 & 16. HEX NUTS TO BE ON TRAFFIC SIDE.
4. SLOT ON POSTS 1 AND 2 TO FACE GUARDRAIL PANEL.
5. IF ROCK OR STIFF SOIL IS ENCOUNTERED, THE POST AND SOIL PLATE MAY BE INSTALLED BY AUGERING AND BACKFILLING THE HOLE. EXTRA CARE MUST BE TAKEN TO PREVENT SETTLEMENT OR LATERAL DISPLACEMENT OF THE POST. BACKFILL MATERIAL SHALL BE COMPACTED TO OPTIMUM COMPACTION.
6. IF ROCK IS ENCOUNTERED, THE SOIL PLATE MAY BE MODIFIED IF APPROVED BY THE PROJECT ENGINEER.

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APPROVALS

DRAWN BY:	JMT
DRAWN DATE:	10/09/2013
APPR'D BY:	GAD
APPR'D DATE:	10/09/13

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:
FRACTIONS ±1/16 DECIMAL .XX = ±.03 .XXX = ±.010 ANGLES ±1/2°
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

REV	ECN#	DATE
B	2220	01/23/14
A	2165	11/13/13
0	2151	10/09/13

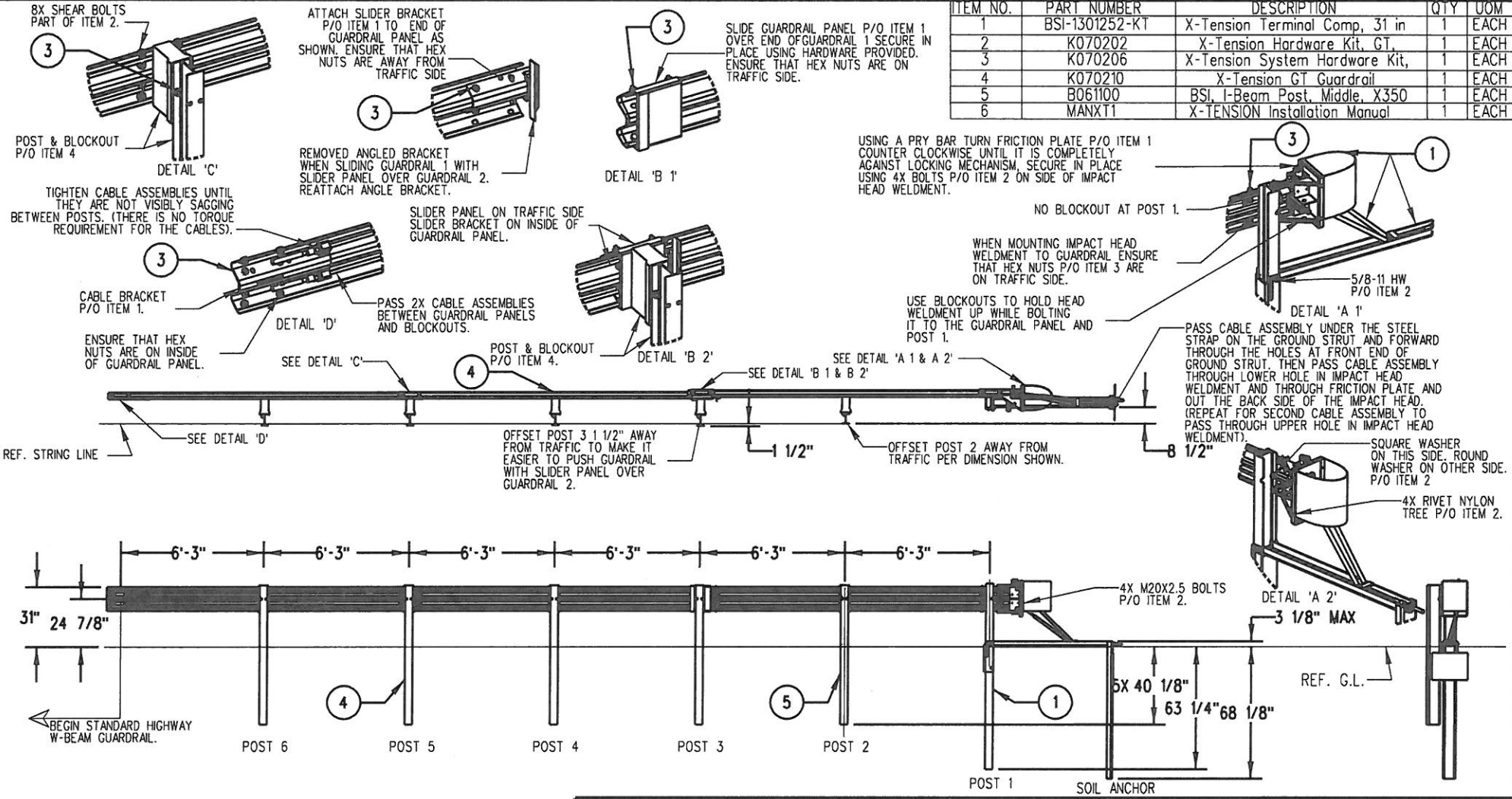
BARRIER SYSTEMS
A LINDSAY TRANSPORTATION SOLUTIONS COMPANY
3333 Vaca Valley Parkway Ste 800
Vacaville, CA 95688
Tel: 888-800-3691
www.barriersystemsinc.com

TITLE
X-LITE SYSTEM ASSEMBLY, TANGENT, TRANSITION TO MGS

SIZE B | DWG NO. XLTSUS-MGS | REV. B
SCALE 1:40 | SHEET 1 OF 2

Doc. B100108

ITEM NO.	PART NUMBER	DESCRIPTION	QTY	UOM
1	BSI-1301252-KT	X-Tension Terminal Comp, 31 in	1	EACH
2	K070202	X-Tension Hardware Kit, GT,	1	EACH
3	K070206	X-Tension System Hardware Kit,	1	EACH
4	K070210	X-Tension GT Guardrail	1	EACH
5	B061100	BSI, I-Beam Post, Middle, X350	1	EACH
6	MANXT1	X-TENSION Installation Manual	1	EACH



NOTES: UNLESS OTHERWISE SPECIFIED.

1. SYSTEM TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS.
2. ONLY TIGHTEN THE CABLE ASSEMBLIES USING THE NUTS AT THE CABLE BRACKET (SEE DETAIL 'D'). DO NOT TIGHTEN THE CABLES AT THE FRONT OF THE GROUND ANCHOR.
3. WHEN DRIVING STEEL POST, ENSURE THAT A DRIVING CAP WITH TIMBER OR PLASTIC INSERT IS USED TO PREVENT DAMAGE TO THE GALVANIZING TO THE TOP OF THE POST.

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APPROVALS

DRAWN BY:	NMV
DRAWN DATE:	2/08/13
APPR'D BY:	JMT
APPR'D DATE:	2/08/13

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:
FRACTIONS ±1/16 DECIMAL .XX - ±.03 .XXX - ±.010 ANGLES ±1/2°
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994
THIRD ANGLE PROJECTION
DO NOT SCALE DRAWING

REV	ECN#	DATE
B	2067	03/02/15
A	2022	2/08/13

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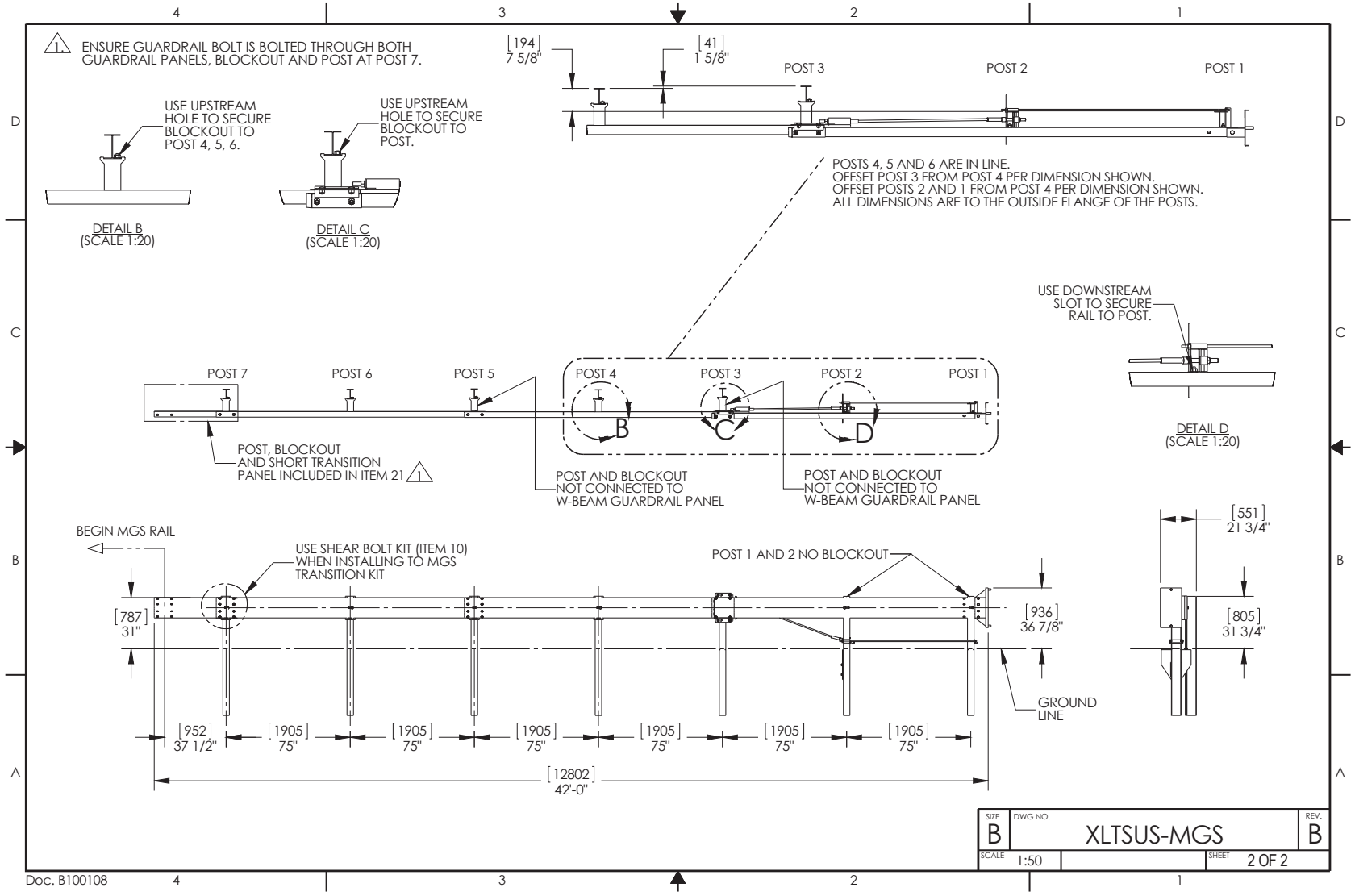
Tel: 888-800-3691
www.barriersystemsinc.com

TITLE
X-TENSION GUARDRAIL TERMINAL SYSTEM STEEL POST WITH COMPOSITE BLOCKOUT 31" RAIL HEIGHT

SIZE	DWG NO.	REV.
B	XTGTSS5	B

SCALE 1:50 SHEET 1 OF 1

Appendix A - System Configuration, 37' 6" MGS



Appendix A -Bill of Materials - X-Lite Tangent, MGS 37’ 6”

Item	Description	Full System	Kit Only
BSI-1310024-00	XLITE,CRIMPED POST SLOTS,GALV	1.00	1.00
BSI-1310027-00	XLITE,CRIMPED POST HOLES,GALV	1.00	1.00
BSI-1012086-00	POST II, X-LITE, GALV	1.00	1.00
BSI-1012078-00	LINE POST,X-LITE,GALV	3.00	-
BSI-1012103-00	IMPACT HEAD,X-LITE, GALV	1.00	1.00
BSI-1012093-00	SLIDER PANEL,FRONT,XLITE,GALV	1.00	1.00
BSI-1012090-00	Slider Bracket, X-Lite	1.00	1.00
BSI-1012096-00	BACK SLIDER PANEL,X-LITE,GALV	1.00	1.00
BSI-1012097-00	Ground Strut, X-Lite	2.00	2.00
BSI-1012098-00	Ground Strut Angle	1.00	1.00
BSI-1012104-00	Cable Anchor Assembly, X-Lite	1.00	1.00
K080123	Kit, X-Tension Shear Bolt,	2.00	2.00
BSI-1102027-00	WASHER,SQUARE,X-LITE,GALV	1.00	1.00
B090534	W-Beam Composite Blockout 8in,	4.00	-
4001115	Guardrail Bolt 5/8-11x 1 1/4	16.00	-
2000464	Bolt CH 5/8-11x1 1/2 Gr5 MGal	2.00	-
2000465	Bolt CH 5/8-11x9 Gr5 MGal	4.00	-
4001116	Guardrail Nut Recessed 5/8-11	26.00	-
2001580	Wshr 1" F436 Structural	1.00	-
4000443	W-Beam Guardrail RWM02a	3.00	-
BSI-1312100-00	Soil Plate	1.00	1.00
2000220	C-Scr HH 5/8-11x3 1/2 Gr5 MGal	2.00	2.00
2001636	Wshr 5/8 F436 Struct MGal	4.00	4.00
2000312	Nut HX 5/8-11 Gr5 Mgal	2.00	1.00
BSI-1303005-00	Bracket, X-Lite, Cable Retenti	1.00	1.00
BSI-1310016-KT	Transition Kit, MGS, X-Lite	1.00	1.00

Division of Engineering Services
Structure Design Services
Structure Hydraulics and Hydrology
Final Hydraulic Report

Main Canal Bridge

Located on Route 33 over Main Canal in the County of Fresno

Bridge Number 42-0134

06-FRE-33-PM 69.1

August 17, 2015

Project 0612000110

PREPARED BY:
Ronald McGaugh

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California

Ronald L. McGaugh

REGISTERED ENGINEER

REGISTRATION NUMBER C 61217

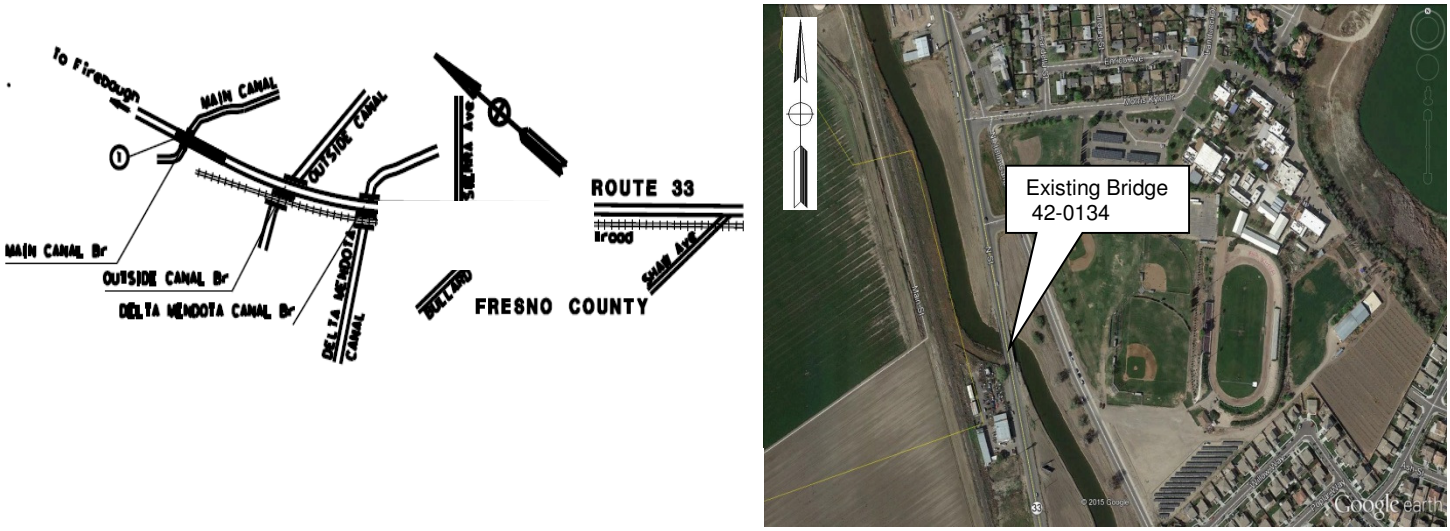


Figure1

General:

Structure Design requested a hydraulic evaluation for retrofitting and scour evaluation/ mitigation of the existing Main Canal Bridge (Bridge No. 42-0134) over the Main Canal in Fresno County. Elevations for this report are in vertical datum NGVD29 (to match the APS plans and the As-Builts). This evaluation is to determine hydraulic conditions pertaining to retrofitting the existing structure. The retrofitting for this structure is to install slab bridge seat extenders.

This evaluation is based on a review of Field Surveys submitted to this office July 2015, Caltrans Bridge Maintenance Records, APS plans dated June 2014, As-Built plans, hydrologic and hydraulic reports, the Canal Modernization in Central California Irrigation District Case Study, Field Surveys submitted July of 2015, and FEMA.

Existing Structure

The structure is 136 feet long and 43.83 feet wide with existing type 25 railing.
Main Canal Bridge is a 6-span continuous reinforced concrete slab on reinforced concrete bents. It has open end bents and cantilever end spans. The structure is built on reinforced concrete 1.5 ft. diameter piles. The original structure was built in 1939 and widened in 1985.
HISTORY -- The bank of the canal along the southern approach roadway at the right side of Abutment 1 is failing. This is likely due to the constant saturated state of the soils and the close proximity of the highway roadway loads and vibrations. The concrete slope paving is undermined upstream of Abutment 7.

The Item 113 code for this structure for scour vulnerability is 4 “Bridge foundations determined to be stable for assessed or calculated scour conditions; field review indicates action is required to protect exposed foundations.” The proposed improvements will not change the length, width, or any of the substructure elements of the existing structure.

Flood History:
There is no history of the bridge overtopping. This structure crosses an irrigation canal owned by Central California Irrigation District (CCID). This canal is not used for flood purposes.

Basin:
The Main Canal is an 80 mi aqueduct managed by the Central California Irrigation District (CCID) in Central California to convey water to approximately 140,000 acres (120,000 irrigated acres) in the central San Joaquin Valley. The Main Canal begins at Mendota Pool and flows northwest through the San Joaquin Valley. The Main Canal is a fairly flat, winding, unlined canal that has remained in about the same condition for the past 100 years.

Streambed:
The bridge has no hydraulic skew. For the natural channel bottom the Log of Test Borings for the existing structure show sand to silty sand to silty clay. For our study portion of the canal the reach is near the middle of a reverse curve. It is a manmade non-lined channel with no access roads as shown in Figure 2.

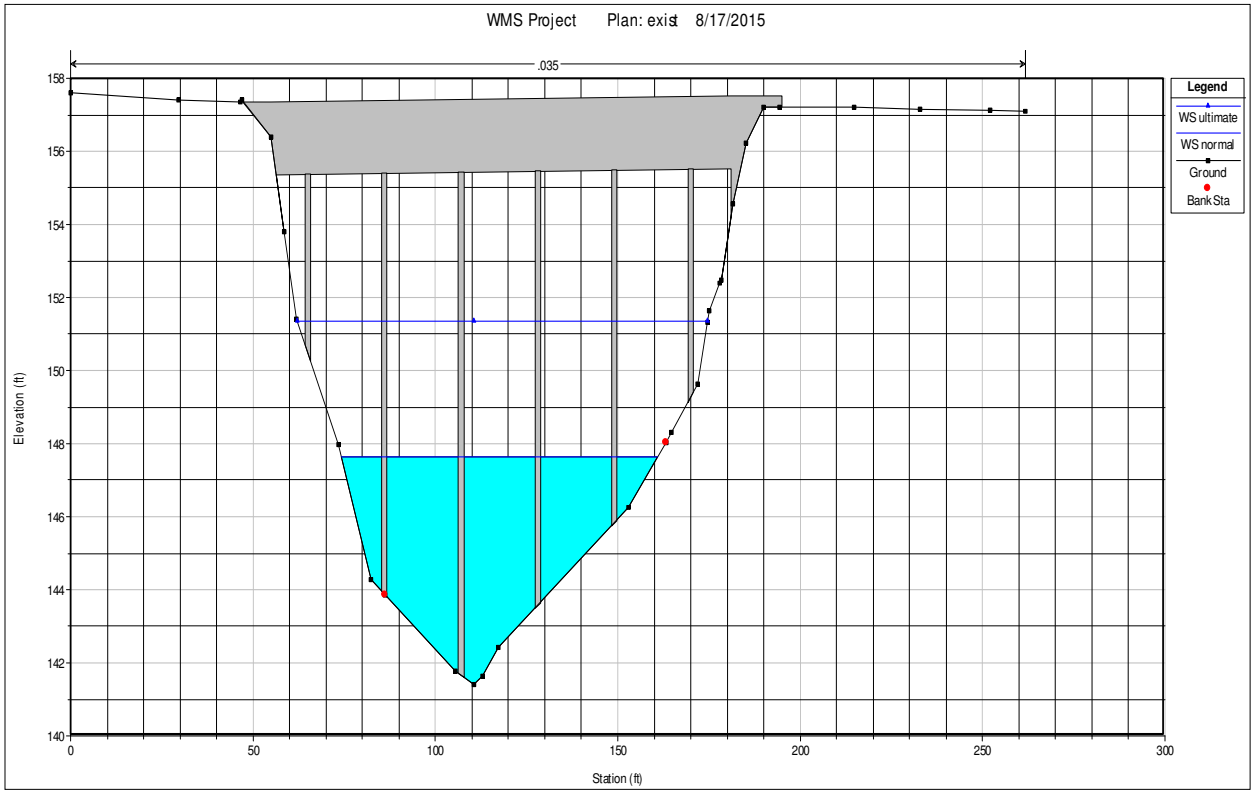


Figure 2

Approximately 15,000 feet upstream of the bridge and 7500 feet downstream of the bridge there are flow control structures. These flow structures determine the depth of flow through the bridge site. The control structure can vary the depth of water. The existing bridge deck top elevation is equal or higher in elevation than the top of the canal banks and the channel slope is very mild so it is unlikely that overtopping flood of the bridge would occur.

Discharge:

There are no FEMA studies for the Main Canal in the vicinity of the structure. The Main Canal designed flow for irrigation is normally 1,600 cu ft. /s. Maximum channel capacity in our study reach is approximately 5,000 cfs. For design purposes only Q_{100} = 5.000 cfs

Model Preparation and Parameters

US Army Corps of Engineers software Hec-Ras version 4.10 was used to create the 1-dimensional model for this project. The APS Plans and As- Builts were referenced to acquire the planned deck elevation height. Proposed freeboard is measured from the water surface elevation to the lowest chord of the soffit of the structure at the downstream edge of the bridge.

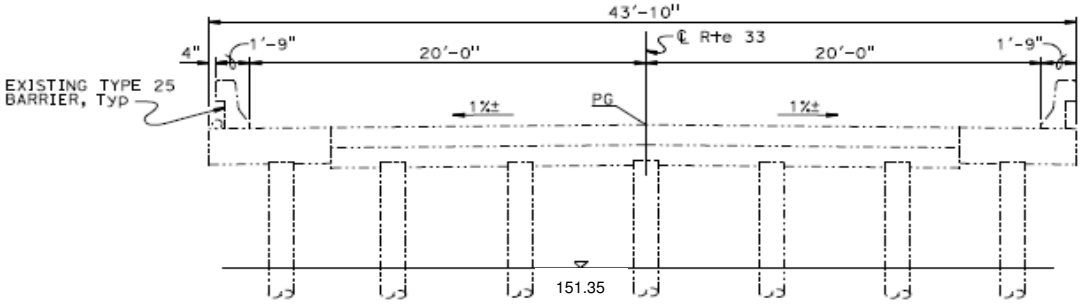
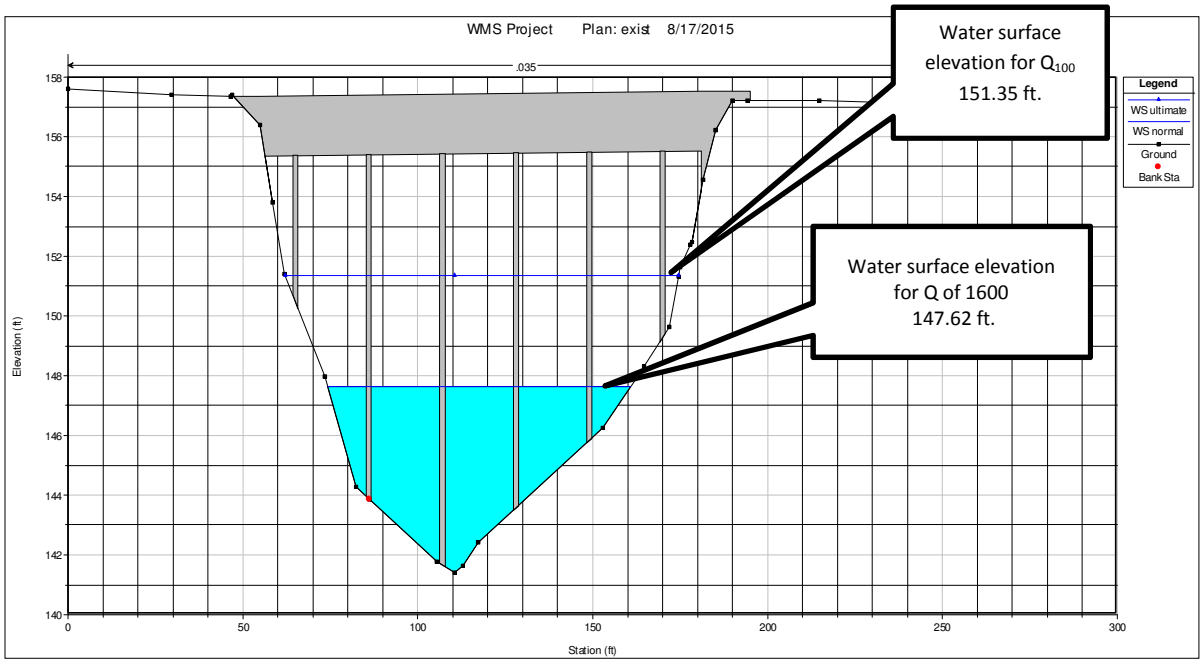


Figure 3 Typical Section
NO SCALE

Structure depth 2.0 feet Q_{100}= 5,000 cfs
Manning's n=0.350
Average Channel Slope = 0.001 ft. /ft.

Water Surface Elevations:



The retrofit does not change any substructure elements so no change in water surface elevations will occur		Water Surface Elevation (ft.)	Soffit (ft.)	Freeboard (ft.)
Existing Structure and retrofitted structure	Q_{100} (5000 cfs)	151.35	155.36	4.01
	Q of 1600 cfs	147.62	155.36	7.74

These water surface elevations are based on the existing ground and assume no changes to the original ground of the channels. The proposed structure causes no significant rise in water surface elevations. The lowest calculated chords of the proposed bridges are used for the freeboard calculations.

Scour:
Historically there is no contraction, abutment, or mitigation scour concerns. Local pier scour is based on 1.5 ft. wide pier columns. Scour calculations are based on the flow of 5000 cfs.

	Abut 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Abut 7
Scour depth (ft.)	0	3.81	4.29	3.91	3.61	2.97	0
Ground elevation (ft.)	157.06	143.31	142.27	144.06	145.28	147.41	156.5
Scour elevations (ft.)	157.06	139.5	137.98	140.15	141.67	144.44	156.5

All scour depths are measured from the existing grade at column locations Per the Hec-Ras model.

For our calculations a 75 year average bridge life is usually assumed for any degradation\aggradation issues; however this structure is beyond that threshold. . Historical cross sections show both aggradation and slight degradations, however over the long run of this channel no capacity has been lost or gained so for design purposes we will not use degradation. There is no contraction or degradation scour.

Drift:
Based on Structure Maintenance investigations and a review of the historical records, there will be no problems with drift or debris.

Recommendations:
There are no restrictions to the widening of this structure as proposed. It may be desirable to keep false work out of the channel. This project should have no impacts on the anticipated flow and functioning for this canal.

Summary:

The retrofit proposals meets hydraulic requirements and is designed not to change the anticipated scour. The retrofit will not adversely affect the hydraulic capacity of the existing channel. There will be no change in water surface elevations.

Hydraulic / Hydrologic Summary Table

Design Q_{100} Discharge 5000 (cfs)	
slope 0.001 ft./ft.	0 degree hydraulic bridge skew
Maximum Velocity 7.36 ft./s	Maximum Scour Depth 4.29 ft.
Freeboard minimum 4.01ft	Maximum Scour elevation 137.98 ft.
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. **The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation. Addendums may be necessary as Foundation Reports are completed.**	

Scour Data Table

Support ##	Long term (Degradation and Contraction) Scour Elevation (ft.)	Short Term (Local) Scour Depth (ft.)
Abutment 1	157.06	0
Bent 2	139.5	2.91
Bent 3	137.98	4.29
Bent 4	140.15	3.91
Bent 5	141.67	3.61
Bent 6	144.44	2.97
Abutment 7	156.5	0

Division of Engineering Services
Structure Design Services
Structure Hydraulics and Hydrology
Final Hydraulic Report

Kings River Bridge

Located on Route 41 over South Fork Kings River in the County of Kings

Bridge Number 45-0007

06-KIN-41-PM 32.26

August 18, 2015

Project 0612000110

PREPARED BY:
Ronald McGaugh

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California

Ronald L. McGaugh
REGISTERED ENGINEER

REGISTRATION NUMBER C 61217

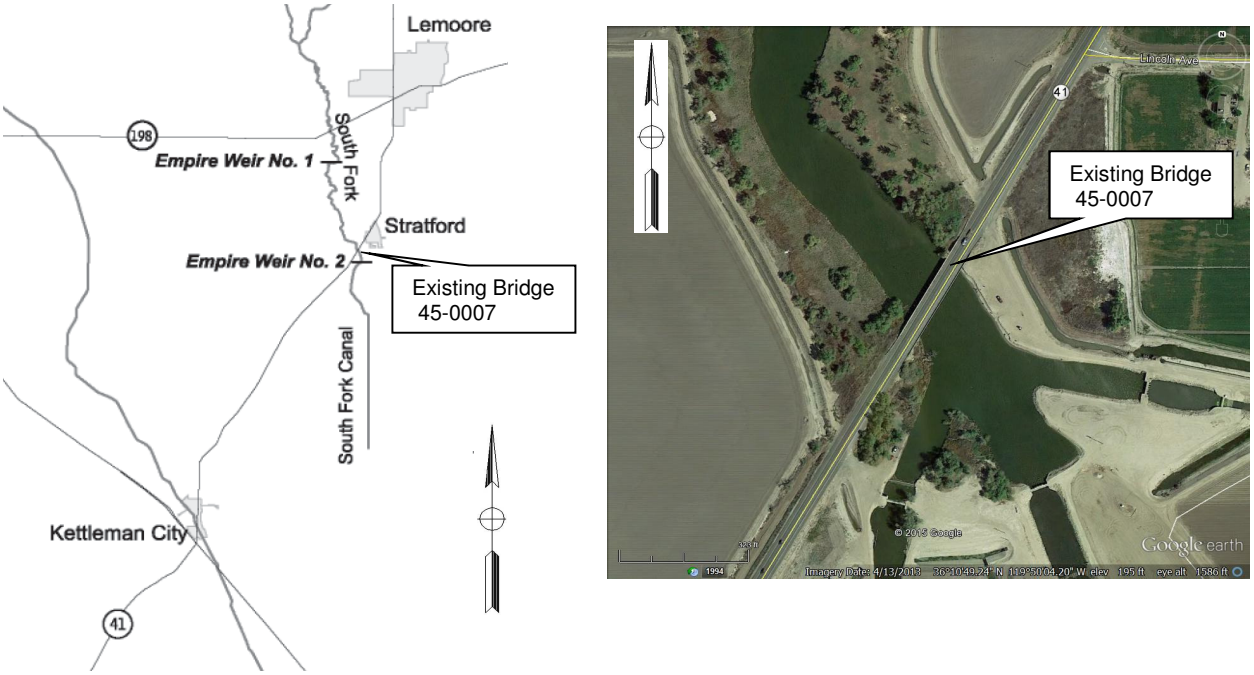


Figure1

General:

Structure Design requested a hydraulic evaluation for retrofit and scour evaluation/ mitigation of the existing Kings River Bridge (Bridge No. 45-0007) over the Kings River in Fresno County. Elevations for this report are in vertical datum NVGD29 (to match the APS plans and the As-Builts). The proposed improvements are to add MCI Stiffeners to each side of each existing bent. The retrofit plans have no substructure work improvements planned for this structure at this time.

This evaluation is based on a review of Field Surveys submitted to this office July 2015, Caltrans Bridge Maintenance Records, APS plans dated June 2014, As-Built plans, hydrologic and hydraulic reports, Bulletin No.23-56 Surface water flow for 1956 from California Department of Water Resources, Tulare Lake Basin Hydrology and hydrography A Summary of Movement of Water and Aquatic Species from the U.S. Environmental Protection Agency Document Number 909R07002, and FEMA.

Existing Structure

The existing structure is a 12 span, 260 feet long and 46 feet wide with existing type 25 railing. The original structure was built in 1942 and widened in 1987. The original structure is a continuous reinforced concrete slab with a curved soffit and cantilever ends on reinforced concrete bents. The 1987 widening was constructed with matching flat slab on extended bents supported by additional exterior piles with the cantilever ends extended with open end diaphragm abutments on piles.

The Item 113 code for this structure for scour vulnerability is 8 “Bridge foundations determined to be stable for the assessed or calculated scour conditions: calculated scour is determined to be above top of footing by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the service life of the bridge), by calculation or by installation of properly designed countermeasures. Bridge foundations determined to be stable

for assessed or calculated scour conditions; field review indicates action is required to protect exposed foundations." The proposed improvements will not lengthen or widen the structure.

Flood History:

There is no history of the bridge overtopping. This structure crosses an irrigation canal managed by the Kings River Conservation District. This canal is primarily used for irrigation purposes, but has an agreement with the US Army Corps of Engineers for emergency use for flood purposes.

Basin:

In the vicinity of our project the South Fork Kings River 4½ miles below Empire No. 1 Weir, meanders in a predominantly southerly direction. This manmade channel was constructed between 1890 and 1915. There are no points of diversion in this reach. High groundwater insures that the channel is generally pooled. The river goes down to Empire Weir No. 2 which is a mile southwest of Stratford (immediately below State Route 41). Our project is just upstream of Empire Weir No 2 along route 41 as shown in Figure 1. Empire Weir No 2 is the limit of our studies for this project.

Streambed:

The bridge has 20 to 27 degrees of hydraulic skew. For the natural channel bottom the Log of Test Borings for the existing structure show sand to silty sand to silty clay. For our study portion of the canal the reach is straight with non- leveed manmade channel as shown in Figure 2.

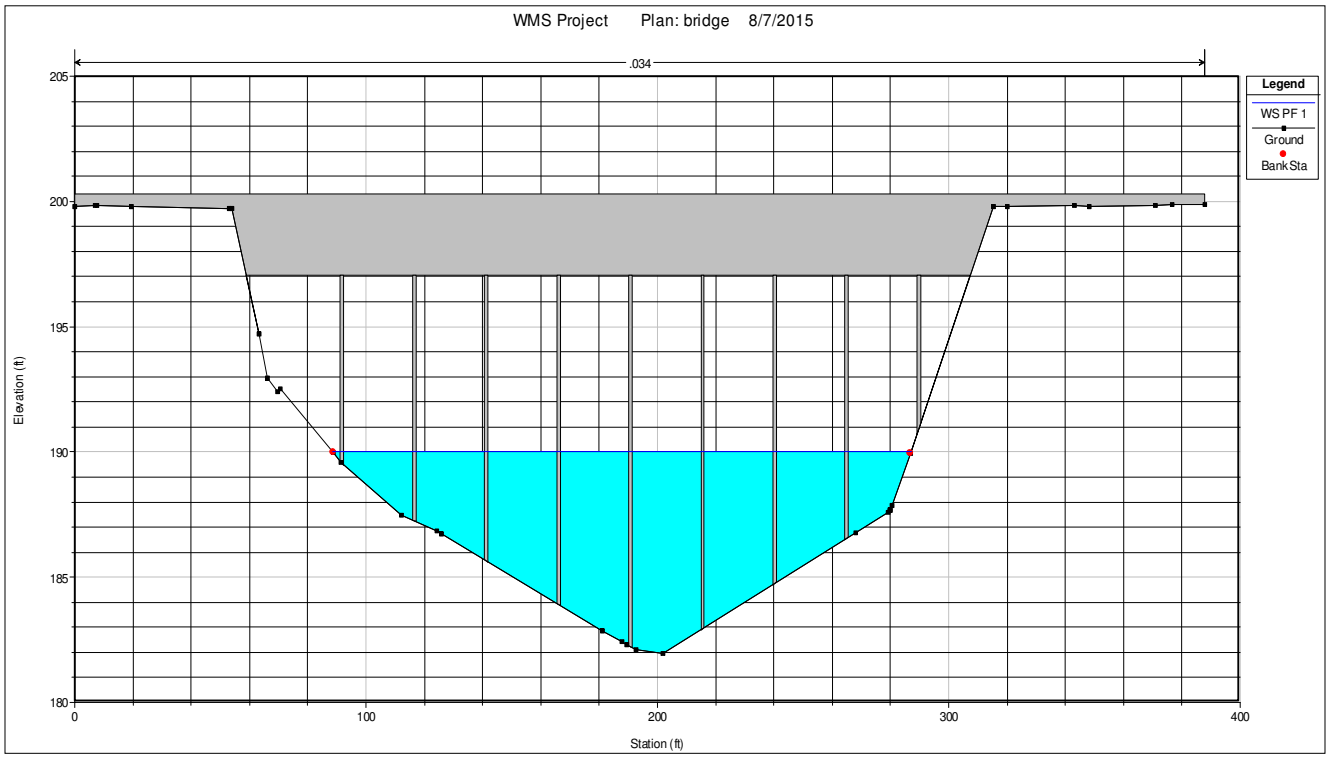


Figure 2

Approximately 500 feet downstream of the bridge there are a series of flow control structures. These flow structures do not determine the depth of flow through the bridge site. The existing

bridge deck top elevation is equal or higher in elevation than the top of the canal banks and the channel slope is very mild so it is unlikely that overtopping flood of the bridge would occur.

Discharge:

There are no FEMA studies for the Kings River in the vicinity of the structure. The Kings River designed flow for irrigation is normally 3,200 cu ft. /s. Maximum channel capacity in our study reach is approximately 6,000 cfs for emergency flood use. For design purposes only Q_{100} = 3.200 cfs, and $Q_{ultimate}$ is 6000 cfs

Model Preparation and Parameters

US Army Corps of Engineers software Hec-Ras version 4.10 was used to create the 1-dimensional model for this project. The General Plans and As-Builts were referenced to acquire the planned deck elevation height. Proposed freeboard is measured from the water surface elevation to the lowest chord of the soffit of the structure at the downstream edge of the bridge.

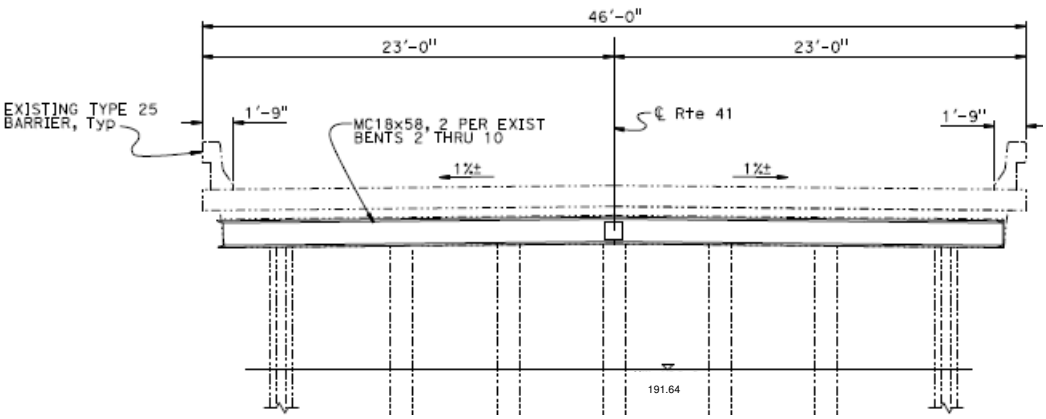
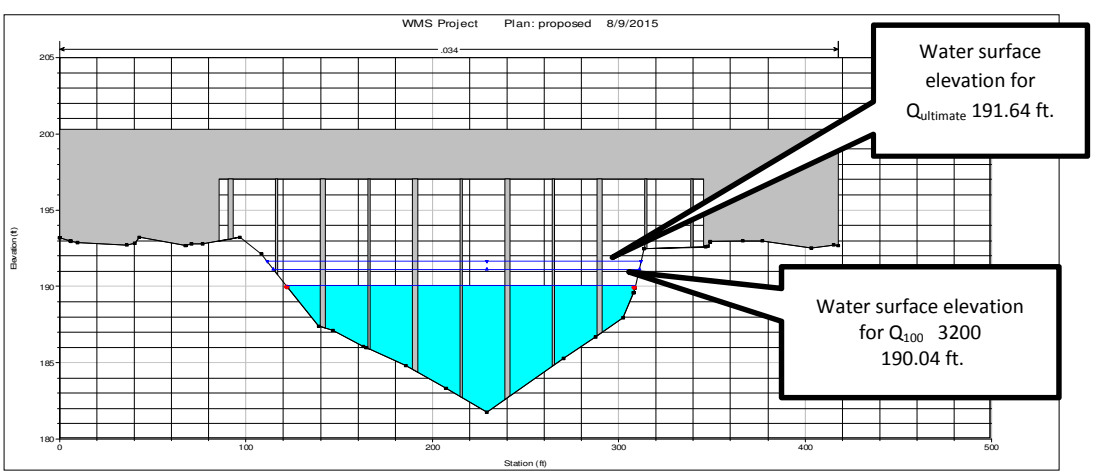


Figure 3 Typical Section
NO SCALE

Structure depth 3.25 feet Q_{100}= 3,200 cfs
Manning's n=0.350
Average Channel Slope = 0.002 ft. /ft.



Water Surface Elevations:

The retrofit does not change any substructure elements so no change in water surface elevations will occur		Water Surface Elevation (ft.)	Soffit (ft.)	Freeboard (ft.) from existing bent cap
Existing Structure and retrofitted structure	$Q_{ultimate}$ 6000 cfs	191.63	196.82	5.19
	Q_{100} (3200 cfs)	190.03	196.82	6.79

These water surface elevations are based on the existing ground and assume no changes to the original ground of the channels. The proposed structure causes no significant rise in water surface elevations. The lowest calculated chords of the proposed bridges are used for the freeboard calculations.

Scour:
Historically there is no contraction, abutment, or mitigation scour concerns. Local pier scour is based on 1.5 ft. wide pier columns. Scour calculations are based on the flow of 6000 cfs. There are no migration concerns for this crossing.

Table 1 Proposed scour based on the $Q_{ultimate}$ 6000 cfs

	Abut 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6
Scour depth	0	2.20	5.91	3.66	6.46	3.57
Ground elevation	192.02	187.32	183.22	181.82	181.82	182.12
Scour elevation	192.02	185.12	177.31	178.16	175.36	178.55

	Bent 7	Bent 8	Bent 9	Bent 10	Abut 11
Scour depth	5.81	2.87	4.27	1.81	0
Ground elevation	183.52	185.22	183.62	189.22	192.92
Scour elevation	177.71	182.35	182.35	187.41	192.92

All scour depths are measured from the existing grade at column locations.

Table 2 Proposed scour based on the Q_{100} 3200 cfs

	Abut 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6
Scour depth	0	0.89	5	3.22	5.68	3.12
Ground elevation	192.02	187.32	183.22	181.82	181.82	182.12
Scour elevation	192.02	186.43	178.22	178.60	176.14	179.00

	Bent 7	Bent 8	Bent 9	Bent 10	Abut 11
Scour depth	4.88	2.22	2.68	0	0
Ground elevation	183.52	185.22	183.62	189.22	192.92
Scour elevation	178.64	183.00	183.94	189.22	192.92

All scour depths are measured from the existing grade at column locations.

For our calculations a 75 year average bridge life is usually assumed for any degradation\aggradation issues; however this structure is 2 years from that threshold. . Historical cross sections show slight degradations; however over the long run of this channel no capacity has been lost or gained so for design purposes we will not use degradation.
There is no contraction or degradation scour.

Drift:
Based on Structure Maintenance investigations and a review of the historical records, there will be no problems with drift or debris.

Recommendations:
There are no restrictions to the retrofitting of this structure as proposed. It may be desirable to keep false work out of the channel. This project should have no impacts on the anticipated flow and functioning for this canal.

Summary:
The proposed improvement meets hydraulic requirements for this channel. The proposed improvements will not adversely affect the hydraulic capacity of the existing channel. There will be no change in water surface elevations.

Hydraulic / Hydrologic Summary Table

Design $Q_{ultimate}$ Discharge 6000 (cfs)	Design Q_{100} Discharge 3200 (cfs)
slope 0.002 ft./ft.	slope 0.002 ft./ft.
Maximum Velocity 5.5 ft./s	Maximum Velocity 3.74 ft./s
Maximum Scour Depth 6.46 ft.	Maximum Scour Depth 5.68 ft.
Maximum Scour elevation 175.36 ft.	Maximum Scour elevation 176.14 ft.
Freeboard minimum 5.12 ft.	Freeboard minimum 5.19 ft.
20 to 27 degree hydraulic bridge skew	20 to 27 degree hydraulic bridge skew
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. **The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation. Addendums may be necessary as Foundation Reports are completed.**	

Scour Data Table for $Q_{ultimate}$ 6000 cfs

Support ##	Long term (Degradation and Contraction) Scour Elevation (ft.)	Short Term (Local) Scour Depth (ft.)
Abutment 1	192.02	0
Bent 2	185.12	2.20
Bent 3	177.31	5..91
Bent 4	178.16	3.66
Bent 5	175.36	6.46
Bent 6	178.55	3.57
Bent 7	177.71	5.81
Bent 8	182.35	2.87
Bent 9	182.35	4.27
Bent 10	187.14	1.61
Abutment 11	192.92	0

Scour Data Table for Q_{100} 3200 cfs

Support ##	Long term (Degradation and Contraction) Scour Elevation (ft.)	Short Term (Local) Scour Depth (ft.)
Abutment 1	192.02	0
Bent 2	186.43	0.89
Bent 3	178.22	5.00
Bent 4	178.60	3.22
Bent 5	176.14	5.68
Bent 6	179.00	3.21
Bent 7	178.64	4.88
Bent 8	183.00	2.22
Bent 9	183.94	2.68
Bent 10	189.22	0
Abutment 11	192.92	0

Division of Engineering Services
Structure Design Services
Structure Hydraulics and Hydrology
Final Hydraulic Report

Kings River Bridge

Located on Route 43 over South Fork Kings River (Dutch John Cut) in the County of Kings

Bridge Number 45-0064

06-KIN-43-PM 26.76

August 15, 2015

Project 0612000110

PREPARED BY:
Ronald McGaugh

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California

Ronald L McGaugh

REGISTERED ENGINEER

REGISTRATION NUMBER C 61217

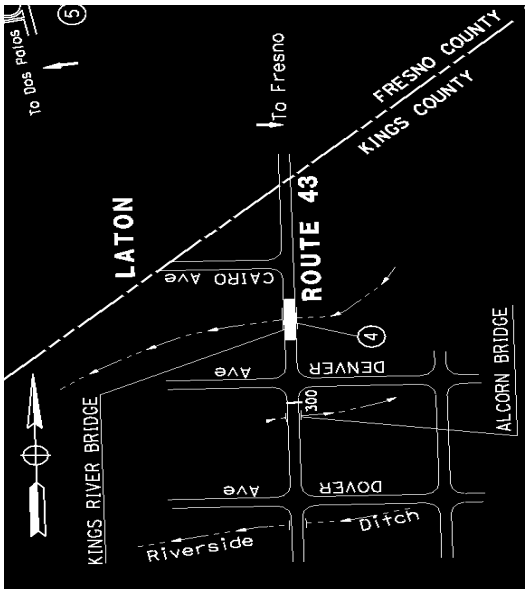


Figure1

General:

Structure Design requested a hydraulic evaluation for retrofit and scour evaluation/ mitigation of the existing Kings River Bridge (Bridge No. 45-0064) over the Dutch Johns Cut portion of the Kings River in Kings County. Elevations for this report are in vertical datum NVGD29 (to match the General Plans and the As-Builts). This evaluation is to determine hydraulic conditions pertaining to enlargement of the existing piers for the retrofit proposals. The proposed improvements are to encase the existing piers widening them to a diameter of 2.25 ft.

This evaluation is based on a review of Field Surveys submitted to this office July 2015, Caltrans Bridge Maintenance Records, General Plan dated June 2015, As-Built plans, hydrologic and hydraulic reports, Bulletin No.23-56 Surface water flow for 1956 from California Department of Water Resources, U S Army Corps of Engineers Pine Flat Lake Study of 1978 Chart A-6, and FEMA.

Existing Structure

The existing structure is a 17 span, 366 feet long and 43.5 feet wide with existing type 25 railing. The original structure was built in 1951 and widened in 1995. The original structure is a continuous reinforced concrete slab, on reinforced concrete pile extensions and open end reinforced concrete diaphragm abutments. At each bent were steel piles shells filled with concrete. The 1995 widening was constructed with matching flat slab supported by additional exterior piles with open end diaphragm abutments on piles.

The Item 113 code for this structure for scour vulnerability is 5 “Bridge foundations determined to be stable for assessed or calculated scour conditions: Scour is determined to be within the limits of footing or piles by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the service life of the bridge), by calculations or by installation of properly designed countermeasures.”

The proposed improvements will not change the existing width or length of the existing structure.

Flood History:

There is no history of the bridge overtopping. This structure crosses a manmade canal built in the late 1800s .This canal is used primarily as an irrigation canal managed by the Kings River Conservation District. Although this river is primarily used for irrigation purposes, there is an agreement with the US Army Corps of Engineers for emergency use for flood purposes.

Basin:

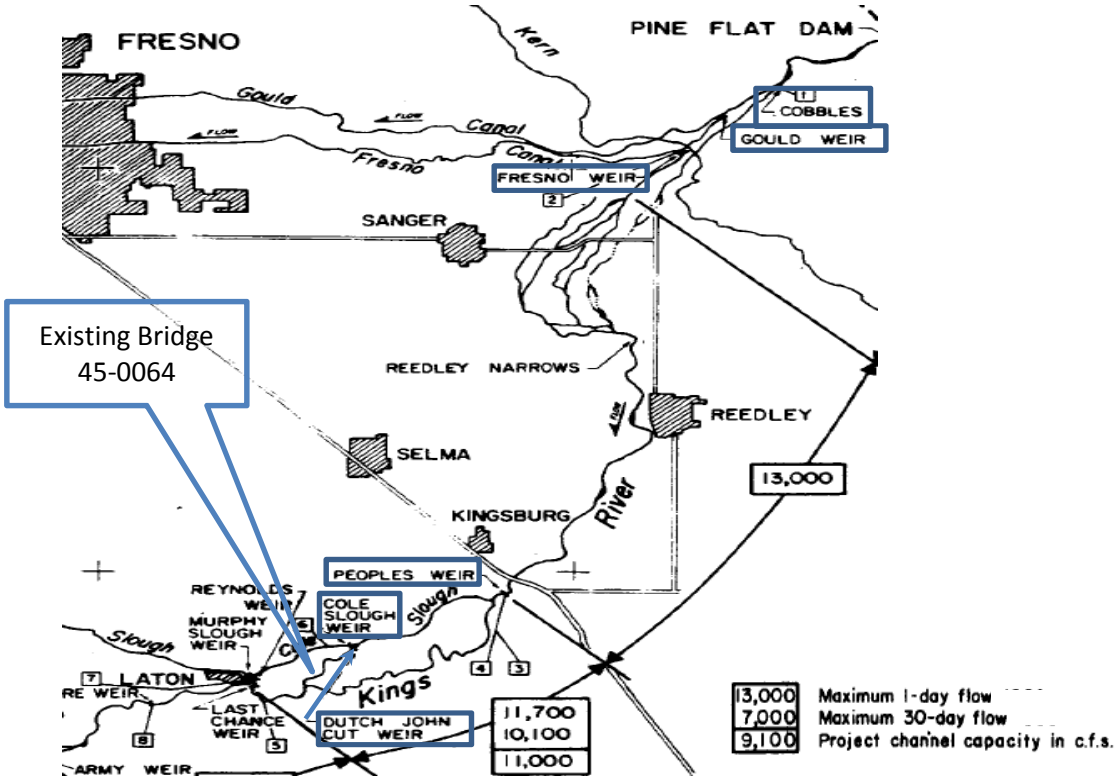


Figure 2

In the vicinity of our project the Kings River system is heavily regulated and meanders in a predominantly southerly direction. The amount of regulation and the many distributaries of the flow make it difficult to point to an exact area of watershed for this project. Figure 2 is from the U S Army Corps of engineers which shows the larger appurtenances that control the flow for irrigation purposes. Our project is just upstream of the confluence of the Kings River and the Dutch John Cut.

Streambed:

The bridge has no hydraulic skew, but it does have a slightly reduced bridge opening as compared to the channel so there is some concern for contraction scour. Even though there has been no bridge overtopping. Prior to the 1995 widening the piles for this structure was exposed and the bank in spans 2 and 3 were experiencing problems. Bents 4 through 10 were improved per the partial As-Built plans shown on Figure 3.

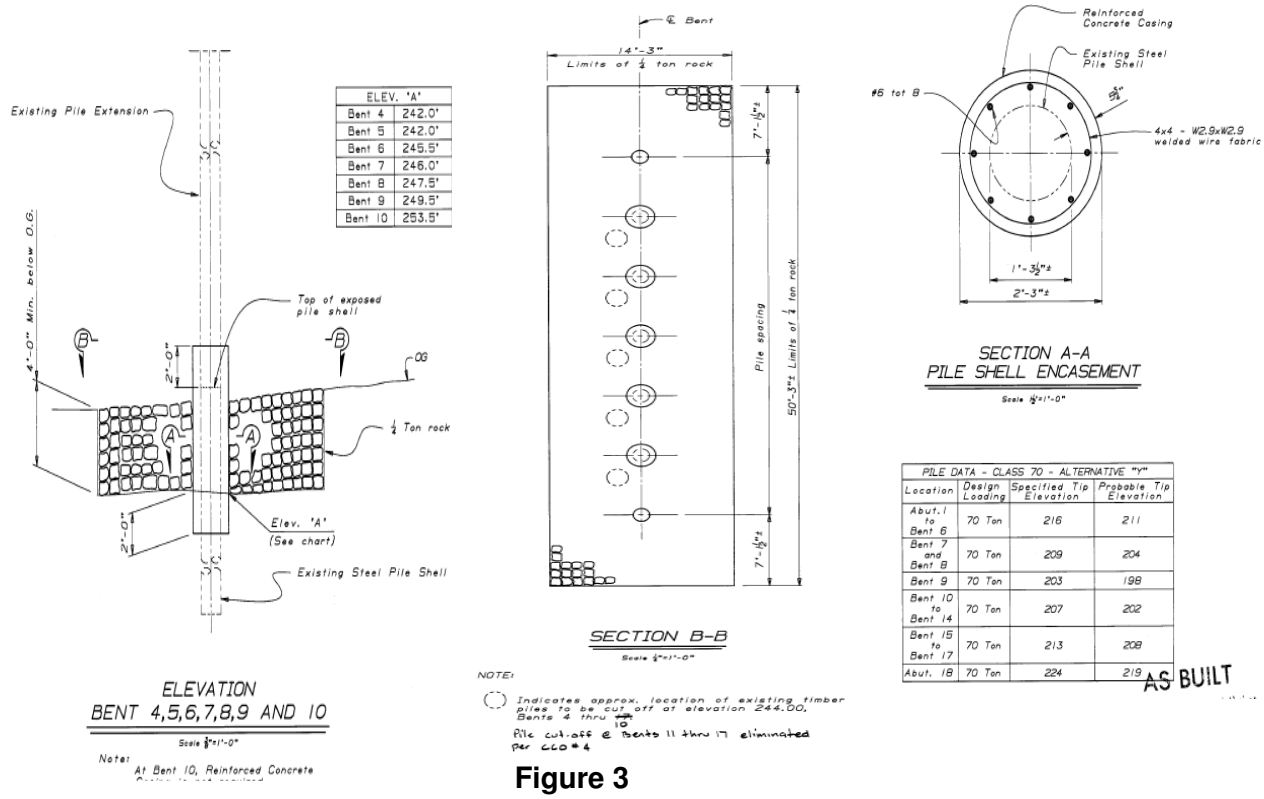
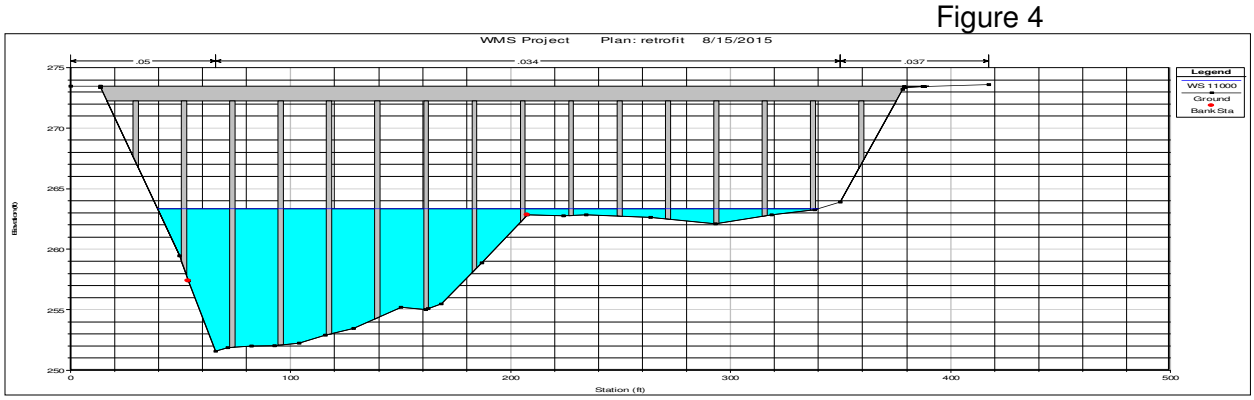


Figure 3

For the natural channel bottom the Log of Test Borings for the existing structure show sand to silty sand to silty clay. For our study portion of the canal the reach is just on the end of a slight curve. This manmade channel has unapproved levees as deemed by the U S Army Corps of Engineers.

Figure 4



The existing bridge deck top elevation is equal or higher in elevation than the top of the canal banks and the channel slope is very mild so it is unlikely that overtopping flood of the bridge would occur.

Discharge:

There are no FEMA studies for the Kings River in the vicinity of the structure. The Kings River System design flow for irrigation is normally 10,000 cu ft. /s. Maximum channel capacity in our study reach is approximately 11,700 cfs for emergency flood use. For design purposes for this study, Q_{100} = 11,700 cfs.

Model Preparation and Parameters

US Army Corps of Engineers software Hec-Ras version 4.10 and BrEase were used to create the 1-dimensional model for this project. The General Plans and As-Builts were referenced to acquire the deck elevation height. Freeboard is measured from the water surface elevation to the lowest chord of the soffit of the structure at the upstream edge of the bridge.

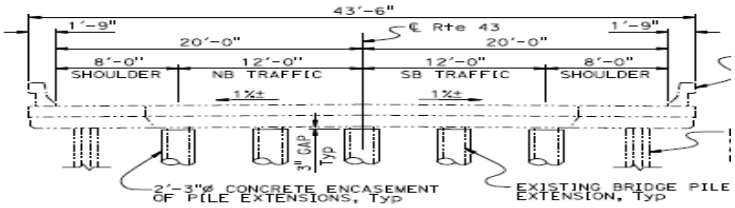
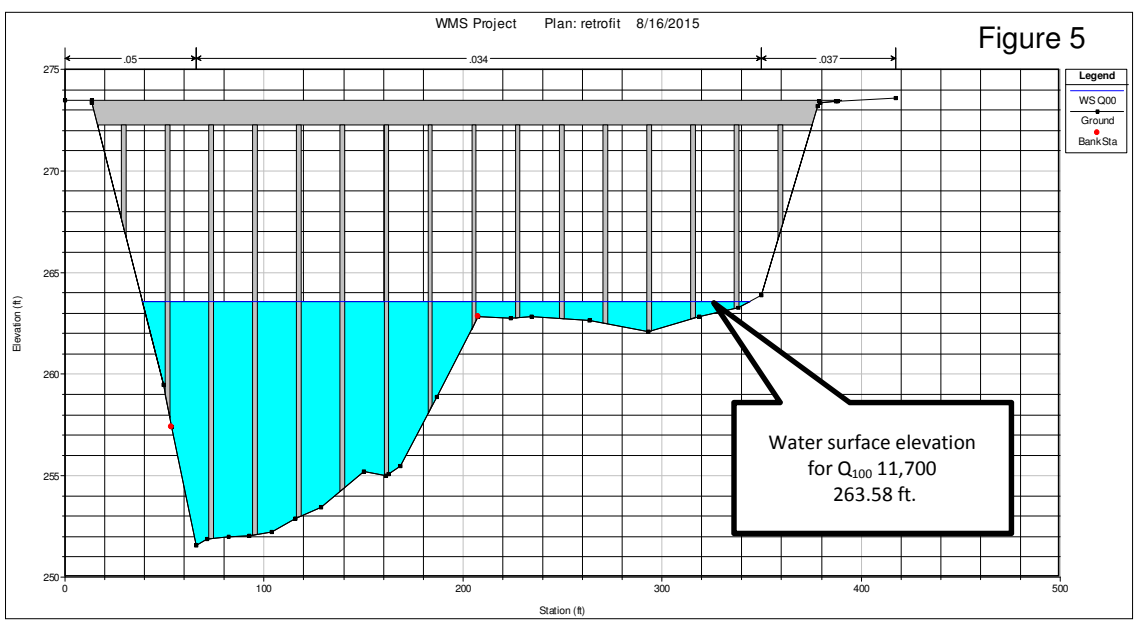


Figure 5 Typical Section

Modeling parameters used for Hec-Ras are:

Structure depth 2.5 feet Q_{100}= 11,700 cfs Manning's n=0.37 for overbank
Manning's n=0.340 for the channel bottom n=0.5 for the slope protection in spans 1, 2, and 3
Average Channel Slope = 0.006 ft. /ft. D_{50} for the existing rock blanket at bent 3 through 10 is approximated at 608mm, D_{95} is 916mm. For all other bents is D_{50}<2mm and D_{95}<20 mm (for sand).



Water Surface Elevations:

		Water Surface Elevation (ft.)	Soffit (ft.)	Freeboard (ft.)
Proposed Structure	Q_{100} 11,7000 cfs	263.58	268.28	4.70
Existing Structure	Q_{100} 11,7000 cfs	263.56	268.28	4.72

These water surface elevations are based on the existing ground and assume no great changes to the original ground of the channels. The proposed structure causes no significant rise in water surface elevations. The lowest calculated chords of the proposed bridges are used for the freeboard calculations.
The proposed improvements raise the water surface elevation 2/100th of a foot per this model.

Scour:
Prior to the 1995 improvements there was contraction scour but the rock rip rap in spans 1 through 3 mitigates the contraction scour to zero. Since the 1995 improvements there are no contraction or abutment scour concerns. The proposed changes to the existing structure are to increase the size of the existing 1.5 ft. diameter pile extensions to 2.25 ft. diameter. Local pier scour is based on the proposed 2.25 ft. diameter pile extensions.

Table 1 Proposed scour based on the Q_{100} 11,700 cfs

	Abut 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6
Scour depth	0	0	1.73	2.33	2.29	2.24
Ground elevation	271.53	265.07	256.31	249.62	249.81	250.69
Scour elevation	271.53	265.07	254.58	247.29	247.52	248.45

	Bent 7	Bent 8	Bent 9	Bent 10	Bent 11	Bent 12
Scour depth	2.15	2.05	1.78	1.31	3.04	3.06
Ground elevation	252.03	252.73	255.94	260.1	257.51	260.47
Scour elevation	249.88	250.68	254.16	258.79	254.47	257.41

	Bent 13	Bent 14	Bent 15	Bent 16	Bent 17	Abut 18
Scour depth	3.19	3.26	3.05	2.83	0	0
Ground elevation	260.23	259.83	260.48	260.96	264.64	270.07
Scour elevation	257.04	256.57	257.43	258.13	264.64	270.07

All scour depths are measured from the existing grade at column locations.

For our calculations a 75 year average bridge life is usually assumed for any degradation\aggradation issues; however this structure is 11 years from that threshold. . Historical cross sections show slight degradations; however over the long run of this channel no capacity has been lost or gained so for design purposes we will not use degradation.
There is no contraction or degradation scour.

Drift:
Based on Structure Maintenance investigations and a review of the historical records, there has been minor instances of drift but not enough to be a major problem so for design purposes there will be no problems with drift or debris.

Recommendations:
There are no restrictions to the widening of the pile extensions as proposed. It may be desirable to keep false work out of the channel. This project should have no impacts on the anticipated flow and functioning for this canal. If the rock riprap in spans 1, 2, and 3 needs to be removed, an evaluation needs to be done to determine if it meets current specifications of the California Bank and Shore Slope Protection or the countermeasures outlined in FHWA's HEC 23 Manual. If the rip rap does not meet current specifications district forces or structures hydraulics can design bank slope protection to current standards.

Summary:
The proposed improvement meets hydraulic requirements for this channel. The proposed improvements will not adversely affect the hydraulic capacity of the existing channel. There will not be significant change in water surface elevations.

Hydraulic / Hydrologic Summary Table

Design Q_{100} 11,700 (cfs)
slope 0.006 ft./ft.
Maximum Velocity 9.1 ft./s
Maximum Scour Depth 3.26 ft.
Maximum Scour elevation 256.57 ft. at Bent 14
Freeboard minimum 4.70 ft.
negligible hydraulic bridge skew
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. **The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation. Addendums may be necessary as Foundation Reports are completed.**

Scour Data Table for Q_{100} 11,700 cfs

Support ##	Long term (Degradation and Contraction) Scour Elevation (ft.)	Short Term (Local) Scour Depth (ft.)
Abutment 1	271.53	0
Bent 2	265.07	0
Bent 3	254.58	1.73
Bent 4	247.29	2.33
Bent 5	247.52	2.29
Bent 6	248.45	2.24
Bent 7	249.88	2.15
Bent 8	250.68	2.05
Bent 9	254.16	1.78
Bent 10	258.79	1.31
Bent 11	254.47	3.04
Bent 12	257.41	3.06
Bent 13	257.04	3.19
Bent 14	256.57	3.26
Bent 15	257.43	3.05
Bent 16	258.13	2.83
Bent 17	264.64	0
Abutment 18	270.07	0

September 21, 2015
File No.: 20143390.074A

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

Attn: Mr. John Huang

SUBJECT:

Foundation Report
State Route 43 Bridge over Kings River
Bridge No. 45-0064
Kings County, California

Dear Mr. Huang:

The attached report presents the results of the geotechnical study for the State Route 43 Bridge over Kings River project located north of Hanford, in Kings County, California. This report describes our study and provides conclusions and recommendations for use in seismic rehabilitation evaluation.

We appreciate the opportunity to provide geotechnical engineering services to Caltrans and other project designers. We trust this information meets your current needs. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully Submitted,
KLEINFELDER, INC.

Neva M. Popenoe, PE, GE
Project Engineer

Nathan L. Dahlen, PE
Senior Project Manager

NMP:NLD:sj

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FOUNDATION REPORT
SR 43 BRIDGE OVER KINGS RIVER
BRIDGE NO. 45-0064
KINGS COUNTY, CALIFORNIA

A report prepared for:

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

September 21, 2015
File No.: 20143390.074A

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Prepared For:
STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

FOUNDATION REPORT
STATE ROUTE 43 BRIDGE OVER KINGS RIVER
BRIDGE NO. 45-0064
KINGS COUNTY, CALIFORNIA

Kleinfelder Job No.: 20143390.074A

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September 21, 2015

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1. INTRODUCTION

1.1. GENERAL

This report presents the results of the geotechnical investigation for the proposed rehabilitation of the State Route 43 Bridge over Kings River (No. 45-0064), located north of Hanford in Kings County, California. The scope of services consisted of a field exploration program, laboratory testing, engineering analysis, and preparation of this written report.

1.2. SCOPE OF SERVICES

The purpose of the Preliminary Foundation Report is to provide geotechnical recommendations and opinions to aid in project design. The report provides the following:

- A description of the proposed project;
- A summary of the field exploration and laboratory testing programs;
- Comments on the regional geology and site engineering seismology, including the recommended peak ground acceleration and Caltrans Seismic Design Criteria Version 1.7 ARS curve;
- Comments on liquefaction potential of subsurface soils and seismically induced vertical settlement ;
- Evaluation of seismic lateral ground deformation and its potential impact on the existing pile foundation;
- Provide factored nominal axial capacity and t-z and q-u curves for existing pile foundations under Extreme Event Limit State loading;
- Recommended LPILE parameters for use in evaluating the existing pile in response to lateral loads and p-y curves for the existing piles;
- Log of Test Borings drawing.

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1.3. PROJECT DESCRIPTION

The proposed project will involve the evaluation of State Route 43 Bridge over the Kings River. Based on information provided by Caltrans, the existing bridge is supported on two abutments and 16 bents. The span lengths (center of bearing (c.o.b.) to c.o.b.) are 22.0 feet, with a total bridge length of 366 feet. The original 17-span structure is supported by small diameter, cast-in-place Union fluted steel shell tapered piles with 5 piles at each abutment/bent location. The original pile has a tip diameter of 8 inches and a butt diameter of 15.5 inches. A taper of 0.125 inch per foot was assumed, indicating the tapered portion of the Monotube pile is about 30 feet in length. The non-tapered portion above this 30-foot section of the Monotube pile is assumed be 15.5 inches in diameter. The bridge was widened in 1993 by adding one pile on each side of the bridge at each abutment/bent locations. The overall widening of the bridge totaled 12'-2". The bridge widening piles consist of Class 70 18-inch diameter octagonal prestressed concrete piles (Alternative "Y").

Table 1.3-1 provides the data for the existing bridge foundations, as provided in the As-Built Drawings, dated April 20, 1993, and foundation data tables provided by Caltrans Structures, July 22, 2015. Bending moment and shear force loads for 18-inch Class 70 widen piles are provided on Table 6.1-10.

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TABLE 1.3-1
EXISTING BRIDGE FOUNDATION DATA

Pile Type	Support	Location	Pile Cut-off Elevation (feet)	Tip Elevation (feet)	Service I Limit State Load per Support (kips)	Extreme Event Limit State per pile (kips)
Cast-in-Place Union Fluted Steel Shell[1]	Bent 2	333+90.0	265	215	370	50
	Bent 3	334+12.0	256	215	370	50
	Bent 4	334.34.0	251	215	370	50
	Bent 5	334+56.0	248	215	370	50
	Bent 6	334+78.0	250	215	370	50
	Bent 7	335+00.0	253	209	370	50
	Bent 8	335+22.0	254	209	370	50
	Bent 9	335+44.0	256	203	370	50
	Bent 10	335+66.0	257	206	370	50
	Bent 11	335+88.0	257	206	370	50
	Bent 12	336+10.0	257	206	370	50
	Bent 13	336+32.0	259	206	370	50
	Bent 14	336+54.0	259	206	370	50
	Bent 15	336+76.0	260	213	370	50
	Bent 16	336+98.0	261	213	370	50
	Bent 17	337+20.0	264	213	370	50
18-inch Octagonal[2]	Bent 2	333+90.0	265	211	370	70
	Bent 3	334+12.0	256	211	370	70
	Bent 4	334.34.0	251	211	370	70
	Bent 5	334+56.0	248	211	370	70
	Bent 6	334+78.0	250	211	370	70
	Bent 7	335+00.0	253	207	370	70
	Bent 8	335+22.0	254	204	370	70
	Bent 9	335+44.0	256	198	370	70

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Pile Type	Support	Location	Pile Cut-off Elevation (feet)	Tip Elevation (feet)	Service I Limit State Load per Support (kips)	Extreme Event Limit State per pile (kips)
	Bent 10	335+66.0	257	202	370	70
	Bent 11	335+88.0	257	202	370	70
	Bent 12	336+10.0	257	202	370	70
	Bent 13	336+32.0	259	202	370	70
	Bent 14	336+54.0	259	202	370	70
	Bent 15	336+76.0	260	208	370	70
	Bent 16	336+98.0	261	208	370	70
	Bent 17	337+20.0	264	201	370	70

Notes: 1. Original supports from 1951 design
2. Supports from 1993 widening

Driving records from the 1993 widening were reviewed. Table 1.3-2 presents the pile capacity as determined using the “ENR” capacity as presented in Caltrans Standard Specifications, July 2002, and the “Gates” capacity as presented in the latest Caltrans Standard Specifications.

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TABLE 1.3-2
DRIVING RECORD CAPACITY

Pile Type	Support	Pile Cut-off Elevation (feet)	ENR Capacity (kips)	Gates Capacity (kips)
18-inch Octagonal	Bent 2	212	512	706
	Bent 3	217	281	519
	Bent 4	216	231	477
	Bent 5	212	283	529
	Bent 6	214	294	535
	Bent 7	209	251	495
	Bent 8	208	275	519
	Bent 9	199	590	754
	Bent 10	205	531	720
	Bent 11	203	298	541
	Bent 12	204	401	619
	Bent 13	203	331	570
	Bent 14	206	316	554
	Bent 15	213	307	546
	Bent 16	213	344	576
	Bent 17	214	242	480

1.4. POLICY EXCEPTIONS

No known exceptions to Caltrans policy were made in the geotechnical evaluation for the foundations for this project.

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2. FIELD EXPLORATION AND LABORATORY TESTING

2.1. FIELD EXPLORATION AND TESTING

The field exploration for State Route 43 Bridge over Kings River rehabilitation consisted of 3 test borings. Exploration was performed on June 4 through 17, 2015. The test borings were drilled with either a Christensen or Acker, truck-mounted drill rig using punch core drilling techniques. The two abutment borings were drilled to a depth of 161.5 feet below ground surface, and a third boring was drilled in the Kings River channel from the bridge deck to a depth of 171.5 feet below the surface of the bridge deck. The approximate location of the test borings are shown on the Log of Test Borings drawing in Figures 1 through 4 of this report.

The earth materials encountered in the test borings were visually classified in the field and a continuous log was recorded. Along with the continuous core sampling, in-place samples of soil units were collected from the test boring at selected depths by driving a 2.0-inch I.D. split barrel sampler containing brass liners into the undisturbed soil with a 140-pound automatic safety hammer free falling a distance of 30-inches. In addition, an ASTM D1586 standard penetrometer without liners (barrel I.D. of 1.5 inches) was driven 18-inches in the same manner. This latter sampling procedure generally conformed to the ASTM D1586 test procedure. Resistance to sampler penetration over the last 12-inches is noted on the Log of Test Borings as the "Penetration Index". The penetration indices listed on the Log of Test Borings have not been corrected for the effects of overburden pressure, sampler size, rod length, or hammer efficiency.

Penetration rates determined in general accordance with ASTM D1586 were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils. The hammer test measurement was obtained for the drill rig and hammer from Caltrans Drilling Services. The report was prepared June 2015. The hammer energy transfer measurement for the boring is noted on the Log of Test Boring drawings in Figure 2 through 4 of this report.

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2.2. LABORATORY TESTS

Laboratory tests were performed on selected samples to evaluate certain characteristics and engineering properties. The laboratory testing program was designed with emphasis on the evaluation of geotechnical properties of foundation materials as they pertain to the proposed construction. The laboratory testing program included performing the following tests:

- Moisture Content (ASTM D2216)
- Unit Weight (ASTM D7263)
- Material in Soils Finer than No. 200 (75-µm) Sieve (ASTM D1140)
- Atterberg Limits (ASTM D4318)
- Unconfined Compressive Strength (ASTM D2166)
- Soluble Sulfates (California Test Method No.417)
- Soluble Chlorides (California Test Method No.422)
- Resistivity and pH (California Test Method No. 643)

Geotechnical design parameters were based on project specific laboratory data, and interpretation of the area geology. Consideration was also given to correlations with sample penetration rates. Tables 2.2-1 through 2.2-7 provide a summary of geotechnical design parameters and generalized soil profile used.

TABLE 2.2-1
DESIGN PARAMETERS FOR BENT 2

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
265	251	SM	125	32
251	227.5	SP	58	--
227.5	213	SM/SP	63	30
213	180	SM/SP	63	28

Note: 1. "--" represents liquefied material.

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TABLE 2.2-2
DESIGN PARAMETERS FOR BENT 3

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
256	251	SM	125	32
251	227.5	SP	58	--
227.5	213	SM/SP	63	30
213	180	SM/SP	63	28

Note: 1. "--" represents liquefied material.

TABLE 2.2-3
DESIGN PARAMETERS FOR BENTS 4 THROUGH 7

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
251	232.5	SP	58	--
232.5	220	SM/SP	63	30
220	210	SM/SP	63	32
210	195	SM/SP	63	26
195	180	SM/SP	63	30

Note: 1. "--" represents liquefied material.

TABLE 2.2-4
DESIGN PARAMETERS FOR BENT 8

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
254	251	SM	125	32
251	232.5	SP	58	--
232.5	210	SM/SP	63	30
210	180	SM/SP	63	32

Note: 1. "--" represents liquefied material.

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TABLE 2.2-5
DESIGN PARAMETERS FOR BENT 9

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
257	251	SM	125	32
251	232.5	SP	58	--
232.5	210	SM/SP	63	30
210	180	SM/SP	63	32

Note: 1. "--" represents liquefied material.

TABLE 2.2-6
DESIGN PARAMETERS FOR BENTS 10 THROUGH 16

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
257	251	SM	125	32
251	232.5	SP	58	--
232.5	210	SM/SP	63	30
210	180	SM/SP	63	32

Note: 1. "--" represents liquefied material.

TABLE 2.2-7
DESIGN PARAMETERS FOR BENT 17

Elevation (ft)		Material	Effective Unit Weight (pcf)	Friction Angle[1] (deg)
From	To			
257	251	SM	125	35
251	232.5	SP	58	--
232.5	210	SM/SP	63	30
210	180	SM/SP	63	32

Note: 1. "--" represents liquefied material.

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3. SITE CONDITIONS

3.1 SURFACE CONDITIONS AND TOPOGRAPHY

The existing State Route 43 Bridge over the Kings River is a 2-lane paved road approximately at original grade. At the time of the investigation, no water was present in the river and the banks supported some dry grass and young to mature trees. The general topography along the State Route 43 alignment is relatively flat on either side of the bridge, with thin approach fills (less than about 5 feet) leading up to the levees on either side of the river.

3.2 REGIONAL GEOLOGY

The project site lies in the south central portion of the San Joaquin Valley in the Great Valley geomorphic province in California. This province was formed by the filling of a large structural trough or downwarp in the underlying bedrock. The trough is situated between the Sierra Nevada Range on the east and south and the Coast Range on the west. Both of these mountain ranges were initially formed by uplifts that occurred during the Jurassic and Cretaceous periods of geologic time (greater than 65 million years ago). Renewed uplift began in the Sierra Nevada during the Tertiary time, and is continuing today. The trough that underlies the valley is asymmetrical, with the greatest depths of sediments near the western margin. The sediments that fill the trough originated as erosion material from the adjacent mountains and foothills.

3.3 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at the specific boring locations, refer to the Log of Test Borings presented in Figures 1 to 4. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

The upper soil material consisted primarily of granular alluvial fan sediment, interfingered with fine grained basin deposits. These materials generally consist of medium dense silty to poorly graded sand with thin layers of interspersed silt and sandy silt, and extend to an elevation of

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approximately 210 to 200 feet. These deposits are underlain by dense to very dense poorly graded sand, silty sand, silt and sandy silt to the maximum depth explored, about elevation 100 feet, and likely represent older alluvial fan deposits.

3.4 GROUNDWATER CONDITIONS

Groundwater was encountered at an elevation of approximately 186 feet or about 85 feet below existing grade during drilling at boring RC-15-001, and at an elevation of approximately 211 feet or about 60 feet below existing grade during drilling at boring RC-15-003. Groundwater at the site is affected by flow in the Kings River. Design groundwater is elevation 251 feet. Groundwater conditions at the site could change at some time in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time the test borings were made

3.5 CHANNEL SCOUR/DEGRADATION

Review of the Caltrans Hydraulics report for this structure, dated August 15, 2015, indicated no long-term or contraction scour. Local pier scour is anticipated to be up to 3.3 feet at the bents, as indicated in Table 3.5-1.

TABLE 3.5-1
LOCAL PIER SCOUR

	Abut 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6	Bent 7
Scour Depth (ft.)	0	0	1.73	2.33	2.29	2.24	2.15
Ground Elevation (ft.)	271.53	265.07	256.31	249.62	249.81	250.69	252.03
Scour Elevation (ft.)	271.53	265.07	254.58	247.29	247.52	248.45	249.88

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TABLE 3.5-1
LOCAL PIER SCOUR, CONT.

	Bent 8	Bent 9	Bent 10	Bent 11	Bent 12	Bent 13
Scour Depth (ft.)	2.05	1.78	1.31	3.04	3.06	3.19
Ground Elevation (ft.)	252.73	255.94	260.1	257.51	260.47	260.23
Scour Elevation (ft.)	250.68	254.16	258.79	254.47	257.41	257.04

	Bent 14	Bent 15	Bent 16	Bent 17	Abut 18
Scour Depth (ft.)	3.26	3.05	2.83	0	0
Ground Elevation (ft.)	259.83	260.48	260.96	264.64	270.07
Scour Elevation (ft.)	256.57	257.43	258.13	264.64	270.07

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4. CORROSION EVALUATION

Soil samples from borings RC-15-001 (depth of 21.5 to 25 feet), RC-15-002 (depth of 31.5 to 35 feet), and RC-15-003 (depth of 21.5 to 25 feet) were tested to evaluate the soluble sulfate content, soluble chloride content, pH and minimum resistivity. Specific test results are presented in Table 4.1-1.

TABLE 4.1-1
CORROSION RELATED TESTING

Boring No.	Depth (ft)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	pH	Minimum Resistivity (ohm-cm)
RC-15-001	21.5 - 25	35	22	7.9	12,550
RC-15-002	31.5 - 35	81	42	7.6	7,985
RC-15-003	21.5 - 35	47	46	7.7	12,775

Laboratory tests indicate the soluble sulfates and chlorides, pH and minimum resistivity are all outside the Caltrans threshold limits. Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. Consequently, a qualified corrosion engineer should be consulted if the designer desires more specific recommendations and material types and/or mitigation, particularly with regard to steel piles.

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5. SEISMIC RECOMMENDATIONS

5.1 LOCAL FAULTING

There are no known faults traversing the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone, as defined by Special Publication 42 (revised 2007) published by the California Geologic Survey (CGS). Numerous faults and shear zones within the region could influence the project site.

5.2 SEISMIC DESIGN CRITERIA

Seismic design parameters were developed in accordance with the Caltrans Seismic Design Criteria Version 1.7.

The project site is located in a region with the potential for relatively moderate seismic activity. The more significant faults that could influence the project site include the Great Valley 14 (Kettleman Hills) (Fault ID No. 210), the Creeping Section of the San Andreas Fault (Fault ID No. 182), and the Parkfield Segment of the San Andreas Fault (Fault ID No. 214). According to the Caltrans fault database, the Great Valley 14 (Kettleman Hills) is a reverse fault with a dip angle of 22 degrees towards the west and assigned Maximum Magnitude (M_{Max}) of 7.1, the Creeping Section of the San Andreas Fault is strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 7.9, and the Parkfield Segment of the San Andreas Fault is a strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 7.9. The characteristics of these three faults are summarized in Table 5.2-1.

Based on the data from the previous and recent borings, the near surface sands are potentially liquefiable. Based on this and per Caltrans SDC, this portion of the site can be classified as Soil Profile Type F, which requires site-specific evaluation to develop ARS curves. However, based on our experience on other Caltrans projects and discussions with Caltrans reviewers, enveloping the ARS curves for Soil Profile Types D (stiff soils) and E (soft soils) can be done in lieu of site-specific evaluation. Based on the field investigation and laboratory test data, a V_{S30} (average shear wave velocity in the upper 100 feet) value of 272 m/s was estimated for the site, assuming there is no liquefaction. A V_{S30} value of about 150 m/s was assumed for a typical Soil Profile Type E. Therefore, estimated V_{s30} values of 150 m/s and 272 m/s were used in the

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analysis to represent Soil Profile Types E and D, respectively. The site is not located within a California deep soil basin region, as defined by Caltrans, so $Z_{1.0}$ and $Z_{2.5}$ were considered not applicable. Site characteristics and governing deterministic faults are summarized in Table 5.2-1.

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TABLE 5.2-1
SITE CHARACTERISTICS AND
GOVERNING DETERMINISTIC FAULTS PARAMETERS

Site Coordinates	Lat = 36.435 deg, Long = -119.636 deg
Shear Wave Velocity	272 m/s for Soil Profile Type D and 150 m/s for Soil Profile Type E
Depth to V_s=1.0 km/s, $Z_{1.0}$	N/A
Depth to V_s=2.5 km/s, $Z_{2.5}$	N/A
Fault Name and ID Number	Great Valley 14 (Kettleman Hills), No. 210
Maximum Magnitude (M_{Max})	7.1
Fault Type	Reverse
Fault Dip	22 degrees
Dip Direction	West
Bottom of Rupture Plane	22.50 km
Top of Rupture Plane (Z_{tor})	8.10 km
R_{RUP}[1]	54.19 km
R_{jB}[2]	53.58 km
R_X[3]	53.58 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1
Fault Name and ID Number	San Andreas fault (Creeping section), No. 182
Maximum Magnitude (M_{Max})	7.9
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	12 km
Top of Rupture Plane (Z_{tor})	0 km
R_{RUP}[1]	94.07 km
R_{jB}[2]	94.07 km
R_X[3]	92.78 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0
Fault Name and ID Number	San Andreas fault (Parkfield), No. 214
Maximum Magnitude (M_{Max})	7.9
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	6.00 km
Top of Rupture Plane (Z_{tor})	0 km
R_{RUP}[1]	93.79 km
R_{jB}[2]	93.79 km
R_X[3]	93.79 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0

Notes:
[1]R_{RUP} = Closest distance from the site to the fault rupture plane.
[2]R_{JB} = Joyner-Boore distance; the shortest horizontal distance to the surface projection of the rupture area.
[3]R_X = Horizontal distance from the site to the fault trace or surface projection of the top of the rupture plane.

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5.2.1 Deterministic Response Spectrum

The deterministic response spectrum was developed using ARS Online (v2.3.06). The deterministic response spectrum from the Minimum Spectrum for California governed.

5.2.2 Probabilistic Response Spectrum

The probabilistic response spectrum was developed using ARS Online (v2.3.06).

5.2.3 Design Response Spectrum

The upper envelope of the deterministic and probabilistic spectral values determines the design response spectrum. The deterministic and probabilistic spectral values for Soil Profile Types D (stiff soil) and E (soft soil) were enveloped. The probabilistic response spectra were found to govern for all periods. The recommended acceleration and displacement design response spectra are presented graphically and numerically in Appendix B.

5.2.4 Earthquake Magnitude

Earthquake magnitude is needed for the liquefaction and lateral spreading analysis. Since the ARS is governed by probabilistic values, dominant earthquake magnitude was estimated using USGS interactive deaggregation tool. The controlling earthquake magnitude for this site is M7.9 at a distance of about 95 km from the site.

5.2.5 References

Caltrans. Caltrans ARS Online, http://dap3.dot.ca.gov/ARS_Online

Caltrans. Geotechnical Services Manual, January 2013.

Caltrans. Seismic Design Criteria, Appendix B Design Spectrum

Caltrans. Website http://dap3.dot.ca.gov/shake_stable/v2/technical.php

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5.3 SOIL LIQUEFACTION POTENTIAL EVALUATION

Soil liquefaction is a condition in which saturated, granular, non-plastic or low-plasticity fine-grained soils undergo a substantial loss of their stiffness and strength due to the build-up of excess pore pressure during cyclic loading, such as that induced by earthquakes. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to ground water. Soils most susceptible to liquefaction are saturated loose sands and low- to non-plastic silts (Cetin et al., 2004). The potential consequences of liquefaction to engineered structures include loss of bearing capacity, buoyancy forces on underground structures and utilities, ground oscillations or "cyclic mobility," increased lateral earth pressures on retaining walls, post liquefaction settlement, lateral spreading, and "flow failures" in slopes.

We performed our liquefaction potential evaluation using a PGA of 0.30g which is calculated based on the Caltrans ARS curve, enveloped for Soil Profile Types "D" and "E", and a moment magnitude of 7.9 based on the results of online USGS deaggregation analysis. A design groundwater elevation of 251 feet was used in our evaluation. Our liquefaction potential evaluation was performed using the Youd et al. (2001) procedures. Vertical liquefaction-induced settlement was estimated using the procedures developed by Tokimatsu and Seed (1987). In evaluating liquefaction potential, we used three new borings (RC-15-001 through RC-15-003) that Kleinfelder performed for this investigation and four old borings (B-1 through B-4) that were performed in 1993 for the widening of the bridge. It is our finding that the subsurface soil deposits between elevations of approximately 251 and 227.5 feet in the area of Abutment 1 to Bent 3 and between elevations of approximately 251 to 232.5 feet in areas of Bent 4 to Abutment 18 are likely to liquefy during a design seismic event. Table 5.3-1 shows a summary of results of our liquefaction potential evaluation.

Table 5.3-1 Summary of Results of Liquefaction Potential Evaluation

Boring I.D.	Elevations of Liquefiable Layer (ft)	Soil Type	Calculated Consolidation Settlement (in.)
RC-15-001	251 to 227.5	Poorly-Graded Sand (SP)	10.0
RC-15-002	251 to 232.5	Poorly-Graded Sand (SP)	5.3
RC-15-003	251 to 222.5	Poorly-Graded Sand (SP)	9.0
B-1 (1993)	251 to 227.5	Poorly-Graded Sand (SP)	5.0
B-2 (1993)	251 to 232.5	Poorly-Graded Sand (SP)	2.8
B-3 (1993)	251 to 232.5	Poorly-Graded Sand (SP)	5.4
B-4 (1993)	248.5 to 232.5	Silty Sand (SM)	0.8

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When combined with sloping ground or “free faces” such as the abutment embankment slopes, the loss of soil shear strength that is associated with liquefaction can result in lateral spreading displacements (a form of seismic slope instability) that can impact bridge foundations load capacity and stiffness. The potential for seismic slope instability is evaluated in Section 5.4.
The liquefaction described above would result in a loss of soil support of piles. Downdrag would occur as a result of the post-liquefaction reconsolidation settlements. These hazards need to be included in evaluating seismic performance of existing bridge pile foundation.

5.4 Liquefaction-Induced Lateral Spreading

Liquefaction-induced lateral spreading is defined as the mostly horizontal movement of sloping ground (less than 5% surface slope) due to elevated pore pressures or liquefaction in underlying, saturated soils. Structures at the head of the slide are sometimes pulled apart while those at the toe are subjected to buckling or compression of the foundation soil. Linear infrastructure, such as utility lines and roadways, is particularly susceptible to damage in earthquake from lateral spreads at multiple locations (A. F. Rauch, 1997). Lateral spreading movements typically are greatest near a free-face (such as the bridge abutment embankment slope) and diminish with distance from the free-face.

The overall site surface is relatively level and the only three slopes relevant to the bridge are those associated with the two bridge abutments and the river channel slope near Bent 10. The Abutment 1 slope is approximately 20 feet high with an approximate inclination of 2.9:1 (horizontal to vertical). The Bent 10 river channel slope is approximately 8 feet high with an approximate inclination of 8.2:1. The Abutment 18 slope is approximately 11 feet high with an approximate inclination of 2.9:1. Among these three slopes, Kleinfelder selected the Abutment 1 slope to evaluate liquefaction-induced lateral spreading hazard due to the fact that the Abutment 1 slope has the largest slope height and most significant liquefaction hazard.

We adopted the procedure recommended by Caltrans (2011) to evaluate the potential lateral spreading displacement at the Abutment 1 slope. This procedure requires to run a Newmark type slope stability to obtain a yield acceleration. Then a lateral spreading displacement is calculated by using Bray and Travasarou (2007) model. The liquefied soil in slope stability analysis is modeled as soft clay with undrained shear strength equal to residual strength of liquefied soil. The residual strength of liquefied soil is calculated using the relation by Kramer

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and Wang (2007) as recommended by Caltrans (2011). Soil layering and strength parameters used in our slope stability analysis are presented in Table 3.5-2.

Table 3.5-2
Summary of Soil Engineering Parameters Used in Slope Stability Analysis

Layer No	Predominant USCS	Approximate Elevation (ft)	Total Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Residual Strength (psf)	
						Top	Bottom
1	SM/ML	271 to 251	125	32	50	--	--
2a	SP	251 to 227.5	120	--	--	620	790
2b	SP	251 to 232.5	120	--	--	50	410
3	SM	227.5/232.5 to 200	125	30	0	--	--

Limit-equilibrium slope stability analyses were performed using the computer program Slope/W by Geo-Slope International on the Abutment 1 slope in the longitudinal direction of the bridge. Spencer's method of slices was used, which satisfies both moment and force equilibrium. The analysis employed circular and block critical slip surface search routines. Kleinfelder's slope stability analysis indicates a yield acceleration of 0.09g for the post-liquefaction condition. The calculated lateral spreading displacement is less than 6 inches. Therefore, it is our opinion that the lateral spreading displacement at the bridge site will be likely less than 6 inches during a design seismic event.

This lateral spreading displacement estimate has not accounted for restraining forces of the abutment backwall and abutment pile foundations. The lateral spreading displacement would impart a kinematic load upon the pile foundations and, in turn, the pile foundations would restrain the displacement. To consider both the inertial load from the bridge superstructure and the kinematic load resulting from the lateral spreading displacement, a more deliberate soil-structure interaction analysis as recommended by Caltrans (2011) would be required. After discussion with Caltrans, an agreement was reached not to perform such an analysis because the estimated lateral spreading displacement is not considered large enough to warrant the analysis. However, bridge engineers should check the bridge structure for this estimated lateral spreading displacement.

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6. EVALUATION OF EXISTING PILE FOUNDATION

6.1 GENERAL

The main purpose of this geotechnical investigation is to evaluate seismic performance of existing pile foundation of the bridge during a design seismic event to aid Caltrans in making a decision on retrofitting the existing SR 43 bridge over Kings River. Kleinfelder performed evaluation of seismic performance of existing pile foundations based on the field exploration, laboratory testing, and engineering judgment. Kleinfelder's evaluation was performed in general in accordance with the AASHTO LRFD Bridge Design Specifications (2012) and California Amendments to AASHTO LRFD Bridge Design Specification (Fourth Edition). It is noted that our scope of service does not include Abutments 1 and 18.

6.1.1 Axial Pile Capacity

Pile information and assumptions are described in Section 1.3. The computer program APILE (version 2014) by Ensoft was used to assess axial pile capacity of piles in accordance with the AASHTO LRFD Bridge Design Specifications (2012) under Extreme Event Limit State and California Amendments to AASHTO LRFD Bridge Design Specification (Fourth Edition). A resistance factor of 1.0 was used for side resistance and end bearing. The side resistance in cohesionless soils is calculated using Nordlund method (1963, 1979). Liquefied sands were modeled using soft clay parameters using residual strengths. The side resistance in these liquefied layers is calculated using the alpha method by Tomlinson (1980). The methods are calculated as part of the Federal Highway Administration (FHWA) Method in the APILE program. Soil strength parameters developed for axial pile capacity evaluation for Extreme Event Limit State are presented in Tables 6.1-1 through 6.1-7. A summary of evaluated LRFD axial pile capacities of the existing piles for Extreme Event Limit State are shown in Tables 6.1-8 and 6.1-9.

Drag loads induced by liquefaction-induced consolidation settlements should be considered in assessing structural capacity of the existing piles. Based on our experience on other Caltrans projects and discussions with Caltrans reviewers, the drag loads are calculated as one-half of the total skin resistance acting on the portion of the pile from the bottom of the liquefiable layer

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up to the design ground elevation. The results of the assessed drags loads are provided in Tables 6.1-8 and 6.1-9. Note that these loads should be used as unfactored in evaluating structural capacity of the existing piles. Per Caltrans' request, t-z and q-z data is included in Appendix C. The t-z data include effects of liquefaction-induced consolidation settlement.

TABLE 6.1-1
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENT 2

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	265	251	125	32	--	--
Clay	251	227.5	58	--	260	360
Sand	227.5	213	63	30	--	--
Sand	213	180	63	28	--	--

TABLE 6.1-2
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENT 3

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	256	251	125	32	--	--
Clay	251	227.5	58	--	150	280
Sand	227.5	213	63	30	--	--
Sand	213	180	63	28	--	--

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TABLE 6.1-3
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENTS 4 THROUGH 7

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Clay	251	232.5	58	--	0	350
Sand	232.5	220	63	30	--	--
Sand	220	210	63	32	--	--
Sand	210	195	63	26	--	--
Sand	195	180	63	30	--	--

TABLE 6.1-4
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENT 8

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	254	251	125	32	--	--
Clay	251	232.5	58	--	110	270
Sand	232.5	210	63	30	--	--
Sand	210	180	63	32	--	--

TABLE 6.1-5
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENT 9

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	257	251	125	32	--	--
Clay	251	232.5	58	--	150	270
Sand	232.5	210	63	30	--	--
Sand	210	180	63	32	--	--

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TABLE 6.1-6
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENTS 10 THROUGH 16

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	257	251	125	32	--	--
Clay	251	232.5	58	--	190	320
Sand	232.5	210	63	30	--	--
Sand	210	180	63	32	--	--

TABLE 6.1-7
SOIL PARAMETERS FOR AXIAL PILE CAPACITY
FOR LRFD EXTREME EVENT LIMIT STATE FOR BENT 17

Soil Type	Elevation (ft)		Effective Unit Weight (pcf)	Friction Angle (deg)	Residual Strength (psf)	
	From	To			Top	Bottom
Sand	257	251	125	35	--	--
Clay	251	232.5	58	--	440	530
Sand	232.5	210	63	30	--	--
Sand	210	180	63	32	--	--

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TABLE 6.1-8
EXISTING BRIDGE FOUNDATION DATA FOR MONOTUBE PILES[1]

Support	Pile Head Cut-off Elevation (feet)	Pile Tip Elevation (feet)	Estimated LRFD Pile Capacity (kips)	Estimated Drag Load (kips)
Bent 2	265	215	60	22
Bent 3	256	215	90	11
Bent 4	251	215	120	8
Bent 5	248	215	100	7
Bent 6	250	215	115	8
Bent 7	253	209	170	8
Bent 8	254	209	170	8
Bent 9	256	203	260	9
Bent 10	257	206	260	12
Bent 11	257	206	260	12
Bent 12	257	206	260	12
Bent 13	256	206	280	14
Bent 14	259	206	280	14
Bent 15	260	213	215	15
Bent 16	261	213	215	15
Bent 17	264	213	240	32

Notes: 1. Original supports from 1939 design

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TABLE 6.1-9
EXISTING BRIDGE FOUNDATION DATA FOR OCTAGONAL PCC PILES[1]

Support	Pile Head Cut-off Elevation (feet)	Pile Tip Elevation (feet)	Estimated LRFD Pile Capacity (kips)	Estimated Drag Load (kips)
Bent 2	265	215	200	40
Bent 3	256	215	110	16
Bent 4	251	215	130	10
Bent 5	248	215	120	8
Bent 6	250	215	125	9
Bent 7	253	209	180	9
Bent 8	254	209	180	10
Bent 9	256	203	250	12
Bent 10	257	206	250	16
Bent 11	257	206	250	16
Bent 12	257	206	250	16
Bent 13	256	206	265	16
Bent 14	259	206	270	16
Bent 15	260	213	190	22
Bent 16	261	213	190	22
Bent 17	264	213	250	46

Notes: 1. Supports from 1983 widening

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6.1.2 Lateral Pile Capacity

Kleinfelder performed lateral pile capacity analysis using LPILE v2013 based on the loads provided by Caltrans as presented in Table 6.1-10 for octagonal PCC piles. The original widen piles analysis assumed pinned head connection at the bridge deck and a range of head deflections up to 1 inch. Tables 6.1-1 through 6.1-7 presented geotechnical soil parameters for Extreme Event Limit State used in the analysis, and liquefied materials labeled “clay” were modeled using the “soft clay” p-y curve. Default values for subgrade reaction modulus (k-value) and strain factor (ε_{50}) were used in the analysis. Computed curves displaying the deflection, the moment, and the shear force distribution along the pile for octagonal PCC piles and for tapered Monotube piles are presented in Appendix C.

For closely spaced piles, the p-y curves developed using the recommended parameters should be adjusted using a P-multiplier, Pm, with the values determined per Section 10.7.2.4 of AASHTO (2012) and the Caltrans (2014b) Amendments. Estimated p-y (lateral) curves for the existing piles are provided in Appendix C. It should be noted that p-y data does not include the effect of lateral ground deformation due to soil liquefaction.

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TABLE 6.1-10
STRUCTURAL LOADS FOR LATERAL PILE CAPACITY ANALYSIS
OCTAGONAL PCC PILES[1]

Support	Bending Moment (ft-kips)	Shear Force (kips)
Bent 2	171	74
Bent 3	68	11
Bent 4	55	6
Bent 5	122	20
Bent 6	141	16
Bent 7	184	25
Bent 8	186	28
Bent 9	166	29
Bent 10	136	24
Bent 11	124	26
Bent 12	81	18
Bent 13	85	20
Bent 14	113	24
Bent 15	104	24
Bent 16	115	36
Bent 17	140	50

Notes:
1. Supports from 1983 widening
2. Loads are provided by Caltrans on 3/25/2015.
3. Loads are provided at the elevation of riverbed (pile cut-off elevation)

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7. CLOSURE

The conclusions and recommendations in this report are for the design of the State Route 43 Bridge Rehabilitation over Kings River, located in Kings County, California, as described in the text of this report. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. The field exploration program and this report were based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the recommendations given herein.

This report is intended for use by Caltrans and their subconsultants within a reasonable time from its issuance. Noncompliance with the recommendations of the report or misuse of the report will release Kleinfelder from any liability.

The scope of the geotechnical services did not include an environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands.

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FIGURES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	KIN	43	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Nathan Dahlen No. 71344 Exp. 12/31/15 CIVIL STATE OF CALIFORNIA

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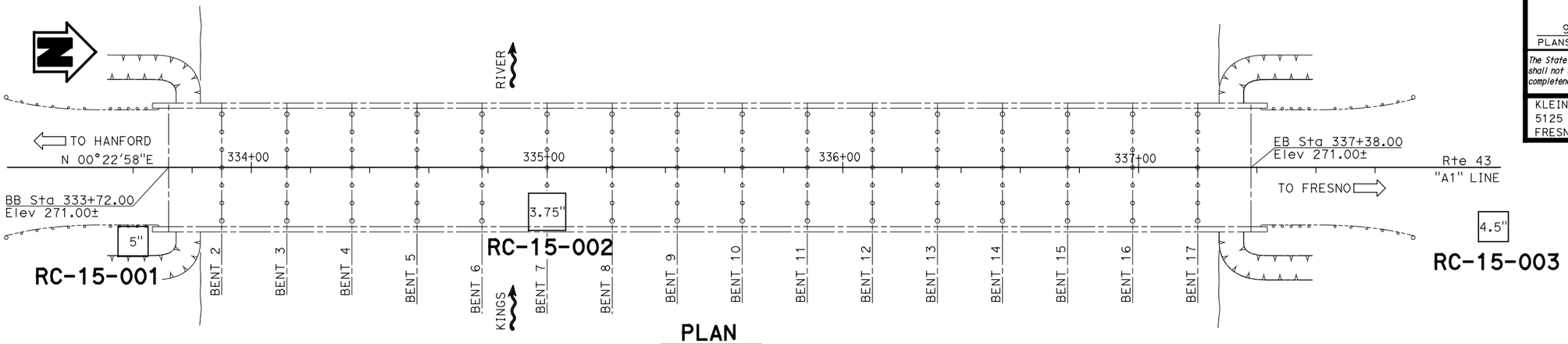

PLAN
1" = 20'

BENCHMARKS

STATION	OFFSET	N	E	ELEV	DESCRIPTION
11+25.94	23.58' Rt	2,041,801.40	6,374,552.23	272.88	DNK0336. Found 1" Iron pipe w/ red CT plug and tack
15+45.14	23.68' Lt	2,042,220.88	6,374,507.51	273.62	DNK0337. Found 1" Iron pipe w/ red CT plug and tack

SURVEY CONTROL
1. Coordinates bearing and distances are based on the California State Plane Coordinate system of NAD 83 (1986). Elevations are based on NGVD29 for Plan. Elevations are based on NAVD88 for borings.

Notes:

1. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (ID) of 1.4" and an outside diameter (OD) of 2".
2. 2.0" samples were taken using a CAL split-barrel sampler with an inside diameter (ID) of 2.0" and an outside diameter (OD) of 2.5"
3. An automatic hammer (140 lb) with a 30" drop was used to advance the sampler.
4. Blowcounts noted for boring are field blowcounts and have not been corrected.
5. Blowcounts 50/5 means 50 blows per 5" penetration.
6. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2010)

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

M.O. & A.M.
FIELD INVESTIGATION BY:
DATE: 6/4/15 - 6/16/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 45-0064
POST MILES 26.76

ROUTE 43 KINGS RIVER BRIDGE SEISMIC RETROFIT
LOG OF TEST BORINGS 1 OF 4

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 9/23/15
SHEET X OF X

FILE => 45-0064-z-ltb01.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 4

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

25.00' Rt Sta 333+60.00
"A1" Line

RC-15-001

5"

Elev 271.0'

Blows	Hammer Energy (J)	Sample
6	1.4	WA
10	1.4	WA
19	1.4	
12	1.4	CR
10	1.4	WA
12	1.4	
14	1.4	WA
13	1.4	
25	1.4	
50/4	1.4	M UW
27	1.4	
22	1.4	
23	1.4	
32	1.4	
17	1.4	
52	1.4	M UW
50/6	1.4	
30	1.4	
17	1.4	
34	1.4	
27	1.4	
34	1.4	
47	1.4	
49	1.4	
37	1.4	
35	1.4	
66	1.4	
40	1.4	
64	1.4	
35	1.4	
49	1.4	
34	1.4	

GWS Elev 186.0'
06-04-15

06-04-15
Terminated at Elev 109.5'
ER_i = 92%

SANDY SILT (ML); loose; dark grayish brown; moist; some fine SAND; non-plastic

SILTY SAND (SM); medium dense; very dark grayish brown; moist; fine SAND; some fines

POORLY-GRADED SAND with SILT (SP-SM); medium dense; brown; moist to wet; fine to medium SAND

-light brownish gray; fine SAND; few fines

-grayish brown; wet; fine to medium SAND; trace fines

SILTY SAND (SM); medium dense; light yellowish brown; moist to wet; fine SAND; some fines

SANDY SILT (ML); light brownish gray; moist; few fine SAND; non-plastic

SILT (ML); very dense; light brownish gray; moist; non-plastic

SILTY SAND (SM); light brownish gray; moist; fine to medium SAND; some fines

POORLY-GRADED SAND (SP); medium dense; light brownish gray; moist to wet; fine to medium SAND; trace

SILT (ML); grayish brown; moist; weak to moderate cementation

SANDY SILT (ML); medium dense; grayish brown; moist; few fine SAND; red-orange oxidation throughout

SILTY SAND (SM); grayish brown; moist; fine SAND; some fines

-dense

POORLY-GRADED SAND with FINES (SP-SM); medium dense; moist; fine SAND; few fines

SILT (ML)

SANDY SILT (ML); grayish brown; moist; some fine SAND

SILT (ML); very dense; brownish gray with red brown laminations of iron oxidation; trace fine SAND; non-plastic

-thinly to moderately bedded SILT and SILTY SAND

SILTY SAND (SM); very dense; brownish gray with red-orange iron oxidation; moist; fine SAND; some fines; moderate cementation

SILT (ML); dense; brownish gray; moist; non-plastic

SANDY SILT (ML); brownish gray; moist to wet; few fine SAND

SILTY SAND (SM); brownish gray; moist to wet; fine SAND; some fines; laminated

SANDY SILT (ML); medium dense; brownish gray; moist to wet; few fine SAND

SILTY SAND (SM); yellowish brown; fine SAND

POORLY-GRADED SAND with FINES (SP); dense; brown; fine to medium SAND; trace to few fines

SILTY SAND (SM); medium dense; brownish gray; fine to medium SAND; some fines; moderate cementation

-fine SAND; no cementation

POORLY-GRADED SAND (SP); dense; brownish gray; wet; fine to medium SAND; trace fines

SILTY SAND (SM); brownish gray; moist to wet; fine SAND; some fines

POORLY-GRADED SAND (SP); dense; light brownish gray; wet; fine to medium SAND; trace fines

SILTY SAND (SM); grayish brown; moist; fine SAND; some fines; weak cementation

SILT (ML); dense; pinkish gray; moist; non-plastic

SILTY SAND (SM); grayish brown; moist to wet; fine SAND; some fines

SILT (ML); light brownish gray; moist to wet; non-plastic

SILTY SAND (SM); very dense; light olive brown; moist; fine SAND; some fines

SILT (ML); light olive brown; moist to wet; trace fine SAND; non-plastic;

SANDY SILT (ML); grayish brown; moist; some fine SAND; non-plastic;

SILT (ML); dense; grayish brown; moist; trace fine SAND; non-plastic;

-laminated SAND layers; very dense

-dense

SILTY SAND (SM); brownish gray; fine SAND; some fines

SANDY SILT (ML); brownish gray; few to some fine SAND; non-plastic

POORLY-GRADED SAND (SP); brownish gray; moist to wet; fine to medium SAND; trace fines

SILT (ML); brownish gray; moist; trace fine SAND

SILTY SAND (SM); dense; brownish gray; moist; fine SAND; some fines

300 290 280 270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20

333+00 334+00 335+00

PROFILE
HOR. 1"=20'
VER. 1"=10'

KLEINFELDER
5125 N. GATES AVE., SUITE 102
FRESNO, CA 93722

Nathan Dahlen
REGISTERED CIVIL ENGINEER 9/15/15
DATE

9/22/15
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	KIN	43	VARIOUS		

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY: A. Sanchez
CHECKED BY: N. Dahlen

M. Owens
FIELD INVESTIGATION BY:
DATE: 6/4/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 45-0064
POST MILES 26.76

ROUTE 43 KINGS RIVER BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 2 OF 4

SHEET X OF X

REVISION DATES

DISREGARD PRINTS BEARING EARLIER REVISION DATES

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

FOR FULL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001
FILE => 45-0064-2-1TD02.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 4

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

15.00' Rt Sta 335+00.00
"A1" Line

RC-15-002

3.75"

Elev 271.0'

Core through bridge deck (12.5" thick) to river bed surface at 20 feet. Case to 30 feet.

POORLY-GRADED SAND (SP); medium dense; light brownish gray; moist; fine to coarse SAND; non-plastic

-medium dense; trace GRAVEL

-medium dense; few GRAVEL

-no GRAVEL

SANDY SILT (ML); medium dense; light brownish gray; moist to wet; little fine SAND; non-plastic

POORLY-GRADED SAND (SP); brown; moist to wet; fine to coarse SAND; non-plastic

SILTY SAND (SM); dense; brown; moist to wet; some fines; non-plastic to low plasticity

SANDY SILT (ML); pale brown; moist to wet; some fine SAND; non-plastic

SILTY SAND (SM); pale brown; moist to wet; some fines; trace CLAY; low plasticity

SILT (ML); dense; light brownish gray; wet; few SAND; non-plastic

SILTY SAND (SM); pale brown; moist to wet; fine SAND; some fines; trace CLAY; low plasticity

SILT (ML); medium dense; pale brown; moist to wet; few fine SAND; non-plastic

SILTY SAND (SM); very dense; light brownish gray; moist to wet; fine to medium SAND; some fines; non-plastic

POORLY-GRADED SAND (SP); dense; light brownish gray; wet; fine to coarse SAND

SILTY SAND (SM); pale brown; wet; some fines; non-plastic to low plasticity

SANDY SILT (ML); pale brown; wet; some fine to medium SAND; non-plastic to low plasticity

POORLY-GRADED SAND (SP); dense; brown to light brownish gray; wet; fine to coarse SAND

SILT (ML); very dense; pale brown; wet

SILTY SAND (SM); pale brown; wet; fine to coarse SAND; some fines

SANDY SILT (ML); dark brownish gray; wet; few fine SAND; non-plastic

SILTY SAND (SM); medium dense; light brownish gray; wet; fine to coarse SAND; little fines

-very dense

SANDY SILT (ML); medium dense; pale brown; wet; some fine SAND; non-plastic

SILTY SAND (SM); medium dense; pale brown; wet; fine to medium SAND; little fines

POORLY-GRADED SAND (SP); dense; light brownish gray; wet; fine to coarse SAND

SILTY SAND (SM); dense; pale brown to reddish brown; wet; fine to coarse SAND; little fines

POORLY-GRADED SAND (SP); dense; brown to pale brown; wet; fine to coarse SAND; trace fines

-light brownish gray

SANDY SILT (ML); medium dense; pale brown; wet; some fine to medium SAND; non-plastic to low plasticity

POORLY-GRADED SAND (SP); brown to pale brown; wet; fine to coarse SAND; trace fines

SILTY SAND (SM); medium dense; pale brown; wet; fine to medium SAND; some fines

-very dense; olive; moist; fine SAND; some fines; trace mica flakes

SANDY SILT (ML); light brownish gray; moist; some fine SAND; trace mica flakes; non-plastic; PP=1.5 tsf

SILT (ML); dense; light brownish gray; moist; non-plastic

-PP>=4.5 tsf

SANDY SILT (ML); very dense; light brownish gray; moist; some fine SAND; trace mica flakes; non-plastic; PP=4.5 tsf

-strong cementation; PP>=4.5 tsf

SILT with SAND (ML); light brownish gray; moist; few fine SAND; trace mica flakes; non-plastic; no cementation

SILTY SAND (SM); very dense; light brownish gray; moist; some fines; trace mica flakes

POORLY-GRADED SAND with SILT (SP-SM); very dense; light brownish gray; moist; fine SAND; few fines; trace mica flakes

SILTY SAND (SM); light brownish gray; moist; fine SAND; some fines; trace mica flakes

SILT with SAND (ML); light brownish gray; moist; little fine SAND

-SILTY SAND lense from 155 to 155.5 feet

SANDY SILT (ML); dense; light brownish gray; moist; some fine SAND; trace mica flakes; PP>=4.5 tsf

SILT (ML); hard; light brownish gray; moist; trace SAND; trace mica flakes; low plasticity; PP>=4.5 tsf

SILTY SAND (SM); dense; yellowish brown; moist; fine SAND; some fines

-very dense; trace mica flakes

-olive yellow

POORLY-GRADED SAND (SP); very dense; light brownish gray; moist; fine SAND; trace mica flakes; non-plastic

Elev	Blows	Dry Density	Sample
240	12	1.4	WA
	13	1.4	CR
230	28	1.4	
	61	1.4	M UW
220	50	1.4	
	23	1.4	WA
210	109	1.4	
	37	1.4	
200	47	1.4	M UW
	65	1.4	
190	25	1.4	
	68	1.4	M UW
180	20	1.4	
	29	1.4	
170	32	1.4	
	31	1.4	M UW
160	37	1.4	
	44	1.4	M UW
150	23	1.4	
	19	1.4	
140	50/5	1.4	
	50/5	1.4	
130	50/5	1.4	
	72	1.4	
120	69	1.4	
	34	1.4	
110	46	1.4	
	64	1.4	
100	51	1.4	

06-16-15
Terminated at Elev 99.5'
ER_i = 84%

PROFILE

HOR. 1"=20'
VER. 1"=10'

335+00 336+00 337+00

KLEINFELDER
5125 N. GATES AVE., SUITE 102
FRESNO, CA 93722

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
06	KIN	43	VARIOUS		

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

A. Mohammad
FIELD INVESTIGATION BY:
DATE: 6/16/15

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 45-0064
POST MILES 26.76

ROUTE 43 KINGS RIVER BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 3 OF 4

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 9/22/15

SHEET X OF X

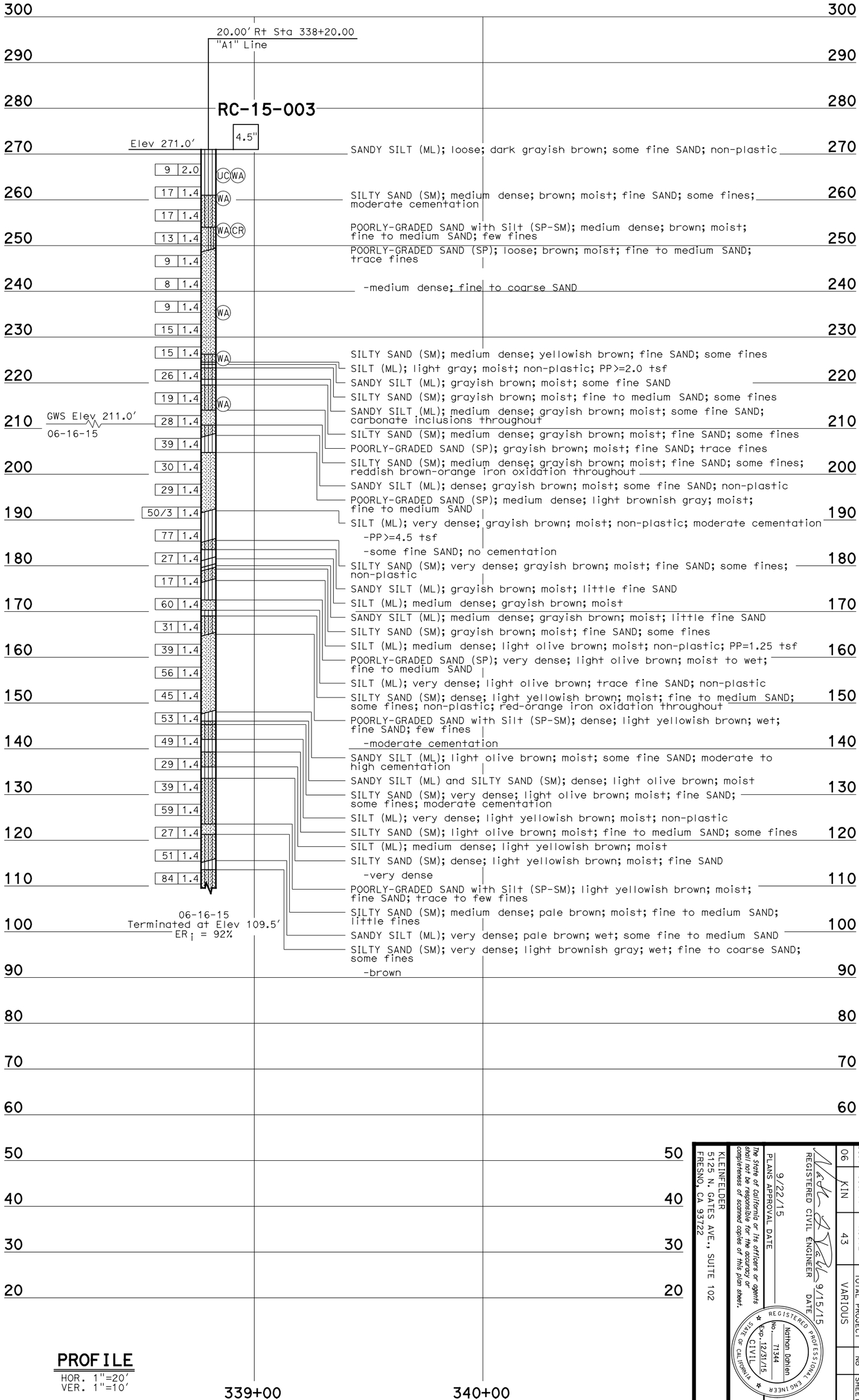
GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

FILE => 45-0064-Z-1T003.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 4

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).



J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

M. Owens
FIELD INVESTIGATION BY:
DATE: 6/16/15

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
FILE => 45-0064-2-1tb04.dgn

BRIDGE NO. 45-0064
POST MILES 26.76

ROUTE 43 KINGS RIVER BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 4 OF 4

CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 9/23/15

SHEET X OF X

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

KLEINFELDER
5125 N. GATES AVE., SUITE 102
FRESNO, CA 93722

9/15/15
REGISTERED CIVIL ENGINEER DATE

9/22/15
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	KIN	43	VARIOUS		

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX A

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
RC-15-001	5.0 - 6.5	SANDY SILT (ML)					67	NP	NP	NP	
RC-15-001	12.0 - 15.0						29				
RC-15-001	25.0 - 26.5						10				
RC-15-001	35.0 - 37.5						6.0				
RC-15-001	51.5 - 52.0		27.4	96.4							
RC-15-001	77.0 - 77.5		26.0	101.4							
RC-15-002	30.0 - 31.5						4.4				
RC-15-002	44.5 - 45.0		13.0	119.0							
RC-15-002	55.0 - 56.5						87				
RC-15-002	69.0 - 69.5		24.4	96.5							
RC-15-002	84.5 - 85.0		19.6	98.5							
RC-15-002	104.0 - 104.5		17.5	116.6							
RC-15-002	112.0 - 112.5		27.9	99.3							
RC-15-003	5.0 - 6.5		7.1	97.5			63				**Unconfined Compressive Strength=**
											q_u: 1.23 tsf Strain at Failure: 10.0%
RC-15-003	10.0 - 11.5						46				
RC-15-003	17.0 - 18.0						4.6				
RC-15-003	35.0 - 36.5						5.2				
RC-15-003	45.0 - 46.5						32				
RC-15-003	55.0 - 56.5						44				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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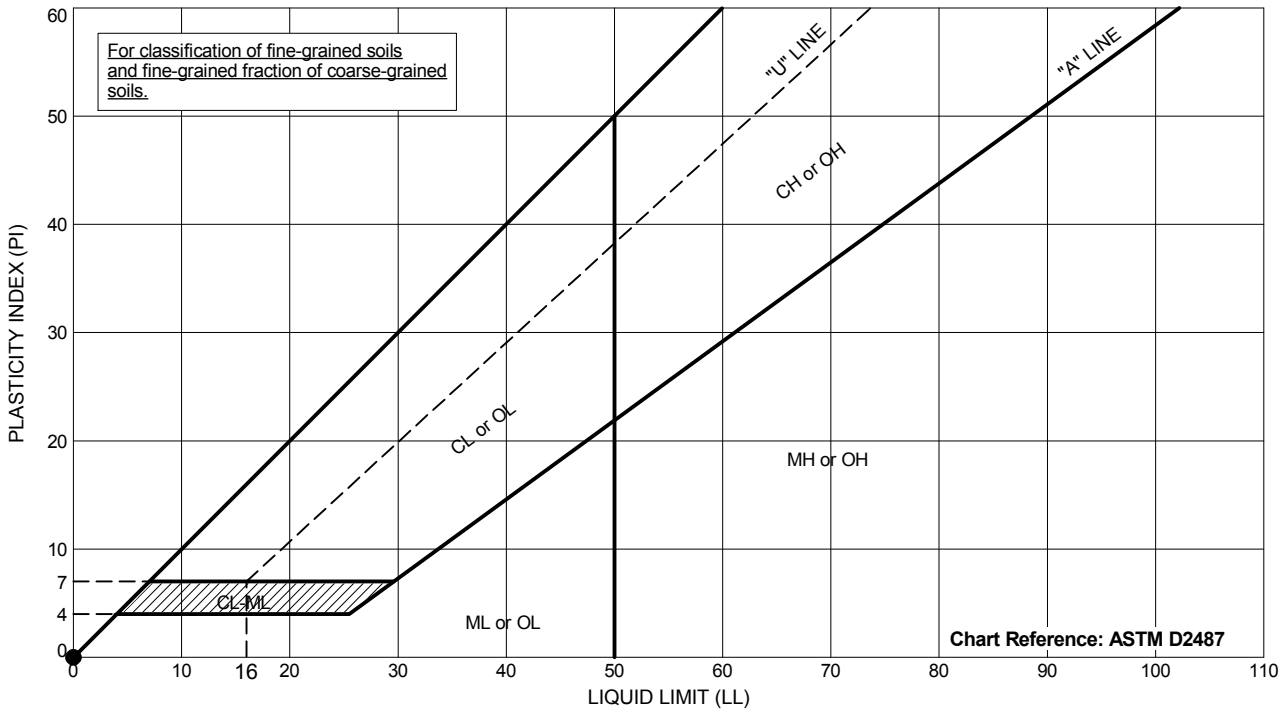
PROJECT NO.: 20143390
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

LABORATORY TEST RESULT SUMMARY

43 over Kings River (Bridge #45-0064)
Kings County, CA

TABLE
A-1

PLOTTED: 09/16/2015 08:30 AM BY: SJLinton



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	RC-15-001	5 - 6.5	SANDY SILT (ML)	67	NP	NP	NP

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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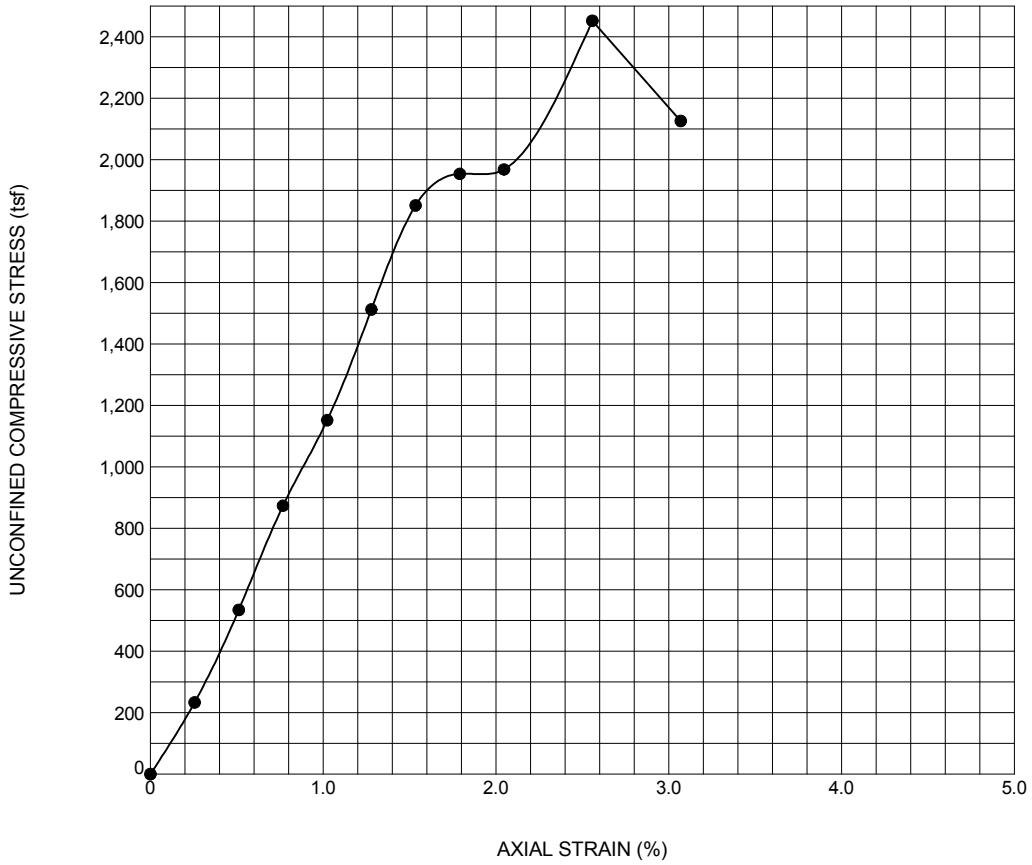
PROJECT NO.: 20143390
DRAWN BY: M. PALMER
CHECKED BY:
DATE:
REVISED: -

ATTERBERG LIMITS

43 over Kings River (Bridge #45-0064)
Kings County, CA

A-2

gINT FILE: PROJECTWISE: 20143390.074a_43 Over Kings.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_ATTERBERG (ASTM)]



	Exploration ID	Depth (ft.)	Sample Description	q_u (psf)	Failure Strain (%)
●	RC-15-003	5 - 6.5		2452.276	2.6

	Exploration ID	Depth (ft.)	Sample Condition Type	Initial Dry Unit Wt. (pcf)	Initial Water Content (%)	Initial Saturation (%)	Initial Void Ratio (%)	Specific Gravity	Passing #200	LL	PL	PI
●	RC-15-003	5 - 6.5	Undisturbed	97.5	7.1	NM	NM	NM	63	NM	NM	NM

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.: 20143390
DRAWN BY: M. PALMER
CHECKED BY:
DATE:
REVISED: -

UNCONFINED COMPRESSIVE STRENGTH

43 over Kings River (Bridge #45-0064)
Kings County, CA

A-3

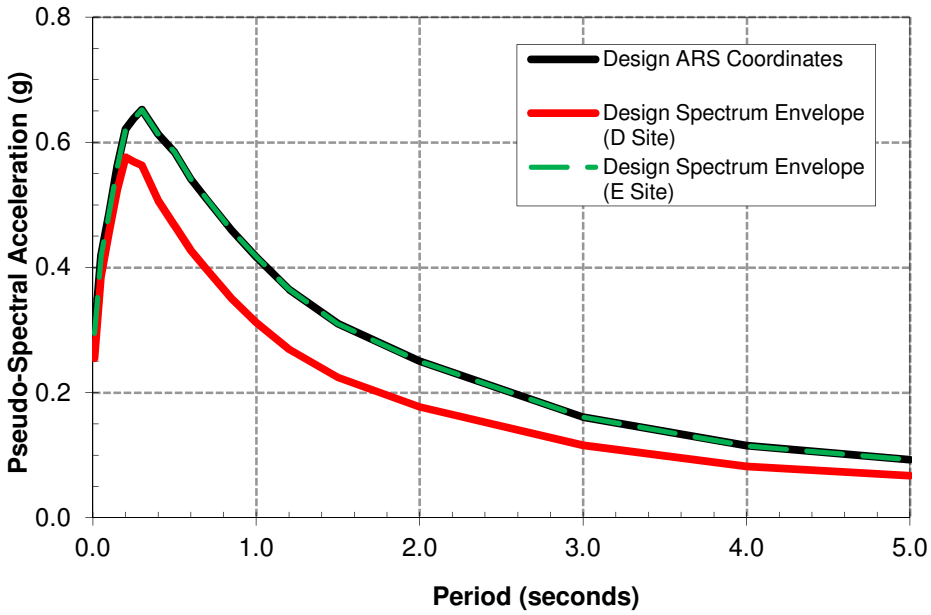
PLOTTED: 09/16/2015 08:45 AM BY: SJLinton
gINT FILE: PROJECTWISE: 20143390.074a_43 Over Kings.gpj [KLF_UNC COMPRESSIVE STRENGTH(MULTI)]
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB

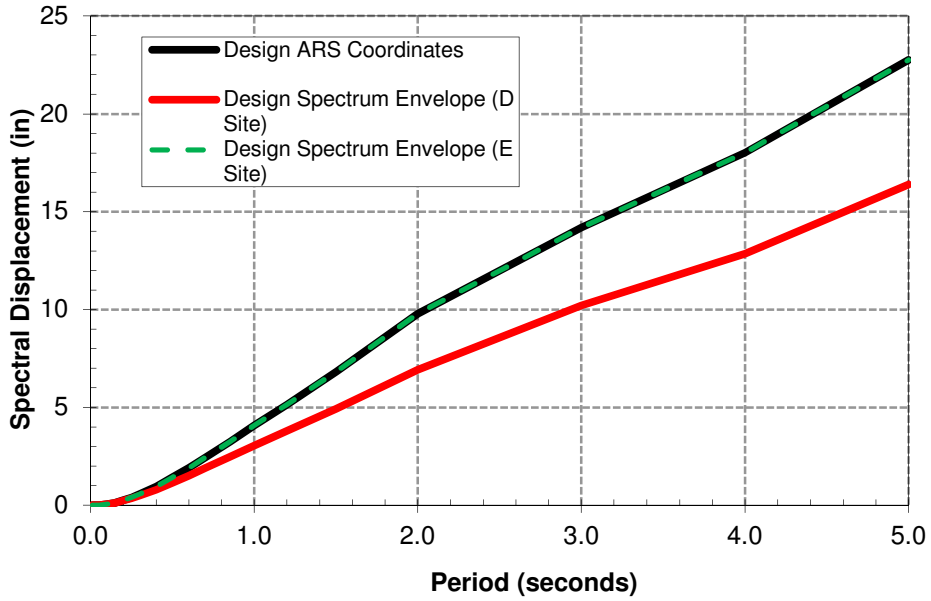
APPENDIX B

SITE DATA

Latitude:	36.434749	Shear Wave Velocity	D/E
Longitude:	-119.636182	Depth to Vs = 1.0 km/s:	N/A
		Depth to Vs = 2.5 km/s:	N/A

Period (s)	SA (g)	SD (in)
0.01 (PGA)	0.295	0.00
0.05	0.419	0.01
0.1	0.488	0.04
0.15	0.562	0.12
0.2	0.621	0.23
0.25	0.638	0.35
0.3	0.652	0.50
0.4	0.613	0.79
0.5	0.584	1.14
0.6	0.541	1.50
0.7	0.508	1.90
0.85	0.459	2.48
1	0.417	3.05
1.2	0.365	3.79
1.5	0.310	4.93
2	0.250	6.93
3	0.161	10.22
4	0.115	12.84
5	0.093	16.39





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PROJECT NO	20143390
DRAWN:	7/22/15
DRAWN BY:	JL
CHECKED BY:	ZZ
FILE NAME:	Design ARS

CALTRANS ARS CURVES

SR 43 Over Kings River
Bridge No. 45-0064
Kings County, CA

PLATE
B-1

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: J Liao — Date: 7/28/2015
Checked by: Neva Popenoe — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 20
Design Ground Water Depth (ft): 20

Existing Ground Surface Elevation (ft): 271
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 60
Bore Hole Diameter (mm): 76.2
Distance between Hammer and Ground Surface (ft): 5

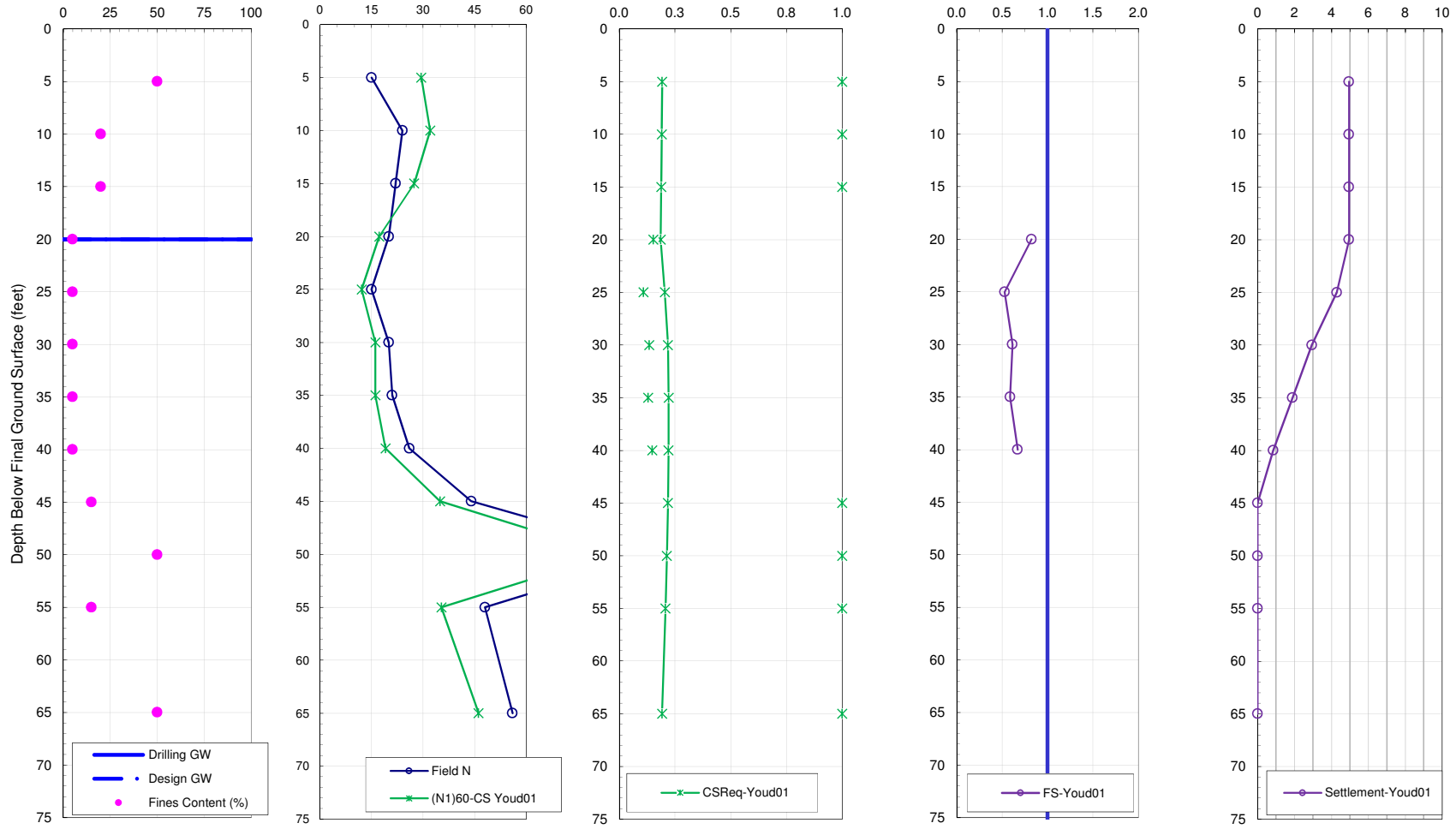
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: B-1 (1993)

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
5	15	120	1	No	50				7.0	Sandy SILT (ML)	Yes	Yes	Yes
10	24	120	1	No	20				4.0	Clayey Silty SAND (SM)	Yes	Yes	Yes
15	22	120	1	No	20				6.0	Silty SAND (SM)	Yes	Yes	Yes
20	20	127	1	No	5				4.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
25	15	127	1	No	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
30	20	127	1	No	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
35	21	127	1	No	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
40	26	127	1	No	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
45	44	127	1	No	15				3.0	Clayey Silty SAND (SM)	Yes	Yes	Yes
50	98	127	1	No	50				7.0	Sandy SILT (ML)	Yes	Yes	Yes
55	48	127	1	No	15				5.0	Sandy SILT (ML)	Yes	Yes	Yes
65	56	127	1	No	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes

Boring ID:	B-1 (1993)	M_w= 7.9 PGA= 0.30g	Groundwater Depth During Drilling (ft) = **20.0 ft** Design Groundwater Depth (ft) = **20.0 ft**	Existing Ground Elevation = **271.0 ft** Final Ground Elevation = **271.0 ft**	Ana. by: J Liao Checked by: Neva Popenoe



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

5125 N. Gates Ave., Suite 102
Fresno, California 93722
t: 559.486.0750 f: 559.442.5081

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-1

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popeno — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 0
Design Ground Water Depth (ft): 0

Existing Ground Surface Elevation (ft): 251
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 60
Bore Hole Diameter (mm): 100
Distance between Hammer and Ground Surface (ft): 5

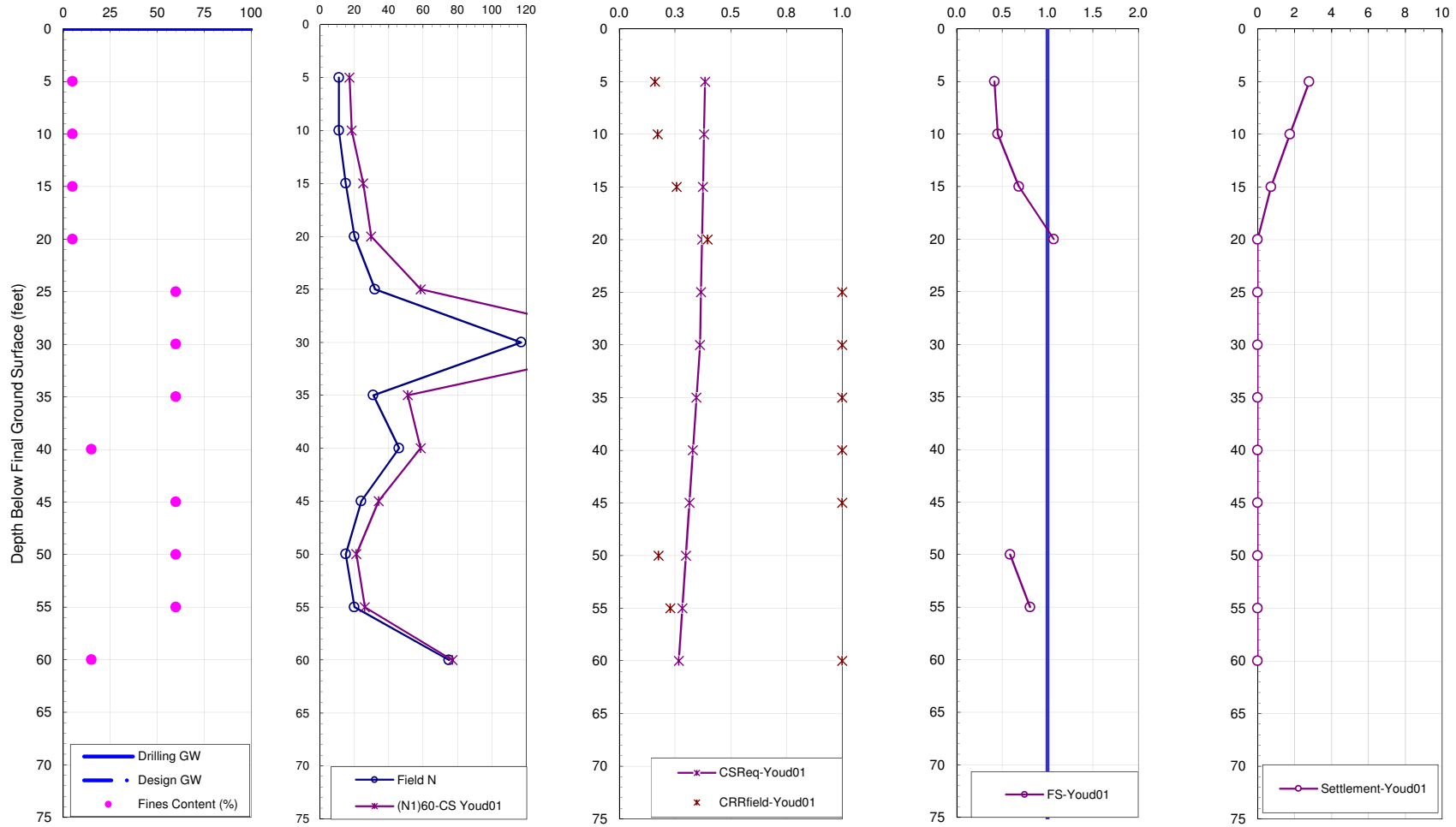
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: B-2 (1993)

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
5	11	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
10	11	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
15	15	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
20	20	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
25	32	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
30	117	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
35	31	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
40	46	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
45	24	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
50	15	125	1	Yes	60				10.0	Sandy SILT (ML)	Yes	Yes	Yes
55	20	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
60	75	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes

Boring ID:	B-2 (1993)	M_w= 7.9 PGA= 0.30g	Groundwater Depth During Drilling (ft) = **0.0 ft** Design Groundwater Depth (ft) = **0.0 ft**	Existing Ground Elevation = **251.0 ft** Final Ground Elevation = **251.0 ft**	Ana. by: John Liao Checked by: Neva Popeno



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

2001 Arch-Airport Road, Suite 100
Stockton, California 95206
t: 209.948.1345 f: 209.234.4700

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-2

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popeno — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 16
Design Ground Water Depth (ft): 10

Existing Ground Surface Elevation (ft): 261
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 60
Bore Hole Diameter (mm): 100
Distance between Hammer and Ground Surface (ft): 5

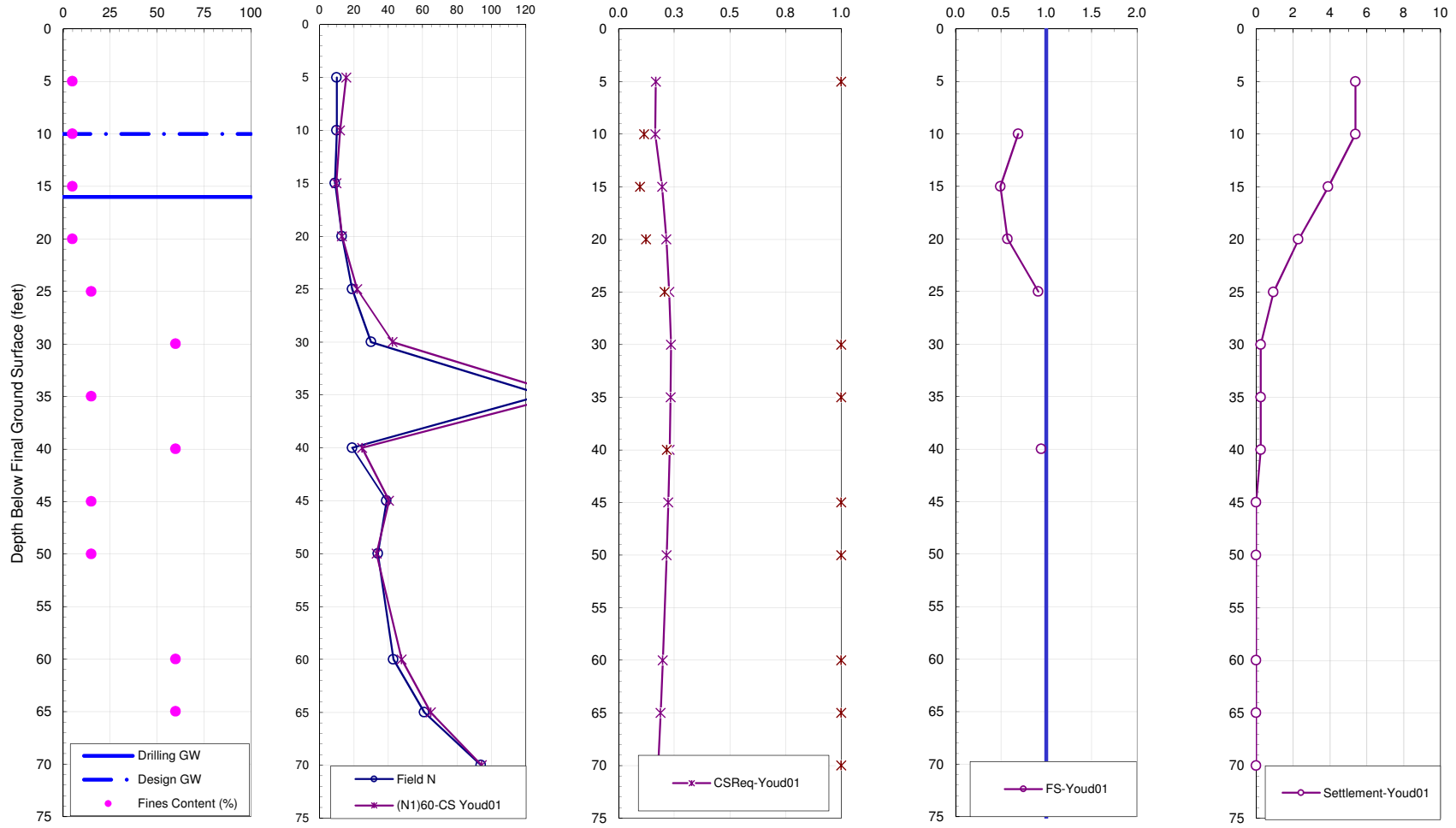
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: B-3 (1993)

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
5	10	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
10	10	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
15	9	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
20	13	125	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
25	19	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
30	30	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
35	130	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
40	19	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
45	39	125	1	Yes	15				5.0	Sandy SILT (ML)	Yes	Yes	Yes
50	34	125	1	Yes	15				10.0	Sandy SILT (ML)	Yes	Yes	Yes
60	43	125	1	Yes	60				5.0	Silty SAND (SM)	Yes	Yes	Yes
65	61	125	1	Yes	60				5.0	Silty SAND (SM)	Yes	Yes	Yes
70	94	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes

Boring ID:	B-3 (1993)	M_w= 7.9	Groundwater Depth During Drilling (ft) = 16.0 ft	Existing Ground Elevation = 261.0 ft	Ana. by: John Liao
		PGA= 0.30g	Design Groundwater Depth (ft) = 10.0 ft	Final Ground Elevation = 261.0 ft	Checked by: Neva Popeno



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-3

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popeno — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 20
Design Ground Water Depth (ft): 20

Existing Ground Surface Elevation (ft): 271
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 60
Bore Hole Diameter (mm): 100
Distance between Hammer and Ground Surface (ft): 5

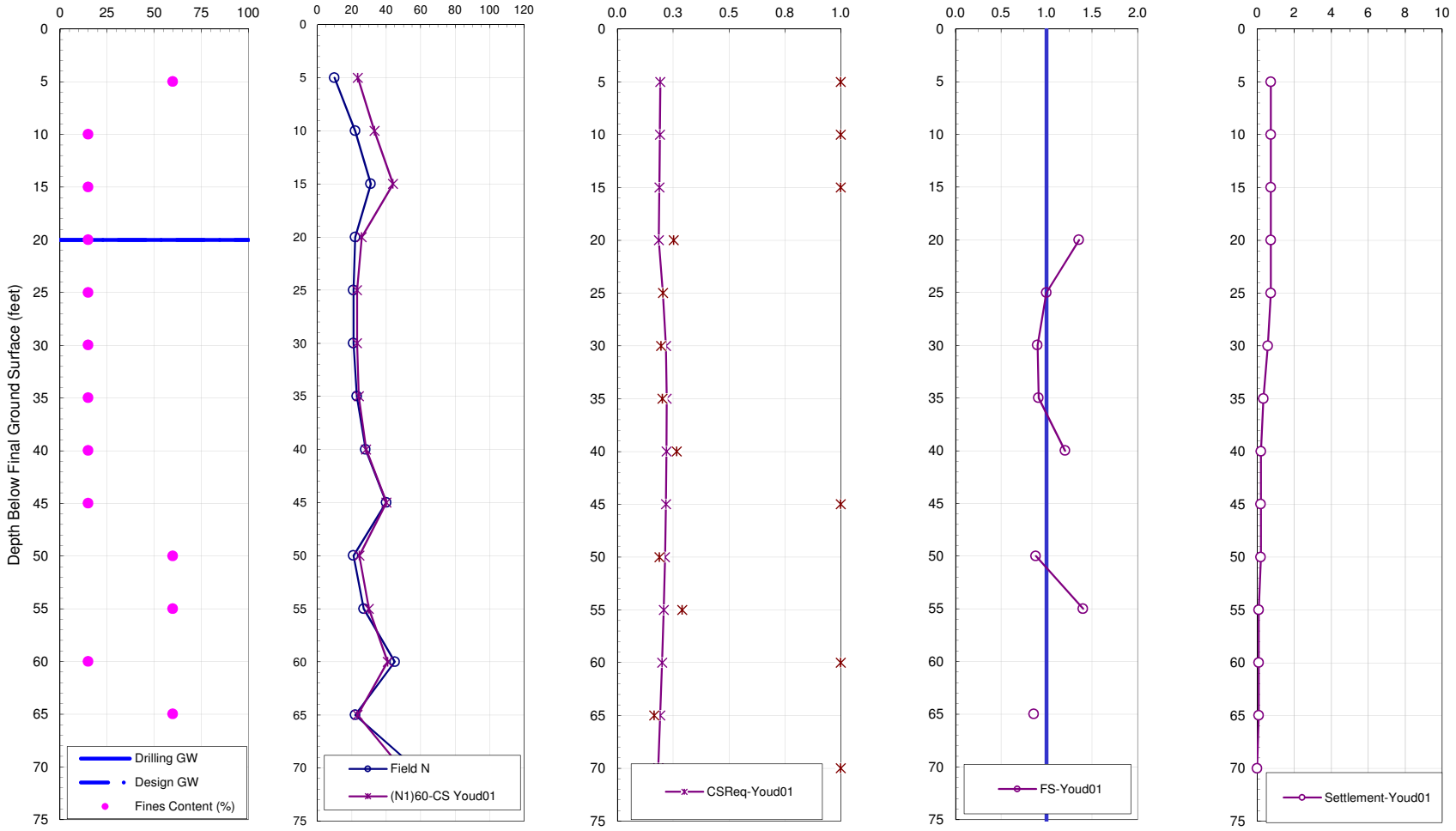
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: B-4 (1993)

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
5	10	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
10	22	125	1	Yes	15				5.0	Clayey SAND (SC)	Yes	Yes	Yes
15	31	125	1	Yes	15				5.0	Clayey SAND (SC)	Yes	Yes	Yes
20	22	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
25	21	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
30	21	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
35	23	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
40	28	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
45	40	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
50	21	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
55	27	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
60	45	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
65	22	125	1	Yes	60				5.0	Sandy SILT (ML)	Yes	Yes	Yes
70	57	125	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes

Boring ID:	B-4 (1993)	M_w= 7.9	Groundwater Depth During Drilling (ft) = 20.0 ft	Existing Ground Elevation = 271.0 ft	Ana. by: John Liao
		PGA= 0.300g	Design Groundwater Depth (ft) = 20.0 ft	Final Ground Elevation = 271.0 ft	Checked by: Neva Popeno



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-4

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popenoe — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 90
Design Ground Water Depth (ft): 20

Existing Ground Surface Elevation (ft): 271
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 80
Bore Hole Diameter (mm): 125
Distance between Hammer and Ground Surface (ft): 5

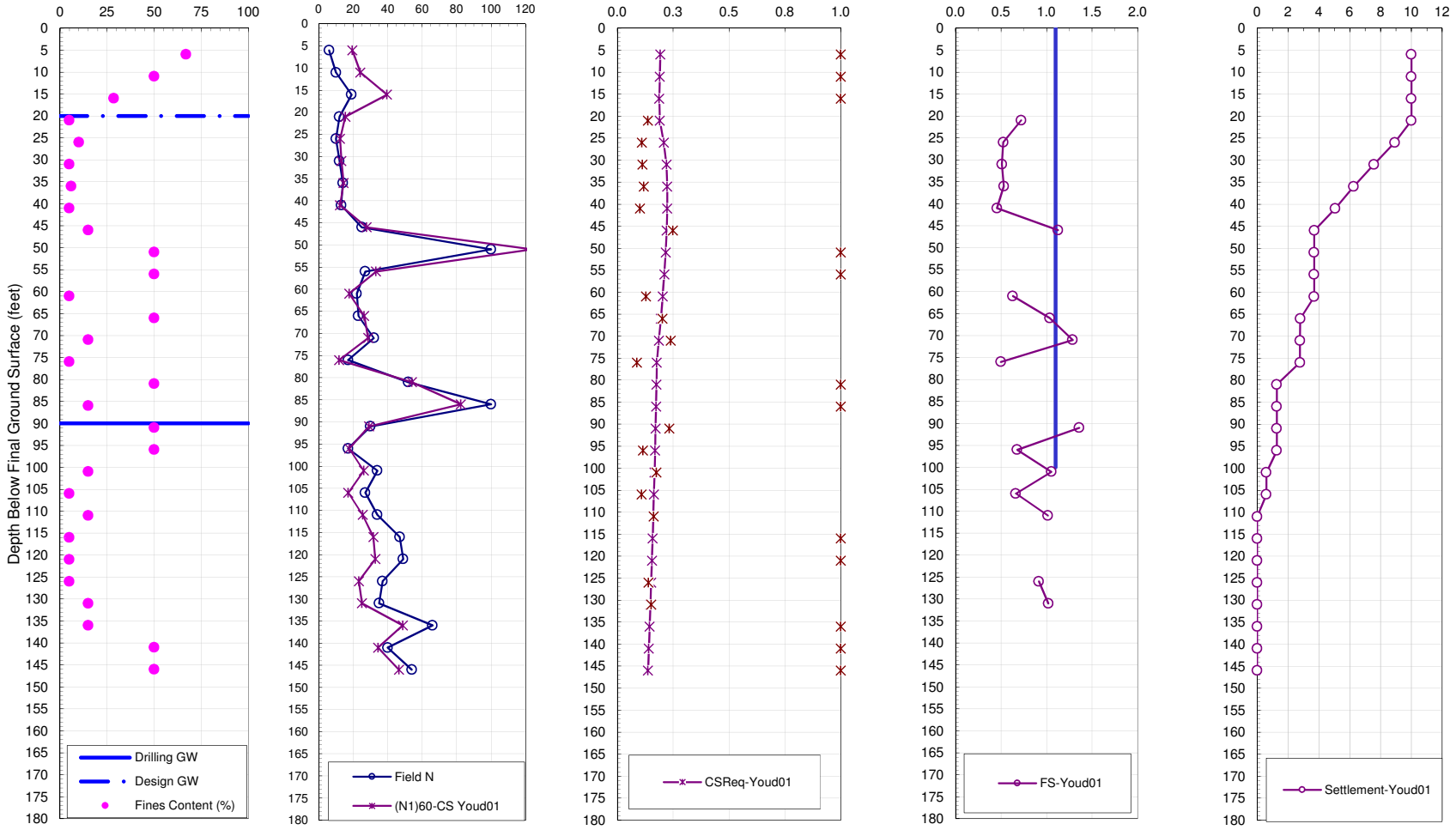
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.1
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: Boring RC-15-001

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
6	6	120	1	Yes	67				7.5	Sandy SILT (ML)	Yes	Yes	Yes
11	10	120	1	Yes	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes
16	19	120	1	Yes	28.6				5.0	Silty SAND (SM)	Yes	Yes	Yes
21	12	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
26	10	120	1	Yes	10				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
31	12	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
36	14	120	1	Yes	6				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
41	13	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
46	25	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
51	100	120	1	Yes	50			27.4	5.0	SILT (ML)	Yes	Yes	Yes
56	27	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
61	22	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
66	23	120	1	Yes	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes
71	32	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
76	17	120	1	Yes	5			26	5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
81	52	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
86	100	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
91	30	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
96	17	120	1	Yes	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes
101	34	120	1	Yes	15				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
106	27	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
111	34	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
116	47	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
121	49	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
126	37	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
131	35	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
136	66	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
141	40	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
146	54	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes

Boring ID:	**Boring RC-15-001**	M_w= **7.9**	Groundwater Depth During Drilling (ft) = **90.0 ft**	Existing Ground Elevation = **271.0 ft**	Ana. by:	John Liao
		PGA= **0.300g**	Design Groundwater Depth (ft) = **20.0 ft**	Final Ground Elevation = **271.0 ft**	Checked by:	Neva Popenoe



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-5

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popeno — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.26

Field Ground Water Depth (ft): 20
Design Ground Water Depth (ft): 0

Existing Ground Surface Elevation (ft): 251
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 80
Bore Hole Diameter (mm): 100
Distance between Hammer and Ground Surface (ft): 5

Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: Boring RD-15-002

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
5	12	120	1	Yes	5				3.5	Poorly Graded SAND (SP)	Yes	Yes	Yes
11	12	120	1	Yes	5				4.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
16	13	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
21	28	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
26	61	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
31	50	120	1	Yes	5				5.0	Sandy SILT (ML)	Yes	Yes	Yes
36	23	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
41	100	120	1	Yes	5			13	5.0	Silty SAND (SM)	Yes	Yes	Yes
46	37	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
51	47	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
56	65	120	1	Yes	5				5.0	SILT (ML)	Yes	Yes	Yes
61	25	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
66	68	120	1	Yes	5			24.4	5.0	Silty SAND (SM)	Yes	Yes	Yes
71	20	120	1	Yes	5				5.0	Sandy SILT (ML)	Yes	Yes	Yes
76	29	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
81	32	120	1	Yes	5			19.6	5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
86	31	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
91	37	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
96	44	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
101	23	120	1	Yes	5			17.5	5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
106	19	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
111	82	120	1	Yes	5			27.9	5.0	Silty SAND (SM)	Yes	Yes	Yes
116	63	120	1	Yes	5				5.0	Sandy SILT (ML)	Yes	Yes	Yes
121	100	120	1	Yes	5				5.0	Sandy SILT (ML)	Yes	Yes	Yes
126	72	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
131	69	120	1	Yes	5				5.0	Poorly Graded SAND With Silt (SP-SM)	Yes	Yes	Yes
136	34	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
141	46	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes
146	64	120	1	Yes	5				5.0	Silty SAND (SM)	Yes	Yes	Yes

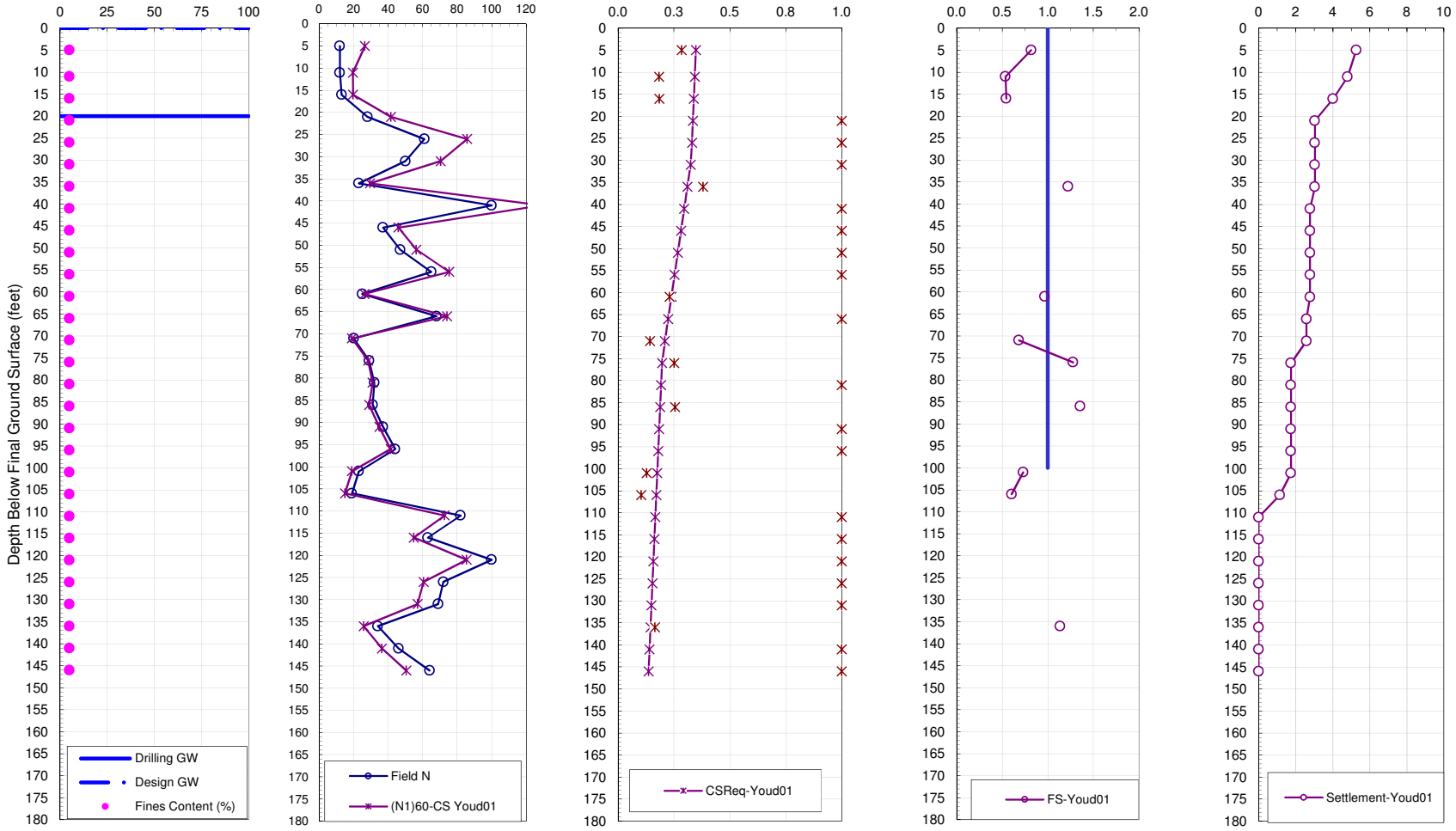
Boring ID: **Boring RD-15-002**

M_w= **7.9**
PGA= **0.26g**

Groundwater Depth During Drilling (ft) = **20.0 ft**
Design Groundwater Depth (ft) = **0.0 ft**

Existing Ground Elevation = **251.0 ft**
Final Ground Elevation = **251.0 ft**

Ana. by: John Liao
Checked by: Neva Popeno



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

FIGURE B-6

STEP 1:

Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

Analyzed by: John Liao — Date: 7/28/2015
Checked by: Neva Popeno — Date: 8/20/2015

STEP 2:

Mw: 7.9 (5.5≤Mw≤8.5)
PGA: 0.3

Field Ground Water Depth (ft): 99
Design Ground Water Depth (ft): 20

Existing Ground Surface Elevation (ft): 271
New Fill Height (ft): 0
Unit Weight of New Fill (pcf): 120

STEP 3:

Hammer Energy Efficiency Ratio (%): 80
Bore Hole Diameter (mm): 150
Distance between Hammer and Ground Surface (ft): 5

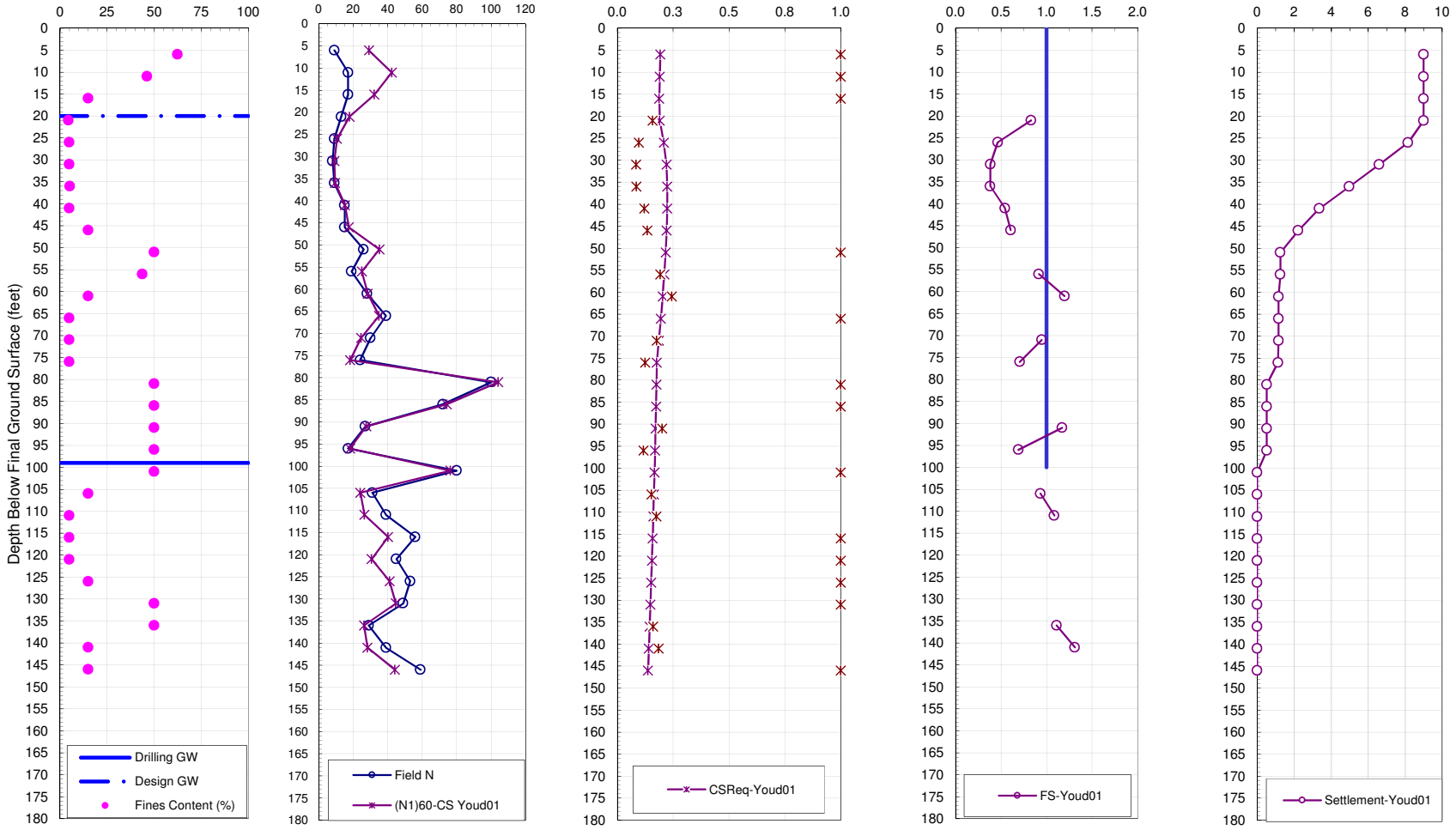
Probability to Liquefy (Seed et al.): 15 %

Factor of Safety for Liquefaction = 1.0
Factor of Safety for Settlement Calculation = 1.3

STEP 4: Boring I.D.: Boring RD-15-003

Sample Depth (ft)	N_{field}	γ_{total} (pcf)	C_{S1}[1]	C_{S2}[2]	LAB Data				Layer Thickness (ft)[5]	USCS Classification[6]	Liquefaction Susceptability		
					% Fines[3]	LL[4]	PI[4]	WC (%)[4]			Seed03[7]	IB04[8]	Youd01[9]
6	9	120	1	Yes	62.5				7.5	Sandy SILT (ML)	Yes	Yes	Yes
11	17	120	1	Yes	46.3				5.0	Silty SAND (SM)	Yes	Yes	Yes
16	17	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
21	13	120	1	Yes	4.6				5.0	Poorly Graded SAND With Silt (SP-SM)	Yes	Yes	Yes
26	9	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
31	8	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
36	9	120	1	Yes	5.2				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
41	15	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
46	15	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
51	26	120	1	Yes	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes
56	19	120	1	Yes	43.8				5.0	Silty SAND (SM)	Yes	Yes	Yes
61	28	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
66	39	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
71	30	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
76	24	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
81	100	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
86	72	120	1	Yes	50				5.0	Sandy SILT (ML)	Yes	Yes	Yes
91	27	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
96	17	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
101	80	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
106	31	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
111	39	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
116	56	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
121	45	120	1	Yes	5				5.0	Poorly Graded SAND (SP)	Yes	Yes	Yes
126	53	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
131	49	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
136	29	120	1	Yes	50				5.0	SILT (ML)	Yes	Yes	Yes
141	39	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes
146	59	120	1	Yes	15				5.0	Silty SAND (SM)	Yes	Yes	Yes

Boring ID:	**Boring RD-15-003**	M_w= **7.9**	Groundwater Depth During Drilling (ft) = **99.0 ft**	Existing Ground Elevation = **271.0 ft**	Ana. by:	John Liao
		PGA= **0.300g**	Design Groundwater Depth (ft) = **20.0 ft**	Final Ground Elevation = **271.0 ft**	Checked by:	Neva Popeno



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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Project Name: Route 43 Bridge over Kings River
Project No.: 20143390.074A
Project Location: Kings County

LIQUEFACTION ANALYSIS

Date 7/28/2015

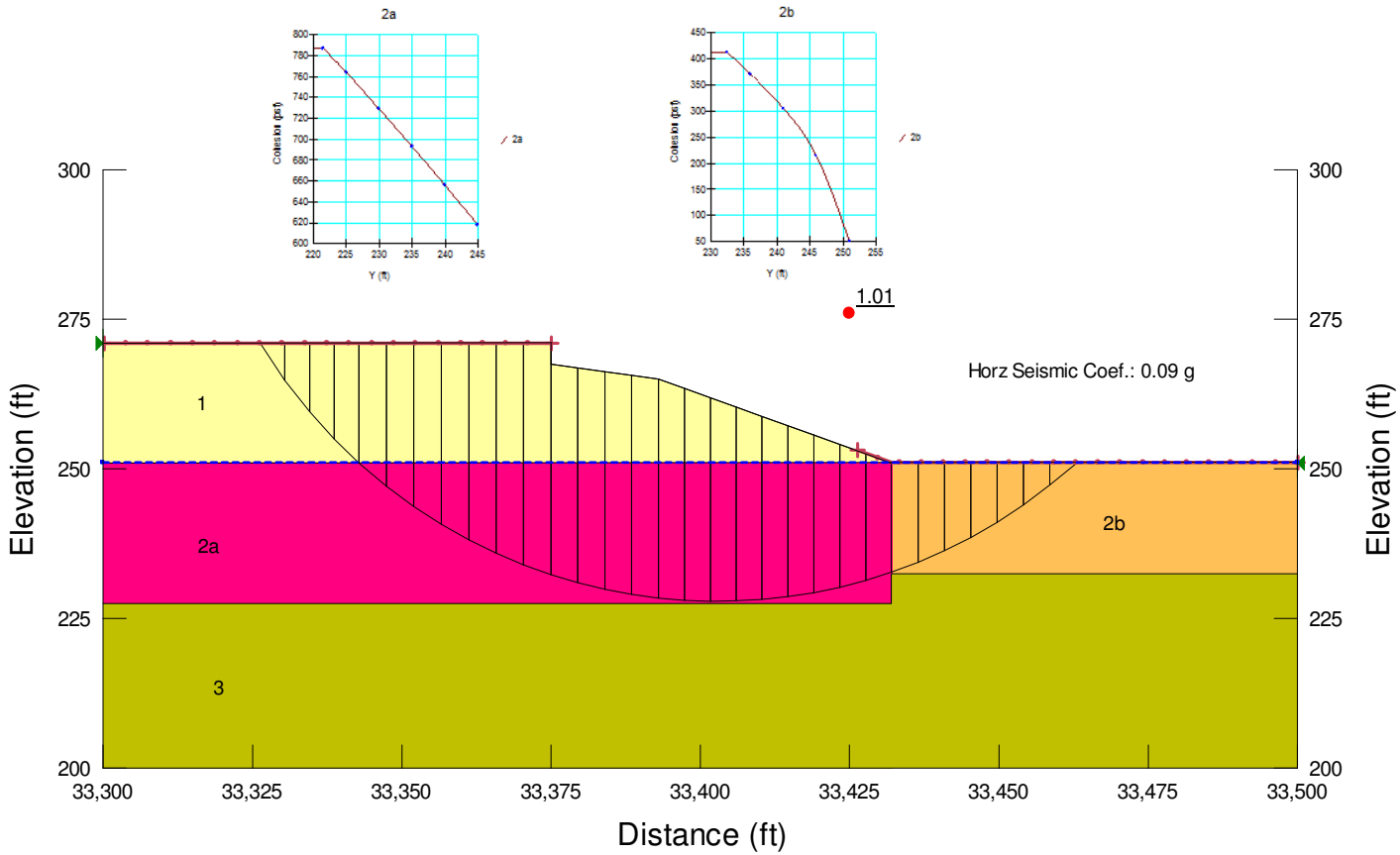
FIGURE B-7

Name: 1 Silty SAND
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 32 °

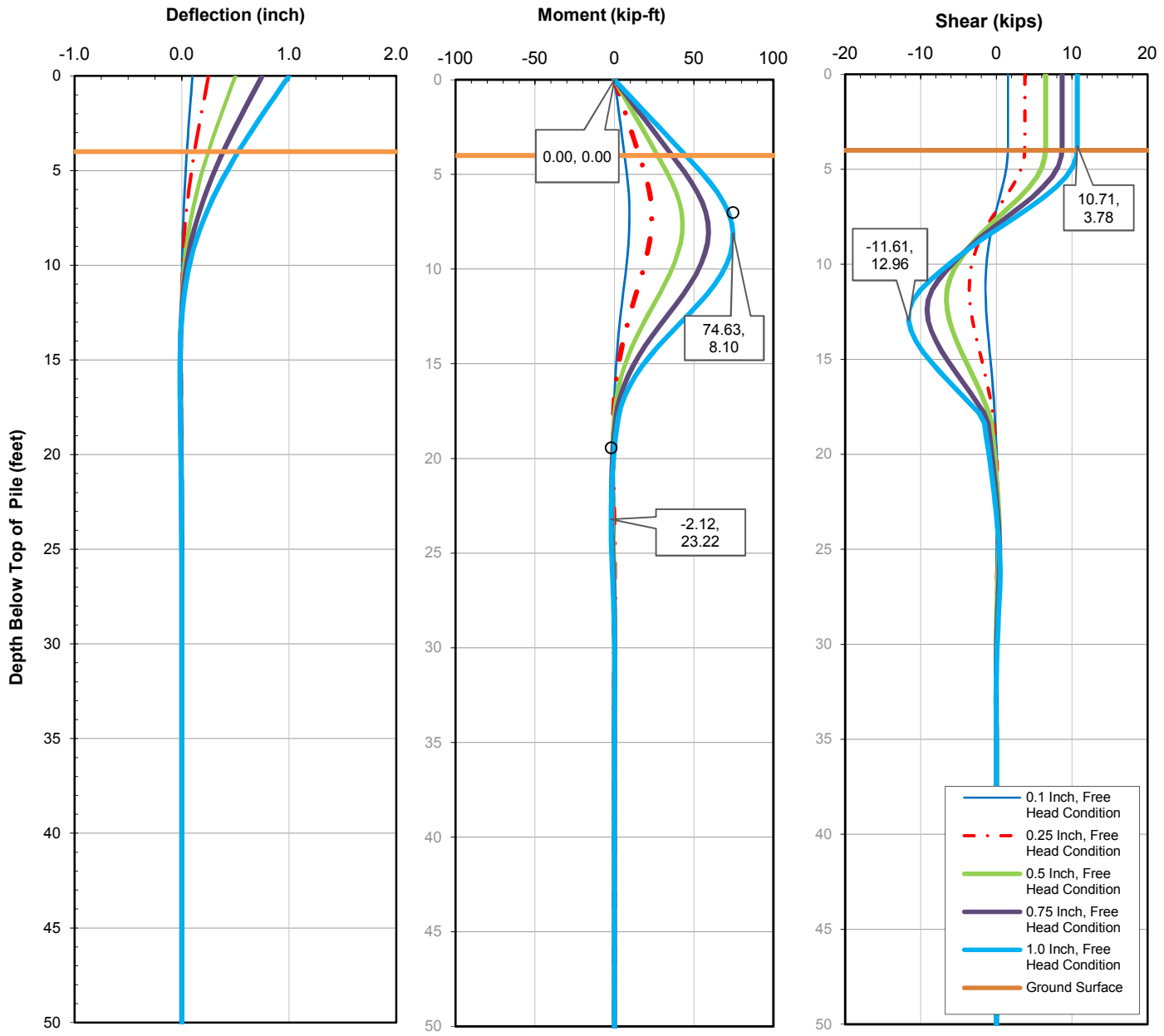
Name: 2a Poorly-Graded SAND (Liquefied)
Model: Spatial Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion Fn: 2a
Phi': 0 °

Name: 2b Poorly-Graded SAND (Liquefied)
Model: Spatial Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion Fn: 2b
Phi': 0 °

Name: 3 Silty SAND
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 30 °



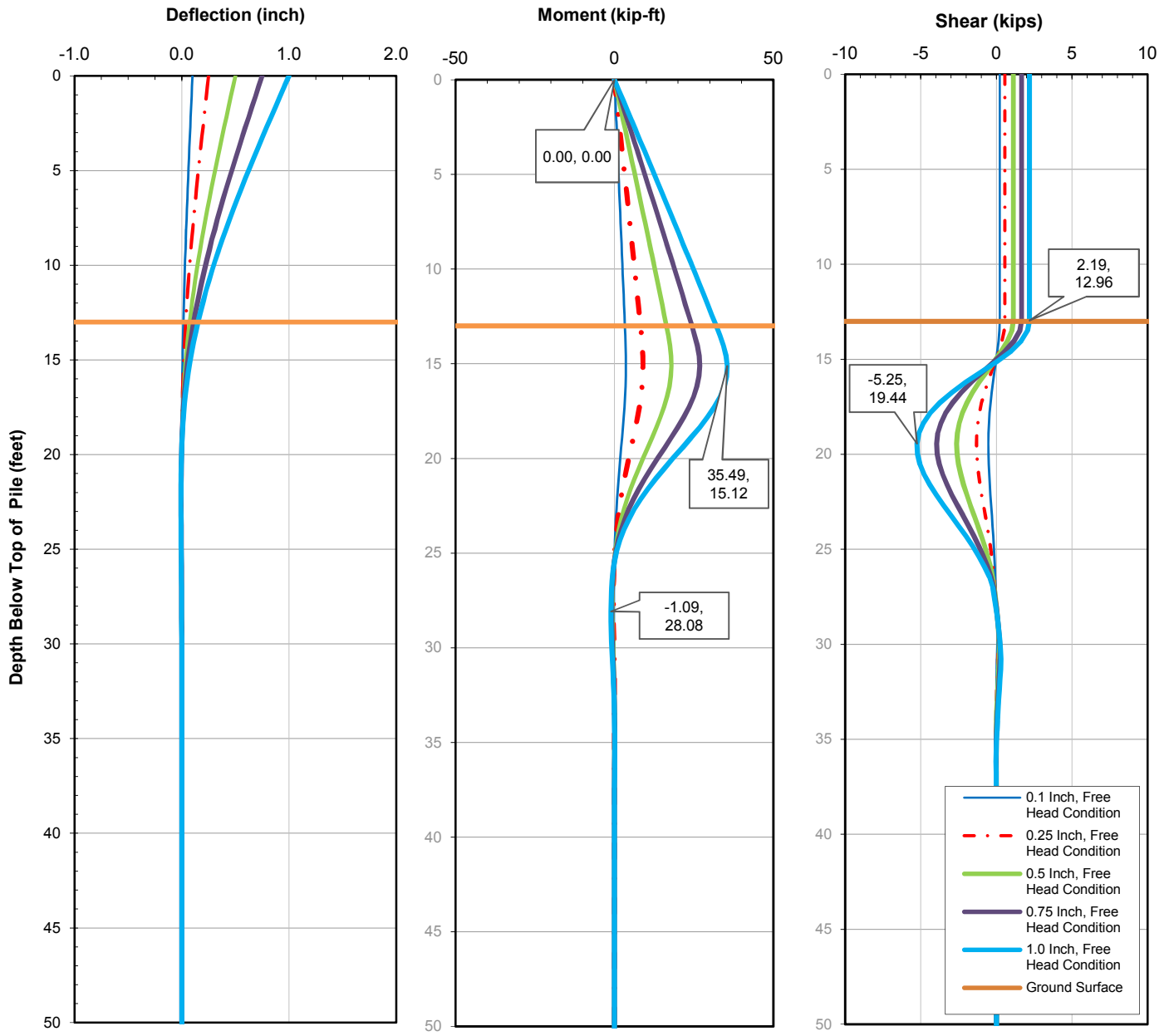
APPENDIX C



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (50-foot length)
2. 0.0 Depth represents the pile head, Elevation 265
3. Piles modeled as elastic piles

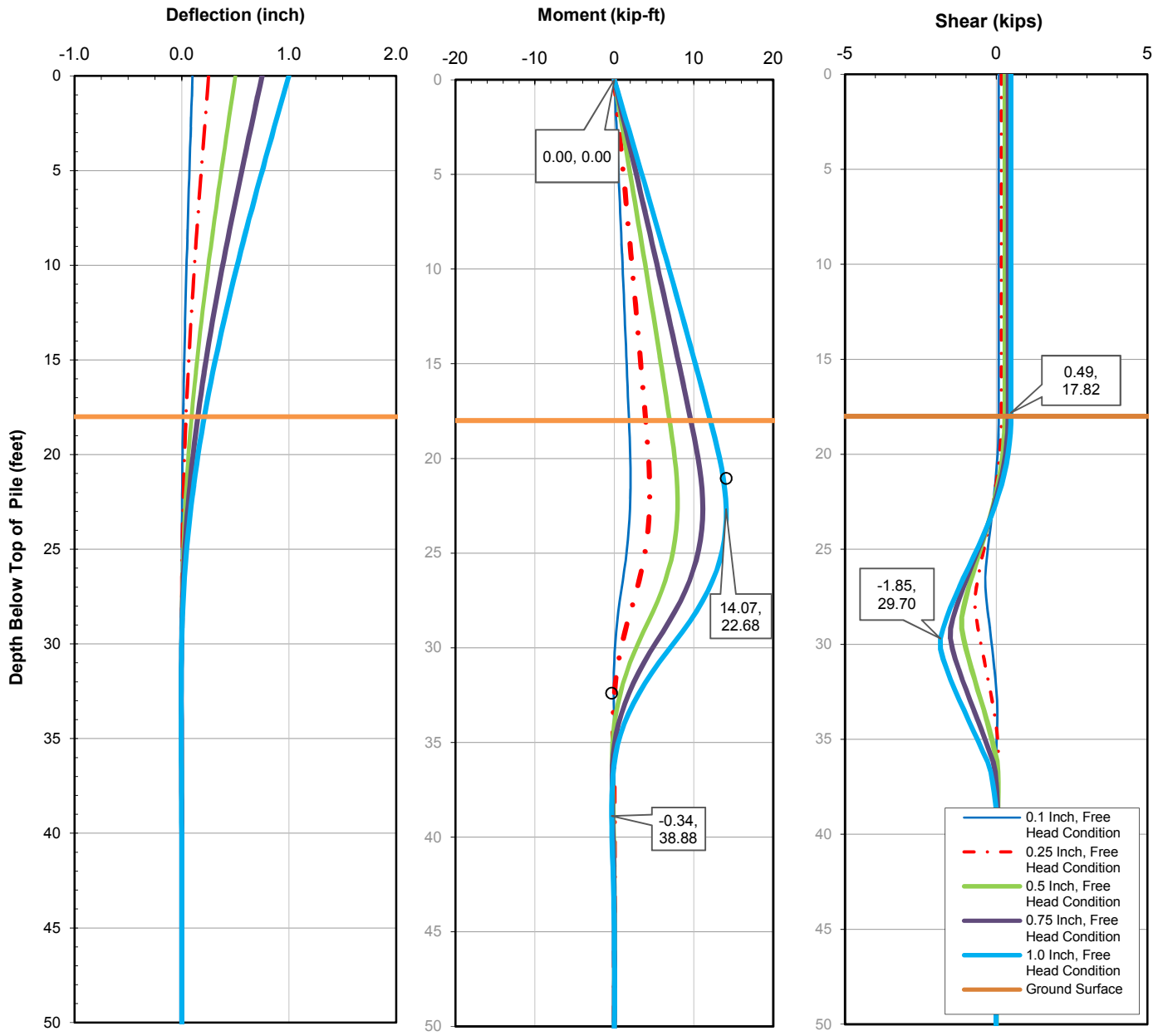
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 2, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-1**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (41-foot length)
2. 0.0 Depth represents the pile head, Elevation 256
3. Piles modeled as elastic piles

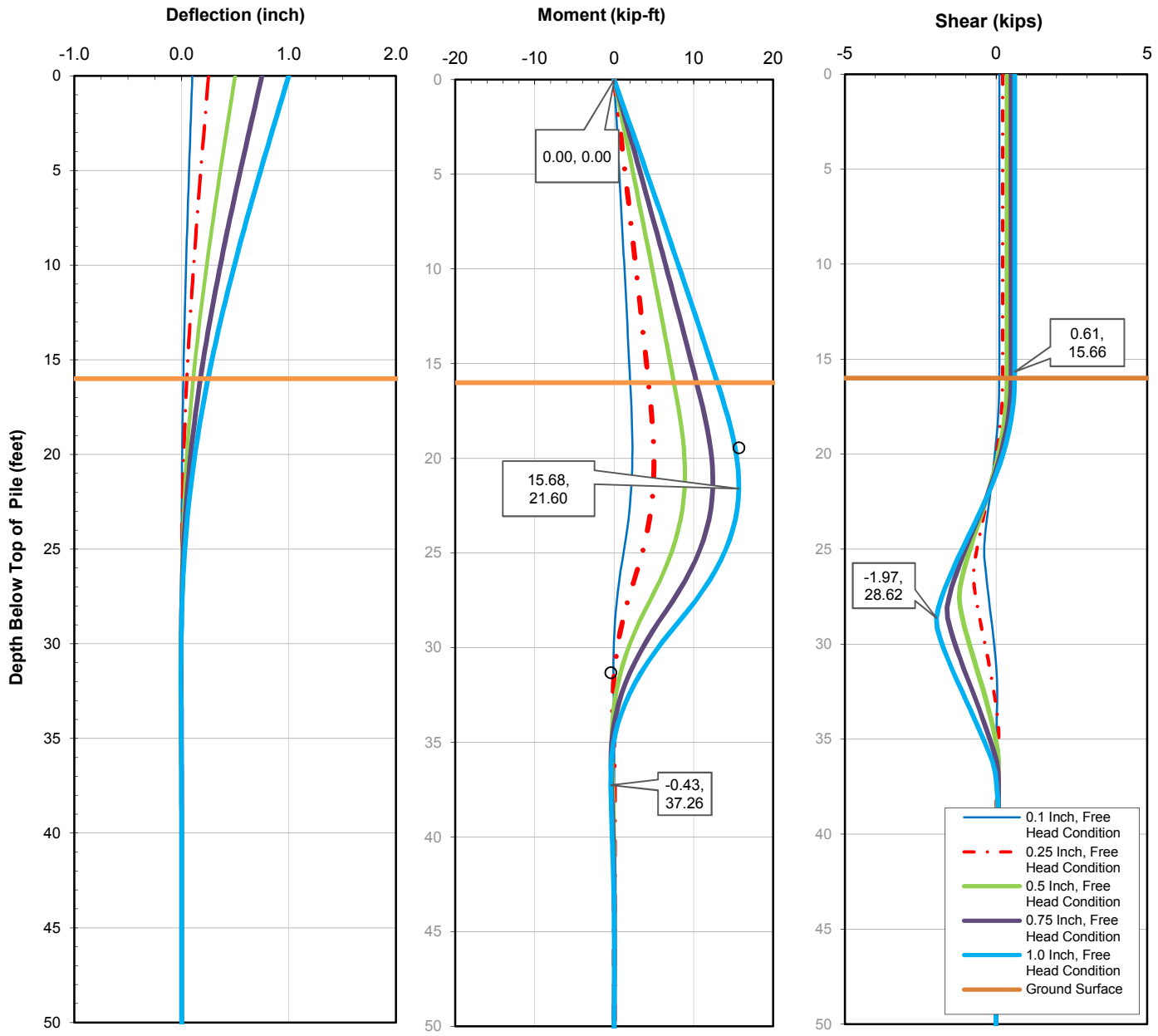
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 3, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-2**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (36-foot length)
2. 0.0 Depth represents the pile head, Elevation 251
3. Piles modeled as elastic piles

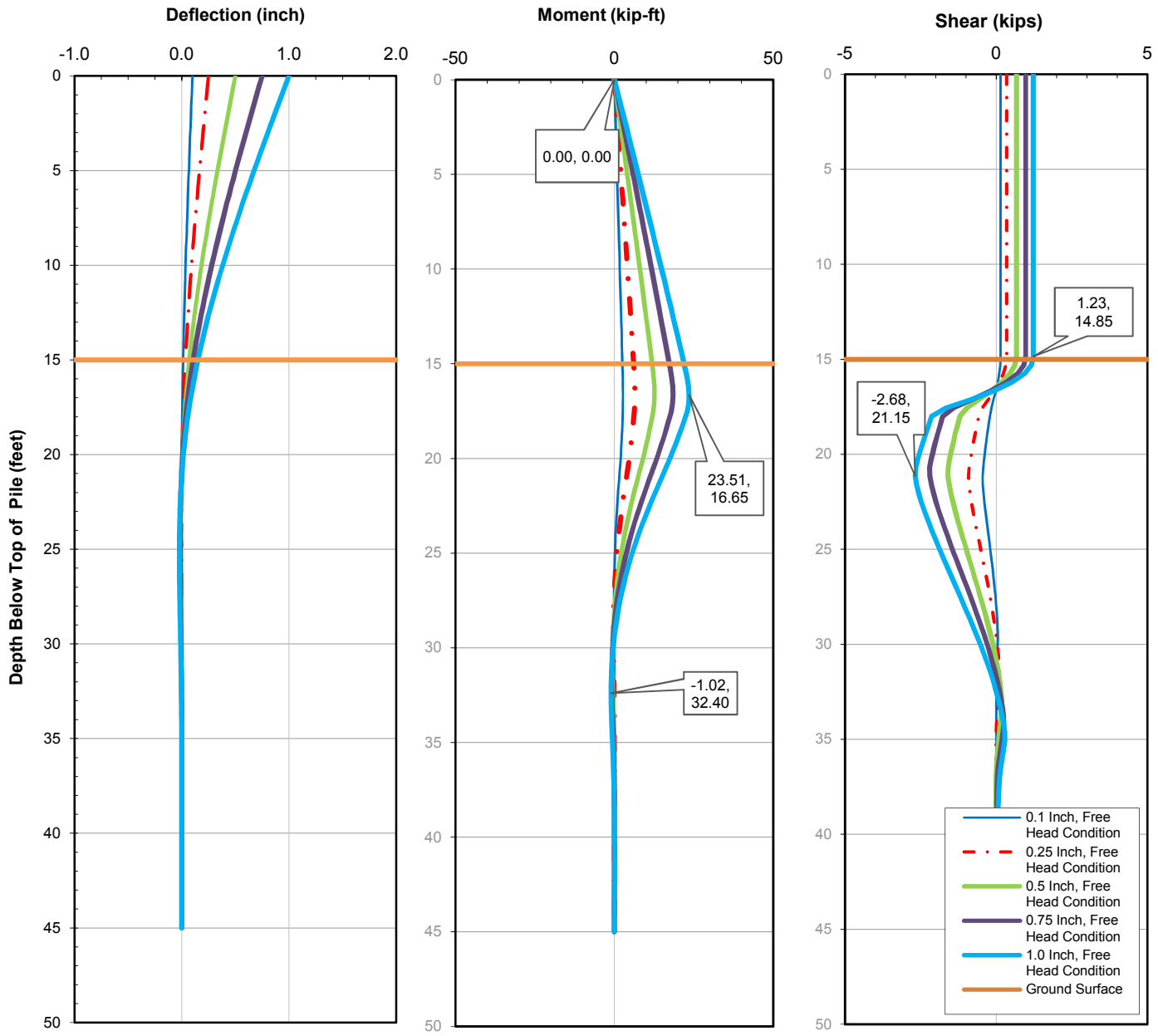
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 4, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-3**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (44-foot length)
2. 0.0 Depth represents the pile head, Elevation 253
3. Piles modeled as elastic piles

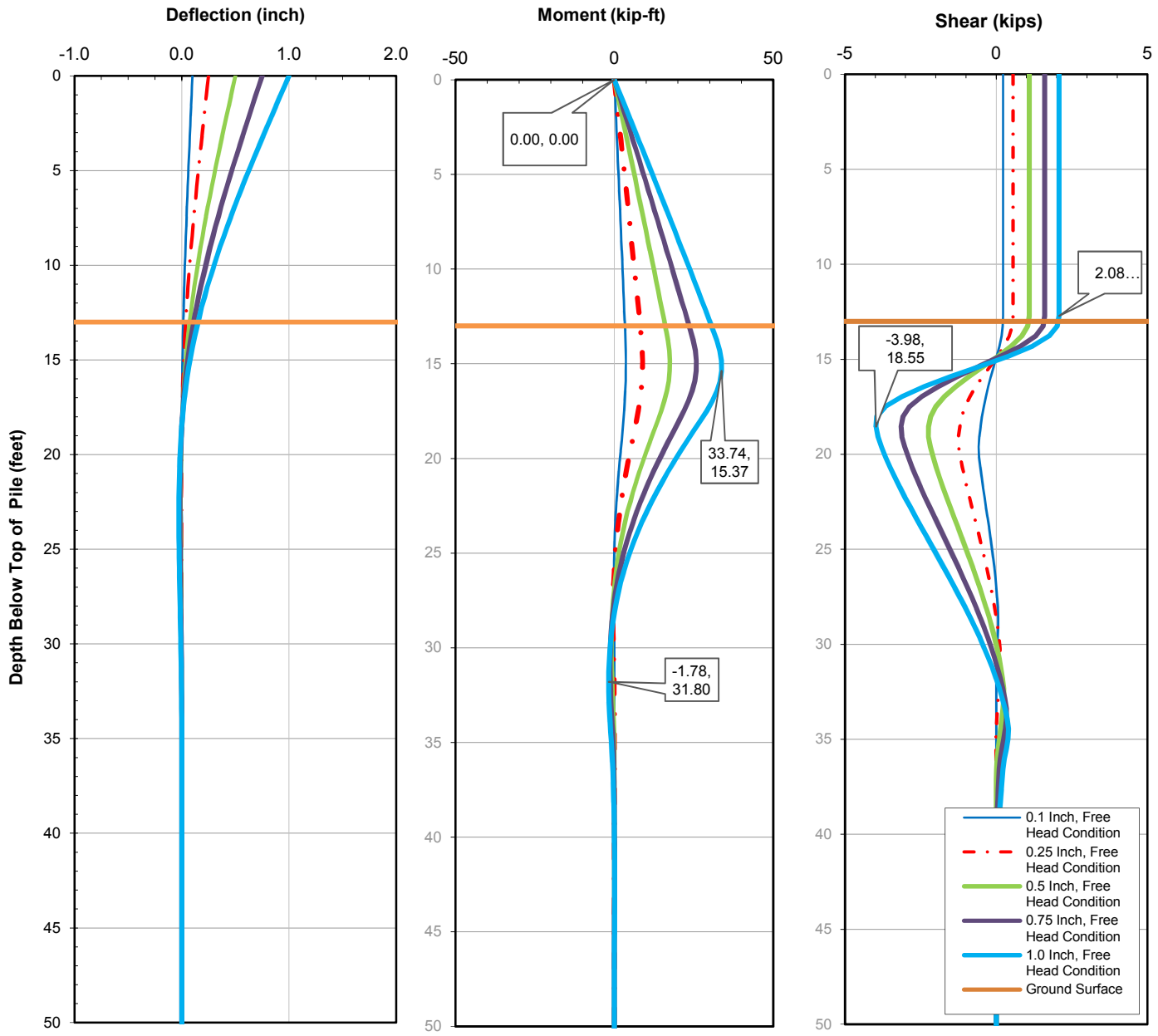
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 7, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-4**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (45-foot length)
2. 0.0 Depth represents the pile head, Elevation 254
3. Piles modeled as elastic piles

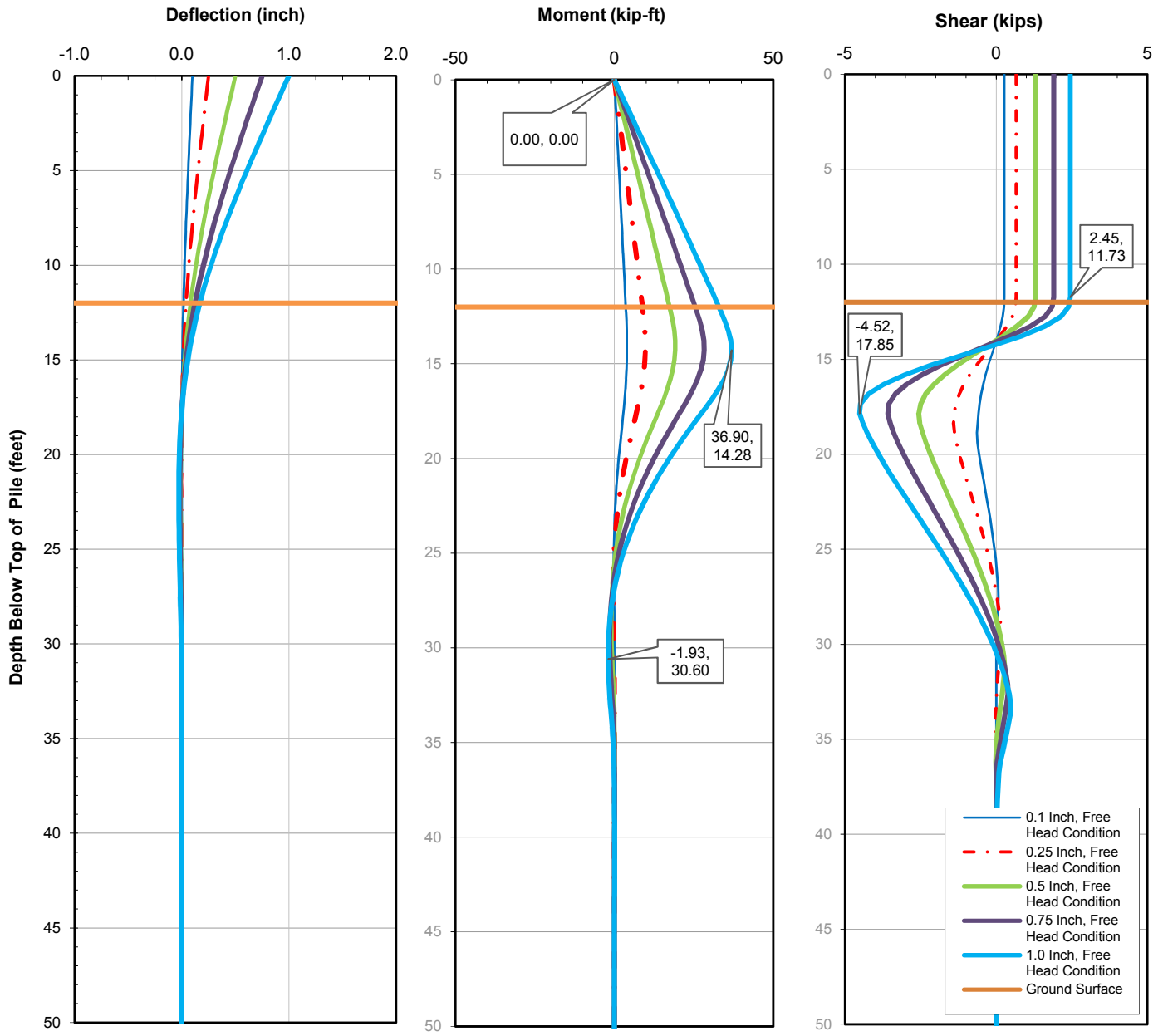
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 8, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-5**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (53-foot length)
2. 0.0 Depth represents the pile head, Elevation 256
3. Piles modeled as elastic piles

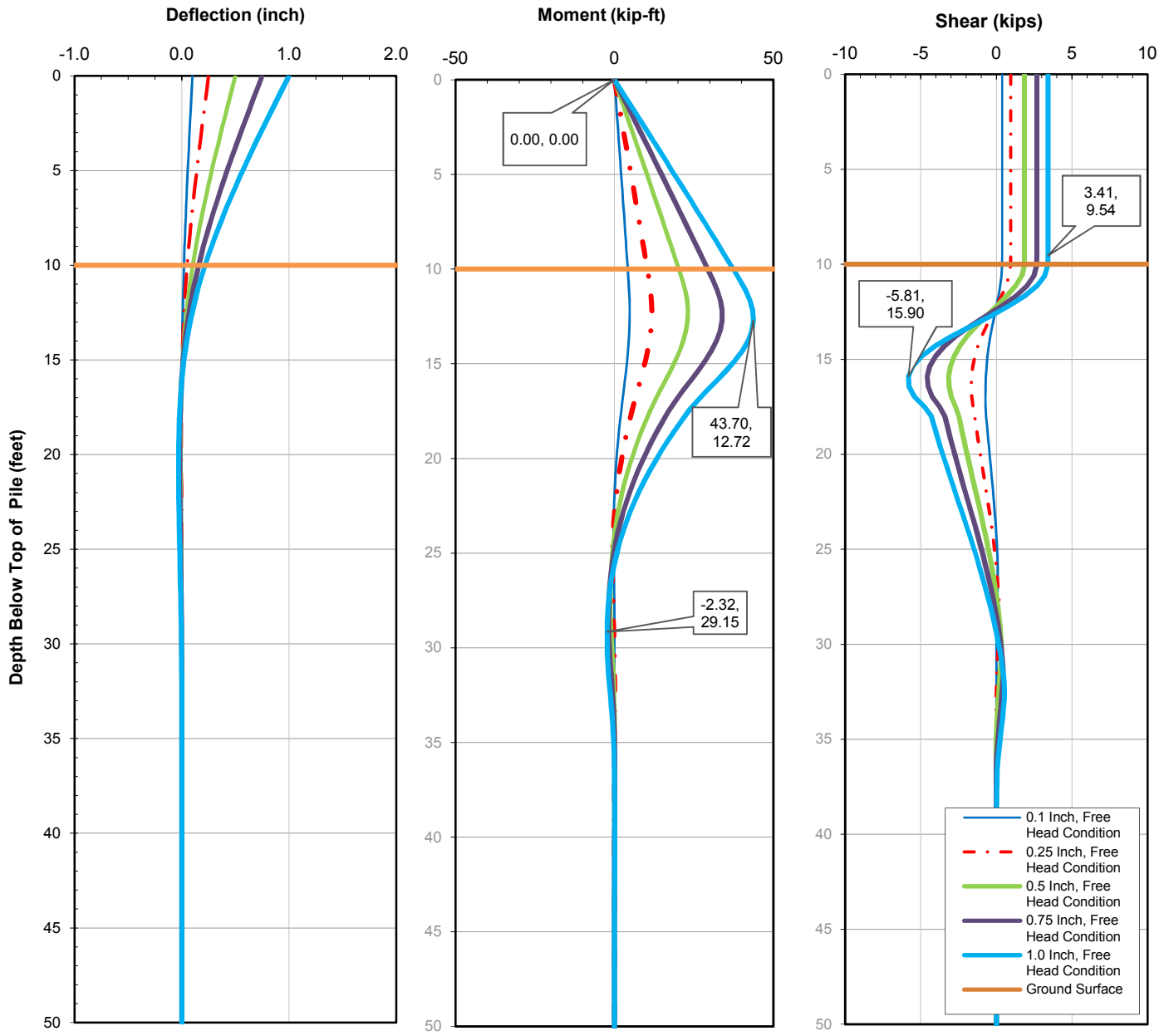
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 9, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-6**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (51-foot length)
2. 0.0 Depth represents the pile head, Elevation 257
3. Piles modeled as elastic piles

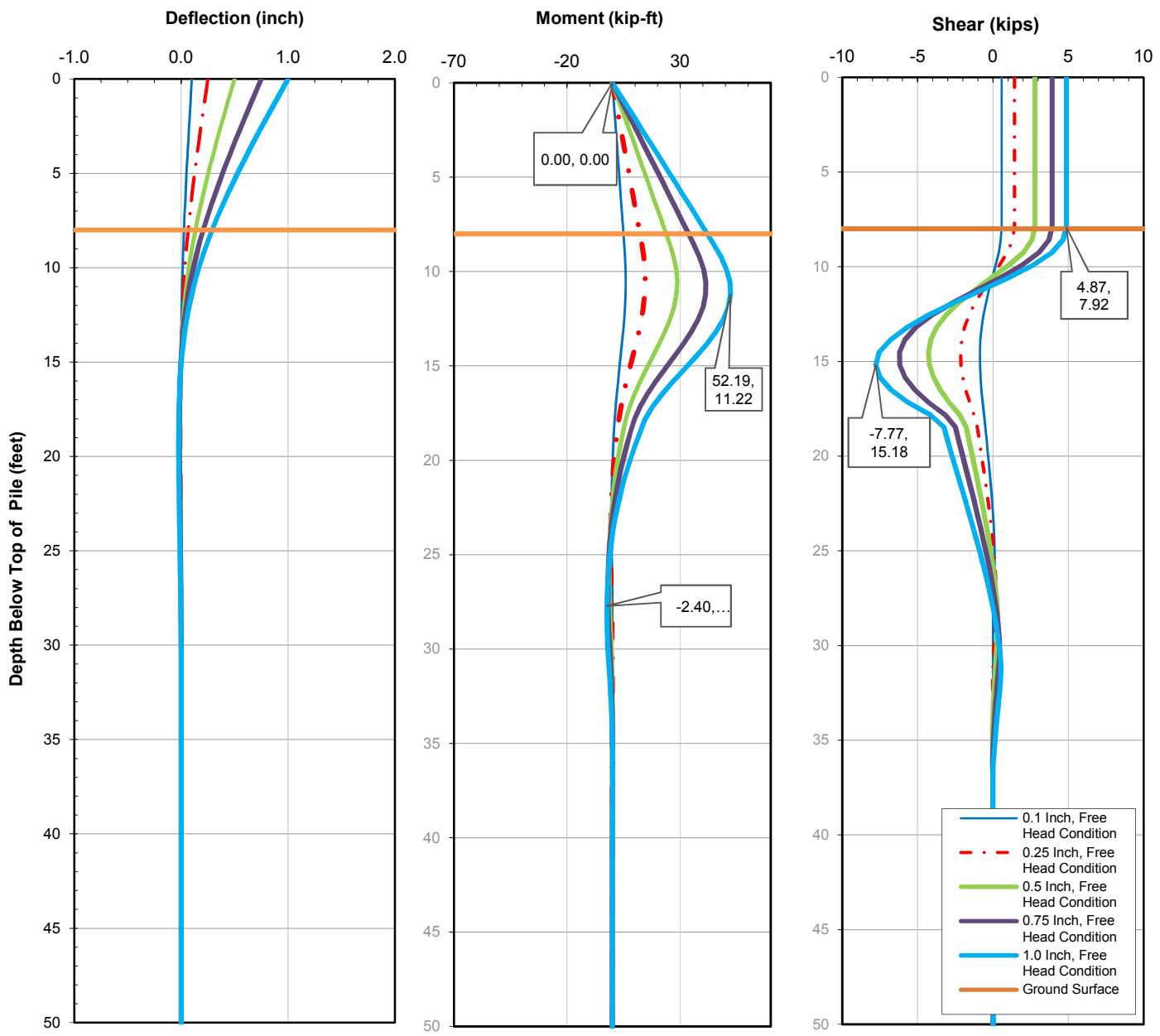
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 10-12, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-7**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (53-foot length)
2. 0.0 Depth represents the pile head, Elevation 259
3. Piles modeled as elastic piles

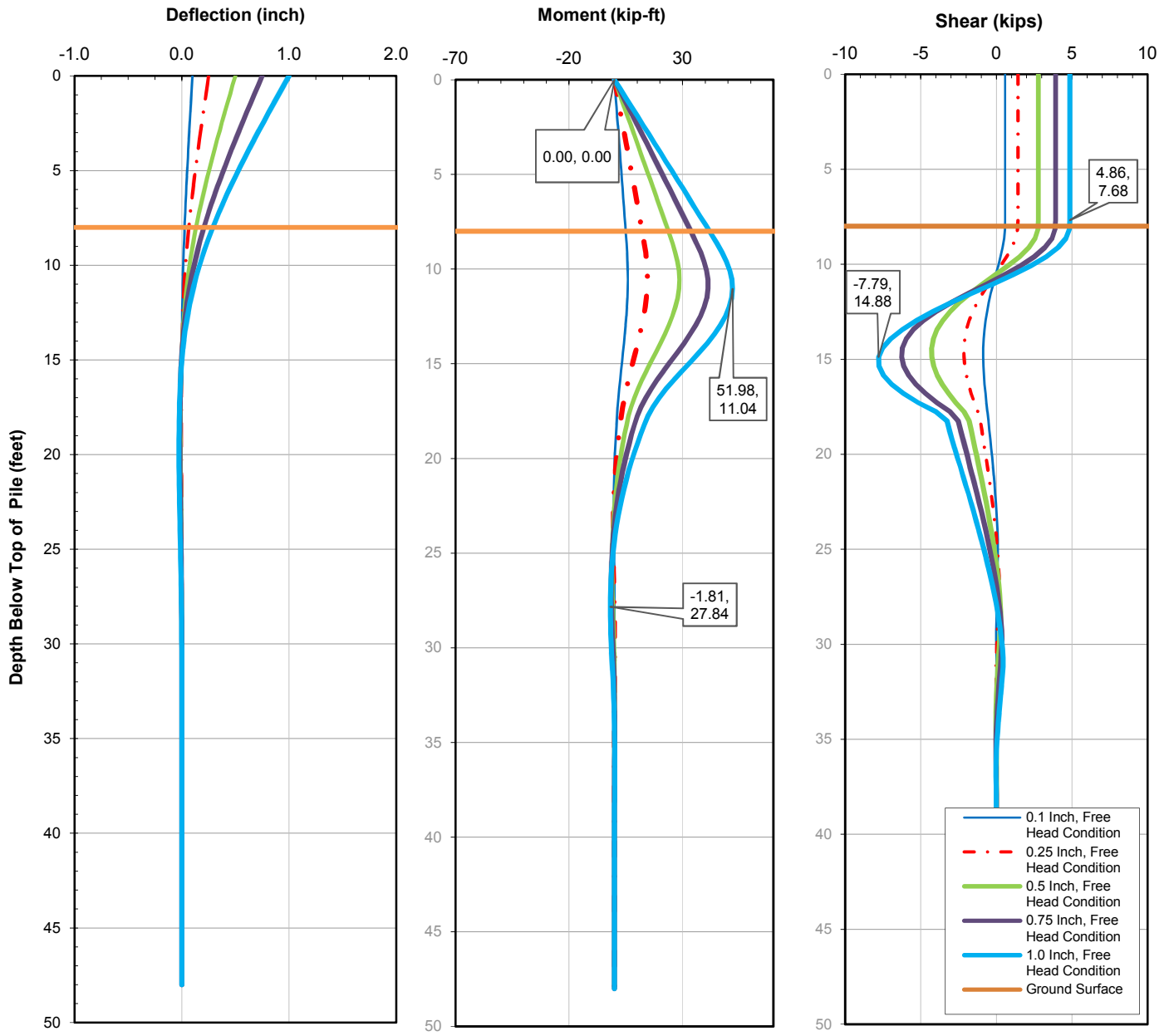
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 13-14, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-8**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (47-foot length)
2. 0.0 Depth represents the pile head, Elevation 260
3. Piles modeled as elastic piles

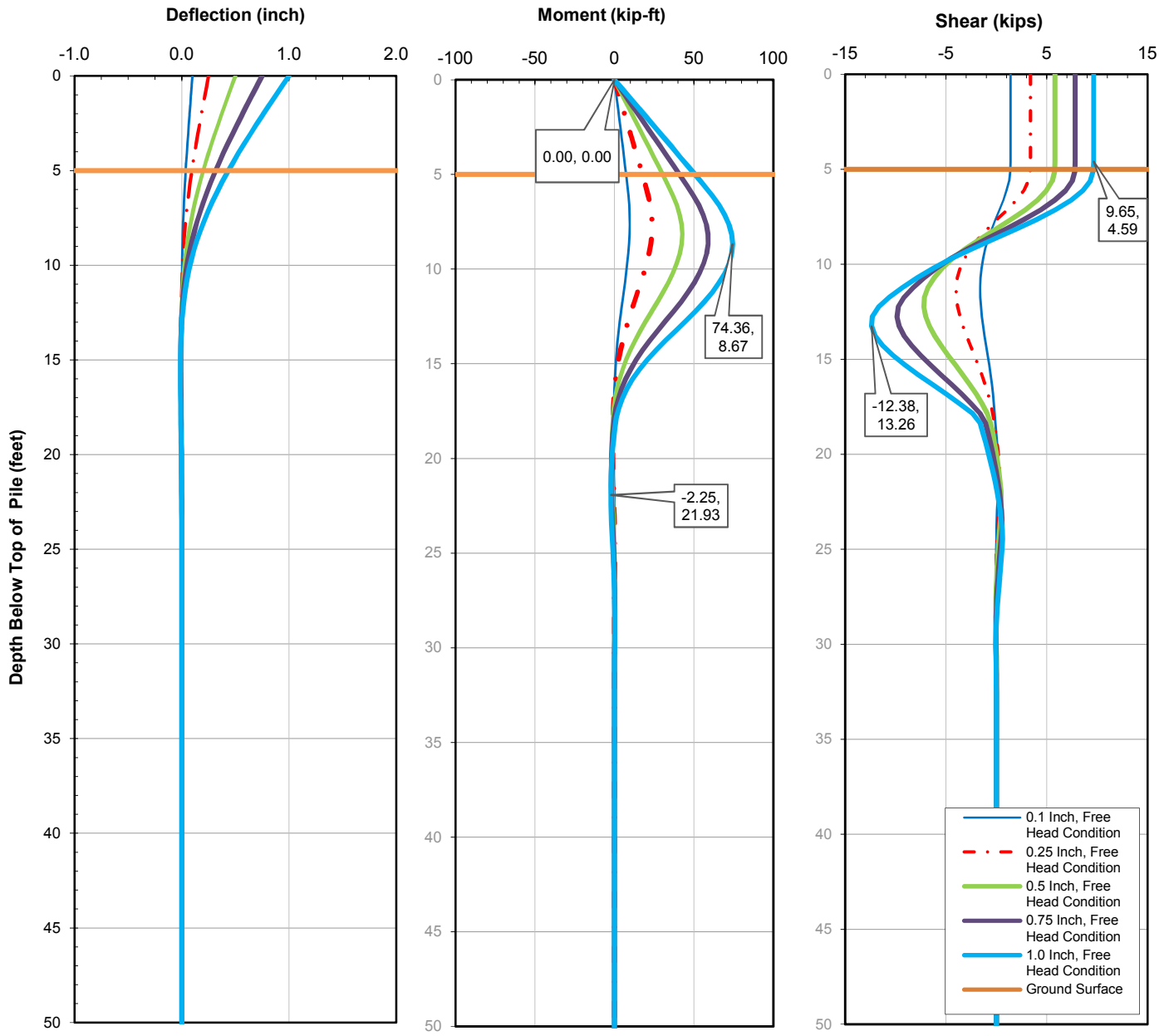
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 15, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-9**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (48-foot length)
2. 0.0 Depth represents the pile head, Elevation 261
3. Piles modeled as elastic piles

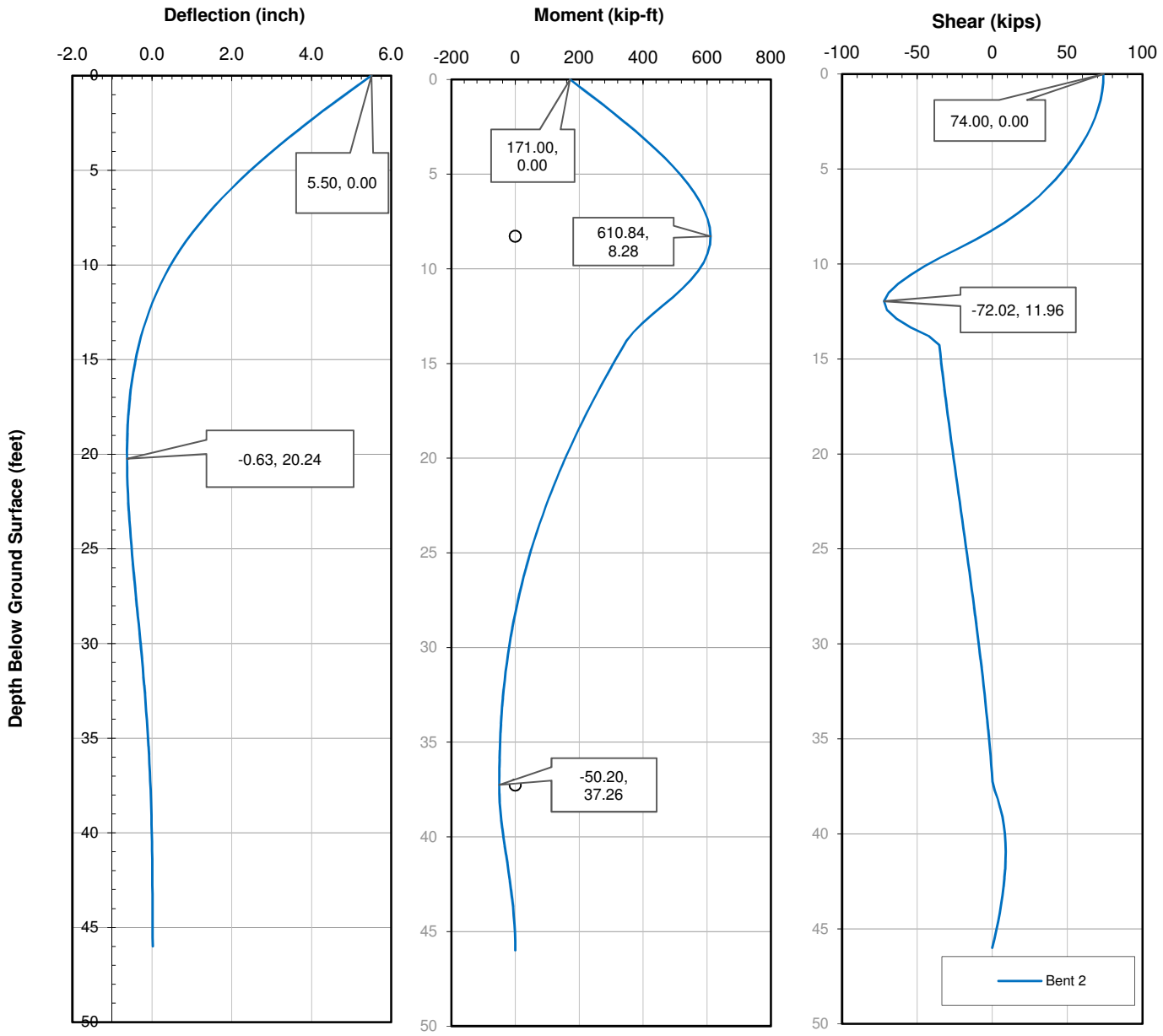
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 16, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-10**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 Inch Pile (51-foot length)
2. 0.0 Depth represents the pile head, Elevation 264
3. Piles modeled as elastic piles

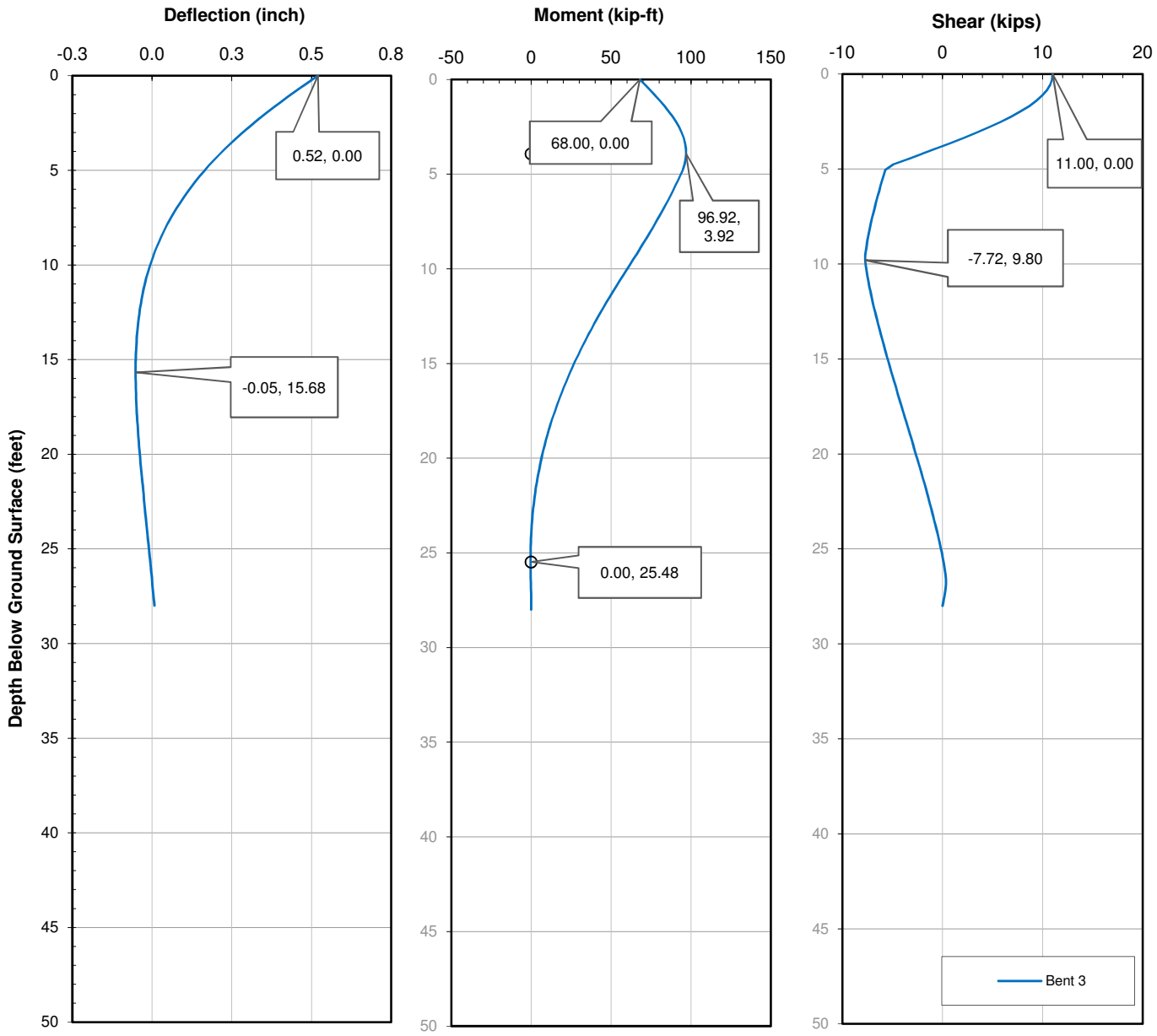
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 17, Original Tapered Monotube**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-11**
PROJECT NO. 20143390	9/15/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (50-foot length)
2. 0.0 Depth represents the ground surface, Elevation 265
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 171 k-ft, V = 74 kips at ground surface.

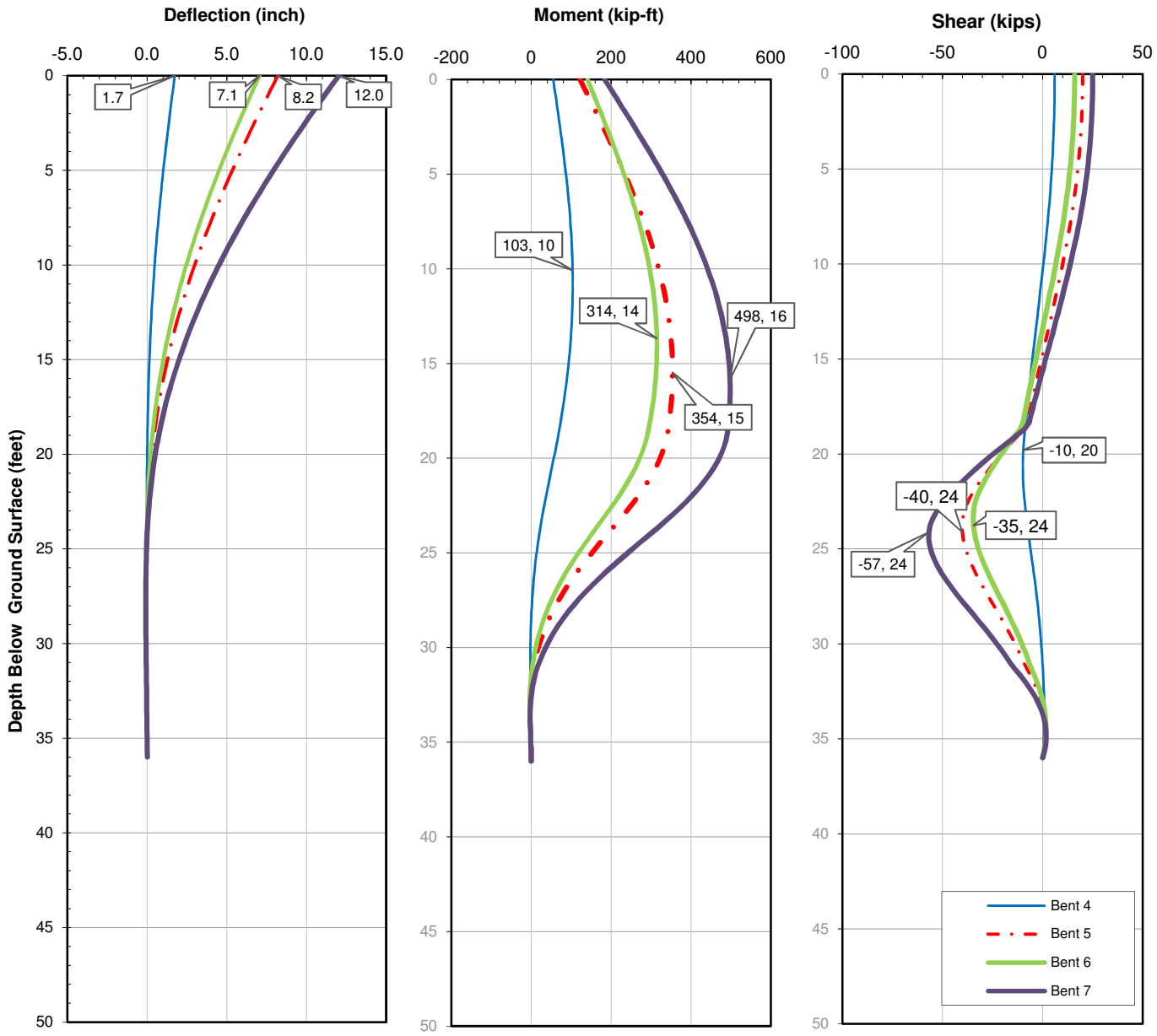
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 2, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-12**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (41-foot length)
2. 0.0 Depth represents the ground surface, Elevation 256
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 68 k-ft, V = 11 kips at ground surface.

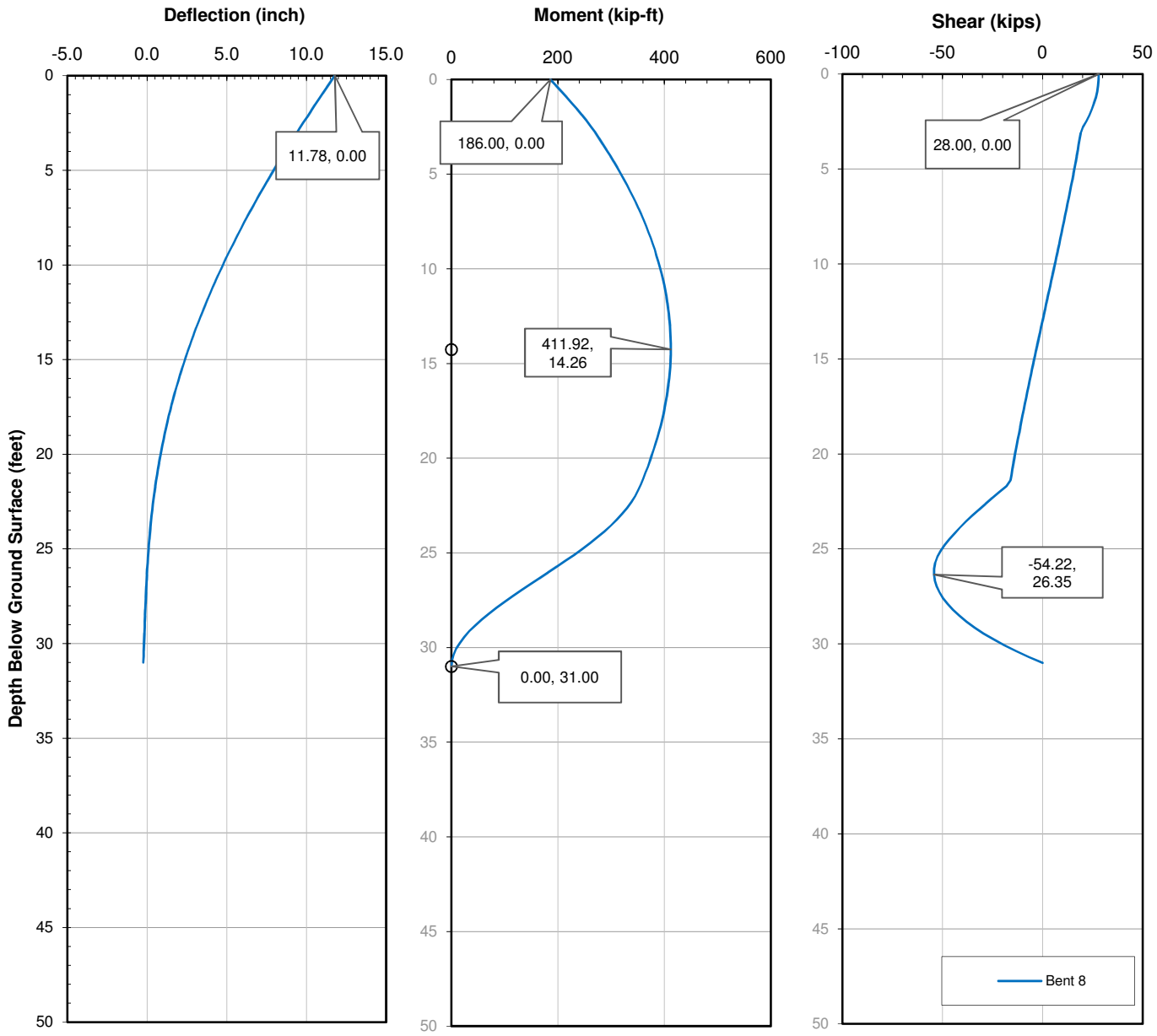
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 3, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-13**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (36-foot length)
2. 0.0 Depth represents the ground surface, Elevation 251
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. Bents 4, 5, 6, and 7, M=55, 122, 141, and 184 k-ft respectively and V=6, 20, 16, and 25 kips respectively.

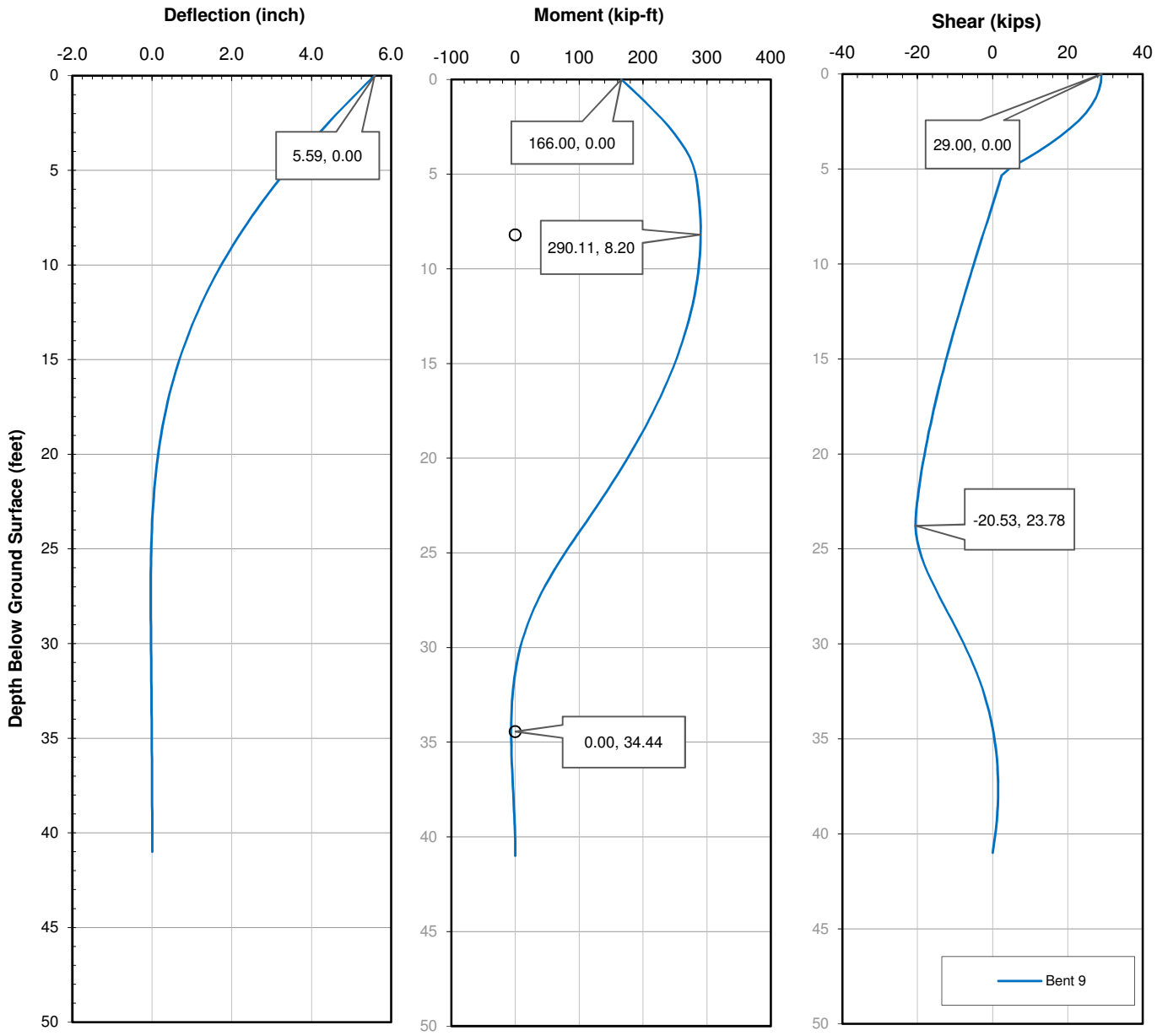
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 4-7, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-14**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (45-foot length)
2. 0.0 Depth represents the ground surface, Elevation 254
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 186 k-ft, V = 28 kips at ground surface.

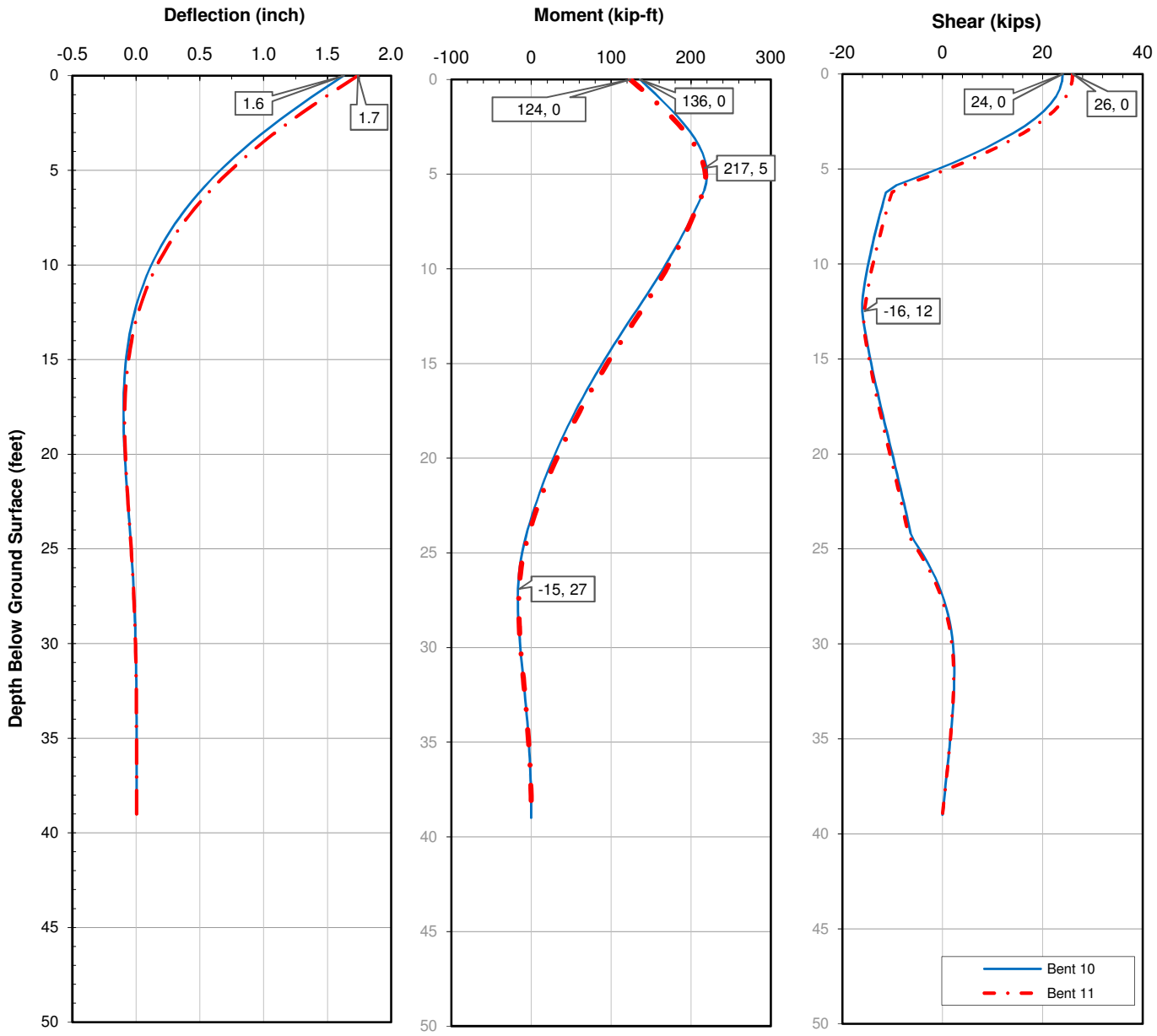
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 8, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-15**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (53-foot length)
2. 0.0 Depth represents the ground surface, Elevation 256
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 166 k-ft, V = 29 kips at ground surface.

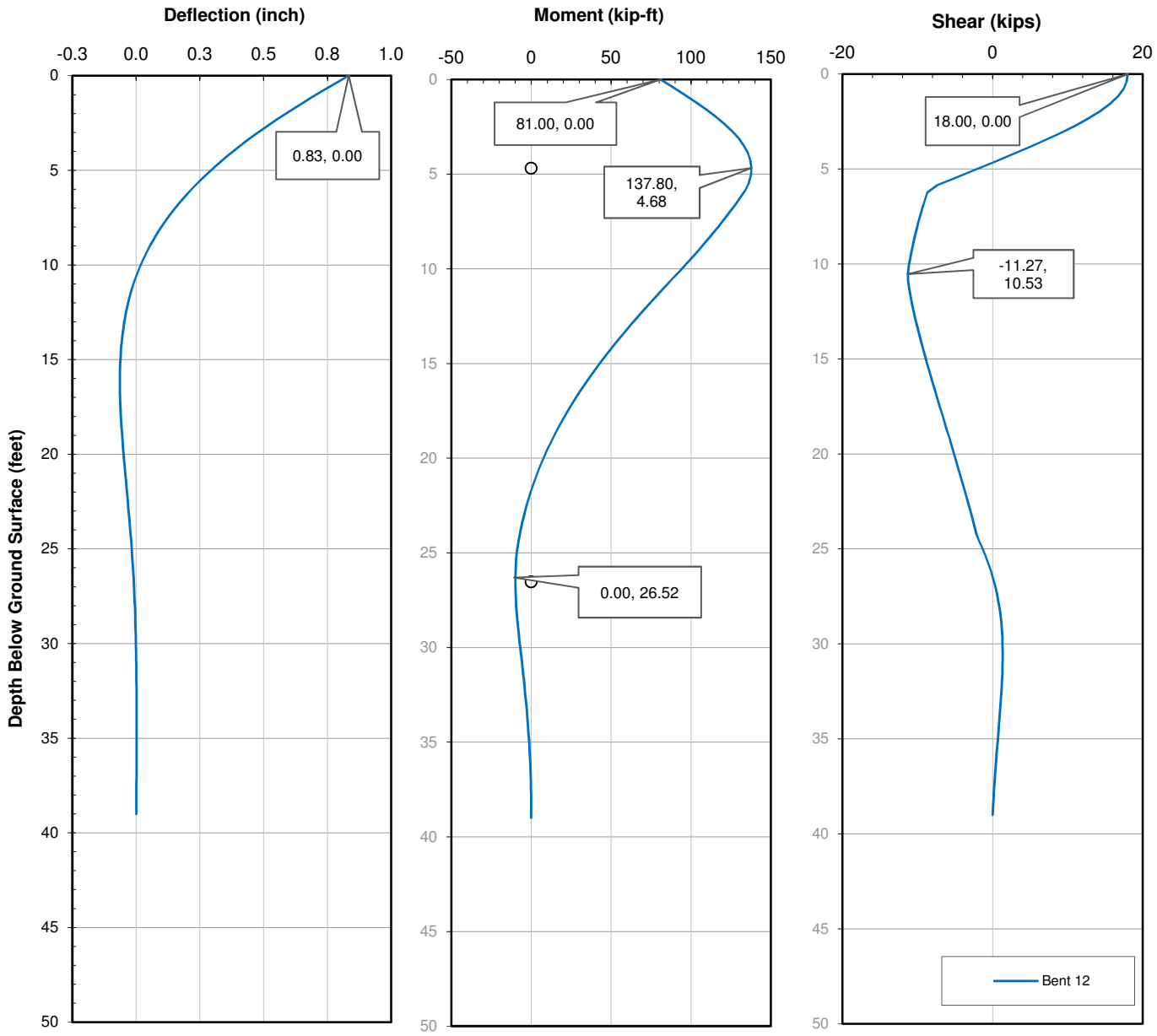
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 9, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-16**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (51-foot length)
2. 0.0 Depth represents the ground surface, Elevation 257
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. Bent 10: M = 136 k-ft, V = 24 kips. Bent 11: M =

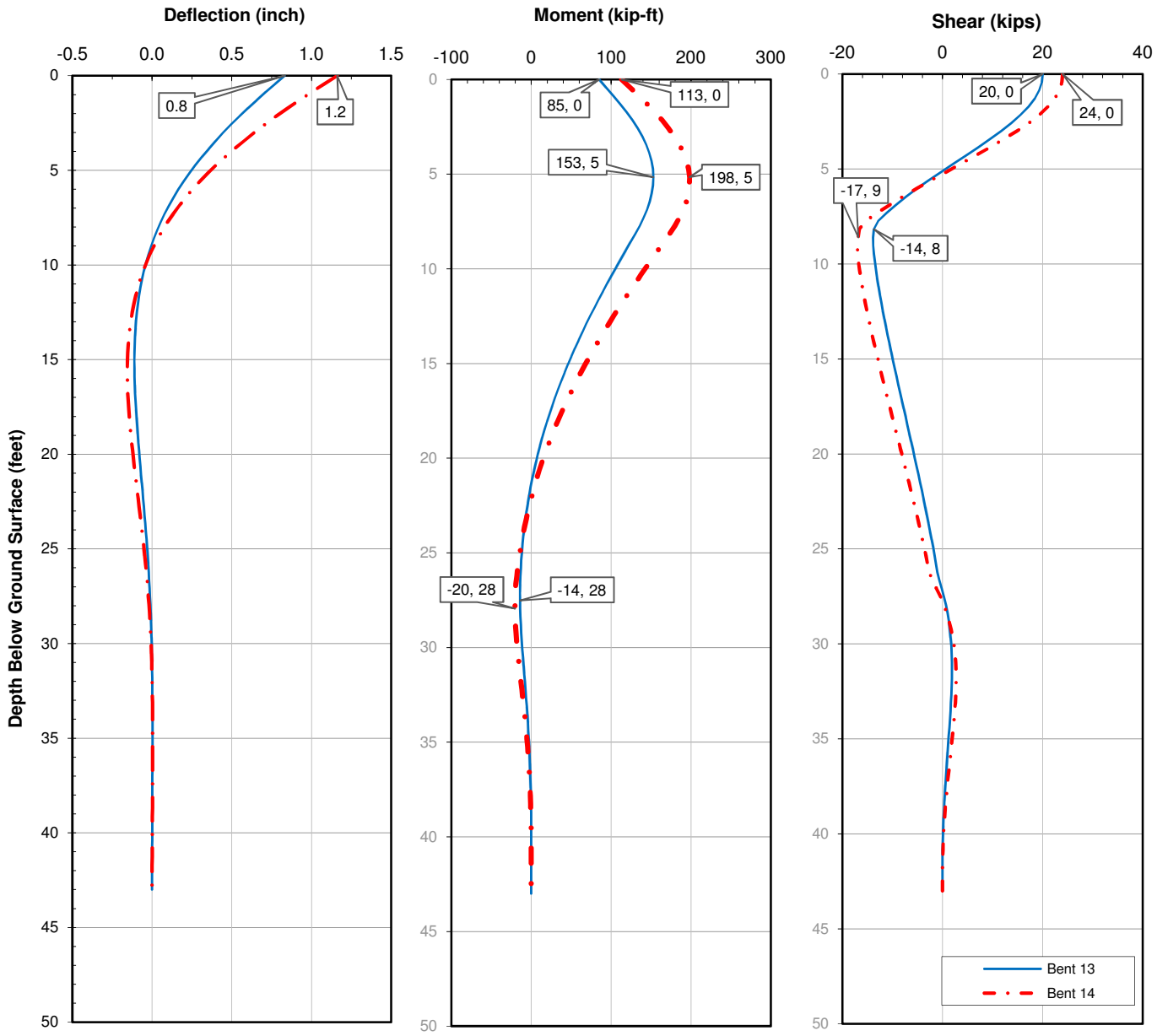
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 10 and 11, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-17**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (51-foot length)
2. 0.0 Depth represents the ground surface, Elevation 257
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 81 k-ft, V = 18 kips at ground surface.

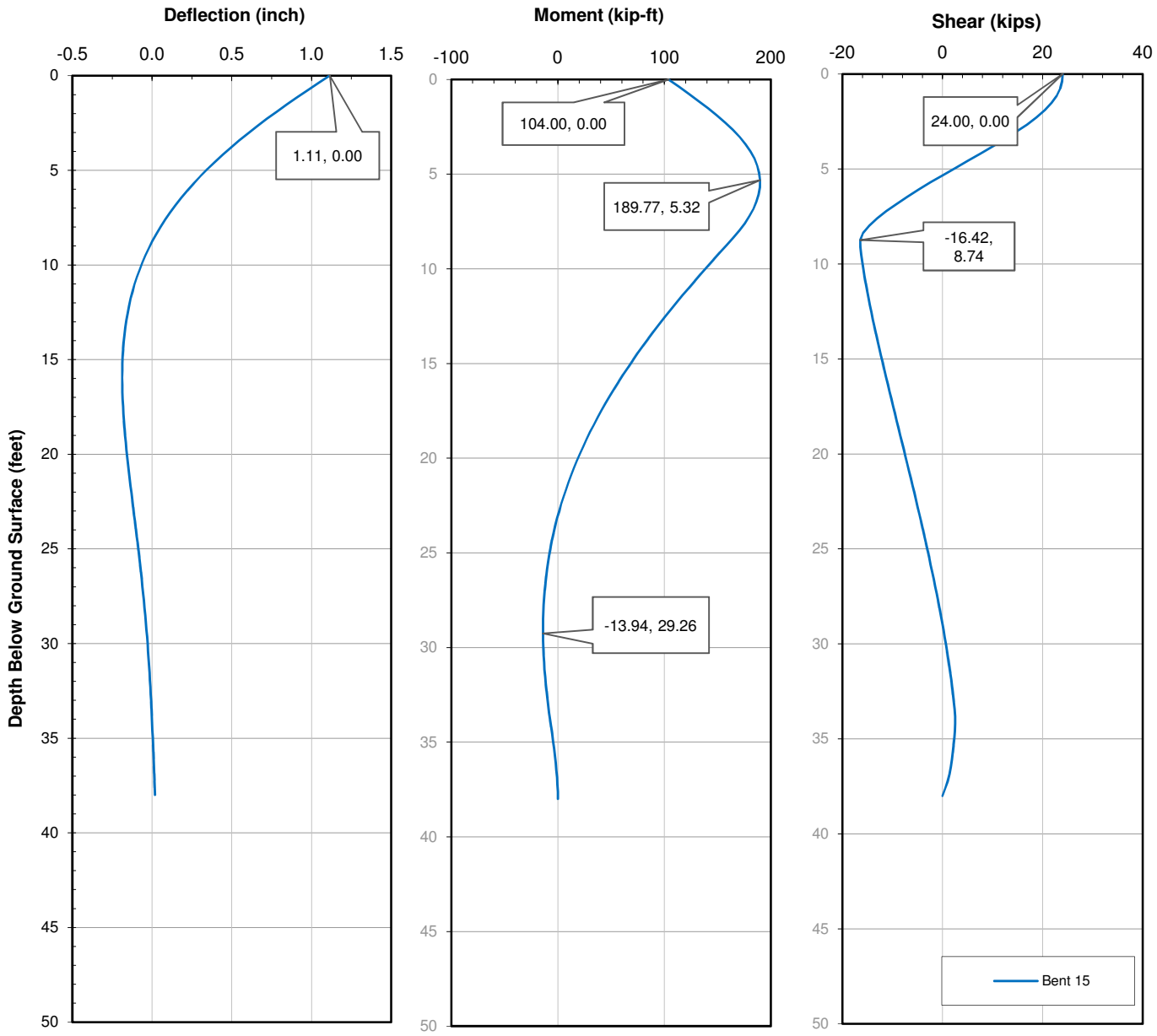
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 12, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-18**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (53-foot length)
2. 0.0 Depth represents the ground surface, Elevation 259
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. Bent 13: M = 85 k-ft, V = 20 kips. Bent 14: M = 113

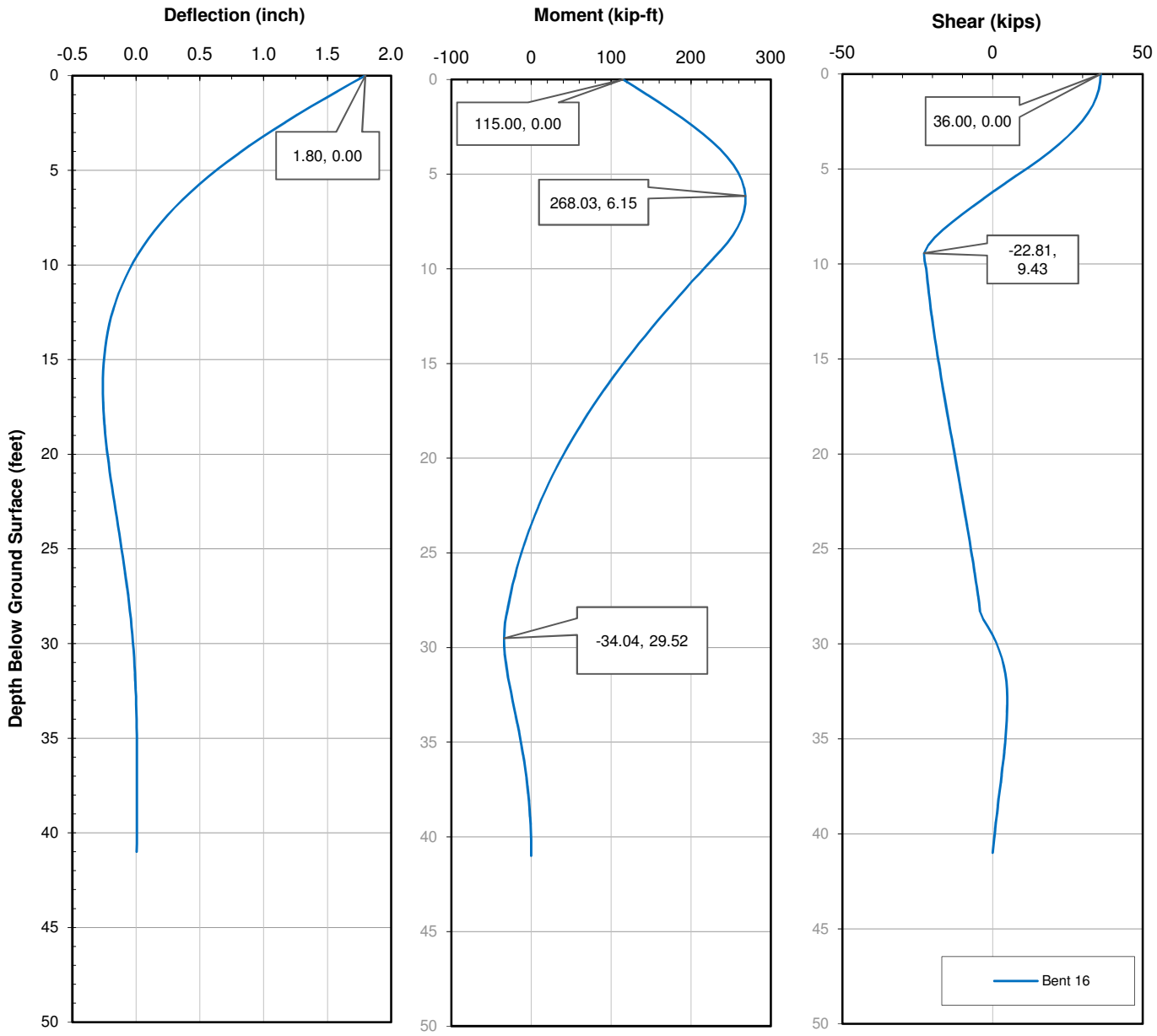
KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bent 13 and 14, Widen Class 70**	PLATE
BY: NAS / REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-19**
PROJECT NO. 20143390 / 9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (47-foot length)
2. 0.0 Depth represents the ground surface, Elevation 260
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 104 k-ft, V = 24 kips at ground surface.

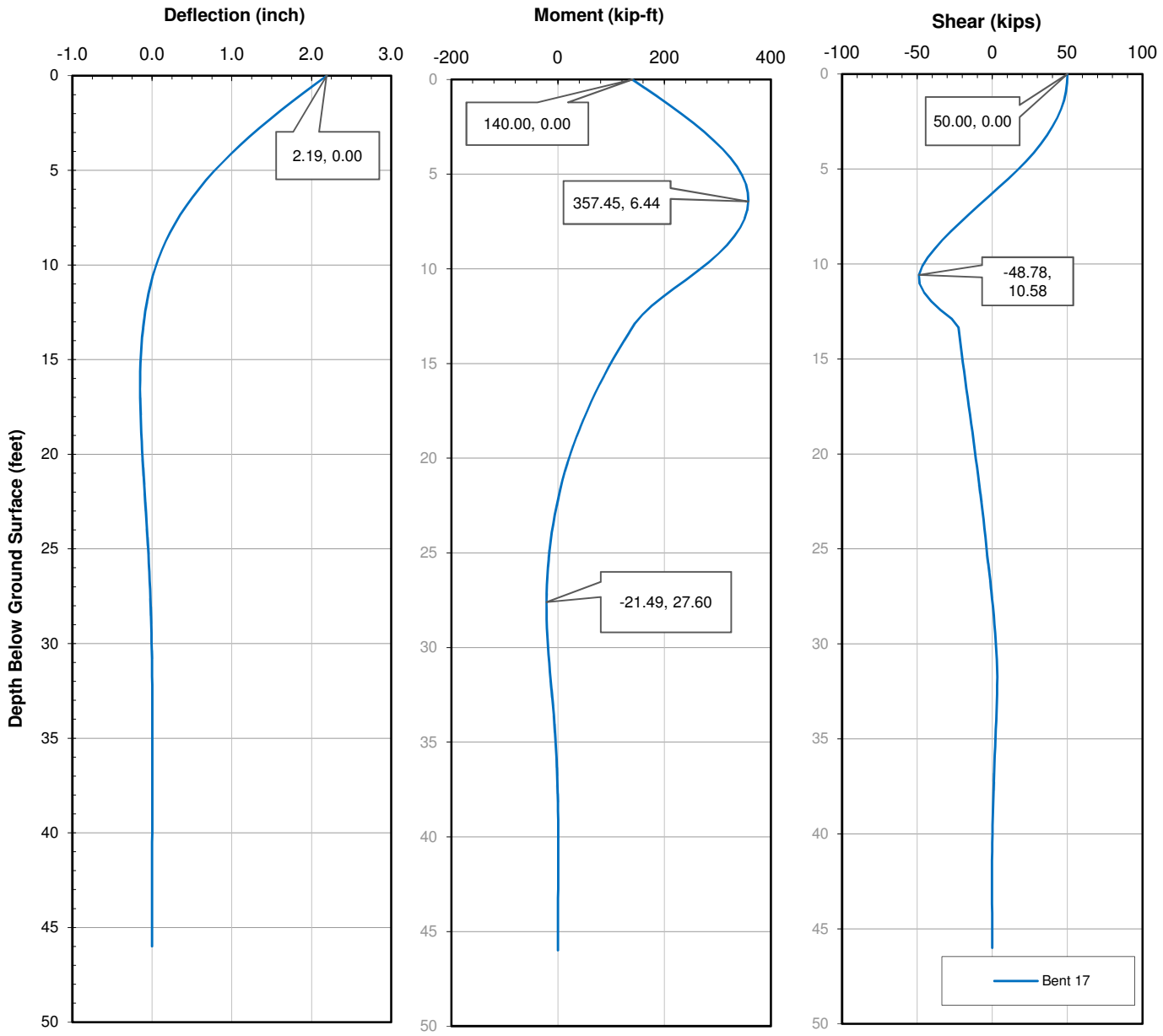
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 15, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-20**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (48-foot length)
2. 0.0 Depth represents the ground surface, Elevation 261
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 115 k-ft, V = 36 kips at ground surface.

KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 16, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-21**
PROJECT NO. 20143390	9/14/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, Alternative "Y" Piles (51-foot length)
2. 0.0 Depth represents the ground surface, Elevation 264
3. Piles modeled as elastic piles
4. Loading as provided by Caltrans Structures, dated 3/25/15. M = 140 k-ft, V = 50 kips at ground surface.

KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bent 17, Widen Class 70**	PLATE
BY: NAS	REV. BY: NMP	**SR 43 Over Kings River** Bridge No. 45-0064 Kings County, CA	**C-22**
PROJECT NO. 20143390	9/14/2015		

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	265	Pile Type:	Fluted Piles
Br. No. =	45-0064		FG	265	Pile Dia.:	15.5" for extension; taper to 8" at tip
			Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bent 2		GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 2.5 ft	
z (in)	t(kips)
-9.000	-2.548
-7.500	-2.548
-7.100	-2.548
-7.090	-2.293
-7.080	-2.038
-7.060	-1.529
-7.040	-1.019
-7.020	-0.510
-7.010	-0.255
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.364
7.020	0.728
7.040	1.456
7.060	2.184
7.080	2.912
7.090	3.275
7.100	3.640
7.500	3.640
9.000	3.640

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.000	-6.794
-7.500	-6.794
-7.100	-6.794
-7.090	-6.115
-7.080	-5.436
-7.060	-4.076
-7.040	-2.718
-7.020	-1.359
-7.010	-0.679
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.971
7.020	1.941
7.040	3.883
7.060	5.823
7.080	7.766
7.090	8.736
7.100	9.706
7.500	9.706
9.000	9.706

10' - 14'	
@Depth 12.5 ft	
z (in)	t(kips)
-11.100	-8.832
-8.025	-8.832
-7.615	-8.832
-7.410	-7.948
-7.205	-7.066
-7.164	-5.299
-7.117	-3.532
-7.064	-1.767
-7.033	-0.883
-7.000	-0.007
0.000	0.000
7.000	0.010
7.033	1.262
7.064	2.524
7.117	5.046
7.164	7.571
7.205	10.095
7.410	11.355
7.615	12.617
8.025	12.617
11.100	12.617

14' - 21'	
@Depth 17.5 ft	
z (in)	t(kips)
-9.057	-4.919
-6.732	-4.919
-6.422	-4.919
-6.267	-4.919
-6.112	-5.466
-6.081	-4.919
-6.046	-4.100
-6.005	-2.733
-5.982	-1.640
-5.957	-0.007
0.000	0.000
5.957	0.010
5.982	2.343
6.005	3.904
6.046	5.857
6.081	7.027
6.112	7.808
6.267	7.027
6.422	7.027
6.732	7.027
9.057	7.027

21' - 28'	
@Depth 24.5 ft	
z (in)	t(kips)
-7.972	-3.484
-4.897	-3.484
-4.487	-3.484
-4.282	-3.484
-4.077	-3.872
-4.036	-3.484
-3.989	-2.902
-3.936	-1.935
-3.905	-1.161
-3.872	-0.007
0.000	0.000
3.872	0.010
3.905	1.659
3.936	2.765
3.989	4.146
4.036	4.977
4.077	5.531
4.282	4.977
4.487	4.977
4.897	4.977
7.972	4.977

28' - 37.5'	
@Depth 31.5 ft	
z (in)	t(kips)
-5.887	-3.994
-2.812	-3.994
-2.402	-3.994
-2.197	-3.994
-1.992	-4.437
-1.951	-3.994
-1.904	-3.326
-1.851	-2.219
-1.820	-1.331
-1.787	-0.007
0.000	0.000
1.787	0.010
1.820	1.902
1.851	3.170
1.904	4.752
1.951	5.706
1.992	6.339
2.197	5.706
2.402	5.706
2.812	5.706
5.887	5.706

37.5' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-4.251
-0.500	-12.221
-0.100	-14.346
-0.090	-12.962
-0.080	-11.561
-0.060	-8.734
-0.040	-5.865
-0.020	-2.954
-0.010	-1.482
0.000	0.000
0.010	2.125
0.020	4.251
0.040	8.499
0.060	12.750
0.080	17.001
0.090	19.132
0.100	21.253
0.500	21.253
2.000	21.253

42' - 47'	
@Depth 44.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-4.383
-0.500	-12.600
-0.100	-14.791
-0.090	-13.361
-0.080	-11.918
-0.060	-9.004
-0.040	-6.047
-0.020	-3.045
-0.010	-1.528
0.000	0.000
0.010	2.191
0.020	4.381
0.040	8.763
0.060	13.144
0.080	17.527
0.090	19.721
0.100	21.913
0.500	21.913
2.000	21.913

47' - 50'	
@Depth 47.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-2.158
-0.500	-6.203
-0.100	-7.282
-0.090	-6.576
-0.080	-5.867
-0.060	-4.432
-0.040	-2.976
-0.020	-1.499
-0.010	-0.753
0.000	0.000
0.010	1.079
0.020	2.157
0.040	4.314
0.060	6.470
0.080	8.628
0.090	9.706
0.100	10.789
0.500	10.789
2.000	10.789

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	256	Pile Type:	Fluted Piles
Br. No. =	45-0064			FG	256	Pile Dia.:	15.5" for extension; taper to 8" at tip
				Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bent 3			GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 3.5 ft	
z (in)	t(kips)
-9.000	-3.397
-7.500	-3.397
-7.100	-3.397
-7.090	-3.058
-7.080	-2.718
-7.060	-2.038
-7.040	-1.359
-7.020	-0.679
-7.010	-0.340
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.485
7.020	0.971
7.040	1.941
7.060	2.912
7.080	3.883
7.090	4.368
7.100	4.853
7.500	4.853
9.000	4.853

5' - 12'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.057	-3.032
-6.732	-3.032
-6.422	-3.032
-6.267	-3.032
-6.112	-3.367
-6.081	-3.032
-6.046	-2.526
-6.005	-1.684
-5.982	-1.010
-5.957	-0.007
0.000	0.000
5.957	0.010
5.982	1.443
6.005	2.406
6.046	3.608
6.081	4.332
6.112	4.810
6.267	4.332
6.422	4.332
6.732	4.332
9.057	4.332

12' - 19'	
@Depth 15.5 ft	
z (in)	t(kips)
-7.522	-2.671
-4.785	-2.671
-4.420	-2.671
-4.237	-2.671
-4.055	-2.969
-4.018	-2.671
-3.976	-2.227
-3.929	-1.485
-3.902	-0.891
-3.872	-0.007
0.000	0.000
3.872	0.010
3.902	1.273
3.929	2.121
3.976	3.182
4.018	3.816
4.055	4.241
4.237	3.816
4.420	3.816
4.785	3.816
7.522	3.816

19' - 28.5'	
@Depth 22.5 ft	
z (in)	t(kips)
-5.437	-3.311
-2.700	-3.311
-2.335	-3.311
-2.152	-3.311
-1.970	-3.678
-1.933	-3.311
-1.891	-2.758
-1.844	-1.839
-1.816	-1.103
-1.787	-0.007
0.000	0.000
1.787	0.010
1.816	1.576
1.844	2.627
1.891	3.941
1.933	4.730
1.970	5.254
2.152	4.730
2.335	4.730
2.700	4.730
5.437	4.730

28.5' - 33'	
@Depth 29.5 ft	
z (in)	t(kips)
-2.000	-2.711
-0.500	-7.794
-0.100	-9.149
-0.090	-8.266
-0.080	-7.374
-0.060	-5.571
-0.040	-3.741
-0.020	-1.884
-0.010	-0.945
0.000	0.000
0.010	1.355
0.020	2.710
0.040	5.422
0.060	8.132
0.080	10.844
0.090	12.200
0.100	13.554
0.500	13.554
2.000	13.554

33' - 38'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-2.917
-0.500	-8.386
-0.100	-9.844
-0.090	-8.892
-0.080	-7.933
-0.060	-5.994
-0.040	-4.025
-0.020	-2.028
-0.010	-1.017
0.000	0.000
0.010	1.458
0.020	2.918
0.040	5.833
0.060	8.751
0.080	11.667
0.090	13.125
0.100	14.584
0.500	14.584
2.000	14.584

38' - 41'	
@Depth 38.5 ft	
z (in)	t(kips)
-2.000	-1.470
-0.500	-4.227
-0.100	-4.962
-0.090	-4.483
-0.080	-3.999
-0.060	-3.022
-0.040	-2.029
-0.020	-1.022
-0.010	-0.513
0.000	0.000
0.010	0.735
0.020	1.470
0.040	2.940
0.060	4.411
0.080	5.881
0.090	6.617
0.100	7.351
0.500	7.351
2.000	7.351

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	251	Pile Type:	Fluted Piles
Br. No. =	45-0064	FG	251	Pile Dia.:	15.5" for extension; taper to 8" at tip
		Pile Cut-Off=	251	Extension Pile Perimeter:	48.7
Support(s):	Bents 4 to 6	GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 2.5 ft	
z (in)	t(kips)
-3.100	-2.622
-0.775	-2.622
-0.465	-2.622
-0.310	-2.622
-0.155	-2.912
-0.124	-2.622
-0.088	-2.184
-0.048	-1.456
-4.162	-0.874
-6.054	-0.010
0.000	0.000
6.054	0.010
4.162	1.248
0.048	2.081
0.088	3.120
0.124	3.746
0.155	4.160
0.310	3.746
0.465	3.746
0.775	3.746
3.100	3.746

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-7.562	-2.712
-5.012	-2.712
-4.672	-2.712
-4.502	-2.712
-4.332	-3.014
-4.298	-2.712
-4.259	-2.261
-4.215	-1.507
-4.189	-0.904
-4.162	-0.010
0.000	0.000
4.162	0.010
4.189	1.292
4.215	2.153
4.259	3.230
4.298	3.875
4.332	4.306
4.502	3.875
4.672	3.875
5.012	3.875
7.562	3.875

10' - 15'	
@Depth 12.5 ft	
z (in)	t(kips)
-5.670	-2.269
-3.120	-2.269
-2.780	-2.269
-2.610	-2.269
-2.440	-2.522
-2.406	-2.269
-2.367	-1.891
-2.323	-1.261
-2.297	-0.756
-2.270	-0.010
0.000	0.000
2.270	0.010
2.297	1.080
2.323	1.801
2.367	2.702
2.406	3.241
2.440	3.602
2.610	3.241
2.780	3.241
3.120	3.241
5.670	3.241

15' - 18.5'	
@Depth 17.5 ft	
z (in)	t(kips)
-3.778	-1.506
-1.228	-1.506
-0.888	-1.506
-0.718	-1.506
-0.548	-1.674
-0.514	-1.506
-0.475	-1.255
-0.431	-0.837
-0.406	-0.502
-0.378	-0.010
0.000	0.000
0.378	0.010
0.406	0.717
0.431	1.196
0.475	1.792
0.514	2.151
0.548	2.391
0.718	2.151
0.888	2.151
1.228	2.151
3.778	2.151

18.5' - 25'	
@Depth 22.5 ft	
z (in)	t(kips)
-2.000	-15.018
-0.500	-15.018
-0.100	-15.018
-0.090	-13.516
-0.080	-12.014
-0.060	-9.011
-0.040	-6.007
-0.020	-3.004
-0.010	-1.502
0.000	0.000
0.000	0.000
0.000	0.000
0.010	2.145
0.020	4.291
0.040	8.581
0.060	12.872
0.080	17.163
0.090	19.308
0.100	21.454
0.500	21.454
2.000	21.454

25' - 31'	
@Depth 27.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-3.448
-0.500	-9.912
-0.100	-11.636
-0.090	-10.511
-0.080	-9.377
-0.060	-7.086
-0.040	-4.758
-0.020	-2.396
-0.010	-1.202
0.000	0.000
0.010	1.724
0.020	3.448
0.040	6.896
0.060	10.344
0.080	13.790
0.090	15.514
0.100	17.238
0.500	17.238
2.000	17.238

31' - 36'	
@Depth 32.5 ft	
z (in)	t(kips)
-2.000	-3.379
-0.500	-9.713
-0.100	-11.403
-0.090	-10.299
-0.080	-9.189
-0.060	-6.942
-0.040	-4.661
-0.020	-2.348
-0.010	-1.178
0.000	0.000
0.010	1.689
0.020	3.379
0.040	6.756
0.060	10.134
0.080	13.513
0.090	15.202
0.100	16.893
0.500	16.893
2.000	16.893

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	253	Pile Type:	Fluted Piles
Br. No. =	45-0064			FG	253	Pile Dia.:	15.5" for extension; taper to 8" at tip
				Pile Cut-Off=	253	Extension Pile Perimeter:	48.7
Support(s):	Bent 7			GW Elev. =	251		

Note: All depths are in feet.

0' - 7'	
@Depth 4.5 ft	
z (in)	t(kips)
-9.154	-2.355
-6.829	-2.355
-6.519	-2.355
-6.364	-2.355
-6.209	-2.617
-6.178	-2.355
-6.142	-1.963
-6.102	-1.309
-6.079	-0.785
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	1.122
6.102	1.869
6.142	2.804
6.178	3.365
6.209	3.739
6.364	3.365
6.519	3.365
6.829	3.365
9.154	3.365

7' - 12'	
@Depth 9.5 ft	
z (in)	t(kips)
-7.262	-2.235
-4.937	-2.235
-4.627	-2.235
-4.472	-2.235
-4.317	-2.483
-4.286	-2.235
-4.251	-1.863
-4.210	-1.242
-4.187	-0.745
-4.162	-0.007
0.000	0.000
4.162	0.010
4.187	1.064
4.210	1.774
4.251	2.661
4.286	3.193
4.317	3.547
4.472	3.193
4.627	3.193
4.937	3.193
7.262	3.193

12' - 17'	
@Depth 14.5 ft	
z (in)	t(kips)
-6.120	-2.173
-3.233	-2.173
-2.848	-2.173
-2.655	-2.173
-2.463	-2.414
-2.424	-2.173
-2.380	-1.810
-2.330	-1.207
-2.301	-0.724
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	1.034
2.330	1.724
2.380	2.586
2.424	3.104
2.463	3.449
2.655	3.104
2.848	3.104
3.233	3.104
6.120	3.104

17' - 20.5'	
@Depth 19.5 ft	
z (in)	t(kips)
-4.228	-1.536
-1.341	-1.536
-0.956	-1.536
-0.763	-1.536
-0.571	-1.706
-0.532	-1.536
-0.488	-1.280
-0.438	-0.853
-0.409	-0.512
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	0.731
0.438	1.219
0.488	1.828
0.532	2.194
0.571	2.438
0.763	2.194
0.956	2.194
1.341	2.194
4.228	2.194

20.5' - 27'	
@Depth 24.5 ft	
z (in)	t(kips)
-2.000	-7.383
-0.500	-21.225
-0.100	-24.916
-0.090	-22.508
-0.080	-20.078
-0.060	-15.169
-0.040	-10.186
-0.020	-5.131
-0.010	-2.575
0.000	0.000
0.010	3.691
0.020	7.383
0.040	14.762
0.060	22.145
0.080	29.527
0.090	33.222
0.100	36.913
0.500	36.913
2.000	36.913

27' - 33'	
@Depth 29.5 ft	
z (in)	t(kips)
-2.000	-6.022
-0.500	-17.312
-0.100	-20.323
-0.090	-18.349
-0.080	-16.379
-0.060	-12.374
-0.040	-8.310
-0.020	-4.185
-0.010	-2.100
0.000	0.000
0.010	3.011
0.020	6.022
0.040	12.043
0.060	18.065
0.080	24.086
0.090	27.084
0.100	30.108
0.500	30.108
2.000	30.108

33' - 44'	
@Depth 34.5 ft	
z (in)	t(kips)
-2.000	-9.190
-0.500	-26.421
-0.100	-31.016
-0.090	-28.009
-0.080	-24.991
-0.060	-18.879
-0.040	-12.679
-0.020	-6.384
-0.010	-3.205
0.000	0.000
0.010	4.595
0.020	9.186
0.040	18.376
0.060	27.561
0.080	36.751
0.090	41.342
0.100	45.950
0.500	45.950
2.000	45.950

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	254	Pile Type:	Fluted Piles
Br. No. =	45-0064	FG	254	Pile Dia.:	15.5" for extension; taper to 8" at tip
		Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bent 8	GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 2.5 ft	
z (in)	t(kips)
-9.000	-1.263
-7.500	-1.263
-7.100	-1.263
-7.090	-1.136
-7.080	-1.010
-7.060	-0.758
-7.040	-0.505
-7.020	-0.253
-7.010	-0.126
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.180
7.020	0.361
7.040	0.722
7.060	1.082
7.080	1.443
7.090	1.623
7.100	1.804
7.500	1.804
9.000	1.804

3' - 8'	
@Depth 5.5 ft	
z (in)	t(kips)
-9.154	-1.682
-6.829	-1.682
-6.519	-1.682
-6.364	-1.682
-6.209	-1.869
-6.178	-1.682
-6.142	-1.402
-6.102	-0.935
-6.079	-0.561
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	0.801
6.102	1.335
6.142	2.003
6.178	2.403
6.209	2.670
6.364	2.403
6.519	2.403
6.829	2.403
9.154	2.403

8' - 13'	
@Depth 10.5 ft	
z (in)	t(kips)
-4.937	-2.235
-4.627	-2.235
-4.472	-2.235
-4.317	-2.483
-4.286	-2.235
-4.251	-1.863
-4.210	-1.242
-4.187	-0.745
-4.162	-0.007
0.000	0.000
4.162	0.010
4.187	1.064
4.210	1.774
4.251	2.661
4.286	3.193
4.317	3.547
4.472	3.193
4.627	3.193
4.937	3.193
7.262	3.193

13' - 18'	
@Depth 15.5 ft	
z (in)	t(kips)
-3.233	-2.173
-2.848	-2.173
-2.655	-2.173
-2.463	-2.414
-2.424	-2.173
-2.380	-1.810
-2.330	-1.207
-2.301	-0.724
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	1.034
2.330	1.724
2.380	2.586
2.424	3.104
2.463	3.449
2.655	3.104
2.848	3.104
3.233	3.104
6.120	3.104

18' - 21.5'	
@Depth 20.5 ft	
z (in)	t(kips)
-1.341	-1.536
-0.956	-1.536
-0.763	-1.536
-0.571	-1.706
-0.532	-1.536
-0.488	-1.280
-0.438	-0.853
-0.409	-0.512
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	0.731
0.438	1.219
0.488	1.828
0.532	2.194
0.571	2.438
0.763	2.194
0.956	2.194
1.341	2.194
4.228	2.194

21.5' - 28'	
@Depth 25.5 ft	
z (in)	t(kips)
-2.000	-7.383
-0.500	-21.225
-0.100	-24.916
-0.090	-22.508
-0.080	-20.078
-0.060	-15.169
-0.040	-10.186
-0.020	-5.131
-0.010	-2.575
0.000	0.000
0.010	3.691
0.020	7.383
0.040	14.762
0.060	22.145
0.080	29.527
0.090	33.222
0.100	36.913
0.500	36.913
2.000	36.913

28' - 33'	
@Depth 30.5 ft	
z (in)	t(kips)
-2.000	-5.018
-0.500	-14.427
-0.100	-16.936
-0.090	-15.291
-0.080	-13.649
-0.060	-10.312
-0.040	-6.925
-0.020	-3.488
-0.010	-1.750
0.000	0.000
0.010	2.509
0.020	5.018
0.040	10.036
0.060	15.054
0.080	20.072
0.090	22.570
0.100	25.090
0.500	25.090
2.000	25.090

33' - 39'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-5.617
-0.500	-16.148
-0.100	-18.956
-0.090	-17.118
-0.080	-15.274
-0.060	-11.539
-0.040	-7.749
-0.020	-3.902
-0.010	-1.959
0.000	0.000
0.010	2.808
0.020	5.614
0.040	11.231
0.060	16.845
0.080	22.461
0.090	25.267
0.100	28.083
0.500	28.083
2.000	28.083

39' - 45'	
@Depth 41.5 ft	
z (in)	t(kips)
-2.000	-5.251
-0.500	-15.096
-0.100	-17.721
-0.090	-16.007
-0.080	-14.282
-0.060	-10.790
-0.040	-7.246
-0.020	-3.649
-0.010	-1.831
0.000	0.000
0.010	2.625
0.020	5.251
0.040	10.502
0.060	15.752
0.080	21.003
0.090	23.627
0.100	26.254
0.500	26.254
2.000	26.254

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	256	Pile Type:	Fluted Piles
Br. No. =	45-0064	FG	256	Pile Dia.:	15.5" for extension; taper to 8" at tip
		Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bent 9	GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 4.5 ft	
z (in)	t(kips)
-9.000	-3.379
-7.500	-3.379
-7.100	-3.379
-7.090	-3.041
-7.080	-2.704
-7.060	-2.027
-7.040	-1.351
-7.020	-0.676
-7.010	-0.338
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.483
7.020	0.965
7.040	1.931
7.060	2.896
7.080	3.862
7.090	4.345
7.100	4.827
7.500	4.827
9.000	4.827

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.154	-1.682
-6.829	-1.682
-6.519	-1.682
-6.364	-1.682
-6.209	-1.869
-6.178	-1.682
-6.142	-1.402
-6.102	-0.935
-6.079	-0.561
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	0.801
6.102	1.335
6.142	2.003
6.178	2.403
6.209	2.670
6.364	2.403
6.519	2.403
6.829	2.403
9.154	2.403

10' - 15'	
@Depth 12.5 ft	
z (in)	t(kips)
-4.937	-2.235
-4.627	-2.235
-4.472	-2.235
-4.317	-2.483
-4.286	-2.235
-4.251	-1.863
-4.210	-1.242
-4.187	-0.745
-4.162	-0.007
0.000	0.000
4.162	0.010
4.187	1.064
4.210	1.774
4.251	2.661
4.286	3.193
4.317	3.547
4.472	3.193
4.627	3.193
4.937	3.193
7.262	3.193

15' - 20'	
@Depth 17.5 ft	
z (in)	t(kips)
-3.045	-2.788
-2.735	-2.788
-2.580	-2.788
-2.425	-3.098
-2.394	-2.788
-2.359	-2.323
-2.318	-1.549
-2.295	-0.929
-2.270	-0.007
0.000	0.000
2.270	0.010
2.295	1.328
2.318	2.213
2.359	3.319
2.394	3.982
2.425	4.426
2.580	3.982
2.735	3.982
3.045	3.982
5.370	3.982

20' - 23.5'	
@Depth 22.5 ft	
z (in)	t(kips)
-1.153	-2.299
-0.843	-2.299
-0.688	-2.299
-0.533	-2.555
-0.502	-2.299
-0.467	-1.917
-0.426	-1.278
-0.403	-0.767
-0.378	-0.007
0.000	0.000
0.378	0.010
0.403	1.095
0.426	1.825
0.467	2.738
0.502	3.285
0.533	3.651
0.688	3.285
0.843	3.285
1.153	3.285
3.478	3.285

23.5' - 30'	
@Depth 27.5 ft	
z (in)	t(kips)
-2.000	-10.377
-0.500	-29.835
-0.100	-35.023
-0.090	-31.621
-0.080	-28.217
-0.060	-21.321
-0.040	-14.318
-0.020	-7.210
-0.010	-3.619
0.000	0.000
0.010	5.189
0.020	10.374
0.040	20.751
0.060	31.125
0.080	41.495
0.090	46.673
0.100	51.887
0.500	51.887
2.000	51.887

30' - 35'	
@Depth 32.5 ft	
z (in)	t(kips)
-2.000	-7.214
-0.500	-20.741
-0.100	-24.348
-0.090	-21.991
-0.080	-19.616
-0.060	-14.825
-0.040	-9.956
-0.020	-5.014
-0.010	-2.516
0.000	0.000
0.010	3.607
0.020	7.214
0.040	14.428
0.060	21.643
0.080	28.847
0.090	32.459
0.100	36.071
0.500	36.071
2.000	36.071

35' - 41'	
@Depth 37.5 ft	
z (in)	t(kips)
-2.000	-7.403
-0.500	-21.283
-0.100	-24.984
-0.090	-22.566
-0.080	-20.147
-0.060	-15.215
-0.040	-10.218
-0.020	-5.145
-0.010	-2.582
0.000	0.000
0.010	3.701
0.020	7.403
0.040	14.808
0.060	22.211
0.080	29.627
0.090	33.307
0.100	37.014
0.500	37.014
2.000	37.014

41' - 53'	
@Depth 43.5 ft	
z (in)	t(kips)
-2.000	-19.619
-0.500	-56.405
-0.100	-66.214
-0.090	-59.835
-0.080	-53.371
-0.060	-40.332
-0.040	-27.082
-0.020	-13.639
-0.010	-6.842
0.000	0.000
0.010	9.809
0.020	19.624
0.040	39.249
0.060	58.878
0.080	78.487
0.090	88.318
0.100	98.095
0.500	98.095
2.000	98.095

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	257	Pile Type:	Fluted Piles
Br. No. =	45-0064	FG	257	Pile Dia.:	15.5" for extension; taper to 8" at tip
		Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bents 10 to 12	GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 0.5 ft	
z (in)	t(kips)
-9.000	-0.764
-7.500	-0.764
-7.100	-0.764
-7.090	-0.688
-7.080	-0.611
-7.060	-0.459
-7.040	-0.306
-7.020	-0.153
-7.010	-0.076
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.109
7.020	0.218
7.040	0.437
7.060	0.655
7.080	0.874
7.090	0.983
7.100	1.092
7.500	1.092
9.000	1.092

3' - 6'	
@Depth 5.5 ft	
z (in)	t(kips)
-9.000	-2.578
-7.500	-2.578
-7.100	-2.578
-7.090	-2.320
-7.080	-2.063
-7.060	-1.546
-7.040	-1.031
-7.020	-0.516
-7.010	-0.258
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.368
7.020	0.737
7.040	1.473
7.060	2.209
7.080	2.947
7.090	3.315
7.100	3.683
7.500	3.683
9.000	3.683

6' - 11'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.154	-2.653
-6.829	-2.653
-6.519	-2.653
-6.364	-2.653
-6.209	-2.947
-6.178	-2.653
-6.142	-2.211
-6.102	-1.474
-6.079	-0.884
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	1.263
6.102	2.106
6.142	3.158
6.178	3.789
6.209	4.210
6.364	3.789
6.519	3.789
6.829	3.789
9.154	3.789

11' - 16'	
@Depth 13.5 ft	
z (in)	t(kips)
-4.937	-3.103
-4.627	-3.103
-4.472	-3.103
-4.317	-3.446
-4.286	-3.103
-4.251	-2.585
-4.210	-1.723
-4.187	-1.034
-4.162	-0.007
0.000	0.000
4.162	0.010
4.187	1.477
4.210	2.462
4.251	3.693
4.286	4.432
4.317	4.923
4.472	4.432
4.627	4.432
4.937	4.432
7.262	4.432

16' - 21'	
@Depth 18.5 ft	
z (in)	t(kips)
-3.045	-3.550
-2.735	-3.550
-2.580	-3.550
-2.425	-3.945
-2.394	-3.550
-2.359	-2.959
-2.318	-1.973
-2.295	-1.184
-2.270	-0.007
0.000	0.000
2.270	0.010
2.295	1.691
2.318	2.819
2.359	4.228
2.394	5.072
2.425	5.636
2.580	5.072
2.735	5.072
3.045	5.072
5.370	5.072

21' - 24.5'	
@Depth 23.5 ft	
z (in)	t(kips)
-1.416	-1.893
-1.001	-1.893
-0.793	-1.893
-0.586	-2.105
-0.544	-1.893
-0.497	-1.579
-0.443	-1.052
-0.412	-0.631
-0.378	-0.007
0.000	0.000
0.378	0.010
0.412	0.902
0.443	1.503
0.497	2.255
0.544	2.705
0.586	3.007
0.793	2.705
1.001	2.705
1.416	2.705
4.528	2.705

24.5' - 31'	
@Depth 28.5 ft	
z (in)	t(kips)
-2.000	-9.809
-0.500	-28.201
-0.100	-33.106
-0.090	-29.903
-0.080	-26.676
-0.060	-20.153
-0.040	-13.534
-0.020	-6.815
-0.010	-3.421
0.000	0.000
0.010	4.905
0.020	9.806
0.040	19.615
0.060	29.421
0.080	39.230
0.090	44.138
0.100	49.046
0.500	49.046
2.000	49.046

31' - 36'	
@Depth 33.5 ft	
z (in)	t(kips)
-2.000	-6.592
-0.500	-18.952
-0.100	-22.248
-0.090	-20.102
-0.080	-17.940
-0.060	-13.551
-0.040	-9.100
-0.020	-4.583
-0.010	-2.299
0.000	0.000
0.010	3.296
0.020	6.594
0.040	13.189
0.060	19.783
0.080	26.382
0.090	29.671
0.100	32.960
0.500	32.960
2.000	32.960

36' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
-2.000	-7.345
-0.500	-21.117
-0.100	-24.789
-0.090	-22.397
-0.080	-19.986
-0.060	-15.098
-0.040	-10.138
-0.020	-5.107
-0.010	-2.562
0.000	0.000
0.010	3.672
0.020	7.348
0.040	14.693
0.060	22.041
0.080	29.391
0.090	33.058
0.100	36.725
0.500	36.725
2.000	36.725

42' - 51'	
@Depth 44.5 ft	
z (in)	t(kips)
-2.000	-10.364
-0.500	-29.798
-0.100	-34.980
-0.090	-31.602
-0.080	-28.201
-0.060	-21.305
-0.040	-14.306
-0.020	-7.206
-0.010	-3.615
0.000	0.000
0.010	5.182
0.020	10.369
0.040	20.733
0.060	31.103
0.080	41.472
0.090	46.645
0.100	51.822
0.500	51.822
2.000	51.822

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	257	Pile Type:	Fluted Piles
Br. No. =	45-0064		FG	257	Pile Dia.:	15.5" for extension; taper to 8" at tip
			Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bents 13&14		GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 0.5 ft	
z (in)	t(kips)
-9.000	-0.764
-7.500	-0.764
-7.100	-0.764
-7.090	-0.688
-7.080	-0.611
-7.060	-0.459
-7.040	-0.306
-7.020	-0.153
-7.010	-0.076
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.109
7.020	0.218
7.040	0.437
7.060	0.655
7.080	0.874
7.090	0.983
7.100	1.092
7.500	1.092
9.000	1.092

3' - 6'	
@Depth 5.5 ft	
z (in)	t(kips)
-17.000	-3.681
-9.000	-3.058
-7.500	-3.058
-7.100	-3.058
-7.090	-2.751
-7.080	-2.446
-7.060	-1.835
-7.040	-1.223
-7.020	-0.611
-7.000	-0.007
0.010	0.437
7.000	0.010
7.020	0.874
7.040	1.747
7.060	2.621
7.080	3.494
7.090	3.930
7.100	4.368
7.500	4.368
9.000	4.368
17.000	5.259

6' - 11'	
@Depth 8.5 ft	
z (in)	t(kips)
-16.054	-8.181
-9.154	-3.407
-6.829	-3.407
-6.519	-3.407
-6.364	-3.407
-6.209	-3.786
-6.178	-3.407
-6.142	-2.839
-6.102	-1.892
-6.054	-0.007
0.025	1.622
6.054	0.010
6.102	2.703
6.142	4.055
6.178	4.868
6.209	5.408
6.364	4.868
6.519	4.868
6.829	4.868
9.154	4.868
16.054	11.687

11' - 16'	
@Depth 13.5 ft	
z (in)	t(kips)
-7.262	-2.923
-4.937	-2.923
-4.627	-2.923
-4.472	-2.923
-4.317	-3.248
-4.286	-2.923
-4.251	-2.436
-4.210	-1.624
-4.162	-0.007
0.000	0.000
4.162	0.010
4.210	2.320
4.251	3.480
4.286	4.175
4.317	4.640
4.472	4.175
4.627	4.175
4.937	4.175
7.262	4.175
14.162	14.608

16' - 21'	
@Depth 18.5 ft	
z (in)	t(kips)
-3.333	-2.720
-2.908	-2.720
-2.695	-2.720
-2.483	-3.021
-2.440	-2.720
-2.391	-2.266
-2.336	-1.511
-2.304	-0.906
-2.270	-0.007
0.025	1.605
2.270	0.010
2.304	1.295
2.336	2.158
2.391	3.237
2.440	3.886
2.483	4.315
2.695	3.886
2.908	3.886
3.333	3.886
6.520	3.886

21' - 24.5'	
@Depth 23.5 ft	
z (in)	t(kips)
-0.878	-22.906
-0.478	-22.906
-0.468	-20.620
-0.458	-18.319
-0.438	-13.745
-0.418	-9.162
-0.398	-4.581
-0.388	-2.291
-0.378	-0.007
0.000	0.000
0.378	0.010
0.388	3.272
0.398	6.545
0.418	13.089
0.438	19.636
0.458	26.170
0.468	29.456
0.478	32.723
0.878	32.723
2.378	32.723

24.5' - 31'	
@Depth 28.5 ft	
z (in)	t(kips)
-2.000	-11.166
-0.500	-32.102
-0.100	-37.685
-0.090	-34.049
-0.080	-30.362
-0.060	-22.948
-0.040	-15.409
-0.020	-7.760
-0.010	-3.894
0.000	0.000
0.010	5.583
0.020	11.166
0.040	22.332
0.060	33.501
0.080	44.650
0.090	50.257
0.100	55.830
0.500	55.830
2.000	55.830

31' - 36'	
@Depth 33.5 ft	
z (in)	t(kips)
-2.000	-7.577
-0.500	-21.783
-0.100	-25.571
-0.090	-23.101
-0.080	-20.612
-0.060	-15.568
-0.040	-10.454
-0.020	-5.266
-0.010	-2.642
0.000	0.000
0.010	3.788
0.020	7.577
0.040	15.151
0.060	22.728
0.080	30.312
0.090	34.098
0.100	37.884
0.500	37.884
2.000	37.884

36' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
-2.000	-8.457
-0.500	-24.314
-0.100	-28.543
-0.090	-25.788
-0.080	-23.011
-0.060	-17.382
-0.040	-11.671
-0.020	-5.878
-0.010	-2.949
0.000	0.000
0.010	4.229
0.020	8.457
0.040	16.914
0.060	25.374
0.080	33.840
0.090	38.063
0.100	42.286
0.500	42.286
2.000	42.286

42' - 51'	
@Depth 44.5 ft	
z (in)	t(kips)
-2.000	-12.115
-0.500	-34.832
-0.100	-40.890
-0.090	-36.950
-0.080	-32.947
-0.060	-24.897
-0.040	-16.719
-0.020	-8.420
-0.010	-4.225
0.000	0.000
0.010	6.058
0.020	12.115
0.040	24.231
0.060	36.346
0.080	48.452
0.090	54.539
0.100	60.577
0.500	60.577
2.000	60.577

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	260	Pile Type:	Fluted Piles
Br. No. =	45-0064		FG	260	Pile Dia.:	15.5" for extension; taper to 8" at tip
			Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bents 15&16		GW Elev. =	251		

Note: All depths are in feet.

0' - 6'	
@Depth 3.5 ft	
z (in)	t(kips)
-9.000	-3.058
-7.500	-3.058
-7.100	-3.058
-7.090	-2.751
-7.080	-2.446
-7.060	-1.835
-7.040	-1.223
-7.020	-0.612
-7.010	-0.306
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.437
7.020	0.874
7.040	1.747
7.060	2.621
7.080	3.494
7.090	3.930
7.100	4.368
7.500	4.368
9.000	4.368

6' - 9'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.000	-4.076
-7.500	-4.076
-7.100	-4.076
-7.090	-3.669
-7.080	-3.262
-7.060	-2.446
-7.040	-1.631
-7.020	-0.815
-7.010	-0.408
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.582
7.020	1.165
7.040	2.330
7.060	3.494
7.080	4.659
7.090	5.241
7.100	5.823
7.500	5.823
9.000	5.823

9' - 14'	
@Depth 11.5 ft	
z (in)	t(kips)
-9.154	-2.653
-6.829	-2.653
-6.519	-2.653
-6.364	-2.653
-6.209	-2.947
-6.178	-2.653
-6.142	-2.211
-6.102	-1.474
-6.079	-0.884
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	1.263
6.102	2.106
6.142	3.158
6.178	3.789
6.209	4.210
6.364	3.789
6.519	3.789
6.829	3.789
9.154	3.789

14' - 19'	
@Depth 16.5 ft	
z (in)	t(kips)
-8.162	-2.380
-5.162	-2.380
-4.762	-2.380
-4.562	-2.380
-4.362	-2.645
-4.322	-2.380
-4.276	-1.984
-4.224	-1.322
-4.194	-0.793
-4.162	-0.007
0.000	0.000
4.162	0.010
4.194	1.133
4.224	1.889
4.276	2.834
4.322	3.399
4.362	3.779
4.562	3.399
4.762	3.399
5.162	3.399
8.162	3.399

19' - 24'	
@Depth 21.5 ft	
z (in)	t(kips)
-6.270	-2.285
-3.270	-2.285
-2.870	-2.285
-2.670	-2.285
-2.470	-2.538
-2.430	-2.285
-2.384	-1.905
-2.332	-1.270
-2.302	-0.762
-2.270	-0.007
0.000	0.000
2.270	0.010
2.302	1.088
2.332	1.814
2.384	2.721
2.430	3.264
2.470	3.626
2.670	3.264
2.870	3.264
3.270	3.264
6.270	3.264

24' - 27.5'	
@Depth 26.5 ft	
z (in)	t(kips)
-4.378	-1.497
-1.378	-1.497
-0.978	-1.497
-0.778	-1.497
-0.578	-1.664
-0.538	-1.497
-0.492	-1.247
-0.440	-0.832
-0.410	-0.499
-0.378	-0.007
0.000	0.000
0.378	0.010
0.410	0.713
0.440	1.188
0.492	1.782
0.538	2.139
0.578	2.377
0.778	2.139
0.978	2.139
1.378	2.139
4.378	2.139

27.5' - 34'	
@Depth 31.5 ft	
z (in)	t(kips)
-2.000	-8.341
-0.500	-23.980
-0.100	-28.150
-0.090	-25.417
-0.080	-22.683
-0.060	-17.138
-0.040	-11.508
-0.020	-5.797
-0.010	-2.909
0.000	0.000
0.010	4.170
0.020	8.341
0.040	16.679
0.060	25.020
0.080	33.358
0.090	37.517
0.100	41.704
0.500	41.704
2.000	41.704

34' - 39'	
@Depth 36.5 ft	
z (in)	t(kips)
-2.000	-5.225
-0.500	-15.023
-0.100	-17.636
-0.090	-15.939
-0.080	-14.216
-0.060	-10.741
-0.040	-7.213
-0.020	-3.633
-0.010	-1.822
0.000	0.000
0.010	2.613
0.020	5.227
0.040	10.453
0.060	15.680
0.080	20.906
0.090	23.526
0.100	26.127
0.500	26.127
2.000	26.127

39' - 45'	
@Depth 41.5 ft	
z (in)	t(kips)
-2.000	-4.731
-0.500	-13.601
-0.100	-15.966
-0.090	-14.431
-0.080	-12.870
-0.060	-9.723
-0.040	-6.530
-0.020	-3.288
-0.010	-1.650
0.000	0.000
0.010	2.365
0.020	4.731
0.040	9.464
0.060	14.194
0.080	18.927
0.090	21.301
0.100	23.654
0.500	23.654
2.000	23.654

45' - 47'	
@Depth 47.5 ft	
z (in)	t(kips)
-9.693	0.010
-9.693	0.010
-9.693	0.010
-8.724	0.010
-7.755	0.010
-5.816	0.010
-3.877	0.010
-1.939	-0.240
-0.969	-0.255
0.000	0.000
0.969	0.557
1.939	1.115
3.877	2.229
5.816	3.344
7.755	4.458
8.724	5.016
9.693	5.573
9.693	5.573
9.693	5.573

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	264	Pile Type:	Fluted Piles
Br. No. =	45-0064			FG	264	Pile Dia.:	15.5" for extension; taper to 8" at tip
				Pile Cut-Off=		Extension Pile Perimeter:	48.7
Support(s):	Bent 17			GW Elev. =	251		

Note: All depths are in feet.

0' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.000	-18.120
-7.500	-18.120
-7.100	-18.120
-7.090	-16.308
-7.080	-14.496
-7.060	-10.872
-7.040	-7.248
-7.020	-3.624
-7.010	-1.812
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	2.589
7.020	5.177
7.040	10.354
7.060	15.532
7.080	20.709
7.090	23.297
7.100	25.886
7.500	25.886
9.000	25.886

10' - 13'	
@Depth 12.5 ft	
z (in)	t(kips)
-9.000	-7.397
-7.500	-7.397
-7.100	-7.397
-7.090	-6.658
-7.080	-5.918
-7.060	-4.438
-7.040	-2.959
-7.020	-1.480
-7.010	-0.740
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	1.057
7.020	2.114
7.040	4.227
7.060	6.341
7.080	8.455
7.090	9.512
7.100	10.567
7.500	10.567
9.000	10.567

13' - 18'	
@Depth 15.5 ft	
z (in)	t(kips)
-6.054	-5.780
-9.154	-5.780
-6.829	-5.780
-6.519	-5.780
-6.364	-6.422
-6.178	-5.780
-6.142	-4.816
-6.102	-3.211
-6.079	-1.927
-6.054	-0.007
0.000	0.000
6.054	0.010
6.079	2.752
6.102	4.587
6.142	6.881
6.178	8.257
6.364	9.174
6.519	8.257
6.829	8.257
9.154	8.257
6.054	8.257

18' - 23'	
@Depth 20.5 ft	
z (in)	t(kips)
-8.312	-4.548
-5.200	-4.548
-4.785	-4.548
-4.577	-4.548
-4.370	-5.055
-4.328	-4.548
-4.280	-3.791
-4.226	-2.528
-4.195	-1.516
-4.162	-0.007
0.000	0.000
4.162	0.010
4.195	2.166
4.226	3.611
4.280	5.416
4.328	6.497
4.370	7.222
4.577	6.497
4.785	6.497
5.200	6.497
8.312	6.497

23' - 28'	
@Depth 25.5 ft	
z (in)	t(kips)
-6.420	-4.040
-3.308	-4.040
-2.893	-4.040
-2.685	-4.040
-2.478	-4.490
-2.436	-4.040
-2.389	-3.367
-2.335	-2.246
-2.303	-1.347
-2.270	-0.007
0.000	0.000
2.270	0.010
2.303	1.924
2.335	3.208
2.389	4.810
2.436	5.771
2.478	6.414
2.685	5.771
2.893	5.771
3.308	5.771
6.420	5.771

28' - 31.5'	
@Depth 30.5 ft	
z (in)	t(kips)
-4.528	-2.465
-1.416	-2.465
-1.001	-2.465
-0.793	-2.465
-0.586	-2.737
-0.544	-2.465
-0.497	-2.054
-0.443	-1.369
-0.412	-0.821
-0.378	-0.007
0.000	0.000
0.378	0.010
0.412	1.173
0.443	1.955
0.497	2.934
0.544	3.521
0.586	3.910
0.793	3.521
1.001	3.521
1.416	3.521
4.528	3.521

31.5' - 38'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-9.399
-0.500	-27.022
-0.100	-31.722
-0.090	-28.645
-0.080	-25.565
-0.060	-19.313
-0.040	-12.969
-0.020	-6.532
-0.010	-3.278
0.000	0.000
0.010	4.699
0.020	9.399
0.040	18.795
0.060	28.194
0.080	37.596
0.090	42.281
0.100	46.995
0.500	46.995
2.000	46.995

38' - 43'	
@Depth 40.5 ft	
z (in)	t(kips)
-2.000	-5.444
-0.500	-15.650
-0.100	-18.372
-0.090	-16.595
-0.080	-14.804
-0.060	-11.188
-0.040	-7.513
-0.020	-3.783
-0.010	-1.898
0.000	0.000
0.010	2.722
0.020	5.444
0.040	10.889
0.060	16.333
0.080	21.770
0.090	24.494
0.100	27.218
0.500	27.218
2.000	27.218

43' - 51'	
@Depth 45.5 ft	
z (in)	t(kips)
-2.000	-5.135
-0.500	-14.762
-0.100	-17.329
-0.090	-15.654
-0.080	-13.966
-0.060	-10.552
-0.040	-7.086
-0.020	-3.569
-0.010	-1.791
0.000	0.000
0.010	2.567
0.020	5.135
0.040	10.269
0.060	15.404
0.080	20.538
0.090	23.106
0.100	25.673
0.500	25.673
2.000	25.673

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	265	Pile Type:	Octagonal Piles
Br. No. =	45-0064			FG	265	Pile Dia.:	18" Octagonal Piles
				Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bent 2			GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 2.5 ft	
z (in)	t(kips)
-9.000	-4.433
-7.500	-4.433
-7.100	-4.433
-7.090	-3.990
-7.080	-3.547
-7.060	-2.658
-7.040	-1.773
-7.020	-0.887
-7.010	-0.443
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.633
7.020	1.267
7.040	2.533
7.060	3.798
7.080	5.067
7.090	5.700
7.100	6.333
7.500	6.333
9.000	6.333

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.000	-11.820
-7.500	-11.820
-7.100	-11.820
-7.090	-10.639
-7.080	-9.457
-7.060	-7.092
-7.040	-4.729
-7.020	-2.364
-7.010	-1.182
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	1.689
7.020	3.377
7.040	6.755
7.060	10.131
7.080	13.510
7.090	15.198
7.100	16.886
7.500	16.886
9.000	16.886

10' - 14'	
@Depth 12.5 ft	
z (in)	t(kips)
-10.794	-15.368
-7.949	-15.368
-7.569	-15.368
-7.379	-13.830
-7.190	-12.294
-7.152	-9.220
-7.108	-6.146
-7.059	-3.074
-7.030	-1.537
-7.000	-0.007
0.000	0.000
7.000	0.010
7.030	2.195
7.059	4.391
7.108	8.780
7.152	13.171
7.190	17.562
7.379	19.757
7.569	21.954
7.949	21.954
10.794	21.954

14' - 21'	
@Depth 17.5 ft	
z (in)	t(kips)
-9.751	-6.021
-6.906	-6.021
-6.527	-6.021
-6.337	-6.021
-6.147	-6.690
-6.109	-6.021
-6.066	-5.018
-6.016	-3.345
-5.988	-2.007
-5.957	-0.007
0.000	0.000
5.957	0.010
5.988	2.867
6.016	4.779
6.066	7.169
6.109	8.601
6.147	9.557
6.337	8.601
6.527	8.601
6.906	8.601
9.751	8.601

21' - 28'	
@Depth 24.5 ft	
z (in)	t(kips)
-7.666	-6.673
-4.821	-6.673
-4.441	-6.673
-4.252	-6.673
-4.062	-7.415
-4.024	-6.673
-3.980	-5.562
-3.931	-3.708
-3.903	-2.224
-3.872	-0.007
0.000	0.000
3.872	0.010
3.903	3.178
3.931	5.297
3.980	7.945
4.024	9.532
4.062	10.594
4.252	9.532
4.441	9.532
4.821	9.532
7.666	9.532

28' - 37.5'	
@Depth 31.5 ft	
z (in)	t(kips)
-5.581	-9.940
-2.736	-9.940
-2.356	-9.940
-2.167	-9.940
-1.977	-11.048
-1.939	-9.940
-1.895	-8.285
-1.846	-5.522
-1.818	-3.314
-1.787	-0.007
0.000	0.000
1.787	0.010
1.818	4.734
1.846	7.888
1.895	11.836
1.939	14.200
1.977	15.783
2.167	14.200
2.356	14.200
2.736	14.200
5.581	14.200

37.5' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-21.420
-0.500	-21.420
-0.100	-21.420
-0.090	-19.278
-0.080	-17.135
-0.060	-12.853
-0.040	-8.568
-0.020	-4.285
-0.010	-2.142
0.000	0.000
0.010	3.060
0.020	6.121
0.040	12.240
0.060	18.361
0.080	24.479
0.090	27.540
0.100	30.601
0.500	30.601
2.000	30.601

42' - 47'	
@Depth 44.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-32.917
-0.500	-32.917
-0.100	-32.917
-0.090	-29.613
-0.080	-26.334
-0.060	-19.750
-0.040	-13.167
-0.020	-6.583
-0.010	-3.292
0.000	0.000
0.010	4.702
0.020	9.405
0.040	18.810
0.060	28.215
0.080	37.620
0.090	42.304
0.100	47.024
0.500	47.024
2.000	47.024

47' - 50'	
@Depth 47.5 ft	
z (in)	t(kips)
0.000	0.000
-2.000	-20.787
-0.500	-20.787
-0.100	-20.787
-0.090	-18.714
-0.080	-16.626
-0.060	-12.473
-0.040	-8.316
-0.020	-4.157
-0.010	-2.079
0.000	0.000
0.010	2.970
0.020	5.939
0.040	11.880
0.060	17.819
0.080	23.752
0.090	26.734
0.100	29.695
0.500	29.695
2.000	29.695

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	256	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	256	Pile Dia.:	18" Octagonal Piles
			Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bent 3		GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 3.5 ft	
z (in)	t(kips)
-9.000	-5.910
-7.500	-5.910
-7.100	-5.910
-7.090	-5.319
-7.080	-4.729
-7.060	-3.547
-7.040	-2.364
-7.020	-1.182
-7.010	-0.591
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.844
7.020	1.689
7.040	3.377
7.060	5.067
7.080	6.755
7.090	7.599
7.100	8.443
7.500	8.443
9.000	8.443

5' - 12'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.751	-3.711
-6.906	-3.711
-6.527	-3.711
-6.337	-3.711
-6.147	-4.121
-6.109	-3.711
-6.066	-3.091
-6.016	-2.061
-5.988	-1.236
-5.957	-0.007
0.000	0.000
5.957	0.010
5.988	1.766
6.016	2.944
6.066	4.416
6.109	5.302
6.147	5.888
6.337	5.302
6.527	5.302
6.906	5.302
9.751	5.302

12' - 19'	
@Depth 15.5 ft	
z (in)	t(kips)
-7.666	-4.559
-4.821	-4.559
-4.441	-4.559
-4.252	-4.559
-4.062	-5.064
-4.024	-4.559
-3.980	-3.799
-3.931	-2.532
-3.903	-1.519
-3.872	-0.007
0.000	0.000
3.872	0.010
3.903	2.170
3.931	3.617
3.980	5.427
4.024	6.513
4.062	7.234
4.252	6.513
4.441	6.513
4.821	6.513
7.666	6.513

19' - 28.5'	
@Depth 22.5 ft	
z (in)	t(kips)
-5.581	-7.339
-2.736	-7.339
-2.356	-7.339
-2.167	-7.339
-1.977	-8.152
-1.939	-7.339
-1.895	-6.112
-1.846	-4.076
-1.818	-2.446
-1.787	-0.007
0.000	0.000
1.787	0.010
1.818	3.494
1.846	5.823
1.895	8.731
1.939	10.484
1.977	11.646
2.167	10.484
2.356	10.484
2.736	10.484
5.581	10.484

28.5' - 33'	
@Depth 29.5 ft	
z (in)	t(kips)
-2.000	-13.044
-0.500	-13.044
-0.100	-13.044
-0.090	-11.740
-0.080	-10.435
-0.060	-7.827
-0.040	-5.218
-0.020	-2.609
-0.010	-1.304
0.000	0.000
0.010	1.863
0.020	3.727
0.040	7.454
0.060	11.181
0.080	14.908
0.090	16.771
0.100	18.635
0.500	18.635
2.000	18.635

33' - 38'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-20.704
-0.500	-20.704
-0.100	-20.704
-0.090	-18.634
-0.080	-16.564
-0.060	-12.423
-0.040	-8.281
-0.020	-4.140
-0.010	-2.070
0.000	0.000
0.010	2.958
0.020	5.915
0.040	11.829
0.060	17.748
0.080	23.662
0.090	26.620
0.100	29.577
0.500	29.577
2.000	29.577

38' - 41'	
@Depth 38.5 ft	
z (in)	t(kips)
-2.000	-13.376
-0.500	-13.376
-0.100	-13.376
-0.090	-12.038
-0.080	-10.701
-0.060	-8.026
-0.040	-5.350
-0.020	-2.675
-0.010	-1.338
0.000	0.000
0.010	1.911
0.020	3.821
0.040	7.643
0.060	11.466
0.080	15.287
0.090	17.197
0.100	19.109
0.500	19.109
2.000	19.109

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	251	Pile Type:	Octagonal Piles
Br. No. =	45-0064	FG	251	Pile Dia.:	18" Octagonal Piles
		Pile Cut-Off=	251	Extension Pile Perimeter:	59.6
Support(s):	Bents 4 to 6	GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 2.5 ft	
z (in)	t(kips)
-3.794	-0.685
-0.949	-0.685
-0.569	-0.685
-0.379	-0.685
-0.190	-0.761
-0.152	-0.685
-0.108	-0.571
-0.059	-0.380
-0.030	-0.228
-6.054	-0.007
0.000	0.000
6.054	0.010
0.030	0.326
0.059	0.543
0.108	0.815
0.152	0.978
0.190	1.087
0.379	0.978
0.569	0.978
0.949	0.978
3.794	0.978

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-7.956	-3.424
-5.111	-3.424
-4.731	-3.424
-4.542	-3.424
-4.352	-3.805
-4.314	-3.424
-4.270	-2.854
-4.221	-1.902
-4.193	-1.141
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.631
4.221	2.717
4.270	4.077
4.314	4.892
4.352	5.436
4.542	4.892
4.731	4.892
5.111	4.892
7.956	4.892

10' - 15'	
@Depth 12.5 ft	
z (in)	t(kips)
-6.064	-3.424
-3.219	-3.424
-2.839	-3.424
-2.650	-3.424
-2.460	-3.805
-2.422	-3.424
-2.378	-2.854
-2.329	-1.902
-2.301	-1.141
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	1.631
2.329	2.717
2.378	4.077
2.422	4.892
2.460	5.436
2.650	4.892
2.839	4.892
3.219	4.892
6.064	4.892

15' - 18.5'	
@Depth 17.5 ft	
z (in)	t(kips)
-4.172	-3.115
-1.327	-3.115
-0.947	-3.115
-0.758	-3.115
-0.568	-3.461
-0.530	-3.115
-0.486	-2.595
-0.437	-1.730
-0.409	-1.038
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.483
0.437	2.472
0.486	3.707
0.530	4.451
0.568	4.944
0.758	4.451
0.947	4.451
1.327	4.451
4.172	4.451

18.5' - 25'	
@Depth 22.5 ft	
z (in)	t(kips)
-2.000	-16.118
-0.500	-16.118
-0.100	-16.118
-0.090	-14.504
-0.080	-12.893
-0.060	-9.671
-0.040	-6.446
-0.020	-3.223
-0.010	-1.612
0.000	-0.007
0.000	0.000
0.000	0.010
0.010	2.303
0.020	4.605
0.040	9.209
0.060	13.816
0.080	18.419
0.090	20.720
0.100	23.026
0.500	23.026
2.000	23.026

25' - 31'	
@Depth 27.5 ft	
z (in)	t(kips)
-2.000	-18.338
-0.500	-18.338
-0.100	-18.338
-0.090	-16.506
-0.080	-14.671
-0.060	-11.003
-0.040	-7.335
-0.020	-3.668
-0.010	-1.834
0.000	0.000
0.010	2.620
0.020	5.240
0.040	10.479
0.060	15.719
0.080	20.958
0.090	23.580
0.100	26.198
0.500	26.198
2.000	26.198

31' - 36'	
@Depth 32.5 ft	
z (in)	t(kips)
-2.000	-23.295
-0.500	-23.295
-0.100	-23.295
-0.090	-20.967
-0.080	-18.636
-0.060	-13.978
-0.040	-9.319
-0.020	-4.658
-0.010	-2.329
0.000	0.000
0.010	3.328
0.020	6.655
0.040	13.313
0.060	19.968
0.080	26.623
0.090	29.953
0.100	33.278
0.500	33.278
2.000	33.278

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	253	Pile Type:	Octagonal Piles
Br. No. =	45-0064			FG	253	Pile Dia.:	18" Octagonal Piles
				Pile Cut-Off=	253	Extension Pile Perimeter:	59.6
Support(s):	Bent 7			GW Elev. =	251		

Note: All depths are in feet.

0' - 7'	
@Depth 4.5 ft	
z (in)	t(kips)
-9.848	-2.883
-7.003	-2.883
-6.623	-2.883
-6.433	-2.883
-6.244	-3.203
-6.206	-2.883
-6.162	-2.402
-6.113	-1.602
-6.084	-0.961
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	1.373
6.113	2.288
6.162	3.432
6.206	4.118
6.244	4.576
6.433	4.118
6.623	4.118
7.003	4.118
9.848	4.118

7' - 12'	
@Depth 9.5 ft	
z (in)	t(kips)
-7.956	-2.736
-5.111	-2.736
-4.731	-2.736
-4.542	-2.736
-4.352	-3.039
-4.314	-2.736
-4.270	-2.280
-4.221	-1.520
-4.193	-0.912
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.303
4.221	2.171
4.270	3.257
4.314	3.909
4.352	4.341
4.542	3.909
4.731	3.909
5.111	3.909
7.956	3.909

12' - 17'	
@Depth 14.5 ft	
z (in)	t(kips)
-6.064	-3.412
-3.219	-3.412
-2.839	-3.412
-2.650	-3.412
-2.460	-3.792
-2.422	-3.412
-2.378	-2.844
-2.329	-1.896
-2.301	-1.137
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	1.625
2.329	2.708
2.378	4.062
2.422	4.874
2.460	5.418
2.650	4.874
2.839	4.874
3.219	4.874
6.064	4.874

17' - 20.5'	
@Depth 19.5 ft	
z (in)	t(kips)
-4.172	-2.861
-1.327	-2.861
-0.947	-2.861
-0.758	-2.861
-0.568	-3.180
-0.530	-2.861
-0.486	-2.385
-0.437	-1.590
-0.409	-0.954
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.363
0.437	2.272
0.486	3.407
0.530	4.088
0.568	4.543
0.758	4.088
0.947	4.088
1.327	4.088
4.172	4.088

20.5' - 27'	
@Depth 24.5 ft	
z (in)	t(kips)
-2.000	-3.143
-0.500	-3.143
-0.100	-3.143
-0.090	-2.829
-0.080	-2.515
-0.060	-1.886
-0.040	-1.257
-0.020	-0.629
-0.010	-0.314
0.000	0.000
0.010	0.449
0.020	0.898
0.040	1.796
0.060	2.694
0.080	3.592
0.090	4.042
0.100	4.490
0.500	4.490
2.000	4.490

27' - 33'	
@Depth 29.5 ft	
z (in)	t(kips)
-2.000	-3.720
-0.500	-3.720
-0.100	-3.720
-0.090	-3.348
-0.080	-2.976
-0.060	-2.232
-0.040	-1.488
-0.020	-0.744
-0.010	-0.372
0.000	0.000
0.010	0.531
0.020	1.063
0.040	2.126
0.060	3.189
0.080	4.252
0.090	4.783
0.100	5.315
0.500	5.315
2.000	5.315

33' - 44'	
@Depth 34.5 ft	
z (in)	t(kips)
-2.000	-4.297
-0.500	-4.297
-0.100	-4.297
-0.090	-3.867
-0.080	-3.438
-0.060	-2.578
-0.040	-1.719
-0.020	-0.860
-0.010	-0.430
0.000	0.000
0.010	0.614
0.020	1.228
0.040	2.456
0.060	3.683
0.080	4.911
0.090	5.525
0.100	6.139
0.500	6.139
2.000	6.139

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	254	Pile Type:	Octagonal Piles
Br. No. =	45-0064	FG	254	Pile Dia.:	18" Octagonal Piles
		Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bent 8	GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 2.5 ft	
z (in)	t(kips)
-17.000	-3.004
-9.000	-2.001
-7.500	-2.001
-7.100	-2.001
-7.090	-1.801
-7.080	-1.600
-7.060	-1.200
-7.040	-0.800
-7.020	-0.400
-7.000	-0.007
0.010	0.286
7.000	0.010
7.020	0.572
7.040	1.143
7.060	1.715
7.080	2.285
7.090	2.573
7.100	2.858
7.500	2.858
9.000	2.858
17.000	4.291

3' - 8'	
@Depth 5.5 ft	
z (in)	t(kips)
-16.054	-7.510
-9.848	-2.059
-7.003	-2.059
-6.623	-2.059
-6.433	-2.059
-6.244	-2.288
-6.206	-2.059
-6.162	-1.716
-6.113	-1.144
-6.054	-0.007
0.030	0.981
6.054	0.010
6.113	1.634
6.162	2.451
6.206	2.942
6.244	3.268
6.433	2.942
6.623	2.942
7.003	2.942
9.848	2.942
16.054	10.728

8' - 13'	
@Depth 10.5 ft	
z (in)	t(kips)
-7.956	-2.736
-5.111	-2.736
-4.731	-2.736
-4.542	-2.736
-4.352	-3.039
-4.314	-2.736
-4.270	-2.280
-4.221	-1.520
-4.162	-0.007
0.000	0.000
4.162	0.010
4.221	2.171
4.270	3.257
4.314	3.909
4.352	4.341
4.542	3.909
4.731	3.909
5.111	3.909
7.956	3.909
14.162	14.304

13' - 18'	
@Depth 15.5 ft	
z (in)	t(kips)
-3.219	-4.088
-2.839	-4.088
-2.650	-4.088
-2.460	-4.543
-2.422	-4.088
-2.378	-3.407
-2.329	-2.272
-2.301	-1.363
-2.270	-0.007
0.030	1.625
2.270	0.010
2.301	1.947
2.329	3.245
2.378	4.867
2.422	5.840
2.460	6.490
2.650	5.840
2.839	5.840
3.219	5.840
6.064	5.840

18' - 21.5'	
@Depth 20.5 ft	
z (in)	t(kips)
-0.878	-11.001
-0.478	-11.001
-0.468	-9.902
-0.458	-8.802
-0.438	-6.601
-0.418	-4.400
-0.398	-2.201
-0.388	-1.100
-0.378	-0.007
0.000	0.000
0.378	0.010
0.388	1.572
0.398	3.144
0.418	6.286
0.438	9.430
0.458	12.574
0.468	14.146
0.478	15.715
0.878	15.715
2.378	15.715

21.5' - 28'	
@Depth 25.5 ft	
z (in)	t(kips)
-2.000	-20.430
-0.500	-20.430
-0.100	-20.430
-0.090	-18.389
-0.080	-16.346
-0.060	-12.258
-0.040	-8.171
-0.020	-4.087
-0.010	-2.043
0.000	0.000
0.010	2.919
0.020	5.839
0.040	11.673
0.060	17.512
0.080	23.351
0.090	26.270
0.100	29.185
0.500	29.185
2.000	29.185

28' - 33'	
@Depth 30.5 ft	
z (in)	t(kips)
-2.000	-18.601
-0.500	-18.601
-0.100	-18.601
-0.090	-16.741
-0.080	-14.882
-0.060	-11.162
-0.040	-7.440
-0.020	-3.720
-0.010	-1.860
0.000	0.000
0.010	2.657
0.020	5.314
0.040	10.628
0.060	15.945
0.080	21.259
0.090	23.916
0.100	26.573
0.500	26.573
2.000	26.573

33' - 39'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-25.785
-0.500	-25.785
-0.100	-25.785
-0.090	-23.205
-0.080	-20.627
-0.060	-15.470
-0.040	-10.315
-0.020	-5.158
-0.010	-2.578
0.000	0.000
0.010	3.684
0.020	7.368
0.040	14.736
0.060	22.100
0.080	29.468
0.090	33.150
0.100	36.836
0.500	36.836
2.000	36.836

39' - 45'	
@Depth 41.5 ft	
z (in)	t(kips)
-2.000	-29.939
-0.500	-29.939
-0.100	-29.939
-0.090	-26.944
-0.080	-23.953
-0.060	-17.963
-0.040	-11.976
-0.020	-5.987
-0.010	-2.994
0.000	0.000
0.010	4.277
0.020	8.552
0.040	17.109
0.060	25.661
0.080	34.218
0.090	38.492
0.100	42.770
0.500	42.770
2.000	42.770

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit	Elevation (ft)	256	Pile Type:	Octagonal Piles
Br. No. =	45-0064	FG	256	Pile Dia.:	18" Octagonal Piles
		Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bent 9	GW Elev. =	251		

Note: All depths are in feet.

0' - 5'	
@Depth 4.5 ft	
z (in)	t(kips)
-9.000	-5.462
-7.500	-5.462
-7.100	-5.462
-7.090	-4.916
-7.080	-4.368
-7.060	-3.277
-7.040	-2.185
-7.020	-1.092
-7.010	-0.546
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.780
7.020	1.561
7.040	3.121
7.060	4.681
7.080	6.240
7.090	7.023
7.100	7.803
7.500	7.803
9.000	7.803

5' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.848	-2.059
-7.003	-2.059
-6.623	-2.059
-6.433	-2.059
-6.244	-2.288
-6.206	-2.059
-6.162	-1.716
-6.113	-1.144
-6.084	-0.686
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	0.981
6.113	1.634
6.162	2.451
6.206	2.942
6.244	3.268
6.433	2.942
6.623	2.942
7.003	2.942
9.848	2.942

10' - 15'	
@Depth 12.5 ft	
z (in)	t(kips)
-5.111	-2.736
-4.731	-2.736
-4.542	-2.736
-4.352	-3.039
-4.314	-2.736
-4.270	-2.280
-4.221	-1.520
-4.193	-0.912
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.303
4.221	2.171
4.270	3.257
4.314	3.909
4.352	4.341
4.542	3.909
4.731	3.909
5.111	3.909
7.956	3.909

15' - 20'	
@Depth 17.5 ft	
z (in)	t(kips)
-3.219	-3.412
-2.839	-3.412
-2.650	-3.412
-2.460	-3.792
-2.422	-3.412
-2.378	-2.844
-2.329	-1.896
-2.301	-1.137
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	1.625
2.329	2.708
2.378	4.062
2.422	4.874
2.460	5.418
2.650	4.874
2.839	4.874
3.219	4.874
6.064	4.874

20' - 23.5'	
@Depth 22.5 ft	
z (in)	t(kips)
-1.327	-2.861
-0.947	-2.861
-0.758	-2.861
-0.568	-3.180
-0.530	-2.861
-0.486	-2.385
-0.437	-1.590
-0.409	-0.954
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.363
0.437	2.272
0.486	3.407
0.530	4.088
0.568	4.543
0.758	4.088
0.947	4.088
1.327	4.088
4.172	4.088

23.5' - 30'	
@Depth 27.5 ft	
z (in)	t(kips)
-2.000	-23.306
-0.500	-23.306
-0.100	-23.306
-0.090	-20.976
-0.080	-18.646
-0.060	-13.983
-0.040	-9.323
-0.020	-4.660
-0.010	-2.331
0.000	0.000
0.010	3.329
0.020	6.657
0.040	13.319
0.060	19.976
0.080	26.638
0.090	29.966
0.100	33.295
0.500	33.295
2.000	33.295

30' - 35'	
@Depth 32.5 ft	
z (in)	t(kips)
-2.000	-20.814
-0.500	-20.814
-0.100	-20.814
-0.090	-18.734
-0.080	-16.651
-0.060	-12.488
-0.040	-8.326
-0.020	-4.163
-0.010	-2.081
0.000	0.000
0.010	2.973
0.020	5.947
0.040	11.894
0.060	17.841
0.080	23.788
0.090	26.763
0.100	29.734
0.500	29.734
2.000	29.734

35' - 41'	
@Depth 37.5 ft	
z (in)	t(kips)
-2.000	-28.440
-0.500	-28.440
-0.100	-28.440
-0.090	-25.596
-0.080	-22.751
-0.060	-17.065
-0.040	-11.376
-0.020	-5.689
-0.010	-2.844
0.000	0.000
0.010	4.063
0.020	8.128
0.040	16.251
0.060	24.378
0.080	32.502
0.090	36.565
0.100	40.629
0.500	40.629
2.000	40.629

41' - 53'	
@Depth 43.5 ft	
z (in)	t(kips)
-2.000	-65.183
-0.500	-65.183
-0.100	-65.183
-0.090	-58.671
-0.080	-52.153
-0.060	-39.116
-0.040	-26.073
-0.020	-13.037
-0.010	-6.518
0.000	0.000
0.010	9.312
0.020	18.624
0.040	37.248
0.060	55.880
0.080	74.504
0.090	83.816
0.100	93.119
0.500	93.119
2.000	93.119

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	257	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	257	Pile Dia.:	18" Octagonal Piles
			Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bents 10 to 12		GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 0.5 ft	
z (in)	t(kips)
-9.000	-1.277
-7.500	-1.277
-7.100	-1.277
-7.090	-1.149
-7.080	-1.021
-7.060	-0.766
-7.040	-0.511
-7.020	-0.255
-7.010	-0.128
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.182
7.020	0.365
7.040	0.730
7.060	1.094
7.080	1.459
7.090	1.641
7.100	1.824
7.500	1.824
9.000	1.824

3' - 6'	
@Depth 5.5 ft	
z (in)	t(kips)
-9.000	-4.121
-7.500	-4.121
-7.100	-4.121
-7.090	-3.710
-7.080	-3.297
-7.060	-2.474
-7.040	-1.649
-7.020	-0.824
-7.010	-0.412
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.589
7.020	1.178
7.040	2.356
7.060	3.534
7.080	4.710
7.090	5.300
7.100	5.888
7.500	5.888
9.000	5.888

6' - 11'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.848	-3.247
-7.003	-3.247
-6.623	-3.247
-6.433	-3.247
-6.244	-3.607
-6.206	-3.247
-6.162	-2.706
-6.113	-1.804
-6.084	-1.082
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	1.546
6.113	2.577
6.162	3.866
6.206	4.638
6.244	5.153
6.433	4.638
6.623	4.638
7.003	4.638
9.848	4.638

11' - 16'	
@Depth 13.5 ft	
z (in)	t(kips)
-5.111	-3.797
-4.731	-3.797
-4.542	-3.797
-4.352	-4.218
-4.314	-3.797
-4.270	-3.164
-4.221	-2.109
-4.193	-1.266
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.808
4.221	3.013
4.270	4.520
4.314	5.425
4.352	6.026
4.542	5.425
4.731	5.425
5.111	5.425
7.956	5.425

16' - 21'	
@Depth 18.5 ft	
z (in)	t(kips)
-3.219	-4.346
-2.839	-4.346
-2.650	-4.346
-2.460	-4.829
-2.422	-4.346
-2.378	-3.622
-2.329	-2.415
-2.301	-1.449
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	2.070
2.329	3.450
2.378	5.174
2.422	6.208
2.460	6.898
2.650	6.208
2.839	6.208
3.219	6.208
6.064	6.208

21' - 24.5'	
@Depth 23.5 ft	
z (in)	t(kips)
-1.327	-3.427
-0.947	-3.427
-0.758	-3.427
-0.568	-3.808
-0.530	-3.427
-0.486	-2.856
-0.437	-1.905
-0.409	-1.142
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.632
0.437	2.721
0.486	4.080
0.530	4.896
0.568	5.439
0.758	4.896
0.947	4.896
1.327	4.896
4.172	4.896

24.5' - 31'	
@Depth 28.5 ft	
z (in)	t(kips)
-0.500	-24.745
-0.100	-24.745
-0.090	-22.271
-0.080	-19.795
-0.060	-14.849
-0.040	-9.899
-0.020	-4.950
-0.010	-2.474
0.000	0.000
0.010	3.535
0.020	7.071
0.040	14.142
0.060	21.212
0.080	28.279
0.090	31.816
0.100	35.349
0.500	35.349

31' - 36'	
@Depth 33.5 ft	
z (in)	t(kips)
-0.500	-21.921
-0.100	-21.921
-0.090	-19.728
-0.080	-17.537
-0.060	-13.152
-0.040	-8.769
-0.020	-4.383
-0.010	-2.192
0.000	0.000
0.010	3.132
0.020	6.262
0.040	12.527
0.060	18.788
0.080	25.053
0.090	28.182
0.100	31.315
0.500	31.315

36' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
-0.500	-29.768
-0.100	-29.768
-0.090	-26.791
-0.080	-23.814
-0.060	-17.861
-0.040	-11.907
-0.020	-5.954
-0.010	-2.977
0.000	0.000
0.010	4.253
0.020	8.505
0.040	17.010
0.060	25.515
0.080	34.021
0.090	38.273
0.100	42.526
0.500	42.526

42' - 51'	
@Depth 44.5 ft	
z (in)	t(kips)
-2.000	-50.870
-0.500	-50.870
-0.100	-50.870
-0.090	-45.779
-0.080	-40.705
-0.060	-30.531
-0.040	-20.353
-0.020	-10.179
-0.010	-5.087
0.000	0.000
0.010	7.267
0.020	14.541
0.040	29.075
0.060	43.616
0.080	58.150
0.090	65.398
0.100	72.671
0.500	72.671
2.000	72.671

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	257	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	257	Pile Dia.:	18" Octagonal Piles
			Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bents 13&14		GW Elev. =	251		

Note: All depths are in feet.

0' - 3'	
@Depth 0.5 ft	
z (in)	t(kips)
-9.000	-1.277
-7.500	-1.277
-7.100	-1.277
-7.090	-1.149
-7.080	-1.021
-7.060	-0.766
-7.040	-0.511
-7.020	-0.255
-7.010	-0.128
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.182
7.020	0.365
7.040	0.730
7.060	1.094
7.080	1.459
7.090	1.641
7.100	1.824
7.500	1.824
9.000	1.824

3' - 6'	
@Depth 5.5 ft	
z (in)	t(kips)
-9.000	-5.107
-7.500	-5.107
-7.100	-5.107
-7.090	-4.596
-7.080	-4.085
-7.060	-3.064
-7.040	-2.043
-7.020	-1.021
-7.010	-0.511
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.730
7.020	1.459
7.040	2.918
7.060	4.377
7.080	5.836
7.090	6.566
7.100	7.295
7.500	7.295
9.000	7.295

6' - 11'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.848	-4.851
-7.003	-4.851
-6.623	-4.851
-6.433	-4.851
-6.244	-5.389
-6.206	-4.851
-6.162	-4.043
-6.113	-2.696
-6.084	-1.617
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	2.310
6.113	3.851
6.162	5.775
6.206	6.930
6.244	7.699
6.433	6.930
6.623	6.930
7.003	6.930
9.848	6.930

11' - 16'	
@Depth 13.5 ft	
z (in)	t(kips)
-5.111	-3.577
-4.731	-3.577
-4.542	-3.577
-4.352	-3.975
-4.314	-3.577
-4.270	-2.981
-4.221	-1.987
-4.193	-1.192
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.703
4.221	2.839
4.270	4.259
4.314	5.110
4.352	5.679
4.542	5.110
4.731	5.110
5.111	5.110
7.956	5.110

16' - 21'	
@Depth 18.5 ft	
z (in)	t(kips)
-3.219	-4.676
-2.839	-4.676
-2.650	-4.676
-2.460	-5.197
-2.422	-4.676
-2.378	-3.897
-2.329	-2.598
-2.301	-1.559
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	2.227
2.329	3.712
2.378	5.568
2.422	6.680
2.460	7.424
2.650	6.680
2.839	6.680
3.219	6.680
6.064	6.680

21' - 24.5'	
@Depth 23.5 ft	
z (in)	t(kips)
-0.878	-14.065
-0.478	-14.065
-0.468	-12.658
-0.458	-11.253
-0.438	-8.439
-0.418	-5.626
-0.398	-2.812
-0.388	-1.407
-0.378	-0.007
0.000	0.000
0.378	0.010
0.388	2.009
0.398	4.018
0.418	8.038
0.438	12.055
0.458	16.076
0.468	18.083
0.478	20.093
0.878	20.093
2.378	20.093

24.5' - 31'	
@Depth 28.5 ft	
z (in)	t(kips)
-2.000	-26.121
-0.500	-26.121
-0.100	-26.121
-0.090	-23.508
-0.080	-20.898
-0.060	-15.672
-0.040	-10.449
-0.020	-5.223
-0.010	-2.612
0.000	0.000
0.010	3.732
0.020	7.461
0.040	14.927
0.060	22.389
0.080	29.855
0.090	33.583
0.100	37.316
0.500	37.316
2.000	37.316

31' - 36'	
@Depth 33.5 ft	
z (in)	t(kips)
-2.000	-22.979
-0.500	-22.979
-0.100	-22.979
-0.090	-20.681
-0.080	-18.384
-0.060	-13.788
-0.040	-9.192
-0.020	-4.596
-0.010	-2.298
0.000	0.000
0.010	3.283
0.020	6.566
0.040	13.131
0.060	19.697
0.080	26.262
0.090	29.545
0.100	32.828
0.500	32.828
2.000	32.828

36' - 42'	
@Depth 38.5 ft	
z (in)	t(kips)
-2.000	-31.030
-0.500	-31.030
-0.100	-31.030
-0.090	-27.933
-0.080	-24.830
-0.060	-18.621
-0.040	-12.415
-0.020	-6.206
-0.010	-3.103
0.000	0.000
0.010	4.433
0.020	8.866
0.040	17.736
0.060	26.601
0.080	35.471
0.090	39.904
0.100	44.328
0.500	44.328
2.000	44.328

42' - 51'	
@Depth 44.5 ft	
z (in)	t(kips)
-2.000	-52.808
-0.500	-52.808
-0.100	-52.808
-0.090	-47.491
-0.080	-42.232
-0.060	-31.671
-0.040	-21.114
-0.020	-10.557
-0.010	-5.281
0.000	0.000
0.010	7.544
0.020	15.081
0.040	30.163
0.060	45.244
0.080	60.332
0.090	67.844
0.100	75.439
0.500	75.439
2.000	75.439

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit		Elevation (ft)	260	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	260	Pile Dia.:	18" Octagonal Piles
			Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bents 15&16		GW Elev. =	251		

Note: All depths are in feet.

0' - 6'	
@Depth 3.5 ft	
z (in)	t(kips)
-9.000	-6.810
-7.500	-6.810
-7.100	-6.810
-7.090	-6.128
-7.080	-5.446
-7.060	-4.085
-7.040	-2.724
-7.020	-1.362
-7.010	-0.681
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	0.973
7.020	1.945
7.040	3.891
7.060	5.836
7.080	7.780
7.090	8.754
7.100	9.728
7.500	9.728
9.000	9.728

6' - 9'	
@Depth 8.5 ft	
z (in)	t(kips)
-9.000	-7.660
-7.500	-7.660
-7.100	-7.660
-7.090	-6.894
-7.080	-6.128
-7.060	-4.596
-7.040	-3.064
-7.020	-1.532
-7.010	-0.766
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	1.094
7.020	2.189
7.040	4.377
7.060	6.566
7.080	8.754
7.090	9.848
7.100	10.943
7.500	10.943
9.000	10.943

9' - 14'	
@Depth 11.5 ft	
z (in)	t(kips)
-9.848	-3.137
-7.003	-3.137
-6.623	-3.137
-6.433	-3.137
-6.244	-3.487
-6.206	-3.137
-6.162	-2.613
-6.113	-1.743
-6.084	-1.046
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	1.494
6.113	2.490
6.162	3.733
6.206	4.481
6.244	4.981
6.433	4.481
6.623	4.481
7.003	4.481
9.848	4.481

14' - 19'	
@Depth 16.5 ft	
z (in)	t(kips)
-7.956	-3.687
-5.111	-3.687
-4.731	-3.687
-4.542	-3.687
-4.352	-4.098
-4.314	-3.687
-4.270	-3.071
-4.221	-2.048
-4.193	-1.229
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	1.756
4.221	2.926
4.270	4.388
4.314	5.267
4.352	5.854
4.542	5.267
4.731	5.267
5.111	5.267
7.956	5.267

19' - 24'	
@Depth 21.5 ft	
z (in)	t(kips)
-6.064	-4.238
-3.219	-4.238
-2.839	-4.238
-2.650	-4.238
-2.460	-4.709
-2.422	-4.238
-2.378	-3.530
-2.329	-2.354
-2.301	-1.412
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	2.018
2.329	3.363
2.378	5.042
2.422	6.054
2.460	6.726
2.650	6.054
2.839	6.054
3.219	6.054
6.064	6.054

24' - 27.5'	
@Depth 26.5 ft	
z (in)	t(kips)
-4.172	-3.350
-1.327	-3.350
-0.947	-3.350
-0.758	-3.350
-0.568	-3.724
-0.530	-3.350
-0.486	-2.791
-0.437	-1.861
-0.409	-1.117
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.596
0.437	2.658
0.486	3.988
0.530	4.786
0.568	5.319
0.758	4.786
0.947	4.786
1.327	4.786
4.172	4.786

27.5' - 34'	
@Depth 31.5 ft	
z (in)	t(kips)
-2.000	-29.746
-0.500	-29.746
-0.100	-29.746
-0.090	-26.772
-0.080	-23.798
-0.060	-17.849
-0.040	-11.900
-0.020	-5.949
-0.010	-2.975
0.000	0.000
0.010	4.249
0.020	8.498
0.040	17.001
0.060	25.499
0.080	33.997
0.090	38.246
0.100	42.495
0.500	42.495
2.000	42.495

34' - 39'	
@Depth 36.5 ft	
z (in)	t(kips)
-2.000	-25.758
-0.500	-25.758
-0.100	-25.758
-0.090	-23.192
-0.080	-20.614
-0.060	-15.460
-0.040	-10.308
-0.020	-5.154
-0.010	-2.576
0.000	0.000
0.010	3.680
0.020	7.363
0.040	14.726
0.060	22.085
0.080	29.448
0.090	33.132
0.100	36.797
0.500	36.797
2.000	36.797

39' - 45'	
@Depth 41.5 ft	
z (in)	t(kips)
-2.000	-34.394
-0.500	-34.394
-0.100	-34.394
-0.090	-30.940
-0.080	-27.506
-0.060	-20.630
-0.040	-13.755
-0.020	-6.876
-0.010	-3.439
0.000	0.000
0.010	4.913
0.020	9.823
0.040	19.649
0.060	29.472
0.080	39.295
0.090	44.199
0.100	49.134
0.500	49.134
2.000	49.134

45' - 47'	
@Depth 47.5 ft	
z (in)	t(kips)
-2.000	-12.726
-0.500	-12.726
-0.100	-12.726
-0.090	-11.455
-0.080	-10.183
-0.060	-7.639
-0.040	-5.093
-0.020	-2.546
-0.010	-1.273
0.000	0.000
0.010	1.818
0.020	3.638
0.040	7.275
0.060	10.913
0.080	14.547
0.090	16.364
0.100	18.180
0.500	18.180
2.000	18.180

Data: t-z Curves

Br. Name:	Route 43 over Kings River Seismic Retrofit			Elevation (ft)	264	Pile Type:	Octagonal Piles
Br. No. =	45-0064			FG	264	Pile Dia.:	18" Octagonal Piles
				Pile Cut-Off=		Extension Pile Perimeter:	59.6
Support(s):	Bent 17			GW Elev. =	251		

Note: All depths are in feet.

0' - 10'	
@Depth 7.5 ft	
z (in)	t(kips)
-9.000	-25.250
-7.500	-25.250
-7.100	-25.250
-7.090	-22.726
-7.080	-20.202
-7.060	-15.151
-7.040	-10.099
-7.020	-5.052
-7.010	-2.525
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	3.607
7.020	7.217
7.040	14.427
7.060	21.644
7.080	28.860
7.090	32.466
7.100	36.071
7.500	36.071
9.000	36.071

10' - 13'	
@Depth 12.5 ft	
z (in)	t(kips)
-9.000	-9.938
-7.500	-9.938
-7.100	-9.938
-7.090	-8.944
-7.080	-7.950
-7.060	-5.963
-7.040	-3.976
-7.020	-1.988
-7.010	-0.994
-7.000	-0.007
0.000	0.000
7.000	0.010
7.010	1.420
7.020	2.840
7.040	5.680
7.060	8.518
7.080	11.358
7.090	12.778
7.100	14.198
7.500	14.198
9.000	14.198

13' - 18'	
@Depth 15.5 ft	
z (in)	t(kips)
-9.848	-5.780
-7.003	-5.780
-6.623	-5.780
-6.433	-5.780
-6.244	-6.422
-6.206	-5.780
-6.162	-4.816
-6.113	-3.211
-6.084	-1.927
-6.054	-0.007
0.000	0.000
6.054	0.010
6.084	2.752
6.113	4.587
6.162	6.881
6.206	8.257
6.244	9.174
6.433	8.257
6.623	8.257
7.003	8.257
9.848	8.257

18' - 23'	
@Depth 20.5 ft	
z (in)	t(kips)
-7.956	-6.140
-5.111	-6.140
-4.731	-6.140
-4.542	-6.140
-4.352	-6.822
-4.314	-6.140
-4.270	-5.117
-4.221	-3.410
-4.193	-2.047
-4.162	-0.007
0.000	0.000
4.162	0.010
4.193	2.924
4.221	4.871
4.270	7.310
4.314	8.771
4.352	9.746
4.542	8.771
4.731	8.771
5.111	8.771
7.956	8.771

23' - 28'	
@Depth 25.5 ft	
z (in)	t(kips)
-6.064	-5.937
-3.219	-5.937
-2.839	-5.937
-2.650	-5.937
-2.460	-6.597
-2.422	-5.937
-2.378	-4.947
-2.329	-3.298
-2.301	-1.978
-2.270	-0.007
0.000	0.000
2.270	0.010
2.301	2.826
2.329	4.712
2.378	7.067
2.422	8.481
2.460	9.424
2.650	8.481
2.839	8.481
3.219	8.481
6.064	8.481

28' - 31.5'	
@Depth 30.5 ft	
z (in)	t(kips)
-4.172	-3.977
-1.327	-3.977
-0.947	-3.977
-0.758	-3.977
-0.568	-4.419
-0.530	-3.977
-0.486	-3.314
-0.437	-2.210
-0.409	-1.326
-0.378	-0.007
0.000	0.000
0.378	0.010
0.409	1.895
0.437	3.157
0.486	4.735
0.530	5.682
0.568	6.312
0.758	5.682
0.947	5.682
1.327	5.682
4.172	5.682

31.5' - 38'	
@Depth 35.5 ft	
z (in)	t(kips)
-2.000	-21.795
-0.500	-21.795
-0.100	-21.795
-0.090	-19.612
-0.080	-17.432
-0.060	-13.075
-0.040	-8.716
-0.020	-4.359
-0.010	-2.180
0.000	0.000
0.010	3.114
0.020	6.227
0.040	12.451
0.060	18.679
0.080	24.903
0.090	28.017
0.100	31.136
0.500	31.136
2.000	31.136

38' - 43'	
@Depth 40.5 ft	
z (in)	t(kips)
-2.000	-15.940
-0.500	-15.940
-0.100	-15.940
-0.090	-14.342
-0.080	-12.748
-0.060	-9.561
-0.040	-6.373
-0.020	-3.187
-0.010	-1.594
0.000	0.000
0.010	2.277
0.020	4.552
0.040	9.105
0.060	13.659
0.080	18.211
0.090	20.488
0.100	22.771
0.500	22.771
2.000	22.771

43' - 51'	
@Depth 45.5 ft	
z (in)	t(kips)
-2.000	-21.613
-0.500	-21.613
-0.100	-21.613
-0.090	-19.446
-0.080	-17.284
-0.060	-12.964
-0.040	-8.643
-0.020	-4.321
-0.010	-2.161
0.000	0.000
0.010	3.088
0.020	6.172
0.040	12.347
0.060	18.520
0.080	24.692
0.090	27.780
0.100	30.876
0.500	30.876
2.000	30.876

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 2
All depths are measured below ground surface.

Layer 1 0' - 5'

Depth = 2.5 feet	
Elevation = 262.5 feet	
y (in)	p (kip)
-0.61	-22.53
-0.60	-22.53
-0.58	-22.53
-0.42	-19.28
-0.26	-16.02
-0.24	-15.67
-0.22	-15.30
-0.21	-14.91
-0.19	-14.50
-0.17	-14.06
-0.16	-13.59
-0.14	-13.09
-0.12	-12.54
-0.10	-11.94
-0.09	-11.26
-0.07	-10.49
0.00	0.00
0.07	10.49
0.09	11.26
0.10	11.94
0.12	12.54
0.14	13.09
0.16	13.59
0.17	14.06
0.19	14.50
0.21	14.91
0.22	15.30
0.24	15.67
0.26	16.02
0.42	19.28
0.58	22.53
0.60	22.53
0.61	22.53

Layer 2 5' - 10'

Depth = 7.5 feet	
Elevation = 257.5 feet	
y (in)	p (kip)
-0.61	-86.28
-0.60	-86.28
-0.58	-86.28
-0.42	-67.65
-0.26	-49.02
-0.24	-46.58
-0.22	-44.04
-0.20	-41.41
-0.17	-38.67
-0.15	-35.79
-0.13	-32.76
-0.11	-29.53
-0.09	-26.06
-0.07	-22.25
-0.05	-17.98
-0.03	-12.90
0.00	0.00
0.03	12.90
0.05	17.98
0.07	22.25
0.09	26.06
0.11	29.53
0.13	32.76
0.15	35.79
0.17	38.67
0.20	41.41
0.22	44.04
0.24	46.58
0.26	49.02
0.42	67.65
0.58	86.28
0.60	86.28
0.61	86.28

Layer 3 10' - 14'

Depth = 12.5 feet	
Elevation = 252.5 feet	
y (in)	p (kip)
-0.61	-177.78
-0.60	-177.78
-0.58	-177.78
-0.42	-139.40
-0.26	-101.01
-0.24	-97.27
-0.23	-93.43
-0.21	-89.49
-0.20	-85.43
-0.18	-81.24
-0.16	-76.91
-0.15	-72.42
-0.13	-67.73
-0.12	-62.83
-0.10	-57.67
-0.09	-52.19
0.00	0.00
0.09	52.19
0.10	57.67
0.12	62.83
0.13	67.73
0.15	72.42
0.16	76.91
0.18	81.24
0.20	85.43
0.21	89.49
0.23	93.43
0.24	97.27
0.26	101.01
0.42	139.40
0.58	177.78
0.60	177.78
0.61	177.78

Layer 4 14' - 21'

Depth = 17.5 feet	
Elevation = 247.5 feet	
y (in)	p (kip)
-6.59	-22.37
-6.20	-22.37
-5.04	-20.88
-4.04	-19.39
-3.17	-17.90
-2.45	-16.40
-1.84	-14.91
-1.34	-13.42
-0.94	-11.93
-0.63	-10.44
-0.40	-8.95
-0.23	-7.46
-0.12	-5.97
-0.05	-4.47
-0.01	-2.98
0.00	-1.49
0.00	0.00
0.00	1.49
0.01	2.98
0.05	4.47
0.12	5.97
0.23	7.46
0.40	8.95
0.63	10.44
0.94	11.93
1.34	13.42
1.84	14.91
2.45	16.40
3.17	17.90
4.04	19.39
5.04	20.88
6.20	22.37
6.59	22.37

Layer 5 21' - 28'

Depth = 24.5 feet	
Elevation = 240.5 feet	
y (in)	p (kip)
-6.11	-22.99
-5.75	-22.99
-4.67	-21.46
-3.74	-19.93
-2.94	-18.40
-2.27	-16.86
-1.70	-15.33
-1.24	-13.80
-0.87	-12.26
-0.58	-10.73
-0.37	-9.20
-0.21	-7.66
-0.11	-6.13
-0.05	-4.60
-0.01	-3.07
0.00	-1.53
0.00	0.00
0.00	1.53
0.01	3.07
0.05	4.60
0.11	6.13
0.21	7.66
0.37	9.20
0.58	10.73
0.87	12.26
1.24	13.80
1.70	15.33
2.27	16.86
2.94	18.40
3.74	19.93
4.67	21.46
5.75	22.99
6.11	22.99

Layer 6 28' - 37.5'

Depth = 31.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.37	-30.09
-5.05	-30.09
-4.11	-28.08
-3.29	-26.07
-2.59	-24.07
-1.99	-22.06
-1.50	-20.06
-1.09	-18.05
-0.77	-16.05
-0.51	-14.04
-0.32	-12.03
-0.19	-10.03
-0.10	-8.02
-0.04	-6.02
-0.01	-4.01
0.00	-2.01
0.00	0.00
0.00	2.01
0.01	4.01
0.04	6.02
0.10	8.02
0.19	10.03
0.32	12.03
0.51	14.04
0.77	16.05
1.09	18.05
1.50	20.06
1.99	22.06
2.59	24.07
3.29	26.07
4.11	28.08
5.05	30.09
5.37	30.09

Layer 7 37.5' - 42'

Depth = 38.5 feet	
Elevation = 226.5 feet	
y (in)	p (kip)
-0.43	-191.72
-0.42	-191.72
-0.41	-191.72
-0.40	-187.51
-0.38	-183.30
-0.37	-179.10
-0.36	-174.89
-0.35	-170.69
-0.34	-166.48
-0.33	-162.28
-0.32	-158.07
-0.30	-153.87
-0.29	-149.66
-0.28	-145.45
-0.27	-141.09
-0.26	-135.07
0.00	0.00
0.26	135.07
0.27	141.09
0.28	145.45
0.29	149.66
0.30	153.87
0.32	158.07
0.33	162.28
0.34	166.48
0.35	170.69
0.36	174.89
0.37	179.10
0.38	183.30
0.40	187.51
0.41	191.72
0.42	191.72
0.43	191.72

Layer 8 42' - 47'

Depth = 44.5 feet	
Elevation = 220.5 feet	
y (in)	p (kip)
-0.47	-349.97
-0.46	-349.97
-0.44	-349.97
-0.41	-324.97
-0.38	-299.97
-0.35	-274.98
-0.32	-249.98
-0.29	-224.98
-0.25	-199.98
-0.22	-174.99
-0.19	-149.99
-0.16	-124.99
-0.13	-99.99
-0.10	-74.99
-0.06	-50.00
-0.03	-25.00
0.00	0.00
0.03	25.00
0.06	50.00
0.10	74.99
0.13	99.99
0.16	124.99
0.19	149.99
0.22	174.99
0.25	199.98
0.29	224.98
0.32	249.98
0.35	274.98
0.38	299.97
0.41	324.97
0.44	349.97
0.46	349.97
0.47	349.97

Layer 9 47' - 50'

Depth = 47.5 feet	
Elevation = 217.5 feet	
y (in)	p (kip)
-0.40	-203.43
-0.39	-203.43
-0.38	-203.43
-0.35	-188.90
-0.33	-174.37
-0.30	-159.84
-0.27	-145.30
-0.24	-130.77
-0.22	-116.24
-0.19	-101.71
-0.16	-87.18
-0.14	-72.65
-0.11	-58.12
-0.08	-43.59
-0.05	-29.06
-0.03	-14.53
0.00	0.00
0.03	14.53
0.05	29.06
0.08	43.59
0.11	58.12
0.14	72.65
0.16	87.18
0.19	101.71
0.22	116.24
0.24	130.77
0.27	145.30
0.30	159.84
0.33	174.37
0.35	188.90
0.38	203.43
0.39	203.43
0.40	203.43

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 3
All depths are measured below ground surface.

Layer 1 0' - 5'

Depth = 3.5 feet	
Elevation = 252.5 feet	
y (in)	p (kip)
-0.61	-29.89
-0.60	-29.89
-0.58	-29.89
-0.42	-25.22
-0.26	-20.56
-0.24	-20.02
-0.22	-19.45
-0.20	-18.85
-0.18	-18.21
-0.17	-17.54
-0.15	-16.81
-0.13	-16.02
-0.11	-15.16
-0.09	-14.20
-0.07	-13.12
-0.06	-11.85
0.00	0.00
0.06	11.85
0.07	13.12
0.09	14.20
0.11	15.16
0.13	16.02
0.15	16.81
0.17	17.54
0.18	18.21
0.20	18.85
0.22	19.45
0.24	20.02
0.26	20.56
0.42	25.22
0.58	29.89
0.60	29.89
0.61	29.89

Layer 2 5' - 12'

Depth = 8.5 feet	
Elevation = 247.5 feet	
y (in)	p (kip)
-6.59	-13.78
-6.20	-13.78
-5.04	-12.86
-4.04	-11.94
-3.17	-11.03
-2.45	-10.11
-1.84	-9.19
-1.34	-8.27
-0.94	-7.35
-0.63	-6.43
-0.40	-5.51
-0.23	-4.59
-0.12	-3.68
-0.05	-2.76
-0.01	-1.84
0.00	-0.92
0.00	0.00
0.00	0.92
0.01	1.84
0.05	2.76
0.12	3.68
0.23	4.59
0.40	5.51
0.63	6.43
0.94	7.35
1.34	8.27
1.84	9.19
2.45	10.11
3.17	11.03
4.04	11.94
5.04	12.86
6.20	13.78
6.59	13.78

Layer 3 12' - 19'

Depth = 15.5 feet	
Elevation = 240.5 feet	
y (in)	p (kip)
-6.11	-15.70
-5.75	-15.70
-4.67	-14.66
-3.74	-13.61
-2.94	-12.56
-2.27	-11.52
-1.70	-10.47
-1.24	-9.42
-0.87	-8.38
-0.58	-7.33
-0.37	-6.28
-0.21	-5.23
-0.11	-4.19
-0.05	-3.14
-0.01	-2.09
0.00	-1.05
0.00	0.00
0.00	1.05
0.01	2.09
0.05	3.14
0.11	4.19
0.21	5.23
0.37	6.28
0.58	7.33
0.87	8.38
1.24	9.42
1.70	10.47
2.27	11.52
2.94	12.56
3.74	13.61
4.67	14.66
5.75	15.70
6.11	15.70

Layer 4 19' - 28.5'

Depth = 22.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.37	-22.20
-5.05	-22.20
-4.11	-20.72
-3.29	-19.24
-2.59	-17.76
-1.99	-16.28
-1.50	-14.80
-1.09	-13.32
-0.77	-11.84
-0.51	-10.36
-0.32	-8.88
-0.19	-7.40
-0.10	-5.92
-0.04	-4.44
-0.01	-2.96
0.00	-1.48
0.00	0.00
0.00	1.48
0.01	2.96
0.04	4.44
0.10	5.92
0.19	7.40
0.32	8.88
0.51	10.36
0.77	11.84
1.09	13.32
1.50	14.80
1.99	16.28
2.59	17.76
3.29	19.24
4.11	20.72
5.05	22.20
5.37	22.20

Layer 5 28.5' - 33'

Depth = 29.5 feet	
Elevation = 226.5 feet	
y (in)	p (kip)
-0.43	-91.06
-0.42	-91.06
-0.41	-91.06
-0.39	-88.12
-0.37	-85.19
-0.36	-82.26
-0.34	-79.32
-0.32	-76.39
-0.31	-73.46
-0.29	-70.52
-0.27	-67.59
-0.26	-64.66
-0.24	-61.72
-0.22	-58.79
-0.21	-55.86
-0.19	-52.92
0.00	0.00
0.19	52.92
0.21	55.86
0.22	58.79
0.24	61.72
0.26	64.66
0.27	67.59
0.29	70.52
0.31	73.46
0.32	76.39
0.34	79.32
0.36	82.26
0.37	85.19
0.39	88.12
0.41	91.06
0.42	91.06
0.43	91.06

Layer 6 33' - 38'

Depth = 35.5 feet	
Elevation = 220.5 feet	
y (in)	p (kip)
-0.48	-209.01
-0.46	-209.01
-0.45	-209.01
-0.42	-194.08
-0.39	-179.15
-0.36	-164.22
-0.32	-149.29
-0.29	-134.36
-0.26	-119.44
-0.23	-104.51
-0.19	-89.58
-0.16	-74.65
-0.13	-59.72
-0.10	-44.79
-0.06	-29.86
-0.03	-14.93
0.00	0.00
0.03	14.93
0.06	29.86
0.10	44.79
0.13	59.72
0.16	74.65
0.19	89.58
0.23	104.51
0.26	119.44
0.29	134.36
0.32	149.29
0.36	164.22
0.39	179.15
0.42	194.08
0.45	209.01
0.46	209.01
0.48	209.01

Layer 7 38' - 41'

Depth = 38.5 feet	
Elevation = 217.5 feet	
y (in)	p (kip)
-0.46	-142.06
-0.45	-142.06
-0.44	-142.06
-0.41	-131.92
-0.38	-121.77
-0.35	-111.62
-0.32	-101.47
-0.28	-91.33
-0.25	-81.18
-0.22	-71.03
-0.19	-60.88
-0.16	-50.74
-0.13	-40.59
-0.09	-30.44
-0.06	-20.29
-0.03	-10.15
0.00	0.00
0.03	10.15
0.06	20.29
0.09	30.44
0.13	40.59
0.16	50.74
0.19	60.88
0.22	71.03
0.25	81.18
0.28	91.33
0.32	101.47
0.35	111.62
0.38	121.77
0.41	131.92
0.44	142.06
0.45	142.06
0.46	142.06

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 4, 5, AND 6
All depths are measured below ground surface.

Layer 1 0' - 7'

Depth = 4.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.43	-11.27
-6.05	-11.27
-4.92	-10.52
-3.94	-9.76
-3.10	-9.01
-2.39	-8.26
-1.79	-7.51
-1.31	-6.76
-0.92	-6.01
-0.61	-5.26
-0.39	-4.51
-0.22	-3.76
-0.11	-3.00
-0.05	-2.25
-0.01	-1.50
0.00	-0.75
0.00	0.00
0.00	0.75
0.01	1.50
0.05	2.25
0.11	3.00
0.22	3.76
0.39	4.51
0.61	5.26
0.92	6.01
1.31	6.76
1.79	7.51
2.39	8.26
3.10	9.01
3.94	9.76
4.92	10.52
6.05	11.27
6.43	11.27

Layer 2 7' - 12'

Depth = 9.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-5.90	-12.30
-5.55	-12.30
-4.51	-11.48
-3.61	-10.66
-2.84	-9.84
-2.19	-9.02
-1.64	-8.20
-1.20	-7.38
-0.84	-6.56
-0.56	-5.74
-0.36	-4.92
-0.21	-4.10
-0.11	-3.28
-0.04	-2.46
-0.01	-1.64
0.00	-0.82
0.00	0.00
0.00	0.82
0.01	1.64
0.04	2.46
0.11	3.28
0.21	4.10
0.36	4.92
0.56	5.74
0.84	6.56
1.20	7.38
1.64	8.20
2.19	9.02
2.84	9.84
3.61	10.66
4.51	11.48
5.55	12.30
5.90	12.30

Layer 3 12' - 15.5'

Depth = 14.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.37	-10.97
-5.05	-10.97
-4.11	-10.24
-3.29	-9.51
-2.59	-8.78
-1.99	-8.05
-1.50	-7.31
-1.09	-6.58
-0.77	-5.85
-0.51	-5.12
-0.32	-4.39
-0.19	-3.66
-0.10	-2.93
-0.04	-2.19
-0.01	-1.46
0.00	-0.73
0.00	0.00
0.00	0.73
0.01	1.46
0.04	2.19
0.10	2.93
0.19	3.66
0.32	4.39
0.51	5.12
0.77	5.85
1.09	6.58
1.50	7.31
1.99	8.05
2.59	8.78
3.29	9.51
4.11	10.24
5.05	10.97
5.37	10.97

Layer 4 15.5' - 22'

Depth = 19.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.45	-121.89
-0.44	-121.89
-0.43	-121.89
-0.31	-95.57
-0.19	-69.25
-0.18	-68.01
-0.18	-66.76
-0.17	-65.48
-0.17	-64.20
-0.16	-62.89
-0.16	-61.57
-0.15	-60.23
-0.15	-58.87
-0.14	-57.49
-0.13	-56.09
-0.13	-54.66
0.00	0.00
0.13	54.66
0.13	56.09
0.14	57.49
0.15	58.87
0.15	60.23
0.16	61.57
0.16	62.89
0.17	64.20
0.17	65.48
0.18	66.76
0.18	68.01
0.19	69.25
0.31	95.57
0.43	121.89
0.44	121.89
0.45	121.89

Layer 5 22' - 28'

Depth = 24.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.40	-208.61
-0.39	-208.61
-0.38	-205.79
-0.38	-203.59
-0.37	-201.39
-0.37	-199.19
-0.36	-196.99
-0.36	-194.79
-0.36	-192.59
-0.35	-190.39
-0.35	-188.19
-0.34	-185.99
-0.34	-183.79
-0.34	-181.59
-0.33	-179.39
-0.33	-177.18
0.00	0.00
0.33	177.18
0.33	179.39
0.34	181.59
0.34	183.79
0.34	185.99
0.35	188.19
0.35	190.39
0.36	192.59
0.36	194.79
0.36	196.99
0.37	199.19
0.37	201.39
0.38	203.59
0.38	205.79
0.39	208.61
0.40	208.61

Layer 6 28' - 33'

Depth = 29.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.35	-223.46
-0.34	-223.46
-0.33	-223.46
-0.32	-218.75
-0.31	-214.04
-0.31	-209.33
-0.30	-204.62
-0.29	-199.91
-0.28	-195.20
-0.27	-190.49
-0.26	-185.78
-0.25	-181.08
-0.24	-176.37
-0.23	-171.66
-0.22	-166.29
-0.22	-159.61
0.00	0.00
0.22	159.61
0.22	166.29
0.23	171.66
0.24	176.37
0.25	181.08
0.26	185.78
0.27	190.49
0.28	195.20
0.29	199.91
0.30	204.62
0.31	209.33
0.31	214.04
0.32	218.75
0.33	223.46
0.34	223.46
0.35	223.46

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 7
All depths are measured below ground surface.

Layer 1 0' - 7'

Depth = 4.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-3.00
-6.20	-3.00
-5.04	-2.80
-4.04	-2.60
-3.17	-2.40
-2.45	-2.20
-1.84	-2.00
-1.34	-1.80
-0.94	-1.60
-0.63	-1.40
-0.40	-1.20
-0.23	-1.00
-0.12	-0.80
-0.05	-0.60
-0.01	-0.40
0.00	-0.20
0.00	0.00
0.00	0.20
0.01	0.40
0.05	0.60
0.12	0.80
0.23	1.00
0.40	1.20
0.63	1.40
0.94	1.60
1.34	1.80
1.84	2.00
2.45	2.20
3.17	2.40
4.04	2.60
5.04	2.80
6.20	3.00
6.59	3.00

Layer 2 7' - 12'

Depth = 9.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.43	-8.05
-6.05	-8.05
-4.92	-7.51
-3.94	-6.97
-3.10	-6.44
-2.39	-5.90
-1.79	-5.37
-1.31	-4.83
-0.92	-4.29
-0.61	-3.76
-0.39	-3.22
-0.22	-2.68
-0.11	-2.15
-0.05	-1.61
-0.01	-1.07
0.00	-0.54
0.00	0.00
0.00	0.54
0.01	1.07
0.05	1.61
0.11	2.15
0.22	2.68
0.39	3.22
0.61	3.76
0.92	4.29
1.31	4.83
1.79	5.37
2.39	5.90
3.10	6.44
3.94	6.97
4.92	7.51
6.05	8.05
6.43	8.05

Layer 3 12' - 17'

Depth = 14.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-5.90	-12.30
-5.55	-12.30
-4.51	-11.48
-3.61	-10.66
-2.84	-9.84
-2.19	-9.02
-1.64	-8.20
-1.20	-7.38
-0.84	-6.56
-0.56	-5.74
-0.36	-4.92
-0.21	-4.10
-0.11	-3.28
-0.04	-2.46
-0.01	-1.64
0.00	-0.82
0.00	0.00
0.00	0.82
0.01	1.64
0.04	2.46
0.11	3.28
0.21	4.10
0.36	4.92
0.56	5.74
0.84	6.56
1.20	7.38
1.64	8.20
2.19	9.02
2.84	9.84
3.61	10.66
4.51	11.48
5.55	12.30
5.90	12.30

Layer 4 17' - 20.5'

Depth = 19.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.37	-10.97
-5.05	-10.97
-4.11	-10.24
-3.29	-9.51
-2.59	-8.78
-1.99	-8.05
-1.50	-7.31
-1.09	-6.58
-0.77	-5.85
-0.51	-5.12
-0.32	-4.39
-0.19	-3.66
-0.10	-2.93
-0.04	-2.19
-0.01	-1.46
0.00	-0.73
0.00	0.00
0.00	0.73
0.01	1.46
0.04	2.19
0.10	2.93
0.19	3.66
0.32	4.39
0.51	5.12
0.77	5.85
1.09	6.58
1.50	7.31
1.99	8.05
2.59	8.78
3.29	9.51
4.11	10.24
5.05	10.97
5.37	10.97

Layer 5 20.5' - 27'

Depth = 24.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.45	-121.89
-0.44	-121.89
-0.43	-121.89
-0.31	-95.57
-0.19	-69.25
-0.18	-68.01
-0.18	-66.76
-0.17	-65.48
-0.17	-64.20
-0.16	-62.89
-0.16	-61.57
-0.15	-60.23
-0.15	-58.87
-0.14	-57.49
-0.13	-56.09
-0.13	-54.66
0.00	0.00
0.13	54.66
0.13	56.09
0.14	57.49
0.15	58.87
0.15	60.23
0.16	61.57
0.16	62.89
0.17	64.20
0.17	65.48
0.18	66.76
0.18	68.01
0.19	69.25
0.31	95.57
0.43	121.89
0.44	121.89
0.45	121.89

Layer 6 27' - 33'

Depth = 29.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.40	-208.61
-0.39	-208.61
-0.38	-205.79
-0.38	-203.59
-0.37	-201.39
-0.37	-199.19
-0.36	-196.99
-0.36	-194.79
-0.36	-192.59
-0.35	-190.39
-0.35	-188.19
-0.34	-185.99
-0.34	-183.79
-0.34	-181.59
-0.33	-179.39
-0.33	-177.18
0.00	0.00
0.33	177.18
0.33	179.39
0.34	181.59
0.34	183.79
0.34	185.99
0.35	188.19
0.35	190.39
0.36	192.59
0.36	194.79
0.36	196.99
0.37	199.19
0.37	201.39
0.38	203.59
0.38	205.79
0.39	208.61
0.40	208.61

Layer 7 33' - 44'

Depth = 34.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.35	-491.61
-0.34	-491.61
-0.33	-491.61
-0.32	-481.25
-0.31	-470.89
-0.31	-460.53
-0.30	-450.17
-0.29	-439.81
-0.28	-429.45
-0.27	-419.09
-0.26	-408.73
-0.25	-398.37
-0.24	-388.01
-0.23	-377.65
-0.22	-365.84
-0.22	-351.14
0.00	0.00
0.22	351.14
0.22	365.84
0.23	377.65
0.24	388.01
0.25	398.37
0.26	408.73
0.27	419.09
0.28	429.45
0.29	439.81
0.30	450.17
0.31	460.53
0.31	470.89
0.32	481.25
0.33	491.61
0.34	491.61
0.35	491.61

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 8
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 2.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.61	-79.88
-0.60	-79.88
-0.58	-79.88
-0.42	-62.63
-0.26	-45.39
-0.24	-43.31
-0.22	-41.16
-0.20	-38.94
-0.18	-36.64
-0.16	-34.24
-0.14	-31.73
-0.12	-29.07
-0.11	-26.26
-0.09	-23.23
-0.07	-19.92
-0.05	-16.21
0.00	0.00
0.05	16.21
0.07	19.92
0.09	23.23
0.11	26.26
0.12	29.07
0.14	31.73
0.16	34.24
0.18	36.64
0.20	38.94
0.22	41.16
0.24	43.31
0.26	45.39
0.42	62.63
0.58	79.88
0.60	79.88
0.61	79.88

Layer 2 3' - 8'

Depth = 5.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 3 8' - 13'

Depth = 10.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 4 13' - 18'

Depth = 15.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 5 18' - 21.5'

Depth = 20.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 6 21.5' - 28'

Depth = 25.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 7 28' - 33'

Depth = 30.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 8 33' - 39'

Depth = 35.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.47	-378.49
-0.46	-378.49
-0.45	-378.49
-0.41	-351.45
-0.38	-324.42
-0.35	-297.38
-0.32	-270.35
-0.29	-243.31
-0.25	-216.28
-0.22	-189.24
-0.19	-162.21
-0.16	-135.17
-0.13	-108.14
-0.10	-81.10
-0.06	-54.07
-0.03	-27.03
0.00	0.00
0.03	27.03
0.06	54.07
0.10	81.10
0.13	108.14
0.16	135.17
0.19	162.21
0.22	189.24
0.25	216.28
0.29	243.31
0.32	270.35
0.35	297.38
0.38	324.42
0.41	351.45
0.45	378.49
0.46	378.49
0.47	378.49

Layer 9 39' - 45'

Depth = 41.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip/ft)
-0.36	-355.34
-0.35	-355.34
-0.35	-355.34
-0.32	-329.96
-0.30	-304.58
-0.27	-279.20
-0.25	-253.81
-0.22	-228.43
-0.20	-203.05
-0.17	-177.67
-0.15	-152.29
-0.12	-126.91
-0.10	-101.53
-0.07	-76.14
-0.05	-50.76
-0.02	-25.38
0.00	0.00
0.02	25.38
0.05	50.76
0.07	76.14
0.10	101.53
0.12	126.91
0.15	152.29
0.17	177.67
0.20	203.05
0.22	228.43
0.25	253.81
0.27	279.20
0.30	304.58
0.32	329.96
0.35	355.34
0.35	355.34
0.36	355.34

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 9
All depths are measured below ground surface.

Layer 1 0' - 5'

Depth = 4.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.61	-133.13
-0.60	-133.13
-0.58	-133.13
-0.42	-104.39
-0.26	-75.64
-0.24	-72.18
-0.22	-68.61
-0.20	-64.91
-0.18	-61.07
-0.16	-57.07
-0.14	-52.88
-0.12	-48.46
-0.11	-43.76
-0.09	-38.72
-0.07	-33.20
-0.05	-27.02
0.00	0.00
0.05	27.02
0.07	33.20
0.09	38.72
0.11	43.76
0.12	48.46
0.14	52.88
0.16	57.07
0.18	61.07
0.20	64.91
0.22	68.61
0.24	72.18
0.26	75.64
0.42	104.39
0.58	133.13
0.60	133.13
0.61	133.13

Layer 2 5' - 10'

Depth = 7.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 3 10' - 15'

Depth = 12.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 4 15' - 20'

Depth = 17.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 5 20' - 23.5'

Depth = 22.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 6 23.5' - 30'

Depth = 27.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 7 30' - 35'

Depth = 32.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 8 35' - 41'

Depth = 37.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.47	-378.49
-0.46	-378.49
-0.45	-378.49
-0.41	-351.45
-0.38	-324.42
-0.35	-297.38
-0.32	-270.35
-0.29	-243.31
-0.25	-216.28
-0.22	-189.24
-0.19	-162.21
-0.16	-135.17
-0.13	-108.14
-0.10	-81.10
-0.06	-54.07
-0.03	-27.03
0.00	0.00
0.03	27.03
0.06	54.07
0.10	81.10
0.13	108.14
0.16	135.17
0.19	162.21
0.22	189.24
0.25	216.28
0.29	243.31
0.32	270.35
0.35	297.38
0.38	324.42
0.41	351.45
0.45	378.49
0.46	378.49
0.47	378.49

Layer 9 41' - 53'

Depth = 43.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.36	-710.68
-0.35	-710.68
-0.35	-710.68
-0.32	-659.92
-0.30	-609.15
-0.27	-558.39
-0.25	-507.63
-0.22	-456.87
-0.20	-406.10
-0.17	-355.34
-0.15	-304.58
-0.12	-253.81
-0.10	-203.05
-0.07	-152.29
-0.05	-101.53
-0.02	-50.76
0.00	0.00
0.02	50.76
0.05	101.53
0.07	152.29
0.10	203.05
0.12	253.81
0.15	304.58
0.17	355.34
0.20	406.10
0.22	456.87
0.25	507.63
0.27	558.39
0.30	609.15
0.32	659.92
0.35	710.68
0.35	710.68
0.36	710.68

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 10 AND 11
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 0.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.61	-23.33
-0.60	-23.33
-0.58	-23.33
-0.42	-19.06
-0.26	-14.79
-0.24	-14.25
-0.22	-13.68
-0.20	-13.09
-0.18	-12.46
-0.16	-11.79
-0.14	-11.07
-0.12	-10.29
-0.10	-9.44
-0.08	-8.49
-0.06	-7.40
-0.04	-6.07
0.00	0.00
0.04	6.07
0.06	7.40
0.08	8.49
0.10	9.44
0.12	10.29
0.14	11.07
0.16	11.79
0.18	12.46
0.20	13.09
0.22	13.68
0.24	14.25
0.26	14.79
0.42	19.06
0.58	23.33
0.60	23.33
0.61	23.33

Layer 2 3' - 6'

Depth = 5.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.61	-79.88
-0.60	-79.88
-0.58	-79.88
-0.42	-62.63
-0.26	-45.39
-0.24	-43.31
-0.22	-41.16
-0.20	-38.94
-0.18	-36.64
-0.16	-34.24
-0.14	-31.73
-0.12	-29.07
-0.11	-26.26
-0.09	-23.23
-0.07	-19.92
-0.05	-16.21
0.00	0.00
0.05	16.21
0.07	19.92
0.09	23.23
0.11	26.26
0.12	29.07
0.14	31.73
0.16	34.24
0.18	36.64
0.20	38.94
0.22	41.16
0.24	43.31
0.26	45.39
0.42	62.63
0.58	79.88
0.60	79.88
0.61	79.88

Layer 3 6' - 11'

Depth = 8.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 4 11' - 16'

Depth = 13.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 5 16' - 21'

Depth = feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 6 21' - 24.5'

Depth = 23.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 7 24.5' - 31'

Depth = 28.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 8 31' - 36'

Depth = 33.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 9 36' - 42'

Depth = 38.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.47	-378.49
-0.46	-378.49
-0.45	-378.49
-0.41	-351.45
-0.38	-324.42
-0.35	-297.38
-0.32	-270.35
-0.29	-243.31
-0.25	-216.28
-0.22	-189.24
-0.19	-162.21
-0.16	-135.17
-0.13	-108.14
-0.10	-81.10
-0.06	-54.07
-0.03	-27.03
0.00	0.00
0.03	27.03
0.06	54.07
0.10	81.10
0.13	108.14
0.16	135.17
0.19	162.21
0.22	189.24
0.25	216.28
0.29	243.31
0.32	270.35
0.35	297.38
0.38	324.42
0.41	351.45
0.45	378.49
0.46	378.49
0.47	378.49

Layer 10 42' - 51'

Depth = 44.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.36	-533.01
-0.35	-533.01
-0.35	-533.01
-0.32	-494.94
-0.30	-456.87
-0.27	-418.79
-0.25	-380.72
-0.22	-342.65
-0.20	-304.58
-0.17	-266.50
-0.15	-228.43
-0.12	-190.36
-0.10	-152.29
-0.07	-114.22
-0.05	-76.14
-0.02	-38.07
0.00	0.00
0.02	38.07
0.05	76.14
0.07	114.22
0.10	152.29
0.12	190.36
0.15	228.43
0.17	266.50
0.20	304.58
0.22	342.65
0.25	380.72
0.27	418.79
0.30	456.87
0.32	494.94
0.35	533.01
0.35	533.01
0.36	533.01

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 12, 13, AND 14
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 0.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.61	-23.33
-0.60	-23.33
-0.58	-23.33
-0.42	-19.06
-0.26	-14.79
-0.24	-14.25
-0.22	-13.68
-0.20	-13.09
-0.18	-12.46
-0.16	-11.79
-0.14	-11.07
-0.12	-10.29
-0.10	-9.44
-0.08	-8.49
-0.06	-7.40
-0.04	-6.07
0.00	0.00
0.04	6.07
0.06	7.40
0.08	8.49
0.10	9.44
0.12	10.29
0.14	11.07
0.16	11.79
0.18	12.46
0.20	13.09
0.22	13.68
0.24	14.25
0.26	14.79
0.42	19.06
0.58	23.33
0.60	23.33
0.61	23.33

Layer 2 3' - 6'

Depth = 5.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.61	-79.88
-0.60	-79.88
-0.58	-79.88
-0.42	-62.63
-0.26	-45.39
-0.24	-43.31
-0.22	-41.16
-0.20	-38.94
-0.18	-36.64
-0.16	-34.24
-0.14	-31.73
-0.12	-29.07
-0.11	-26.26
-0.09	-23.23
-0.07	-19.92
-0.05	-16.21
0.00	0.00
0.05	16.21
0.07	19.92
0.09	23.23
0.11	26.26
0.12	29.07
0.14	31.73
0.16	34.24
0.18	36.64
0.20	38.94
0.22	41.16
0.24	43.31
0.26	45.39
0.42	62.63
0.58	79.88
0.60	79.88
0.61	79.88

Layer 3 6' - 11'

Depth = 8.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 4 11' - 16'

Depth = 13.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 5 16' - 21'

Depth = 18.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 6 21' - 24.5'

Depth = 23.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 7 24.5' - 31'

Depth = 28.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 8 31' - 36'

Depth = 33.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 9 36' - 42'

Depth = 38.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.47	-378.49
-0.46	-378.49
-0.45	-378.49
-0.41	-351.45
-0.38	-324.42
-0.35	-297.38
-0.32	-270.35
-0.29	-243.31
-0.25	-216.28
-0.22	-189.24
-0.19	-162.21
-0.16	-135.17
-0.13	-108.14
-0.10	-81.10
-0.06	-54.07
-0.03	-27.03
0.00	0.00
0.03	27.03
0.06	54.07
0.10	81.10
0.13	108.14
0.16	135.17
0.19	162.21
0.22	189.24
0.25	216.28
0.29	243.31
0.32	270.35
0.35	297.38
0.38	324.42
0.41	351.45
0.45	378.49
0.46	378.49
0.47	378.49

Layer 10 42' - 51'

Depth = 44.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.36	-533.01
-0.35	-533.01
-0.35	-533.01
-0.32	-494.94
-0.30	-456.87
-0.27	-418.79
-0.25	-380.72
-0.22	-342.65
-0.20	-304.58
-0.17	-266.50
-0.15	-228.43
-0.12	-190.36
-0.10	-152.29
-0.07	-114.22
-0.05	-76.14
-0.02	-38.07
0.00	0.00
0.02	38.07
0.05	76.14
0.07	114.22
0.10	152.29
0.12	190.36
0.15	228.43
0.17	266.50
0.20	304.58
0.22	342.65
0.25	380.72
0.27	418.79
0.30	456.87
0.32	494.94
0.35	533.01
0.35	533.01
0.36	533.01

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 15 AND 16
All depths are measured below ground surface.

Layer 1 0' - 6'

Depth = 3.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.61	-46.67
-0.60	-46.67
-0.58	-46.67
-0.42	-38.13
-0.26	-29.59
-0.24	-28.50
-0.22	-27.37
-0.20	-26.17
-0.18	-24.91
-0.16	-23.57
-0.14	-22.14
-0.12	-20.59
-0.10	-18.89
-0.08	-16.99
-0.06	-14.80
-0.04	-12.14
0.00	0.00
0.04	12.14
0.06	14.80
0.08	16.99
0.10	18.89
0.12	20.59
0.14	22.14
0.16	23.57
0.18	24.91
0.20	26.17
0.22	27.37
0.24	28.50
0.26	29.59
0.42	38.13
0.58	46.67
0.60	46.67
0.61	46.67

Layer 2 6' - 9'

Depth = 8.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.61	-79.88
-0.60	-79.88
-0.58	-79.88
-0.42	-62.63
-0.26	-45.39
-0.24	-43.31
-0.22	-41.16
-0.20	-38.94
-0.18	-36.64
-0.16	-34.24
-0.14	-31.73
-0.12	-29.07
-0.11	-26.26
-0.09	-23.23
-0.07	-19.92
-0.05	-16.21
0.00	0.00
0.05	16.21
0.07	19.92
0.09	23.23
0.11	26.26
0.12	29.07
0.14	31.73
0.16	34.24
0.18	36.64
0.20	38.94
0.22	41.16
0.24	43.31
0.26	45.39
0.42	62.63
0.58	79.88
0.60	79.88
0.61	79.88

Layer 3 9' - 14'

Depth = 11.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 4 14' - 19'

Depth = 16.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 5 19' - 24'

Depth = 21.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 6 24' - 27.5'

Depth = 26.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 7 27.5' - 34'

Depth = 31.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 8 34' - 39'

Depth = 36.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 9 39' - 45'

Depth = 41.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.47	-378.49
-0.46	-378.49
-0.45	-378.49
-0.41	-351.45
-0.38	-324.42
-0.35	-297.38
-0.32	-270.35
-0.29	-243.31
-0.25	-216.28
-0.22	-189.24
-0.19	-162.21
-0.16	-135.17
-0.13	-108.14
-0.10	-81.10
-0.06	-54.07
-0.03	-27.03
0.00	0.00
0.03	27.03
0.06	54.07
0.10	81.10
0.13	108.14
0.16	135.17
0.19	162.21
0.22	189.24
0.25	216.28
0.29	243.31
0.32	270.35
0.35	297.38
0.38	324.42
0.41	351.45
0.45	378.49
0.46	378.49
0.47	378.49

Layer 10 45' - 47'

Depth = 47.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.36	-118.45
-0.35	-118.45
-0.35	-118.45
-0.32	-109.99
-0.30	-101.53
-0.27	-93.07
-0.25	-84.60
-0.22	-76.14
-0.20	-67.68
-0.17	-59.22
-0.15	-50.76
-0.12	-42.30
-0.10	-33.84
-0.07	-25.38
-0.05	-16.92
-0.02	-8.46
0.00	0.00
0.02	8.46
0.05	16.92
0.07	25.38
0.10	33.84
0.12	42.30
0.15	50.76
0.17	59.22
0.20	67.68
0.22	76.14
0.25	84.60
0.27	93.07
0.30	101.53
0.32	109.99
0.35	118.45
0.35	118.45
0.36	118.45

P-Y CURVES TABULAR DATA
ORIGINAL 15.5" TAPERED STEEL PILES
BENT 17
All depths are measured below ground surface.

Layer 1 0' - 10'
Depth = 7.5 feet
Elevation = 256.5 feet

y (in)	p (kip)
-0.61	-77.78
-0.60	-77.78
-0.58	-77.78
-0.42	-63.55
-0.26	-49.31
-0.24	-47.50
-0.22	-45.61
-0.20	-43.62
-0.18	-41.52
-0.16	-39.29
-0.14	-36.90
-0.12	-34.31
-0.10	-31.48
-0.08	-28.31
-0.06	-24.66
-0.04	-20.24
0.00	0.00
0.04	20.24
0.06	24.66
0.08	28.31
0.10	31.48
0.12	34.31
0.14	36.90
0.16	39.29
0.18	41.52
0.20	43.62
0.22	45.61
0.24	47.50
0.26	49.31
0.42	63.55
0.58	77.78
0.60	77.78
0.61	77.78

Layer 2 10' - 13'
Depth = 12.5 feet
Elevation = 251.5 feet

y (in)	p (kip)
-0.61	-79.88
-0.60	-79.88
-0.58	-79.88
-0.42	-62.63
-0.26	-45.39
-0.24	-43.31
-0.22	-41.16
-0.20	-38.94
-0.18	-36.64
-0.16	-34.24
-0.14	-31.73
-0.12	-29.07
-0.11	-26.26
-0.09	-23.23
-0.07	-19.92
-0.05	-16.21
0.00	0.00
0.05	16.21
0.07	19.92
0.09	23.23
0.11	26.26
0.12	29.07
0.14	31.73
0.16	34.24
0.18	36.64
0.20	38.94
0.22	41.16
0.24	43.31
0.26	45.39
0.42	62.63
0.58	79.88
0.60	79.88
0.61	79.88

Layer 3 13' - 18'
Depth = 15.5 feet
Elevation = 248.5 feet

y (in)	p (kip)
-6.59	-12.06
-6.20	-12.06
-5.04	-11.26
-4.04	-10.46
-3.17	-9.65
-2.45	-8.85
-1.84	-8.04
-1.34	-7.24
-0.94	-6.43
-0.63	-5.63
-0.40	-4.83
-0.23	-4.02
-0.12	-3.22
-0.05	-2.41
-0.01	-1.61
0.00	-0.80
0.00	0.00
0.00	0.80
0.01	1.61
0.05	2.41
0.12	3.22
0.23	4.02
0.40	4.83
0.63	5.63
0.94	6.43
1.34	7.24
1.84	8.04
2.45	8.85
3.17	9.65
4.04	10.46
5.04	11.26
6.20	12.06
6.59	12.06

Layer 4 18' - 23'
Depth = 20.5 feet
Elevation = 243.5 feet

y (in)	p (kip)
-6.59	-14.11
-6.20	-14.11
-5.04	-13.17
-4.04	-12.23
-3.17	-11.29
-2.45	-10.35
-1.84	-9.40
-1.34	-8.46
-0.94	-7.52
-0.63	-6.58
-0.40	-5.64
-0.23	-4.70
-0.12	-3.76
-0.05	-2.82
-0.01	-1.88
0.00	-0.94
0.00	0.00
0.00	0.94
0.01	1.88
0.05	2.82
0.12	3.76
0.23	4.70
0.40	5.64
0.63	6.58
0.94	7.52
1.34	8.46
1.84	9.40
2.45	10.35
3.17	11.29
4.04	12.23
5.04	13.17
6.20	14.11
6.59	14.11

Layer 5 23' - 28'
Depth = 25.5 feet
Elevation = 238.5 feet

y (in)	p (kip)
-6.11	-14.98
-5.75	-14.98
-4.67	-13.98
-3.74	-12.98
-2.94	-11.98
-2.27	-10.98
-1.70	-9.98
-1.24	-8.99
-0.87	-7.99
-0.58	-6.99
-0.37	-5.99
-0.21	-4.99
-0.11	-3.99
-0.05	-3.00
-0.01	-2.00
0.00	-1.00
0.00	0.00
0.00	1.00
0.01	2.00
0.05	3.00
0.11	3.99
0.21	4.99
0.37	5.99
0.58	6.99
0.87	7.99
1.24	8.99
1.70	9.98
2.27	10.98
2.94	11.98
3.74	12.98
4.67	13.98
5.75	14.98
6.11	14.98

Layer 6 28' - 31.5'
Depth = 30.5 feet
Elevation = 233.5 feet

y (in)	p (kip)
-5.58	-10.78
-5.25	-10.78
-4.27	-10.06
-3.42	-9.35
-2.69	-8.63
-2.07	-7.91
-1.56	-7.19
-1.13	-6.47
-0.80	-5.75
-0.53	-5.03
-0.34	-4.31
-0.19	-3.59
-0.10	-2.88
-0.04	-2.16
-0.01	-1.44
0.00	-0.72
0.00	0.00
0.00	0.72
0.01	1.44
0.04	2.16
0.10	2.88
0.19	3.59
0.34	4.31
0.53	5.03
0.80	5.75
1.13	6.47
1.56	7.19
2.07	7.91
2.69	8.63
3.42	9.35
4.27	10.06
5.25	10.78
5.58	10.78

Layer 7 31.5' - 38'
Depth = 35.5 feet
Elevation = 228.5 feet

y (in)	p (kip)
-0.47	-316.52
-0.46	-316.52
-0.45	-316.52
-0.43	-308.38
-0.42	-300.23
-0.40	-292.08
-0.39	-283.94
-0.37	-275.79
-0.36	-267.64
-0.34	-259.50
-0.33	-251.35
-0.31	-243.20
-0.30	-235.05
-0.28	-226.91
-0.27	-218.76
-0.25	-209.11
0.00	0.00
0.25	209.11
0.27	218.76
0.28	226.91
0.30	235.05
0.31	243.20
0.33	251.35
0.34	259.50
0.36	267.64
0.37	275.79
0.39	283.94
0.40	292.08
0.42	300.23
0.43	308.38
0.45	316.52
0.46	316.52
0.47	316.52

Layer 8 38' - 43'
Depth = 40.5 feet
Elevation = 223.5 feet

y (in)	p (kip)
-0.58	-322.41
-0.57	-322.41
-0.55	-322.41
-0.51	-299.38
-0.47	-276.35
-0.43	-253.32
-0.39	-230.29
-0.36	-207.26
-0.32	-184.23
-0.28	-161.20
-0.24	-138.18
-0.20	-115.15
-0.16	-92.12
-0.12	-69.09
-0.08	-46.06
-0.04	-23.03
0.00	0.00
0.04	23.03
0.08	46.06
0.12	69.09
0.16	92.12
0.20	115.15
0.24	138.18
0.28	161.20
0.32	184.23
0.36	207.26
0.39	230.29
0.43	253.32
0.47	276.35
0.51	299.38
0.55	322.41
0.57	322.41
0.58	322.41

Layer 9 43' - 51'
Depth = 45.5 feet
Elevation = 218.5 feet

y (in)	p (kip)
-0.47	-504.65
-0.46	-504.65
-0.45	-504.65
-0.41	-468.60
-0.38	-432.56
-0.35	-396.51
-0.32	-360.46
-0.29	-324.42
-0.25	-288.37
-0.22	-252.32
-0.19	-216.28
-0.16	-180.23
-0.13	-144.19
-0.10	-108.14
-0.06	-72.09
-0.03	-36.05
0.00	0.00
0.03	36.05
0.06	72.09
0.10	108.14
0.13	144.19
0.16	180.23
0.19	216.28
0.22	252.32
0.25	288.37
0.29	324.42
0.32	360.46
0.35	396.51
0.38	432.56
0.41	468.60
0.45	504.65
0.46	504.65
0.47	504.65

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 2
All depths are measured below ground surface.

Layer 1 0' - 5'
Depth = 2.5 feet
Elevation = 262.5 feet

y (in)	p (kip)
-0.73	-27.09
-0.71	-27.09
-0.69	-27.09
-0.50	-23.28
-0.31	-19.48
-0.29	-19.07
-0.27	-18.65
-0.25	-18.20
-0.23	-17.73
-0.21	-17.23
-0.19	-16.69
-0.17	-16.11
-0.15	-15.49
-0.13	-14.80
-0.11	-14.03
-0.09	-13.16
0.00	0.00
0.09	13.16
0.11	14.03
0.13	14.80
0.15	15.49
0.17	16.11
0.19	16.69
0.21	17.23
0.23	17.73
0.25	18.20
0.27	18.65
0.29	19.07
0.31	19.48
0.50	23.28
0.69	27.09
0.71	27.09
0.73	27.09

Layer 2 5' - 10'
Depth = 7.5 feet
Elevation = 257.5 feet

y (in)	p (kip)
-0.73	-89.60
-0.71	-89.60
-0.69	-89.60
-0.50	-70.38
-0.31	-51.16
-0.28	-48.55
-0.26	-45.85
-0.23	-43.03
-0.21	-40.09
-0.18	-36.99
-0.15	-33.72
-0.13	-30.21
-0.10	-26.41
-0.08	-22.21
-0.05	-17.39
-0.03	-11.43
0.00	0.00
0.03	11.43
0.05	17.39
0.08	22.21
0.10	26.41
0.13	30.21
0.15	33.72
0.18	36.99
0.21	40.09
0.23	43.03
0.26	45.85
0.28	48.55
0.31	51.16
0.50	70.38
0.69	89.60
0.71	89.60
0.73	89.60

Layer 3 10' - 14'
Depth = 12.5 feet
Elevation = 252.5 feet

y (in)	p (kip)
-0.73	-181.83
-0.71	-181.83
-0.69	-181.83
-0.50	-142.57
-0.31	-103.31
-0.29	-98.84
-0.27	-94.23
-0.24	-89.48
-0.22	-84.55
-0.20	-79.43
-0.18	-74.09
-0.16	-68.49
-0.14	-62.57
-0.11	-56.27
-0.09	-49.47
-0.07	-42.02
0.00	0.00
0.07	42.02
0.09	49.47
0.11	56.27
0.14	62.57
0.16	68.49
0.18	74.09
0.20	79.43
0.22	84.55
0.24	89.48
0.27	94.23
0.29	98.84
0.31	103.31
0.50	142.57
0.69	181.83
0.71	181.83
0.73	181.83

Layer 4 14' - 21'
Depth = 17.5 feet
Elevation = 247.5 feet

y (in)	p (kip)
-7.86	-26.70
-7.40	-26.70
-6.02	-24.92
-4.82	-23.14
-3.79	-21.36
-2.92	-19.58
-2.19	-17.80
-1.60	-16.02
-1.12	-14.24
-0.75	-12.46
-0.47	-10.68
-0.27	-8.90
-0.14	-7.12
-0.06	-5.34
-0.02	-3.56
0.00	-1.78
0.00	0.00
0.00	1.78
0.02	3.56
0.06	5.34
0.14	7.12
0.27	8.90
0.47	10.68
0.75	12.46
1.12	14.24
1.60	16.02
2.19	17.80
2.92	19.58
3.79	21.36
4.82	23.14
6.02	24.92
7.40	26.70
7.86	26.70

Layer 5 21' - 28'
Depth = 24.5 feet
Elevation = 240.5 feet

y (in)	p (kip)
-7.86	-29.59
-7.40	-29.59
-6.02	-27.62
-4.82	-25.65
-3.79	-23.67
-2.92	-21.70
-2.19	-19.73
-1.60	-17.76
-1.12	-15.78
-0.75	-13.81
-0.47	-11.84
-0.27	-9.86
-0.14	-7.89
-0.06	-5.92
-0.02	-3.95
0.00	-1.97
0.00	0.00
0.00	1.97
0.02	3.95
0.06	5.92
0.14	7.89
0.27	9.86
0.47	11.84
0.75	13.81
1.12	15.78
1.60	17.76
2.19	19.73
2.92	21.70
3.79	23.67
4.82	25.65
6.02	27.62
7.40	29.59
7.86	29.59

Layer 6 28' - 37.5'
Depth = 31.5 feet
Elevation = 233.5 feet

y (in)	p (kip)
-7.86	-44.09
-7.40	-44.09
-6.02	-41.15
-4.82	-38.21
-3.79	-35.27
-2.92	-32.33
-2.19	-29.39
-1.60	-26.45
-1.12	-23.51
-0.75	-20.57
-0.47	-17.63
-0.27	-14.70
-0.14	-11.76
-0.06	-8.82
-0.02	-5.88
0.00	-2.94
0.00	0.00
0.00	2.94
0.02	5.88
0.06	8.82
0.14	11.76
0.27	14.70
0.47	17.63
0.75	20.57
1.12	23.51
1.60	26.45
2.19	29.39
2.92	32.33
3.79	35.27
4.82	38.21
6.02	41.15
7.40	44.09
7.86	44.09

Layer 7 37.5' - 42'
Depth = 38.5 feet
Elevation = 226.5 feet

y (in)	p (kip)
-0.73	-279.67
-0.71	-279.67
-0.69	-279.67
-0.50	-219.29
-0.31	-158.90
-0.30	-155.52
-0.29	-152.09
-0.28	-148.60
-0.27	-145.07
-0.25	-141.47
-0.24	-137.82
-0.23	-134.10
-0.22	-130.32
-0.21	-126.46
-0.20	-122.53
-0.19	-118.51
0.00	0.00
0.19	118.51
0.20	122.53
0.21	126.46
0.22	130.32
0.23	134.10
0.24	137.82
0.25	141.47
0.27	145.07
0.28	148.60
0.29	152.09
0.30	155.52
0.31	158.90
0.50	219.29
0.67	479.44
0.69	279.67
0.71	279.67
0.73	279.67

Layer 8 42' - 47'
Depth = 44.5 feet
Elevation = 220.5 feet

y (in)	p (kip)
-0.73	-495.33
-0.71	-495.33
-0.69	-495.33
-0.67	-479.44
-0.64	-463.56
-0.61	-447.67
-0.58	-431.78
-0.55	-415.89
-0.52	-400.00
-0.49	-384.11
-0.46	-368.22
-0.44	-352.34
-0.41	-336.45
-0.38	-320.56
-0.35	-304.67
-0.32	-288.72
0.00	0.00
0.32	288.72
0.35	304.67
0.38	320.56
0.41	336.45
0.44	352.34
0.46	368.22
0.49	384.11
0.52	400.00
0.55	415.89
0.58	431.78
0.61	447.67
0.64	463.56
0.67	479.44
0.69	495.33
0.71	495.33
0.73	495.33

Layer 9 47' - 50'
Depth = 47.5 feet
Elevation = 217.5 feet

y (in)	p (kip)
-0.73	-361.48
-0.71	-361.48
-0.69	-361.48
-0.67	-352.38
-0.65	-343.28
-0.63	-334.18
-0.60	-325.08
-0.58	-315.98
-0.56	-306.89
-0.54	-297.79
-0.51	-288.69
-0.49	-279.59
-0.47	-270.49
-0.45	-261.39
-0.42	-252.29
-0.40	-241.21
0.00	0.00
0.40	241.21
0.42	252.29
0.45	261.39
0.47	270.49
0.49	279.59
0.51	288.69
0.54	297.79
0.56	306.89
0.58	315.98
0.60	325.08
0.63	334.18
0.65	343.28
0.67	352.38
0.69	361.48
0.71	361.48
0.73	361.48

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 3
All depths are measured below ground surface.

Layer 1 0' - 5'

Depth = 3.5 feet	
Elevation = 252.5 feet	
y (in)	p (kip)
-0.73	-36.86
-0.71	-36.86
-0.69	-36.86
-0.50	-31.41
-0.31	-25.96
-0.29	-25.36
-0.27	-24.72
-0.25	-24.05
-0.22	-23.34
-0.20	-22.59
-0.18	-21.78
-0.16	-20.91
-0.14	-19.96
-0.12	-18.91
-0.10	-17.74
-0.08	-16.38
0.00	0.00
0.08	16.38
0.10	17.74
0.12	18.91
0.14	19.96
0.16	20.91
0.18	21.78
0.20	22.59
0.22	23.34
0.25	24.05
0.27	24.72
0.29	25.36
0.31	25.96
0.50	31.41
0.69	36.86
0.71	36.86
0.73	36.86

Layer 2 5' - 12'

Depth = 8.5 feet	
Elevation = 247.5 feet	
y (in)	p (kip)
-7.86	-16.45
-7.40	-16.45
-6.02	-15.35
-4.82	-14.26
-3.79	-13.16
-2.92	-12.06
-2.19	-10.97
-1.60	-9.87
-1.12	-8.77
-0.75	-7.68
-0.47	-6.58
-0.27	-5.48
-0.14	-4.39
-0.06	-3.29
-0.02	-2.19
0.00	-1.10
0.00	0.00
0.00	1.10
0.02	2.19
0.06	3.29
0.14	4.39
0.27	5.48
0.47	6.58
0.75	7.68
1.12	8.77
1.60	9.87
2.19	10.97
2.92	12.06
3.79	13.16
4.82	14.26
6.02	15.35
7.40	16.45
7.86	16.45

Layer 3 12' - 19'

Depth = 15.5 feet	
Elevation = 240.5 feet	
y (in)	p (kip)
-7.86	-20.21
-7.40	-20.21
-6.02	-18.86
-4.82	-17.52
-3.79	-16.17
-2.92	-14.82
-2.19	-13.47
-1.60	-12.13
-1.12	-10.78
-0.75	-9.43
-0.47	-8.08
-0.27	-6.74
-0.14	-5.39
-0.06	-4.04
-0.02	-2.69
0.00	-1.35
0.00	0.00
0.00	1.35
0.02	2.69
0.06	4.04
0.14	5.39
0.27	6.74
0.47	8.08
0.75	9.43
1.12	10.78
1.60	12.13
2.19	13.47
2.92	14.82
3.79	16.17
4.82	17.52
6.02	18.86
7.40	20.21
7.86	20.21

Layer 4 19' - 28.5'

Depth = 22.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-32.53
-7.40	-32.53
-6.02	-30.36
-4.82	-28.19
-3.79	-26.03
-2.92	-23.86
-2.19	-21.69
-1.60	-19.52
-1.12	-17.35
-0.75	-15.18
-0.47	-13.01
-0.27	-10.84
-0.14	-8.68
-0.06	-6.51
-0.02	-4.34
0.00	-2.17
0.00	0.00
0.00	2.17
0.02	4.34
0.06	6.51
0.14	8.68
0.27	10.84
0.47	13.01
0.75	15.18
1.12	17.35
1.60	19.52
2.19	21.69
2.92	23.86
3.79	26.03
4.82	28.19
6.02	30.36
7.40	32.53
7.86	32.53

Layer 5 28.5' - 33'

Depth = 29.5 feet	
Elevation = 226.5 feet	
y (in)	p (kip)
-0.73	-106.40
-0.71	-106.40
-0.69	-106.40
-0.50	-83.43
-0.31	-60.46
-0.29	-58.26
-0.27	-56.01
-0.25	-53.69
-0.24	-51.31
-0.22	-48.86
-0.20	-46.33
-0.18	-43.70
-0.16	-40.97
-0.14	-38.11
-0.13	-35.11
-0.11	-31.94
0.00	0.00
0.11	31.94
0.13	35.11
0.14	38.11
0.16	40.97
0.18	43.70
0.20	46.33
0.22	48.86
0.24	51.31
0.25	53.69
0.27	56.01
0.29	58.26
0.31	60.46
0.50	83.43
0.69	106.40
0.71	106.40
0.73	106.40

Layer 6 33' - 38'

Depth = 35.5 feet	
Elevation = 220.5 feet	
y (in)	p (kip)
-0.73	-235.15
-0.71	-235.15
-0.69	-235.15
-0.50	-184.38
-0.31	-133.61
-0.30	-131.97
-0.30	-130.31
-0.29	-128.65
-0.28	-126.96
-0.28	-125.27
-0.27	-123.55
-0.26	-121.83
-0.26	-120.08
-0.25	-118.32
-0.25	-116.55
-0.24	-114.75
0.00	0.00
0.24	114.75
0.25	116.55
0.25	118.32
0.26	120.08
0.26	121.83
0.27	123.55
0.28	125.27
0.28	126.96
0.29	128.65
0.30	130.31
0.30	131.97
0.31	133.61
0.50	184.38
0.69	235.15
0.71	235.15
0.73	235.15

Layer 7 38' - 41'

Depth = 38.5 feet	
Elevation = 217.5 feet	
y (in)	p (kip)
-0.73	-184.85
-0.71	-184.85
-0.69	-184.85
-0.67	-179.06
-0.64	-173.27
-0.61	-167.48
-0.58	-161.69
-0.55	-155.90
-0.53	-150.11
-0.50	-144.32
-0.47	-138.53
-0.44	-132.74
-0.41	-126.95
-0.39	-121.16
-0.36	-115.37
-0.33	-109.52
0.00	0.00
0.33	109.52
0.36	115.37
0.39	121.16
0.41	126.95
0.44	132.74
0.47	138.53
0.50	144.32
0.53	150.11
0.55	155.90
0.58	161.69
0.61	167.48
0.64	173.27
0.67	179.06
0.69	184.85
0.71	184.85
0.73	184.85

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENTS 4, 5, AND 6
All depths are measured below ground surface.

Layer 1 0' - 7'

Depth = 4.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-12.98
-7.40	-12.98
-6.02	-12.12
-4.82	-11.25
-3.79	-10.38
-2.92	-9.52
-2.19	-8.65
-1.60	-7.79
-1.12	-6.92
-0.75	-6.06
-0.47	-5.19
-0.27	-4.33
-0.14	-3.46
-0.06	-2.60
-0.02	-1.73
0.00	-0.87
0.00	0.00
0.00	0.87
0.02	1.73
0.06	2.60
0.14	3.46
0.27	4.33
0.47	5.19
0.75	6.06
1.12	6.92
1.60	7.79
2.19	8.65
2.92	9.52
3.79	10.38
4.82	11.25
6.02	12.12
7.40	12.98
7.86	12.98

Layer 2 7' - 12'

Depth = 9.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-16.41
-7.40	-16.41
-6.02	-15.31
-4.82	-14.22
-3.79	-13.13
-2.92	-12.03
-2.19	-10.94
-1.60	-9.84
-1.12	-8.75
-0.75	-7.66
-0.47	-6.56
-0.27	-5.47
-0.14	-4.38
-0.06	-3.28
-0.02	-2.19
0.00	-1.09
0.00	0.00
0.00	1.09
0.02	2.19
0.06	3.28
0.14	4.38
0.27	5.47
0.47	6.56
0.75	7.66
1.12	8.75
1.60	9.84
2.19	10.94
2.92	12.03
3.79	13.13
4.82	14.22
6.02	15.31
7.40	16.41
7.86	16.41

Layer 3 12' - 15.5'

Depth = 14.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-16.08
-7.40	-16.08
-6.02	-15.01
-4.82	-13.93
-3.79	-12.86
-2.92	-11.79
-2.19	-10.72
-1.60	-9.65
-1.12	-8.58
-0.75	-7.50
-0.47	-6.43
-0.27	-5.36
-0.14	-4.29
-0.06	-3.22
-0.02	-2.14
0.00	-1.07
0.00	0.00
0.00	1.07
0.02	2.14
0.06	3.22
0.14	4.29
0.27	5.36
0.47	6.43
0.75	7.50
1.12	8.58
1.60	9.65
2.19	10.72
2.92	11.79
3.79	12.86
4.82	13.93
6.02	15.01
7.40	16.08
7.86	16.08

Layer 4 15.5' - 22'

Depth = 19.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-136.51
-0.71	-136.51
-0.69	-136.51
-0.50	-107.03
-0.31	-77.56
-0.29	-74.26
-0.27	-70.87
-0.24	-67.37
-0.22	-63.75
-0.20	-59.99
-0.18	-56.07
-0.16	-51.96
-0.14	-47.64
-0.12	-43.04
-0.10	-38.10
-0.07	-32.71
0.00	0.00
0.07	32.71
0.10	38.10
0.12	43.04
0.14	47.64
0.16	51.96
0.18	56.07
0.20	59.99
0.22	63.75
0.24	67.37
0.27	70.87
0.29	74.26
0.31	77.56
0.50	107.03
0.69	136.51
0.71	136.51
0.73	136.51

Layer 5 22' - 28'

Depth = 24.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-230.15
-0.71	-230.15
-0.69	-230.15
-0.50	-180.46
-0.31	-130.77
-0.29	-127.16
-0.28	-123.48
-0.27	-119.73
-0.25	-115.91
-0.24	-112.00
-0.23	-108.00
-0.21	-103.90
-0.20	-99.69
-0.18	-95.37
-0.17	-90.92
-0.16	-86.32
0.00	0.00
0.16	86.32
0.17	90.92
0.18	95.37
0.20	99.69
0.21	103.90
0.23	108.00
0.24	112.00
0.25	115.91
0.27	119.73
0.28	123.48
0.29	127.16
0.31	130.77
0.50	180.46
0.69	230.15
0.71	230.15
0.73	230.15

Layer 6 28' - 33'

Depth = 29.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.73	-321.35
-0.71	-321.35
-0.69	-321.35
-0.50	-251.96
-0.31	-182.58
-0.29	-176.18
-0.27	-169.62
-0.26	-162.89
-0.24	-155.98
-0.22	-148.87
-0.20	-141.53
-0.19	-133.93
-0.17	-126.05
-0.15	-117.83
-0.13	-109.23
-0.11	-100.17
0.00	0.00
0.11	100.17
0.13	109.23
0.15	117.83
0.17	126.05
0.19	133.93
0.20	141.53
0.22	148.87
0.24	155.98
0.26	162.89
0.27	169.62
0.29	176.18
0.31	182.58
0.50	251.96
0.69	321.35
0.71	321.35
0.73	321.35

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 7
All depths are measured below ground surface.

Layer 1 0' - 7'

Depth = 4.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-3.50
-7.40	-3.50
-6.02	-3.27
-4.82	-3.03
-3.79	-2.80
-2.92	-2.57
-2.19	-2.33
-1.60	-2.10
-1.12	-1.87
-0.75	-1.63
-0.47	-1.40
-0.27	-1.17
-0.14	-0.93
-0.06	-0.70
-0.02	-0.47
0.00	-0.23
0.00	0.00
0.00	0.23
0.02	0.47
0.06	0.70
0.14	0.93
0.27	1.17
0.47	1.40
0.75	1.63
1.12	1.87
1.60	2.10
2.19	2.33
2.92	2.57
3.79	2.80
4.82	3.03
6.02	3.27
7.40	3.50
7.86	3.50

Layer 2 7' - 12'

Depth = 9.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-9.27
-7.40	-9.27
-6.02	-8.65
-4.82	-8.04
-3.79	-7.42
-2.92	-6.80
-2.19	-6.18
-1.60	-5.56
-1.12	-4.94
-0.75	-4.33
-0.47	-3.71
-0.27	-3.09
-0.14	-2.47
-0.06	-1.85
-0.02	-1.24
0.00	-0.62
0.00	0.00
0.00	0.62
0.02	1.24
0.06	1.85
0.14	2.47
0.27	3.09
0.47	3.71
0.75	4.33
1.12	4.94
1.60	5.56
2.19	6.18
2.92	6.80
3.79	7.42
4.82	8.04
6.02	8.65
7.40	9.27
7.86	9.27

Layer 3 12' - 17'

Depth = 14.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-16.41
-7.40	-16.41
-6.02	-15.31
-4.82	-14.22
-3.79	-13.13
-2.92	-12.03
-2.19	-10.94
-1.60	-9.84
-1.12	-8.75
-0.75	-7.66
-0.47	-6.56
-0.27	-5.47
-0.14	-4.38
-0.06	-3.28
-0.02	-2.19
0.00	-1.09
0.00	0.00
0.00	1.09
0.02	2.19
0.06	3.28
0.14	4.38
0.27	5.47
0.47	6.56
0.75	7.66
1.12	8.75
1.60	9.84
2.19	10.94
2.92	12.03
3.79	13.13
4.82	14.22
6.02	15.31
7.40	16.41
7.86	16.41

Layer 4 17' - 20.5'

Depth = 19.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-16.08
-7.40	-16.08
-6.02	-15.01
-4.82	-13.93
-3.79	-12.86
-2.92	-11.79
-2.19	-10.72
-1.60	-9.65
-1.12	-8.58
-0.75	-7.50
-0.47	-6.43
-0.27	-5.36
-0.14	-4.29
-0.06	-3.22
-0.02	-2.14
0.00	-1.07
0.00	0.00
0.00	1.07
0.02	2.14
0.06	3.22
0.14	4.29
0.27	5.36
0.47	6.43
0.75	7.50
1.12	8.58
1.60	9.65
2.19	10.72
2.92	11.79
3.79	12.86
4.82	13.93
6.02	15.01
7.40	16.08
7.86	16.08

Layer 5 20.5' - 27'

Depth = 24.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-136.51
-0.71	-136.51
-0.69	-136.51
-0.50	-107.03
-0.31	-77.56
-0.29	-74.26
-0.27	-70.87
-0.24	-67.37
-0.22	-63.75
-0.20	-59.99
-0.18	-56.07
-0.16	-51.96
-0.14	-47.64
-0.12	-43.04
-0.10	-38.10
-0.07	-32.71
0.00	0.00
0.07	32.71
0.10	38.10
0.12	43.04
0.14	47.64
0.16	51.96
0.18	56.07
0.20	59.99
0.22	63.75
0.24	67.37
0.27	70.87
0.29	74.26
0.31	77.56
0.50	107.03
0.69	136.51
0.71	136.51
0.73	136.51

Layer 6 27' - 33'

Depth = 29.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-230.15
-0.71	-230.15
-0.69	-230.15
-0.50	-180.46
-0.31	-130.77
-0.29	-127.16
-0.28	-123.48
-0.27	-119.73
-0.25	-115.91
-0.24	-112.00
-0.23	-108.00
-0.21	-103.90
-0.20	-99.69
-0.18	-95.37
-0.17	-90.92
-0.16	-86.32
0.00	0.00
0.16	86.32
0.17	90.92
0.18	95.37
0.20	99.69
0.21	103.90
0.23	108.00
0.24	112.00
0.25	115.91
0.27	119.73
0.28	123.48
0.29	127.16
0.31	130.77
0.50	180.46
0.69	230.15
0.71	230.15
0.73	230.15

Layer 7 33' - 44'

Depth = 34.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.73	-706.96
-0.71	-706.96
-0.69	-706.96
-0.50	-554.32
-0.31	-401.68
-0.29	-387.59
-0.27	-373.16
-0.26	-358.36
-0.24	-343.16
-0.22	-327.51
-0.20	-311.36
-0.19	-294.65
-0.17	-277.30
-0.15	-259.23
-0.13	-240.30
-0.11	-220.36
0.00	0.00
0.11	220.36
0.13	240.30
0.15	259.23
0.17	277.30
0.19	294.65
0.20	311.36
0.22	327.51
0.24	343.16
0.26	358.36
0.27	373.16
0.29	387.59
0.31	401.68
0.50	554.32
0.69	706.96
0.71	706.96
0.73	706.96

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 8
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 2.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-78.90
-0.71	-78.90
-0.69	-78.90
-0.50	-61.87
-0.31	-44.83
-0.28	-42.60
-0.26	-40.29
-0.23	-37.89
-0.21	-35.39
-0.18	-32.76
-0.16	-30.00
-0.13	-27.06
-0.11	-23.90
-0.08	-20.44
-0.06	-16.55
-0.04	-11.94
0.00	0.00
0.04	11.94
0.06	16.55
0.08	20.44
0.11	23.90
0.13	27.06
0.16	30.00
0.18	32.76
0.21	35.39
0.23	37.89
0.26	40.29
0.28	42.60
0.31	44.83
0.50	61.87
0.69	78.90
0.71	78.90
0.73	78.90

Layer 2 3' - 8'

Depth = 5.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 3 8' - 13'

Depth = 10.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 4 13' - 18'

Depth = 15.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 5 18' - 21.5'

Depth = 20.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 6 21.5' - 28'

Depth = 25.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 7 28' - 33'

Depth = 30.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 8 33' - 39'

Depth = 35.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-660.18
-0.79	-660.18
-0.77	-660.18
-0.72	-613.02
-0.66	-565.87
-0.61	-518.71
-0.55	-471.56
-0.50	-424.40
-0.44	-377.24
-0.39	-330.09
-0.33	-282.93
-0.28	-235.78
-0.22	-188.62
-0.17	-141.47
-0.11	-94.31
-0.06	-47.16
0.00	0.00
0.06	47.16
0.11	94.31
0.17	141.47
0.22	188.62
0.28	235.78
0.33	282.93
0.39	330.09
0.44	377.24
0.50	424.40
0.55	471.56
0.61	518.71
0.66	565.87
0.72	613.02
0.77	660.18
0.79	660.18
0.81	660.18

Layer 9 39' - 45'

Depth = 41.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip/ft)
-0.83	-823.03
-0.81	-823.03
-0.79	-823.03
-0.74	-764.28
-0.68	-705.49
-0.62	-646.70
-0.57	-587.90
-0.51	-529.11
-0.45	-470.32
-0.40	-411.53
-0.34	-352.74
-0.28	-293.95
-0.23	-235.16
-0.17	-176.37
-0.11	-117.58
-0.06	-58.79
0.00	0.00
0.06	58.79
0.11	117.58
0.17	176.37
0.23	235.16
0.28	293.95
0.34	352.74
0.40	411.53
0.45	470.32
0.51	529.11
0.57	587.90
0.62	646.70
0.68	705.49
0.74	764.28
0.79	823.03
0.81	823.03
0.83	823.03

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 9
All depths are measured below ground surface.

Layer 1 0' - 5'

Depth = 4.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-131.50
-0.71	-131.50
-0.69	-131.50
-0.50	-103.11
-0.31	-74.72
-0.28	-71.00
-0.26	-67.14
-0.23	-63.15
-0.21	-58.98
-0.18	-54.61
-0.16	-50.00
-0.13	-45.10
-0.11	-39.83
-0.08	-34.06
-0.06	-27.58
-0.04	-19.90
0.00	0.00
0.04	19.90
0.06	27.58
0.08	34.06
0.11	39.83
0.13	45.10
0.16	50.00
0.18	54.61
0.21	58.98
0.23	63.15
0.26	67.14
0.28	71.00
0.31	74.72
0.50	103.11
0.69	131.50
0.71	131.50
0.73	131.50

Layer 2 5' - 10'

Depth = 7.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 3 10' - 15'

Depth = 12.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 4 15' - 20'

Depth = 17.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 5 20' - 23.5'

Depth = 22.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 6 23.5' - 30'

Depth = 27.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 7 30' - 35'

Depth = 32.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 8 35' - 41'

Depth = 37.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-660.18
-0.79	-660.18
-0.77	-660.18
-0.72	-613.02
-0.66	-565.87
-0.61	-518.71
-0.55	-471.56
-0.50	-424.40
-0.44	-377.24
-0.39	-330.09
-0.33	-282.93
-0.28	-235.78
-0.22	-188.62
-0.17	-141.47
-0.11	-94.31
-0.06	-47.16
0.00	0.00
0.06	47.16
0.11	94.31
0.17	141.47
0.22	188.62
0.28	235.78
0.33	282.93
0.39	330.09
0.44	377.24
0.50	424.40
0.55	471.56
0.61	518.71
0.66	565.87
0.72	613.02
0.77	660.18
0.79	660.18
0.81	660.18

Layer 9 41' - 53'

Depth = 43.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.83	-1646.06
-0.81	-1646.06
-0.79	-1646.06
-0.74	-1528.56
-0.68	-1410.97
-0.62	-1293.39
-0.57	-1175.81
-0.51	-1058.23
-0.45	-940.65
-0.40	-823.07
-0.34	-705.49
-0.28	-587.90
-0.23	-470.32
-0.17	-352.74
-0.11	-235.16
-0.06	-117.58
0.00	0.00
0.06	117.58
0.11	235.16
0.17	352.74
0.23	470.32
0.28	587.90
0.34	705.49
0.40	823.07
0.45	940.65
0.51	1058.23
0.57	1175.81
0.62	1293.39
0.68	1410.97
0.74	1528.56
0.79	1646.06
0.81	1646.06
0.83	1646.06

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENTS 10 AND 11
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 0.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.73	-26.09
-0.71	-26.09
-0.69	-26.09
-0.50	-21.86
-0.31	-17.62
-0.29	-17.10
-0.26	-16.56
-0.24	-15.99
-0.22	-15.39
-0.19	-14.74
-0.17	-14.05
-0.15	-13.29
-0.13	-12.46
-0.10	-11.54
-0.08	-10.47
-0.06	-9.19
0.00	0.00
0.06	9.19
0.08	10.47
0.10	11.54
0.13	12.46
0.15	13.29
0.17	14.05
0.19	14.74
0.22	15.39
0.24	15.99
0.26	16.56
0.29	17.10
0.31	17.62
0.50	21.86
0.69	26.09
0.71	26.09
0.73	26.09

Layer 2 3' - 6'

Depth = 5.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-78.90
-0.71	-78.90
-0.69	-78.90
-0.50	-61.87
-0.31	-44.83
-0.28	-42.60
-0.26	-40.29
-0.23	-37.89
-0.21	-35.39
-0.18	-32.76
-0.16	-30.00
-0.13	-27.06
-0.11	-23.90
-0.08	-20.44
-0.06	-16.55
-0.04	-11.94
0.00	0.00
0.04	11.94
0.06	16.55
0.08	20.44
0.11	23.90
0.13	27.06
0.16	30.00
0.18	32.76
0.21	35.39
0.23	37.89
0.26	40.29
0.28	42.60
0.31	44.83
0.50	61.87
0.69	78.90
0.71	78.90
0.73	78.90

Layer 3 6' - 11'

Depth = 8.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 4 11' - 16'

Depth = 13.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 5 16' - 21'

Depth = feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 6 21' - 24.5'

Depth = 23.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 7 24.5' - 31'

Depth = 28.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 8 31' - 36'

Depth = 33.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 9 36' - 42'

Depth = 38.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-660.18
-0.79	-660.18
-0.77	-660.18
-0.72	-613.02
-0.66	-565.87
-0.61	-518.71
-0.55	-471.56
-0.50	-424.40
-0.44	-377.24
-0.39	-330.09
-0.33	-282.93
-0.28	-235.78
-0.22	-188.62
-0.17	-141.47
-0.11	-94.31
-0.06	-47.16
0.00	0.00
0.06	47.16
0.11	94.31
0.17	141.47
0.22	188.62
0.28	235.78
0.33	282.93
0.39	330.09
0.44	377.24
0.50	424.40
0.55	471.56
0.61	518.71
0.66	565.87
0.72	613.02
0.77	660.18
0.79	660.18
0.81	660.18

Layer 10 42' - 51'

Depth = 44.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.83	-1234.55
-0.81	-1234.55
-0.79	-1234.55
-0.74	-1146.42
-0.68	-1058.23
-0.62	-970.04
-0.57	-881.86
-0.51	-793.67
-0.45	-705.49
-0.40	-617.30
-0.34	-529.11
-0.28	-440.93
-0.23	-352.74
-0.17	-264.56
-0.11	-176.37
-0.06	-88.19
0.00	0.00
0.06	88.19
0.11	176.37
0.17	264.56
0.23	352.74
0.28	440.93
0.34	529.11
0.40	617.30
0.45	705.49
0.51	793.67
0.57	881.86
0.62	970.04
0.68	1058.23
0.74	1146.42
0.79	1234.55
0.81	1234.55
0.83	1234.55

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENTS 12, 13, AND 14
All depths are measured below ground surface.

Layer 1 0' - 3'

Depth = 0.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.73	-26.09
-0.71	-26.09
-0.69	-26.09
-0.50	-21.86
-0.31	-17.62
-0.29	-17.10
-0.26	-16.56
-0.24	-15.99
-0.22	-15.39
-0.19	-14.74
-0.17	-14.05
-0.15	-13.29
-0.13	-12.46
-0.10	-11.54
-0.08	-10.47
-0.06	-9.19
0.00	0.00
0.06	9.19
0.08	10.47
0.10	11.54
0.13	12.46
0.15	13.29
0.17	14.05
0.19	14.74
0.22	15.39
0.24	15.99
0.26	16.56
0.29	17.10
0.31	17.62
0.50	21.86
0.69	26.09
0.71	26.09
0.73	26.09

Layer 2 3' - 6'

Depth = 5.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-78.90
-0.71	-78.90
-0.69	-78.90
-0.50	-61.87
-0.31	-44.83
-0.28	-42.60
-0.26	-40.29
-0.23	-37.89
-0.21	-35.39
-0.18	-32.76
-0.16	-30.00
-0.13	-27.06
-0.11	-23.90
-0.08	-20.44
-0.06	-16.55
-0.04	-11.94
0.00	0.00
0.04	11.94
0.06	16.55
0.08	20.44
0.11	23.90
0.13	27.06
0.16	30.00
0.18	32.76
0.21	35.39
0.23	37.89
0.26	40.29
0.28	42.60
0.31	44.83
0.50	61.87
0.69	78.90
0.71	78.90
0.73	78.90

Layer 3 6' - 11'

Depth = 8.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 4 11' - 16'

Depth = 13.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 5 16' - 21'

Depth = 18.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 6 21' - 24.5'

Depth = 23.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 7 24.5' - 31'

Depth = 28.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 8 31' - 36'

Depth = 33.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 9 36' - 42'

Depth = 38.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-660.18
-0.79	-660.18
-0.77	-660.18
-0.72	-613.02
-0.66	-565.87
-0.61	-518.71
-0.55	-471.56
-0.50	-424.40
-0.44	-377.24
-0.39	-330.09
-0.33	-282.93
-0.28	-235.78
-0.22	-188.62
-0.17	-141.47
-0.11	-94.31
-0.06	-47.16
0.00	0.00
0.06	47.16
0.11	94.31
0.17	141.47
0.22	188.62
0.28	235.78
0.33	282.93
0.39	330.09
0.44	377.24
0.50	424.40
0.55	471.56
0.61	518.71
0.66	565.87
0.72	613.02
0.77	660.18
0.79	660.18
0.81	660.18

Layer 10 42' - 51'

Depth = 44.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.83	-1234.55
-0.81	-1234.55
-0.79	-1234.55
-0.74	-1146.42
-0.68	-1058.23
-0.62	-970.04
-0.57	-881.86
-0.51	-793.67
-0.45	-705.49
-0.40	-617.30
-0.34	-529.11
-0.28	-440.93
-0.23	-352.74
-0.17	-264.56
-0.11	-176.37
-0.06	-88.19
0.00	0.00
0.06	88.19
0.11	176.37
0.17	264.56
0.23	352.74
0.28	440.93
0.34	529.11
0.40	617.30
0.45	705.49
0.51	793.67
0.57	881.86
0.62	970.04
0.68	1058.23
0.74	1146.42
0.79	1234.55
0.81	1234.55
0.83	1234.55

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENTS 15 AND 16
All depths are measured below ground surface.

Layer 1 0' - 6'

Depth = 3.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.73	-52.19
-0.71	-52.19
-0.69	-52.19
-0.50	-43.71
-0.31	-35.24
-0.29	-34.21
-0.26	-33.13
-0.24	-31.98
-0.22	-30.77
-0.19	-29.48
-0.17	-28.10
-0.15	-26.59
-0.13	-24.93
-0.10	-23.07
-0.08	-20.94
-0.06	-18.39
0.00	0.00
0.06	18.39
0.08	20.94
0.10	23.07
0.13	24.93
0.15	26.59
0.17	28.10
0.19	29.48
0.22	30.77
0.24	31.98
0.26	33.13
0.29	34.21
0.31	35.24
0.50	43.71
0.69	52.19
0.71	52.19
0.73	52.19

Layer 2 6' - 9'

Depth = 8.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-78.90
-0.71	-78.90
-0.69	-78.90
-0.50	-61.87
-0.31	-44.83
-0.28	-42.60
-0.26	-40.29
-0.23	-37.89
-0.21	-35.39
-0.18	-32.76
-0.16	-30.00
-0.13	-27.06
-0.11	-23.90
-0.08	-20.44
-0.06	-16.55
-0.04	-11.94
0.00	0.00
0.04	11.94
0.06	16.55
0.08	20.44
0.11	23.90
0.13	27.06
0.16	30.00
0.18	32.76
0.21	35.39
0.23	37.89
0.26	40.29
0.28	42.60
0.31	44.83
0.50	61.87
0.69	78.90
0.71	78.90
0.73	78.90

Layer 3 9' - 14'

Depth = 11.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 4 14' - 19'

Depth = 16.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 5 19' - 24'

Depth = 21.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 6 24' - 27.5'

Depth = 26.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 7 27.5' - 34'

Depth = 31.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 8 34' - 39'

Depth = 36.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 9 39' - 45'

Depth = 41.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-660.18
-0.79	-660.18
-0.77	-660.18
-0.72	-613.02
-0.66	-565.87
-0.61	-518.71
-0.55	-471.56
-0.50	-424.40
-0.44	-377.24
-0.39	-330.09
-0.33	-282.93
-0.28	-235.78
-0.22	-188.62
-0.17	-141.47
-0.11	-94.31
-0.06	-47.16
0.00	0.00
0.06	47.16
0.11	94.31
0.17	141.47
0.22	188.62
0.28	235.78
0.33	282.93
0.39	330.09
0.44	377.24
0.50	424.40
0.55	471.56
0.61	518.71
0.66	565.87
0.72	613.02
0.77	660.18
0.79	660.18
0.81	660.18

Layer 10 45' - 47'

Depth = 47.5 feet	
Elevation = 212.5 feet	
y (in)	p (kip)
-0.83	-274.34
-0.81	-274.34
-0.79	-274.34
-0.74	-254.76
-0.68	-235.16
-0.62	-215.57
-0.57	-195.97
-0.51	-176.37
-0.45	-156.77
-0.40	-137.18
-0.34	-117.58
-0.28	-97.98
-0.23	-78.39
-0.17	-58.79
-0.11	-39.19
-0.06	-19.60
0.00	0.00
0.06	19.60
0.11	39.19
0.17	58.79
0.23	78.39
0.28	97.98
0.34	117.58
0.40	137.18
0.45	156.77
0.51	176.37
0.57	195.97
0.62	215.57
0.68	235.16
0.74	254.76
0.79	274.34
0.81	274.34
0.83	274.34

P-Y CURVES TABULAR DATA
WIDEN 18" OCTAGONAL PILES
BENT 17
All depths are measured below ground surface.

Layer 1 0' - 10'

Depth = 7.5 feet	
Elevation = 256.5 feet	
y (in)	p (kip)
-0.73	-86.98
-0.71	-86.98
-0.69	-86.98
-0.50	-72.85
-0.31	-58.73
-0.29	-57.01
-0.26	-55.21
-0.24	-53.31
-0.22	-51.29
-0.19	-49.14
-0.17	-46.83
-0.15	-44.31
-0.13	-41.55
-0.10	-38.45
-0.08	-34.90
-0.06	-30.65
0.00	0.00
0.06	30.65
0.08	34.90
0.10	38.45
0.13	41.55
0.15	44.31
0.17	46.83
0.19	49.14
0.22	51.29
0.24	53.31
0.26	55.21
0.29	57.01
0.31	58.73
0.50	72.85
0.69	86.98
0.71	86.98
0.73	86.98

Layer 2 10' - 13'

Depth = 12.5 feet	
Elevation = 251.5 feet	
y (in)	p (kip)
-0.73	-78.90
-0.71	-78.90
-0.69	-78.90
-0.50	-61.87
-0.31	-44.83
-0.28	-42.60
-0.26	-40.29
-0.23	-37.89
-0.21	-35.39
-0.18	-32.76
-0.16	-30.00
-0.13	-27.06
-0.11	-23.90
-0.08	-20.44
-0.06	-16.55
-0.04	-11.94
0.00	0.00
0.04	11.94
0.06	16.55
0.08	20.44
0.11	23.90
0.13	27.06
0.16	30.00
0.18	32.76
0.21	35.39
0.23	37.89
0.26	40.29
0.28	42.60
0.31	44.83
0.50	61.87
0.69	78.90
0.71	78.90
0.73	78.90

Layer 3 13' - 18'

Depth = 15.5 feet	
Elevation = 248.5 feet	
y (in)	p (kip)
-7.86	-14.40
-7.40	-14.40
-6.02	-13.44
-4.82	-12.48
-3.79	-11.52
-2.92	-10.56
-2.19	-9.60
-1.60	-8.64
-1.12	-7.68
-0.75	-6.72
-0.47	-5.76
-0.27	-4.80
-0.14	-3.84
-0.06	-2.88
-0.02	-1.92
0.00	-0.96
0.00	0.00
0.00	0.96
0.02	1.92
0.06	2.88
0.14	3.84
0.27	4.80
0.47	5.76
0.75	6.72
1.12	7.68
1.60	8.64
2.19	9.60
2.92	10.56
3.79	11.52
4.82	12.48
6.02	13.44
7.40	14.40
7.86	14.40

Layer 4 18' - 23'

Depth = 20.5 feet	
Elevation = 243.5 feet	
y (in)	p (kip)
-7.86	-16.84
-7.40	-16.84
-6.02	-15.72
-4.82	-14.59
-3.79	-13.47
-2.92	-12.35
-2.19	-11.23
-1.60	-10.10
-1.12	-8.98
-0.75	-7.86
-0.47	-6.74
-0.27	-5.61
-0.14	-4.49
-0.06	-3.37
-0.02	-2.25
0.00	-1.12
0.00	0.00
0.00	1.12
0.02	2.25
0.06	3.37
0.14	4.49
0.27	5.61
0.47	6.74
0.75	7.86
1.12	8.98
1.60	10.10
2.19	11.23
2.92	12.35
3.79	13.47
4.82	14.59
6.02	15.72
7.40	16.84
7.86	16.84

Layer 5 23' - 28'

Depth = 25.5 feet	
Elevation = 238.5 feet	
y (in)	p (kip)
-7.86	-19.28
-7.40	-19.28
-6.02	-17.99
-4.82	-16.71
-3.79	-15.42
-2.92	-14.14
-2.19	-12.85
-1.60	-11.57
-1.12	-10.28
-0.75	-9.00
-0.47	-7.71
-0.27	-6.43
-0.14	-5.14
-0.06	-3.86
-0.02	-2.57
0.00	-1.29
0.00	0.00
0.00	1.29
0.02	2.57
0.06	3.86
0.14	5.14
0.27	6.43
0.47	7.71
0.75	9.00
1.12	10.28
1.60	11.57
2.19	12.85
2.92	14.14
3.79	15.42
4.82	16.71
6.02	17.99
7.40	19.28
7.86	19.28

Layer 6 28' - 31.5'

Depth = 30.5 feet	
Elevation = 233.5 feet	
y (in)	p (kip)
-7.86	-15.20
-7.40	-15.20
-6.02	-14.19
-4.82	-13.17
-3.79	-12.16
-2.92	-11.15
-2.19	-10.13
-1.60	-9.12
-1.12	-8.11
-0.75	-7.09
-0.47	-6.08
-0.27	-5.07
-0.14	-4.05
-0.06	-3.04
-0.02	-2.03
0.00	-1.01
0.00	0.00
0.00	1.01
0.02	2.03
0.06	3.04
0.14	4.05
0.27	5.07
0.47	6.08
0.75	7.09
1.12	8.11
1.60	9.12
2.19	10.13
2.92	11.15
3.79	12.16
4.82	13.17
6.02	14.19
7.40	15.20
7.86	15.20

Layer 7 31.5' - 38'

Depth = 35.5 feet	
Elevation = 228.5 feet	
y (in)	p (kip)
-0.73	-329.66
-0.71	-329.66
-0.69	-329.66
-0.66	-318.83
-0.64	-308.00
-0.61	-297.17
-0.58	-286.34
-0.55	-275.51
-0.52	-264.68
-0.49	-253.85
-0.46	-243.02
-0.43	-232.19
-0.40	-221.36
-0.37	-210.53
-0.34	-199.70
-0.31	-188.86
0.00	0.00
0.31	188.86
0.34	199.70
0.37	210.53
0.40	221.36
0.43	232.19
0.46	243.02
0.49	253.85
0.52	264.68
0.55	275.51
0.58	286.34
0.61	297.17
0.64	308.00
0.66	318.83
0.69	329.66
0.71	329.66
0.73	329.66

Layer 8 38' - 43'

Depth = 40.5 feet	
Elevation = 223.5 feet	
y (in)	p (kip)
-0.73	-388.39
-0.71	-388.39
-0.69	-388.39
-0.68	-382.12
-0.66	-375.85
-0.65	-369.58
-0.64	-363.31
-0.62	-357.04
-0.61	-350.78
-0.59	-344.51
-0.58	-338.24
-0.56	-331.97
-0.55	-323.86
-0.54	-315.37
-0.52	-306.89
-0.51	-298.40
0.00	0.00
0.51	298.40
0.52	306.89
0.54	315.37
0.55	323.86
0.56	331.97
0.58	338.24
0.59	344.51
0.61	350.78
0.62	357.04
0.64	363.31
0.65	369.58
0.66	375.85
0.68	382.12
0.69	388.39
0.71	388.39
0.73	388.39

Layer 9 43' - 51'

Depth = 45.5 feet	
Elevation = 218.5 feet	
y (in)	p (kip)
-0.81	-880.24
-0.79	-880.24
-0.77	-880.24
-0.72	-817.36
-0.66	-754.49
-0.61	-691.61
-0.55	-628.74
-0.50	-565.87
-0.44	-502.99
-0.39	-440.12
-0.33	-377.24
-0.28	-314.37
-0.22	-251.50
-0.17	-188.62
-0.11	-125.75
-0.06	-62.87
0.00	0.00
0.06	62.87
0.11	125.75
0.17	188.62
0.22	251.50
0.28	314.37
0.33	377.24
0.39	440.12
0.44	502.99
0.50	565.87
0.55	628.74
0.61	691.61
0.66	754.49
0.72	817.36
0.77	880.24
0.79	880.24
0.81	880.24

Data: Q-z Curves

Br. Name:	Route 43 over Kings River Seismic Retr	Elevation (ft)		Pile Type:	Fluted Piles
Br. No. =	45-0064	OG =	Varies	Pile Tip Dia =	15.5" for extension; taper to 8" at tip
		Pile Cut-Off=	Varies		
Support(s):	All Bents	GW =	151.0		

Note: All elevations are in feet.

B2		B3		B4 to B6		B7		B8		B9		B10 to B12		B13 and B14		B15 and B16		B17	
Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1178	0.01025	0.1178	0.009125	0.8311	0.0085	0.05888	0.00925	0.05888	0.00975	0.05888	0.0105	0.05888	0.01038	0.05888	0.01063	0.2055	0.009875	0.1178	0.01038
0.2355	0.0205	0.2355	0.01825	1.662	0.017	0.1178	0.0185	0.1178	0.0195	0.1178	0.021	0.1178	0.02075	0.1178	0.02125	0.411	0.01975	0.2355	0.02075
0.471	0.041	0.4711	0.0365	3.325	0.034	0.2355	0.037	0.2355	0.039	0.2355	0.042	0.2355	0.0415	0.2355	0.0425	0.822	0.0395	0.471	0.0415
0.9421	0.2665	0.9422	0.2373	6.649	0.221	0.4711	0.2405	0.4711	0.2535	0.471	0.273	0.471	0.2698	0.471	0.2763	1.644	0.2568	0.9421	0.2698
1.413	0.861	1.413	0.7665	9.974	0.714	0.7066	0.777	0.7066	0.819	0.7066	0.882	0.7066	0.8715	0.7066	0.8925	2.466	0.8295	1.413	0.8715
1.696	1.496	1.696	1.332	11.97	1.241	0.8479	1.35	0.8479	1.423	0.8479	1.533	0.8479	1.515	0.8479	1.551	2.959	1.442	1.696	1.515
1.884	2.05	1.884	1.825	13.3	1.7	0.9422	1.85	0.9421	1.95	0.9421	2.1	0.9421	2.075	0.9421	2.125	3.288	1.975	1.884	2.075
1.884	3.075	1.884	2.738	13.3	2.55	0.9422	2.775	0.9421	2.925	0.9421	3.15	0.9421	3.113	0.9421	3.188	3.288	2.963	1.884	3.113
1.884	4.1	1.884	3.65	13.3	3.4	0.9422	3.7	0.9421	3.9	0.9421	4.2	0.9421	4.15	0.9421	4.25	3.288	3.95	1.884	4.15

Data: Q-z Curves

Br. Name: Route 43 over Kings River Seismic Retr	Elevatiion (ft)	Pile Type: Octagonal PCC
Br. No. = 45-0064	OG =	Pile Tip Dia = 18 inches
	Pile Cut-Off=	
Support(s): All Bents	GW =	

Note: All elevations are in feet.

B2		B3		B4 to B6		B7		B8		B9		B10 to B12		B13 and B14		B15 and B16		B17	
Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)	Q (kips)	z (inches)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1178	0.01025	0.1178	0.009125	0.8311	0.0085	0.05888	0.00925	0.05888	0.00975	0.05888	0.0105	0.05888	0.01038	0.05888	0.01063	0.2055	0.009875	0.1178	0.01038
0.2355	0.0205	0.2355	0.01825	1.662	0.017	0.1178	0.0185	0.1178	0.0195	0.1178	0.021	0.1178	0.02075	0.1178	0.02125	0.411	0.01975	0.2355	0.02075
0.471	0.041	0.4711	0.0365	3.325	0.034	0.2355	0.037	0.2355	0.039	0.2355	0.042	0.2355	0.0415	0.2355	0.0425	0.822	0.0395	0.471	0.0415
0.9421	0.2665	0.9422	0.2373	6.649	0.221	0.4711	0.2405	0.4711	0.2535	0.471	0.273	0.471	0.2698	0.471	0.2763	1.644	0.2568	0.9421	0.2698
1.413	0.861	1.413	0.7665	9.974	0.714	0.7066	0.777	0.7066	0.819	0.7066	0.882	0.7066	0.8715	0.7066	0.8925	2.466	0.8295	1.413	0.8715
1.696	1.496	1.696	1.332	11.97	1.241	0.8479	1.35	0.8479	1.423	0.8479	1.533	0.8479	1.515	0.8479	1.551	2.959	1.442	1.696	1.515
1.884	2.05	1.884	1.825	13.3	1.7	0.9422	1.85	0.9421	1.95	0.9421	2.1	0.9421	2.075	0.9421	2.125	3.288	1.975	1.884	2.075
1.884	3.075	1.884	2.738	13.3	2.55	0.9422	2.775	0.9421	2.925	0.9421	3.15	0.9421	3.113	0.9421	3.188	3.288	2.963	1.884	3.113
1.884	4.1	1.884	3.65	13.3	3.4	0.9422	3.7	0.9421	3.9	0.9421	4.2	0.9421	4.15	0.9421	4.25	3.288	3.95	1.884	4.15

APPENDIX D

Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ **EA:** _0k800___ **EFIS**__0612000110_____ **Project Name:** Seismic Retrofit Kings River Bridge **Structure Design:** Sara Yip_ **Phone:** _(916) 227-8778__ **e-mail:**_____	__ PSR/PDS (Review No.__ __ APS/PSR (Review No.__) _ APS/PR (Review No.__) __ Type Selection __ 65% PS&E Unchecked Details __ PS&E (Review No.__) __ Construction __X Other:__FR_REVIEW NO 1__	**Reviewer Name:** _Javad Massoomi/John Huang_ _____ **Functional Unit:** _METS/GS **Cost Center:** _59-3657 **Phone Number:**227-1037 _**e-mail:** _____ **Date of Review:** _9/17/15_ **Structure Name*: Kings River Bridge**, 45-0064___ (*Use if necessary to when comment sheets are by individual structure)

Consultant Information

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
Neva Popenoe	Kleinfelder	559-486-0750	npopenoe@kleinfelder.com	9/21/15

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR	11, section 3.4	Please add design groundwater table	The design groundwater elevation has been added to section 3.4.	
2	FR	LOTB	Please add fill the bottom portion of the names, please put John Huang as design oversight, thanks	The LOTB has been updated.	
3					
4					
5					
6					
7	Note		FR by Kleinfelder dated 09/15/15, managed through GS contract. Structure Design in house.		
8	Grade		C2 – conditional approval, subject to above comments addressed satisfactorily		
11					

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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_____ Functional Unit:_____ Br No*._____ *=if applicable

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September 15, 2015
File No.: 20143390.074A

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

Attn: Mr. John Huang

SUBJECT:

Foundation Report
State Route 41 Bridge over Kings River
Bridge No. 45-0007
Kings County, California

Dear Mr. Huang:

The attached report presents the results of the geotechnical study for the State Route 41 Bridge over Kings River project located southeast of Stratford, in Kings County, California. This report describes our study and provides conclusions and recommendations for use in seismic rehabilitation evaluation.

We appreciate the opportunity to provide geotechnical engineering services to Caltrans and other project designers. We trust this information meets your current needs. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully Submitted,
KLEINFELDER, INC.

Neva M. Popenoe, PE, GE
Project Engineer

Nathan L. Dahlen, PE
Senior Project Manager

NMP:NLD:sj

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5125 North Gates Avenue, Suite 102, Fresno, CA 3722 **p|** 559-486-0750 **f|** 559-442-5081

FOUNDATION REPORT
SR 41 BRIDGE OVER KINGS RIVER
BRIDGE NO. 45-0007
KINGS COUNTY, CALIFORNIA

A report prepared for:

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

September 15, 2015
File No.: 20143390.074A

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ONLY THE CLIENT OR ITS DESIGNATED REPRESENTATIVES MAY USE THE DOCUMENT AND ONLY FOR THE SPECIFIC PROJECT FOR WHICH THIS REPORT WAS PREPARED.

Prepared For:
STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

FOUNDATION REPORT
STATE ROUTE 41 BRIDGE OVER KINGS RIVER
BRIDGE NO. 45-0007
KINGS COUNTY, CALIFORNIA

Kleinfelder Job No.: 20143390.074A

Prepared by:

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September 15, 2015

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APPENDIX D

RESPONSE TO CALTRANS COMMENTS

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1. INTRODUCTION

1.1. GENERAL

This report presents the results of the geotechnical investigation for the proposed seismic retrofit evaluation of the State Route 41 Bridge over Kings River (No. 45-0007), located southeast of Stratford in Kings County, California. The scope of services consisted of a field exploration program, laboratory testing, engineering analysis, and preparation of this written report.

1.2. SCOPE OF SERVICES

The purpose of the Foundation Report is to provide geotechnical recommendations and opinions to aid in project design. The report provides the following:

- A description of the proposed project;
- A summary of the field exploration and laboratory testing programs;
- Comments on the regional geology and site engineering seismology, including the recommended peak ground acceleration and Caltrans Seismic Design Criteria Version 1.7 ARS curve;
- Comments on liquefaction potential;
- Available factored nominal axial capacity and t-z and qu curves for existing pile foundations under Extreme Event loading;
- Recommended LPILE parameters for use in evaluating the existing pile response to lateral loads and p-y curves for the existing piles;
- Moment and shear curves for a range of lateral deflections; and
- Log of Test Borings drawing.

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1.3. PROJECT DESCRIPTION

The proposed project will involve the seismic rehabilitation evaluation of State Route 41 Bridge over Kings River. The original 10-span structure is supported by 15-inch diameter, cast-in-place Union fluted steel shell tapered piles. The span lengths center of bearing (c.o.b.) to c.o.b. are 24.75 feet, with a total bridge length of 260 feet. 15-inch Class 70 concrete driven piles were added to both the east and west at each abutment and bent locations as part of a bridge widening conducted in 1986. The overall widening of the bridge totaled 15'-10". Table 1.3-1 provides the data for the existing bridge foundations, as provided in the General Plan, dated June 19, 2015; and foundation data tables provided by Caltrans Structures group.

TABLE 1.3-1
EXISTING BRIDGE FOUNDATION DATA

Pile Type	Support	Location	Pile Cut-off Elevation (feet)	Tip Elevation (feet)
Cast-in-Place Union Fluted Steel Shell[1] And Class 70[2]	Bent 1	203+15	194	100
	Bent 2	203+28	189	100
	Bent 3	203+53	184	100
	Bent 4	203+78	181	100
	Bent 5	204+03	181	100
	Bent 6	204+28	182	100
	Bent 7	204+53	183	100
	Bent 8	204+78	186	100
	Bent 9	205+03	187	100
	Bent 10	205+28	189	100
	Bent 11	205+53	193	100

Notes: 1. Original supports
2. Supports from 1986 widening

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1.4. POLICY EXCEPTIONS

No known exceptions to Caltrans policy were made in the geotechnical evaluation for the foundations for this project.

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2. FIELD EXPLORATION AND LABORATORY TESTING

2.1. FIELD EXPLORATION AND TESTING

The field exploration for State Route 41 Bridge over Kings River rehabilitation consisted of 1 test boring. Exploration was performed on June 23 and 27, 2015. The test boring was drilled with a Christensen, truck-mounted drill rig using punch core drilling techniques. The boring was drilled to a depth of 151.5 feet below ground surface. The approximate location of the test boring is shown on the Log of Test Borings drawing in Figures 1 and 2 of this report.

The earth materials encountered in the test borings were visually classified in the field and a continuous log was recorded. Along with the continuous core sampling, in-place samples of soil units were collected from the test boring at selected depths by driving a 2-inch I.D. split barrel sampler containing brass liners into the undisturbed soil with a 140-pound automatic safety hammer free falling a distance of 30-inches. In addition, an ASTM D1586 standard penetrometer without liners (barrel I.D. of 1.5 inches) was driven 18-inches in the same manner. This latter sampling procedure generally conformed to the ASTM D1586 test procedure. Resistance to sampler penetration over the last 12-inches is noted on the Log of Test Borings as the "Penetration Index". The penetration indices listed on the Log of Test Borings have not been corrected for the effects of overburden pressure, sampler size, rod length, or hammer efficiency.

Penetration rates determined in general accordance with ASTM D1586 were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils. The hammer test measurement was obtained for the drill rig and hammer from Caltrans Drilling Services. The report was prepared June 2015. The hammer energy transfer measurement for the boring is noted on the Log of Test Boring drawing in Figure 2 of this report.

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2.2. LABORATORY TESTS

Laboratory tests were performed on selected samples to evaluate certain characteristics and engineering properties. The laboratory testing program was designed with emphasis on the evaluation of geotechnical properties of foundation materials as they pertain to the proposed project. The laboratory testing program included performing the following tests:

- Moisture Content (ASTM D2216)
- Unit Weight (ASTM D7263)
- Material in Soils Finer than No. 200 (75-µm) Sieve (ASTM D1140)
- Atterberg Limits (ASTM D4318)
- Unconfined Compressive Strength (ASTM D2166)

Geotechnical design parameters were based on project specific laboratory data, and interpretation of the area geology. Consideration was also given to correlations with sample penetration rates. Table 2.2-1 provides a summary of geotechnical design parameters and generalized soil profile used.

TABLE 2.2-1
GEOTECHNICAL DESIGN PARAMETERS

Elevation (feet)	Material	γ_t (pcf)[1]	γ_b (pcf)[2]	Φ (degrees)	c (psf)
195 – 178	ML	125	63	27	-
178 – 172	CL	114	52	-	500
172 – 165	SM	125	63	35	-
165 – 138	CL	115	53	-	500
138 – 104	CH	115	53	-	1500
Below 104	CL	115	53	-	1500

Notes: 1. Total unit weight
2. Buoyant unit weight

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3. SITE CONDITIONS

3.1 SURFACE CONDITIONS AND TOPOGRAPHY

The existing State Route 41 Bridge over Kings River is a 2-lane paved road approximately at original grade. At the time of the investigation, water was present in the Kings River at an approximate elevation of 189 feet and the banks supported some aquatic vegetation near the water line. The general topography along the State Route 41 alignment is relatively flat on either side of the bridge, with thin approach fills (less than about 2 feet).

3.2 REGIONAL GEOLOGY

The project site lies in the central portion of the San Joaquin Valley in the Great Valley geomorphic province in California. This province was formed by the filling of a large structural trough or downwarp in the underlying bedrock. The trough is situated between the Sierra Nevada Range on the east and south and the Coast Range on the west. Both of these mountain ranges were initially formed by uplifts that occurred during the Jurassic and Cretaceous periods of geologic time (greater than 65 million years ago). Renewed uplift began in the Sierra Nevada during the Tertiary time, and is continuing today. The trough that underlies the valley is asymmetrical, with the greatest depths of sediments near the western margin. The sediments that fill the trough originated as erosion material from the adjacent mountains and foothills.

3.3 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at the boring location, refer to the Log of Test Boring presented in Figure 2. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

The upper soil material consisted primarily of fine grained alluvial fan sediment underlain by recent basin deposits. Alluvial fan sediments of lean to fat clay with thin layers of interspersed

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silty sand and sandy silt extends to a depth of approximately 151.5 feet below ground surface. The thickness of the silty sand and sandy silt layers increased with depth.

3.4 GROUNDWATER CONDITIONS

Groundwater was encountered at an elevation of approximately 180 feet or about 15 feet below existing grade during drilling at boring RC-15-006. Groundwater at the site is affected by flow in the Kings River. Groundwater conditions at the site could change at some time in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time the test borings were performed. The design groundwater elevation for the project was 180 feet.

3.5 CHANNEL SCOUR/DEGRADATION

A Structure Hydraulics and Hydrology Final Hydraulics Report for Bridge Number 45-0007 was prepared by Ronald McGaugh and dated August 18, 2015. The report indicates no long term degradation or contraction scour, but notes maximum local pier scour depths at each bent ranging from 1.81 feet to 6.46 feet for an ultimate flow of 6,000 cubic feet per second, as indicated in Table 3.5-1.

TABLE 3.5-1
Local Pier Scour

	Bent 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6	Bent 7
Scour Depth (ft.)	0	2.20	5.91	3.66	6.46	3.57	5.81
Ground Elevation (ft.)	192.02	187.32	183.22	181.82	181.82	182.12	183.52
Scour Elevation (ft.)	192.02	185.12	177.31	178.16	175.36	178.55	177.71

	Bent 8	Bent 9	Bent 10	Abut 11
Scour Depth (ft.)	2.87	4.27	1.81	0
Ground Elevation (ft.)	185.22	183.62	189.22	192.92
Scour Elevation (ft.)	182.35	182.35	187.41	192.92

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4. CORROSION EVALUATION

Soil samples from boring RC-15-006 (depth of 11.5 to 15 feet) were tested to evaluate the soluble sulfate content, soluble chloride content, pH and minimum resistivity. Specific test results are presented in Table 4.1-1.

TABLE 4.1-1
CORROSION RELATED TESTING

Boring No.	Depth (ft)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	pH	Minimum Resistivity (ohm-cm)
RC-15-006	11.5 - 15	70	44	7.8	3335

Laboratory tests indicate the soluble chlorides are outside the Caltrans threshold limits. Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. Consequently, a qualified corrosion engineer should be consulted if the designer desires more specific recommendations and material types and/or mitigation, particularly with regard to steel piles.

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5. SEISMIC RECOMMENDATIONS

5.1 LOCAL FAULTING

There are no known faults, which cut through the local soil at the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone, as defined by Special Publication 42 (revised 2007) published by the California Geologic Survey (CGS). Numerous faults and shear zones within the region could influence the project site.

5.2 SEISMIC DESIGN CRITERIA

Seismic design parameters were developed in accordance with the Caltrans Seismic Design Criteria Version 1.7.

The project site is located in a region with the potential for relatively moderate seismic activity. The more significant faults that could influence the project site include the Great Valley 14 (Kettleman Hills) (Fault ID No. 210), the San Andreas Fault (Parkfield) (Fault ID No. 214), and the Great Valley 13 (Coalinga) (Fault ID No. 205). According to the Caltrans fault database, the Great Valley 14 (Kettleman Hills) is a reverse fault with a dip angle of 22 degrees towards the west and assigned Maximum Magnitude (M_{Max}) of 7.1, the San Andreas Fault (Parkfield) is strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 7.9, and the Great Valley 13 (Coalinga) is a reverse fault with a dip angle of 15 degrees towards the west and assigned Maximum Magnitude (M_{Max}) of 7.0. The characteristics of these three faults are summarized in Table 5.2-1.

Based on the boring data, the site can be classified as Soil Profile Type D. A V_{s30} of 194 m/s was used for the evaluation. The site is not located within a California deep soil basin region, as defined by Caltrans, so $Z_{1.0}$ and $Z_{2.5}$ were considered not applicable. Site characteristics and governing deterministic faults are summarized in Table 5.2-1.

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TABLE 5.2-1
SITE CHARACTERISTICS AND
GOVERNING DETERMINISTIC FAULTS PARAMETERS

Site Coordinates	Lat = 36.181 deg, Long = -119.834 deg
Shear Wave Velocity	194 m/s
Depth to V_s=1.0 km/s, $Z_{1.0}$	N/A
Depth to V_s=2.5 km/s, $Z_{2.5}$	N/A
Fault Name and ID Number	Great Valley 14 (Kettleman Hills), No. 210
Maximum Magnitude (M_{Max})	7.1
Fault Type	Reverse
Fault Dip	22 degrees
Dip Direction	West
Bottom of Rupture Plane	22.50 km
Top of Rupture Plane (Z_{tor})	8.10 km
R_{RUP}[1]	21.83 km
R_{jB}[2]	20.23 km
R_X[3]	20.23 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1
Fault Name and ID Number	San Andreas fault (Parkfield), No. 214
Maximum Magnitude (M_{Max})	7.9
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	6 km
Top of Rupture Plane (Z_{tor})	0 km
R_{RUP}[1]	62.30 km
R_{jB}[2]	62.30 km
R_X[3]	62.30 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0
Fault Name and ID Number	Great Valley 13 (Coalinga), No. 205
Maximum Magnitude (M_{Max})	7.0
Fault Type	Reverse
Fault Dip	15 degrees
Dip Direction	West
Bottom of Rupture Plane	15.30 km
Top of Rupture Plane (Z_{tor})	9.10 km
R_{RUP}[1]	27.02 km
R_{jB}[2]	25.44 km
R_X[3]	20.54 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1

Notes:
[1]R_{RUP} = Closest distance from the site to the fault rupture plane.
[2]R_{JB} = Joyner-Boore distance; the shortest horizontal distance to the surface projection of the rupture area.
[3]R_X = Horizontal distance from the site to the fault trace or surface projection of the top of the rupture plane.

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5.2.1 Deterministic Response Spectrum

The deterministic response spectrum was developed using ARS Online. The deterministic response spectrum from the Minimum Spectrum for California governed.

5.2.2 Probabilistic Response Spectrum

The probabilistic response spectrum was developed using ARS Online.

5.2.3 Design Response Spectrum

The upper envelope of the deterministic and probabilistic spectral values determines the design response spectrum. The probabilistic response spectra were found to govern for all periods. The recommended acceleration and displacement design response spectra are presented graphically and numerically in Appendix B.

5.2.4 References

Caltrans. Caltrans ARS Online, http://dap3.dot.ca.gov/ARS_Online

Caltrans. Geotechnical Services Manual, January 2013.

Caltrans. Seismic Design Criteria, Appendix B Design Spectrum

Caltrans. Website http://dap3.dot.ca.gov/shake_stable/v2/technical.php

5.3 LIQUEFACTION POTENTIAL

In order for liquefaction of soils due to ground shaking to occur, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state,
- The soils are saturated,
- The soils are non-plastic, and

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- ❑ Ground motion is of sufficient intensity to act as a triggering mechanism.

Based on the ARS curve, the design Peak Horizontal Ground Acceleration (PHGA) is 0.39g, with a Moment Magnitude of 6.8. The potential for liquefaction was evaluated using Youd et. al. (2001). The majority of the upper site soil is sufficiently plastic and is not susceptible to liquefaction. However, interbedded zones of poorly graded sand and silty sand within these plastic layers are subject to liquefaction. The consequence of liquefaction at the site is relatively minor, with little to no surface manifestations of seismically induced settlement. The magnitude of the potential settlement is anticipated to be less than ½ inch.

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6. FOUNDATION RECOMMENDATIONS

6.1 GENERAL

Based on the field exploration, laboratory testing, and geotechnical analyses, the soils at the site are suitable to support the existing bridge structure. To support seismic analysis of the structure, axial and lateral capacity have been evaluated for the existing piles.

6.2 PILE FOUNDATIONS

6.2.1 Axial Capacity

Nordlund and alpha methods as outlined in AASHTO for evaluating driven piles were utilized in the analysis for the axial capacity of the 15-inch cast-in-place Union fluted steel shell piles and the 15-inch Class 70 driven piles. Table 6.2-1 provides the estimated nominal capacities and of the existing piles at the provided tip elevations, see Table 1.3-1.

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TABLE 6.2-1
EXISTING BRIDGE FOUNDATION DATA

Pile Type	Support	Pile Cut-off Elevation (feet)	Tip Elevation (feet)	Estimated Nominal Resistance[3] (kips)	Estimated Uplift Capacity[4] (kips)
Cast-in-Place Union Fluted Steel Shell[1]	Bent 1	194	100	140	98
	Bent 2	189	100	140	98
	Bent 3	184	100	140	98
	Bent 4	181	100	140	98
	Bent 5	181	100	140	98
	Bent 6	182	100	140	98
	Bent 7	183	100	140	98
	Bent 8	186	100	140	98
	Bent 9	187	100	140	98
	Bent 10	189	100	140	98
	Bent 11	193	100	140	98
Class 70[2]	Bent 1	194	100	140	98
	Bent 2	189	100	140	98
	Bent 3	184	100	140	98
	Bent 4	181	100	140	98
	Bent 5	181	100	140	98
	Bent 6	182	100	140	98
	Bent 7	183	100	140	98
	Bent 8	186	100	140	98
	Bent 9	187	100	140	98
	Bent 10	189	100	140	98
	Bent 11	193	100	140	98

Notes:
1. Original supports
2. Supports from 1986 widening
3. Estimated nominal resistance may be greater than 200 kips per pile
4. Estimated geotechnical uplift capacity may exceed structural capacity of pile connection

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To assist in evaluation of settlement of piles, t-z and q-z curves are provided graphically and numerically in Appendix C.

6.2.2 Lateral Capacity

The lateral response of pile foundations can be evaluated using LPILE Plus Version 5.0, or greater, for Windows (computer software developed by Ensoft Inc.). The geotechnical parameters summarized in Tables 6.2-2 through 6.2-12 can be used for evaluation of lateral loading of piles at abutments and bents.

TABLE 6.2-2
LPILE PARAMETERS FOR BENT 1

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
194 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-3
LPILE PARAMETERS FOR BENT 2

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
189 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

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TABLE 6.2-4
LPILE PARAMETERS FOR BENT 3

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
184 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-5
LPILE PARAMETERS FOR BENT 4

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
181 – 178	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-6
LPILE PARAMETERS FOR BENT 5

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
181 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/	0.031	-	10.4	350	0.007

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	Groundwater					

TABLE 6.2-7
LPILE PARAMETERS FOR BENT 6

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
182 – 178	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-8
LPILE PARAMETERS FOR BENT 7

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
183 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

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TABLE 6.2-9
LPILE PARAMETERS FOR BENT 8

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
186 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-10
LPILE PARAMETERS FOR BENT 9

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
187 – 178	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

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TABLE 6.2-11
LPILE PARAMETERS FOR BENT 10

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
189 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

TABLE 6.2-12
LPILE PARAMETERS FOR BENT 11

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)	ε_{50}
193 – 180	Sand (Reese)	0.072	27	-	50	-
180 – 178	Sand (Reese)	0.036	27	-	50	-
178 – 172	Soft Clay w/ Groundwater	0.030	-	3.5	-	0.020
172 – 165	Sand (Reese)	0.036	35	-	60	-
165 – 138	Soft Clay w/ Groundwater	0.031	-	3.5	-	0.020
138 – 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007
Below 104	Stiff Clay w/ Groundwater	0.031	-	10.4	350	0.007

Figures 6.2-1 through 6.2-4 present the anticipated deflection of the pile head in response to a lateral load applied at the bridge deck connection elevation for the 15.5-inch cast-in-place Union fluted steel shell piles and the 15-inch Class 70 driven piles. Data are presented for both free and fixed head conditions.

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FIGURE 6.2-1
LATERAL LOAD DEFLECTION CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 1, 2, 10, AND 11

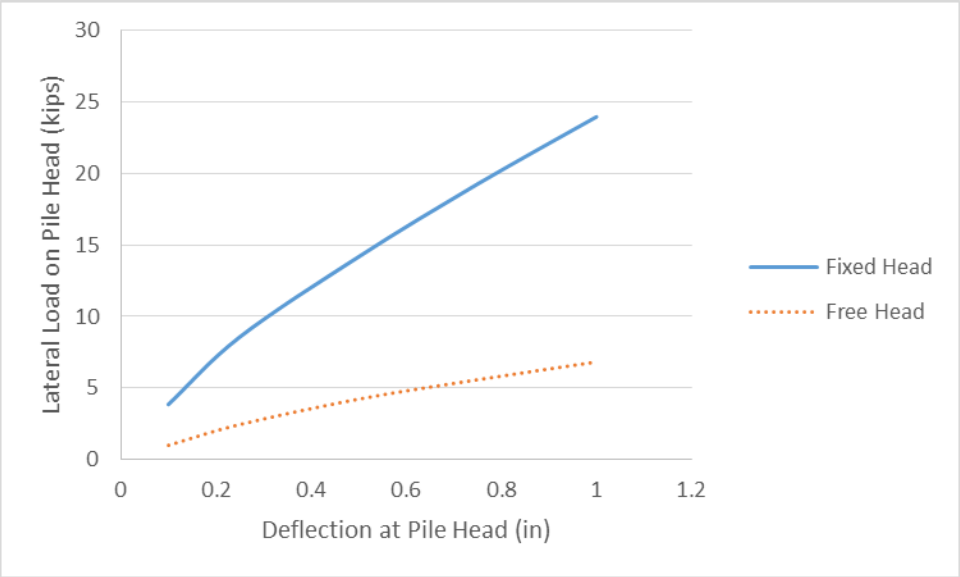

FIGURE 6.2-2
LATERAL LOAD DEFLECTION CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 3-9

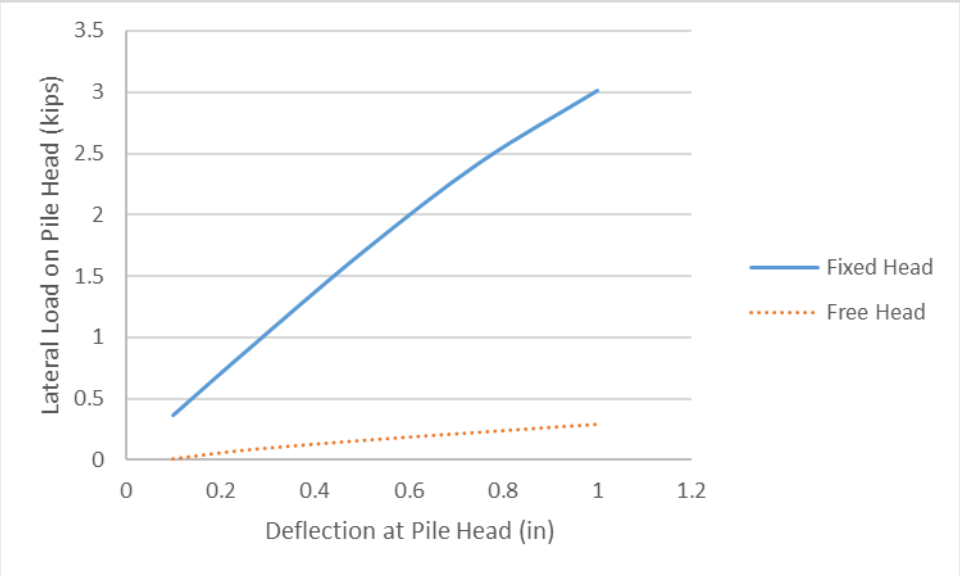

FIGURE 6.2-3

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LATERAL LOAD DEFLECTION CURVES
WIDEN 15" CLASS 45 PILES
BENTS 1, 2, 10, AND 11

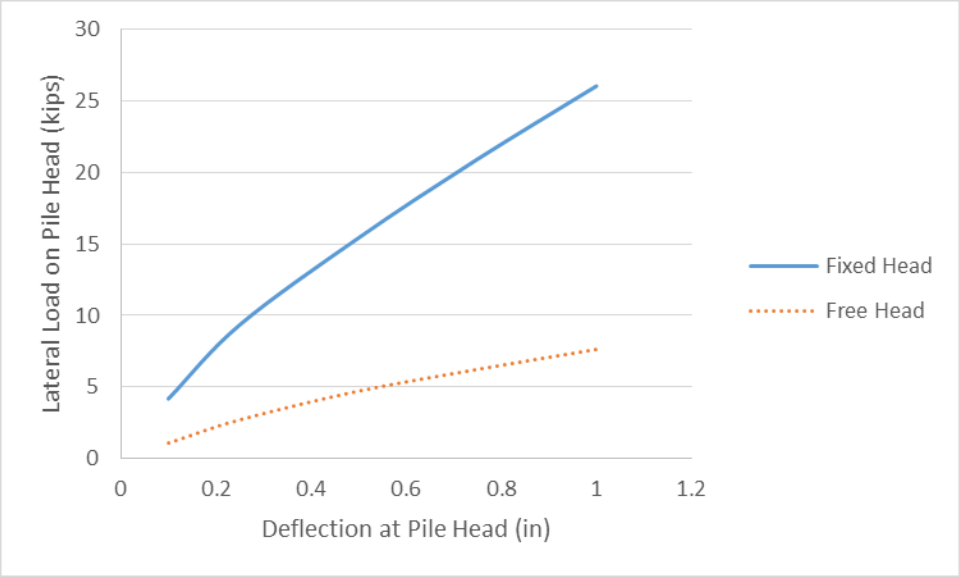
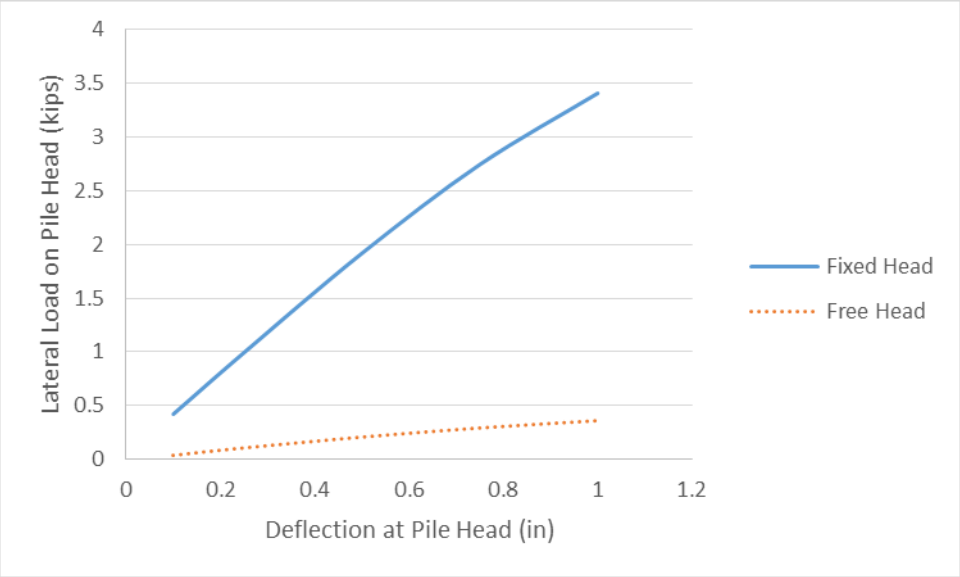


FIGURE 6.2-4
LATERAL LOAD DEFLECTION CURVES
WIDEN 15" CLASS 45 PILES
BENTS 3-9



When considering the lateral capacity of a pile group, it will be necessary to reduce the single pile capacity of trailing piles. The reduction in capacity due to the effects of shaft interaction will

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be dependent upon the center-to-center (CTC) pile spacing. It is understood Ensoft GROUP program will be utilized to determine lateral capacity of pile groups, which incorporates pile spacing effects.

6.2.3 Lateral Deflection Data

Provided in Appendix C are estimated p-y (lateral) curves for the existing piles, as well as moment and shear diagrams for a range of lateral deflections up to 1 inch.

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7. CLOSURE

The conclusions and recommendations in this report are for the seismic rehabilitation evaluation of the State Route 41 Bridge over Kings River, located in Kings County, California, as described in the text of this report. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. The field exploration program and this report were based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the recommendations given herein.

This report is intended for use by Caltrans and their subconsultants within a reasonable time from its issuance. Noncompliance with the recommendations of the report or misuse of the report will release Kleinfelder from any liability.

The scope of the geotechnical services did not include an environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands.

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FIGURES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	KIN	41	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
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No. 71344
Exp. 12/31/15
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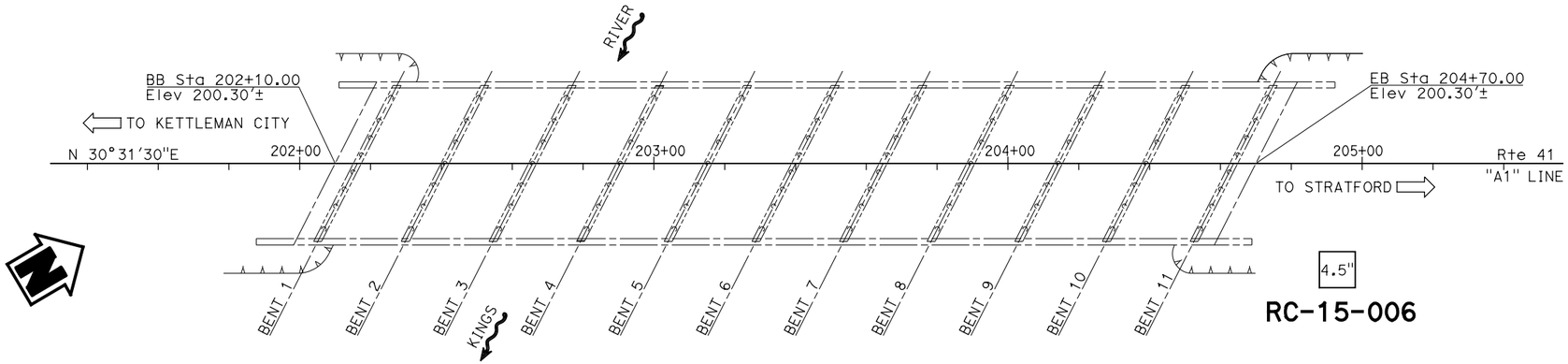

PLAN

1" = 20'

BENCHMARKS

STATION	OFFSET	N	E	ELEV	DESCRIPTION
2+85.68	22.52' Rt	1,949,691.05	6,315,334.68	199.15	DNK0341. Found 1" Iron pipe w/ red CT plug and tack
6+59.54	34.08' Rt	1,950,009.80	6,315,530.10	198.32	DNK0342. Found 1" Iron pipe w/ red CT plug and tack

SURVEY CONTROL
1. Coordinates bearing and distances are based on the California State Plane Coordinate system of NAD 83 (1986). Elevations are based on NGVD29 for Plan. Elevations are based on NAVD88 for borings.

Notes:

1. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (ID) of 1.4" and an outside diameter (OD) of 2".
2. 2.0" samples were taken using a CAL split-barrel sampler with an inside diameter (ID) of 2.0" and an outside diameter (OD) of 2.5"
3. An automatic hammer (140 lb) with a 30" drop was used to advance the sampler.
4. Blowcounts noted for boring are field blowcounts and have not been corrected.
5. Blowcounts 50/5 means 50 blows per 5" penetration.
6. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2010)

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

R. Shiplee
FIELD INVESTIGATION BY:
DATE: 6/24/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 45-0007
POST MILES 32.26

ROUTE 41 KINGS RIVER BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 1 OF 2

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES 9/23/15

REVISION DATES | SHEET X | OF X

FILE => 45-0007-z-ltb01.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 2

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

30.00' Rt Sta 204+93.00
"A1" Line

RC-15-006

Elev 195.0'

4.5"

GWS Elev 180.0'
06-23-15

Blows	Recovery	Sample
6	1.4	
2	1.4	WA CR
2.0		PI
9	1.4	M UW UC
13	1.4	WA
4	1.4	PI
5	1.4	M UW
5	1.4	PI
4	1.4	PI
8	1.4	M UW UC
7	1.4	WA
12	1.4	
9	1.4	PI
12	1.4	
9	1.4	
6	1.4	
7	1.4	PI
20	1.4	
16	1.4	
15	1.4	
14	1.4	WA
13	1.4	
14	1.4	
13	1.4	
32	1.4	
21	1.4	
13	1.4	
11	1.4	
11	1.4	
13	1.4	

06-24-15
Terminated at Elev 43.5'
ER_i = 92%

SANDY LEAN CLAY (CL); dark brown; moist; little fine SAND; low plasticity
SANDY SILT (ML); loose; pale brown; moist; fine to coarse SAND
SANDY LEAN CLAY (CL); gray; moist
SILTY SAND (SM); very loose; pale brown; moist; fine to coarse SAND; few fines
-moist to wet
FAT CLAY (CH); medium stiff; gray; moist; trace fine SAND; high plasticity; PP=1.0 tsf
POORLY-GRADED SAND (SP); loose; moist to wet; fine to coarse SAND; trace fines
LEAN CLAY (CL); stiff; brown to gray; moist; trace fine SAND; low to medium plasticity; PP=1.0 tsf
-very stiff; PP=2.0 tsf
SILTY SAND (SM); medium dense; pale brown to brown; moist to wet; fine to medium SAND; some fines
-brown; fine to coarse SAND; little fines
-fine to medium SAND; some fines
FAT CLAY (CH); medium stiff; brown; moist to wet; high plasticity; PP=0.5 tsf
SILTY SAND (SM); brown; moist to wet; fine to medium SAND; some fines
FAT CLAY (CH); brown; moist to wet; medium to high plasticity
SILTY SAND (SM); brown; moist to wet; fine to medium SAND; some fines
FAT CLAY (CH); medium stiff; brown; moist to wet; medium to high plasticity; PP=0.5 tsf
SILTY SAND (SM); loose; brown; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); medium stiff; brown; moist to wet; medium plasticity; PP=0.5 tsf
SILTY SAND (SM); loose; brown; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); medium stiff; brown; moist to wet; medium plasticity; PP=0.5 tsf
-very stiff; PP=1.5 tsf
SANDY SILT (ML); loose; brown; moist to wet; fine to medium SAND; little fines
FAT CLAY (CH); brown to pale brown; moist to wet; medium to high plasticity
SILTY SAND (SM); brown to pale brown; moist to wet; fine to medium SAND; some fines
FAT CLAY (CH); very stiff; brown to pale brown; moist to wet; high plasticity; PP=1.5 tsf
-gray
-very stiff; PP=2.0 tsf
-stiff; PP=1.0 tsf
-medium stiff; PP=0.5 tsf
-stiff; PP=1.0 tsf
-trace fine to medium SAND
SILTY SAND (SM); medium dense; gray; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); stiff; gray; moist to wet; low to medium plasticity; PP=1.5 tsf
-brown to gray
SILTY SAND (SM); medium dense; brown to gray; moist to wet; fine to medium SAND; little fines
-brown
LEAN CLAY (CL); brown to gray; moist to wet
-stiff; pale brown; PP=1.5 tsf
SILTY SAND (SM); medium dense; brown; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); stiff; brown to gray; moist to wet; PP=1.5 tsf
SILTY SAND (SM); brown to gray; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); brown to gray; moist to wet
SILTY SAND (SM); medium dense; brown to gray; moist to wet; fine to medium SAND; little fines
LEAN CLAY (CL); pale brown; moist to wet; low to medium plasticity
SILTY SAND (SM); dense; pale brown; moist to wet; fine to medium SAND; some fines
-pale brown to brown
SANDY SILT (ML); medium dense; brownish gray; wet; fine SAND
SILTY SAND (SM); brown to pale brown; wet; fine to medium SAND; some fines
LEAN CLAY (CL); very stiff; grayish brown; moist to wet; PP=2.5 tsf
-stiff; PP=1.0-1.5 tsf
-medium stiff to stiff; brown; PP=0.5-1.5 tsf
-stiff; PP=1.5 tsf
-PP=1.0 tsf
-grayish brown; PP=1.5 tsf

230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50

PROFILE
HOR. 1"=20'
VER. 1"=10'

205+00 206+00

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5125 N. GATES AVE., SUITE 102
FRESNO, CA 93722

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS
06	KIN	41	VARIOUS	

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen
R. Shiplee
FIELD INVESTIGATION BY:
DATE: 6/24/15

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

UNIT:
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

BRIDGE NO. 45-0007
POST MILES 32.26

ROUTE 41 KINGS RIVER BRIDGE
SEISMIC RETROFIT

LOG OF TEST BORINGS 2 OF 2

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 9/22/15

SHEET X OF X

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

FILE => 45-0007-2-1tb02.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX A

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
RC-15-006	10.0 - 11.5	SANDY SILT (ML)					53				
RC-15-006	17.0 - 19.0	FAT CLAY (CH)						51	21	30	
RC-15-006	18.0 - 18.5	FAT CLAY (CH)	38.9	82.0							**Unconfined Compressive Strength=**
											q_u: 1170 psf Strain at Failure: 7.8%
RC-15-006	25.0 - 26.5	SILTY SAND (SM)					20				
RC-15-006	30.0 - 31.5	FAT CLAY (CH)						53	22	31	
RC-15-006	34.0 - 34.5	SILTY SAND (SM)	39.3	82.0							
RC-15-006	40.0 - 41.5	LEAN CLAY (CL)						38	21	17	
RC-15-006	45.0 - 46.5	LEAN CLAY (CL)						39	17	22	
RC-15-006	47.0 - 47.5	LEAN CLAY (CL)	32.8	90.3							**Unconfined Compressive Strength=**
											q_u: 1954 psf Strain at Failure: 15.0%
RC-15-006	55.0 - 56.5	SANDY SILT (ML)					64				
RC-15-006	65.0 - 66.5	FAT CLAY (CH)						83	25	58	
RC-15-006	85.0 - 86.5	FAT CLAY (CH)						101	23	78	
RC-15-006	105.0 - 106.5	SILTY SAND (SM)					27				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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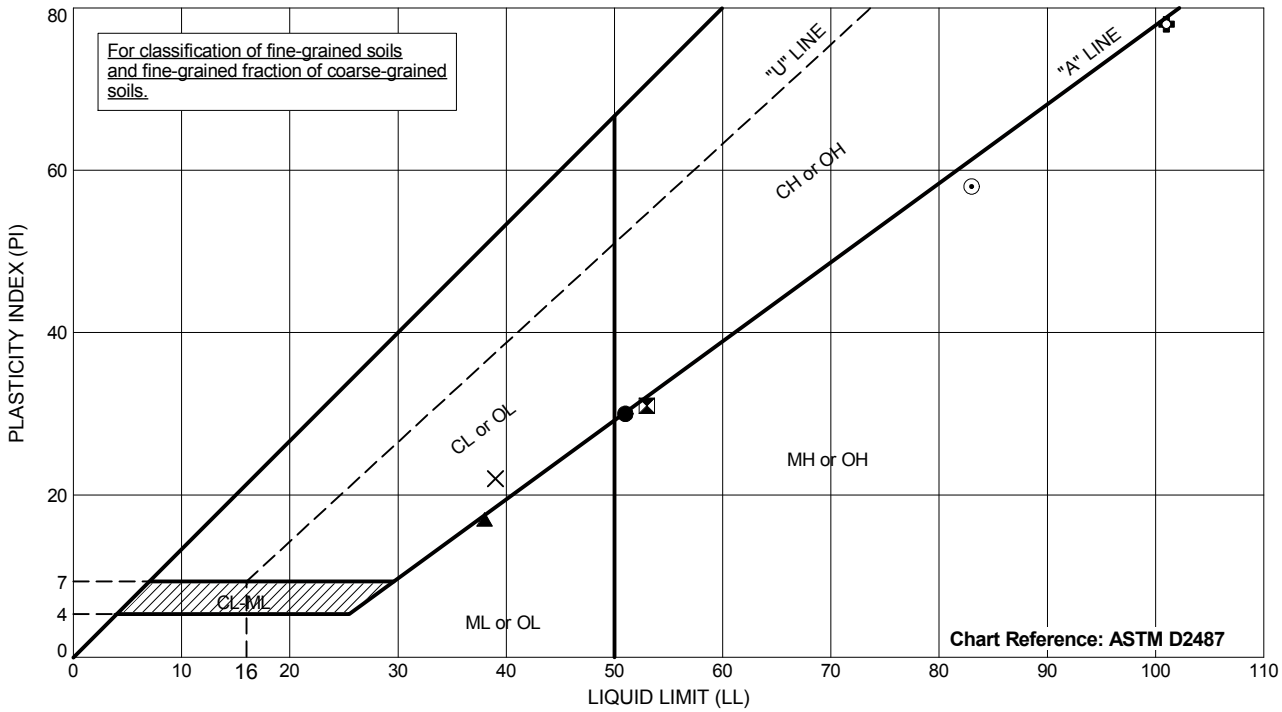
PROJECT NO.: 20143390
DRAWN BY: MAP
CHECKED BY: BC
DATE: 9/3/2015
REVISED: -

LABORATORY TEST RESULT SUMMARY

HIGHWAY 41 BRIDGE
OVER KINGS RIVER
KINGS COUNTY, CALIFORNIA

TABLE
A-1

PLOTTED: 09/03/2015 01:47 PM BY: MPalmer



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	RC-15-006	17 - 19	FAT CLAY (CH)	NM	51	21	30
⧗	RC-15-006	30 - 31.5	FAT CLAY (CH)	NM	53	22	31
▲	RC-15-006	40 - 41.5	LEAN CLAY (CL)	NM	38	21	17
×	RC-15-006	45 - 46.5	LEAN CLAY (CL)	NM	39	17	22
⊙	RC-15-006	65 - 66.5	FAT CLAY (CH)	NM	83	25	58
✿	RC-15-006	85 - 86.5	FAT CLAY (CH)	NM	101	23	78

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
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PROJECT NO.:	20143390
DRAWN BY:	MAP
CHECKED BY:	BC
DATE:	9/3/2015
REVISED:	-

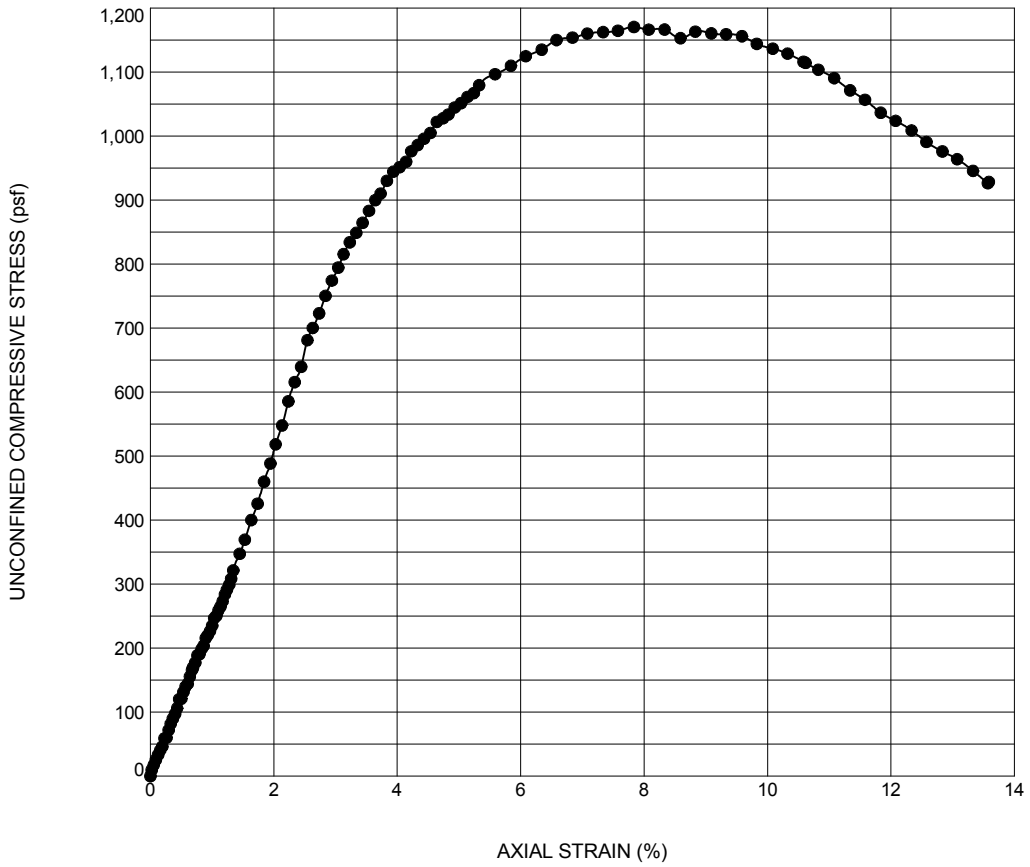
ATTERBERG LIMITS

HIGHWAY 41 BRIDGE
OVER KINGS RIVER
KINGS COUNTY, CALIFORNIA

FIGURE

A-2

gINT FILE: PROJECTWISE: 20143390.074a_41 Over Kings.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_ATTERBERG (ASTM)]



Exploration ID	Depth (ft.)	Sample Description
RC-15-006	18 - 18.5	FAT CLAY (CH)

Time to Failure (min)	Average Rate of Strain to Failure (%/min)	Shear Strength (psf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
3.9	2.0	585.0	1170	7.8

Specimen No.	Sample Condition Type	Initial Sample Dia. (mm)	Initial Height (mm)	Initial Height to Diameter Ratio	Initial Water Content (%)	Initial Dry Unit Wt. (pcf)	Initial Saturation (%)	Initial Void Ratio	Specific Gravity (Assumed)	Passing #200	LL	PL	PI
1	Undisturbed	61.7	112.0	1.8:1	38.9	82.0	100.6	1.055	2.70	NM	NM	NM	NM

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
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PROJECT NO.:	20143390
DRAWN BY:	MAP
CHECKED BY:	BC
DATE:	9/3/2015
REVISED:	-

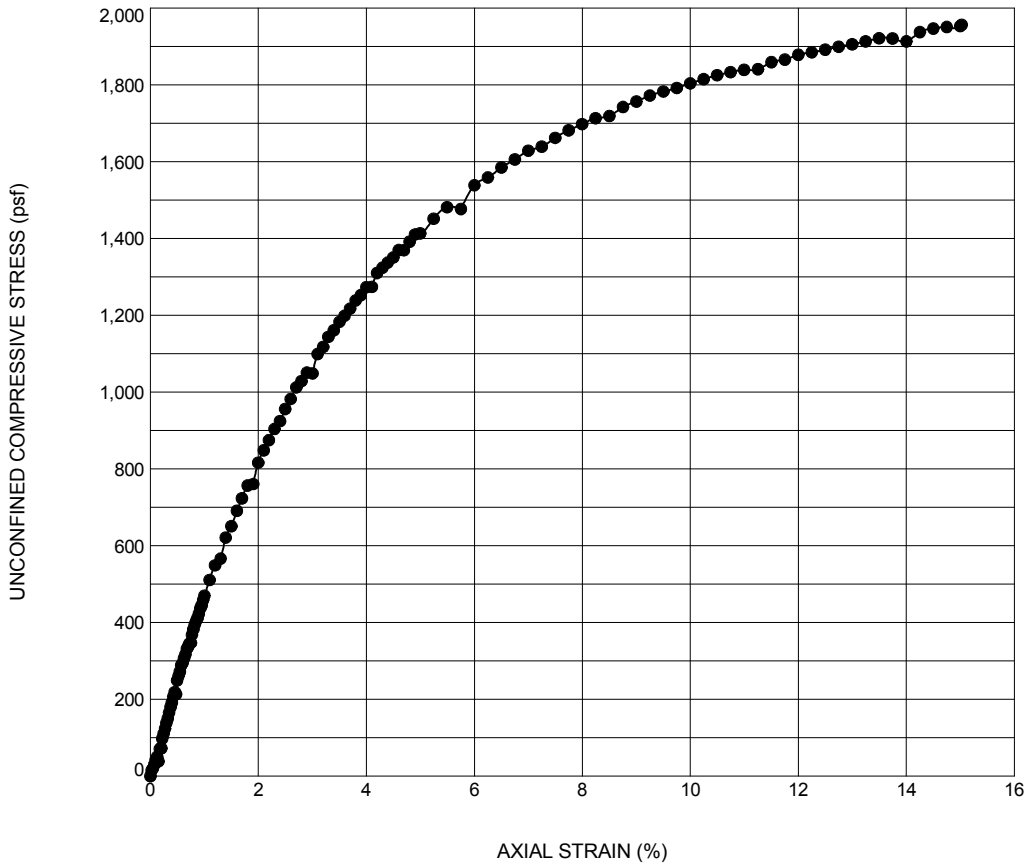
UNCONFINED COMPRESSIVE STRENGTH

HIGHWAY 41 BRIDGE
OVER KINGS RIVER
KINGS COUNTY, CALIFORNIA

FIGURE

A-3

PLOTTED: 09/03/2015 01:48 PM BY: MPalmer
gINT FILE: PROJECTWISE: 20143390.074a_41 Over Kings.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_UNC COMPRESSIVE STRENGTH]



Exploration ID	Depth (ft.)	Sample Description
RC-15-006	47 - 47.5	LEAN CLAY (CL)

Time to Failure (min)	Average Rate of Strain to Failure (%/min)	Shear Strength (psf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
15.0	1.0	977.0	1954	15.0

Specimen No.	Sample Condition Type	Initial Sample Dia. (mm)	Initial Height (mm)	Initial Height to Diameter Ratio	Initial Water Content (%)	Initial Dry Unit Wt. (pcf)	Initial Saturation (%)	Initial Void Ratio	Specific Gravity (Assumed)	Passing #200	LL	PL	PI
1	Undisturbed	60.5	122.4	2:1	32.8	90.3	101.8	0.900	2.70	NM	NM	NM	NM

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
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PROJECT NO.:	20143390
DRAWN BY:	MAP
CHECKED BY:	BC
DATE:	9/3/2015
REVISED:	-

UNCONFINED COMPRESSIVE STRENGTH

HIGHWAY 41 BRIDGE
OVER KINGS RIVER
KINGS COUNTY, CALIFORNIA

FIGURE

A-4

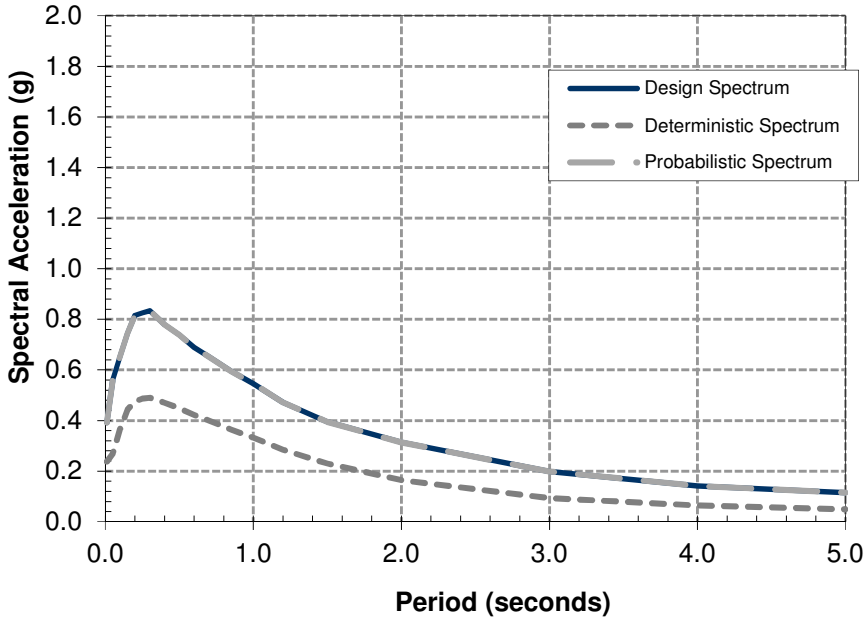
PLOTTED: 09/03/2015 01:48 PM BY: MPalmer
gINT FILE: PROJECTWISE: 20143390.074a_41 Over Kings.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_UNC COMPRESSIVE STRENGTH]

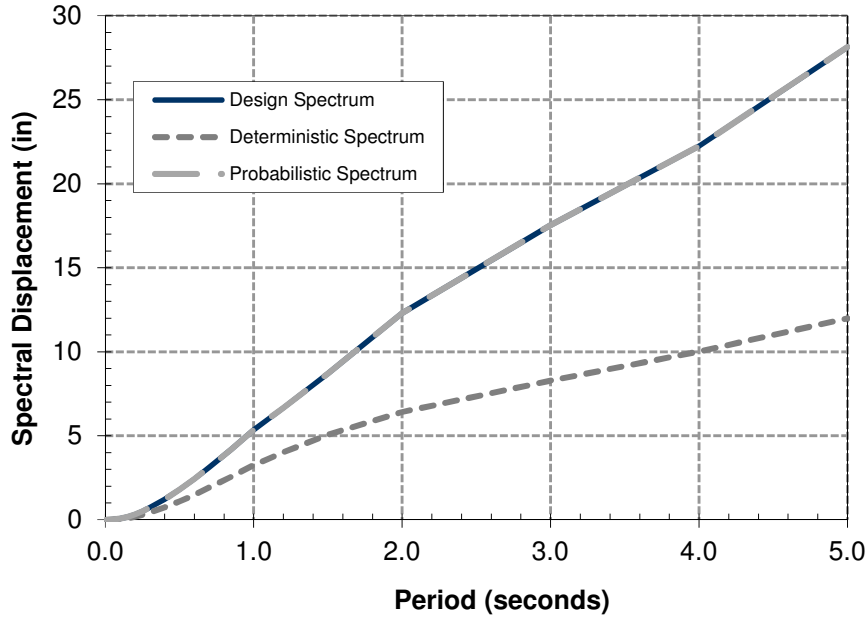
APPENDIX B

SITE DATA

Latitude:	36.1807	Shear Wave Velocity	194 m/s
Longitude:	-119.8344	Depth to Vs = 1.0 km/s:	N/A
		Depth to Vs = 2.5 km/s:	N/A

Period (s)	SA (g)	SD (in)
0.01 (PGA)	0.392	0.00
0.05	0.561	0.01
0.1	0.655	0.06
0.15	0.745	0.16
0.2	0.815	0.32
0.25	0.826	0.51
0.3	0.834	0.73
0.4	0.779	1.22
0.5	0.738	1.81
0.6	0.689	2.43
0.7	0.651	3.12
0.85	0.594	4.20
1	0.546	5.34
1.2	0.472	6.65
1.5	0.395	8.70
2	0.314	12.29
3	0.199	17.53
4	0.142	22.24
5	0.115	28.14





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PROJECT NO	20143390
DRAWN:	7/1/15
DRAWN BY:	B. Campbell
CHECKED BY:	NP
FILE NAME:	

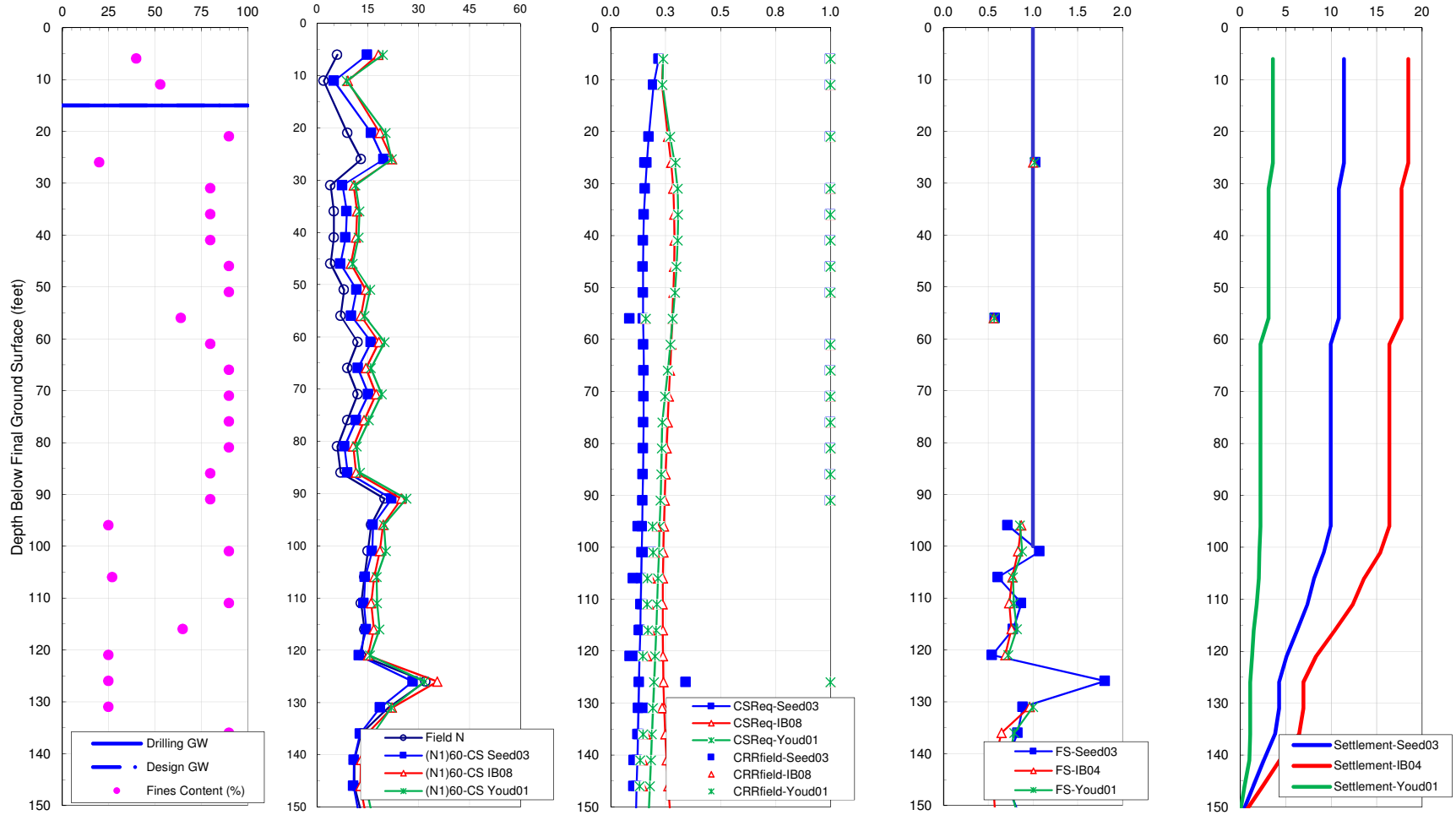
CALTRANS ARS CURVES

HIGHWAY 41 BRIDGE OVER KINGS RIVER
KINGS COUNTY, CALIFORNIA

PLATE

B-1

Boring ID:	RC-15-006	M_w= 6.8	Groundwater Depth During Drilling (ft) = 15.0 ft	Existing Ground Elevation = 195.0 ft	Ana. by: Brock Campbell
		PGA= 0.37g	Design Groundwater Depth (ft) = 15.0 ft	Final Ground Elevation = 195.0 ft	Checked by: Neva Popenoe



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

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1330 Broadway, #1200
Oakland, California 94612
t: 510628 9000 f: 510 628 9009

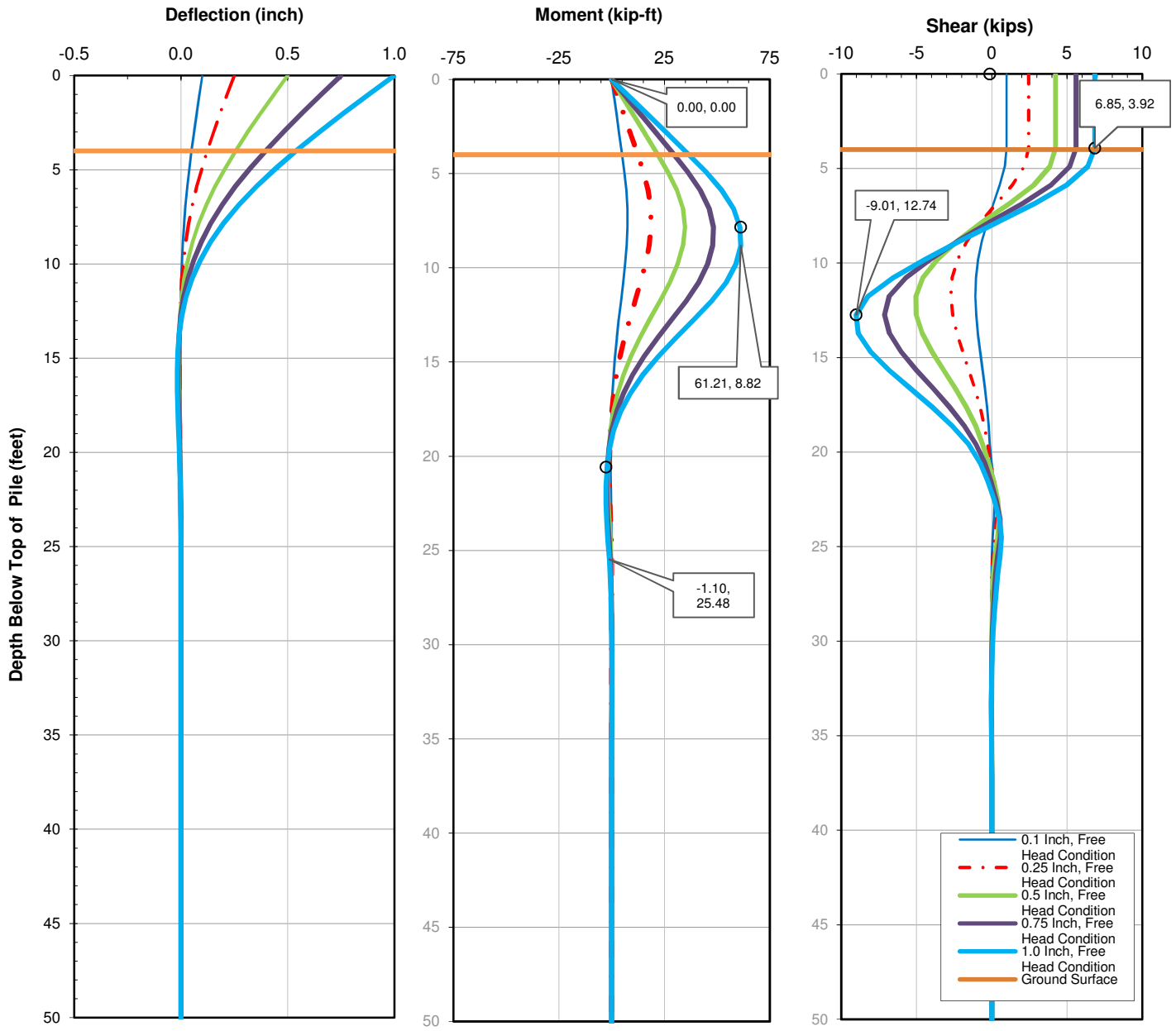
Project Name: Hwy 41 at Kings River
Project No.: 20143390
Project Location: Kings County, CA

LIQUEFACTION ANALYSIS

Date 7/1/2015

FIGURE B-2

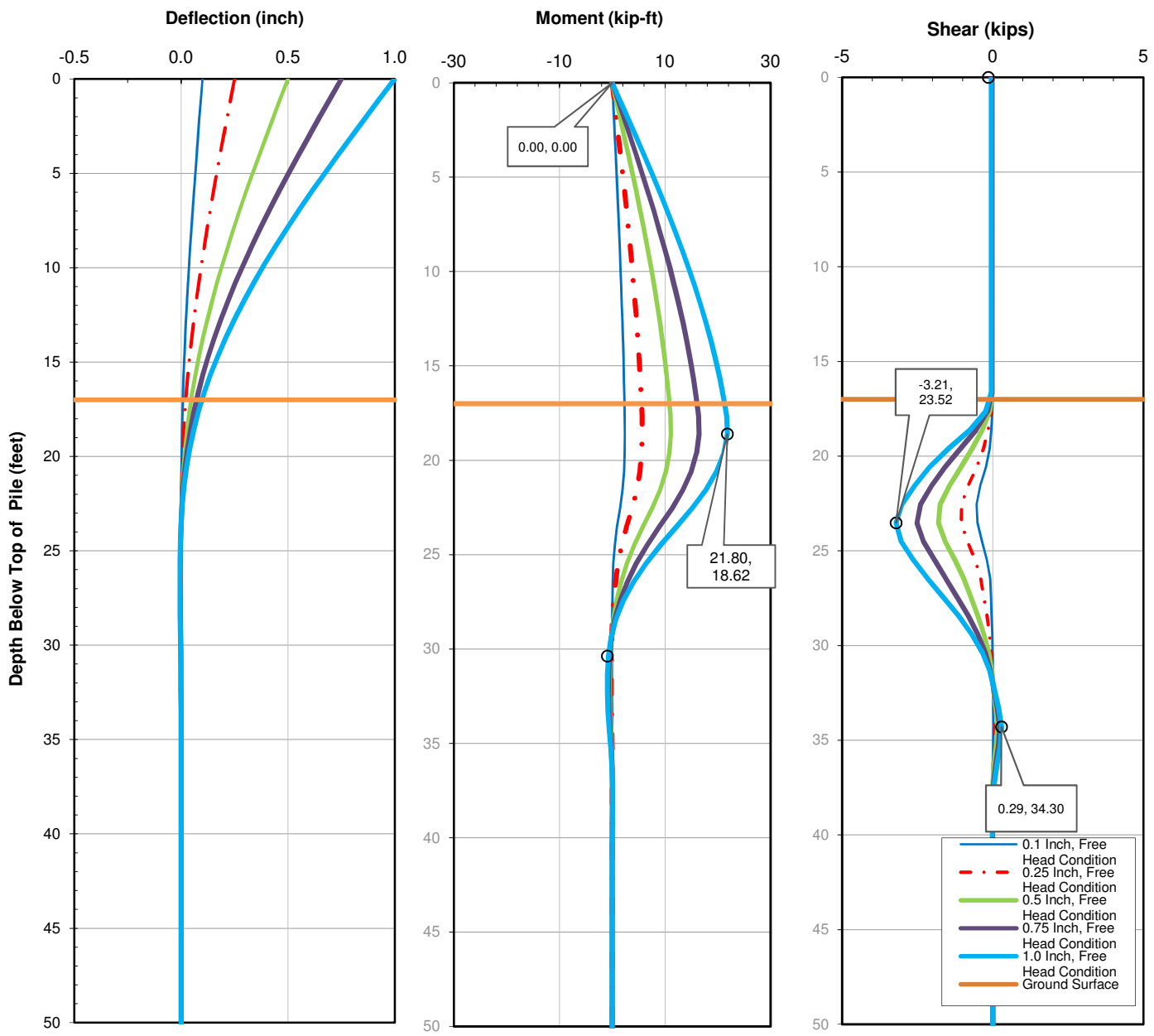
APPENDIX C



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 inch Pile (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

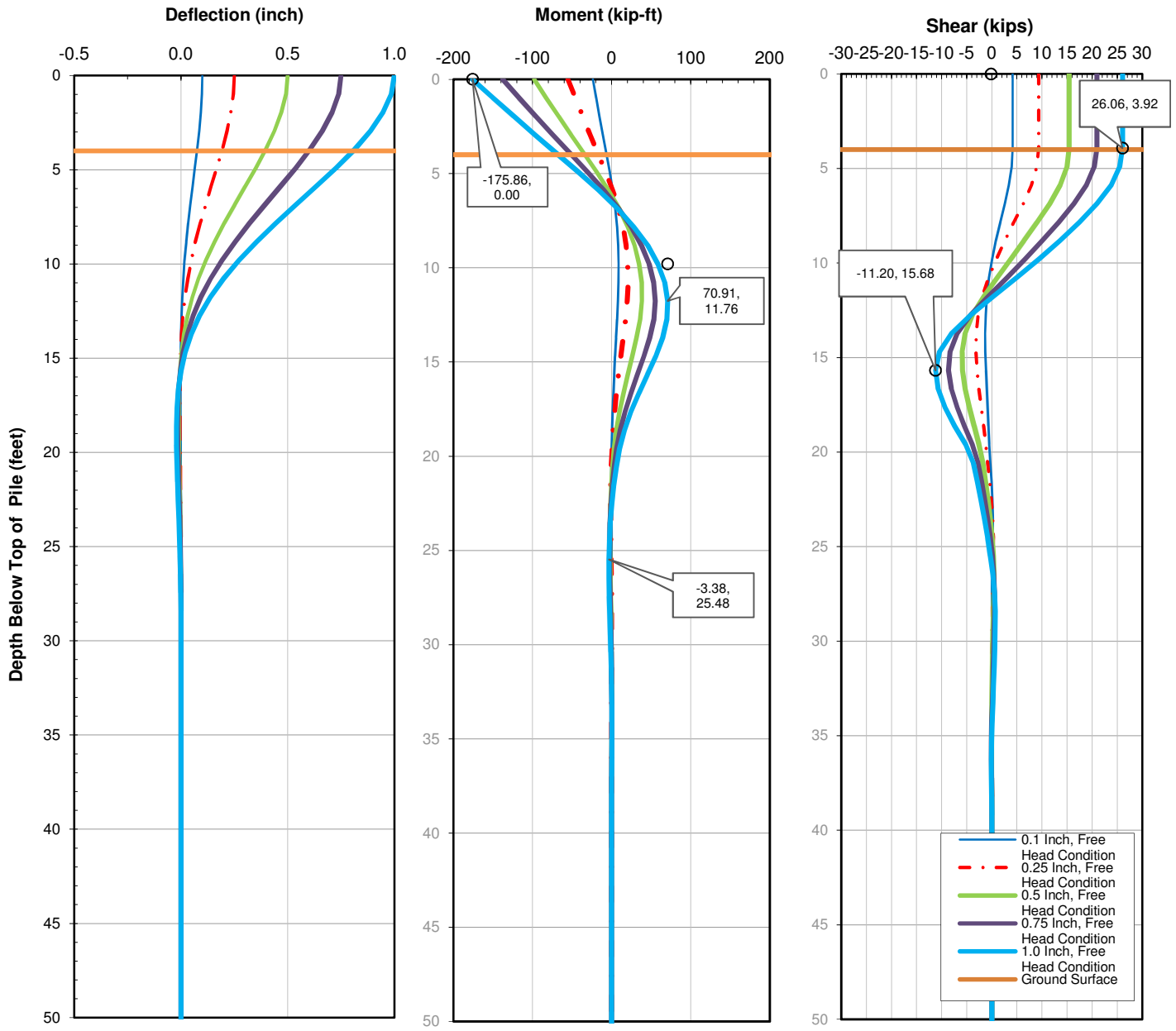
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 1,2,10,11, Original Tapered Monotube** **Free Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-1**
PROJECT NO. 20143390	8/24/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 inch Piles (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

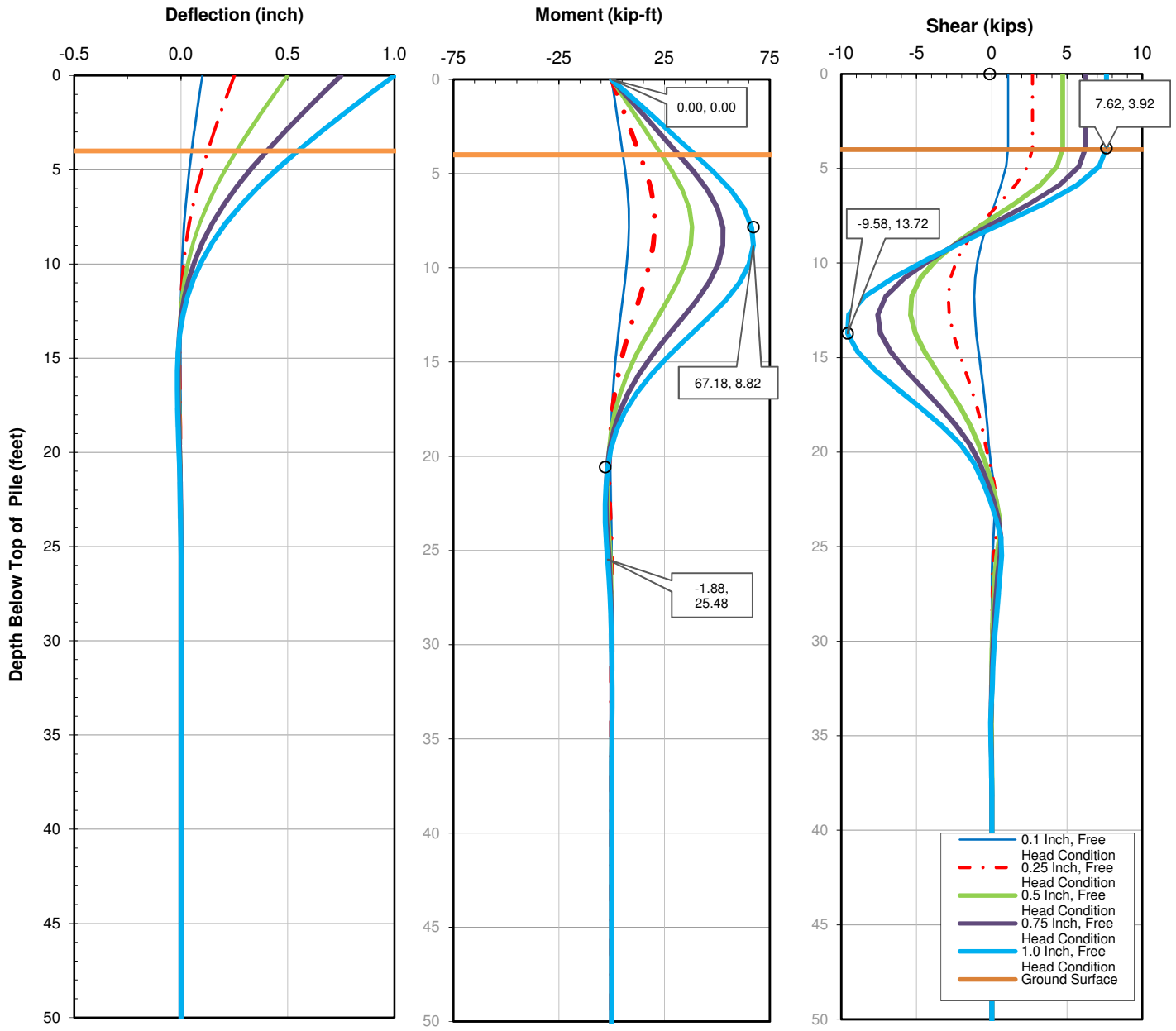
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 3 - 9, Original Tapered Monotube** **Free Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-2**
PROJECT NO. 20143390	8/24/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, 15 inch octagonal Piles (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

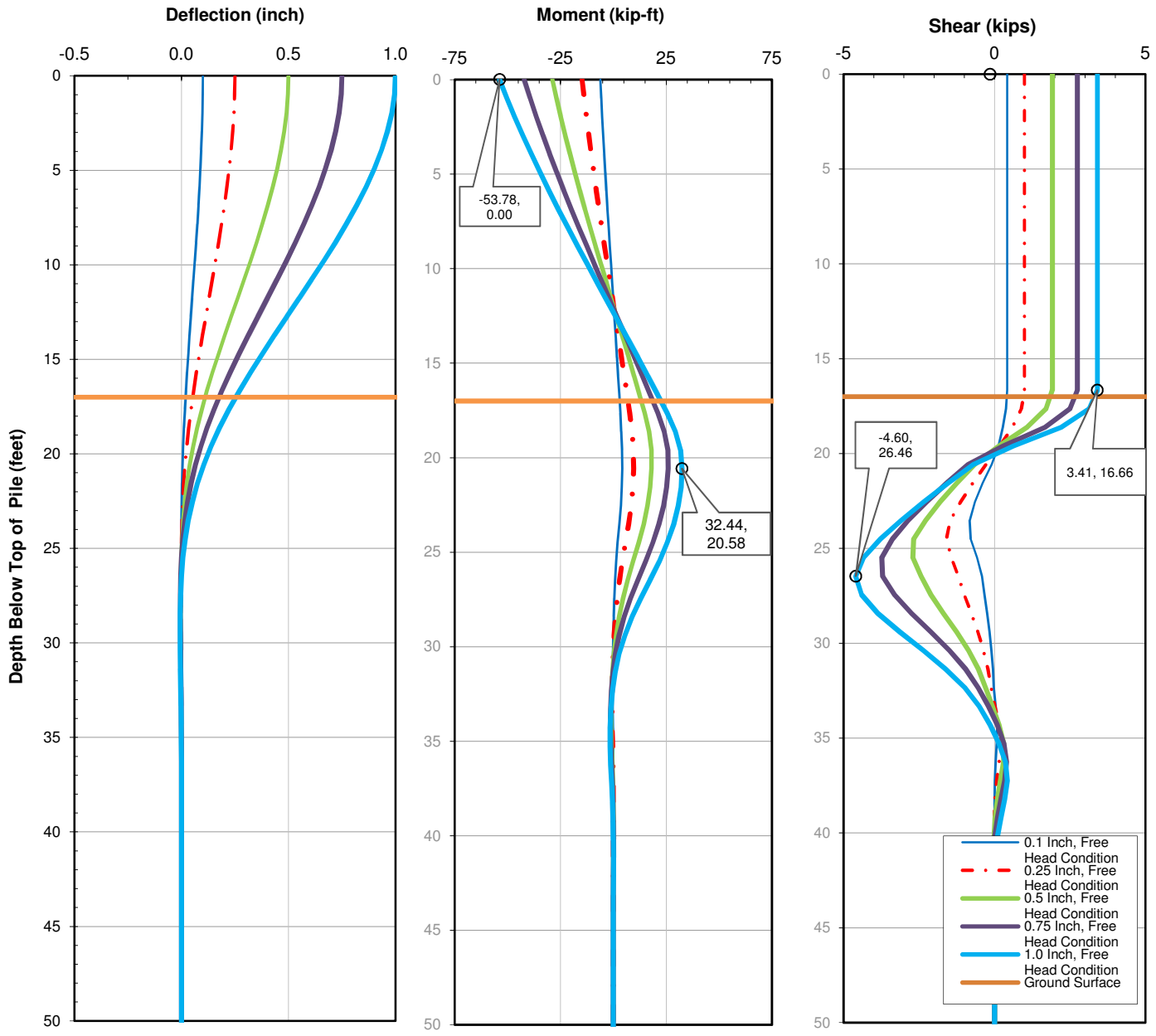
KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bents 1,2,10,11, Widen Class 70** **Fixed Head Condition**	PLATE
BY: NAS / REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-3a**
PROJECT NO. 20143390 / 8/24/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, 15 inch octagonal Piles (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

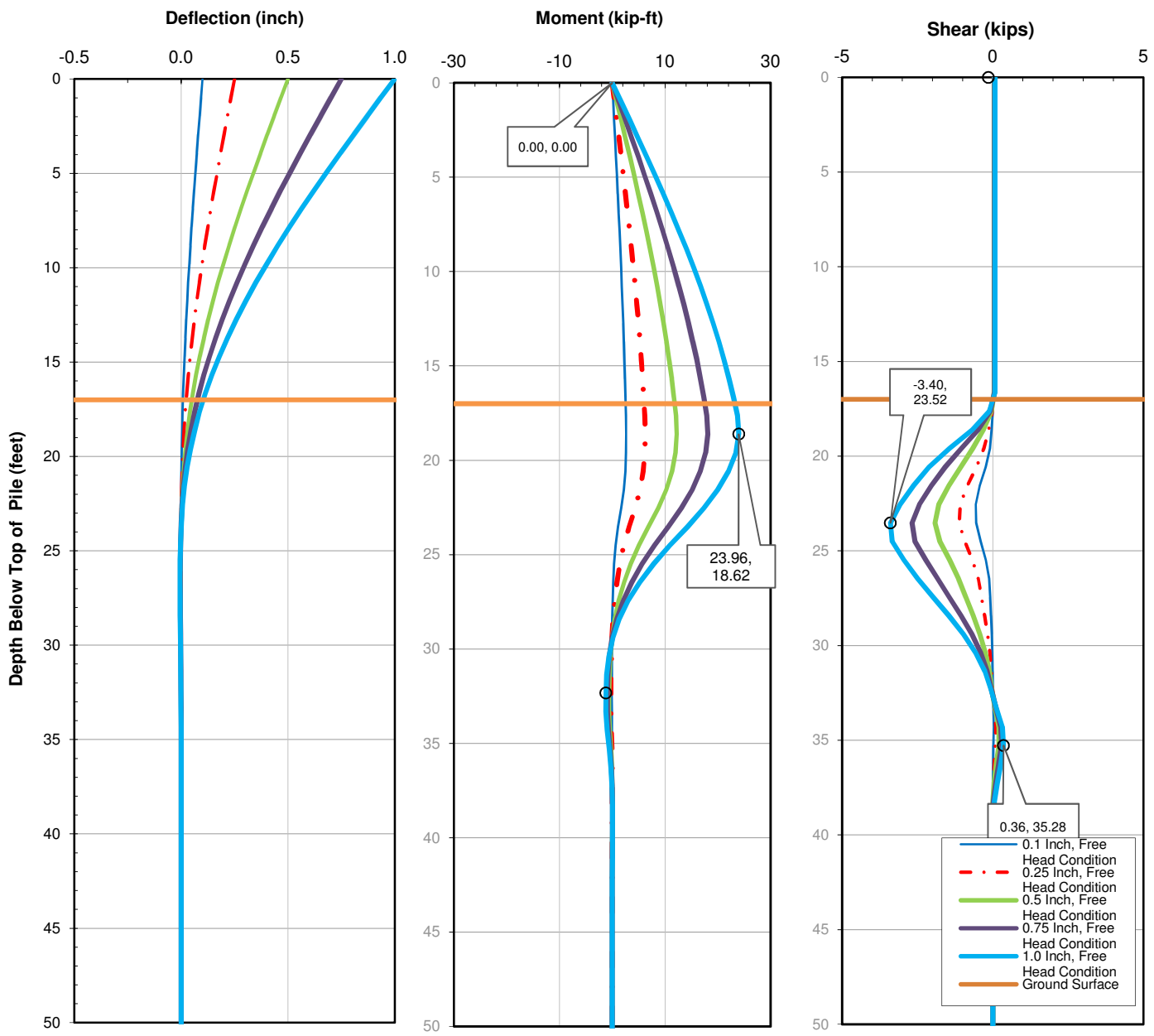
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 1,2,10,11, Widen Class 70** **Free Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-3b**
PROJECT NO. 20143390	8/24/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, 15 inch octagonal piles (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 3 - 9, Widen Class 70** **Fixed Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-4a**
PROJECT NO. 20143390	8/24/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 70, 15 inch octagonal piles (98-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 198

KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 3 - 9, Widen Class 70** **Free Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 41 Over Kings River** Bridge No. 45-0007 Kings County, CA	**C-4b**
PROJECT NO. 20143390	8/24/2015		

FIGURE C.1-1
P-Y CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 1, 2, 10, AND 11

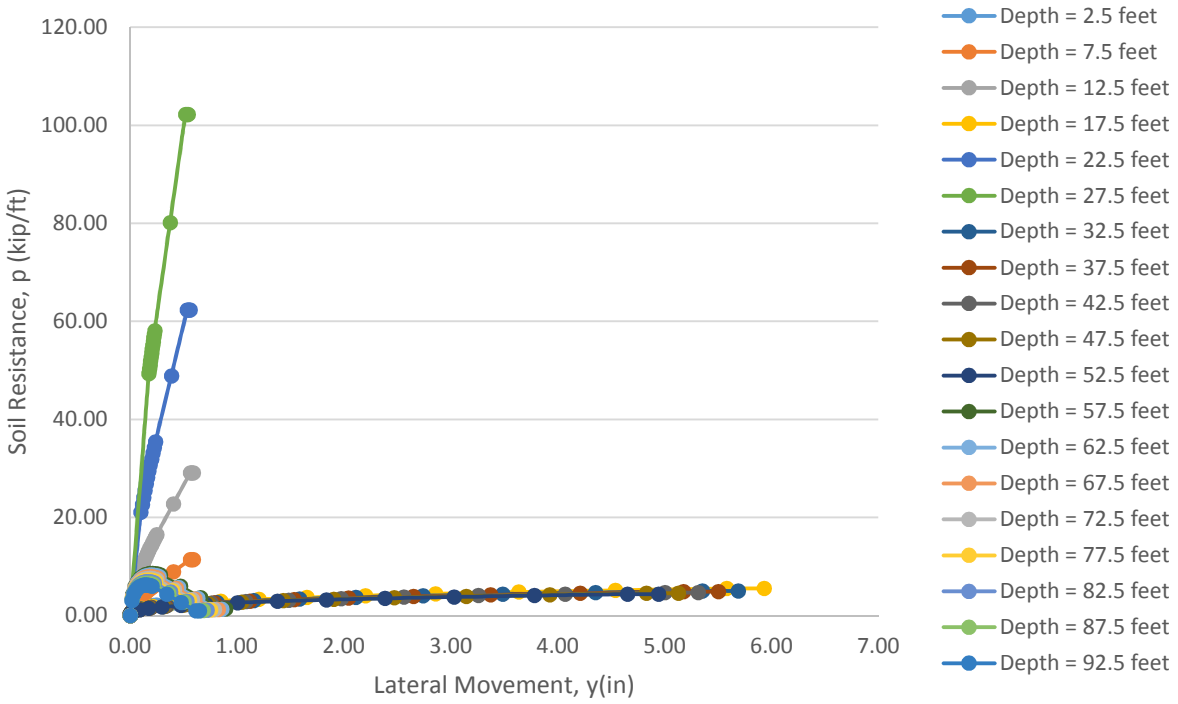


FIGURE C.1-2
P-Y CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 3-9

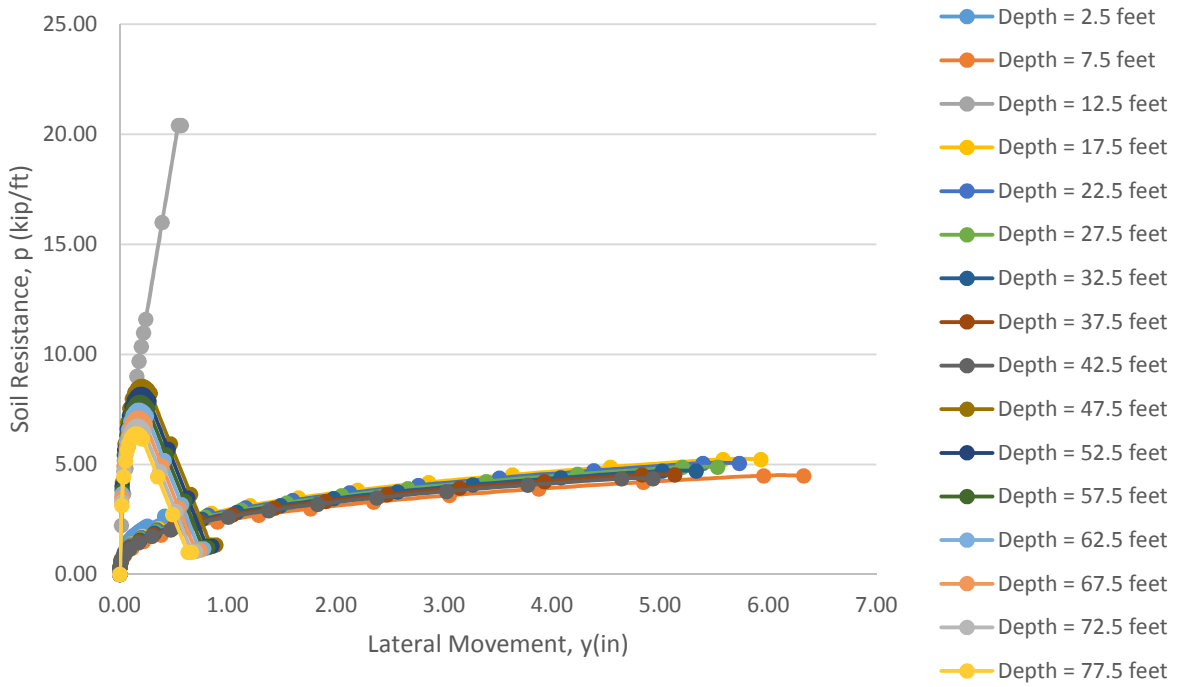


FIGURE C.1-3
P-Y CURVES
WIDEN 15" CLASS 70 PILES
BENTS 1, 2, 10, AND 11

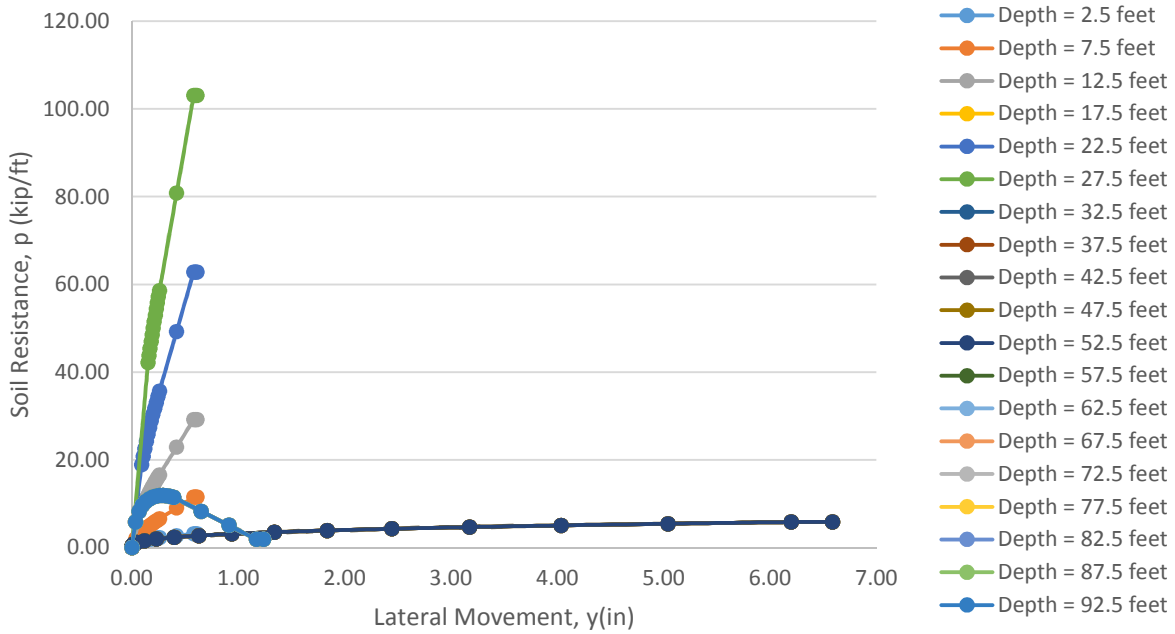


FIGURE C.1-4
P-Y CURVES
WIDEN 15" CLASS 70 PILES
BENTS 3-9

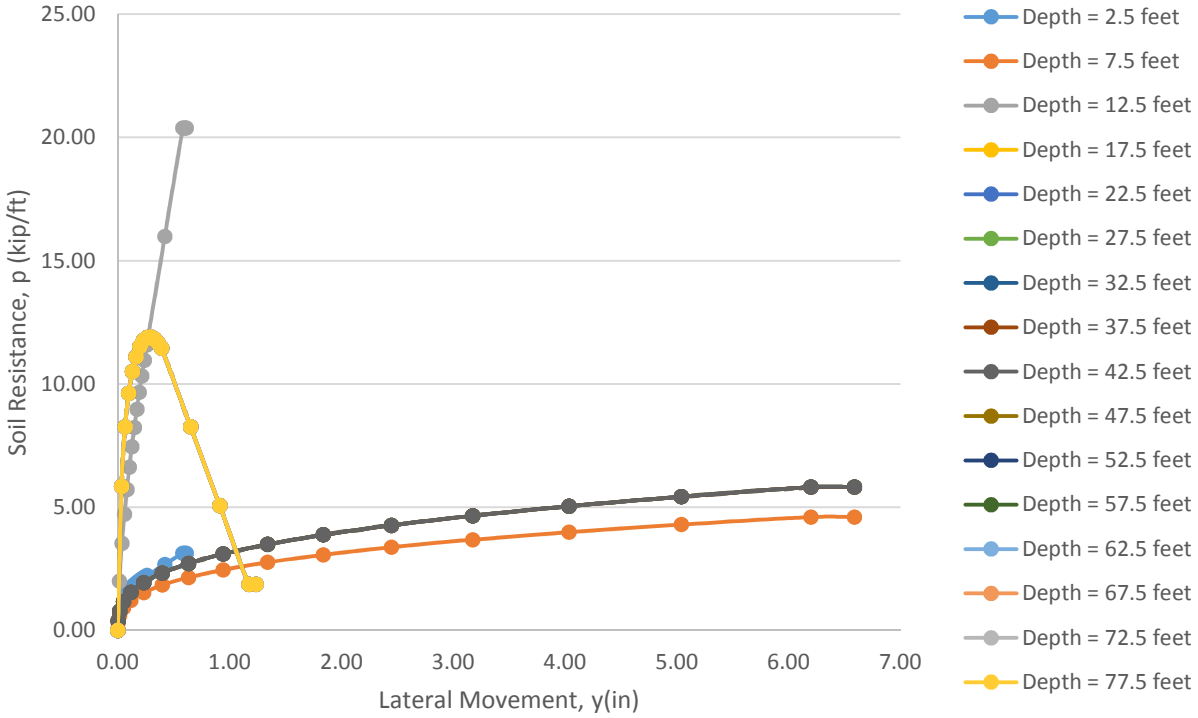


FIGURE C.3-1
Q-U CURVES
ORIGINAL 15.5" FLUTED STEEL PILES

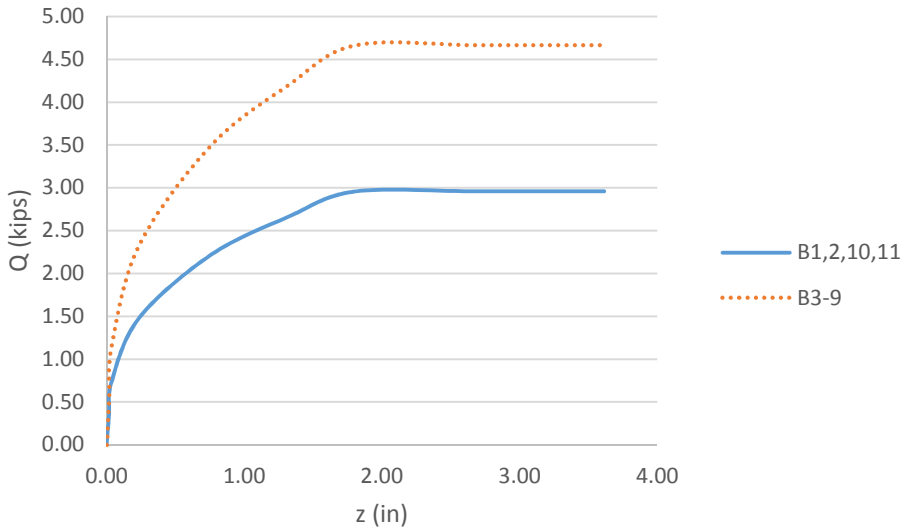
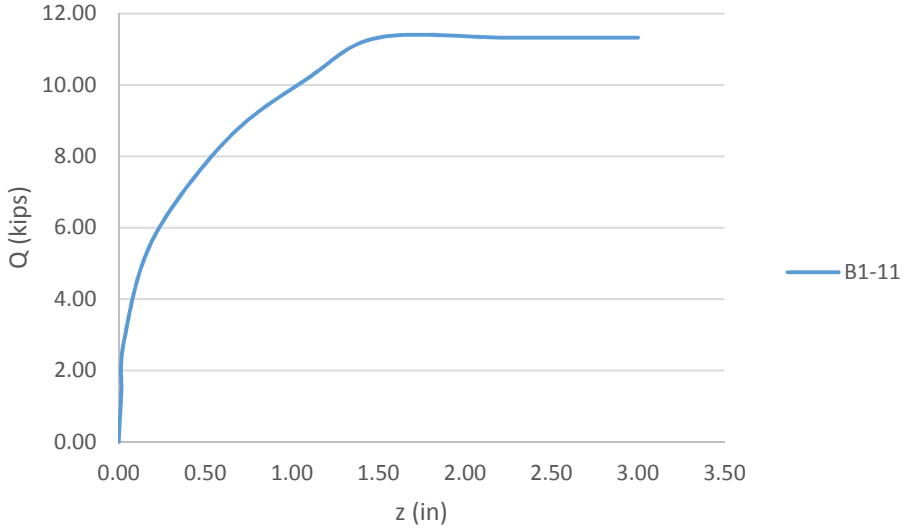


FIGURE C.3-2
Q-U CURVES
WIDEN 15" CLASS 70 PILES



Data: t-z Curves

Br. Name:	Hwy 41 over Kings River	Elevation (ft)	194	Pile Type:	Monotube
Br. No. =	45-0007	FG	194	Pile Dia.:	15.5" Diameter
		Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bents 1,2,10, and 11	GW Elev. =	180		

Note: All depths are in feet.

Layer 0-5 feet
@Depth 2.5 ft
@Elevation 191.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.010	0.127
0.020	0.255
0.040	0.509
0.060	0.764
0.080	1.018
0.090	1.145
0.100	1.273
0.500	1.273
2.000	1.273

Layer 5-10 feet
@Depth 7.5 ft
@Elevation 186.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.010	0.218
0.020	0.436
0.040	0.872
0.060	1.309
0.080	1.745
0.090	1.964
0.100	2.182
0.500	2.182
2.000	2.182

Layer 10-16 feet
@Depth 12.5 ft
@Elevation 181.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.024	0.687
0.047	1.145
0.086	1.717
0.120	2.061
0.150	2.290
0.300	2.061
0.450	2.061
0.750	2.061
3.000	2.061

Layer 16-20 feet
@Depth 17.5 ft
@Elevation 176.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.497
0.056	0.829
0.103	1.243
0.145	1.492
0.181	1.659
0.361	1.492
0.542	1.492
0.904	1.492
3.614	1.492

Layer 20-23 feet
@Depth 22.5 ft
@Elevation 171.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.010	1.529
0.020	3.058
0.040	6.118
0.060	9.176
0.080	12.235
0.090	13.764
0.100	15.294
0.500	15.294
2.000	15.294

Layer 23-30 feet
@Depth 27.5 ft
@Elevation 166.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.413
0.056	0.689
0.103	1.033
0.145	1.240
0.181	1.378
0.361	1.240
0.542	1.240
0.904	1.240
3.614	1.240

Layer 30-35 feet
@Depth 32.5 ft
@Elevation 161.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.391
0.056	0.652
0.103	0.979
0.145	1.175
0.181	1.305
0.361	1.175
0.542	1.175
0.904	1.175
3.614	1.175

Layer 35-40 feet
@Depth 37.5 ft
@Elevation 156.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.337
0.056	0.562
0.103	0.842
0.145	1.010
0.181	1.123
0.361	1.010
0.542	1.010
0.904	1.010
3.614	1.010

Layer 40-45 feet
@Depth 42.5 ft
@Elevation 151.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.301
0.056	0.503
0.103	0.754
0.145	0.904
0.181	1.005
0.361	0.904
0.542	0.904
0.904	0.904
3.614	0.904

Layer 45-50 feet
@Depth 47.5 ft
@Elevation 146.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.268
0.056	0.447
0.103	0.670
0.145	0.804
0.181	0.893
0.361	0.804
0.542	0.804
0.904	0.804
3.614	0.804

Layer 50-57 feet
@Depth 52.5 ft
@Elevation 141.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.322
0.056	0.536
0.103	0.804
0.145	0.965
0.181	1.072
0.361	0.965
0.542	0.965
0.904	0.965
3.614	0.965

Layer 57-60 feet
@Depth 57.5 ft
@Elevation 136.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.506
0.056	0.844
0.103	1.266
0.145	1.519
0.181	1.688
0.361	1.519
0.542	1.519
0.904	1.519
3.614	1.519

Layer 60-65 feet
@Depth 62.5 ft
@Elevation 131.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.439
0.056	0.732
0.103	1.097
0.145	1.317
0.181	1.463
0.361	1.317
0.542	1.317
0.904	1.317
3.614	1.317

Layer 65-70 feet
@Depth 67.5 ft
@Elevation 126.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.376
0.056	0.627
0.103	0.941
0.145	1.129
0.181	1.254
0.361	1.129
0.542	1.129
0.904	1.129
3.614	1.129

Layer 70-75 feet
@Depth 72.5 ft
@Elevation 121.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.514
0.056	0.856
0.103	1.283
0.145	1.540
0.181	1.711
0.361	1.540
0.542	1.540
0.904	1.540
3.614	1.540

Layer 75-80 feet
@Depth 77.5 ft
@Elevation 116.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.265
0.056	0.442
0.103	0.663
0.145	0.795
0.181	0.884
0.361	0.795
0.542	0.795
0.904	0.795
3.614	0.795

Layer 80-85 feet
@Depth 82.5 ft
@Elevation 111.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.217
0.056	0.361
0.103	0.542
0.145	0.650
0.181	0.722
0.361	0.650
0.542	0.650
0.904	0.650
3.614	0.650

Layer 85-91 feet
@Depth 87.5 ft
@Elevation 106.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.173
0.056	0.288
0.103	0.432
0.145	0.519
0.181	0.577
0.361	0.519
0.542	0.519
0.904	0.519
3.614	0.519

Layer 91-95 feet
@Depth 92.5 ft
@Elevation 101.5 ft

z (in)	t(kips/ft)
0.000	0.000
0.029	0.144
0.056	0.240
0.103	0.360
0.145	0.432
0.181	0.480
0.361	0.432
0.542	0.432
0.904	0.432
3.614	0.432

Data: t-z Curves

Br. Name:	Hwy 41 over Kings River		Elevation (ft)	181	Pile Type:	Monotube
Br. No. =	45-0007		FG	181	Pile Dia.:	15.5" Diameter
			Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bents 3-9		GW Elev. =	180		

Note: All depths are in feet.

Layer 0-5 feet	
@Depth 2.5 ft	
@Elevation 178.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.515
0.056	0.859
0.103	1.288
0.145	1.546
0.181	1.718
0.361	1.546
0.542	1.546
0.904	1.546
3.614	1.546

Layer 5-10 feet	
@Depth 7.5 ft	
@Elevation 173.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.471
0.056	0.785
0.103	1.179
0.145	1.414
0.181	1.572
0.361	1.414
0.542	1.414
0.904	1.414
3.614	1.414

Layer 10-16 feet	
@Depth 12.5 ft	
@Elevation 168.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.429
0.056	0.716
0.103	1.074
0.145	1.289
0.181	1.432
0.361	1.289
0.542	1.289
0.904	1.289
3.614	1.289

Layer 16-20 feet	
@Depth 17.5 ft	
@Elevation 163.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.390
0.056	0.649
0.103	0.974
0.145	1.169
0.181	1.298
0.361	1.169
0.542	1.169
0.904	1.169
3.614	1.169

Layer 20-23 feet	
@Depth 22.5 ft	
@Elevation 158.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.351
0.056	0.586
0.103	0.879
0.145	1.054
0.181	1.172
0.361	1.054
0.542	1.054
0.904	1.054
3.614	1.054

Layer 23-30 feet	
@Depth 27.5 ft	
@Elevation 153.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.771
0.056	1.285
0.103	1.927
0.145	2.313
0.181	2.570
0.361	2.313
0.542	2.313
0.904	2.313
3.614	2.313

Layer 30-35 feet	
@Depth 32.5 ft	
@Elevation 148.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.688
0.056	1.146
0.103	1.719
0.145	2.063
0.181	2.292
0.361	2.063
0.542	2.063
0.904	2.063
3.614	2.063

Layer 35-40 feet	
@Depth 37.5 ft	
@Elevation 143.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.609
0.056	1.015
0.103	1.522
0.145	1.826
0.181	2.029
0.361	1.826
0.542	1.826
0.904	1.826
3.614	1.826

Layer 40-45 feet	
@Depth 42.5 ft	
@Elevation 138.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.535
0.056	0.891
0.103	1.337
0.145	1.604
0.181	1.782
0.361	1.604
0.542	1.604
0.904	1.604
3.614	1.604

Layer 45-50 feet	
@Depth 47.5 ft	
@Elevation 133.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.465
0.056	0.775
0.103	1.163
0.145	1.396
0.181	1.551
0.361	1.396
0.542	1.396
0.904	1.396
3.614	1.396

Layer 50-57 feet	
@Depth 52.5 ft	
@Elevation 128.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.401
0.056	0.668
0.103	1.002
0.145	1.202
0.181	1.336
0.361	1.202
0.542	1.202
0.904	1.202
3.614	1.202

Layer 57-60 feet	
@Depth 57.5 ft	
@Elevation 123.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.341
0.056	0.568
0.103	0.852
0.145	1.023
0.181	1.137
0.361	1.023
0.542	1.023
0.904	1.023
3.614	1.023

Layer 60-65 feet	
@Depth 62.5 ft	
@Elevation 118.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.286
0.056	0.477
0.103	0.715
0.145	0.858
0.181	0.953
0.361	0.858
0.542	0.858
0.904	0.858
3.614	0.858

Layer 65-70 feet	
@Depth 67.5 ft	
@Elevation 113.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.253
0.056	0.422
0.103	0.633
0.145	0.760
0.181	0.845
0.361	0.760
0.542	0.760
0.904	0.760
3.614	0.760

Layer 70-75 feet	
@Depth 72.5 ft	
@Elevation 108.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.374
0.056	0.624
0.103	0.936
0.145	1.123
0.181	1.248
0.361	1.123
0.542	1.123
0.904	1.123
3.614	1.123

Layer 75-81 feet	
@Depth 77.5 ft	
@Elevation 103.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.029	0.193
0.056	0.322
0.103	0.482
0.145	0.579
0.181	0.643
0.361	0.579
0.542	0.579
0.904	0.579
3.614	0.579

Data: t-z Curves

Br. Name:	Hwy 41 over Kings River	Elevation (ft)	194	Pile Type:	Octagonal Piles
Br. No. =	45-0007	FG	194	Pile Dia.:	15" Diameter
		Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bents 1,2,10, and 11	GW Elev. =	180		

Note: All depths are in feet.

Layer 0-5 feet	
@Depth 2.5 ft	
@Elevation 191.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.127
0.020	0.255
0.040	0.509
0.060	0.764
0.080	1.018
0.090	1.145
0.100	1.273
0.500	1.273
2.000	1.273

Layer 5-10 feet	
@Depth 7.5 ft	
@Elevation 186.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.218
0.020	0.436
0.040	0.872
0.060	1.309
0.080	1.745
0.090	1.964
0.100	2.182
0.500	2.182
2.000	2.182

Layer 10-16 feet	
@Depth 12.5 ft	
@Elevation 181.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.687
0.047	1.145
0.086	1.717
0.120	2.061
0.150	2.290
0.300	2.061
0.450	2.061
0.750	2.061
3.000	2.061

Layer 16-20 feet	
@Depth 17.5 ft	
@Elevation 176.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 20-23 feet	
@Depth 22.5 ft	
@Elevation 171.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.850
0.020	1.700
0.040	3.401
0.060	5.102
0.080	6.804
0.090	7.650
0.100	8.502
0.500	8.502
2.000	8.502

Layer 23-30 feet	
@Depth 27.5 ft	
@Elevation 166.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 30-35 feet	
@Depth 32.5 ft	
@Elevation 161.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 35-40 feet	
@Depth 37.5 ft	
@Elevation 156.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 40-45 feet	
@Depth 42.5 ft	
@Elevation 151.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 45-50 feet	
@Depth 47.5 ft	
@Elevation 146.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 50-57 feet	
@Depth 52.5 ft	
@Elevation 141.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.851
0.047	1.418
0.086	2.127
0.120	2.552
0.150	2.836
0.300	2.552
0.450	2.552
0.750	2.552
3.000	2.552

Layer 57-60 feet	
@Depth 57.5 ft	
@Elevation 136.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 60-65 feet	
@Depth 62.5 ft	
@Elevation 131.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 65-70 feet	
@Depth 67.5 ft	
@Elevation 126.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 70-75 feet	
@Depth 72.5 ft	
@Elevation 121.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 75-80 feet	
@Depth 77.5 ft	
@Elevation 116.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 80-85 feet	
@Depth 82.5 ft	
@Elevation 111.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 85-91 feet	
@Depth 87.5 ft	
@Elevation 106.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 91-95 feet	
@Depth 92.5 ft	
@Elevation 101.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Data: t-z Curves

Br. Name:	Hwy 41 over Kings River		Elevation (ft)	181	Pile Type:	Octagonal Piles
Br. No. =	45-0007		FG	181	Pile Dia.:	15" Diameter
			Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bents 3-9		GW Elev. =	180		

Note: All depths are in feet.

Layer 0-3 feet	
@Depth 2.5 ft	
@Elevation 178.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 3-10 feet	
@Depth 7.5 ft	
@Elevation 173.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 10-17 feet	
@Depth 12.5 ft	
@Elevation 168.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 17-20 feet	
@Depth 17.5 ft	
@Elevation 163.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 20-25 feet	
@Depth 22.5 ft	
@Elevation 158.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	0.625
0.047	1.042
0.086	1.562
0.120	1.875
0.150	2.083
0.300	1.875
0.450	1.875
0.750	1.875
3.000	1.875

Layer 25-30 feet	
@Depth 27.5 ft	
@Elevation 153.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.303
0.047	2.171
0.086	3.256
0.120	3.907
0.150	4.341
0.300	3.907
0.450	3.907
0.750	3.907
3.000	3.907

Layer 30-35 feet	
@Depth 32.5 ft	
@Elevation 148.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 35-40 feet	
@Depth 37.5 ft	
@Elevation 143.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 40-44 feet	
@Depth 42.5 ft	
@Elevation 138.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 44-50 feet	
@Depth 47.5 ft	
@Elevation 133.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 50-55 feet	
@Depth 52.5 ft	
@Elevation 128.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 55-60 feet	
@Depth 57.5 ft	
@Elevation 123.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 60-65 feet	
@Depth 62.5 ft	
@Elevation 118.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 65-70 feet	
@Depth 67.5 ft	
@Elevation 113.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 70-75 feet	
@Depth 72.5 ft	
@Elevation 108.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

Layer 75-81 feet	
@Depth 77.5 ft	
@Elevation 103.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.024	1.528
0.047	2.547
0.086	3.820
0.120	4.585
0.150	5.094
0.300	4.585
0.450	4.585
0.750	4.585
3.000	4.585

TABLE C.2-1
P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILE
BENTS 1, 2, 10, & 11
All depths are measured below ground surface.

Layer 1 0'-5'
Depth = 2.5 feet
Elevation = 191.5 feet

y (in)	p (kip/ft)
-0.59	-3.01
-0.58	-3.01
-0.56	-3.01
-0.41	-2.57
-0.25	-2.14
-0.23	-2.09
-0.22	-2.05
-0.20	-2.00
-0.19	-1.95
-0.17	-1.90
-0.16	-1.84
-0.14	-1.78
-0.13	-1.72
-0.11	-1.65
-0.10	-1.57
-0.08	-1.49
0.00	0.00
0.08	1.49
0.10	1.57
0.11	1.65
0.13	1.72
0.14	1.78
0.16	1.84
0.17	1.90
0.19	1.95
0.20	2.00
0.22	2.05
0.23	2.09
0.25	2.14
0.41	2.57
0.56	3.01
0.58	3.01
0.59	3.01

Layer 2 5'-10'
Depth = 7.5 feet
Elevation = 186.5 feet

y (in)	p (kip/ft)
-0.59	-11.40
-0.58	-11.40
-0.56	-11.40
-0.41	-8.94
-0.25	-6.48
-0.23	-6.17
-0.21	-5.85
-0.19	-5.52
-0.17	-5.18
-0.15	-4.82
-0.13	-4.45
-0.12	-4.05
-0.10	-3.62
-0.08	-3.16
-0.06	-2.66
-0.04	-2.08
0.00	0.00
0.04	2.08
0.06	2.66
0.08	3.16
0.10	3.62
0.12	4.05
0.13	4.45
0.15	4.82
0.17	5.18
0.19	5.52
0.21	5.85
0.23	6.17
0.25	6.48
0.41	8.94
0.56	11.40
0.58	11.40
0.59	11.40

Layer 3 10'-16'
Depth = 12.5 feet
Elevation = 181.5 feet

y (in)	p (kip/ft)
-0.59	-29.06
-0.58	-29.06
-0.56	-29.06
-0.41	-22.78
-0.25	-16.51
-0.24	-16.01
-0.23	-15.49
-0.21	-14.97
-0.20	-14.43
-0.19	-13.88
-0.18	-13.32
-0.16	-12.73
-0.15	-12.14
-0.14	-11.52
-0.13	-10.88
-0.11	-10.21
0.00	0.00
0.11	10.21
0.13	10.88
0.14	11.52
0.15	12.14
0.16	12.73
0.18	13.32
0.19	13.88
0.20	14.43
0.21	14.97
0.23	15.49
0.24	16.01
0.25	16.51
0.41	22.78
0.56	29.06
0.58	29.06
0.59	29.06

Layer 4 16'-20'
Depth = 17.5 feet
Elevation = 176.5 feet

y (in)	p (kip/ft)
-5.93	-5.51
-5.58	-5.51
-4.54	-5.14
-3.63	-4.78
-2.86	-4.41
-2.20	-4.04
-1.65	-3.67
-1.21	-3.31
-0.85	-2.94
-0.57	-2.57
-0.36	-2.20
-0.21	-1.84
-0.11	-1.47
-0.04	-1.10
-0.01	-0.73
0.00	-0.37
0.00	0.00
0.00	0.37
0.01	0.73
0.04	1.10
0.11	1.47
0.21	1.84
0.36	2.20
0.57	2.57
0.85	2.94
1.21	3.31
1.65	3.67
2.20	4.04
2.86	4.41
3.63	4.78
4.54	5.14
5.58	5.51
5.93	5.51

Layer 5 20'-23'
Depth = 22.5 feet
Elevation = 171.5 feet

y (in)	p (kip/ft)
-0.56	-62.31
-0.55	-62.31
-0.53	-62.31
-0.39	-48.86
-0.24	-35.40
-0.23	-34.27
-0.21	-33.11
-0.20	-31.92
-0.19	-30.71
-0.18	-29.46
-0.16	-28.17
-0.15	-26.85
-0.14	-25.49
-0.13	-24.07
-0.11	-22.60
-0.10	-21.07
0.00	0.00
0.10	21.07
0.11	22.60
0.13	24.07
0.14	25.49
0.15	26.85
0.16	28.17
0.18	29.46
0.19	30.71
0.20	31.92
0.21	33.11
0.23	34.27
0.24	35.40
0.39	48.86
0.53	62.31
0.55	62.31
0.56	62.31

Layer 6 23'-30'
Depth = 27.5 feet
Elevation = 166.5 feet

y (in)	p (kip/ft)
-0.54	-102.21
-0.53	-102.21
-0.52	-102.21
-0.37	-80.15
-0.23	-58.08
-0.23	-57.32
-0.22	-56.55
-0.22	-55.77
-0.21	-54.99
-0.21	-54.20
-0.20	-53.41
-0.20	-52.61
-0.19	-51.79
-0.19	-50.97
-0.18	-50.15
-0.18	-49.31
0.00	0.00
0.18	49.31
0.18	50.15
0.19	50.97
0.19	51.79
0.20	52.61
0.20	53.41
0.21	54.20
0.21	54.99
0.22	55.77
0.22	56.55
0.23	57.32
0.23	58.08
0.37	80.15
0.52	102.21
0.53	102.21
0.54	102.21

Layer 7 30'-35'
Depth = 32.5 feet
Elevation = 161.5 feet

y (in)	p (kip/ft)
-5.69	-5.02
-5.35	-5.02
-4.35	-4.68
-3.48	-4.35
-2.74	-4.01
-2.11	-3.68
-1.59	-3.35
-1.16	-3.01
-0.81	-2.68
-0.54	-2.34
-0.34	-2.01
-0.20	-1.67
-0.10	-1.34
-0.04	-1.00
-0.01	-0.67
0.00	-0.33
0.00	0.00
0.00	0.33
0.01	0.67
0.04	1.00
0.10	1.34
0.20	1.67
0.34	2.01
0.54	2.34
0.81	2.68
1.16	3.01
1.59	3.35
2.11	3.68
2.74	4.01
3.48	4.35
4.35	4.68
5.35	5.02
5.69	5.02

Layer 8 35'-40'
Depth = 37.5 feet
Elevation = 156.5 feet

y (in)	p (kip/ft)
-5.50	-4.85
-5.18	-4.85
-4.21	-4.53
-3.37	-4.21
-2.65	-3.88
-2.04	-3.56
-1.53	-3.24
-1.12	-2.91
-0.79	-2.59
-0.53	-2.27
-0.33	-1.94
-0.19	-1.62
-0.10	-1.29
-0.04	-0.97
-0.01	-0.65
0.00	-0.32
0.00	0.00
0.00	0.32
0.01	0.65
0.04	0.97
0.10	1.29
0.19	1.62
0.33	1.94
0.53	2.27
0.79	2.59
1.12	2.91
1.53	3.24
2.04	3.56
2.65	3.88
3.37	4.21
4.21	4.53
5.18	4.85
5.50	4.85

Layer 9 40'-45'
Depth = 42.5 feet
Elevation = 151.5 feet

y (in)	p (kip/ft)
-5.32	-4.69
-5.00	-4.69
-4.07	-4.38
-3.26	-4.06
-2.56	-3.75
-1.97	-3.44
-1.48	-3.13
-1.08	-2.81
-0.76	-2.50
-0.51	-2.19
-0.32	-1.88
-0.19	-1.56
-0.09	-1.25
-0.04	-0.94
-0.01	-0.63
0.00	-0.31
0.00	0.00
0.00	0.31
0.01	0.63
0.04	0.94
0.09	1.25
0.19	1.56
0.32	1.88
0.51	2.19
0.76	2.50
1.08	2.81
1.48	3.13
1.97	3.44
2.56	3.75
3.26	4.06
4.07	4.38
5.00	4.69
5.32	4.69

Layer 10 45'-50'
Depth = 47.5 feet
Elevation = 146.5 feet

y (in)	p (kip/ft)
-5.13	-4.53
-4.83	-4.53
-3.92	-4.22
-3.14	-3.92
-2.47	-3.62
-1.90	-3.32
-1.43	-3.02
-1.04	-2.72
-0.73	-2.41
-0.49	-2.11
-0.31	-1.81
-0.18	-1.51
-0.09	-1.21
-0.04	-0.91
-0.01	-0.60
0.00	-0.30
0.00	0.00
0.00	0.30
0.01	0.60
0.04	0.91
0.09	1.21
0.18	1.51
0.31	1.81
0.49	2.11
0.73	2.41
1.04	2.72
1.43	3.02
1.90	3.32
2.47	3.62
3.14	3.92
3.92	4.22
4.83	4.53
5.13	4.53

Layer 11 50'-57'
Depth = 52.5 feet
Elevation = 141.5 feet

y (in)	p (kip/ft)
-4.94	-4.36
-4.65	-4.36
-3.78	-4.07
-3.03	-3.78
-2.38	-3.49
-1.83	-3.20
-1.38	-2.91
-1.00	-2.62
-0.71	-2.33
-0.47	-2.04
-0.30	-1.74
-0.17	-1.45
-0.09	-1.16
-0.04	-0.87
-0.01	-0.58
0.00	-0.29
0.00	0.00
0.00	0.29
0.01	0.58
0.04	0.87
0.09	1.16
0.17	1.45
0.30	1.74
0.47	2.04
0.71	2.33
1.00	2.62
1.38	2.91
1.83	3.20
2.38	3.49
3.03	3.78
3.78	4.07
4.65	4.36
4.94	4.36

Layer 12 57'-60'
Depth = 57.5 feet
Elevation = 136.5 feet

y (in)	p (kip/ft)
-0.89	-1.35
-0.85	-1.35
-0.66	-3.66
-0.47	-5.97
-0.28	-8.27
-0.26	-8.43
-0.24	-8.54
-0.21	-8.59
-0.19	-8.58
-0.16	-8.49
-0.14	-8.31
-0.12	-8.02
-0.09	-7.58
-0.07	-6.94
-0.05	-5.96
-0.02	-4.22
0.00	0.00
0.02	4.22
0.05	5.96
0.07	6.94
0.09	7.58
0.12	8.02
0.14	8.31
0.16	8.49
0.19	8.58
0.21	8.59
0.24	8.54
0.26	8.43
0.28	8.27
0.47	5.97
0.66	3.66
0.85	1.35
0.89	1.35

Layer 13 60'-65'
Depth = 62.5 feet
Elevation = 131.5 feet

y (in)	p (kip/ft)
-0.86	-1.30
-0.81	-1.30
-0.63	-3.52
-0.45	-5.73
-0.27	-7.95
-0.25	-8.10
-0.23	-8.21
-0.20	-8.26
-0.18	-8.24
-0.16	-8.16
-0.14	-7.99
-0.11	-7.71
-0.09	-7.29
-0.07	-6.67
-0.05	-5.73
-0.02	-4.05
0.00	0.00
0.02	4.05
0.05	5.73
0.07	6.67
0.09	7.29
0.11	7.71
0.14	7.99
0.16	8.16
0.18	8.24
0.20	8.26
0.23	8.21
0.25	8.10
0.27	7.95
0.45	5.73
0.63	3.52
0.81	1.30
0.86	1.30

Layer 14 65'-70'
Depth = 67.5 feet
Elevation = 126.5 feet

y (in)	p (kip/ft)
-0.82	-1.24
-0.78	-1.24
-0.61	-3.37
-0.43	-5.50
-0.26	-7.63
-0.24	-7.77
-0.22	-7.87
-0.20	-7.92
-0.17	-7.91
-0.15	-7.83
-0.13	-7.66
-0.11	-7.39
-0.09	-6.99
-0.07	-6.40
-0.04	-5.50
-0.02	-3.89
0.00	0.00
0.02	3.89
0.04	5.50
0.07	6.40
0.09	6.99
0.11	7.39
0.13	7.66
0.15	7.83
0.17	7.91
0.20	7.92
0.22	7.87
0.24	7.77
0.26	7.63
0.43	5.50
0.61	3.37
0.78	1.24
0.82	1.24

Layer 15 70'-75'
Depth = 72.5 feet
Elevation = 121.5 feet

y (in)	p (kip/ft)
-0.79	-1.19
-0.75	-1.19
-0.58	-3.23
-0.42	-5.27
-0.25	-7.30
-0.23	-7.44
-0.21	-7.54
-0.19	-7.59
-0.17	-7.57
-0.15	-7.50
-0.12	-7.34
-0.10	-7.08
-0.08	-6.69
-0.06	-6.13
-0.04	-5.26
-0.02	-3.72
0.00	0.00
0.02	3.72
0.04	5.26
0.06	6.13
0.08	6.69
0.10	7.08
0.12	7.34
0.15	7.50
0.17	7.57
0.19	7.59
0.21	7.54
0.23	7.44
0.25	7.30
0.42	5.27
0.58	3.23
0.75	1.19
0.79	1.19

Layer 16 75'-80'
Depth = 77.5 feet
Elevation = 116.5 feet

y (in)	p (kip/ft)
-0.75	-1.14
-0.71	-1.14
-0.56	-3.09
-0.40	-5.03
-0.24	-6.98
-0.22	-7.11
-0.20	-7.21
-0.18	-7.25
-0.16	-7.24
-0.14	-7.16
-0.12	-7.01
-0.10	-6.77
-0.08	-6.40
-0.06	-5.86
-0.04	-5.03
-0.02	-3.56
0.00	0.00
0.02	3.56
0.04	5.03
0.06	5.86
0.08	6.40
0.10	6.77
0.12	7.01
0.14	7.16
0.16	7.24
0.18	7.25
0.20	7.21
0.22	7.11
0.24	6.98
0.40	5.03
0.56	3.09
0.71	1.14
0.75	1.14

Layer 17 80'-85'
Depth = 82.5 feet
Elevation = 111.5 feet

y (in)	p (kip/ft)
-0.72	-1.09
-0.68	-1.09
-0.53	-2.94
-0.38	-4.80
-0.23	-6.66
-0.21	-6.78
-0.19	-6.87
-0.17	-6.91
-0.15	-6.90
-0.13	-6.83
-0.11	-6.69
-0.09	-6.45
-0.08	-6.10
-0.06	-5.59
-0.04	-4.80
-0.02	-3.39
0.00	0.00
0.02	3.39
0.04	4.80
0.06	5.59
0.08	6.10
0.09	6.45
0.11	6.69
0.13	6.83
0.15	6.90
0.17	6.91
0.19	6.87
0.21	6.78
0.23	6.66
0.38	4.80
0.53	2.94
0.68	1.09
0.72	1.09

Layer 18 85'-91'
Depth = 87.5 feet
Elevation = 106.5 feet

y (in)	p (kip/ft)
-0.68	-1.03
-0.65	-1.03
-0.50	-2.80
-0.36	-4.57
-0.22	-6.33
-0.20	-6.45
-0.18	-6.54
-0.16	-6.58
-0.14	-6.57
-0.13	-6.50
-0.11	-6.36
-0.09	-6.14
-0.07	-5.81
-0.05	-5.32
-0.04	-4.56
-0.02	-3.23
0.00	0.00
0.02	3.23
0.04	4.56
0.05	5.32
0.07	5.81
0.09	6.14
0.11	6.36
0.13	6.50
0.14	6.57
0.16	6.58
0.18	6.54
0.20	6.45
0.22	6.33
0.36	4.57
0.50	2.80
0.65	1.03
0.68	1.03

Layer 19 91'-95'
Depth = 92.5 feet
Elevation = 101.5 feet

y (in)	p (kip/ft)
-0.65	-0.98
-0.61	-0.98
-0.48	-2.66
-0.34	-4.33
-0.20	-6.01
-0.19	-6.12
-0.17	-6.20
-0.15	-6.24
-0.14	-6.23
-0.12	-6.17
-0.10	-6.04
-0.09	-5.83
-0.07	-5.51
-0.05	-5.04
-0.03	-4.33
-0.02	-3.06
0.00	0.00
0.02	3.06
0.03	4.33
0.05	5.04
0.07	5.51
0.09	5.83
0.10	6.04
0.12	6.17
0.14	6.23
0.15	6.24
0.17	6.20
0.19	6.12
0.20	6.01
0.34	4.33
0.48	2.66
0.61	0.98
0.65	0.98

TABLE C.2-2
P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 3 THROUGH 9
All depths are measured below ground surface.

Layer 1 0'-3'
Depth = 2.5 feet
Elevation = 184.5 feet

y (in)	p (kip/ft)
-0.60	-3.10
-0.59	-3.10
-0.58	-3.10
-0.42	-2.65
-0.26	-2.20
-0.24	-2.16
-0.23	-2.11
-0.21	-2.06
-0.19	-2.01
-0.18	-1.96
-0.16	-1.90
-0.15	-1.84
-0.13	-1.78
-0.12	-1.70
-0.10	-1.63
-0.09	-1.54
0.00	0.00
0.09	1.54
0.10	1.63
0.12	1.70
0.13	1.78
0.15	1.84
0.16	1.90
0.18	1.96
0.19	2.01
0.21	2.06
0.23	2.11
0.24	2.16
0.26	2.20
0.42	2.65
0.58	3.10
0.59	3.10
0.60	3.10

Layer 2 3'-9'
Depth = 7.5 feet
Elevation = 179.5 feet

y (in)	p (kip/ft)
-6.33	-4.49
-5.96	-4.49
-4.84	-4.19
-3.88	-3.89
-3.05	-3.59
-2.35	-3.29
-1.76	-2.99
-1.29	-2.70
-0.90	-2.40
-0.61	-2.10
-0.38	-1.80
-0.22	-1.50
-0.11	-1.20
-0.05	-0.90
-0.01	-0.60
0.00	-0.30
0.00	0.00
0.00	0.30
0.01	0.60
0.05	0.90
0.11	1.20
0.22	1.50
0.38	1.80
0.61	2.10
0.90	2.40
1.29	2.70
1.76	2.99
2.35	3.29
3.05	3.59
3.88	3.89
4.84	4.19
5.96	4.49
6.33	4.49

Layer 3 9'-16'
Depth = 12.5 feet
Elevation = 174.5 feet

y (in)	p (kip/ft)
-0.57	-20.40
-0.55	-20.40
-0.54	-20.40
-0.39	-16.00
-0.24	-11.59
-0.22	-10.98
-0.20	-10.35
-0.18	-9.70
-0.16	-9.01
-0.14	-8.29
-0.12	-7.52
-0.10	-6.70
-0.08	-5.81
-0.06	-4.82
-0.04	-3.68
-0.02	-2.23
0.00	0.00
0.02	2.23
0.04	3.68
0.06	4.82
0.08	5.81
0.10	6.70
0.12	7.52
0.14	8.29
0.16	9.01
0.18	9.70
0.20	10.35
0.22	10.98
0.24	11.59
0.39	16.00
0.54	20.40
0.55	20.40
0.57	20.40

Layer 4 16-20'
Depth = 17.5 feet
Elevation = 169.5 feet

y (in)	p (kip/ft)
-5.93	-5.23
-5.58	-5.23
-4.54	-4.88
-3.63	-4.53
-2.86	-4.19
-2.20	-3.84
-1.65	-3.49
-1.21	-3.14
-0.85	-2.79
-0.57	-2.44
-0.36	-2.09
-0.21	-1.74
-0.11	-1.40
-0.04	-1.05
-0.01	-0.70
0.00	-0.35
0.00	0.00
0.00	0.35
0.01	0.70
0.04	1.05
0.11	1.40
0.21	1.74
0.36	2.09
0.57	2.44
0.85	2.79
1.21	3.14
1.65	3.49
2.20	3.84
2.86	4.19
3.63	4.53
4.54	4.88
5.58	5.23
5.93	5.23

Layer 5 20'-25'
Depth = 22.5 feet
Elevation = 164.5 feet

y (in)	p (kip/ft)
-5.73	-5.06
-5.39	-5.06
-4.39	-4.72
-3.51	-4.38
-2.76	-4.05
-2.13	-3.71
-1.60	-3.37
-1.17	-3.03
-0.82	-2.70
-0.55	-2.36
-0.35	-2.02
-0.20	-1.69
-0.10	-1.35
-0.04	-1.01
-0.01	-0.67
0.00	-0.34
0.00	0.00
0.00	0.34
0.01	0.67
0.04	1.01
0.10	1.35
0.20	1.69
0.35	2.02
0.55	2.36
0.82	2.70
1.17	3.03
1.60	3.37
2.13	3.71
2.76	4.05
3.51	4.38
4.39	4.72
5.39	5.06
5.73	5.06

Layer 6 25'-30'
Depth = 27.5 feet
Elevation = 159.5 feet

y (in)	p (kip/ft)
-5.53	-4.88
-5.21	-4.88
-4.23	-4.56
-3.39	-4.23
-2.67	-3.90
-2.05	-3.58
-1.54	-3.25
-1.12	-2.93
-0.79	-2.60
-0.53	-2.28
-0.33	-1.95
-0.19	-1.63
-0.10	-1.30
-0.04	-0.98
-0.01	-0.65
0.00	-0.33
0.00	0.00
0.00	0.33
0.01	0.65
0.04	0.98
0.10	1.30
0.19	1.63
0.33	1.95
0.53	2.28
0.79	2.60
1.12	2.93
1.54	3.25
2.05	3.58
2.67	3.90
3.39	4.23
4.23	4.56
5.21	4.88
5.53	4.88

Layer 7 30'-35'
Depth = 32.5 feet
Elevation = 154.5 feet

y (in)	p (kip/ft)
-5.33	-4.71
-5.02	-4.71
-4.08	-4.39
-3.27	-4.08
-2.57	-3.76
-1.98	-3.45
-1.49	-3.14
-1.08	-2.82
-0.76	-2.51
-0.51	-2.20
-0.32	-1.88
-0.19	-1.57
-0.10	-1.25
-0.04	-0.94
-0.01	-0.63
0.00	-0.31
0.00	0.00
0.00	0.31
0.01	0.63
0.04	0.94
0.10	1.25
0.19	1.57
0.32	1.88
0.51	2.20
0.76	2.51
1.08	2.82
1.49	3.14
1.98	3.45
2.57	3.76
3.27	4.08
4.08	4.39
5.02	4.71
5.33	4.71

Layer 8 35'-40'
Depth = 37.5 feet
Elevation = 149.5 feet

y (in)	p (kip/ft)
-5.13	-4.53
-4.83	-4.53
-3.93	-4.23
-3.14	-3.93
-2.47	-3.62
-1.91	-3.32
-1.43	-3.02
-1.04	-2.72
-0.73	-2.42
-0.49	-2.11
-0.31	-1.81
-0.18	-1.51
-0.09	-1.21
-0.04	-0.91
-0.01	-0.60
0.00	-0.30
0.00	0.00
0.00	0.30
0.01	0.60
0.04	0.91
0.09	1.21
0.18	1.51
0.31	1.81
0.49	2.11
0.73	2.42
1.04	2.72
1.43	3.02
1.91	3.32
2.47	3.62
3.14	3.93
3.93	4.23
4.83	4.53
5.13	4.53

Layer 9 40'-43'
Depth = 42.5 feet
Elevation = 144.5 feet

y (in)	p (kip/ft)
-4.93	-4.35
-4.64	-4.35
-3.78	-4.06
-3.02	-3.77
-2.38	-3.48
-1.83	-3.19
-1.38	-2.90
-1.00	-2.61
-0.70	-2.32
-0.47	-2.03
-0.30	-1.74
-0.17	-1.45
-0.09	-1.16
-0.04	-0.87
-0.01	-0.58
0.00	-0.29
0.00	0.00
0.00	0.29
0.01	0.58
0.04	0.87
0.09	1.16
0.17	1.45
0.30	1.74
0.47	2.03
0.70	2.32
1.00	2.61
1.38	2.90
1.83	3.19
2.38	3.48
3.02	3.77
3.78	4.06
4.64	4.35
4.93	4.35

Layer 10 43'-49'
Depth = 47.5 feet
Elevation = 139.5 feet

y (in)	p (kip/ft)
-0.89	-1.34
-0.84	-1.34
-0.66	-3.64
-0.47	-5.94
-0.28	-8.24
-0.26	-8.39
-0.23	-8.50
-0.21	-8.55
-0.19	-8.54
-0.16	-8.45
-0.14	-8.27
-0.12	-7.98
-0.09	-7.55
-0.07	-6.91
-0.05	-5.93
-0.02	-4.20
0.00	0.00
0.02	4.20
0.05	5.93
0.07	6.91
0.09	7.55
0.12	7.98
0.14	8.27
0.16	8.45
0.19	8.54
0.21	8.55
0.23	8.50
0.26	8.39
0.28	8.24
0.47	5.94
0.66	3.64
0.84	1.34
0.89	1.34

Layer 11 49'-55'
Depth = 52.5 feet
Elevation = 134.5 feet

y (in)	p (kip/ft)
-0.85	-1.29
-0.81	-1.29
-0.63	-3.49
-0.45	-5.69
-0.27	-7.89
-0.25	-8.04
-0.22	-8.14
-0.20	-8.19
-0.18	-8.18
-0.16	-8.10
-0.13	-7.92
-0.11	-7.65
-0.09	-7.23
-0.07	-6.62
-0.04	-5.68
-0.02	-4.02
0.00	0.00
0.02	4.02
0.04	5.68
0.07	6.62
0.09	7.23
0.11	7.65
0.13	7.92
0.16	8.10
0.18	8.18
0.20	8.19
0.22	8.14
0.25	8.04
0.27	7.89
0.45	5.69
0.63	3.49
0.81	1.29
0.85	1.29

Layer 12 55'-60'
Depth = 57.5 feet
Elevation = 129.5 feet

y (in)	p (kip/ft)
-0.81	-1.23
-0.77	-1.23
-0.60	-3.33
-0.43	-5.44
-0.26	-7.54
-0.24	-7.69
-0.21	-7.78
-0.19	-7.83
-0.17	-7.82
-0.15	-7.74
-0.13	-7.58
-0.11	-7.31
-0.09	-6.91
-0.06	-6.33
-0.04	-5.43
-0.02	-3.84
0.00	0.00
0.02	3.84
0.04	5.43
0.06	6.33
0.09	6.91
0.11	7.31
0.13	7.58
0.15	7.74
0.17	7.82
0.19	7.83
0.21	7.78
0.24	7.69
0.26	7.54
0.43	5.44
0.60	3.33
0.77	1.23
0.81	1.23

Layer 13 60'-65'
Depth = 62.5 feet
Elevation = 124.5 feet

y (in)	p (kip/ft)
-0.78	-1.17
-0.74	-1.17
-0.57	-3.18
-0.41	-5.19
-0.25	-7.19
-0.22	-7.33
-0.20	-7.43
-0.18	-7.47
-0.16	-7.46
-0.14	-7.38
-0.12	-7.23
-0.10	-6.97
-0.08	-6.59
-0.06	-6.04
-0.04	-5.18
-0.02	-3.67
0.00	0.00
0.02	3.67
0.04	5.18
0.06	6.04
0.08	6.59
0.10	6.97
0.12	7.23
0.14	7.38
0.16	7.46
0.18	7.47
0.20	7.43
0.22	7.33
0.25	7.19
0.41	5.19
0.57	3.18
0.74	1.17
0.78	1.17

Layer 14 65'-70'
Depth = 67.5 feet
Elevation = 119.5 feet

y (in)	p (kip/ft)
-0.74	-1.12
-0.70	-1.12
-0.54	-3.03
-0.39	-4.94
-0.23	-6.85
-0.21	-6.98
-0.19	-7.07
-0.18	-7.11
-0.16	-7.10
-0.14	-7.03
-0.12	-6.88
-0.10	-6.64
-0.08	-6.28
-0.06	-5.75
-0.04	-4.93
-0.02	-3.49
0.00	0.00
0.02	3.49
0.04	4.93
0.06	5.75
0.08	6.28
0.10	6.64
0.12	6.88
0.14	7.03
0.16	7.10
0.18	7.11
0.19	7.07
0.21	6.98
0.23	6.85
0.39	4.94
0.54	3.03
0.70	1.12
0.74	1.12

Layer 15 70'-77'
Depth = 72.5 feet
Elevation = 114.5 feet

y (in)	p (kip/ft)
-0.70	-1.06
-0.67	-1.06
-0.52	-2.87
-0.37	-4.69
-0.22	-6.50
-0.20	-6.63
-0.18	-6.71
-0.17	-6.75
-0.15	-6.74
-0.13	-6.67
-0.11	-6.53
-0.09	-6.30
-0.07	-5.96
-0.06	-5.46
-0.04	-4.68
-0.02	-3.31
0.00	0.00
0.02	3.31
0.04	4.68
0.06	5.46
0.07	5.96
0.09	6.30
0.11	6.53
0.13	6.67
0.15	6.74
0.17	6.75
0.18	6.71
0.20	6.63
0.22	6.50
0.37	4.69
0.52	2.87
0.67	1.06
0.70	1.06

Layer 16 77'-82'
Depth = 77.5 feet
Elevation = 109.5 feet

y (in)	p (kip/ft)
-0.66	-1.00
-0.63	-1.00
-0.49	-2.72
-0.35	-4.44
-0.21	-6.15
-0.19	-6.27
-0.17	-6.35
-0.16	-6.39
-0.14	-6.38
-0.12	-6.32
-0.10	-6.18
-0.09	-5.97
-0.07	-5.64
-0.05	-5.17
-0.03	-4.44
-0.02	-3.14
0.00	0.00
0.02	3.14
0.03	4.44
0.05	5.17
0.07	5.64
0.09	5.97
0.10	6.18
0.12	6.32
0.14	6.38
0.16	6.39
0.17	6.35
0.19	6.27
0.21	6.15
0.35	4.44
0.49	2.72
0.63	1.00
0.66	1.00

TABLE C.2-3
P-Y CURVES TABULAR DATA
WIDEN 15" CLASS 70 PILES
BENTS 1, 2, 10, and 11
All depths are measured below ground surface.

Layer 1 0'-5'
Depth = 2.5 feet
Elevation = 191.5 feet

y (in)	p (kip/ft)
-0.61	-3.13
-0.60	-3.13
-0.58	-3.13
-0.42	-2.68
-0.26	-2.23
-0.24	-2.18
-0.23	-2.14
-0.21	-2.09
-0.20	-2.04
-0.18	-1.98
-0.16	-1.92
-0.15	-1.86
-0.13	-1.80
-0.12	-1.73
-0.10	-1.65
-0.09	-1.56
0.00	0.00
0.09	1.56
0.10	1.65
0.12	1.73
0.13	1.80
0.15	1.86
0.16	1.92
0.18	1.98
0.20	2.04
0.21	2.09
0.23	2.14
0.24	2.18
0.26	2.23
0.42	2.68
0.58	3.13
0.60	3.13
0.61	3.13

Layer 2 5'-10'
Depth = 7.5 feet
Elevation = 186.5 feet

y (in)	p (kip/ft)
-0.61	-11.48
-0.60	-11.48
-0.58	-11.48
-0.42	-9.00
-0.26	-6.52
-0.24	-6.21
-0.22	-5.89
-0.20	-5.55
-0.18	-5.20
-0.16	-4.83
-0.14	-4.45
-0.12	-4.04
-0.10	-3.61
-0.08	-3.13
-0.06	-2.61
-0.04	-2.01
0.00	0.00
0.04	2.01
0.06	2.61
0.08	3.13
0.10	3.61
0.12	4.04
0.14	4.45
0.16	4.83
0.18	5.20
0.20	5.55
0.22	5.89
0.24	6.21
0.26	6.52
0.42	9.00
0.58	11.48
0.60	11.48
0.61	11.48

Layer 3 10'-16'
Depth = 12.5 feet
Elevation = 181.5 feet

y (in)	p (kip/ft)
-0.61	-29.19
-0.60	-29.19
-0.58	-29.19
-0.42	-22.89
-0.26	-16.58
-0.24	-16.05
-0.23	-15.50
-0.22	-14.94
-0.20	-14.37
-0.19	-13.78
-0.18	-13.17
-0.16	-12.55
-0.15	-11.91
-0.14	-11.24
-0.12	-10.54
-0.11	-9.82
0.00	0.00
0.11	9.82
0.12	10.54
0.14	11.24
0.15	11.91
0.16	12.55
0.18	13.17
0.19	13.78
0.20	14.37
0.22	14.94
0.23	15.50
0.24	16.05
0.26	16.58
0.42	22.89
0.58	29.19
0.60	29.19
0.61	29.19

Layer 4 16'20'
Depth = 17.5 feet
Elevation = 176.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 5 20'-23'
Depth = 22.5 feet
Elevation = 171.5 feet

y (in)	p (kip/ft)
-0.61	-62.83
-0.60	-62.83
-0.58	-62.83
-0.42	-49.27
-0.26	-35.70
-0.24	-34.40
-0.23	-33.08
-0.21	-31.71
-0.20	-30.31
-0.18	-28.86
-0.17	-27.37
-0.15	-25.82
-0.14	-24.21
-0.12	-22.53
-0.11	-20.76
-0.09	-18.89
0.00	0.00
0.09	18.89
0.11	20.76
0.12	22.53
0.14	24.21
0.15	25.82
0.17	27.37
0.18	28.86
0.20	30.31
0.21	31.71
0.23	33.08
0.24	34.40
0.26	35.70
0.42	49.27
0.58	62.83
0.60	62.83
0.61	62.83

Layer 6 23'30'
Depth = 27.5 feet
Elevation = 166.5 feet

y (in)	p (kip/ft)
-0.61	-103.07
-0.60	-103.07
-0.58	-103.07
-0.42	-80.82
-0.26	-58.56
-0.25	-57.20
-0.24	-55.81
-0.23	-54.41
-0.22	-52.97
-0.21	-51.52
-0.20	-50.03
-0.19	-48.52
-0.18	-46.98
-0.17	-45.40
-0.16	-43.79
-0.15	-42.13
0.00	0.00
0.15	42.13
0.16	43.79
0.17	45.40
0.18	46.98
0.19	48.52
0.20	50.03
0.21	51.52
0.22	52.97
0.23	54.41
0.24	55.81
0.25	57.20
0.26	58.56
0.42	80.82
0.58	103.07
0.60	103.07
0.61	103.07

Layer 7 30'-35'
Depth = 32.5 feet
Elevation = 161.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 8 35'-40'
Depth = 37.5 feet
Elevation = 156.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 9 40'-45'
Depth = 42.5 feet
Elevation = 151.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 10 45'-50'
Depth = 47.5 feet
Elevation = 146.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 11 50'-57'
Depth = 52.5 feet
Elevation = 141.5 feet

y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 12 57'-60'
Depth = 57.5 feet
Elevation = 136.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 13 60'-65'
Depth = 62.5 feet
Elevation = 131.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 14 65'-70'
Depth = 67.5 feet
Elevation = 126.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 15 70'-75'
Depth = 72.5 feet
Elevation = 121.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 16 75'-80'
Depth = 77.5 feet
Elevation = 116.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 17 80'-85'
Depth = 82.5 feet
Elevation = 111.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 18 85'-91'
Depth = 87.5 feet
Elevation = 106.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 19 91'-95'
Depth = 92.5 feet
Elevation = 101.5 feet

y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

TABLE 3.2-4
P-Y CURVES TABULAR DATA
WIDEN 15" CLASS 70 PILES
BENTS 3 THROUGH 9
All depths are measured below ground surface.

Layer 1 0'-3'

Depth = 2.5 feet	
Elevation = 178.5 feet	
y (in)	p (kip/ft)
-0.61	-3.13
-0.60	-3.13
-0.58	-3.13
-0.42	-2.68
-0.26	-2.23
-0.24	-2.18
-0.23	-2.14
-0.21	-2.09
-0.20	-2.04
-0.18	-1.98
-0.16	-1.92
-0.15	-1.86
-0.13	-1.80
-0.12	-1.73
-0.10	-1.65
-0.09	-1.56
0.00	0.00
0.09	1.56
0.10	1.65
0.12	1.73
0.13	1.80
0.15	1.86
0.16	1.92
0.18	1.98
0.20	2.04
0.21	2.09
0.23	2.14
0.24	2.18
0.26	2.23
0.42	2.68
0.58	3.13
0.60	3.13
0.61	3.13

Layer 2 3'-9'

Depth = 7.5 feet	
Elevation = 173.5 feet	
y (in)	p (kip/ft)
-6.59	-4.60
-6.20	-4.60
-5.04	-4.29
-4.04	-3.99
-3.17	-3.68
-2.45	-3.37
-1.84	-3.07
-1.34	-2.76
-0.94	-2.45
-0.63	-2.15
-0.40	-1.84
-0.23	-1.53
-0.12	-1.23
-0.05	-0.92
-0.01	-0.61
0.00	-0.31
0.00	0.00
0.00	0.31
0.01	0.61
0.05	0.92
0.12	1.23
0.23	1.53
0.40	1.84
0.63	2.15
0.94	2.45
1.34	2.76
1.84	3.07
2.45	3.37
3.17	3.68
4.04	3.99
5.04	4.29
6.20	4.60
6.59	4.60

Layer 3 9'-16'

Depth = 12.5 feet	
Elevation = 168.5 feet	
y (in)	p (kip/ft)
-0.61	-20.37
-0.60	-20.37
-0.58	-20.37
-0.42	-15.98
-0.26	-11.58
-0.24	-10.96
-0.21	-10.32
-0.19	-9.66
-0.17	-8.96
-0.15	-8.23
-0.13	-7.46
-0.10	-6.62
-0.08	-5.72
-0.06	-4.71
-0.04	-3.53
-0.01	-2.00
0.00	0.00
0.01	2.00
0.04	3.53
0.06	4.71
0.08	5.72
0.10	6.62
0.13	7.46
0.15	8.23
0.17	8.96
0.19	9.66
0.21	10.32
0.24	10.96
0.26	11.58
0.42	15.98
0.58	20.37
0.60	20.37
0.61	20.37

Layer 4 16'-20'

Depth = 17.5 feet	
Elevation = 163.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 5 20'-25'

Depth = 22.5 feet	
Elevation = 158.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 6 25'-30'

Depth = 27.5 feet	
Elevation = 153.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 7 30'35'

Depth = 32.5 feet	
Elevation = 148.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 8 35'-40'

Depth = 37.5 feet	
Elevation = 143.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 9 40'-43'

Depth = 42.5 feet	
Elevation = 138.5 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0.00	0.00
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 10 43'-49'

Depth = 47.5 feet	
Elevation = 133.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 11 49'-55'

Depth = 52.5 feet	
Elevation = 128.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 12 55'-60'

Depth = 57.5 feet	
Elevation = 123.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 13 60'-65'

Depth = 62.5 feet	
Elevation = 118.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 14 65'-70'

Depth = 67.5 feet	
Elevation = 113.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 15 70'-77'

Depth = 72.5 feet	
Elevation = 108.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Layer 16 77'-82'

Depth = 77.5 feet	
Elevation = 103.5 feet	
y (in)	p (kip/ft)
-1.24	-1.87
-1.17	-1.87
-0.91	-5.07
-0.65	-8.26
-0.39	-11.45
-0.36	-11.68
-0.33	-11.83
-0.29	-11.90
-0.26	-11.88
-0.23	-11.76
-0.20	-11.51
-0.16	-11.11
-0.13	-10.50
-0.10	-9.62
-0.07	-8.25
-0.03	-5.84
0.00	0.00
0.03	5.84
0.07	8.25
0.10	9.62
0.13	10.50
0.16	11.11
0.20	11.51
0.23	11.76
0.26	11.88
0.29	11.90
0.33	11.83
0.36	11.68
0.39	11.45
0.65	8.26
0.91	5.07
1.17	1.87
1.24	1.87

Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: 10 **EA:** 0k800 **EFIS** 0612000110 **Project Name:** Seismic Retrofit Kings River Bridge **Structure Design:** Sara Yip **Phone:** (916) 227-8778 **e-mail:**	__ PSR/PDS (Review No.__ __ APS/PSR (Review No.__) _ APS/PR (Review No.__) __ Type Selection __ 65% PS&E Unchecked Details __ PS&E (Review No.__) __ Construction __X Other: FR REVIEW NO 1	**Reviewer Name:** Javad Massoomi/John Huang **Functional Unit:** METS/GS **Cost Center:** 59-3657 **Phone Number:**227-1037 **e-mail:** **Date of Review:** 9/10/15 **Structure Name*: Kings River Bridge**, 45-0007 (*Use if necessary to when comment sheets are by individual structure)

Consultant Information

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
Neva Popenoe	Kleinfelder	559-486-0750	npopenoe@kleinfelder.com	9/15/15

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR	ii of iv	Please add a geologist's signature	The geologist responsible for the review of the geology section has been included on the signature page.	
2	FR	7, section 3.4	Please add design groundwater table	The design groundwater elevation has been added to section 3.4.	
3	FR	7, Section 3.5	Please mention the design scour depths, reference to hydraulic report	The design scour depths have been referenced in the report.	
4	FR	18, section 6.2.3	Typo– 2 "in"s	The typo was corrected.	
5	FR	15, Table 6.2.2	This bridge has many support locations; abutments are on fills, and bents are in the water; was this idealized single soil profile the worst case? How the different ground surface elevations was considered? Javad, John (Liao) and Tony need to discuss more on the details and reach agreement based on needs. Thanks	Only one of the six planned borings was completed for this project due to access issues. Soil encountered in the new boring was relatively consistent with the previous drilled borings as shown on the As-Built LOTB. Due to the agreement of the current boring and the previous borings, one soil profile utilizing the current boring was used for analysis.	

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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_____ Functional Unit:_____ Br No*._____ *=if applicable

				For clarification, tables for abutments and bents were added.	
6	FR	LOTB	Please follow Caltrans Soil and Rock Logging manual for format, thanks	The LOTB was prepared using the Caltrans Soil and Rock Logging manual, June 2010. Borings were very deep and contained too much information to be aligned vertically, and were rotated to fit the page and placed on separate pages, as permitted in the manual.	
7	Note		FR by Kleinfelder dated 09/03/15, managed through GS contract. Structure Design in house.		
8	Grade		C2 – conditional approval, subject to above comments addressed satisfactorily		
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Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ EA: _0k800___ **EFIS__**0612000110_____ **Project Name:** Seismic Retrofit **Kings River Bridge** **Structure Design:** Sara Yip **Phone: __**(916) 227-8778__ **e-mail:_____**	**__ PSR/PDS (Review No.___** **__ APS/PSR (Review No.___)** **_ APS/PR (Review No.___)** **__ Type Selection** **__ 65% PS&E Unchecked Details** **__ PS&E (Review No.___)** **__ Construction** **__X Other:__FR_REVIEW NO 2__**	**Reviewer Name: _Javad Massoomi/John Huang_ _____** **Functional Unit: _METS/GS** **Cost Center: _59-3657** **Phone Number:227-1037 _e-mail: _____** **Date of Review: _10/5/15_** **Structure Name*: Kings River Bridge**, 45-0007___ (*Use if necessary to when comment sheets are by individual structure)

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR		No More comments		
2	FR				
3	FR				
4	FR				
5	FR				
6	FR				
7	Note		FR by Kleinfelder dated 09/15/15, managed through GS contract. Structure Design in house.		
8	Grade		C1 – approved		
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14					
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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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_ _____ Functional Unit:_____ Br No*._____ *=if applicable

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September 15, 2015
File No.: 20143390.074A

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

Attn: Mr. John Huang

SUBJECT:

Foundation Report
State Route 41/State Route 99 Connector Separation Bridge
Bridge No. 42-0216F
Fresno, California

Dear Mr. Huang:

The attached report presents the results of the geotechnical study for the State Route 41/State Route 99 Connector Separation Bridge (Bridge No. 42-0216F) project located in the City of Fresno, in Fresno County, California. This report describes our study and provides conclusions and recommendations for use in seismic rehabilitation evaluation.

We appreciate the opportunity to provide geotechnical engineering services to Caltrans and other project designers. We trust this information meets your current needs. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully Submitted,
KLEINFELDER, INC.

Neva M. Popenoe, PE, GE
Project Engineer

Nathan L. Dahlen, PE
Senior Project Manager

NMP:NLD:

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5125 North Gates Avenue, Suite 102, Fresno, CA 93722 **p|** 559-486-0750 **f|** 559-442-5081

FOUNDATION REPORT
SR 41/SR 99 CONNECTOR SEPARATION BRIDGE
BRIDGE NO. 42-0216F
FRESNO COUNTY, CALIFORNIA

A report prepared for:

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

September 15, 2015
File No.: 20143390.074A

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Prepared For:
STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

FOUNDATION REPORT
STATE ROUTE 41/STATE ROUTE 99 CONNECTOR SEPARATION BRIDGE
BRIDGE NO. 42-0216F
FRESNO COUNTY, CALIFORNIA

Kleinfelder Job No.: 20143390.074A

Prepared by:

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September 15, 2015

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RESPONSE TO CALTRANS COMMENTS

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1. INTRODUCTION

1.1 GENERAL

This report presents the results of the geotechnical investigation for the proposed seismic retrofit evaluation of the State Route 41/State Route 99 Connector Separation Bridge (No. 42-0216F), located in the City of Fresno in Fresno County, California. The scope of services consisted of a field exploration program, laboratory testing, engineering analysis, and preparation of this written report.

1.2 SCOPE OF SERVICES

The purpose of the Foundation Report is to provide geotechnical recommendations and opinions to aid in project design. The report provides the following:

- A description of the proposed project;
- A summary of the field exploration and laboratory testing programs;
- Comments on the regional geology and site engineering seismology, including the recommended peak ground acceleration and Caltrans Seismic Design Criteria Version 1.7 ARS curve;
- Comments on liquefaction potential;
- Available gross and net permissible contract stress associated with the permissible settlement and bearing capacity of spread footing foundations; for Service Limit, and Extreme Event loading;
- Available resistance of lateral loading on spread footings;
- Log of Test Borings drawing.

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1.3 PROJECT DESCRIPTION

The proposed project will involve the rehabilitation of State Route 41/State Route 99 Connector Separation Bridge. The original 4-span structure is supported by spread footings. The span lengths (center of bearing (c.o.b.) to c.o.b.) range from approximately 145 feet to 186 feet, with a total bridge length of 665 feet. Table 1.3-1 provides the data for the existing bridge foundations, as provided by Caltrans Structures and on the General Plan, dated June 10, 2015.

TABLE 1.3-1
EXISTING BRIDGE FOUNDATION DATA

Bent Number	Location	Finished Grade Elev. (ft)	Bottom of Footing Elev. (ft)	Footing Size (ft)	
				B	L
2	1112+10	260	252	22	20
3	1113+98	260	252	22	20
4	1115+83	261	255	22	20

TABLE 1.3-2
BENT LRFD SERVICE LIMIT STATE

Bent Number	Service I Limit State Permanent Load Per Support (kips)	Extreme Event Limit State (tsf)
2	2520	4.8
3	2835	5.9
4	2510	4.9

Notes: (1) Single column on 22ft x 20ft spread footing

1.4 POLICY EXCEPTIONS

No known exceptions to Caltrans policy were made in the geotechnical evaluation for the foundations for this project.

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2. FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION AND TESTING

The field exploration for the State Route 41/State Route 99 Connector Separation Bridge rehabilitation consisted of 2 test borings. Exploration was performed between June 9 and 11, 2015. Test borings RC-15-001 and RC-15-002 were drilled with Chang Shin 2000 and Acker MPCA truck-mounted drill rigs, respectively, using punch core drilling techniques. The two borings were drilled to a depth of 101.5 feet below ground surface. The approximate location of the test borings are shown on the Log of Test Borings drawing in Figures 2 through 4 of this report.

The earth materials encountered in the test borings were visually classified in the field and a continuous log was recorded. Along with the continuous core sampling, in-place samples of soil units were collected from the test boring at selected depths by driving a 2.0-inch I.D. split barrel sampler containing brass liners into the undisturbed soil with a 140-pound automatic safety hammer free falling a distance of 30-inches. In addition, an ASTM D1586 standard penetrometer without liners (barrel I.D. of 1.5 inches) was driven 18-inches in the same manner. This latter sampling procedure generally conformed to the ASTM D1586 test procedure. Resistance to sampler penetration over the last 12-inches is noted on the Log of Test Borings as the "Penetration Index". The penetration indices listed on the Log of Test Borings have not been corrected for the effects of overburden pressure, sampler size, rod length, or hammer efficiency. In addition, bulk samples were obtained from auger cuttings at selected borings.

Penetration rates determined in general accordance with ASTM D1586 were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils.

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2.2 LABORATORY TESTS

Laboratory tests were performed on selected samples to evaluate certain characteristics and engineering properties. The laboratory testing program was designed with emphasis on the evaluation of geotechnical properties of foundation materials as they pertain to the proposed project. The laboratory testing program included performing the following tests:

- Material in Soils Finer than No. 200 (75-µm) Sieve (ASTM D1140)
- Sieve Analysis (ASTM C136)
- Atterberg Limits (ASTM D4318)
- Direct Shear Testing (ASTM D3080)
- Minimum Resistivity and pH (California Test Method No. 643)
- Soluble Sulfate Content (California Test Method No.417
- Soluble Chloride Content (California Test Method No.422

Geotechnical design parameters were based on project specific laboratory data, and interpretation of the area geology. Consideration was also given to correlations with sample penetration rates. Tables 2.2-1 provides a summary of geotechnical design parameters and generalized soil profile used.

TABLE 2.2-1
GEOTECHNICAL DESIGN PARAMETERS

Elevation (feet)	Material	γ_t (pcf)[1]	Φ (degrees)	c (psf)
260 – 225	SM	120	37	200

Notes: 1. Total unit weight

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3. SITE CONDITIONS

3.1 SURFACE CONDITIONS AND TOPOGRAPHY

The existing State Route (SR) 41/SR 99 Connector Separation Bridge is a 2-lane paved road which connects southbound SR 41 with southbound SR 99. SR 99 is generally in cut below original grade and travels below SR 41. SR 41 northbound off-ramp to SR 99 northbound on-ramp is also below the SR 41/SR 99 Connector Separation Bridge structure. The general topography along the SR 41/SR 99 alignment is relatively flat on either side of the bridge, with the north abutment adjoining the SR 41 off-ramp is in fill and approximately 15 feet higher than the south abutment adjoining the SR 99 on-ramp.

3.2 REGIONAL GEOLOGY

The project site lies in the central portion of the San Joaquin Valley in the Great Valley geomorphic province in California. This province was formed by the filling of a large structural trough or downwarp in the underlying bedrock. The trough is situated between the Sierra Nevada Range on the east and south and the Coast Range on the west. Both of these mountain ranges were initially formed by uplifts that occurred during the Jurassic and Cretaceous periods of geologic time (greater than 65 million years ago). Renewed uplift began in the Sierra Nevada during the Tertiary time, and is continuing today. The trough that underlies the valley is asymmetrical, with the greatest depths of sediments near the western margin. The sediments that fill the trough originated as erosion material from the adjacent mountains and foothills.

3.3 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at the specific boring locations, refer to the Log of Test Borings presented in Figures 2 to 4. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

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Soils consisted of silty sand with interbedded layers of sand, sand with clay, sand with silt, silty sand, clayey sand, sandy clay, clay with sand, sandy silt, and silt. The upper soil material consisted primarily of sands, sands with silt, silty sands, and clayey sands within the upper 27 to 34 feet and with interbedded layers of sandy clay, clay with sand, sandy silt, and silt extending to the total depth explored, 101.5 feet below ground surface.

3.4 GROUNDWATER CONDITIONS

Groundwater was not encountered within the total depth explored in either boring. The California Department of Water Resources groundwater elevation contours from well data indicate the static groundwater elevation in the general project area is about elevation 190 feet. A review of groundwater monitoring well data in the area published on the California Department of Water Resources Water Data Library indicates historic high groundwater elevation of approximately 225 feet (NGVD29) in the 1970s, or approximately 40 feet below ground surface. The design groundwater elevation for the project was 225 feet. Groundwater conditions at the site could change at some time in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time the test borings were made.

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4. CORROSION EVALUATION

Soil samples from borings RC-15-001 (depth of 0 to 6.5 feet) and RC-15-002 (depth of 0 to 6.5 feet) were tested to evaluate the soluble sulfate content, soluble chloride content, pH and minimum resistivity. Specific test results are presented in Table 4.1-1.

TABLE 4.1-1
CORROSION RELATED TESTING

Boring No.	Depth (ft)	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	pH	Minimum Resistivity (ohm-cm)
RC-15-001	0 - 6.5	184	86	7.8	4579
RC-15-002	0 - 6.5	296	127	7.9	1856

Laboratory tests indicate the soluble sulfates, soluble chlorides, pH and resistivity are outside the Caltrans threshold limits. Consequently, the site would be considered to be a non-corrosive environment with respect to foundations. Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. A qualified corrosion engineer should be consulted if the designer desires more specific recommendations.

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5. SEISMIC RECOMMENDATIONS

5.1 LOCAL FAULTING

There are no known faults, which cut through the local soil at the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone, as defined by Special Publication 42 (revised 2007) published by the California Geologic Survey (CGS). Numerous faults and shear zones within the region could influence the project site.

5.2 SEISMIC DESIGN CRITERIA

Seismic design parameters were developed in accordance with the Caltrans Seismic Design Criteria Version 1.7.

The project site is located in a region with the potential for relatively moderate seismic activity. The more significant faults that could influence the project site include the Coalinga and Kettleman Hills sections of the Great Valley Fault (Fault ID Nos. 205 and 210) and the Creeping Section of the San Andreas Fault (Fault ID No. 182). According to the Caltrans fault database, the Great Valley Fault Coalinga and Kettleman Hills sections are reverse fault with a dip angle of 15 and 22 degrees towards the west and assigned Maximum Magnitude (M_{Max}) of 7.0 and 7.1, respectively, the San Andreas Fault is strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 7.9. The characteristics of these three faults are summarized in Table 5.2-1.

Based on the boring data, the site can be classified as Soil Profile Type D. A V_{s30} of 297 m/s was used for the evaluation. The site is not located within a California deep soil basin region, as defined by Caltrans, so $Z_{1.0}$ and $Z_{2.5}$ were considered not applicable. Site characteristics and governing deterministic faults are summarized in Table 5.2-1.

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TABLE 5.2-1
SITE CHARACTERISTICS AND
GOVERNING DETERMINISTIC FAULTS PARAMETERS

Site Coordinates	Lat = 36.718328 deg, Long = -119.785327 deg
Shear Wave Velocity	297 m/s
Depth to V_s=1.0 km/s, $Z_{1.0}$	N/A
Depth to V_s=2.5 km/s, $Z_{2.5}$	N/A
Fault Name and ID Number	Great Valley 13 (Coalinga), No. 205
Maximum Magnitude (M_{Max})	7.0
Fault Type	Reverse
Fault Dip	15 degrees
Dip Direction	West
Bottom of Rupture Plane	15.30 km
Top of Rupture Plane (Z_{tor})	9.10 km
R_{RUP}[1]	65.639 km
R_{jB}[2]	65.005 km
R_X[3]	65.005 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1
Fault Name and ID Number	Great Valley 14 (Kettleman Hills), No. 210
Maximum Magnitude (M_{Max})	7.1
Fault Type	Reverse
Fault Dip	22 degrees
Dip Direction	West
Bottom of Rupture Plane	22.50 km
Top of Rupture Plane (Z_{tor})	8.10 km
R_{RUP}[1]	72.939 km
R_{jB}[2]	72.488 km
R_X[3]	71.490 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1
Fault Name and ID Number	San Andreas (Creeping Section), No. 182
Maximum Magnitude (M_{Max})	7.9
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	12.00 km
Top of Rupture Plane (Z_{tor})	0.00 km
R_{RUP}[1]	104.931 km
R_{jB}[2]	104.931 km
R_X[3]	104.931 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0

Notes:
[1]R_{RUP} = Closest distance from the site to the fault rupture plane.
[2]R_{JB} = Joyner-Boore distance; the shortest horizontal distance to the surface projection of the rupture area.
[3]R_X = Horizontal distance from the site to the fault trace or surface projection of the top of the rupture plane.

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5.2.1 Deterministic Response Spectrum

The deterministic response spectrum was developed using ARS Online. The deterministic response spectrum from the Minimum Spectrum for California governed.

5.2.2 Probabilistic Response Spectrum

The probabilistic response spectrum was developed using ARS Online.

5.2.3 Design Response Spectrum

The upper envelope of the deterministic and probabilistic spectral values determines the design response spectrum. The probabilistic response spectra were found to govern for all periods. The recommended acceleration and displacement design response spectra are presented graphically and numerically in Appendix B.

5.2.4 References

Caltrans. Caltrans ARS Online, http://dap3.dot.ca.gov/ARS_Online

Caltrans. Geotechnical Services Manual, January 2013.

Caltrans. Seismic Design Criteria, Appendix B Design Spectrum

Caltrans. Website http://dap3.dot.ca.gov/shake_stable/v2/technical.php

5.3 LIQUEFACTION POTENTIAL

In order for liquefaction of soils due to ground shaking to occur, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state,
- The soils are saturated,
- The soils are non-plastic, and

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- ❑ Ground motion is of sufficient intensity to act as a triggering mechanism.

Based on the ARS curve, the design Peak Horizontal Ground Acceleration (PHGA) is 0.24g, with a Moment Magnitude of 5.2 based on the USGS 2008 Deaggregations. Ground water was not observed within the total depth explored (101.5 feet) and therefore the potential for liquefaction is considered low. Dry, loose sands and non-plastic silts may experience some settlement or subsidence when subjected to cyclic application of loads such as ground shaking from near-by-seismic events. The potential for earthquake-induced settlements in dry sandy soils in the upper 50 feet was evaluated using Pradel (1998a and 1998b [based on Tokimatsu and Seed, 1987]). The analysis indicates that the there is a potential for seismic induced settlement of the non-saturated soil to occur at the site. The consequence of liquefaction at the site is relatively minor, with little to no surface manifestations of seismically induced settlement. The magnitude of the potential settlement is anticipated to be less than ½ inch.

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6. FOUNDATION RECOMMENDATIONS

6.1 GENERAL

Based on the field exploration, laboratory testing, and geotechnical analyses, the soils at the site are suitable to support the existing bridge structure. To support seismic analysis of the structure, Available Permissible Net Contact Stress and Factored Gross Nominal Bearing Resistance have been evaluated for the existing bent footings.

6.2 SHALLOW FOUNDATIONS

6.2.1 Axial Capacity

Table 6.2-1 presents the existing footing elevations, foundation geometry, and footing embedment for bents based on the furnished data (Tables 1.3-1 and 1.3-2). For analysis of bents, Table 6.2-1 provides the available gross and net permissible contact stress for 1.0 inch of settlement under Service Limit loads and the factored gross nominal bearing capacities for use in LRFD.

The settlements were evaluated using methods by Hough. Hough's method allows for consideration of the complex stress history of the foundation soil (i.e., pre-stressing associated with the freeway excavation and 1955 and 2002 foundations). FHWA considers the method conservative.

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TABLE 6.2-1
FOUNDATION DESIGN RECOMMENDATIONS FOR SPREAD FOOTINGS[1,2]

Support	Footing Size[3] (ft)		BOF Elev. (ft)	Footing Embed-ment Depth (ft)	LRFD	
					Service	Extreme Event ϕ_b=1.0
	B	L			Permissible Net Contact Stress (ksf)	Available Factored Gross Nominal Bearing Resistance (ksf)
Bent 2	22	20	252	8	6900	20
Bent 3	22	20	252	8	6900	20
Bent 4	22	20	252	6	6900	20

Notes: (1) Recommendations are based on the foundation geometry and the loads provided by Structure Design in the Foundation Design Data sheet. The footing contact area is taken as equal to the effective footing area, where applicable.
(2) See MTD 4-1 for definitions and applications of the recommended design parameters.

6.2.2 Spread Footing - Lateral Capacity

Static lateral loads applied to foundations can be resisted by a combination of passive lateral bearing and base friction. Available and factored nominal passive pressures and frictional coefficients for Service Limit, Strength Limit, and Extreme Event loads at bent are presented in Table 6.2-2. Passive pressures were determined by the log spiral method for cohessionless soils using NAVFAC charts. The passive pressure considers a conservative value of wall friction (δ) equal to one-half the angle of internal friction (ϕ), to allow for formed foundations.

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TABLE 6.2-2
LATERAL RESISTANCE OF FOUNDATION SOILS

	Service ϕ**=0.5**	**Extreme** ϕ**=1.0**
Frictional Coefficient	0.50	0.75
Passive Pressure (psf/ft of depth)[1]	450 psf/ft	900 psf/ft
Lateral translation needed to develop passive pressure[2]	0.008D	0.050D

Notes: (1) Passive pressure is presented for level adjacent ground surface.
(2) D is depth of footing below adjacent grade. Lateral translation will be in same units as D.

If the deflection resulting from the strain necessary to develop the passive pressure is within structural tolerance, the passive pressure and frictional resistance can be used in combination. Otherwise, additional passive pressure values could be provided based on tolerable deflection. It is suggested this strain compatibility approach be considered instead of an arbitrary reduction in passive pressure.

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7. CLOSURE

The conclusions and recommendations in this report are for the seismic analysis of the State Route 41/State Route 99 Connector Separation Bridge project located in the City of Fresno, in Fresno County, California, as described in the text of this report. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. The field exploration program and this report were based on the proposed project information provided to Kleinfelder. If any change (i.e., design loads, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the recommendations given herein.

This report is intended for use by Caltrans and their subconsultants within a reasonable time from its issuance. Noncompliance with the recommendations of the report or misuse of the report will release Kleinfelder from any liability.

The scope of the geotechnical services did not include an environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands.

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FIGURES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	FRE	41	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Nathan Dahlen No. 71344 Exp. 12/31/15 CIVIL STATE OF CALIFORNIA

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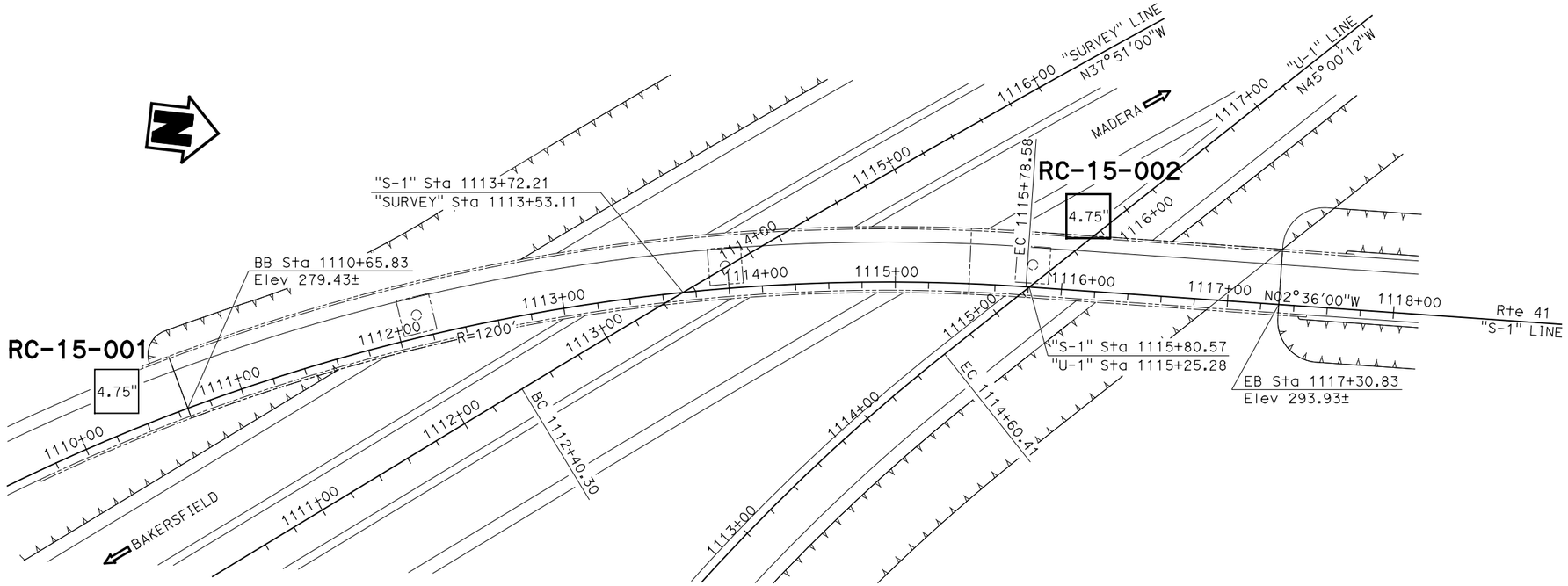
FRESNO, CA 93722



PLAN
1" = 40'

BENCHMARKS

STATION	OFFSET	N	E	ELEV	DESCRIPTION
35+81.19	77.01' Lt	2,193,822.88	6,137,391.65	280.274	"Lilly" RR spike in anchor pole NE corner Lilly & Florence (1960)

SURVEY CONTROL
1. Coordinates bearing and distances are based on the California State Plane Coordinate system of NAD 83 (1986). Elevations are based on NAVD29.

Notes:

1. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (ID) of 1.4" and an outside diameter (OD) of 2".
2. 2.0" samples were taken using a CAL split-barrel sampler with an inside diameter (ID) of 2.0" and an outside diameter (OD) of 2.5"
3. An automatic hammer (140 lb) with a 30" drop was used to advance the sampler.
4. Blowcounts noted for boring are field blowcounts and have not been corrected.
5. Blowcounts 50/5 means 50 blows per 5" penetration.
6. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2010)

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

A.M. & J.W.
FIELD INVESTIGATION BY:
DATE: 6/11/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 42-0216F
POST MILES R21.81

SR 41/99 CONNECTOR SEPARATION SEISMIC RETROFIT
LOG OF TEST BORINGS 1 OF 3

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 9/23/15

REVISION DATES | SHEET X | OF X

FILE => 42-0216f-z-ltb01.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE
"LOG OF TEST BORINGS" SHEET 1 OF 3

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	FRE	41	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

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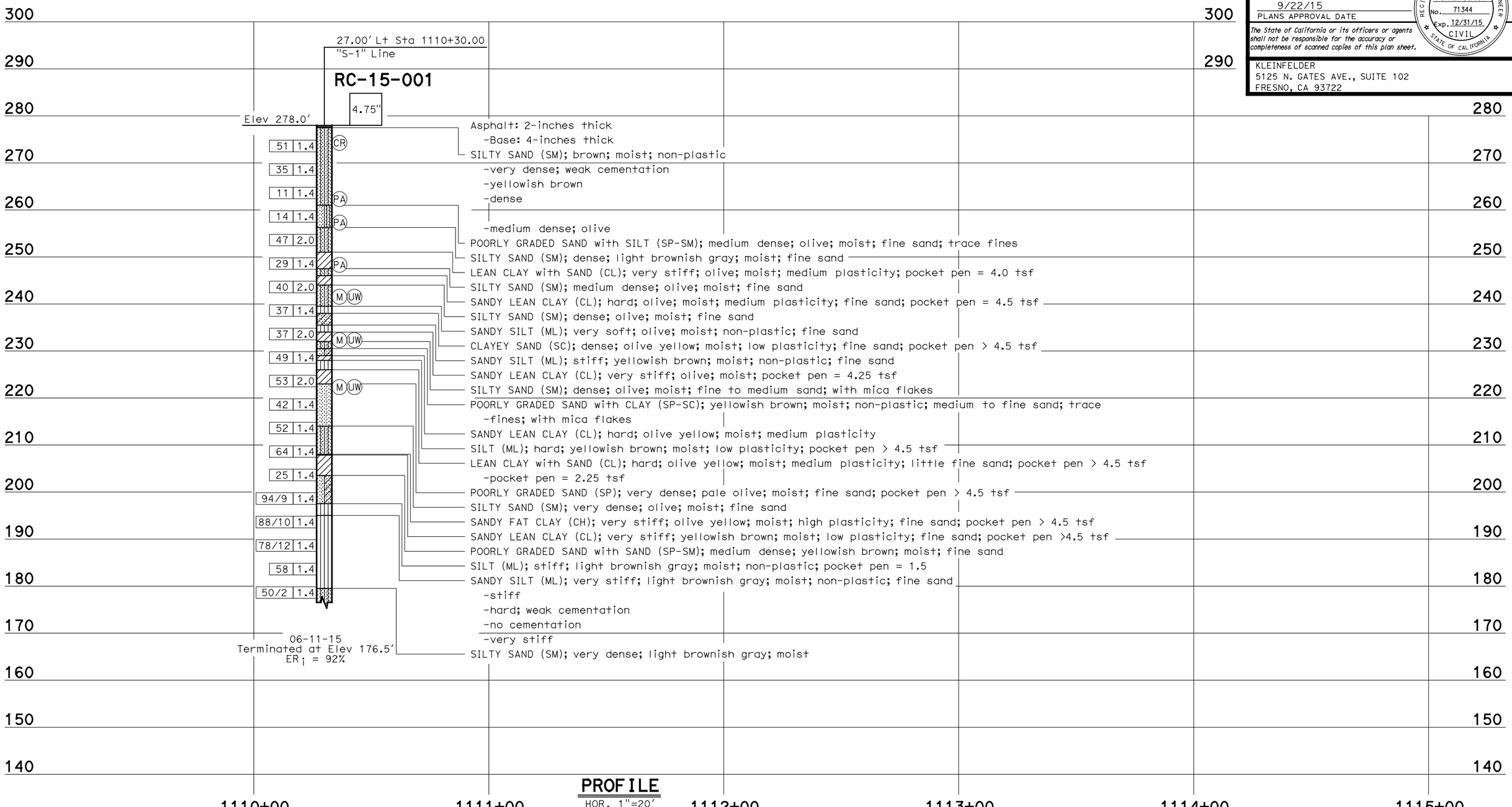

PROFILE
HOR. 1"=20'
VER. 1"=10'

J. Huang DESIGN OVERSIGHT 9/22/15 SIGN OFF DATE	DRAWN BY CHECKED BY	A. Sanchez N. Dahlen	A. Mohammad FIELD INVESTIGATION BY: DATE: 6/11/15	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	N. Dahlen PROJECT ENGINEER

BRIDGE NO. 42-0216F
POST MILES R21.81

SR 41/99 CONNECTOR SEPARATION SEISMIC RETROFIT

LOG OF TEST BORINGS 2 OF 3

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 9/23/15

REVISION DATES | SHEET X | OF X

FILE => 42-0216f-z-ltb02.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE
"LOG OF TEST BORINGS" SHEET 1 OF 3

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	FRE	41	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

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PROFILE
HOR. 1"=20'
VER. 1"=10'

J. Huang DESIGN OVERSIGHT 9/22/15 SIGN OFF DATE	DRAWN BY A. Sanchez CHECKED BY N. Dahlen	J. Wetenkamp FIELD INVESTIGATION BY: DATE: 6/11/15	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 42-0216F
POST MILES R21.81

SR 41/99 CONNECTOR SEPARATION SEISMIC RETROFIT

LOG OF TEST BORINGS 3 OF 3

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 9/23/15

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FILE => 42-0216f-z-ltb03.dgn

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APPENDIX A

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
RC-15-001	15.0						13				
RC-15-001	20.0						5.2				
RC-15-001	29.0						84				
RC-15-001	35.8		13.9	109.6							**Consolidation**
RC-15-001	45.0		19.6	108.1							**Consolidation**
RC-15-001	55.0		4.8	110.9							
RC-15-002	1.0	SILT (ML)					95	30	24	6	
RC-15-002	11.0						47				
RC-15-002	17.0		15.0	110.4							**Consolidation**
RC-15-002	20.0		20.1	110.5			13				
RC-15-002	30.0		11.1	118.4							**Consolidation**
RC-15-002	35.0						34				
RC-15-002	40.0		17.8	102.9							
RC-15-002	50.0		18.6	113.7							

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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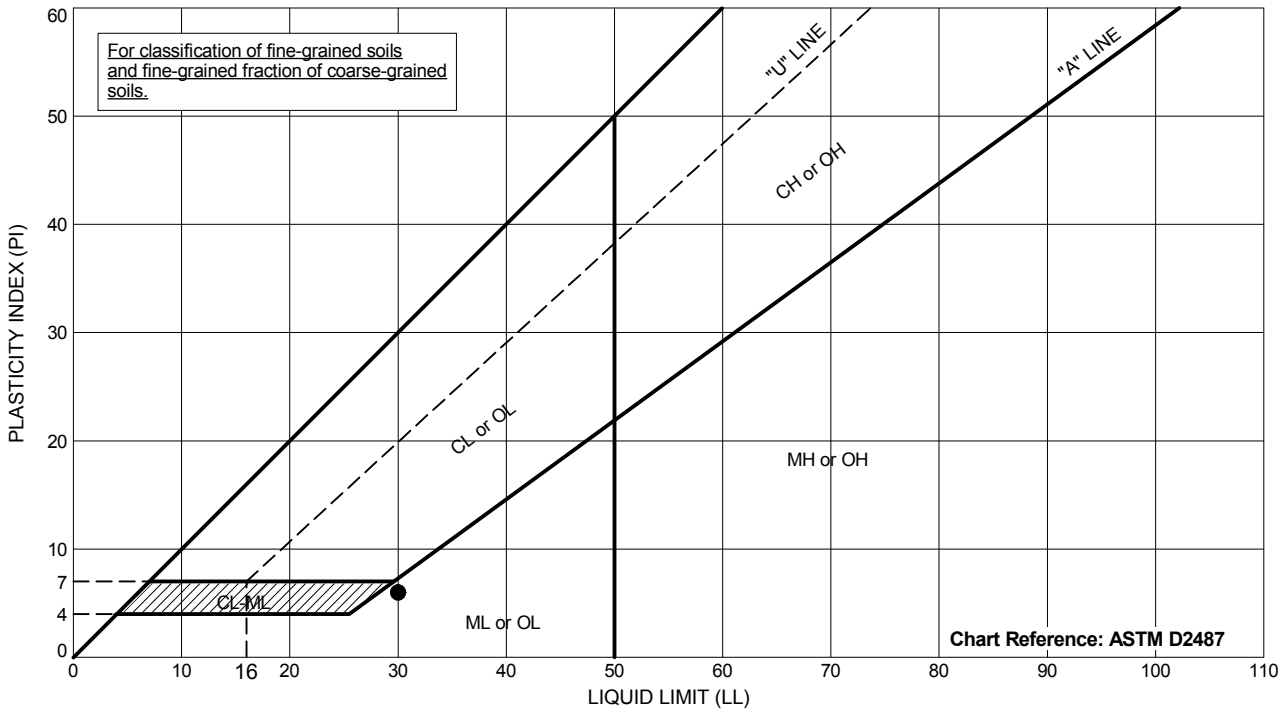
PROJECT NO.: 20143390
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

LABORATORY TEST RESULT SUMMARY

Caltrans Bridge Assessment
Bridge No. 42-0216
Fresno, California

TABLE
A-1

PLOTTED: 09/15/2015 03:37 PM BY: sjlinton



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	RC-15-002	1 - 2.5	SILT (ML)	95	30	24	6

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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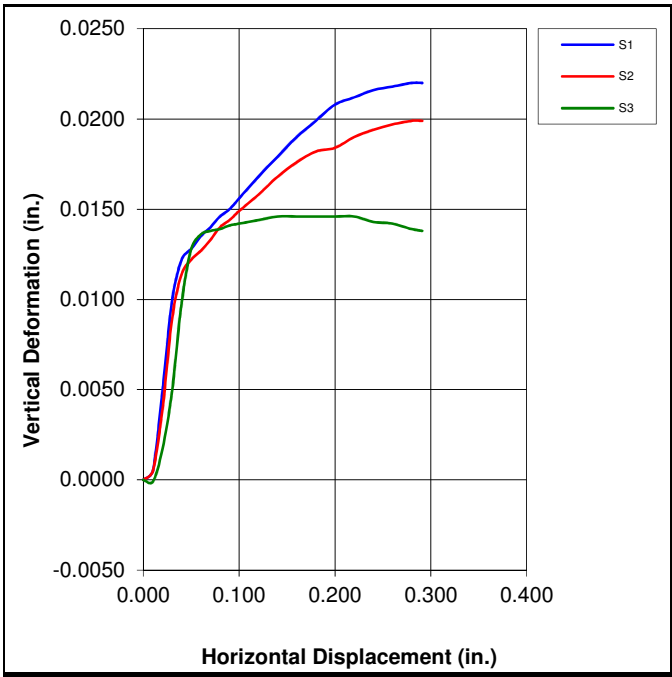
PROJECT NO.: 20143390
DRAWN BY: MO
CHECKED BY:
DATE:
REVISED: -

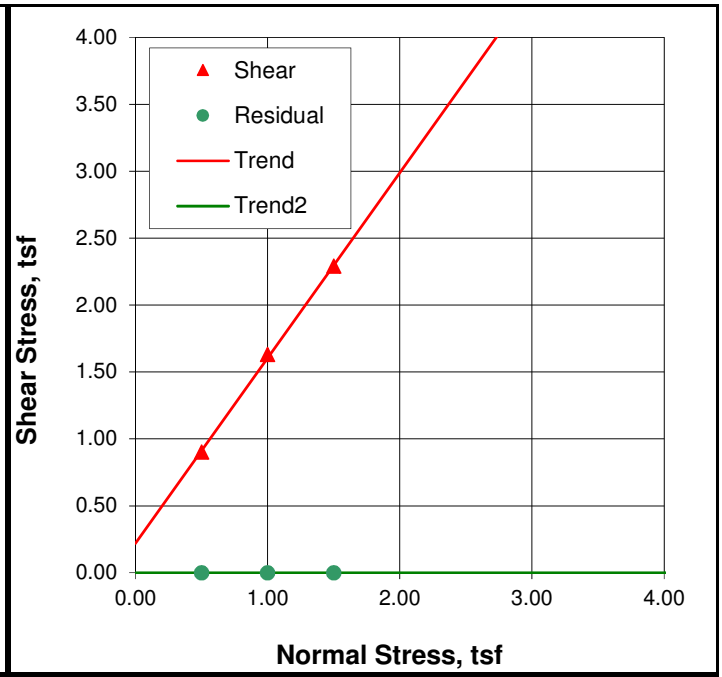
ATTERBERG LIMITS

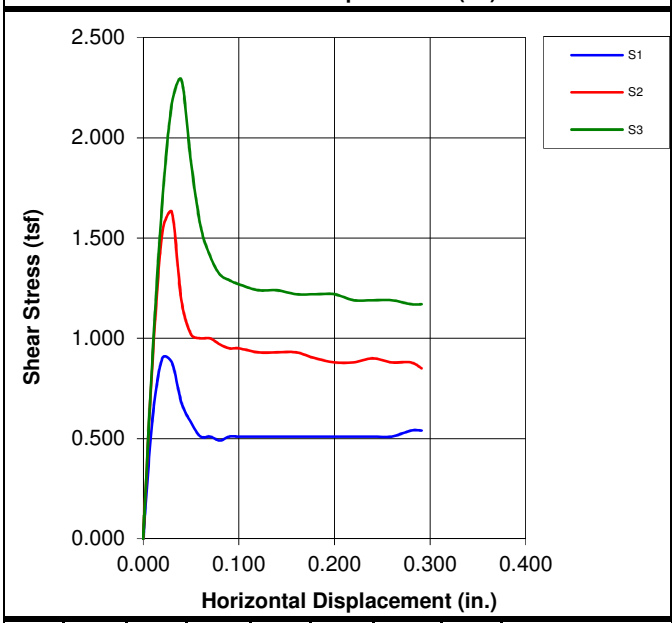
Caltrans Bridge Assessment
Bridge No. 42-0216
Fresno, California

PLATE
A-2

gINT FILE: PROJECTWISE: 42-0216.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_ATTERBERG (ASTM)]







Specimen Number		1	2	3	4
Initial	Water Content, %	8.2	8.1	8.4	
	Dry Density, pcf	117.7	119.4	119.4	
	Void Ratio	0.405	0.384	0.385	
	Saturation, %	53.6	55.6	57.5	
	Diameter, in	1.94	1.94	1.94	
	Height, in	1.00	1.00	1.00	
At Test	Water Content, %	13.2	12.2	12.0	
	Dry Density, pcf	118.9	120.8	120.6	
	Void Ratio	0.384	0.357	0.357	
	Saturation, %	91.1	91.0	88.6	
	Diameter, in	1.94	1.94	1.94	
	Height, in	0.99	0.98	0.98	
Maximum Shear Stress, tsf		0.90	1.63	2.29	
Residual Shear Stress, tsf		na	na	na	
Hoizontal Displacment, in.		0.020	0.030	0.040	
Normal Stress, tsf		0.50	1.00	1.50	
Strain Rate, in./min.		0.010	0.010	0.010	

LL:	nm	PL:	nm	PI:	nm	G_S:	2.65	Assumed

	c, tsf	ϕ, deg.	Tan ϕ
Failure	0.2	54.2	1.39
Residual	na	na	na

Test Conditions: Undisturbed / Inundated

Specimen 1: Silty Sand

Specimen 2: Silty Sand

Specimen 3: Silty Sand

Boring:	RC-15-001
Sample:	S10
Depth, ft:	25-25.5
Test Date:	7/13/2015 - 7/16/2015

Remarks: nm = not measured, na = not applicable

The determination of strength envelopes and the development of relationships to aid in interpreting and evaluating test results are beyond the scope of this test method. The user of this report retains the sole responsibility to evaluate and approve any interpreted values from the testing.

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3077 Fite Circle, Sacramento, CA 95827

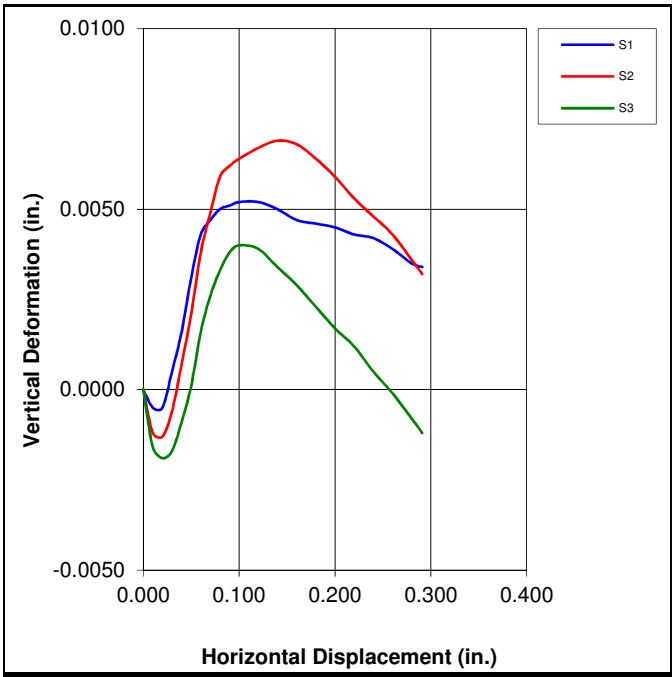
PROJECT NO.:	20143390
ENTRY BY:	S. Rader
CHECKED BY:	C. Pollack
DATE:	7/23/2015

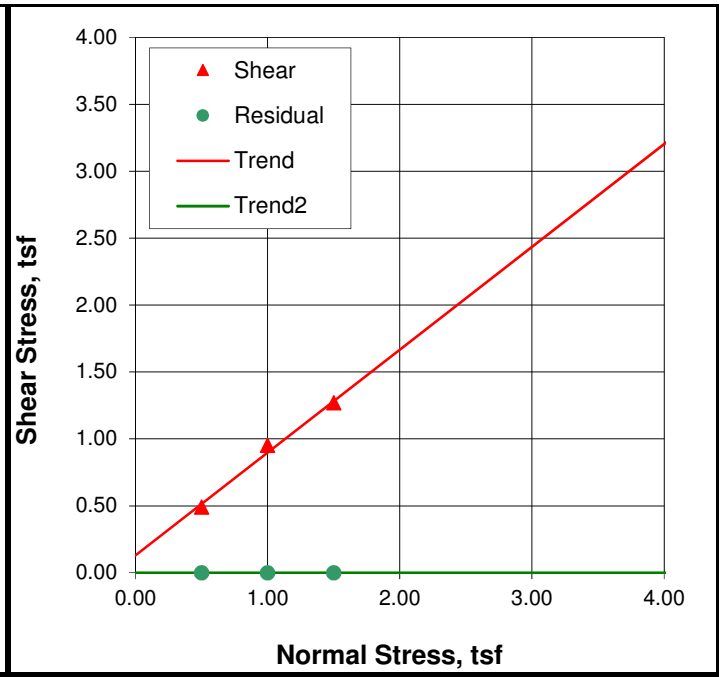
DIRECT SHEAR TEST ASTM D3080

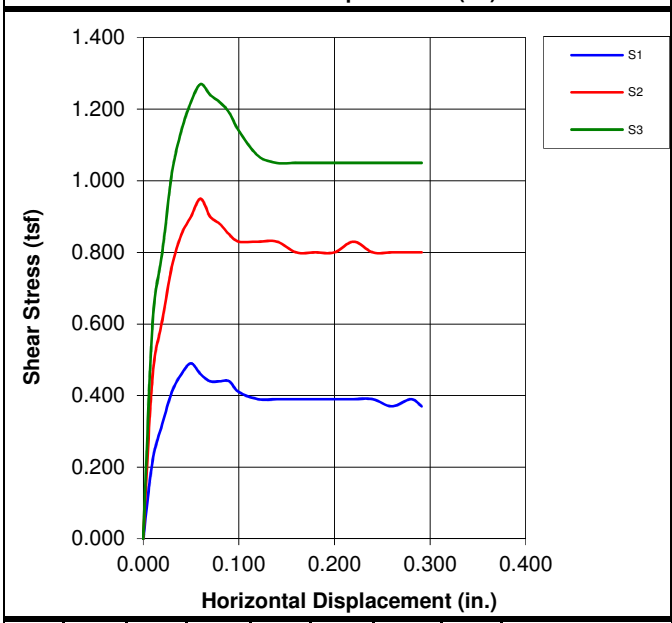
Caltrans TO83474 FRs for Five Bridges
SR 41/SR 99 Connector Separation
Bridge (Bridge No. 42-0216F)
Fresno, California

FIGURE

A-3







	Specimen Number	1	2	3	4
Initial	Water Content, %	25.5	26.8	25.5	
	Dry Density, pcf	90.7	88.2	91.9	
	Void Ratio	0.822	0.875	0.800	
	Saturation, %	82.3	81.2	84.3	
	Diameter, in	1.94	1.94	1.94	
	Height, in	1.00	1.00	1.00	
At Test	Water Content, %	27.6	29.1	26.3	
	Dry Density, pcf	91.2	89.1	93.5	
	Void Ratio	0.807	0.849	0.766	
	Saturation, %	90.7	90.8	90.9	
	Diameter, in	1.94	1.94	1.94	
	Height, in	0.99	0.99	0.98	
	Maximum Shear Stress, tsf	0.49	0.95	1.27	
	Residual Shear Stress, tsf	na	na	na	
	Hoizontal Displacment, in.	0.050	0.060	0.060	
	Normal Stress, tsf	0.50	1.00	1.50	
	Strain Rate, in./min.	0.010	0.010	0.010	

LL:	nm	PL:	nm	PI:	nm	G_S:	2.65	Assumed

	c, tsf	ϕ, deg.	Tan ϕ
Failure	0.1	37.5	0.77
Residual	na	na	na

Test Conditions: Undisturbed / Inundated

Specimen 1: Silty Sand

Specimen 2: Silty Sand

Specimen 3: Silty Sand

Boring:	RC-15-002
Sample:	04M
Depth, ft:	11-11.5
Test Date:	7/16/2015 - 7/18/2015

Remarks: nm = not measured, na = not applicable

The determination of strength envelopes and the development of relationships to aid in interpreting and evaluating test results are beyond the scope of this test method. The user of this report retains the sole responsibility to evaluate and approve any interpreted values from the testing.

KLEINFELDER
Bright People. Right Solutions.
3077 Fite Circle, Sacramento, CA 95827

PROJECT NO.:	20143390
ENTRY BY:	S. Rader
CHECKED BY:	C. Pollack
DATE:	7/23/2015

DIRECT SHEAR TEST ASTM D3080

Caltrans TO83474 FRs for Five Bridges
SR 41/SR 99 Connector Separation
Bridge (Bridge No. 42-0216F)
Fresno, California

FIGURE

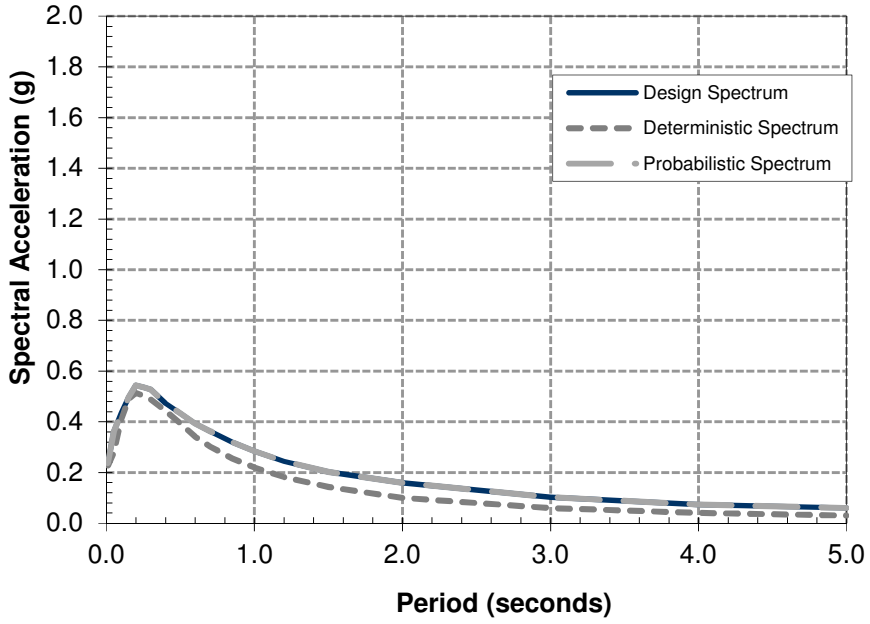
A-4

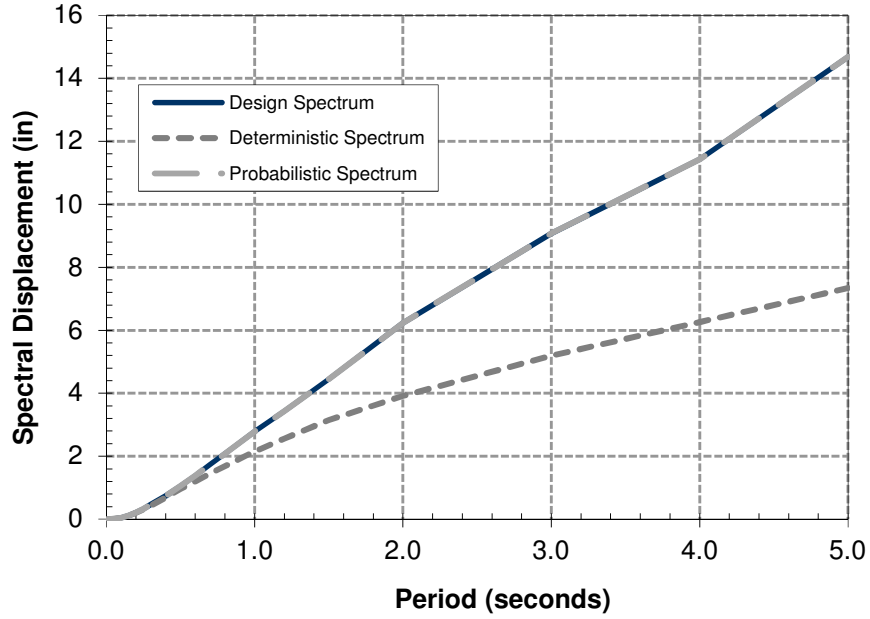
APPENDIX B

SITE DATA

Latitude:	36.7183	Shear Wave Velocity	297 m/s
Longitude:	-119.7853	Depth to Vs = 1.0 km/s:	N/A
		Depth to Vs = 2.5 km/s:	N/A

Period (s)	SA (g)	SD (in)
	0.237	0.00
0.05	0.362	0.01
0.1	0.435	0.04
0.15	0.496	0.11
0.2	0.544	0.21
0.25	0.535	0.33
0.3	0.527	0.46
0.4	0.472	0.74
0.5	0.433	1.06
0.6	0.393	1.38
0.7	0.362	1.74
0.85	0.319	2.26
1	0.284	2.78
1.2	0.244	3.44
1.5	0.202	4.45
2	0.159	6.22
3	0.103	9.07
4	0.073	11.43
5	0.060	14.68





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PROJECT NO	20143390
DRAWN:	8/26/15
DRAWN BY:	N. Popenoe
CHECKED BY:	NLD
FILE NAME:	

CALTRANS ARS CURVES

SR 41/SR 99 CONNECTOR SEPARATION
BRIDGE (BRIDGE NO. 42-0216F)
FRESNO, CALIFORNIA

PLATE

B-1

Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ **EA:** _0k800___ **EFIS**__0612000110_____ **Project Name:** Seismic Retrofit SR41-99 Connector Separation **Structure Design:** Sara Yip_ **Phone:** _(916) 227-8778__ **e-mail:**_____	__ PSR/PDS (Review No.__ __ APS/PSR (Review No.__) _ APS/PR (Review No.__) __ Type Selection __ 65% PS&E Unchecked Details __ PS&E (Review No.__) __ Construction __X Other:__FR_REVIEW NO 1__	**Reviewer Name:** _Javad Massoomi/John Huang_ _____ **Functional Unit:** _METS/GS **Cost Center:** _59-3657 **Phone Number:**227-1037 _**e-mail:** _____ **Date of Review:** _9/10/15_ **Structure Name*:** SR41-99 Connector Separation, 42-0216F___ (*Use if necessary to when comment sheets are by individual structure)

Consultant Information

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
Neva Popenoe	Kleinfelder	559-486-0750	npopenoe@kleinfelder.com	9/15/15

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR	Ii of iv	Please add a geologist's signature	The geologist responsible for the review of the geology section has been included on the signature page.	
2	FR	7, section 3.4	Please add design groundwater table	The design groundwater elevation has been added to section 3.4.	
3	FR	11, section 5.5.2	Please mention USGS 2008 deaggregation was checked	The USGS 2008 deaggregation tool was utilized to determine the Moment Magnitude for the probabilistic governed design earthquake, as per the Caltrans SDC. A note was added to Section 5.3.	
4	FR	15	Please clarify how 900 pcf of passive pressure was derived	Passive pressures were determined by the log spiral method for cohessionless soils using NAVFAC charts. The passive pressure considers a conservative value of wall friction (δ) equal to one-half the angle of internal friction (ϕ), to allow for formed foundations. A note was added to Section 6.2.2 to clarify.	
5					
6	FR	LOTB	Please follow Caltrans Soil and Rock Logging manual for	The LOTB was prepared using the Caltrans Soil and Rock	

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)

			format, thanks	Logging manual, June 2010. Considering depth of borings and information on logs, borings were placed on separate pages, as permitted in the manual.	
7					
8					
9	Note		FR by Kleinfelder dated 08/26/15, managed through GS contract. Structure Design in house.		
10	Grade		C2 – conditional approval, subject to above comments addressed satisfactorily		
11					
12					
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Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ EA: _0k800___ **EFIS__**0612000110_____ **Project Name:** Seismic Retrofit SR41-99 Connector Separation **Structure Design:** Sara Yip_ **Phone: _**(916) 227-8778__ **e-mail:_____**	**__ PSR/PDS (Review No.___** **__ APS/PSR (Review No.___)** **_ APS/PR (Review No.___)** **__ Type Selection** **__ 65% PS&E Unchecked Details** **__ PS&E (Review No.___)** **__ Construction** **__X Other:__FR_REVIEW NO 2__**	**Reviewer Name: _Javad Massoomi/John Huang_ _____** **Functional Unit: _METS/GS** **Cost Center: _59-3657** **Phone Number:227-1037 _e-mail: _____** **Date of Review: _10/5/15_** **Structure Name*:** SR41-99 Connector Separation, 42-0216F___ (*Use if necessary to when comment sheets are by individual structure)

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR		No more comments		
2	FR				
3	FR				
4	FR				
5					
6	FR				
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8					
9	Note		FR by Kleinfelder dated 09/15/15, managed through GS contract. Structure Design in house.		
10	Grade		C1 – approved		
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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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_ _____ Functional Unit:_____ Br No*._____ *=if applicable

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September 15, 2015
File No.: 20143390.074A

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

Attn: Mr. John Huang

SUBJECT:

Foundation Report
State Route 33 Bridge over CCID Main Canal
Bridge No. 42-0134
Firebaugh, Fresno County, California

Dear Mr. Huang:

The attached report presents the results of the geotechnical study for the State Route 33 Bridge over CCID Main Canal project located south of Firebaugh, in Fresno County, California. This report describes our study and provides conclusions and recommendations for use in seismic rehabilitation evaluation.

We appreciate the opportunity to provide geotechnical engineering services to Caltrans and other project designers. We trust this information meets your current needs. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully Submitted,
KLEINFELDER, INC.

Neva M. Popenoe, PE, GE
Project Engineer

Nathan L. Dahlen, PE
Senior Project Manager

NMP:NLD:sj

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FOUNDATION REPORT
SR 33 BRIDGE OVER CCID MAIN CANAL
BRIDGE NO. 42-0134
FRESNO COUNTY, CALIFORNIA

A report prepared for:

STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

September 15, 2015
File No.: 20143390.074A

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Prepared For:
STATE OF CALIFORNIA
Department of Transportation
Geotechnical Design North
Division of Engineering Services

FOUNDATION REPORT
STATE ROUTE 33 BRIDGE OVER CCID MAIN CANAL
BRIDGE NO. 42-0134
FRESNO COUNTY, CALIFORNIA

Kleinfelder Job No.: 20143390.074A

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September 15, 2015

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1. INTRODUCTION

1.1. GENERAL

This report presents the results of the geotechnical investigation for the proposed seismic retrofit evaluation of the State Route 33 Bridge over CCID Main Canal (No. 42-0134), located south of Firebaugh in Fresno County, California. The scope of services consisted of a field exploration program, laboratory testing, engineering analysis, and preparation of this written report.

1.2. SCOPE OF SERVICES

The purpose of the Foundation Report is to provide geotechnical recommendations and opinions to aid in project design. The report provides the following:

- A description of the proposed project;
- A summary of the field exploration and laboratory testing programs;
- Comments on the regional geology and site engineering seismology, including the recommended peak ground acceleration and Caltrans Seismic Design Criteria Version 1.7 ARS curve;
- Comments on liquefaction potential;
- Available factored nominal axial capacity and t-z and q-z curves for existing pile foundations under Extreme Event loading;
- Recommended LPILE parameters for use in evaluating the existing pile response to lateral loads and p-y curves for the existing piles;
- Moment and shear curves for a range of lateral deflections; and
- Log of Test Borings drawing.

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1.3. PROJECT DESCRIPTION

The proposed project will involve the seismic rehabilitation evaluation of State Route 33 Bridge over the CCID Main Canal. The original 6-span structure is supported by 15.5-inch diameter, cast-in-place Union fluted steel shell tapered piles. The span lengths (center of bearing (c.o.b.) to c.o.b.) are 21.0 feet, with a total bridge length of 126 feet. 15-inch Class 45 concrete driven piles were added to both the east and west at of each abutment and bent locations as part of a bridge widening conducted in 1983. The overall widening of the bridge totaled 12'-1". Table 1.3-1 provides the data for the existing bridge foundations, as provided in the As-Built Drawings, dated March 6, 1984; General Plan, dated June 19, 2015; and foundation data tables provided by Caltrans Structures group.

TABLE 1.3-1
EXISTING BRIDGE FOUNDATION DATA

Pile Type	Support	Location	Pile Cut-off Elevation (feet)	Tip Elevation (feet)
Cast-in-Place Union Fluted Steel Shell1	Bent 2	36+62	148	107
	Bent 3	36+83	145	103
	Bent 4	37+04	143	103
	Bent 5	37+25	138	103
	Bent 6	37+46	145	108
Class 45[2]	Bent 2	36+62	148	107
	Bent 3	36+83	145	103
	Bent 4	37+04	143	103
	Bent 5	37+25	138	103
	Bent 6	37+46	145	108

Notes: 1. Original supports from 1939 design
2. Supports from 1983 widening

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1.4. POLICY EXCEPTIONS

No known exceptions to Caltrans policy were made in the geotechnical evaluation for the foundations for this project.

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2. FIELD EXPLORATION AND LABORATORY TESTING

2.1. FIELD EXPLORATION AND TESTING

The field exploration for State Route 33 Bridge over CCID Main Canal rehabilitation consisted of 2 test borings. Exploration was performed on May 26 and 27, 2015. The test borings were drilled with a Christensen, truck-mounted drill rig using punch core drilling techniques. The two abutment borings were drilled to a depth of 151.5 feet below ground surface. The approximate location of the test borings are shown on the Log of Test Borings drawing in Figures 1 through 3 of this report.

The earth materials encountered in the test borings were visually classified in the field and a continuous log was recorded. Along with the continuous core sampling, in-place samples of soil units were collected from the test boring at selected depths by pushing a 2-inch I.D. Shelby tube into the undisturbed soil with a 140-pound automatic safety hammer free falling a distance of 30-inches. In addition, an ASTM D1586 standard penetrometer without liners (barrel I.D. of 1.4 inches) was driven 18-inches in the same manner. This latter sampling procedure generally conformed to the ASTM D1586 test procedure. Resistance to sampler penetration over the last 12-inches is noted on the Log of Test Borings as the "Penetration Index". The penetration indices listed on the Log of Test Borings have not been corrected for the effects of overburden pressure, sampler size, rod length, or hammer efficiency.

Penetration rates determined in general accordance with ASTM D1586 were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils. Hammer test measurements were obtained for the drill rig and hammer from Caltrans Drilling Services. The report was prepared June 2015. Hammer energy transfer measurements for each specific boring are noted on the Log of Test Borings drawing in Figures 2 through 3 of this report.

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2.2. LABORATORY TESTS

Laboratory tests were performed on selected samples to evaluate certain characteristics and engineering properties. The laboratory testing program was designed with emphasis on the evaluation of geotechnical properties of foundation materials as they pertain to the project. The laboratory testing program included performing the following tests:

- Grain Size Distribution (ASTM D422, without hydrometer)
- Material in Soils Finer than No. 200 (75-µm) Sieve (ASTM D1140)
- Atterberg Limits (ASTM D4318)
- Unconfined Compressive Strength (ASTM D2166)

Geotechnical design parameters were based on project specific laboratory data and interpretation of the area geology. Consideration was also given to correlations with sample penetration rates. Table 2.2-1 provides a summary of geotechnical design parameters and generalized soil profile used.

TABLE 2.2-1
GEOTECHNICAL DESIGN PARAMETERS

Elevation (feet)	Material	γ_t (pcf)[1]	γ_b (pcf)[2]	Φ (degrees)	c (psf)
157.5 – 142	CH	121	58.6	-	500
136– 130	SC	125	62.6	30	-
132 – 117	CH	121	58.6	-	500
117 – 112	SM	125	62.6	30	-
Below 112	SP	125	62.6	38	-

Notes: 1. Total unit weight
2. Buoyant unit weight

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3. SITE CONDITIONS

3.1 SURFACE CONDITIONS AND TOPOGRAPHY

The existing State Route 33 Bridge over CCID Main Canal is a 2-lane paved road approximately at original grade. At the time of the investigation, water was present in the CCID Main Canal at an approximate elevation of 145 feet and the banks supported some aquatic vegetation near the water line. The general topography along the State Route 33 alignment is relatively flat on either side of the bridge, with thin approach fills (less than about 2 feet).

3.2 REGIONAL GEOLOGY

The project site lies in the western portion of the San Joaquin Valley in the Great Valley geomorphic province in California. This province was formed by the filling of a large structural trough or downwarp in the underlying bedrock. The trough is situated between the Sierra Nevada Range on the east and south and the Coast Range on the west. Both of these mountain ranges were initially formed by uplifts that occurred during the Jurassic and Cretaceous periods of geologic time (greater than 65 million years ago). Renewed uplift began in the Sierra Nevada during the Tertiary time, and is continuing today. The trough that underlies the valley is asymmetrical, with the greatest depths of sediments near the western margin. The sediments that fill the trough originated as erosion material from the adjacent mountains and foothills.

3.3 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at the specific boring locations, refer to the Log of Test Borings presented in Figures 2 to 3. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

The upper soil material consisted primarily of fine grained distal alluvial fan sediment of the Panoche fan, interfingered with recent basin deposits. These materials generally consist of lean to fat clay with thin layers of interspersed clayey and silty sand, and extend to a depth of

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approximately 37 to 50 feet. These deposits are underlain by medium dense to very dense poorly graded sand and silty sand to depth explored, 151.5 feet below ground surface, and likely represent older (Pleistocene age) mid-fan deposits of the Modesto formation.

3.4 GROUNDWATER CONDITIONS

Groundwater was encountered at elevations of approximately 141 feet or about 10 feet below existing grade during drilling at boring RC-15-001. Groundwater at the site is affected by flow in the CCID Main Canal. A design groundwater elevation of 141 was utilized for design. Groundwater conditions at the site could change at some time in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time the test borings were made

3.5 CHANNEL SCOUR/DEGRADATION

Review of the Caltrans Hydraulics report for this structure, dated August 17, 2015, indicated no long-term or contraction scour. Local pier scour is anticipated to be between 3 and 4.3 feet at the bents, as indicated in Table 3.5-1.

TABLE 3.5-1
Local Pier Scour

	Abut 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Abut 7
Scour Depth (ft.)	0	3.81	4.29	3.91	3.61	2.97	0
Ground Elevation (ft.)	157.06	143.31	142.27	144.06	145.28	147.41	156.5
Scour Elevation (ft.)	157.06	139.5	137.98	140.15	141.67	144.44	156.5

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4. CORROSION EVALUATION

Soil samples from borings RC-15-001 (depth of 6.5 to 10 feet) and RC-15-002 (depth of 6.5 to 10 feet) were tested to evaluate the soluble sulfate content, soluble chloride content, pH and minimum resistivity. Specific test results are presented in Table 4.1-1.

TABLE 4.1-1
CORROSION RELATED TESTING

Boring No.	Depth (ft)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	pH	Minimum Resistivity (ohm-cm)
RC-15-001	6.5 - 10	3889	702	7.4	324
RC-15-002	6.5 - 10	3116	139	7.1	527

Laboratory tests indicate the soluble chlorides are outside the Caltrans threshold limits. However, the soluble sulfates are relatively high and minimum resistivity is relatively low, and within the Caltrans threshold limits of a corrosive environment with respect to foundations. Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. Consequently, a qualified corrosion engineer should be consulted if the designer desires more specific recommendations and material types and/or mitigation, particularly with regard to steel piles.

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5. SEISMIC RECOMMENDATIONS

5.1 LOCAL FAULTING

There are no known faults, which cut through the local soil at the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone, as defined by Special Publication 42 (revised 2007) published by the California Geologic Survey (CGS). Numerous faults and shear zones within the region could influence the project site.

5.2 SEISMIC DESIGN CRITERIA

Seismic design parameters were developed in accordance with the Caltrans Seismic Design Criteria Version 1.7.

The project site is located in a region with the potential for relatively moderate seismic activity. The more significant faults that could influence the project site include the Great Valley 09 (Laguna Seca) (Fault ID No. 167), the Creeping Section of the San Andreas Fault (Fault ID No. 182), and the Santa Cruz Mountains of the San Andreas Fault (Fault ID No. 158). According to the Caltrans fault database, the Great Valley 09 (Laguna Seca) is a reverse fault with a dip angle of 15 degrees towards the west and assigned Maximum Magnitude (M_{Max}) of 6.8, the Creeping Section of the San Andreas Fault is strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 7.9, and the Santa Cruz Mountains of the San Andreas Fault is a strike slip fault with a dip angle of 90 degrees and assigned Maximum Magnitude (M_{Max}) of 8.0. The characteristics of these three faults are summarized in Table 5.2-1.

Based on the boring data, the site can be classified as Soil Profile Type D. A V_{s30} of 221 m/s was used for the evaluation. The site is not located within a California deep soil basin region, as defined by Caltrans, so $Z_{1.0}$ and $Z_{2.5}$ were considered not applicable. Site characteristics and governing deterministic faults are summarized in Table 5.2-1.

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TABLE 5.2-1
SITE CHARACTERISTICS AND
GOVERNING DETERMINISTIC FAULTS PARAMETERS

Site Coordinates	Lat = 36.844 deg, Long = -120.450 deg
Shear Wave Velocity	221 m/s
Depth to V_s=1.0 km/s, $Z_{1.0}$	N/A
Depth to V_s=2.5 km/s, $Z_{2.5}$	N/A
Fault Name and ID Number	Great Valley 09 (Laguna Seca), No. 167
Maximum Magnitude (M_{Max})	6.8
Fault Type	Reverse
Fault Dip	15 degrees
Dip Direction	West
Bottom of Rupture Plane	9.60 km
Top of Rupture Plane (Z_{tor})	7.00 km
R_{RUP}[1]	27.89km
R_{jB}[2]	27.00km
R_X[3]	24.63 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	1
Fault Name and ID Number	San Andreas fault (Creeping section), No. 182
Maximum Magnitude (M_{Max})	7.9
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	12 km
Top of Rupture Plane (Z_{tor})	0 km
R_{RUP}[1]	68.48 km
R_{jB}[2]	68.48 km
R_X[3]	68.48 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0
Fault Name and ID Number	San Andreas fault (Santa Cruz Mts), No. 158
Maximum Magnitude (M_{Max})	8.0
Fault Type	Strike Slip
Fault Dip	90 degrees
Dip Direction	Vertical
Bottom of Rupture Plane	14.80 km
Top of Rupture Plane (Z_{tor})	0 km
R_{RUP}[1]	92.33 km
R_{jB}[2]	92.33 km
R_X[3]	92.33 km
F_{norm} (1 for normal, 0 for others)	0
F_{rev} (1 for reverse, 0 for others)	0

Notes:
[1]R_{RUP} = Closest distance from the site to the fault rupture plane.
[2]R_{JB} = Joyner-Boore distance; the shortest horizontal distance to the surface projection of the rupture area.
[3]R_X = Horizontal distance from the site to the fault trace or surface projection of the top of the rupture plane.

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5.2.1 Deterministic Response Spectrum

The deterministic response spectrum was developed using ARS Online. The deterministic response spectrum from the Minimum Spectrum for California governed.

5.2.2 Probabilistic Response Spectrum

The probabilistic response spectrum was developed using ARS Online.

5.2.3 Design Response Spectrum

The upper envelope of the deterministic and probabilistic spectral values determines the design response spectrum. The probabilistic response spectra were found to govern for all periods. The recommended acceleration and displacement design response spectra are presented graphically and numerically in Appendix B.

5.2.4 References

Caltrans. Caltrans ARS Online, http://dap3.dot.ca.gov/ARS_Online

Caltrans. Geotechnical Services Manual, January 2013.

Caltrans. Seismic Design Criteria, Appendix B Design Spectrum

Caltrans. Website http://dap3.dot.ca.gov/shake_stable/v2/technical.php

5.3 LIQUEFACTION POTENTIAL

In order for liquefaction of soils due to ground shaking to occur, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state,
- The soils are saturated,
- The soils are non-plastic, and

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- ❑ Ground motion is of sufficient intensity to act as a triggering mechanism.

Based on the ARS curve, the design Peak Horizontal Ground Acceleration (PHGA) is 0.44g, with a Moment Magnitude of 6.4 based on the results of online USGS deaggregation analysis. The potential for liquefaction was evaluated using Youd et. al. (2001). The majority of the upper site soil is sufficiently plastic and is not susceptible to liquefaction. However, interbedded zones of poorly graded sand and silty sand within these plastic layers are subject to liquefaction. The consequence of liquefaction at the site is relatively minor, with little to no surface manifestations of seismically induced settlement. The magnitude of the potential settlement is anticipated to be less than ½ inch.

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6. FOUNDATION RECOMMENDATIONS

6.1 GENERAL

Based on the field exploration, laboratory testing, and geotechnical analyses, the soils at the site are suitable to support the existing bridge structure. To support seismic analysis of the structure, axial and lateral capacity have been evaluated for the existing piles.

6.2 PILE FOUNDATIONS

6.2.1 Axial Capacity

Nordlund and Tomlinson methods were utilized in the analysis for the axial capacity of the 15.5-inch cast-in-place Union fluted steel shell piles and the 15-inch Class 45 driven piles. Table 6.2-1 provides the estimated nominal capacities and of the existing piles at the As-Built tip elevations. Provided in Appendix C are the t-z and q-z curves and tabular data.

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TABLE 6.2-1
EXISTING BRIDGE FOUNDATION DATA

Pile Type	Support	Pile Cut-off Elevation (feet)	Tip Elevation (feet)	Estimated Available Nominal Resistance[3] (kips)
Cast-in-Place Union Fluted Steel Shell[1]	Bent 2	148	107	90
	Bent 3	145	103	90
	Bent 4	143	103	90
	Bent 5	138	103	90
	Bent 6	145	108	90
Class 45[2]	Bent 2	148	107	90
	Bent 3	145	103	90
	Bent 4	143	103	90
	Bent 5	138	103	90
	Bent 6	145	108	90

Notes: 1. Original supports from 1939 design
2. Supports from 1983 widening
3. Estimated nominal resistance may be greater than 180 kips per pile for union fluted steel shell piles.

6.2.2 Lateral Capacity

The lateral response of pile foundations can be evaluated using LPILE Plus Version 5.0, or greater, for Windows (computer software developed by Ensoft Inc.). The geotechnical parameters summarized in Tables 6.2-2 through 6.2-7 can be used for evaluation of lateral loading of piles at bent supports.

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TABLE 6.2-2
LPILE PARAMETERS FOR BENT 2

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)[1]	ε_{50}[1]
143 - 136	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
136 - 130	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
130 - 117	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
117 - 112	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
Below 112	Sand (Reese) w/ Groundwater	0.036	38	-	0	0

Notes: 1. Enter 0 in LPILE to use default values.

TABLE 6.2-3
LPILE PARAMETERS FOR BENT 3

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)[1]	ε_{50}[1]
142 - 136	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
136 - 130	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
130 - 117	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
117 - 112	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
Below 112	Sand (Reese) w/ Groundwater	0.036	38	-	0	0

Notes: 1. Enter 0 in LPILE to use default values.

TABLE 6.2-4
LPILE PARAMETERS FOR BENT 4

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)[1]	ε_{50}[1]
144 - 136	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
136 - 130	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
130 - 117	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
117 - 112	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
Below 112	Sand (Reese) w/ Groundwater	0.036	38	-	0	0

Notes: 1. Enter 0 in LPILE to use default values.

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TABLE 6.2-5
LPILE PARAMETERS FOR BENT 5

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)[1]	ε_{50}[1]
145 - 136	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
136 - 130	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
130 - 117	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
117 - 112	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
Below 112	Sand (Reese) w/ Groundwater	0.036	38	-	0	0

Notes: 1. Enter 0 in LPILE to use default values.

TABLE 6.2-6
LPILE PARAMETERS FOR BENT 6

Elevation (feet)	Recommended P-Y Curve	γ (pci)	ϕ (degree)	c (psi)	k (pci)[1]	ε_{50}[1]
147 - 136	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
136 - 130	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
130 - 117	Soft Clay w/ Groundwater	0.034	-	3.5	0	0
117 - 112	Sand (Reese) w/ Groundwater	0.036	30	-	0	0
Below 112	Sand (Reese) w/ Groundwater	0.036	38	-	0	0

Notes: 1. Enter 0 in LPILE to use default values.

Figures 6.2-1 to 6.2-4 present the anticipated deflection of the pile head in response to a lateral load applied at the cut-off elevation for the 15.5-inch cast-in-place Union fluted steel shell piles and the 15-inch Class 45 driven piles, respectively. Data are presented for both free and fixed head conditions.

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FIGURE 6.2-1
LATERAL LOAD DEFLECTION CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 2 AND 6

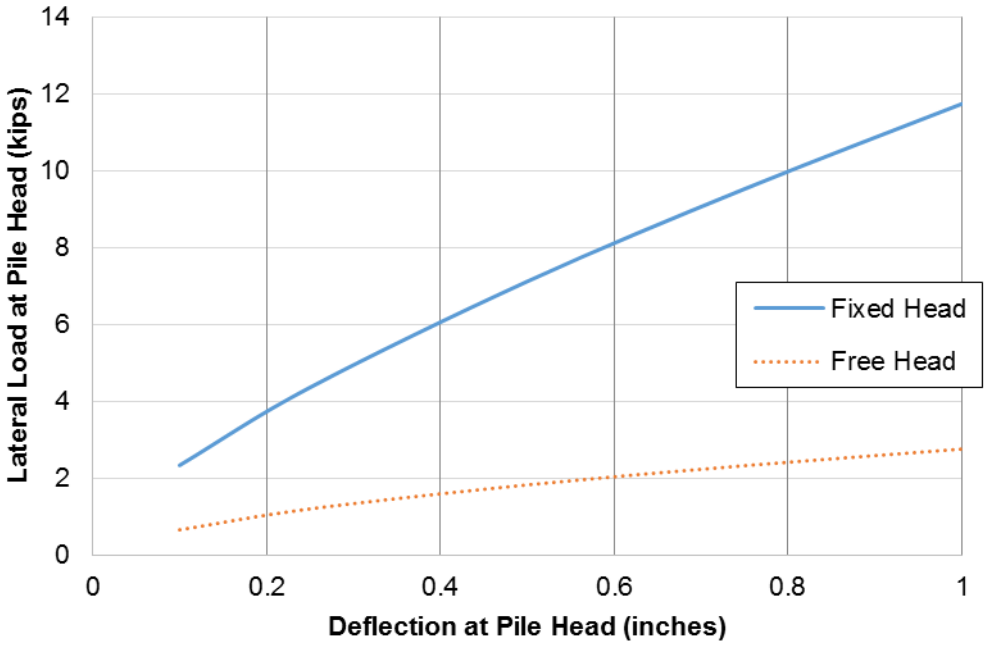

FIGURE 6.2-2
LATERAL LOAD DEFLECTION CURVES
ORIGINAL 15.5" FLUTED STEEL SHELL PILES
BENTS 3-5

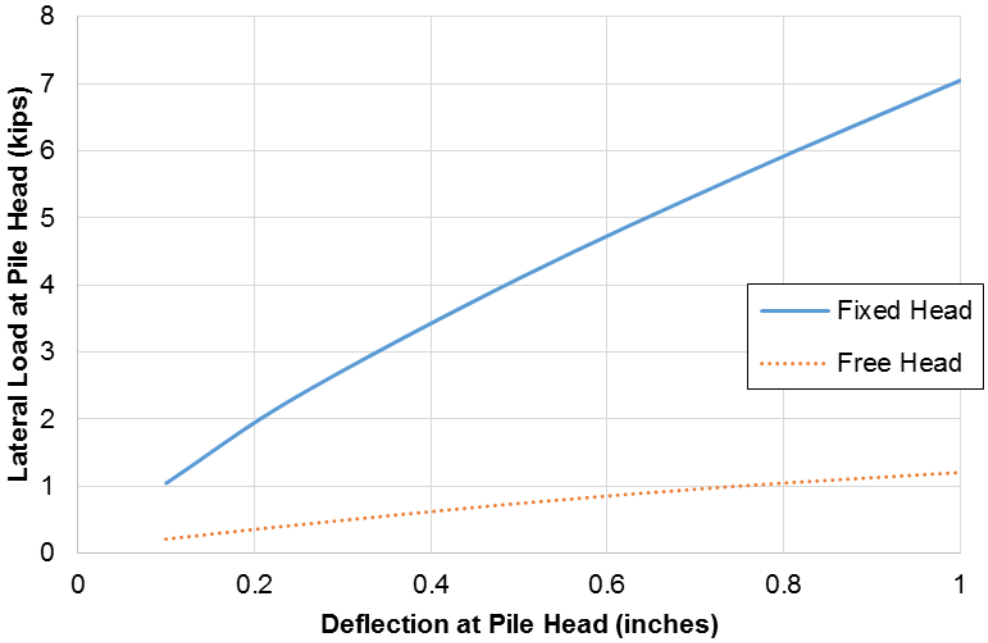

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FIGURE 6.2-3
LATERAL LOAD DEFLECTION CURVES
WIDEN 15" CLASS 45 PILES
BENTS 2 AND 6

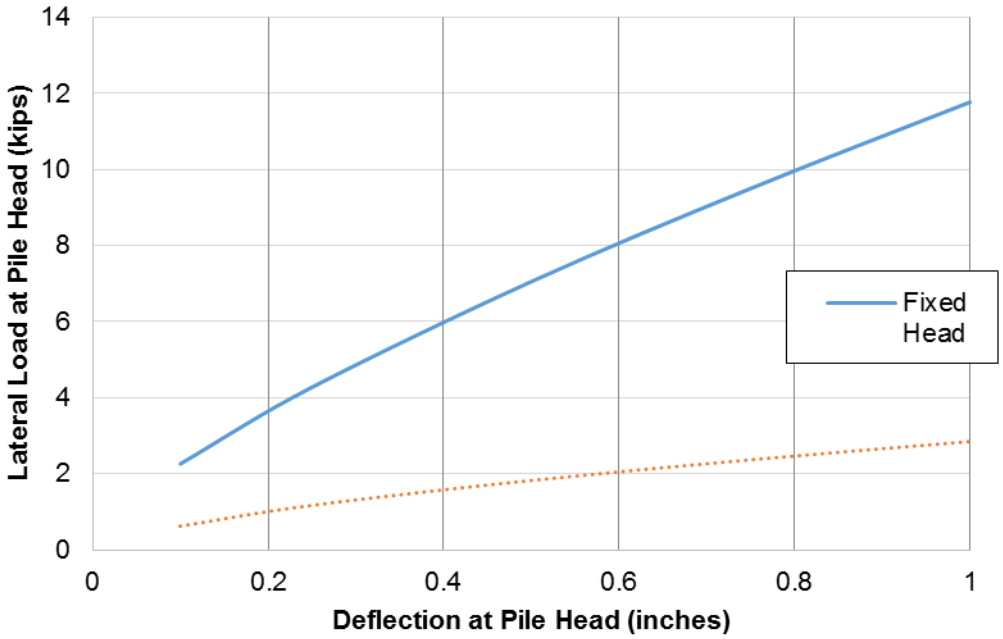
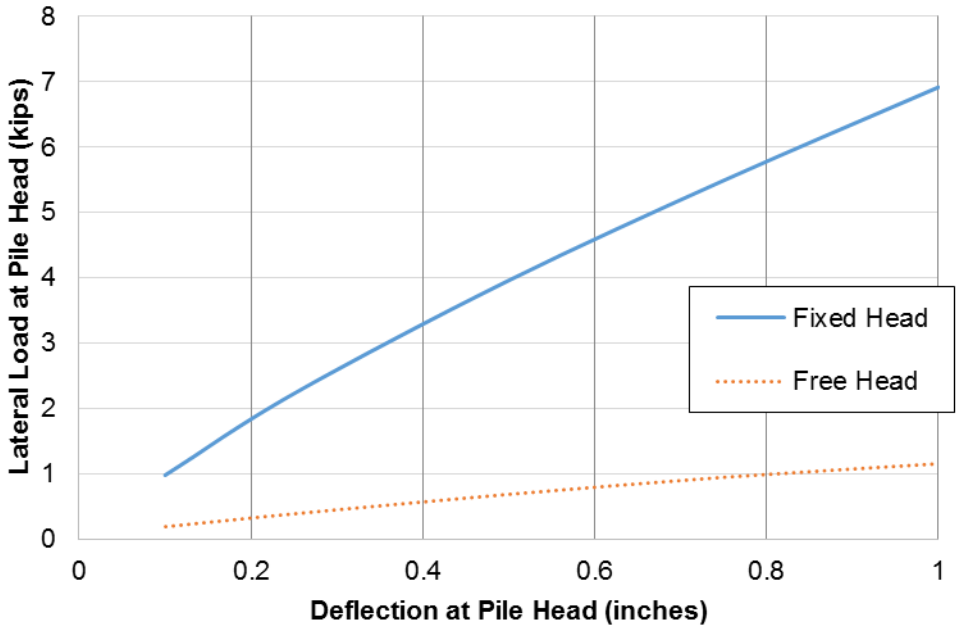


FIGURE 6.2-4
LATERAL LOAD DEFLECTION CURVES
WIDEN 15" CLASS 45 PILES
BENTS 3-5



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When considering the lateral capacity of a pile group, it will be necessary to reduce the single pile capacity of trailing piles. The reduction in capacity due to the effects of shaft interaction will be dependent upon the center-to-center (CTC) pile spacing. It is understood Ensoft GROUP program will be utilized to determine lateral capacity of pile groups, which incorporates pile spacing effects.

6.2.3 Lateral Deflection Data

Estimated p-y (lateral) curves for the existing piles are provided in Appendix C.

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7. CLOSURE

The conclusions and recommendations in this report are for the seismic rehabilitation evaluation of the State Route 33 Bridge over CCID Main Canal, located south of Firebaugh in Fresno County, California, as described in the text of this report. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. The field exploration program and this report were based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the recommendations given herein.

This report is intended for use by Caltrans and their subconsultants within a reasonable time from its issuance. Noncompliance with the recommendations of the report or misuse of the report will release Kleinfelder from any liability.

The scope of the geotechnical services did not include an environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands.

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FIGURES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
06	FRE	33	VARIOUS		

REGISTERED CIVIL ENGINEER 9/15/15 DATE

9/22/15
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

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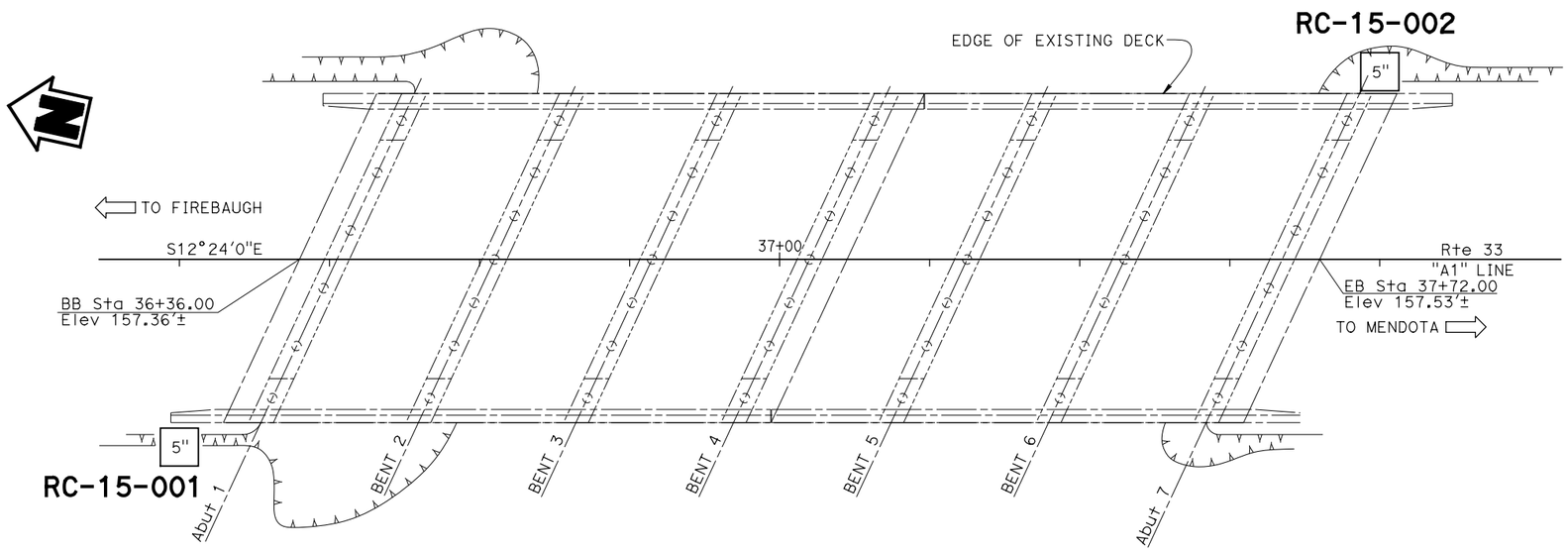


PLAN
1" = 10'

Notes:

1. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (ID) of 1.4" and an outside diameter (OD) of 2".
2. 3.0" samples were taken using a Shelby tube sampler with an inside diameter (ID) of 3.0" and pushed.
3. 2.0" samples were taken using a CAL split-barrel sampler with an inside diameter (ID) of 2.0" and an outside diameter (OD) of 2.5"
4. An automatic hammer (140 lb) with a 30" drop was used to advance the sampler.
5. Blowcounts noted for boring are field blowcounts and have not been corrected.
6. Blowcounts 50/5 means 50 blows per 5" penetration.
7. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2010)

BENCHMARKS

STATION	OFFSET	N	E	ELEV	DESCRIPTION
35+81.19	77.01' Lt	2,193,822.88	6,137,391.65	148.65	PT-DNK0332. Found 1" Iron pipe w/ red CT plug and tack
38+27.27	34.08' Rt	2,193,603.76	6,137,549.39	152.13	PT-DNK0335. Found 1" Iron pipe w/ red CT plug and tack

SURVEY CONTROL
1. Coordinates bearing and distances are based on the California State Plane Coordinate system of NAD 83 (1986). Elevations are based on NGVD29 for Plan. Elevations are based on NAVD88 for borings.

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

M.O. & J.W.
FIELD INVESTIGATION BY:
DATE: 5/28/15 - 6/4/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 42-0134
POST MILES 69.1

ROUTE 33 MAIN CANAL BRIDGE SEISMIC RETROFIT
LOG OF TEST BORINGS 1 OF 3

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

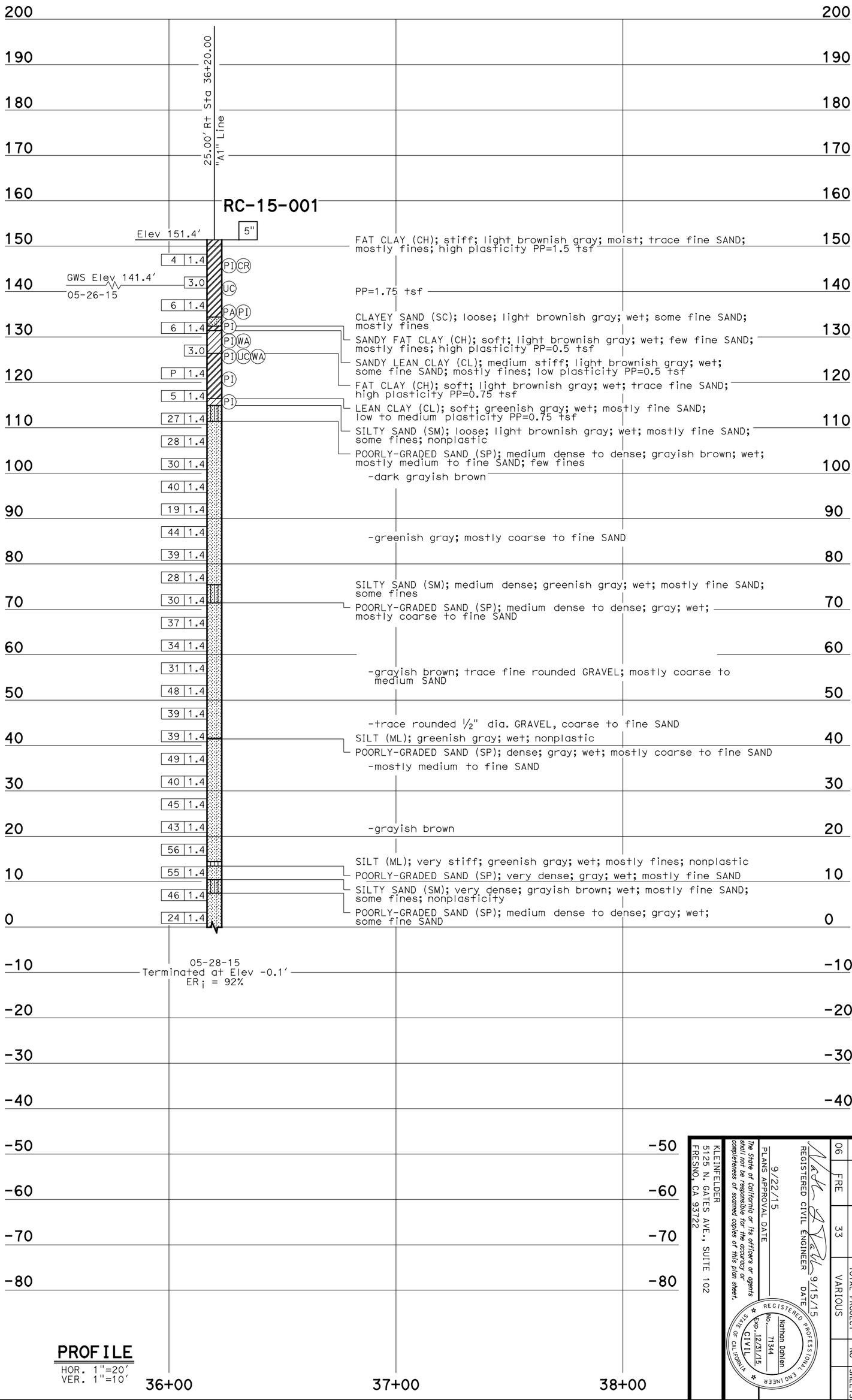
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 9/23/15
SHEET X OF X

FILE => 42-0134-z-ltb01.dgn

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 3

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).



J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen
M. Owens
FIELD INVESTIGATION BY:
DATE: 5/28/15

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 42-0134
POST MILES 69.1

ROUTE 33 MAIN CANAL BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 2 OF 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
FILE => 42-0134-Z-TTD02.dgn
CONTRACT NO.: 06-0K8001

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 9/22/15

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DATE

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REGISTERED PROFESSIONAL ENGINEER
Nathan Dahlen
No. 71344
Exp. 12/31/15
CIVIL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL No SHEETS
06	FRE	33	VARIOUS	

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FOR PLAN VIEW AND ADDITIONAL NOTES, SEE "LOG OF TEST BORINGS" SHEET 1 OF 3

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

25.00' Lt Sta 37+80.00 "A1" Line

RC-15-002

Elev 152.6'

5"

GWS Elev 142.6'
05-26-15

Blows	Dry Density (pcf)	Symbols
4	1.4	PI CR
3.0		PI
3	1.4	PI
3.0		WA
		WA
5	1.4	PI WA
4	1.4	PI WA
5	1.4	WA
48	2.0	PI WA
		UC
39	1.4	
23	1.4	
29	1.4	
54	1.4	
44	1.4	
35	1.4	
35	1.4	
21	1.4	
20	1.4	
35	1.4	
32	1.4	
33	1.4	
43	1.4	
28	1.4	
40	1.4	
59	1.4	
33	1.4	
28	1.4	
37	1.4	
45	1.4	
42	1.4	
40	1.4	

06-04-15
Terminated at Elev 1.1'
ER_i = 92%

200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80

SANDY FAT CLAY (CH); dark grayish brown; moist; some fine SAND; mostly fines; high plasticity
- -dark brown
- -stiff; wet; PP=0.5 tsf
- - PP=1.5 tsf

SANDY LEAN CLAY (CL); stiff; brown; wet; some SAND; mostly fines; medium plasticity; PP=1.25 tsf

CLAYEY SAND (SC); very loose; brown; wet; mostly SAND; some fines

SANDY LEAN CLAY (CL); stiff to very stiff; brown; wet; some SAND; mostly fines

SILTY SAND (SM); brown; wet; mostly SAND; some fines

SANDY LEAN CLAY (CL); stiff to very stiff; brown; wet; some SAND; mostly fines; cemented nodules, thin layers (2-3") Clayey Sand

FAT CLAY (CH); medium stiff; brown; wet; little SAND; mostly fines; high plasticity; cemented nodules
- -some SAND

CLAYEY SAND (SC); very loose; black; wet; mostly SAND; little fines

SANDY LEAN CLAY (CL); medium stiff; dark grayish brown to greenish brown; wet; some SAND; mostly fines
- -4" lense of Silty Sand (SM)

SANDY FAT CLAY (CH); medium stiff; greenish gray; wet; some SAND; mostly fines; high plasticity

SILTY SAND (SM); greenish gray; wet; mostly medium to fine SAND; some fines

POORLY-GRADED SAND (SP); medium dense to very dense; greenish gray; wet; mostly medium to fine SAND; trace fines
- -dark gray
- -6" lense of Silty Sand (SM)
- -mostly coarse to fine SAND
- -mostly medium to fine SAND
- -2" lense of Silty Sand (SM)
- -1" lense of Lean Clay with Sand (CL)
- -1" lens of Sandy Lean Clay (CLO
- -3" lens of Silty Sand (SM)
- -medium to fine SAND
- -4" lens of Sandy Lean CLay (CL)

SILTY SAND (SM); gray; wet; mostly medium to fine SAND; little fines
- -1" lens of Sandy Lean Clay (CL)

POORLY-GRADED SAND (SP); dense; gray; wet; mostly medium to fine SAND; trace fines
- -wood, black

SILTY SAND (SM); gray; wet; mostly medium to fine SAND; little fines

POORLY-GRADED SAND (SP); dense; gray; wet; mostly coarse to fine SAND; trace fines

SILTY SAND (SM); gray; wet; mostly medium to fine SAND; little fines

POORLY-GRADED SAND (SP); dense; gray; wet; mostly medium to fine SAND; trace fines
- -6" lens of Silty Sand (SM)
- -greenish black
- -gray; no clay blebs

CLAYEY SAND (SC); light brownish gray; wet; mostly medium to fine SAND; little fines

POORLY-GRADED SAND (SP); medium dense to very dense; gray; wet; mostly medium to fine SAND; trace fines
- -3" lens of Clayey Sand (SC)
- -6" of wood
- -3" lens of Clayey Sand (SC)

LEAN CLAY (CL); medium stiff; dark greenish gray; wet; trace fine SAND; mostly fines; medium plasticity; PP=1.0 tsf

POORLY-GRADED SAND (SP); dense; gray; wet; mostly medium to fine SAND; trace fines
- -with thin (<1") clay stringers

PROFILE

HOR. 1"=20'
VER. 1"=10'

38+00 39+00

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5125 N. GATES AVE., SUITE 102
FRESNO, CA 93722

Nathan Dahlen
REGISTERED CIVIL ENGINEER
9/15/15
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Nathan Dahlen
No. 71344
Exp. 12/31/15
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STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
06	FRE	33	VARIOUS		

J. Huang
DESIGN OVERSIGHT
9/22/15
SIGN OFF DATE

DRAWN BY A. Sanchez
CHECKED BY N. Dahlen

J. Wetenkamp
FIELD INVESTIGATION BY:
DATE: 6/4/15

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

N. Dahlen
PROJECT ENGINEER

BRIDGE NO. 42-0134
POST MILES 69.1

ROUTE 33 MAIN CANAL BRIDGE SEISMIC RETROFIT

LOG OF TEST BORINGS 3 OF 3

UNIT: 3604
PROJECT NUMBER & PHASE: 0612000110
CONTRACT NO.: 06-0K8001

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 9/23/15

SHEET 1 OF X

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 03/14/12)

FILE => 42-0134-2-ltb03.dgn

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APPENDIX A

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
RC-15-001	5.0	FAT CLAY (CH)						52	19	33	
RC-15-001	10.0	FAT CLAY (CH)									**Unconfined Compressive Strength=**
											q_u: 640 psf Strain at Failure: 4.0%
RC-15-001	17.0	CLAYEY SAND (SC)					30	31	15	16	
RC-15-001	19.0	SANDY FAT CLAY (CH)						62	26	36	
RC-15-001	20.0	SANDY LEAN CLAY (CL)					68	33	19	14	
RC-15-001	25.0	FAT CLAY (CH)					99	85	25	60	**Unconfined Compressive Strength=**
											q_u: 1890 psf Strain at Failure: 7.2%
RC-15-001	30.0	FAT CLAY (CH)						63	22	41	
RC-15-001	35.0	LEAN CLAY (CL)						50	17	33	
RC-15-002	5.0	SANDY FAT CLAY (CH)						47	21	26	
RC-15-002	6.5	SANDY FAT CLAY (CH)						53	23	30	
RC-15-002	15.0	SANDY LEAN CLAY (CL)						29	16	13	
RC-15-002	16.0	CLAYEY SAND (SC)					42				
RC-15-002	19.0	SILTY SAND (SM)					22	NP	NP	NP	
RC-15-002	25.0	FAT CLAY (CH)					95	62	24	38	
RC-15-002	30.0	FAT CLAY (CH)					66	77	24	53	
RC-15-002	35.0	CLAYEY SAND (SC)					28	NP	NP	NP	
RC-15-002	38.0	SANDY FAT CLAY (CH)					83	53	18	35	
RC-15-002	40.0	SILTY SAND (SM)									**Unconfined Compressive Strength=**
											q_u: 520 psf Strain at Failure: 4.5%

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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CHECKED BY:
DATE:
REVISED: -

LABORATORY TEST RESULT SUMMARY

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE
A-1

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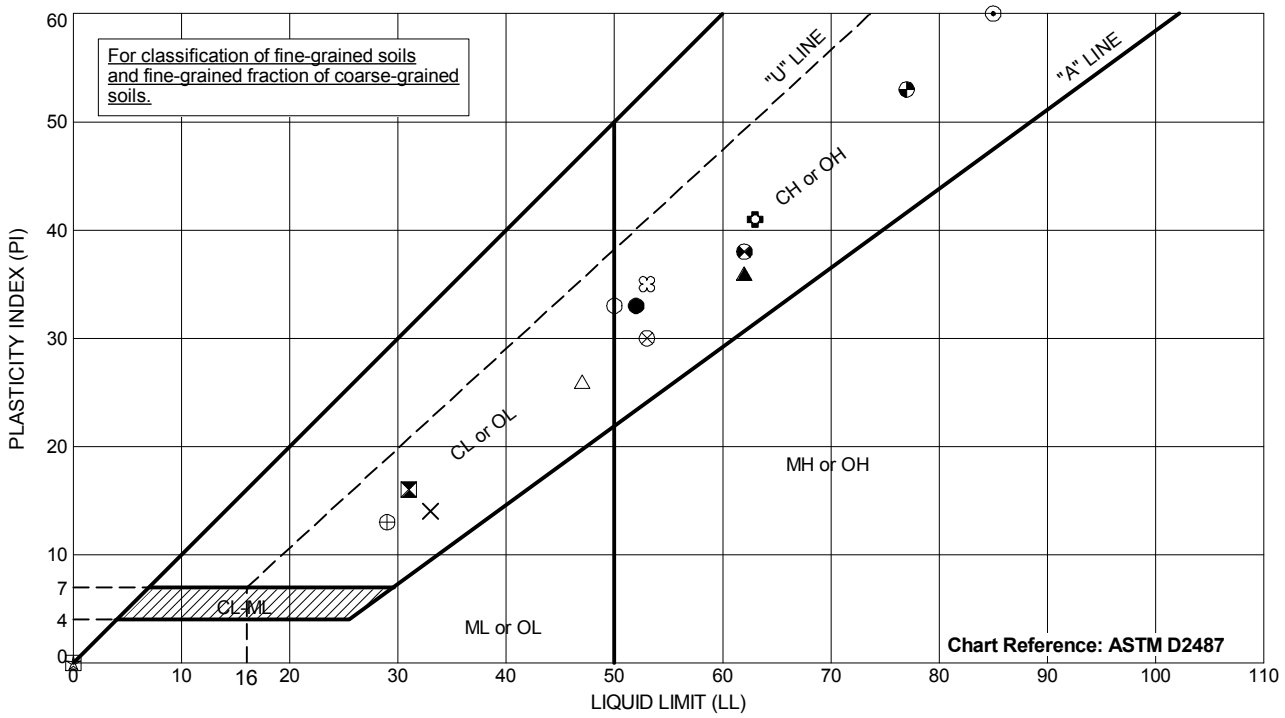

	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	RC-15-001	5	FAT CLAY (CH)	NM	52	19	33
⧗	RC-15-001	17	CLAYEY SAND (SC)	30	31	15	16
▲	RC-15-001	19	SANDY FAT CLAY (CH)	NM	62	26	36
×	RC-15-001	20	SANDY LEAN CLAY (CL)	68	33	19	14
⊙	RC-15-001	25	FAT CLAY (CH)	99	85	25	60
✿	RC-15-001	30	FAT CLAY (CH)	NM	63	22	41
○	RC-15-001	35	LEAN CLAY (CL)	NM	50	17	33
△	RC-15-002	5	SANDY FAT CLAY (CH)	NM	47	21	26
⊗	RC-15-002	6.5	SANDY FAT CLAY (CH)	NM	53	23	30
⊕	RC-15-002	15	SANDY LEAN CLAY (CL)	NM	29	16	13
□	RC-15-002	19	SILTY SAND (SM)	22	NP	NP	NP
◉	RC-15-002	25	FAT CLAY (CH)	95	62	24	38
◕	RC-15-002	30	FAT CLAY (CH)	66	77	24	53
☆	RC-15-002	35	CLAYEY SAND (SC)	28	NP	NP	NP
✿	RC-15-002	38	SANDY FAT CLAY (CH)	83	53	18	35

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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DATE: 7/14/2015
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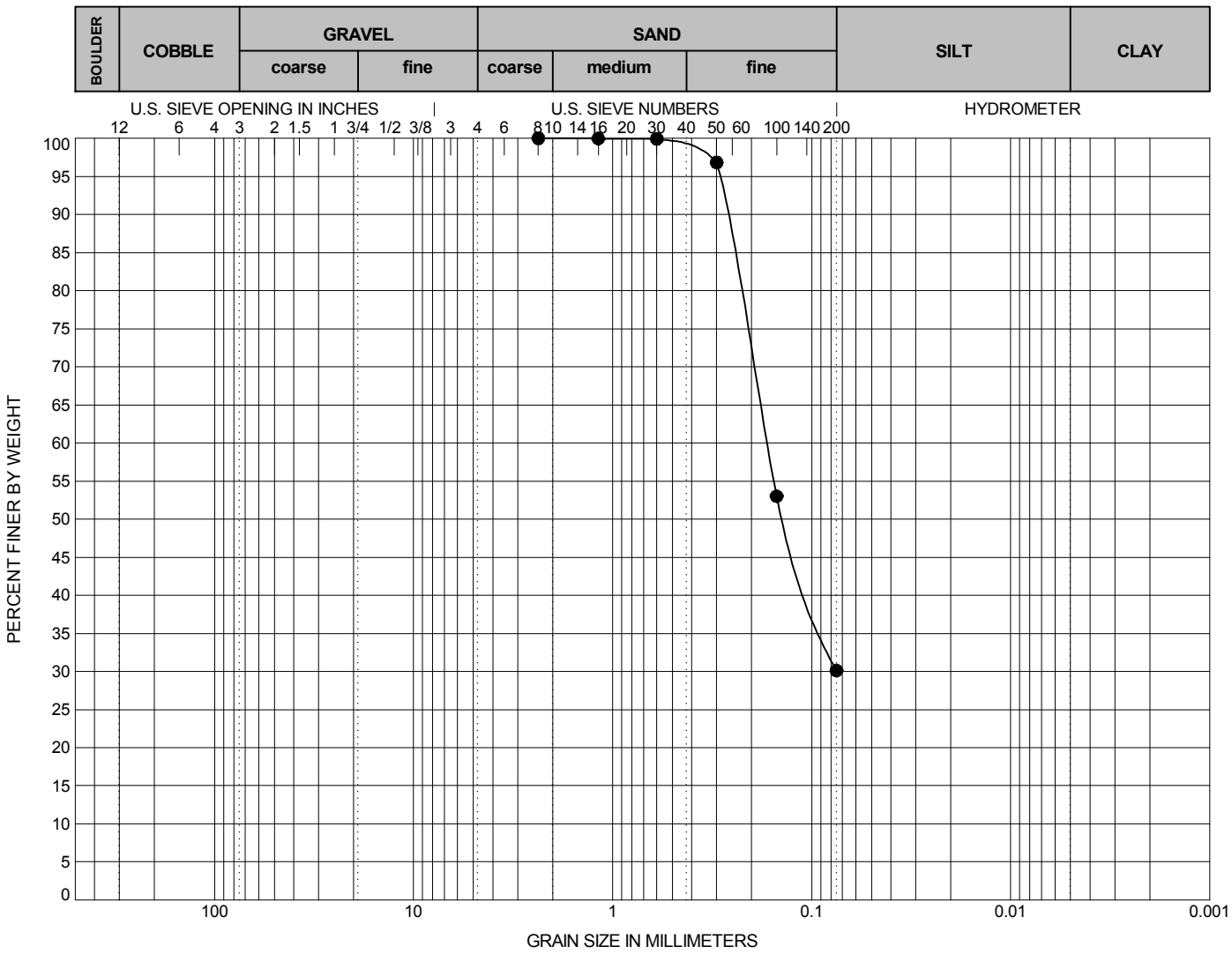
ATTERBERG LIMITS

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE
A-2

gINT FILE: L:\drafting\2015\33 Over Ccid\20143390.074-Hwy 33 Over Ccid Main Canal.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_ATTERBERG (ASTM)]



	Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
●	RC-15-001	17 - 19	CLAYEY SAND (SC)	31	15	16

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	RC-15-001	17 - 19	2.36	0.168	NM	NM	NM	NM			30	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.
NP = Nonplastic
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60}\, D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

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PROJECT NO.:	20143390
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DATE:	7/14/2015
REVISED:	-

SIEVE ANALYSIS

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE

A-3

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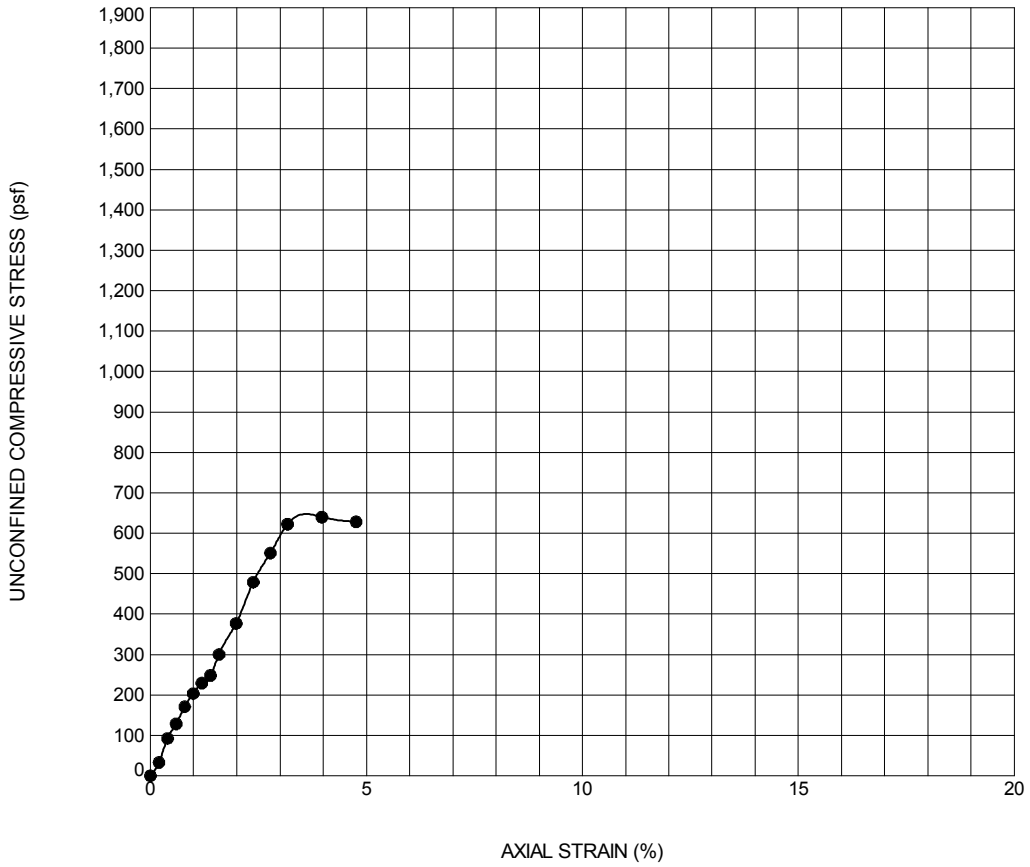
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_SIEVE ANALYSIS]



Exploration ID	Depth (ft.)	Sample Description
RC-15-001	10 - 12	FAT CLAY (CH)

Time to Failure (min)	Average Rate of Strain to Failure (%/min)	Shear Strength (psf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
NM	NM	NM	640	4.0

Specimen No.	Sample Condition Type	Initial Sample Dia. (mm)	Initial Height (mm)	Initial Height to Diameter Ratio	Initial Water Content (%)	Initial Dry Unit Wt. (pcf)	Initial Saturation (%)	Initial Void Ratio	Specific Gravity	Passing #200	LL	PL	PI
1	Cohesive	59.7	128.0	2.1:1	NM	NM	NM	NM	NM	NM	NM	NM	NM

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.:	20143390
DRAWN BY:	TD
CHECKED BY:	NMP
DATE:	7/14/2015
REVISED:	-

UNCONFINED COMPRESSIVE STRENGTH

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE

A-4

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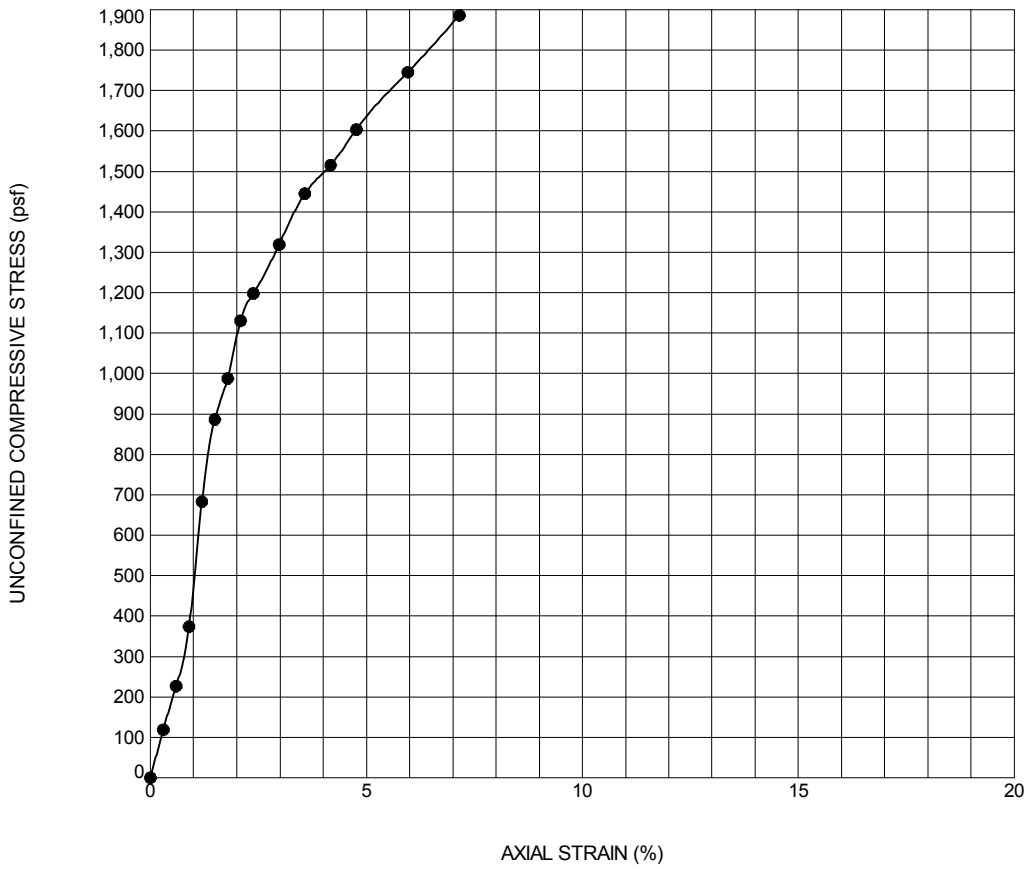
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_UNC COMPRESSIVE STRENGTH]



Exploration ID	Depth (ft.)	Sample Description
RC-15-001	25 - 27	FAT CLAY (CH)

Time to Failure (min)	Average Rate of Strain to Failure (%/min)	Shear Strength (psf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
NM	NM	NM	1890	7.2

Specimen No.	Sample Condition Type	Initial Sample Dia. (mm)	Initial Height (mm)	Initial Height to Diameter Ratio	Initial Water Content (%)	Initial Dry Unit Wt. (pcf)	Initial Saturation (%)	Initial Void Ratio	Specific Gravity	Passing #200	LL	PL	PI
1	Cohesive	59.8	85.2	1.4:1	NM	NM	NM	NM	NM	99	85	25	60

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.:	20143390
DRAWN BY:	TD
CHECKED BY:	NMP
DATE:	7/14/2015
REVISED:	-

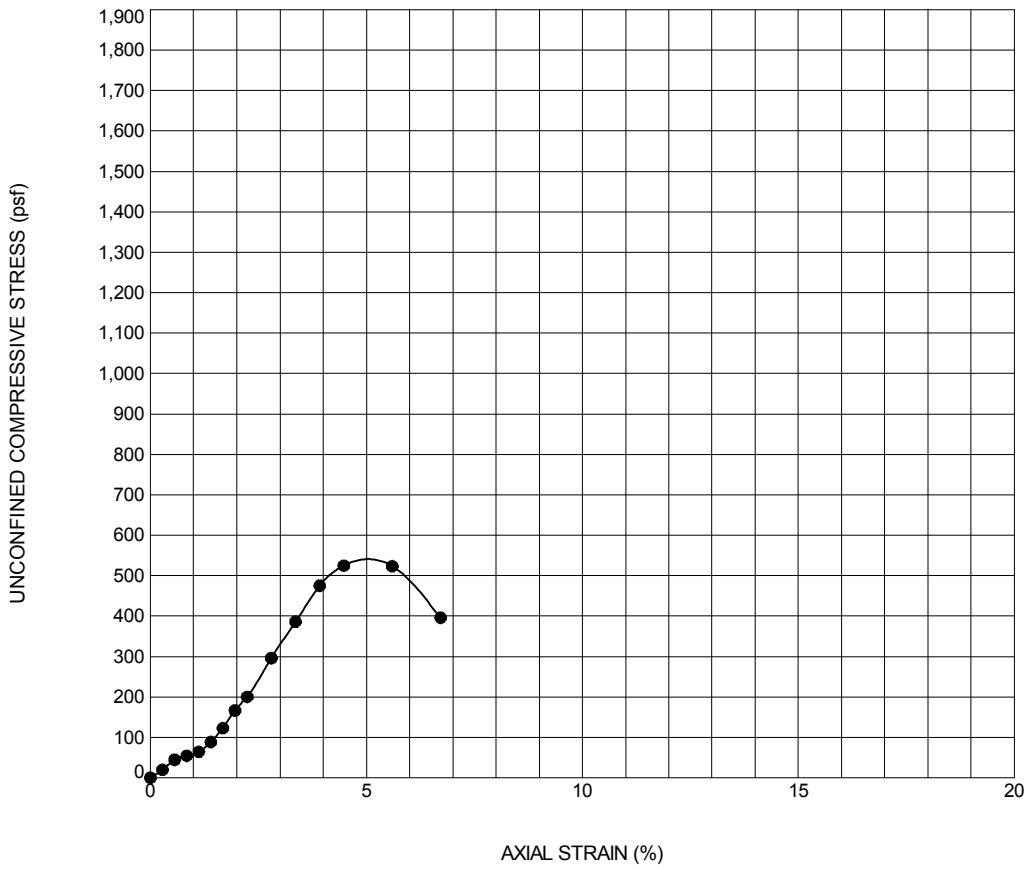
UNCONFINED COMPRESSIVE STRENGTH

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE

A-5

PLOTTED: 07/16/2015 11:05 AM BY: TDeSouza
gINT FILE: L:\drafting\2015\33 Over Ccid\20143390.074-Hwy 33 Over Ccid Main Canal.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_UNC COMPRESSIVE STRENGTH]



Exploration ID	Depth (ft.)	Sample Description
RC-15-002	40 - 41.5	SILTY SAND (SM)

Time to Failure (min)	Average Rate of Strain to Failure (%/min)	Shear Strength (psf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
NM	NM	NM	520	4.5

Specimen No.	Sample Condition Type	Initial Sample Dia. (mm)	Initial Height (mm)	Initial Height to Diameter Ratio	Initial Water Content (%)	Initial Dry Unit Wt. (pcf)	Initial Saturation (%)	Initial Void Ratio	Specific Gravity	Passing #200	LL	PL	PI
1	Cohesionless	48.7	90.8	1.9:1	NM	NM	NM	NM	NM	NM	NM	NM	NM

Testing perfomed in general accordance with ASTM D2166.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20143390
DRAWN BY:	TD
CHECKED BY:	NMP
DATE:	7/14/2015
REVISED:	-

UNCONFINED COMPRESSIVE STRENGTH

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE

A-6

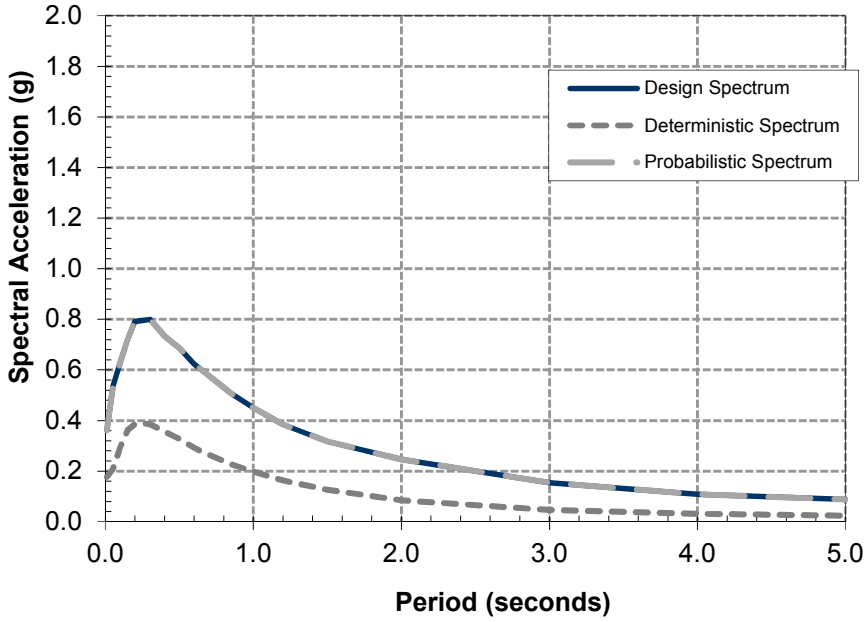
PLOTTED: 07/16/2015 11:05 AM BY: TDeSouza
gINT FILE: L:\drafting\2015\33 Over Ccid\20143390.074-Hwy 33 Over Ccid Main Canal.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_UNC COMPRESSIVE STRENGTH]

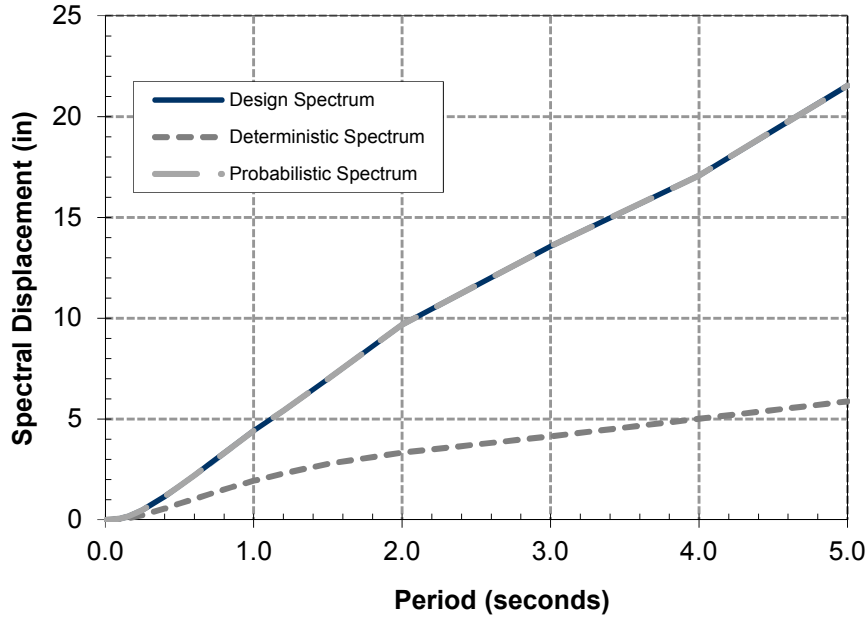
APPENDIX B

SITE DATA

Latitude:	36.8440	Shear Wave Velocity	221 m/s
Longitude:	-120.4500	Depth to Vs = 1.0 km/s:	N/A
		Depth to Vs = 2.5 km/s:	N/A

Period (s)	SA (g)	SD (in)
0.01 (PGA)	0.361	0.00
0.05	0.531	0.01
0.1	0.627	0.06
0.15	0.719	0.16
0.2	0.792	0.31
0.25	0.796	0.49
0.3	0.800	0.70
0.4	0.733	1.15
0.5	0.686	1.68
0.6	0.624	2.20
0.7	0.576	2.76
0.85	0.507	3.59
1	0.450	4.40
1.2	0.384	5.41
1.5	0.317	6.98
2	0.247	9.67
3	0.154	13.57
4	0.109	17.07
5	0.088	21.53





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www.kleinfelder.

PROJECT NO	20143390
DRAWN:	7/8/15
DRAWN BY:	B. Campbell
CHECKED BY:	
FILE NAME:	

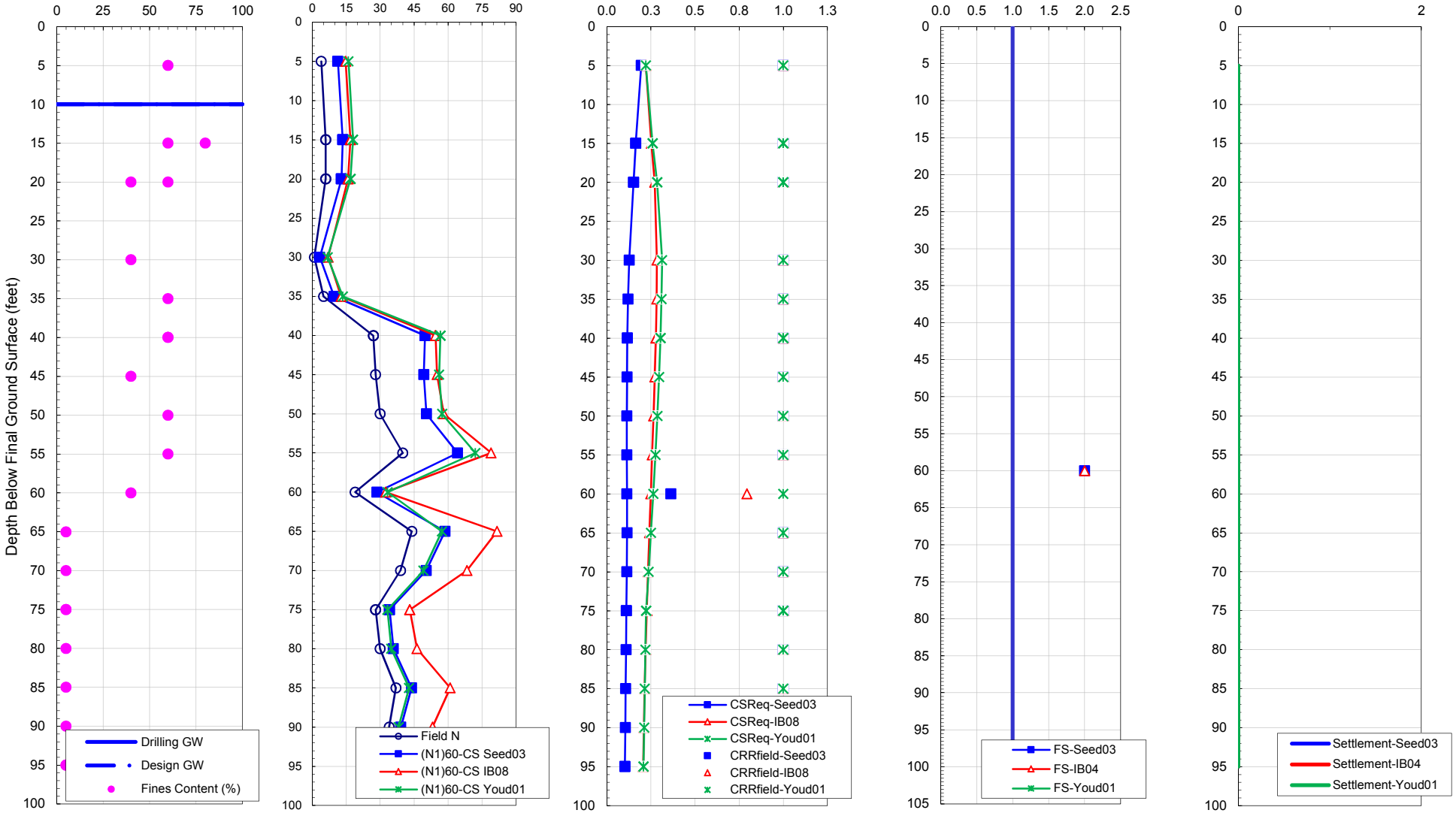
CALTRANS ARS CURVES

HIGHWAY 33 BRIDGE
OVER CCID MAIN CANAL
FRESNO COUNTY, CALIFORNIA

FIGURE

B-1

Boring ID:	RC-15-001	M_w= 6.4	Groundwater Depth During Drilling (ft) = 10.0 ft	Existing Ground Elevation = 0.0 ft	Ana. by: T. DeSouza
		PGA= 0.35g	Design Groundwater Depth (ft) = 10.0 ft	Final Ground Elevation = 0.0 ft	Checked by:



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

1330 Broadway, #1200
Oakland, California 94612
t: 510628 9000 f: 510 628 9009

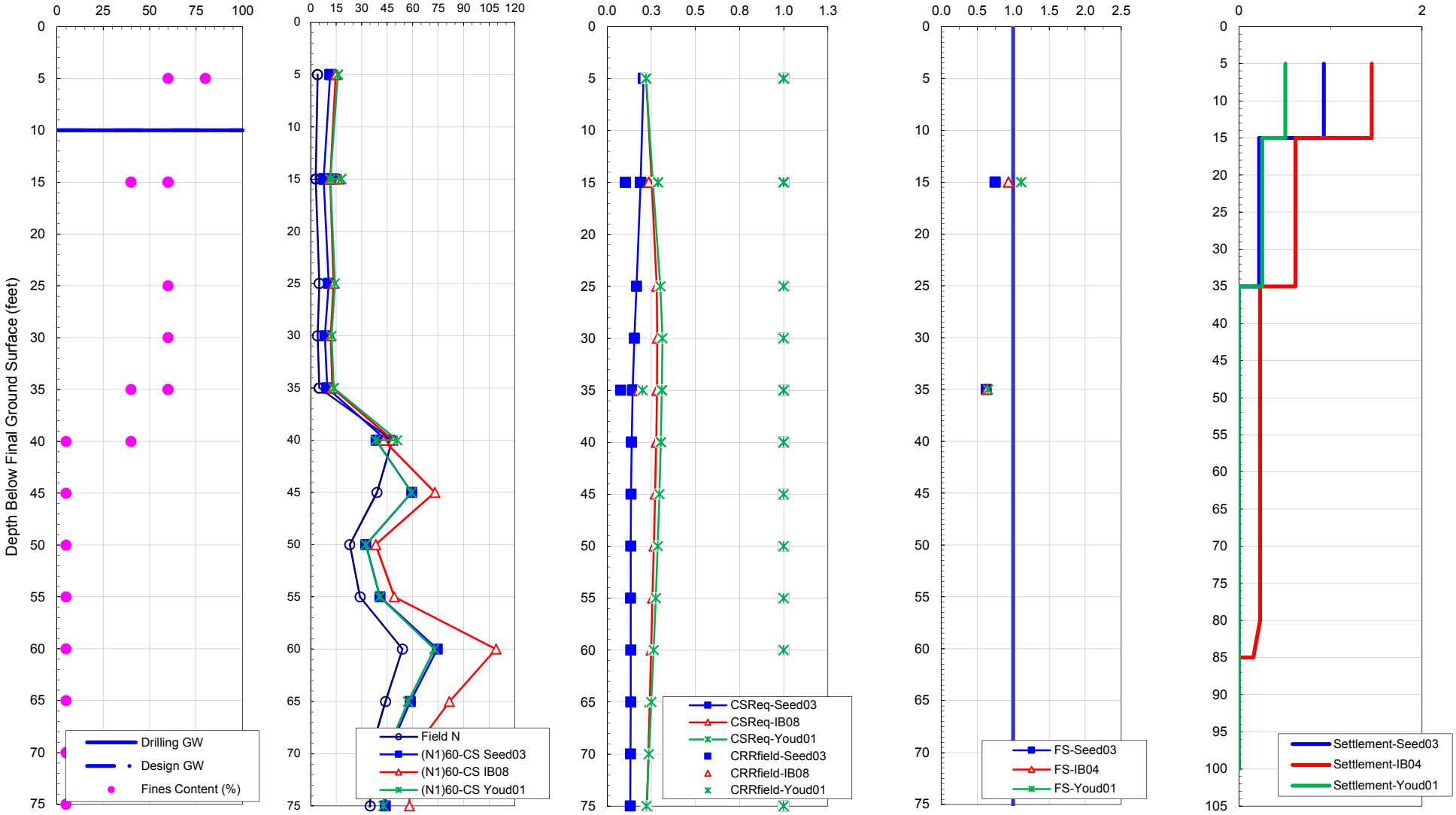
Project Name: Hwy 33 over CCID
Project No.: 20143390
Project Location: Fresno County, CA

LIQUEFACTION ANALYSIS

Date 7/14/2015

B-2

Boring ID:	RC-15-002	M_w= 6.4	Groundwater Depth During Drilling (ft) = 10.0 ft	Existing Ground Elevation = 0.0 ft	Ana. by: R.shiplee
		PGA= 0.35g	Design Groundwater Depth (ft) = 10.0 ft	Final Ground Elevation = 0.0 ft	Checked by: T. DeSouza



1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

1330 Broadway, #1200
Oakland, California 94612
t: 510628 9000 f: 510 628 9009

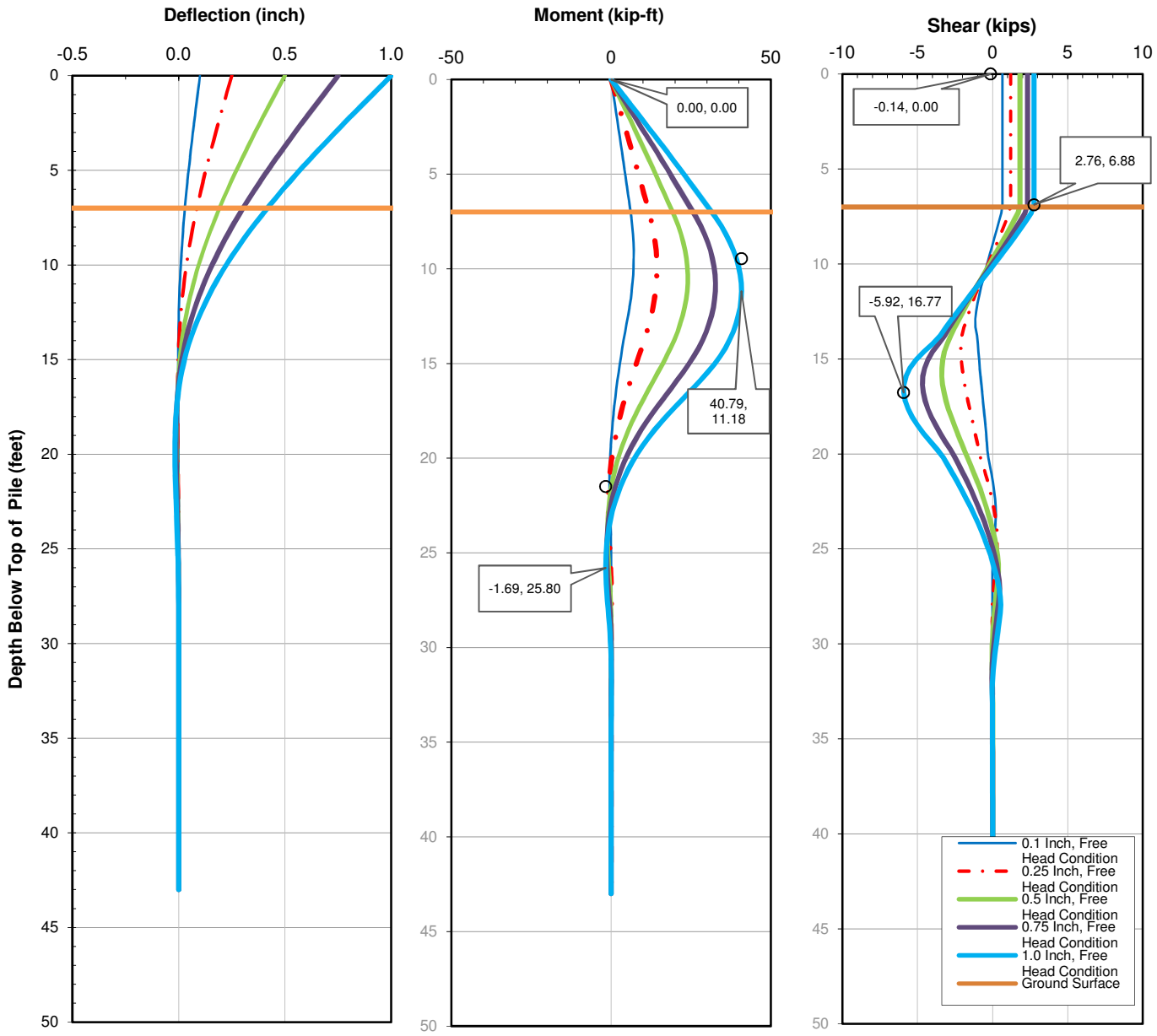
Project Name: Hwy 33 over CCID
Project No.: 20143390
Project Location: Fresno County, CA

LIQUEFACTION ANALYSIS

Date 6/29/2015

B-3

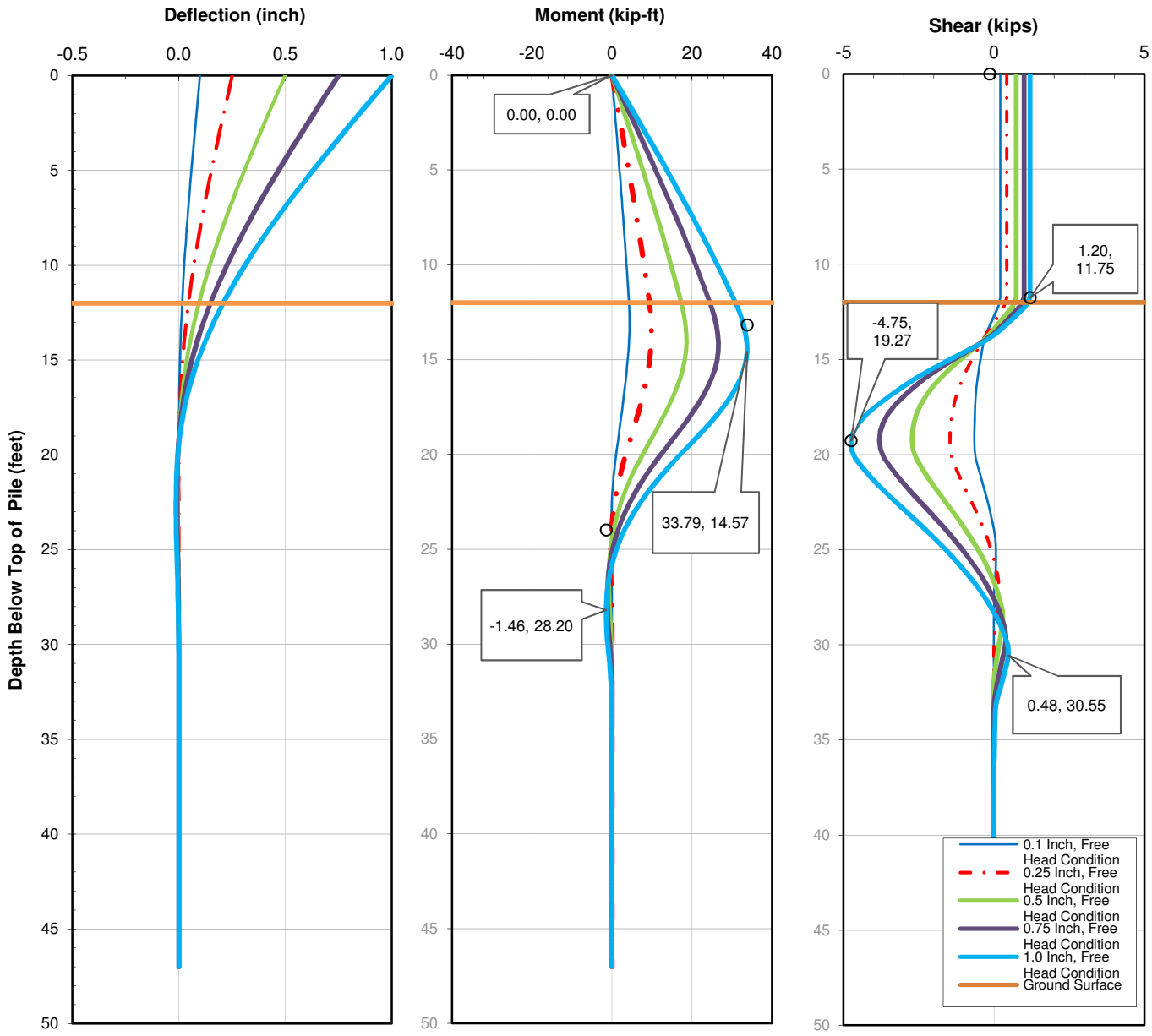
APPENDIX C



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 inch Pile(43-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

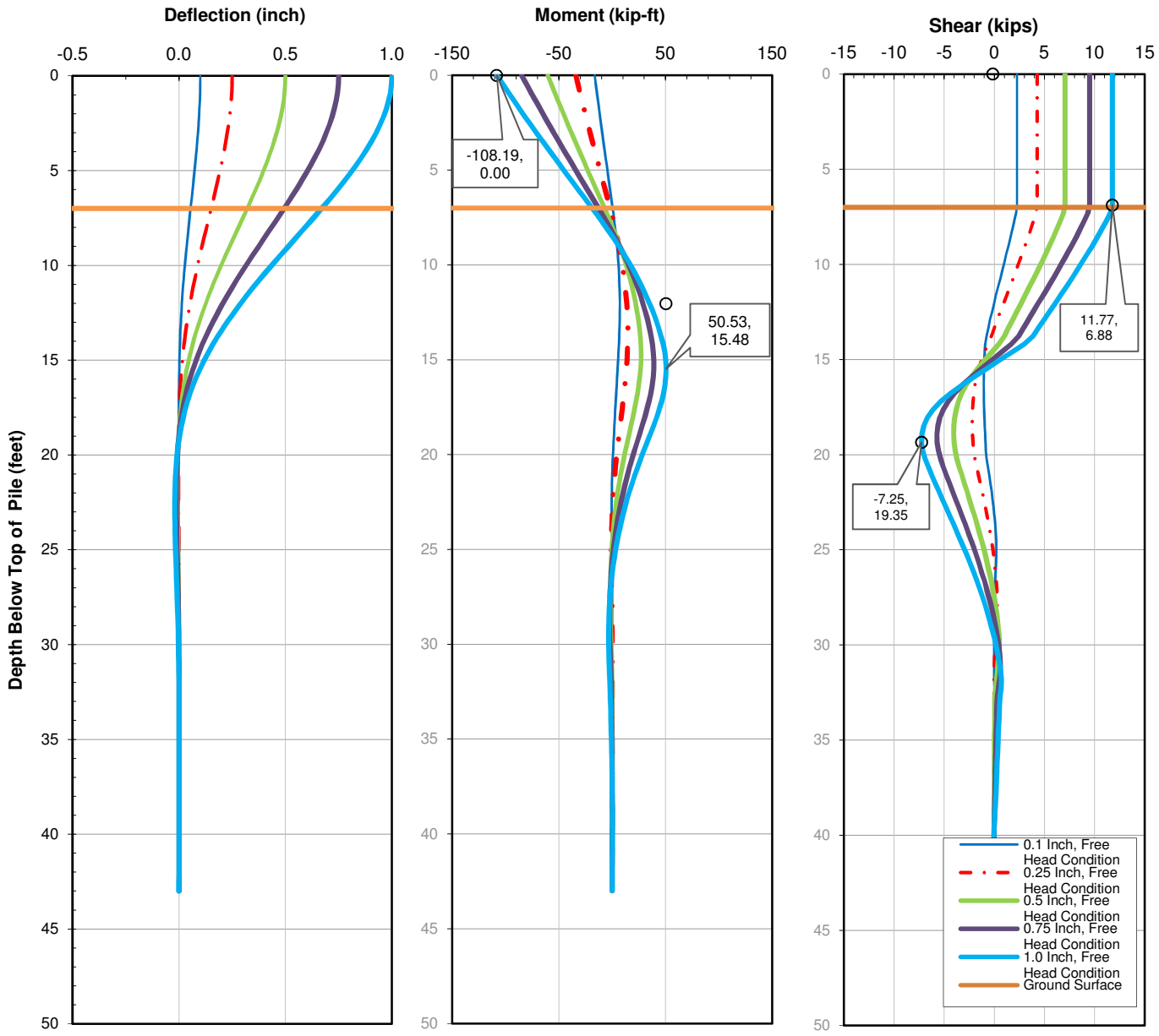
KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bents 2 and 6, Original Tapered Monotube** **Free Head Condition**	PLATE
BY: NAS / REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-1**
PROJECT NO. 20143390 / 9/1/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Original Tapered Monotube 15.5 inch Pile (47-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

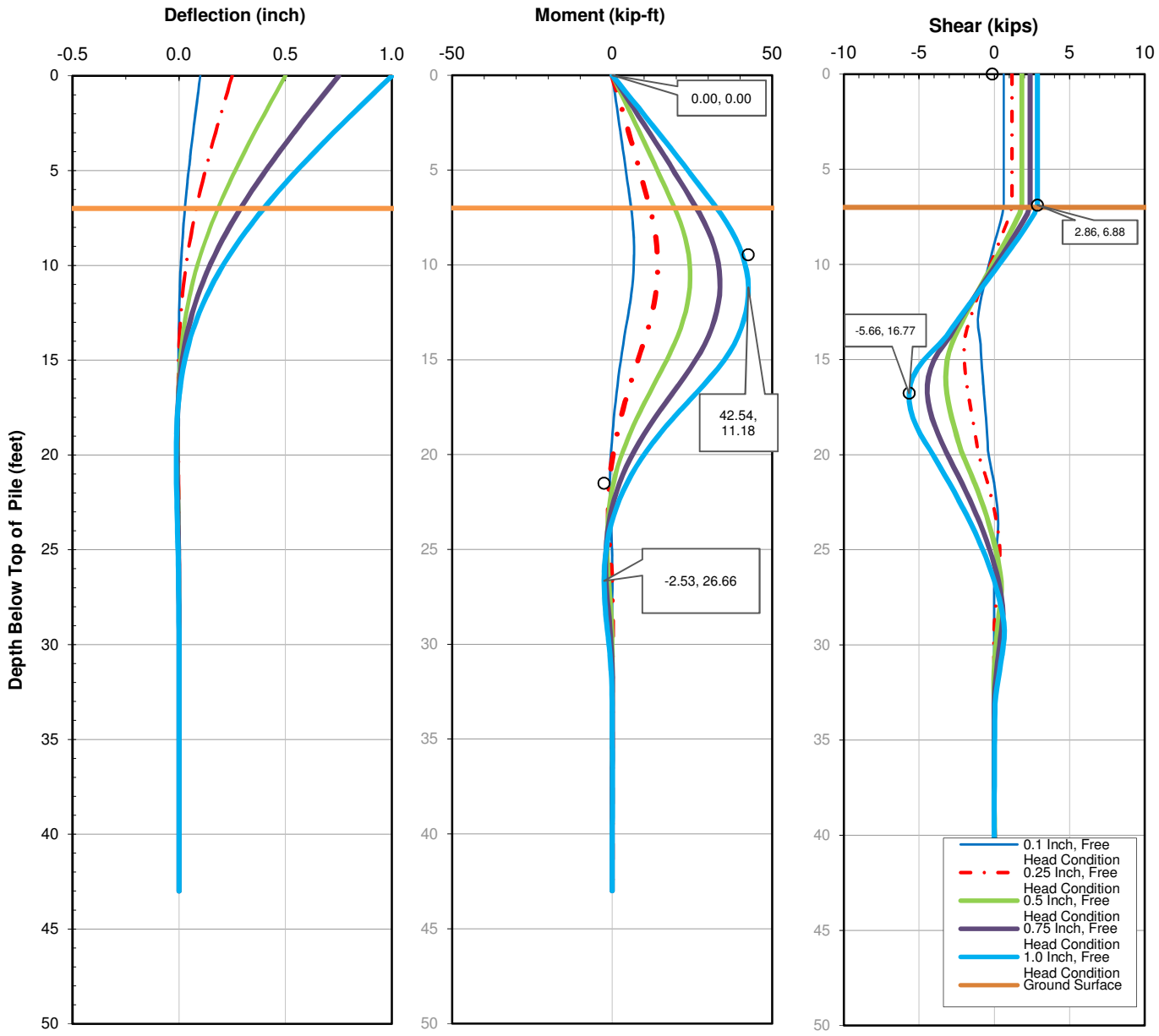
KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bents 3-5, Original Tapered Monotube** **Free Head Condition**	PLATE
BY: NAS / REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-2**
PROJECT NO. 20143390 / 9/1/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 45, 15 inch octagonal piles (43-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

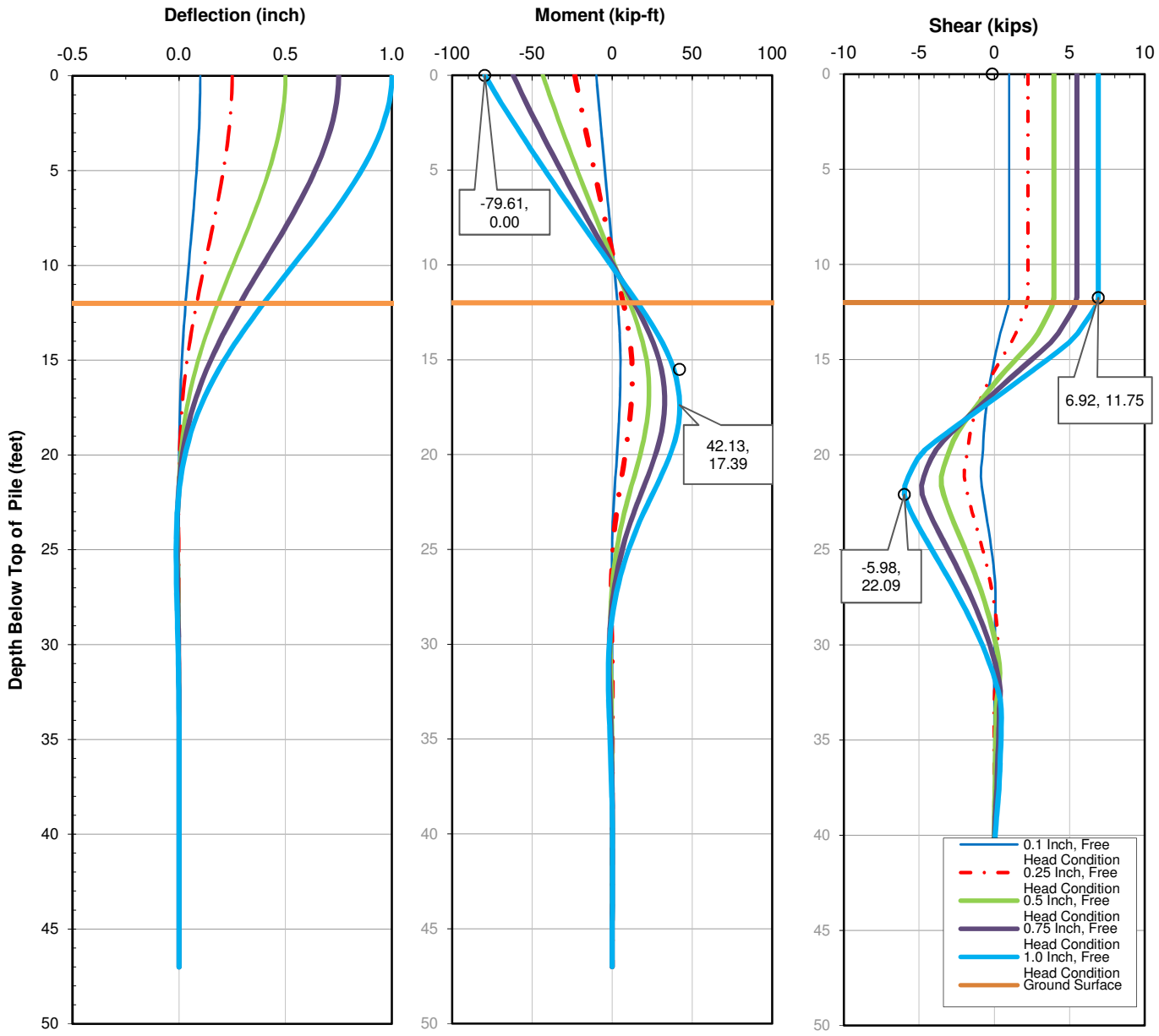
KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bents 2 and 6, Widen Class 45** **Fixed Head Condition**	PLATE
BY: NAS / REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-3a**
PROJECT NO. 20143390 / 9/1/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 45, 15 inch octagonal piles (43-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

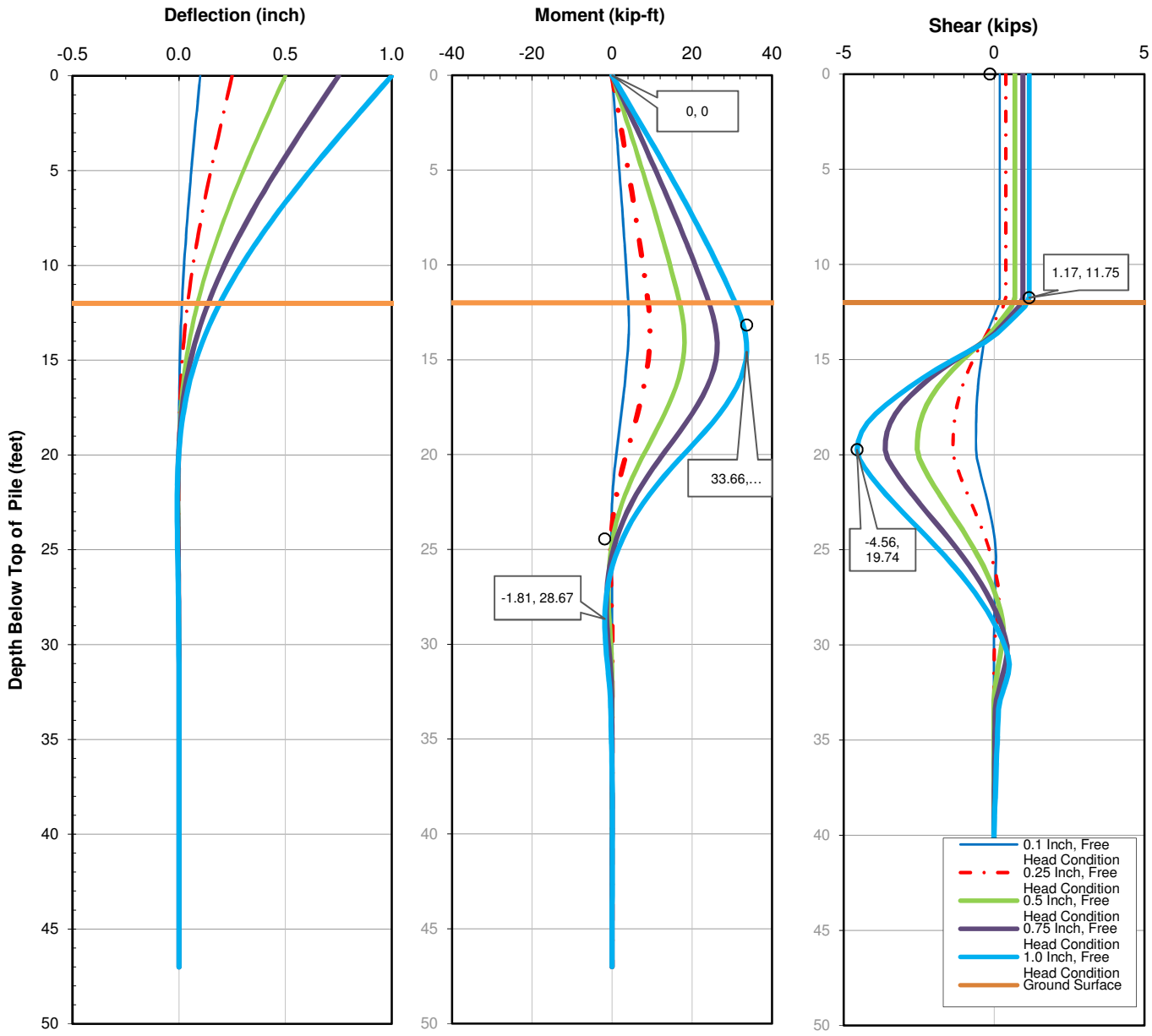
KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 2 and 6, Widen Class 45** **Free Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-3b**
PROJECT NO. 20143390	9/2/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 45, 15 inch octagonal piles (47-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

KLEINFELDER Bright People. Right Solutions.		**Lateral Pile Analysis (LPILE) Results** **Bents 3-5, Widen Class 45** **Fixed Head Condition**	PLATE
BY: NAS	REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-4a**
PROJECT NO. 20143390	9/2/2015		



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder:

1. Class 45, 15 inch octagonal piles (47-foot length)
2. 0.0 Depth represents the top of the pile, Elevation 150

KLEINFELDER Bright People. Right Solutions.	**Lateral Pile Analysis (LPILE) Results** **Bents 3-5, Widen Class 45** **Free Head Condition**	PLATE
BY: NAS / REV. BY:	**SR 33 Over Main Canal** Bridge No. 42-0134 Firebaugh Fresno County, CA	**C-4b**
PROJECT NO. 20143390 / 9/1/2015		

FIGURE C.1-1
P-Y CURVES
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 2 AND 6

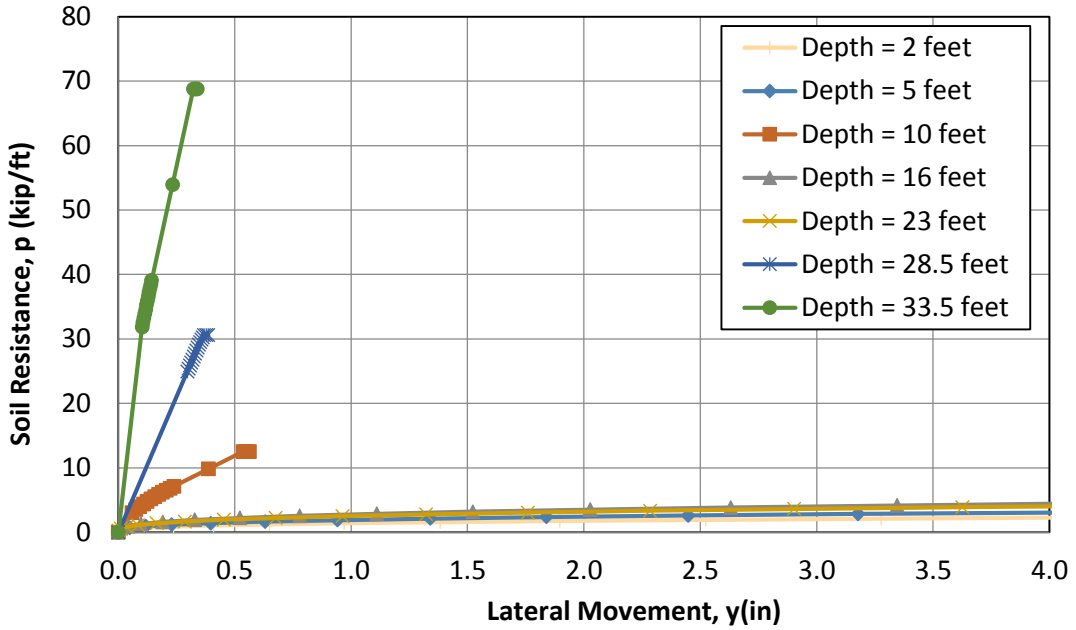


FIGURE C.1-2
P-Y CURVES
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 3 AND 4

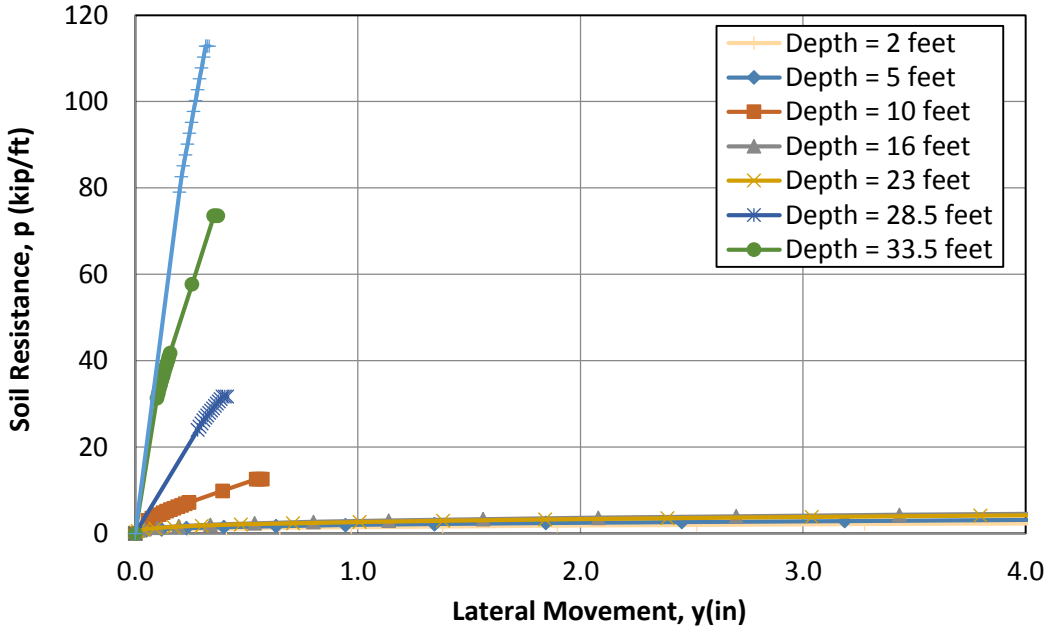


FIGURE C.1-3
P-Y CURVES
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 5

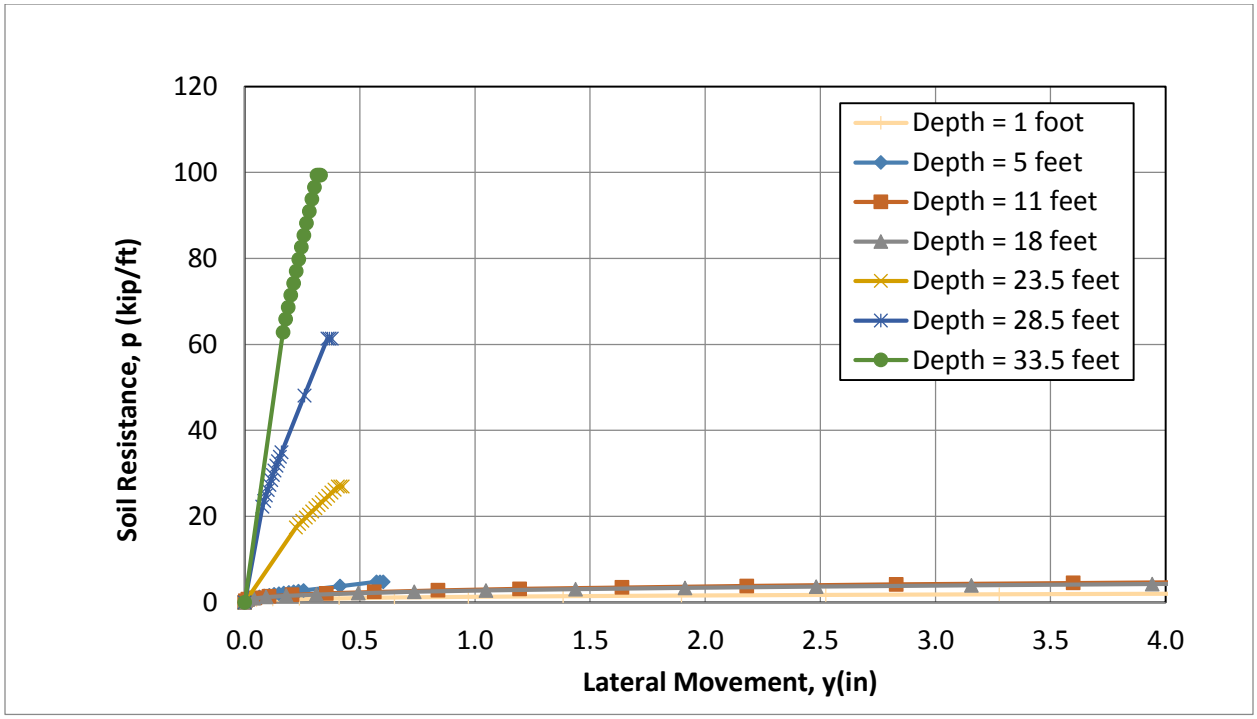


FIGURE C.1-4
P-Y CURVES
WIDEN 15" CLASS 45 PILES
BENTS 2 AND 6

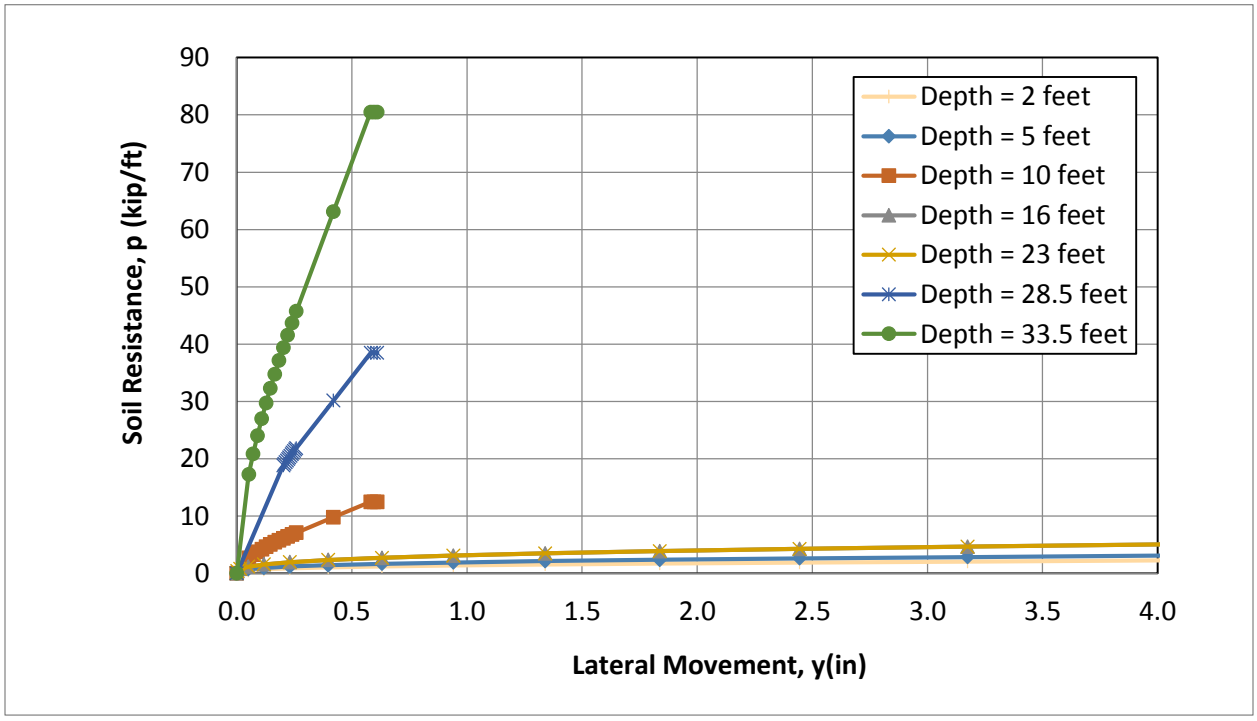


FIGURE C.1-5
P-Y CURVES
WIDEN 15" CLASS 45 PILES
BENTS 3 AND 4

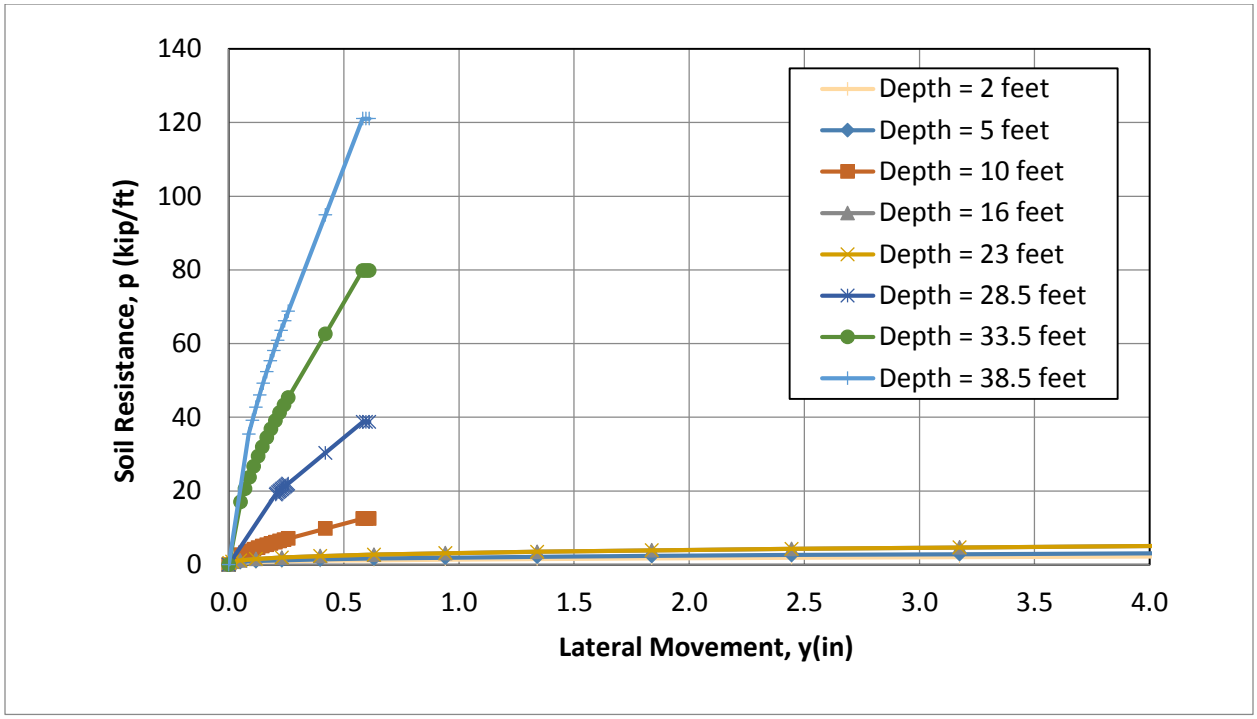


FIGURE C.1-6
P-Y CURVES
WIDEN 15" CLASS 45 PILES
BENT 5

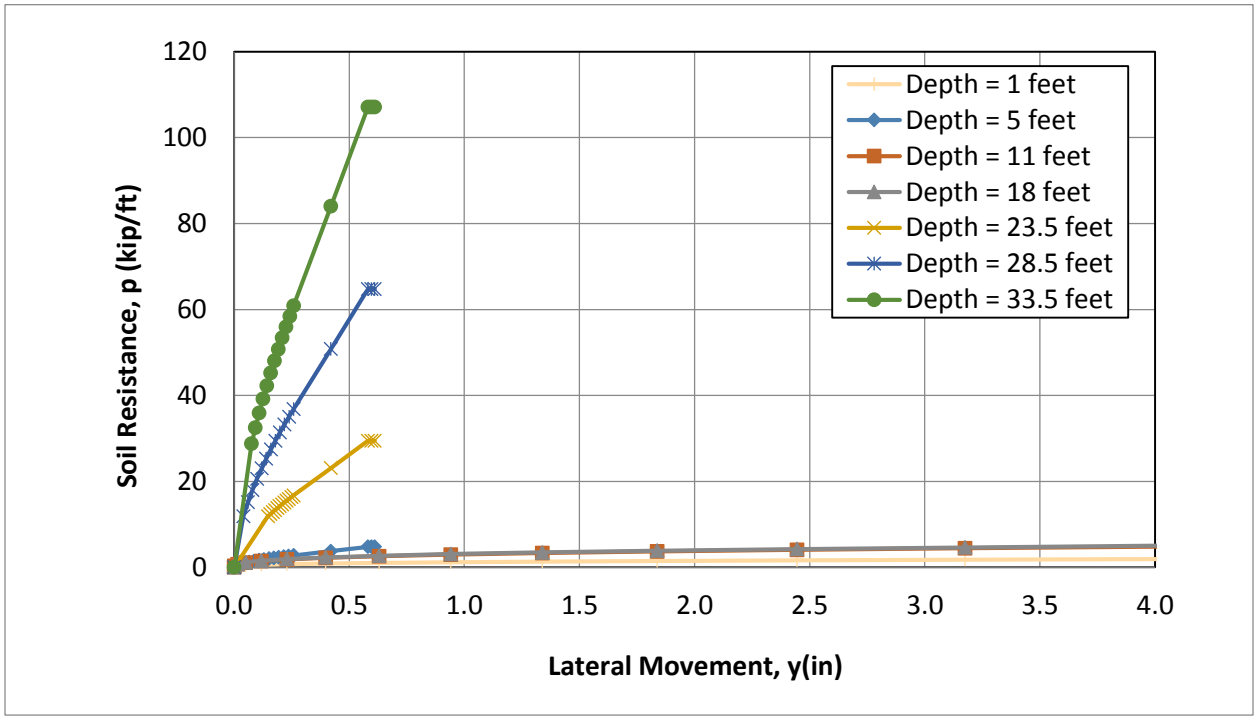


FIGURE C.2-1
Q-Z CURVES
ORIGINAL 15.5" FLUTED STEEL PILES

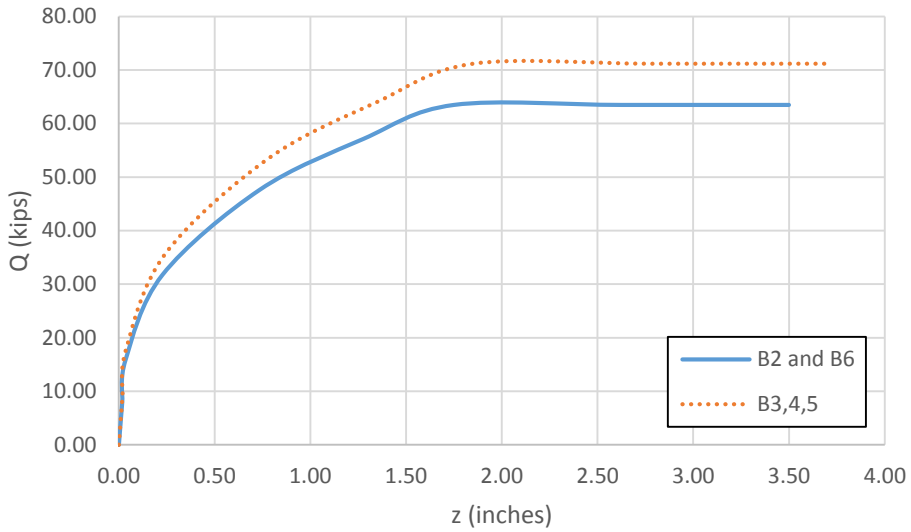
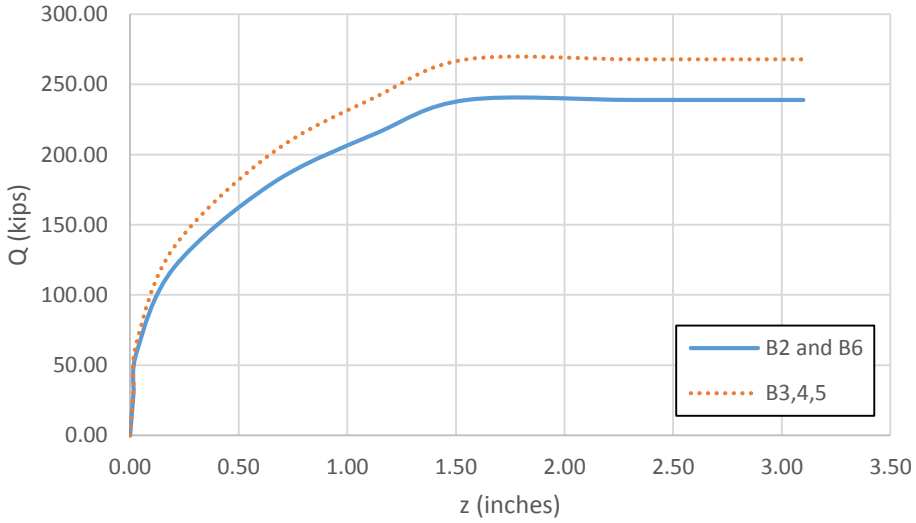


FIGURE C.2-2
Q-Z CURVES
WIDEN 15" CLASS 45 PILES



Data: t-z Curves

Br. Name:	Hwy 33 over CCID		Elevatiion (ft)	143	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	143	Pile Dia.:	15.5" Diameter
			Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bent 2 and 6		GW Elev. =	150		

Note: All depths are in feet.

Layer 0-4 feet	
@Depth 2 ft	
@Elevation 141 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.324
0.048	0.541
0.088	0.811
0.124	0.973
0.155	1.081
0.310	0.973
0.465	0.973
0.775	0.973
3.100	0.973

Layer 4-7 feet	
@Depth 5 ft	
@Elevation 138 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.329
0.048	0.548
0.088	0.821
0.124	0.986
0.155	1.095
0.310	0.986
0.465	0.986
0.775	0.986
3.100	0.986

Layer 7-13 feet	
@Depth 10 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.127
0.020	0.254
0.040	0.507
0.060	0.761
0.080	1.014
0.090	1.141
0.100	1.268
0.500	1.268
2.000	1.268

Layer 13-20 feet	
@Depth 16 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 20-26 feet	
@Depth 23 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.334
0.020	0.667
0.040	1.334
0.060	2.002
0.080	2.669
0.090	3.002
0.100	3.336
0.500	3.336
2.000	3.336

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.033
0.020	2.066
0.040	4.133
0.060	6.198
0.080	8.268
0.090	9.300
0.100	10.332
0.500	10.332
2.000	10.332

Data: t-z Curves

Br. Name:	Hwy 33 over CCID		Elevatiion (ft)	143	Pile Type:	Octagonal Piles
Br. No. =	45-0064		FG	143	Pile Dia.:	15.5" Diameter
			Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bent 3 and 4		GW Elev. =	150		

Note: All depths are in feet.

Layer 0-4 feet	
@Depth 2 ft	
@Elevation 141 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.324
0.048	0.541
0.088	0.811
0.124	0.973
0.155	1.081
0.310	0.973
0.465	0.973
0.775	0.973
3.100	0.973

Layer 4-7 feet	
@Depth 5 ft	
@Elevation 138 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.329
0.048	0.548
0.088	0.821
0.124	0.986
0.155	1.095
0.310	0.986
0.465	0.986
0.775	0.986
3.100	0.986

Layer 7-13 feet	
@Depth 10 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.127
0.020	0.254
0.040	0.507
0.060	0.761
0.080	1.014
0.090	1.141
0.100	1.268
0.500	1.268
2.000	1.268

Layer 13-20 feet	
@Depth 16 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 20-26 feet	
@Depth 23 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.334
0.020	0.667
0.040	1.334
0.060	2.002
0.080	2.669
0.090	3.002
0.100	3.336
0.500	3.336
2.000	3.336

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.033
0.020	2.066
0.040	4.133
0.060	6.198
0.080	8.268
0.090	9.300
0.100	10.332
0.500	10.332
2.000	10.332

Layer 36-41 feet	
@Depth 38.5 ft	
@Elevation 104.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.145
0.020	2.290
0.040	4.580
0.060	6.870
0.080	9.162
0.090	10.308
0.100	11.454
0.500	11.454
2.000	11.454

Data: t-z Curves

Br. Name:	Hwy 33 over CCID			Elevatiion (ft)	138	Pile Type:	Octagonal Piles
Br. No. =	45-0064			FG	138	Pile Dia.:	15.5"
				Pile Cut-Off=		Extension Pile Perimeter:	50
Support(s):	Bent 5			GW Elev. =	150		

Note: All depths are in feet.

Layer 0-2 feet	
@Depth 1 ft	
@Elevation 137 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.214
0.048	0.357
0.088	0.535
0.124	0.642
0.155	0.713
0.310	0.642
0.465	0.642
0.775	0.642
3.100	0.642

Layer 2-8 feet	
@Depth 5 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.071
0.020	0.141
0.040	0.282
0.060	0.423
0.080	0.564
0.090	0.635
0.100	0.706
0.500	0.706
2.000	0.706

Layer 8-15 feet	
@Depth 11 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 15-21 feet	
@Depth 18 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.025	0.625
0.048	1.042
0.088	1.562
0.124	1.875
0.155	2.083
0.310	1.875
0.465	1.875
0.775	1.875
3.100	1.875

Layer 21-26 feet	
@Depth 23.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.277
0.020	0.555
0.040	1.109
0.060	1.664
0.080	2.219
0.090	2.496
0.100	2.774
0.500	2.774
2.000	2.774

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.886
0.020	1.772
0.040	3.544
0.060	5.317
0.080	7.086
0.090	7.974
0.100	8.862
0.500	8.862
2.000	8.862

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 104.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.046
0.020	2.092
0.040	4.184
0.060	6.276
0.080	8.370
0.090	9.414
0.100	10.458
0.500	10.458
2.000	10.458

Layer 36-41 feet	
@Depth 38.5 ft	
@Elevation 99.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.206
0.020	2.411
0.040	4.823
0.060	7.236
0.080	9.648
0.090	10.854
0.100	12.060
0.500	12.060
2.000	12.060

Layer 41-46 feet	
@Depth 43.5 ft	
@Elevation 94.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.286
0.020	2.572
0.040	5.143
0.060	7.716
0.080	10.284
0.090	11.574
0.100	12.858
0.500	12.858
2.000	12.858

Data: t-z Curves

Br. Name:	Hwy 33 over CCID		Elevation (ft)	143	Pile Type:	Fluted Piles
Br. No. =	45-0064		FG	143	Pile Dia.:	
			Pile Cut-Off=		Extension Pile Perimeter:	55
Support(s):	Bents 2 and 6		GW Elev. =	150		

Note: All depths are in feet.

Layer 0-4 feet	
@Depth 2 ft	
@Elevation 141 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.329
0.054	0.549
0.100	0.823
0.140	0.988
0.175	1.097
0.350	0.988
0.525	0.988
0.875	0.988
3.500	0.988

Layer 4-7 feet	
@Depth 5 ft	
@Elevation 138 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.301
0.054	0.502
0.100	0.752
0.140	0.903
0.175	1.003
0.350	0.903
0.525	0.903
0.875	0.903
3.500	0.903

Layer 7-13 feet	
@Depth 10 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.355
0.020	0.710
0.040	1.419
0.060	2.129
0.080	2.839
0.090	3.193
0.100	3.548
0.500	3.548
2.000	3.548

Layer 13-20 feet	
@Depth 16 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.398
0.054	0.663
0.100	0.994
0.140	1.193
0.175	1.325
0.350	1.193
0.525	1.193
0.875	1.193
3.500	1.193

Layer 20-26 feet	
@Depth 23 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.300
0.054	0.500
0.100	0.750
0.140	0.900
0.175	1.000
0.350	0.900
0.525	0.900
0.875	0.900
3.500	0.900

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.336
0.020	0.673
0.040	1.345
0.060	2.018
0.080	2.691
0.090	3.027
0.100	3.364
0.500	3.364
2.000	3.364

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.256
0.020	2.512
0.040	5.022
0.060	7.534
0.080	10.045
0.090	11.304
0.100	12.560
0.500	12.560
2.000	12.560

Data: t-z Curves

Br. Name:	Hwy 33 over CCID		Elevation (ft)	143	Pile Type:	Fluted Piles
Br. No. =	45-0064		FG	143	Pile Dia.:	
			Pile Cut-Off=		Extension Pile Perimeter:	55
Support(s):	Bents 3 and 4		GW Elev. =	150		

Note: All depths are in feet.

Layer 0-4 feet	
@Depth 2 ft	
@Elevation 141 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.329
0.054	0.549
0.100	0.823
0.140	0.988
0.175	1.097
0.350	0.988
0.525	0.988
0.875	0.988
3.500	0.988

Layer 4-7 feet	
@Depth 5 ft	
@Elevation 138 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.301
0.054	0.502
0.100	0.752
0.140	0.903
0.175	1.003
0.350	0.903
0.525	0.903
0.875	0.903
3.500	0.903

Layer 7-13 feet	
@Depth 10 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.355
0.020	0.710
0.040	1.419
0.060	2.129
0.080	2.839
0.090	3.193
0.100	3.548
0.500	3.548
2.000	3.548

Layer 13-20 feet	
@Depth 16 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.398
0.054	0.663
0.100	0.994
0.140	1.193
0.175	1.325
0.350	1.193
0.525	1.193
0.875	1.193
3.500	1.193

Layer 20-26 feet	
@Depth 23 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.028	0.300
0.054	0.500
0.100	0.750
0.140	0.900
0.175	1.000
0.350	0.900
0.525	0.900
0.875	0.900
3.500	0.900

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.336
0.020	0.673
0.040	1.345
0.060	2.018
0.080	2.691
0.090	3.027
0.100	3.364
0.500	3.364
2.000	3.364

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.256
0.020	2.512
0.040	5.022
0.060	7.534
0.080	10.045
0.090	11.304
0.100	12.560
0.500	12.560
2.000	12.560

Layer 36-41 feet	
@Depth 38.5 ft	
@Elevation 104.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.978
0.020	1.955
0.040	3.910
0.060	5.866
0.080	7.820
0.090	8.797
0.100	9.776
0.500	9.776
2.000	9.776

Data: t-z Curves

Br. Name:	Hwy 33 over CCID			Elevatiion (ft)	138	Pile Type:	Fluted Piles
Br. No. =	45-0064			FG	138	Pile Dia.:	
				Pile Cut-Off=		Extension Pile Perimeter:	58
Support(s):	Bent 5			GW Elev. =	150		

Note: All depths are in feet.

Layer 0-2 feet	
@Depth 1 ft	
@Elevation 137 ft	
z (in)	t(kips/ft)
0.000	0.000
0.030	0.000
0.057	0.000
0.106	0.000
0.148	0.000
0.185	0.000
0.370	0.000
0.555	0.000
0.925	0.000
3.700	0.000

Layer 2-8 feet	
@Depth 5 ft	
@Elevation 133 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.155
0.020	0.309
0.040	0.619
0.060	0.928
0.080	1.237
0.090	1.392
0.100	1.546
0.500	1.546
2.000	1.546

Layer 8-15 feet	
@Depth 11 ft	
@Elevation 127 ft	
z (in)	t(kips/ft)
0.000	0.000
0.030	0.514
0.057	0.857
0.106	1.285
0.148	1.542
0.185	1.714
0.370	1.542
0.555	1.542
0.925	1.542
3.700	1.542

Layer 15-21 feet	
@Depth 18 ft	
@Elevation 120 ft	
z (in)	t(kips/ft)
0.000	0.000
0.030	0.405
0.057	0.675
0.106	1.012
0.148	1.214
0.185	1.350
0.370	1.214
0.555	1.214
0.925	1.214
3.700	1.214

Layer 21-26 feet	
@Depth 23.5 ft	
@Elevation 114.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	0.464
0.020	0.928
0.040	1.856
0.060	2.784
0.080	3.712
0.090	4.176
0.100	4.641
0.500	4.641
2.000	4.641

Layer 26-31 feet	
@Depth 28.5 ft	
@Elevation 109.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.985
0.020	3.971
0.040	7.942
0.060	11.913
0.080	15.884
0.090	17.869
0.100	19.855
0.500	19.855
2.000	19.855

Layer 31-36 feet	
@Depth 33.5 ft	
@Elevation 104.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.667
0.020	3.333
0.040	6.665
0.060	9.997
0.080	13.333
0.090	14.997
0.100	16.665
0.500	16.665
2.000	16.665

Layer 36-41 feet	
@Depth 38.5 ft	
@Elevation 99.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.273
0.020	2.546
0.040	5.092
0.060	7.638
0.080	10.185
0.090	11.459
0.100	12.731
0.500	12.731
2.000	12.731

Layer 41-46 feet	
@Depth 43.5 ft	
@Elevation 94.5 ft	
z (in)	t(kips/ft)
0.000	0.000
0.010	1.006
0.020	2.011
0.040	4.022
0.060	6.034
0.080	8.043
0.090	9.049
0.100	10.055
0.500	10.055
2.000	10.055

TABLE C.2-1
P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 2 & 6
All depths measured from ground surface.

Layer 1 0'-4'

Depth = 2 feet	
Elevation = 141 feet	
y (in)	p (kip/ft)
-6.80	-2.65
-6.40	-2.65
-5.20	-2.48
-4.17	-2.30
-3.28	-2.12
-2.52	-1.95
-1.90	-1.77
-1.38	-1.59
-0.97	-1.42
-0.65	-1.24
-0.41	-1.06
-0.24	-0.88
-0.12	-0.71
-0.05	-0.53
-0.02	-0.35
0.00	-0.18
0	0
0.00	0.18
0.02	0.35
0.05	0.53
0.12	0.71
0.24	0.88
0.41	1.06
0.65	1.24
0.97	1.42
1.38	1.59
1.90	1.77
2.52	1.95
3.28	2.12
4.17	2.30
5.20	2.48
6.40	2.65
6.80	2.65

Layer 2 4'-7'

Depth = 5 feet	
Elevation = 138 feet	
y (in)	p (kip/ft)
-6.59	-3.56
-6.21	-3.56
-5.05	-3.33
-4.04	-3.09
-3.18	-2.85
-2.45	-2.61
-1.84	-2.38
-1.34	-2.14
-0.94	-1.90
-0.63	-1.66
-0.40	-1.43
-0.23	-1.19
-0.12	-0.95
-0.05	-0.71
-0.01	-0.48
0.00	-0.24
0	0
0.00	0.24
0.01	0.48
0.05	0.71
0.12	0.95
0.23	1.19
0.40	1.43
0.63	1.66
0.94	1.90
1.34	2.14
1.84	2.38
2.45	2.61
3.18	2.85
4.04	3.09
5.05	3.33
6.21	3.56
6.59	3.56

Layer 3 7'-13'

Depth = 10 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.56	-12.54
-0.55	-12.54
-0.54	-12.54
-0.39	-9.83
-0.24	-7.13
-0.22	-6.83
-0.21	-6.52
-0.19	-6.20
-0.17	-5.87
-0.16	-5.52
-0.14	-5.17
-0.12	-4.79
-0.11	-4.40
-0.09	-3.98
-0.08	-3.53
-0.06	-3.05
0	0
0.06	3.05
0.08	3.53
0.09	3.98
0.11	4.40
0.12	4.79
0.14	5.17
0.16	5.52
0.17	5.87
0.19	6.20
0.21	6.52
0.22	6.83
0.24	7.13
0.39	9.83
0.54	12.54
0.55	12.54
0.56	12.54

Layer 4 13'-20'

Depth = 16 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-5.46	-4.82
-5.14	-4.82
-4.18	-4.50
-3.35	-4.18
-2.63	-3.85
-2.03	-3.53
-1.52	-3.21
-1.11	-2.89
-0.78	-2.57
-0.52	-2.25
-0.33	-1.93
-0.19	-1.61
-0.10	-1.28
-0.04	-0.96
-0.01	-0.64
0.00	-0.32
0	0
0.00	0.32
0.01	0.64
0.04	0.96
0.10	1.28
0.19	1.61
0.33	1.93
0.52	2.25
0.78	2.57
1.11	2.89
1.52	3.21
2.03	3.53
2.63	3.85
3.35	4.18
4.18	4.50
5.14	4.82
5.46	4.82

Layer 5 20'-26'

Depth = 23 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-4.74	-4.18
-4.46	-4.18
-3.63	-3.90
-2.90	-3.62
-2.28	-3.35
-1.76	-3.07
-1.32	-2.79
-0.96	-2.51
-0.68	-2.23
-0.45	-1.95
-0.29	-1.67
-0.17	-1.39
-0.08	-1.12
-0.04	-0.84
-0.01	-0.56
0.00	-0.28
0	0
0.00	0.28
0.01	0.56
0.04	0.84
0.08	1.12
0.17	1.39
0.29	1.67
0.45	1.95
0.68	2.23
0.96	2.51
1.32	2.79
1.76	3.07
2.28	3.35
2.90	3.62
3.63	3.90
4.46	4.18
4.74	4.18

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.39	-30.59
-0.38	-30.59
-0.37	-30.59
-0.36	-30.23
-0.36	-29.87
-0.35	-29.51
-0.35	-29.13
-0.34	-28.66
-0.33	-28.19
-0.33	-27.73
-0.32	-27.26
-0.32	-26.79
-0.31	-26.33
-0.31	-25.86
-0.30	-25.39
-0.30	-24.93
0	0
0.30	24.93
0.30	25.39
0.31	25.86
0.31	26.33
0.32	26.79
0.32	27.26
0.33	27.73
0.33	28.19
0.34	28.66
0.35	29.13
0.35	29.51
0.36	29.87
0.36	30.23
0.37	30.59
0.38	30.59
0.39	30.59

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.34	-68.76
-0.33	-68.76
-0.32	-68.76
-0.23	-53.91
-0.14	-39.07
-0.14	-38.45
-0.14	-37.82
-0.13	-37.19
-0.13	-36.55
-0.12	-35.90
-0.12	-35.25
-0.12	-34.58
-0.11	-33.91
-0.11	-33.23
-0.11	-32.54
-0.10	-31.84
0	0
0.10	31.84
0.11	32.54
0.11	33.23
0.11	33.91
0.12	34.58
0.12	35.25
0.12	35.90
0.13	36.55
0.13	37.19
0.14	37.82
0.14	38.45
0.14	39.07
0.23	53.91
0.32	68.76
0.33	68.76
0.34	68.76

TABLE C.2-2
P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENTS 3 & 4
All depths measured from ground surface.

Layer 1 0'-4'

Depth = 2 feet	
Elevation = 141 feet	
y (in)	p (kip/ft)
-6.80	-2.65
-6.40	-2.65
-5.20	-2.48
-4.17	-2.30
-3.28	-2.12
-2.52	-1.95
-1.90	-1.77
-1.38	-1.59
-0.97	-1.42
-0.65	-1.24
-0.41	-1.06
-0.24	-0.88
-0.12	-0.71
-0.05	-0.53
-0.02	-0.35
0.00	-0.18
0	0
0.00	0.18
0.02	0.35
0.05	0.53
0.12	0.71
0.24	0.88
0.41	1.06
0.65	1.24
0.97	1.42
1.38	1.59
1.90	1.77
2.52	1.95
3.28	2.12
4.17	2.30
5.20	2.48
6.40	2.65
6.80	2.65

Layer 2 4'-7'

Depth = 5 feet	
Elevation = 138 feet	
y (in)	p (kip/ft)
-6.62	-3.57
-6.23	-3.57
-5.06	-3.33
-4.05	-3.10
-3.19	-2.86
-2.46	-2.62
-1.85	-2.38
-1.35	-2.14
-0.94	-1.91
-0.63	-1.67
-0.40	-1.43
-0.23	-1.19
-0.12	-0.95
-0.05	-0.71
-0.01	-0.48
0.00	-0.24
0	0
0.00	0.24
0.01	0.48
0.05	0.71
0.12	0.95
0.23	1.19
0.40	1.43
0.63	1.67
0.94	1.91
1.35	2.14
1.85	2.38
2.46	2.62
3.19	2.86
4.05	3.10
5.06	3.33
6.23	3.57
6.62	3.57

Layer 3 7'-13'

Depth = 10 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.57	-12.55
-0.56	-12.55
-0.54	-12.55
-0.39	-9.84
-0.24	-7.13
-0.22	-6.83
-0.21	-6.51
-0.19	-6.19
-0.17	-5.86
-0.16	-5.51
-0.14	-5.15
-0.12	-4.77
-0.11	-4.37
-0.09	-3.95
-0.07	-3.49
-0.06	-2.99
0	0
0.06	2.99
0.07	3.49
0.09	3.95
0.11	4.37
0.12	4.77
0.14	5.15
0.16	5.51
0.17	5.86
0.19	6.19
0.21	6.51
0.22	6.83
0.24	7.13
0.39	9.84
0.54	12.55
0.56	12.55
0.57	12.55

Layer 4 13'-20'

Depth = 16 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-5.61	-4.95
-5.28	-4.95
-4.29	-4.62
-3.43	-4.29
-2.70	-3.96
-2.08	-3.63
-1.56	-3.30
-1.14	-2.97
-0.80	-2.64
-0.54	-2.31
-0.34	-1.98
-0.20	-1.65
-0.10	-1.32
-0.04	-0.99
-0.01	-0.66
0.00	-0.33
0	0
0.00	0.33
0.01	0.66
0.04	0.99
0.10	1.32
0.20	1.65
0.34	1.98
0.54	2.31
0.80	2.64
1.14	2.97
1.56	3.30
2.08	3.63
2.70	3.96
3.43	4.29
4.29	4.62
5.28	4.95
5.61	4.95

Layer 5 20'-26'

Depth = 23 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-4.96	-4.38
-4.67	-4.38
-3.80	-4.09
-3.04	-3.79
-2.39	-3.50
-1.84	-3.21
-1.38	-2.92
-1.01	-2.63
-0.71	-2.34
-0.47	-2.04
-0.30	-1.75
-0.17	-1.46
-0.09	-1.17
-0.04	-0.88
-0.01	-0.58
0.00	-0.29
0	0
0.00	0.29
0.01	0.58
0.04	0.88
0.09	1.17
0.17	1.46
0.30	1.75
0.47	2.04
0.71	2.34
1.01	2.63
1.38	2.92
1.84	3.21
2.39	3.50
3.04	3.79
3.80	4.09
4.67	4.38
4.96	4.38

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.41	-31.68
-0.40	-31.68
-0.39	-31.68
-0.38	-31.13
-0.38	-30.59
-0.37	-30.05
-0.36	-29.51
-0.35	-28.97
-0.34	-28.42
-0.33	-27.88
-0.32	-27.34
-0.32	-26.80
-0.31	-26.23
-0.30	-25.49
-0.29	-24.75
-0.28	-24.01
0	0
0.28	24.01
0.29	24.75
0.30	25.49
0.31	26.23
0.32	26.80
0.32	27.34
0.33	27.88
0.34	28.42
0.35	28.97
0.36	29.51
0.37	30.05
0.38	30.59
0.38	31.13
0.39	31.68
0.40	31.68
0.41	31.68

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.37	-73.55
-0.36	-73.55
-0.35	-73.55
-0.25	-57.67
-0.16	-41.79
-0.15	-40.91
-0.15	-40.03
-0.14	-39.12
-0.14	-38.21
-0.13	-37.27
-0.12	-36.33
-0.12	-35.37
-0.11	-34.39
-0.11	-33.39
-0.10	-32.37
-0.10	-31.33
0	0
0.10	31.33
0.10	32.37
0.11	33.39
0.11	34.39
0.12	35.37
0.12	36.33
0.13	37.27
0.14	38.21
0.14	39.12
0.15	40.03
0.15	40.91
0.16	41.79
0.25	57.67
0.35	73.55
0.36	73.55
0.37	73.55

Layer 8 36'-41'

Depth = 38.5 feet	
Elevation = 104.5 feet	
y (in)	p (kip/ft)
-0.33	-112.87
-0.32	-112.87
-0.32	-112.87
-0.31	-110.35
-0.30	-107.83
-0.29	-105.31
-0.28	-102.79
-0.27	-100.27
-0.26	-97.75
-0.25	-95.24
-0.24	-92.72
-0.23	-90.20
-0.23	-87.68
-0.22	-85.16
-0.21	-82.64
-0.20	-79.03
0	0
0.20	79.03
0.21	82.64
0.22	85.16
0.23	87.68
0.23	90.20
0.24	92.72
0.25	95.24
0.26	97.75
0.27	100.27
0.28	102.79
0.29	105.31
0.30	107.83
0.31	110.35
0.32	112.87
0.32	112.87
0.33	112.87

TABLE C.2-3
P-Y CURVES TABULAR DATA
ORIGINAL 15.5" FLUTED STEEL PILES
BENT 5
All depths measured from ground surface.

Layer 1 0'-2'

Depth = 1 foot	
Elevation = 137 feet	
y (in)	p (kip/ft)
-6.80	-2.33
-6.40	-2.33
-5.20	-2.17
-4.17	-2.02
-3.28	-1.86
-2.52	-1.71
-1.90	-1.55
-1.38	-1.40
-0.97	-1.24
-0.65	-1.09
-0.41	-0.93
-0.24	-0.78
-0.12	-0.62
-0.05	-0.47
-0.02	-0.31
0.00	-0.16
0	0
0.00	0.16
0.02	0.31
0.05	0.47
0.12	0.62
0.24	0.78
0.41	0.93
0.65	1.09
0.97	1.24
1.38	1.40
1.90	1.55
2.52	1.71
3.28	1.86
4.17	2.02
5.20	2.17
6.40	2.33
6.80	2.33

Layer 2 2'-8'

Depth = 5 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.60	-4.76
-0.59	-4.76
-0.57	-4.76
-0.41	-3.75
-0.25	-2.74
-0.23	-2.60
-0.21	-2.46
-0.19	-2.31
-0.17	-2.15
-0.15	-1.99
-0.13	-1.82
-0.11	-1.63
-0.08	-1.43
-0.06	-1.21
-0.04	-0.95
-0.02	-0.63
0	0
0.02	0.63
0.04	0.95
0.06	1.21
0.08	1.43
0.11	1.63
0.13	1.82
0.15	1.99
0.17	2.15
0.19	2.31
0.21	2.46
0.23	2.60
0.25	2.74
0.41	3.75
0.57	4.76
0.59	4.76
0.60	4.76

Layer 3 8'-15'

Depth = 11 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-5.87	-5.18
-5.53	-5.18
-4.49	-4.84
-3.60	-4.49
-2.83	-4.15
-2.18	-3.80
-1.64	-3.45
-1.19	-3.11
-0.84	-2.76
-0.56	-2.42
-0.35	-2.07
-0.20	-1.73
-0.10	-1.38
-0.04	-1.04
-0.01	-0.69
0.00	-0.35
0	0
0.00	0.35
0.01	0.69
0.04	1.04
0.10	1.38
0.20	1.73
0.35	2.07
0.56	2.42
0.84	2.76
1.19	3.11
1.64	3.45
2.18	3.80
2.83	4.15
3.60	4.49
4.49	4.84
5.53	5.18
5.87	5.18

Layer 4 15'-21'

Depth = 18 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-5.15	-4.55
-4.85	-4.55
-3.94	-4.24
-3.16	-3.94
-2.48	-3.64
-1.91	-3.33
-1.44	-3.03
-1.05	-2.73
-0.74	-2.42
-0.49	-2.12
-0.31	-1.82
-0.18	-1.52
-0.09	-1.21
-0.04	-0.91
-0.01	-0.61
0.00	-0.30
0	0
0.00	0.30
0.01	0.61
0.04	0.91
0.09	1.21
0.18	1.52
0.31	1.82
0.49	2.12
0.74	2.42
1.05	2.73
1.44	3.03
1.91	3.33
2.48	3.64
3.16	3.94
3.94	4.24
4.85	4.55
5.15	4.55

Layer 5 21'-26'

Depth = 23.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.42	-26.93
-0.41	-26.93
-0.40	-26.93
-0.39	-26.21
-0.38	-25.48
-0.36	-24.76
-0.35	-24.03
-0.33	-23.31
-0.32	-22.58
-0.31	-21.85
-0.29	-21.13
-0.28	-20.40
-0.26	-19.68
-0.25	-18.95
-0.24	-18.23
-0.22	-17.41
0	0
0.22	17.41
0.24	18.23
0.25	18.95
0.26	19.68
0.28	20.40
0.29	21.13
0.31	21.85
0.32	22.58
0.33	23.31
0.35	24.03
0.36	24.76
0.38	25.48
0.39	26.21
0.40	26.93
0.41	26.93
0.42	26.93

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.38	-61.34
-0.37	-61.34
-0.36	-61.34
-0.26	-48.09
-0.16	-34.85
-0.15	-33.84
-0.14	-32.80
-0.14	-31.75
-0.13	-30.67
-0.12	-29.56
-0.11	-28.43
-0.11	-27.27
-0.10	-26.08
-0.09	-24.85
-0.08	-23.58
-0.08	-22.26
0	0
0.08	22.26
0.08	23.58
0.09	24.85
0.10	26.08
0.11	27.27
0.11	28.43
0.12	29.56
0.13	30.67
0.14	31.75
0.14	32.80
0.15	33.84
0.16	34.85
0.26	48.09
0.36	61.34
0.37	61.34
0.38	61.34

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 104.5 feet	
y (in)	p (kip/ft)
-0.33	-99.34
-0.32	-99.34
-0.31	-99.34
-0.30	-96.55
-0.29	-93.75
-0.28	-90.96
-0.27	-88.17
-0.26	-85.38
-0.25	-82.58
-0.23	-79.79
-0.22	-77.00
-0.21	-74.20
-0.20	-71.41
-0.19	-68.62
-0.18	-65.83
-0.17	-62.80
0	0
0.17	62.80
0.18	65.83
0.19	68.62
0.20	71.41
0.21	74.20
0.22	77.00
0.23	79.79
0.25	82.58
0.26	85.38
0.27	88.17
0.28	90.96
0.29	93.75
0.30	96.55
0.31	99.34
0.32	99.34
0.33	99.34

TABLE C.2-4
P-Y CURVES TABULAR DATA
WIDEN 15" CLASS 45 PILES
BENTS 2 & 6
All depths measured below ground surface.

Layer 1 0'-4'

Depth = 2 feet	
Elevation = 141 feet	
y (in)	p (kip/ft)
-6.59	-2.59
-6.20	-2.59
-5.04	-2.41
-4.04	-2.24
-3.17	-2.07
-2.45	-1.90
-1.84	-1.72
-1.34	-1.55
-0.94	-1.38
-0.63	-1.21
-0.40	-1.03
-0.23	-0.86
-0.12	-0.69
-0.05	-0.52
-0.01	-0.34
0.00	-0.17
0	0
0.00	0.17
0.01	0.34
0.05	0.52
0.12	0.69
0.23	0.86
0.40	1.03
0.63	1.21
0.94	1.38
1.34	1.55
1.84	1.72
2.45	1.90
3.17	2.07
4.04	2.24
5.04	2.41
6.20	2.59
6.59	2.59

Layer 2 4'-7'

Depth = 5 feet	
Elevation = 138 feet	
y (in)	p (kip/ft)
-6.59	-3.56
-6.20	-3.56
-5.04	-3.32
-4.04	-3.09
-3.17	-2.85
-2.45	-2.61
-1.84	-2.37
-1.34	-2.14
-0.94	-1.90
-0.63	-1.66
-0.40	-1.42
-0.23	-1.19
-0.12	-0.95
-0.05	-0.71
-0.01	-0.47
0.00	-0.24
0	0
0.00	0.24
0.01	0.47
0.05	0.71
0.12	0.95
0.23	1.19
0.40	1.42
0.63	1.66
0.94	1.90
1.34	2.14
1.84	2.37
2.45	2.61
3.17	2.85
4.04	3.09
5.04	3.32
6.20	3.56
6.59	3.56

Layer 3 7'-13'

Depth = 10 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.61	-12.48
-0.60	-12.48
-0.58	-12.48
-0.42	-9.79
-0.26	-7.09
-0.24	-6.77
-0.22	-6.45
-0.20	-6.11
-0.18	-5.76
-0.16	-5.40
-0.15	-5.01
-0.13	-4.61
-0.11	-4.19
-0.09	-3.73
-0.07	-3.24
-0.05	-2.69
0	0
0.05	2.69
0.07	3.24
0.09	3.73
0.11	4.19
0.13	4.61
0.15	5.01
0.16	5.40
0.18	5.76
0.20	6.11
0.22	6.45
0.24	6.77
0.26	7.09
0.42	9.79
0.58	12.48
0.60	12.48
0.61	12.48

Layer 4 13'-20'

Depth = 16 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0	0
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 5 20'-26'

Depth = 23 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0	0
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.61	-38.46
-0.60	-38.46
-0.58	-38.46
-0.42	-30.16
-0.26	-21.85
-0.25	-21.59
-0.25	-21.32
-0.24	-21.06
-0.24	-20.79
-0.23	-20.51
-0.23	-20.24
-0.22	-19.96
-0.22	-19.68
-0.21	-19.40
-0.21	-19.11
-0.20	-18.82
0	0
0.20	18.82
0.21	19.11
0.21	19.40
0.22	19.68
0.22	19.96
0.23	20.24
0.23	20.51
0.24	20.79
0.24	21.06
0.25	21.32
0.25	21.59
0.26	21.85
0.42	30.16
0.58	38.46
0.60	38.46
0.61	38.46

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.61	-80.49
-0.60	-80.49
-0.58	-80.49
-0.42	-63.11
-0.26	-45.73
-0.24	-43.68
-0.22	-41.57
-0.20	-39.39
-0.18	-37.12
-0.16	-34.77
-0.15	-32.30
-0.13	-29.71
-0.11	-26.96
-0.09	-24.02
-0.07	-20.82
-0.05	-17.27
0	0
0.05	17.27
0.07	20.82
0.09	24.02
0.11	26.96
0.13	29.71
0.15	32.30
0.16	34.77
0.18	37.12
0.20	39.39
0.22	41.57
0.24	43.68
0.26	45.73
0.42	63.11
0.58	80.49
0.60	80.49
0.61	80.49

TABLE C.2-5
P-Y CURVES TABULAR DATA
WIDEN 15" CLASS 45 PILES
BENTS 3 & 4
All depths measured below ground surface.

Layer 1 0'-4'

Depth = 2 feet	
Elevation = 141 feet	
y (in)	p (kip/ft)
-6.59	-2.59
-6.20	-2.59
-5.04	-2.41
-4.04	-2.24
-3.17	-2.07
-2.45	-1.90
-1.84	-1.72
-1.34	-1.55
-0.94	-1.38
-0.63	-1.21
-0.40	-1.03
-0.23	-0.86
-0.12	-0.69
-0.05	-0.52
-0.01	-0.34
0.00	-0.17
0	0
0.00	0.17
0.01	0.34
0.05	0.52
0.12	0.69
0.23	0.86
0.40	1.03
0.63	1.21
0.94	1.38
1.34	1.55
1.84	1.72
2.45	1.90
3.17	2.07
4.04	2.24
5.04	2.41
6.20	2.59
6.59	2.59

Layer 2 4'-7'

Depth = 5 feet	
Elevation = 138 feet	
y (in)	p (kip/ft)
-6.59	-3.56
-6.20	-3.56
-5.04	-3.32
-4.04	-3.09
-3.17	-2.85
-2.45	-2.61
-1.84	-2.37
-1.34	-2.14
-0.94	-1.90
-0.63	-1.66
-0.40	-1.42
-0.23	-1.19
-0.12	-0.95
-0.05	-0.71
-0.01	-0.47
0.00	-0.24
0	0
0.00	0.24
0.01	0.47
0.05	0.71
0.12	0.95
0.23	1.19
0.40	1.42
0.63	1.66
0.94	1.90
1.34	2.14
1.84	2.37
2.45	2.61
3.17	2.85
4.04	3.09
5.04	3.32
6.20	3.56
6.59	3.56

Layer 3 7'-13'

Depth = 10 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.61	-12.48
-0.60	-12.48
-0.58	-12.48
-0.42	-9.79
-0.26	-7.09
-0.24	-6.78
-0.22	-6.45
-0.20	-6.11
-0.18	-5.76
-0.16	-5.40
-0.15	-5.02
-0.13	-4.61
-0.11	-4.19
-0.09	-3.73
-0.07	-3.24
-0.05	-2.69
0	0
0.05	2.69
0.07	3.24
0.09	3.73
0.11	4.19
0.13	4.61
0.15	5.02
0.16	5.40
0.18	5.76
0.20	6.11
0.22	6.45
0.24	6.78
0.26	7.09
0.42	9.79
0.58	12.48
0.60	12.48
0.61	12.48

Layer 4 13'-20'

Depth = 16 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0	0
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 5 20'-26'

Depth = 23 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0	0
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.61	-38.70
-0.60	-38.70
-0.58	-38.70
-0.42	-30.34
-0.26	-21.99
-0.25	-21.73
-0.25	-21.47
-0.24	-21.21
-0.24	-20.94
-0.23	-20.68
-0.23	-20.41
-0.22	-20.14
-0.22	-19.86
-0.21	-19.59
-0.21	-19.31
-0.20	-19.03
0	0
0.20	19.03
0.21	19.31
0.21	19.59
0.22	19.86
0.22	20.14
0.23	20.41
0.23	20.68
0.24	20.94
0.24	21.21
0.25	21.47
0.25	21.73
0.26	21.99
0.42	30.34
0.58	38.70
0.60	38.70
0.61	38.70

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.61	-79.82
-0.60	-79.82
-0.58	-79.82
-0.42	-62.59
-0.26	-45.36
-0.24	-43.32
-0.22	-41.22
-0.20	-39.05
-0.18	-36.79
-0.16	-34.45
-0.15	-32.00
-0.13	-29.41
-0.11	-26.68
-0.09	-23.75
-0.07	-20.56
-0.05	-17.02
0	0
0.05	17.02
0.07	20.56
0.09	23.75
0.11	26.68
0.13	29.41
0.15	32.00
0.16	34.45
0.18	36.79
0.20	39.05
0.22	41.22
0.24	43.32
0.26	45.36
0.42	62.59
0.58	79.82
0.60	79.82
0.61	79.82

Layer 8 36'-41'

Depth = 38.5 feet	
Elevation = 104.5 feet	
y (in)	p (kip/ft)
-0.61	-121.04
-0.60	-121.04
-0.58	-121.04
-0.42	-94.91
-0.26	-68.78
-0.24	-66.22
-0.23	-63.60
-0.21	-60.91
-0.20	-58.15
-0.18	-55.29
-0.16	-52.33
-0.15	-49.27
-0.13	-46.07
-0.12	-42.72
-0.10	-39.20
-0.09	-35.46
0	0
0.09	35.46
0.10	39.20
0.12	42.72
0.13	46.07
0.15	49.27
0.16	52.33
0.18	55.29
0.20	58.15
0.21	60.91
0.23	63.60
0.24	66.22
0.26	68.78
0.42	94.91
0.58	121.04
0.60	121.04
0.61	121.04

TABLE C.2-6
P-Y CURVES TABULAR DATA
WIDEN 15" CLASS 45 PILES
BENT 5
All depths measured below ground surface.

Layer 1 0'-2'

Depth = 1 feet	
Elevation = 137 feet	
y (in)	p (kip/ft)
-6.59	-2.26
-6.20	-2.26
-5.04	-2.11
-4.04	-1.96
-3.17	-1.81
-2.45	-1.66
-1.84	-1.51
-1.34	-1.36
-0.94	-1.21
-0.63	-1.06
-0.40	-0.90
-0.23	-0.75
-0.12	-0.60
-0.05	-0.45
-0.01	-0.30
0.00	-0.15
0	0
0.00	0.15
0.01	0.30
0.05	0.45
0.12	0.60
0.23	0.75
0.40	0.90
0.63	1.06
0.94	1.21
1.34	1.36
1.84	1.51
2.45	1.66
3.17	1.81
4.04	1.96
5.04	2.11
6.20	2.26
6.59	2.26

Layer 2 2'-8'

Depth = 5 feet	
Elevation = 133 feet	
y (in)	p (kip/ft)
-0.61	-4.79
-0.60	-4.79
-0.58	-4.79
-0.42	-3.77
-0.26	-2.76
-0.24	-2.62
-0.22	-2.48
-0.19	-2.33
-0.17	-2.17
-0.15	-2.01
-0.13	-1.84
-0.11	-1.65
-0.09	-1.45
-0.06	-1.22
-0.04	-0.96
-0.02	-0.64
0	0
0.02	0.64
0.04	0.96
0.06	1.22
0.09	1.45
0.11	1.65
0.13	1.84
0.15	2.01
0.17	2.17
0.19	2.33
0.22	2.48
0.24	2.62
0.26	2.76
0.42	3.77
0.58	4.79
0.60	4.79
0.61	4.79

Layer 3 8'-15'

Depth = 11 feet	
Elevation = 127 feet	
y (in)	p (kip/ft)
-6.59	-5.55
-6.20	-5.55
-5.04	-5.18
-4.04	-4.81
-3.17	-4.44
-2.45	-4.07
-1.84	-3.70
-1.34	-3.33
-0.94	-2.96
-0.63	-2.59
-0.40	-2.22
-0.23	-1.85
-0.12	-1.48
-0.05	-1.11
-0.01	-0.74
0.00	-0.37
0	0
0.00	0.37
0.01	0.74
0.05	1.11
0.12	1.48
0.23	1.85
0.40	2.22
0.63	2.59
0.94	2.96
1.34	3.33
1.84	3.70
2.45	4.07
3.17	4.44
4.04	4.81
5.04	5.18
6.20	5.55
6.59	5.55

Layer 4 15'-21'

Depth = 18 feet	
Elevation = 120 feet	
y (in)	p (kip/ft)
-6.59	-5.81
-6.20	-5.81
-5.04	-5.43
-4.04	-5.04
-3.17	-4.65
-2.45	-4.26
-1.84	-3.88
-1.34	-3.49
-0.94	-3.10
-0.63	-2.71
-0.40	-2.33
-0.23	-1.94
-0.12	-1.55
-0.05	-1.16
-0.01	-0.77
0.00	-0.39
0	0
0.00	0.39
0.01	0.77
0.05	1.16
0.12	1.55
0.23	1.94
0.40	2.33
0.63	2.71
0.94	3.10
1.34	3.49
1.84	3.88
2.45	4.26
3.17	4.65
4.04	5.04
5.04	5.43
6.20	5.81
6.59	5.81

Layer 5 21'-26'

Depth = 23.5 feet	
Elevation = 114.5 feet	
y (in)	p (kip/ft)
-0.61	-29.45
-0.60	-29.45
-0.58	-29.45
-0.42	-23.09
-0.26	-16.73
-0.25	-16.33
-0.24	-15.92
-0.23	-15.51
-0.22	-15.09
-0.21	-14.66
-0.20	-14.22
-0.19	-13.78
-0.18	-13.32
-0.17	-12.85
-0.16	-12.38
-0.15	-11.89
0	0
0.15	11.89
0.16	12.38
0.17	12.85
0.18	13.32
0.19	13.78
0.20	14.22
0.21	14.66
0.22	15.09
0.23	15.51
0.24	15.92
0.25	16.33
0.26	16.73
0.42	23.09
0.58	29.45
0.60	29.45
0.61	29.45

Layer 6 26'-31'

Depth = 28.5 feet	
Elevation = 109.5 feet	
y (in)	p (kip/ft)
-0.61	-64.76
-0.60	-64.76
-0.58	-64.76
-0.42	-50.78
-0.26	-36.80
-0.24	-35.05
-0.22	-33.25
-0.20	-31.38
-0.18	-29.44
-0.16	-27.41
-0.14	-25.28
-0.12	-23.03
-0.10	-20.62
-0.08	-18.02
-0.06	-15.14
-0.04	-11.86
0	0
0.04	11.86
0.06	15.14
0.08	18.02
0.10	20.62
0.12	23.03
0.14	25.28
0.16	27.41
0.18	29.44
0.20	31.38
0.22	33.25
0.24	35.05
0.26	36.80
0.42	50.78
0.58	64.76
0.60	64.76
0.61	64.76

Layer 7 31'-36'

Depth = 33.5 feet	
Elevation = 104.5 feet	
y (in)	p (kip/ft)
-0.61	-107.11
-0.60	-107.11
-0.58	-107.11
-0.42	-83.99
-0.26	-60.86
-0.24	-58.44
-0.23	-55.96
-0.21	-53.41
-0.19	-50.78
-0.18	-48.05
-0.16	-45.22
-0.14	-42.27
-0.13	-39.18
-0.11	-35.93
-0.09	-32.47
-0.08	-28.76
0	0
0.08	28.76
0.09	32.47
0.11	35.93
0.13	39.18
0.14	42.27
0.16	45.22
0.18	48.05
0.19	50.78
0.21	53.41
0.23	55.96
0.24	58.44
0.26	60.86
0.42	83.99
0.58	107.11
0.60	107.11
0.61	107.11

Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ **EA:** _0k800___ **EFIS**__0612000110_____ **Project Name:** Seismic Retrofit **CCID Main Canal** **Structure Design:** Sara Yip_ **Phone:** _(916) 227-8778__ **e-mail:**_____	__ **PSR/PDS (Review No.__** __ **APS/PSR (Review No.__)** _ **APS/PR (Review No.__)** __ **Type Selection** __ **65% PS&E Unchecked Details** __ **PS&E (Review No.__)** __ **Construction** __X **Other:**__FR_REVIEW NO 1__	**Reviewer Name:** _Javad Massoomi/John Huang_ _____ **Functional Unit:** _METS/GS **Cost Center:** _59-3657 **Phone Number:**227-1037 _**e-mail:** _____ **Date of Review:** _9/11/15_ **Structure Name*: CCID Main Canal**, 42-0134___ (*Use if necessary to when comment sheets are by individual structure)

Consultant Information

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
Neva Popenoe	Kleinfelder	559-486-0750	npopenoe@kleinfelder.com	9/15/15

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR	ii of iv	Please add a geologist's signature	The geologist responsible for the review of the geology section has been included on the signature page.	
2	FR	7, section 3.4	Please add design groundwater table	A comment has been added to note the design groundwater elevation.	
3	FR	7, Section 3.5	Please mention the design scour depths, reference to hydraulic report	The design scour depths have been added to the report.	
4	FR	11, section 5.2.2	Please mention USGS 2008 deaggeregation was checked	The USGS 2008 deaggregation tool was utilized to determine the Moment Magnitude for the probabilistic governed design earthquake, as per the Caltrans SDC. A note was added to Section 5.3.	
5	FR	15, Table 6.2.2	This bridge has 6 spans; was this idealized single soil profile the worst case? How the different ground surface elevations was considered? Javad, John (Liao) and Sara/Tony need to discuss more on the details and reach agreement based on needs. Thanks	The soil profile across the site was relatively consistent. Design parameters used were the worst case for the site. The ground surface at each support will change, but the layer elevations will not. For clarification, a table for each bent support was added.	

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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_____ Functional Unit:_____ Br No*._____ *=if applicable

6	FR	LOTB	Please follow Caltrans Soil and Rock Logging manual for format, thanks	The LOTB was prepared using the Caltrans Soil and Rock Logging manual, June 2010. Borings were very deep and contained too much information to be aligned vertically, and were rotated to fit the page and placed on separate pages, as permitted in the manual.	
7	Note		FR by Kleinfelder dated 09/02/15, managed through GS contract. Structure Design in house.		
8	Grade		C2 – conditional approval, subject to above comments addressed satisfactorily		
11					
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15					
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Comment & Response Form

(Revised 01/15/13)

General Project Information	Review Phase	Reviewer Information
Dist: _10_ EA: _0k800___ **EFIS__**0612000110_____ **Project Name:** Seismic Retrofit **CCID Main Canal** **Structure Design:** Sara Yip **Phone: __**(916) 227-8778__ **e-mail:_____**	**__ PSR/PDS (Review No.___** **__ APS/PSR (Review No.___)** **_ APS/PR (Review No.___)** **__ Type Selection** **__ 65% PS&E Unchecked Details** **__ PS&E (Review No.___)** **__ Construction** **__X Other:__FR_REVIEW NO 2__**	**Reviewer Name: _Javad Massoomi/John Huang_ _____** **Functional Unit: _METS/GS** **Cost Center: _59-3657** **Phone Number:227-1037 _e-mail: _____** **Date of Review: _10/5/15_** **Structure Name*: CCID Main Canal**, 42-0134___ (*Use if necessary to when comment sheets are by individual structure)

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR		No more comments		
2	FR				
3	FR				
4	FR				
5	FR				
6	FR				
7	Note		FR by Kleinfelder dated 09/15/15, managed through GS contract. Structure Design in house.		
8	Grade		C1 – Approved		
11					
12					
13					
14					
15					
16					
17					

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)

Submittal Data (Reviewer to complete)

Dist-EA:_____ Reviewer:_____ Str Name*:_____

Date of Review:_ _____ Functional Unit:_____ Br No*._____ *=if applicable

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20 November 2015

Javier Almaguer, Central Region Biology Chief
California Department of Transportation
1234 E. Shaw Ave.
Fresno, CA 93710

CLEAN WATER ACT §401 TECHNICALLY CONDITIONED WATER QUALITY CERTIFICATION FOR DISCHARGE OF DREDGED AND/OR FILL MATERIALS FOR THE SEISMIC RESTORATION BRIDGE 45-0064, WDID#5C16CR00013, KINGS COUNTY

This Order responds to the 2 July 2015 application submitted by California Department of Transportation (Applicant) for the Water Quality Certification of a transportation project permanently impacting 0.002 acres of waters of the United States.

This Order serves as certification of the subject Project permitted by the United States Army Corps of Engineers' Nationwide Permit 14 under § 401 of the Clean Water Act, and a Waste Discharge Requirement under the Porter-Cologne Water Quality Control Act and State Water Resources Control Board Order 2003-0017-DWQ.

WATER QUALITY CERTIFICATION STANDARD CONDITIONS:

1. This Certification is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to § 13330 of the California Water Code and § 3867 of Title 23 of the California Code of Regulations (23 CCR).

2. This Certification is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR § 3855(b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

3. The validity of any non-denial certification action shall be conditioned upon total payment of the full fee required under 23 CCR § 3860.

4. In the event of any violation or threatened violation of the conditions of this Certification, the violation or threatened violation shall be subject to any remedies, penalties, process, or sanctions as provided for under State law and § 401 (d) of the federal Clean Water Act. The applicability of any State law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to ensure compliance with this Certification.

WATER QUALITY CERTIFICATION GENERAL CONDITIONS:

1. Certification is valid for the duration of the Seismic Restoration Bridge 45-0064 (Project) described in the attached "Project Information Sheet." This Certification is no longer valid if the Project (as summarized in the "Project Information Sheet" and described in the water quality certification

application) is modified, or coverage under the project permit issued by the U.S. Army Corps of Engineers pursuant to § 404 of the Clean Water Act has expired.

2. The Applicant shall provide a Notice of Completion (NOC) no later than 30 days after the Project completion. The NOC shall demonstrate that the Project has been carried out in accordance with the Project description in the Certification and in any approved amendments. The NOC shall include a map of the Project location(s), including final boundaries of any on-site restoration area(s), if appropriate, and representative pre and post construction photographs. Each photograph shall include a descriptive title, date taken, photographic site, and photographic orientation.

3. All reports, notices, or other documents required by this Certification or requested by the Central Valley Water Board shall be signed by a person described below or by a duly authorized representative of that person.

   a. For a corporation: by a responsible corporate officer such as (1) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function; (2) any other person who performs similar policy or decision-making functions for the corporation; or (3) the manager of one or more manufacturing, production, or operating facilities if *authority* to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

   b. For a partnership or sole proprietorship: by a general partner or the proprietor.

   c. For a municipality, State, federal, or other public agency: by either a principal executive officer or ranking elected official.

4. Any person signing a document under General Condition No. 3 shall make the following certification, whether written or implied:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

ADDITIONAL TECHNICALLY CONDITIONED CERTIFICATION CONDITIONS:

In addition to the standard and general conditions above, the Applicant shall satisfy the following:

1. The Applicant shall notify the Central Valley Water Board in writing **seven days** prior to beginning any in-water activities.

2. Except for activities permitted by the U.S. Army Corps of Engineers under § 404 of the Clean Water Act, soil, silt, or other organic materials shall not be placed where such materials could pass into surface water or surface water drainage courses.

3. All areas disturbed by Project activities shall be protected from washout or erosion.

4. The Applicant shall maintain a copy of this Certification and supporting documentation (Project Information Sheet) at the Project site during construction for review by site personnel and agencies. All personnel (employees, contractors, and subcontractors) performing work on the

proposed Project shall be adequately informed and trained regarding the conditions of this Certification.

5. An effective combination of erosion and sediment control Best Management Practices (BMPs) shall be implemented and adequately working during all phases of construction.

6. All temporarily affected areas shall be restored to pre-construction contours and conditions upon completion of construction activities.

7. All Project activity shall take place when the river channel is dry.

8. The discharge of petroleum products or other excavated materials to the surface water channel is prohibited. Activities shall not cause visible oil, grease, or foam in the work area or downstream. The Applicant shall notify the Central Valley Water Board immediately of any spill of petroleum products or other organic or earthen materials.

9. Prior to arrival at the project site and prior to leaving the project site, construction equipment that may contain invasive plants and/or seeds shall be cleaned to reduce the spreading of noxious weeds.

10. The Applicant shall notify the Central Valley Water Board immediately if any of the above conditions are violated, along with a description of measures it is taking to remedy the violation.

11. The Applicant shall comply with all California Department of Fish and Game Code § 1600 requirements for the Project.

12. The Applicant must obtain coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction Activities issued by the State Water Resources Control Board for any project disturbing an area of one acre or greater.

13. In the event of any violation or threatened violation of the conditions of this Certification, the violation or threatened violation shall be subject to any remedies, penalties, process, or sanctions as provided for under State law and § 401 (d) of the federal Clean Water Act. The applicability of any State law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to ensure compliance with this Certification.

14. If the Applicant or a duly authorized representative of the Applicant fails or refuses to furnish technical or monitoring reports, as required under this Certification, or falsifies any information provided in the monitoring reports, the Applicant will be subject to civil liability, for each day of violation, or criminal liability.

15. In response to a suspected violation of any condition of this Certification, the Central Valley Water Board may require the Applicant to furnish, under penalty of perjury, any technical or monitoring reports the Central Valley Water Board deems appropriate, provided that the burden, including cost of the reports, shall be in reasonable relationship to the need for the reports and the benefits to be obtained from them.

16. The Applicant shall allow staff of the Central Valley Water Board, or an authorized representative(s), upon the presentation of credentials and other documents, as may be required by law, to enter the Project premises for inspection, including taking photographs and securing copies of project-related records, for the purpose of assuring compliance with this Certification and determining the ecological success of the Project.

CENTRAL VALLEY WATER BOARD CONTACT PERSON:

Debra Mahnke, Water Resource Control Engineer
1685 E Street
Fresno, CA 93706
(559) 445-6281
debra.mahnke@waterboards.ca.gov

WATER QUALITY CERTIFICATION:

I hereby issue an order certifying that the proposed discharge from the California Department of Transportation Seismic Restoration Bridge 45-0064 Project, WDID 5C16CR00013, will comply with the applicable provisions of § 301 ("Effluent Limitations"), § 302 ("Water Quality Related Effluent Limitations"), § 303 ("Water Quality Standards and Implementation Plans"), § 306 ("National Standards of Performance"), and § 307 ("Toxic and Pretreatment Effluent Standards") of the Clean Water Act. This discharge is also regulated under State Water Resources Control Board Water Quality Order No. 2003-0017 DWQ "Statewide General Waste Discharge Requirements For Dredged Or Fill Discharges That Have Received State Water Quality Certification."

Except insofar as may be modified by any preceding conditions, all certification actions are contingent on (a) the discharge being limited to and all proposed mitigation being completed in strict compliance with the Applicant's project description, the attached "Project Information Sheet," and the Applicant's water quality certification application; and (b) compliance with all applicable requirements of the Central Valley Water Board's *Water Quality Control Plan for the Tulare Lake Basin,* Second Edition, revised January 2004.

Any person aggrieved by this action may petition the State Water Resources Control Board to review the action in accordance with California Water Code § 13320 and California Code of Regulations, title 23, § 2050 and following. The State Water Resources Control Board must receive the petition by 5:00 p.m., 30 days after the date of this action, except that if the thirtieth day following the date of this action falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Resources Control Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at: http://www.waterboards.ca.gov/public_notices/petitions/water_quality or will be provided upon request.

Clay L. Rodgers

for Pamela C. Creedon
Executive Officer

Enclosure: Water Quality Order No. 2003-0017 DWQ
Attachment: Project Information Sheet

cc: Jason Brush, Supervisor, Wetlands Regulatory Office, U.S. Environmental Protection Agency, Region 9, San Francisco (email)
Kate Dadey, Sacramento South Branch Chief, Regulatory Unit, Department of the Army, Corps of Engineers, Sacramento
Bill Orme, Water Quality Certification Unit Chief, Division of Water Quality, State Water Resources Control Board, Sacramento (email)
Regional Manager, San Joaquin Valley-Southern Sierra Region, California Department of Fish and Wildlife, Fresno

PROJECT INFORMATION SHEET

Application Date: 2 July 2015

Applicant: California Department of Transportation

Applicant Representatives: Javier Almaguer, Central Section Biology Chief
David Johnson, Project Biologist

Project Name: Seismic Restoration Bridge 45-0064

Application Number: WDID 5C16CR00013

Type of Project: Transportation

Project Location: SR 43 Kings River Bridge
Section 19, Township 17 South, Range 21 East, MDB&M.
Latitude: 36.43475° and Longitude: -119.63638°

Project Duration: The Project is tentatively scheduled to begin in December 2016 and be completed in 60 working days. The schedule may be adjusted to avoid or minimize environmental impacts.

County: Kings

Receiving Water: Kings River/ Dutch John Cut, Tulare Lake Hydrologic Basin, South Valley Floor Hydrologic Unit #551.20, Raisin HA

Water Body Type: River

Designated Beneficial Uses: The *Water Quality Control Plan for the Tulare Lake Basin,* Second Edition, revised January 2004 (Basin Plan), has designated beneficial uses for surface and ground waters within the region. Beneficial uses that could be impacted by the project include, but are not limited to: Municipal and Domestic Water Supply (MUN); Agricultural Supply (AGR); Industrial Supply (IND); Hydropower Generation (POW); Groundwater Recharge (GWR); Water Contact Recreation (REC-1); Non-Contact Water Recreation (REC-2); Warm Freshwater Habitat (WARM); Cold Freshwater Habitat (COLD); Preservation of Biological Habitats of Special Significance (BIOL); Rare, Threatened, or Endangered Species (RARE); Migration of Aquatic Organisms (MIGR); Spawning, Reproduction, and/or Early Development (SPWN); and Wildlife Habitat (WILD). A comprehensive and specific list of the beneficial uses applicable for the project area can be found at http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml.

Project Description: The Project consists of seismic retrofitting an existing bridge by reinforcing bridge bents and pilings.

Preliminary Water Quality Concerns: Construction activities may impact surface waters with increased turbidity and settleable matter.

Proposed Mitigation to Address Concerns: A Storm Water Pollution Prevention Plan in conjunction with all applicable best management practices will be used pre and post construction. Work in the surface waters will occur during dry conditions. Water in the channel can be controlled and diverted upstream of the Project area, if necessary, to maintain a dry channel.

STATE WATER RESOURCES CONTROL BOARD

WATER QUALITY ORDER NO. 2003 - 0017 - DWQ

STATEWIDE GENERAL WASTE DISCHARGE REQUIREMENTS FOR DREDGED OR FILL DISCHARGES THAT HAVE RECEIVED STATE WATER QUALITY CERTIFICATION (GENERAL WDRs)

The State Water Resources Control Board (SWRCB) finds that:

1. Discharges eligible for coverage under these General WDRs are discharges of dredged or fill material that have received State Water Quality Certification (Certification) pursuant to federal Clean Water Act (CWA) section 401.

2. Discharges of dredged or fill material are commonly associated with port development, stream channelization, utility crossing land development, transportation water resource, and flood control projects. Other activities, such as land clearing, may also involve discharges of dredged or fill materials (e.g., soil) into waters of the United States.

3. CWA section 404 establishes a permit program under which the U.S. Army Corps of Engineers (ACOE) regulates the discharge of dredged or fill material into waters of the United States.

4. CWA section 401 requires every applicant for a federal permit or license for an activity that may result in a discharge of pollutants to a water of the United States (including permits under section 404) to obtain Certification that the proposed activity will comply with State water quality standards. In California, Certifications are issued by the Regional Water Quality Control Boards (RWQCB) or for multi-Region discharges, the SWRCB, in accordance with the requirements of California Code of Regulations (CCR) section 3830 et seq. The SWRCB's water quality regulations do not authorize the SWRCB or RWQCBs to waive certification, and therefore, these General WDRs do not apply to any discharge authorized by federal license or permit that was issued based on a determination by the issuing agency that certification has been waived. Certifications are issued by the RWQCB or SWRCB before the ACOE may issue CWA section 404 permits. Any conditions set forth in a Certification become conditions of the federal permit or license if and when it is ultimately issued.

5. Article 4, of Chapter 4 of Division 7 of the California Water Code (CWC), commencing with section 13260(a), requires that any person discharging or proposing to discharge waste, other than to a community sewer system, that could affect the quality of the waters of the State,[1] file a report of waste discharge (ROWD). Pursuant to Article 4, the RWQCBs are required to prescribe waste discharge requirements (WDRs) for any proposed or existing discharge unless WDRs are waived pursuant to CWC section 13269. These General WDRs fulfill the requirements of Article 4 for proposed dredge or fill discharges to waters of the United States that are regulated under the State's CWA section 401 authority.

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[1] "Waters of the State" as defined in CWC Section 13050(e)

6. These General WDRs require compliance with all conditions of Certification orders to ensure that water quality standards are met.

7. The U.S. Supreme Court decision of *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers*, 531 U.S. 159 (2001) (the *SWANCC* decision) called into question the extent to which certain "isolated" waters are subject to federal jurisdiction. The SWRCB believes that a Certification is a valid and enforceable order of the SWRCB or RWQCBs irrespective of whether the water body in question is subsequently determined not to be federally jurisdictional. Nonetheless, it is the intent of the SWRCB that all Certification conditions be incorporated into these General WDRs and enforceable hereunder even if the federal permit is subsequently deemed invalid because the water is not deemed subject to federal jurisdiction.

8. The beneficial uses for the waters of the State include, but are not limited to, domestic and municipal supply, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, and preservation and enhancement of fish, wildlife, and other aquatic resources.

9. Projects covered by these General WDRs shall be assessed a fee pursuant to Title 23, CCR section 3833.

10. These General WDRs are exempt from the California Environmental Quality Act (CEQA) because (a) they are not a "project" within the meaning of CEQA, since a "project" results in a direct or indirect physical change in the environment (Title 14, CCR section 15378); and (b) the term "project" does not mean each separate governmental approval (Title 14, CCR section 15378(c)). These WDRs do not authorize any specific project. They recognize that dredge and fill discharges that need a federal license or permit must be regulated under CWA section 401 Certification, pursuant to CWA section 401 and Title 23, CCR section 3855, et seq. Certification and issuance of waste discharge requirements are overlapping regulatory processes, which are both administered by the SWRCB and RWQCBs. Each project subject to Certification requires independent compliance with CEQA and is regulated through the Certification process in the context of its specific characteristics. Any effects on the environment will therefore be as a result of the certification process, not from these General WDRs. (Title 14, CCR section 15061(b)(3)).

11. Potential dischargers and other known interested parties have been notified of the intent to adopt these General WDRs by public hearing notice.

12. All comments pertaining to the proposed discharges have been heard and considered at the November 4, 2003 SWRCB Workshop Session.

13. The RWQCBs retain discretion to impose individual or General WDRs or waivers of WDRs in lieu of these General WDRs whenever they deem it appropriate. Furthermore, these General WDRs are not intended to supersede any existing WDRs or waivers of WDRs issued by a RWQCB.

IT IS HEREBY ORDERED that WDRs are issued to all persons proposing to discharge dredged or fill material to waters of the United States where such discharge is also subject to the water quality certification requirements of CWA section 401 of the federal Clean Water Act (Title 33 United States Code section 1341), and such certification has been issued by the applicable RWQCB or the SWRCB, unless the applicable RWQCB notifies the applicant that its discharge will be regulated through WDRs or waivers of WDRs issued by the RWQCB. In order to meet the provisions contained in Division 7 of CWC and regulations adopted thereunder, dischargers shall comply with the following:

1. Dischargers shall implement all the terms and conditions of the applicable CWA section 401 Certification issued for the discharge. This provision shall apply irrespective of whether the federal license or permit for which the Certification was obtained is subsequently deemed invalid because the water body subject to the discharge has been deemed outside of federal jurisdiction.

2. Dischargers are prohibited from discharging dredged of fill material to waters of the United States without first obtaining Certification from the applicable RWQCB or SWRCB.

CERTIFICATION

The undersigned, Clerk to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on November 19, 2003.

AYE: Arthur G. Baggett, Jr.
Peter S. Silva
Richard Katz
Gary M. Carlton
Nancy H. Sutley

NO: None.

ABSENT: None.

ABSTAIN: None.

Debbie Irvin
Clerk to the Board

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
REGION 4 - CENTRAL REGION
1234 EAST SHAW AVENUE
FRESNO, CALIFORNIA 93710

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2015-0096-R4
KINGS RIVER – KINGS COUNTY

CALIFORNIA DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 6
JAVIER ALMAGUER
855 M STREET, SUITE 200
FRESNO, CALIFORNIA 93721

KIN-43 KINGS RIVER BRIDGE SEISMIC RESTORATION (PROJECT)

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Wildlife (CDFW) and California Department of Transportation (referred to as Permittee), represented by Javier Almaguer.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) Section 1602, Permittee notified CDFW on May 11, 2015, that Permittee intends to complete the Project described herein.

WHEREAS, pursuant to FGC Section 1603, CDFW has determined that the Project could substantially adversely affect existing fish or wildlife resources and has included Protective Measures in this Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed this Agreement and accepts its terms and conditions, including the Protective Measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the Project in accordance with this Agreement.

PROJECT LOCATION

The Project is located on the Kings River on State Route (SR) 43 at Post Mile 26.76, 4.5 miles north of the City of Hanford in Kings County, California; Township 17 S, Range 21 E, Section 19, United States Geological Survey (USGS) 7.5 Minute Quad Map Laton, MDB & M; Latitude 36.84414 N, Longitude -120.449614 W (Figure 1).

PROJECT DESCRIPTION

The bridge at the branch of the Kings River also known as Dutch John Cut on SR 43 requires retrofitting to meet current seismic design standards. To increase the flexibility of the bridge, pipe seat extenders will be installed at the two bridge deck hinge points (just south of Bent 6 and just north of Bent 13), requiring access under the bridge, but will otherwise not result in impacts. To strengthen the foundation of the bridge, the supporting piles will be enlarged from 16 inches in diameter to 27 inches in diameter.

The bridge has 17 bents, each consisting of seven columns. The existing outer octagonal concrete columns will remain un-encased. Each of the five interior 16-inch diameter round columns will be encased with 5.5-inch thick cast-in-place concrete reinforced with steel rebar and welded wire mesh. Table 1 below shows the specifications of work at each bent location.

For Bents 4 through 9, the concrete encasement will be installed from the bottom of the bent cap to the existing encasement that is currently exposed above the mud line. No excavation or backfill will occur at these bents. For Bents 2, 3, and 10 through 17, the encasement will be installed around the existing round columns from the bottom of the bent cap to approximately 7 feet below the current river bed elevation. An area 7 feet deep and approximately 4 feet in radius will be excavated around each column.

Table 1

	Depth of concrete encasement (feet)	Volume of concrete per bent (cubic yards)	Total weight reinforcement per bent (pounds)	Volume of Excavation per bent (cubic yards)	Volume of Backfill per bent (cubic yards)
Bent 2	9.6	4.74	719.65	99.3	95.9
Bent 3	17.3	8.54	1,333.06	99.3	95.9
Bent 4	9.9	4.89	783.16	N/A	N/A
Bent 5	9.9	4.89	783.16	N/A	N/A
Bent 6	10.2	5.04	806.67	N/A	N/A
Bent 7	10.6	5.23	838.01	N/A	N/A
Bent 8	9.5	4.69	751.81	N/A	N/A
Bent 9	10.3	5.08	814.50	N/A	N/A
Bent 10	16.7	8.24	1,286.04	99.3	95.9
Bent 11	16.3	8.05	1,254.69	99.3	95.9
Bent 12	16	7.90	1,231.19	99.3	95.9
Bent 13	15.6	7.70	1,199.84	99.3	95.9
Bent 14	15.3	7.55	1,176.33	99.3	95.9
Bent 15	15.1	7.45	1,160.66	99.3	95.9
Bent 16	14.9	7.36	1,144.98	99.3	95.9
Bent 17	11.5	5.68	878.54	99.3	95.9
Totals:	**208.7**	**103.03**	**16,162.29**	**993.0**	**959.0**

- Work will be done during naturally dry conditions so no water diversion will be required.

- No trees will be removed as a result of Project implementation, but riparian woodland shrubs will need to be trimmed for access, and some shrubs will be cut to ground level. Vegetation around the columns of Bents 2, 3, and 10 through 17 will be removed where the ground is excavated.

- Equipment staging areas will be located adjacent to the north bank of the stream on both the east and west sides of the bridge. Equipment to be used include: backhoe, bidwell and roller screeds, bobcat, bulldozer/loader, chainsaw, compressor, concrete pump, concrete truck mixers, crane, dump truck, excavator, flatbed truck, fork lift, front-end loader, genie man lift, grader, haul trucks, motor grader, paint/spray truck, pump truck, redi-mix truck, roller/compactor, scraper, truck with seed sprayer, and water truck.

PROJECT IMPACTS

The Project will result in approximately 1.99 acres of temporary impacts including 0.34 acres to riparian vegetation over 220 linear feet and 0.002 acres (103 square feet) of permanent impacts to riparian vegetation over 55 linear feet. The Project will also permanently impact 0.004 acres (206 square feet) of stream bed. A total of 993 cubic yards of material will be excavated, and 959 cubic yards of material will be back filled around Project materials including 103.03 cubic yards of concrete. Other potential impacts related to disturbance during Project implementation include but are not limited to those resulting from noise, vibration, trampling/crushing, fugitive dust, erosion, sedimentation and turbidity, introduction of fill material, and surface water contact with new concrete or other construction-related materials which could impact water quality.

This Agreement is intended to avoid, minimize, and mitigate adverse impacts to the wildlife resources that occupy the Project area and adjacent habitat. Absent implementation of the Protective Measures required by this Agreement the Federal endangered and State threatened San Joaquin kit fox (*Vulpes macrotis mutica*), as well as other birds, mammals, fish, reptiles, amphibians, invertebrates, and plants that compose the local ecosystem could potentially be impacted.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative Protective Measure described below.

1.1 Documentation at Project Site. Permittee shall make this Agreement, any extensions and amendments to this Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily

available at the Project site at all times and shall be presented to CDFW personnel or personnel from another State, Federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of this Agreement and any extensions and amendments to this Agreement to all persons who will be working on the Project at the Project site on behalf of Permittee, including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3 Notification of Conflicting Provisions. Permittee shall notify CDFW if Permittee determines or learns that a provision in this Agreement might conflict with a Protective Measure imposed on the Project by another local, State, or Federal agency. In that event, CDFW shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that CDFW personnel may enter the Project site at any time to verify compliance with this Agreement.

1.5 Legal Obligations. This Agreement does not exempt Permittee from complying with all other applicable local, State, and Federal law, or other legal obligations.

1.6 Unauthorized Take. This Agreement does not authorize the "take" (defined in Fish and Game Code §86 as to hunt, pursue, catch, capture, or kill; or attempt to hunt, pursue, catch, capture, or kill) of State- or Federally-listed threatened or endangered species. Any such take shall require separate permitting as may be required.

1.7 Property Not Owned by Permittee. To the extent that the Protective Measures of this Agreement provide for activities that require Permittee to enter on another owner's property, they are agreed to with the understanding that Permittee possesses the legal right to so enter.

1.8 Work Schedule. Permittee shall submit a work schedule to CDFW prior to beginning any activities covered by this Agreement. Permittee shall also notify CDFW upon the completion of the activities covered by this Agreement.

1.9 Training. Prior to starting Project activity, all employees and contractors who will be present during Project activities shall receive training from a qualified individual on the contents of this Agreement, the resources at stake, and the legal consequences of non-compliance. A training sign-in sheet for the employees and contractors, including the date of the training and who gave the training shall be submitted to CDFW within one (1) week of completing training.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each Protective Measure listed below.

2.1 Construction/Work Hours.

(a) All work activities shall be confined to daylight hours, except up to 10 nights of bridge deck rehabilitation work including application of the polyester concrete overlay. For purposes of this Agreement, "daylight hours" are defined as that daytime period between sunrise and sunset. Permittee shall indicate in the Final Report when night work occurred (see Reporting Measures 4.2).

(b) For work outside of daylight hours, Permittee shall not use permanent or temporary, fixed, exterior lighting, including motion-triggered security lighting, that casts light into CDFW jurisdictional areas off the bridge deck and bridge structure.

2.2 Flagging/Fencing. Prior to any activity within CDFW jurisdiction, Permittee shall identify the limits of the required access routes and encroachment into the stream. These "work area" limits shall be identified with brightly-colored flagging/fencing. Work completed under this Agreement shall be limited to this defined area only. Flagging/fencing shall be maintained in good repair for the duration of the Project. All CDFW jurisdictional areas beyond the identified work area limits shall be considered Environmentally Sensitive Areas (ESA) and shall not be disturbed.

2.3 Listed Species.

(a) This Agreement does not allow for the take of any State- or Federally-listed threatened or endangered species. Liability for any take of such listed species remains the separate responsibility of Permittee for the duration of the Project.

(b) Permittee affirms that no take of listed species shall occur as a result of this Project and will take prudent measures to ensure that all take is avoided. Permittee acknowledges and fully understands that it does not have State incidental take authority. If any State- or Federally-listed threatened or endangered species occur within the proposed work area or could be impacted by the work proposed, and thus taken as a result of Project activities, Permittee is responsible for obtaining and complying with required State and Federally threatened and endangered species permits or other written authorization before proceeding with this Project.

(c) Permittee shall immediately notify CDFW of the discovery of any such threatened or endangered species prior to and/or during Project implementation.

(d) Pre-activity surveys for potential rare, listed, or other sensitive species shall be conducted by a qualified biologist within 30 days prior to commencement of Project activities unless otherwise specified in species-specific measures below. Surveys shall be conducted within the work area and all access routes to avoid and minimize incidental take, confirm previous observations,

identify any areas occupied by listed or sensitive species, and clearly mark all resources to be avoided by Project activities. If any State- or Federally-listed threatened or endangered species are found or could be impacted by the work proposed, Permittee shall notify CDFW of the discovery prior to commencement of Project activity. An amended Agreement and/or State Incidental Take Permit may be necessary and a new CEQA analysis may need to be conducted, before work can begin.

(e) San Joaquin Kit Fox: Prior to the start of Project activities, a qualified biologist shall perform transect surveys of the Project work area and a 250-foot buffer, to identify potential dens and other kit fox sign. During Project implementation, Permittee shall follow all requirements in the United States Fish and Wildlife Service (USFWS) "USFWS Standardized Recommendations for the Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance" (http://www.fws.gov/sacramento/es/Survey-Protocols-Guidelines/Documents/kitfox_standard_rec_2011.pdf). A qualified biologist shall be on-site during all Project-related activities that could impact the species. If kit fox are found on or adjacent to the Project site, all Project activity shall cease until a qualified biologist confirms that the individual(s) has left of its own volition.

If San Joaquin kit fox dens are found, they shall be avoided by appropriate distances (potential or atypical den = 50 feet; known den = 100 feet; pupping den = 250 feet minimum). During transect surveys the den will be treated as a known den unless sign associated with natal/pupping activity is observed. If any occupied San Joaquin kit fox pupping dens are subsequently discovered, Permittee shall stop work and contact CDFW for further guidance. Absolutely no disturbance to known San Joaquin kit fox dens shall occur and no work shall occur within the above buffers without contacting CDFW and obtaining written authorization to do so. Permittee is advised that an Incidental Take Permit for San Joaquin kit fox may first be required for such activities.

2.4 General Wildlife.

(a) If any fish or wildlife is encountered during the course of Project implementation, said fish or wildlife shall be allowed to leave the Project area unharmed.

(b) Pursuant to FGC Sections 3503 and 3503.5, it is unlawful to take, possess, or destroy the nest or eggs of any bird or bird-of-prey. To protect nesting birds, no Project activity shall be completed from February 15 through August 31 unless the following avian nesting surveys are completed by a qualified biologist within 30 days prior to Project activity at each location.

Raptor Species: Survey for nesting raptors within a 500-foot radius of the Project area. If any active nests are observed, these nests shall be

designated an ESA and protected by a minimum 500-foot avoidance buffer until the breeding season has ended or until a qualified biologist has determined that the young have fledged and are no longer reliant upon the nest or parental care for survival.

Other Avian Species: Survey for nesting activity within a 250-foot radius of the defined work area. If any nesting activity is found, Permittee shall designate nests and nest substrate (trees, shrubs, ground, or burrows) as an ESA protected with a minimum 250-foot buffer until the young have fledged and are no longer reliant upon the nest or parental care for survival.

Swallows: If work cannot be avoid the avian nesting season when it would disturb nesting swallows, then Permittee shall develop a Swallow Exclusion Plan for advance approval by CDFW prior to implementation. The plan shall include methods to prevent swallows from initiating nesting on the existing bridge prior to starting Project activity, and shall include maintenance of any screen or netting used to prevent swallows from accessing bridge structures suitable for nesting. If swallow nesting has already begun on the existing bridge structure, avoidance shall occur until fledging has been completed according to "Other Avian Species", above.

CDFW may consider variances from these buffers when there is a compelling biological or ecological reason to do so, such as when the Project area would be concealed from a nest site by topography.

2.5 Vegetation.

(a) No trees shall be removed during Project implementation.

(b) Removal and trimming of vegetation shall be limited to the minimal amount necessary to complete the Project. Permittee shall minimize the number of shrubs that are cut back to the ground. Shrub roots shall be left intact.

(c) Vegetation or material removed from the Project site shall be disposed of at an appropriate and legal off-site location where the material cannot enter the stream channel. No such material shall be stockpiled in the streambed, banks, or channel, except that native vegetation removed from the channel may be chipped and the chips used as mulch for disturbed soil sites in or near the Project area.

(d) All disturbed invasive, exotic plant species disturbed by Project activities shall be bagged, removed from the Project site, and appropriately disposed of. Non-native species shall not be used in mulching, composting, or otherwise placed in or around the Project site.

(e) All equipment, including but not limited to vehicles, heavy equipment and other construction machinery shall be inspected for the presence of soil, seeds, vegetative matter or other debris that could contain seeds and cleaned prior to on-site use to reduce the risk of introducing exotic, invasive plant species into the Project site.

2.6 Vehicles and Equipment.

(a) Vehicles and equipment shall not be operated in areas where surface water is present. Vehicles and equipment shall only be operated in the channel during naturally dry conditions.

(b) Vehicle access to the channel's banks and bed shall be limited to predetermined ingress and egress corridors on existing roads. All other areas adjacent to the work site shall be considered an ESA and shall remain off-limits to construction equipment.

(c) Any equipment or vehicles driven and/or operated within or adjacent to the channel shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic and terrestrial life.

(d) Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the channel and banks. Stationary equipment such as motors, pumps, generators, compressors and welders, . located within or adjacent to the channel, shall be positioned over drip-pans. Vehicles shall be moved away from the channel prior to refueling and lubrication.

2.7 Structures. Permittee shall confirm that all structures and installed features are designed (i.e., size and alignment), constructed, and maintained such that they will not fail, will accommodate high flows, and will not cause long- term changes in water flows that adversely modify the existing upstream or downstream channel bed/bank contours, increase sediment deposition, or cause significant new erosion.

2.8 Fill/Spoil.

(a) Spoil storage sites shall not be located within the channel, where spoil could be washed into the channel, or where it will cover aquatic or riparian vegetation. Rock, gravel, and/or other materials shall not be imported into or moved within the bed or banks of the channel, except as otherwise addressed in this Agreement.

(b) Fill shall be limited to the minimal amount necessary to accomplish Project activities. Excess fill material shall be moved off-site at Project completion.

(c) Permittee shall cover temporary spoil piles placed on the bank with plastic sheeting or visquine when rainy or windy conditions could erode loose soils, in order to prevent loose soil from moving into the river bed.

2.9 Erosion.

(a) No work within the banks of the channel shall be conducted during or within 24 hours following significant rainfall events (defined as ¼ inch of rain or more in any 24-hour period).

(b) All disturbed soils within the Project site shall be stabilized to reduce erosion potential during and following Project activities. Temporary erosion control devices, such as straw bales, silt fencing, and sand bags, may be used, as appropriate, to prevent siltation of the channel. To minimize the risk of ensnaring and strangling wildlife, coir rolls, erosion control mats or blankets, straw or fiber wattles, or similar erosion control products shall be composed entirely of natural-fiber, biodegradable materials. Permittee shall not use "photodegradable" or other plastic erosion control materials.

2.10 Pollution.

(a) Permittee and all contractors shall be subject to the water pollution regulations found in Fish and Game Code sections 5650 and 12015.

(b) Permittee shall install the necessary containment structures (outside of forms used to shape concrete structures) to control the placement of wet concrete and to prevent it from entering into the channel outside of those structures. No concrete shall be poured below the top of bank if the 5-day weather forecast indicates any chance of rain. At all times when the Permittee is pouring or working with wet concrete there shall be a designated monitor to inspect the containment structures and ensure that no concrete or other debris enters into the channel outside of those structures. Poured concrete shall be isolated from surface waters and allowed to dry/cure for a minimum of 30 days or until the pH as tested with tap water does not exceed 9.5. Any rain water that comes into contact with the concrete structures shall be contained and isolated from stream flows; the water pH shall be tested, and water shall be removed from the site and disposed of lawfully if the pH exceeds 9.5. Permittee shall submit to CDFW the methods and results of all pH testing, including measurements that demonstrate a pH at or below 9.5 as tested prior to removing the containment structures.

(c) Raw cement, concrete or washings thereof, asphalt, drilling fluids or lubricants, paint or other coating material, oil or other petroleum products, or any other substances that could be hazardous to fish or wildlife resulting from or disturbed by Project-related activities, shall be prevented from contaminating the soil and/or entering the "Waters of the State".

(d) An Emergency Response Plan shall be prepared and submitted to CDFW for approval prior to the start of Project activities, and kept on-site during all phases of the Project. The Plan shall identify the actions that shall be taken in the event of a spill of petroleum products, concrete, contaminated soil, or other material harmful to fish, plants, or aquatic life. Emergency response materials shall be kept at the site and readily available to allow rapid containment and cleanup of any spilled material. In the event that a spill occurs, all Project activities shall immediately cease until cleanup of the spilled materials is completed. CDFW shall be notified immediately by Permittee of any spills. The Emergency Response Plan may be part of a document required by another permitting agency, such as a Water Pollution Control Program; however, the Emergency Response Plan shall be clearly identified and readily available to staff in the event of an emergency situation, and accessible during inspection of the site by CDFW personnel.

(e) All Project-generated debris, building materials, and rubbish shall be removed from the stream and from areas where such materials could be washed into the stream.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each Protective Measure listed below.

3.1 Revegetation/Restoration.

(a) Any exposed slopes or exposed areas created by Project activities shall be seeded (with weed-free straw or mulch) with a blend of a minimum of three (3) locally native grass species. One (1) or two (2) sterile non-native perennial grass species may be added to the seed mix provided that amount does not exceed 25 percent of the total seed mix by count. Locally native wildflower and/or shrub seeds may also be included in the seed mix. The seeding shall be completed as soon as possible, but no later than November 15 of the year construction ends or as otherwise approved in writing by CDFW. A seed mixture shall be submitted to CDFW for approval prior to application.

(b) Where suitable vegetation cannot be reasonably expected to become established, non-erodible materials shall be used for such stabilization. Any installation of non-erodible materials not described in the original Project description shall be coordinated with CDFW. Coordination may include the negotiation of additional Protective Measures for this activity.

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 Obligations of Permittee.

(a) Permittee shall have primary responsibility for monitoring compliance with all Protective Measures in this Agreement. Protective Measures must be implemented within the time periods indicated in this Agreement and the reporting program described below.

(b) Permittee (or Permittee's designee) shall ensure the implementation of the Protective Measures of this Agreement, and shall monitor the effectiveness of the Protective Measures.

4.2 Reports. Permittee shall submit the following Reports to CDFW:

- Work schedule, submitted to CDFW prior to commencing Project activities (Administrative Measure 1.8).
- A Training Sign-in Sheet, submitted to CDFW within one (1) week of completing training (Administrative Measure 1.9).
- Pre-activity survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(d)).
- Kit fox survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(e)).
- Results of surveys for nesting birds if any Project activities are scheduled during the avian nesting season, submitted to CDFW within one (1) week of the survey (Avoidance and Minimization Measure 2.4(b)).
- Methods and results of pH testing, if not waiting 30 days for concrete to cure, submitted to CDFW within one (1) week of testing (Avoidance and Minimization Measure 2.10(b)).
- An Emergency Response Plan, submitted to CDFW at least two (2) weeks prior to the start of Project activities (Avoidance and Minimization Measure 2.10(d)).
- A seed mixture to be used to control erosion, submitted to CDFW for approval prior to application (Compensatory Measure 3.1(a)).
- A Final Project Report to be submitted within 30 days after work covered by this Agreement is completed. The final report shall summarize the Project, and address the implementation of each Protective Measure included in this

Agreement. The report shall include a specific summary of when night work occurred. Before, during, and after photo documentation of each Project location shall be included in the report.

CONTACT INFORMATION

Any communication that Permittee or CDFW submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or CDFW specifies by written notice to the other. Permittee shall submit all schedules, survey results, reports, and/or plans required by this Agreement in hard copy to the address below; Permittee may also submit those materials electronically by email to the CDFW contact identified below (or subsequent contact) **and** to R4LSA@wildlife.ca.gov

To Permittee:

California Department of Transportation (Caltrans)
David Johnson
855 M Street, Suite 200
Fresno, California 93721
Phone: (559) 445-6456
Fax: (559) 445-6260
david.johnson@dot.ca.gov

To CDFW:

California Department of Fish and Wildlife
Region 4 - Central Region
1234 East Shaw Avenue
Fresno, California 93710
Attn: Lake and Streambed Alteration Program – Laura Peterson-Diaz
Notification No. 1600-2015-0096-R4
Phone: (559) 243-4017 extension 225
Fax: (559) 243-4020
laura.peterson-diaz@wildlife.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of this Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the Project or any activity related to it that this Agreement authorizes.

This Agreement does not constitute CDFW's endorsement of, or require Permittee to proceed with the Project. The decision to proceed with the Project is Permittee's alone.

SUSPENSION AND REVOCATION

CDFW may suspend or revoke in its entirety this Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with this Agreement.

Before CDFW suspends or revokes this Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before CDFW suspends or revokes this Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused CDFW to issue the notice.

ENFORCEMENT

Nothing in this Agreement precludes CDFW from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking this Agreement.

Nothing in this Agreement limits or otherwise affects CDFW's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from obtaining any other permits or authorizations that might be required under other Federal, State, or local laws or regulations before beginning the Project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in this Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

CDFW may amend this Agreement at any time during its term if CDFW determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend this Agreement at any time during its term, provided the amendment is mutually agreed to in writing by CDFW and Permittee. To request an amendment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Regs., Title 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of this Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter CDFW approves the transfer or assignment in writing.

The transfer or assignment of this Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one (1) extension of this Agreement, provided the request is made prior to the expiration of this Agreement's term. To request an extension, Permittee shall submit to CDFW a completed CDFW "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5). CDFW shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend this Agreement prior to its expiration, Permittee shall submit a new notification and notification fee before beginning or continuing the Project this Agreement covers (FGC § 1605, subd. (f)).

EFFECTIVE DATE

This Agreement becomes effective on the date of CDFW's signature, which shall be: 1) after Permittee's signature; 2) after CDFW complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.wildlife.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall remain in effect for two (2) years beginning on the date signed by CDFW, unless it is terminated or extended before then. All provisions in this Agreement

shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after this Agreement expires or is terminated, as FGC section 1605(a) (2) requires.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) COMPLIANCE

In approving this Agreement, CDFW is independently required to assess the applicability of CEQA. The features of this Agreement shall be considered as part of the overall Project description.

Permittee's concurrence signature on this Agreement serves as confirmation to CDFW that the activities conducted under the terms of this Agreement are consistent with the Project as described in the CEQA Mitigated Negative Declaration prepared by California Department of Transportation as the Lead Agency for the Fresno, Kings, Madera Bridges Seismic Restoration (State Clearinghouse No. 2014081087), approved on March 13, 2015. A copy of the Mitigated Negative Declaration was provided to CDFW by Permittee.

CDFW, as a CEQA Responsible Agency, shall submit a Notice of Determination to the State Clearinghouse upon signing this Agreement.

EXHIBITS

The document listed below is included as exhibits to this Agreement and incorporated herein by reference.

Figure 1. Project Vicinity USGS Quad Map.

AUTHORITY

If the person signing this Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the Project described herein. If Permittee begins or completes a Project different from the Project this Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify CDFW in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all the provisions of this Agreement.

FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION

Javier Almaguer
Branch Chief – Caltrans Central Region Biology

9/15/2015
Date

FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

for Julie Vance
Acting Regional Manager – Central Region

9/23/15
Date

Prepared by: Laura Peterson-Diaz
Environmental Scientist

Figure 1

Exhibit A

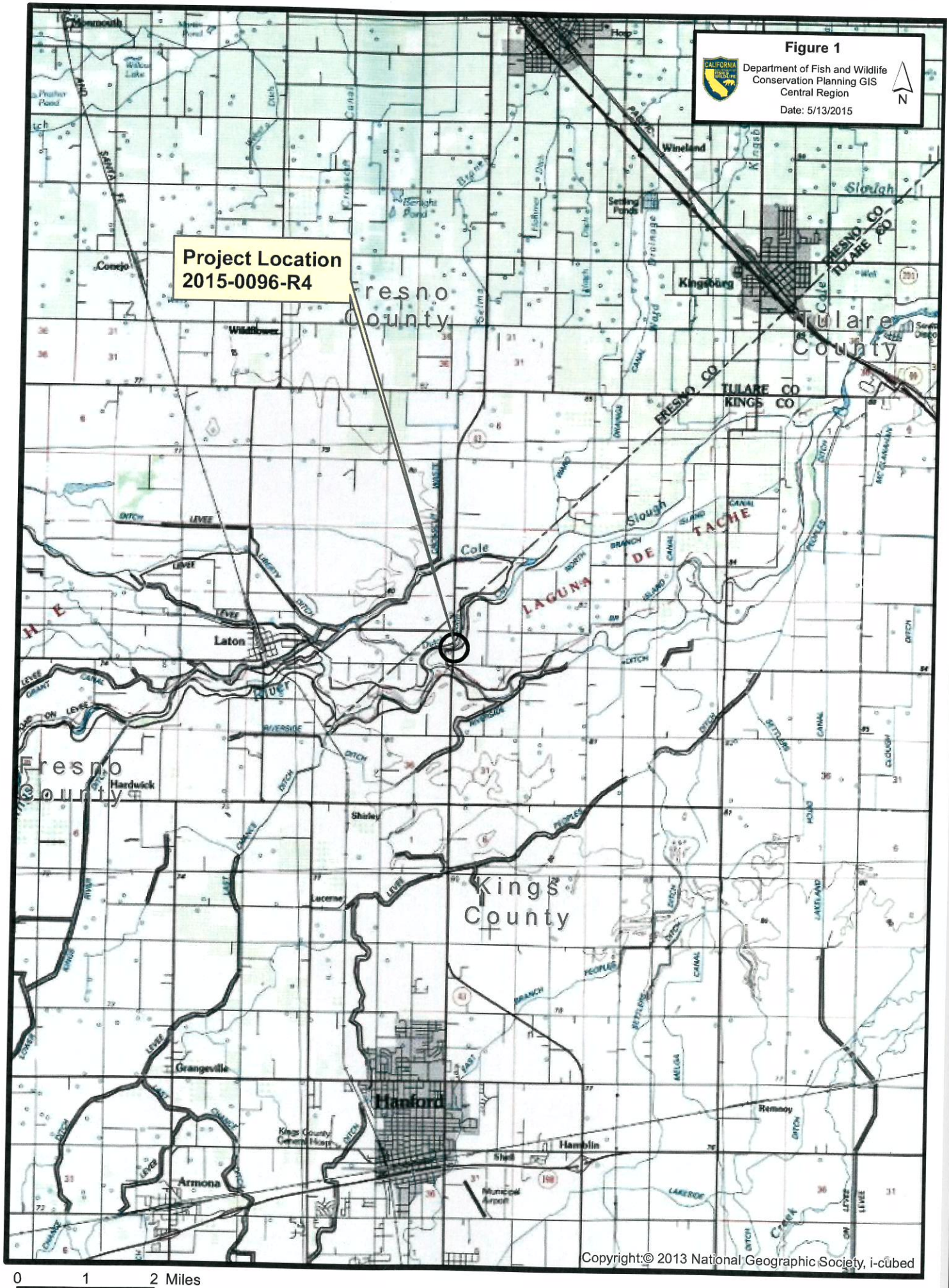
Figure 1
Department of Fish and Wildlife
Conservation Planning GIS
Central Region
Date: 5/13/2015
N
Project Location
2015-0096-R4
Fresno County
Tulare County
Kings County
Laton
Hardwick
Shirley
Lucerne
Grangeville
Hanford
Armona
Hamblin
Remnoy
Kingsburg
Wineland
Wildflower
Conejo
Cole
Slough
LAGUNA DE TACHE
FRESNO CO
TULARE CO
KINGS CO
Copyright:© 2013 National Geographic Society, i-cubed
0 1 2 Miles

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
REGION 4 - CENTRAL REGION
1234 EAST SHAW AVENUE
FRESNO, CALIFORNIA 93710

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2015-0162-R4
MAIN CANAL – FRESNO COUNTY

CALIFORNIA DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 6
JAVIER ALMAGUER
855 M STREET, SUITE 200
FRESNO, CALIFORNIA 93721

FRE-33 MAIN CANAL BRIDGE NO. 42-0134 SEISMIC RESTORATION (PROJECT)

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Wildlife (CDFW) and the California Department of Transportation (referred to as Permittee), represented by Javier Almaguer.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) Section 1602, Permittee notified CDFW on August 5, 2015, that Permittee intends to complete the Project described herein.

WHEREAS, pursuant to FGC Section 1603, CDFW has determined that the Project could substantially adversely affect existing fish or wildlife resources and has included Protective Measures in this Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed this Agreement and accepts its terms and conditions, including the Protective Measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the Project in accordance with this Agreement.

PROJECT LOCATION

The Project is located on the Main Canal on State Route (SR) 33 at Post Mile 69.1, on the southern edge of the City of Firebaugh in Fresno County, California; Township 12 S, Range 14 E, Section 33, United States Geological Survey (USGS) 7.5 Minute Quad Map Firebaugh, MDB & M; Latitude 36.84441 N, Longitude -120.44967 W (Figure 1).

PROJECT DESCRIPTION

The California Department of Transportation has identified Bridge 42-0134 on SR 33 over the Main Canal as needing seismic restoration work. The concrete slab-hinge retrofit will entail three seat extenders, which will be installed at the bridge deck hinge point (just south of Bent 4) to increase the flexibility of the bridge and to catch the slab and prevent it from collapsing in the case of a strong seismic event.

- Seat Extenders: Portions of the hinge seat extenders will need to be installed on the underside of the bridge deck and will require access under the bridge. Each of the three seat extenders along the deck hinge will consist of a support tube held in a bracket attached to the bottom of the bridge deck by nine anchor bolts. In order to install the bolts, a 1-inch diameter core will be cut through the deck with a 4-inch diameter core cut at the top 1.25 inches to 1.50 inches to allow the bolt head to be counter sunk. The gap around the bolt head will be filled with epoxy mortar when installation of the seat extenders is complete. Each bracket will be a ⅝ inch thick and 1-foot 1-inch wide horizontal plate with two ½-inch thick 1-foot by 1-foot plate arms extending down. The 4-foot 8-inch long, 1-foot high, and 6-inch wide support tube will be positioned between the plate arms extending down from the bracket. The support tube will be held in place with a 3-inch diameter round steel bar that in turn will be secured with two tack welded pins outside the arms to prevent lateral movement. The support tube will have a 2-inch by 4-inch by 6-inch elastomeric bearing pad attached to the top at each end for cushioning.

- Work will be done from two floating platforms so that no water diversion will be required. The floating platforms will be positioned on either side of the pile being worked on and will be tied in tandem to bridge piles to remain in place under the bridge. The platforms will be approximately 200 square feet (approximately 10 feet by 20 feet) with 4-foot high rails, and the edges of the platform will have a 6-inch high curb to prevent materials, tools, and debris from rolling or sliding off the edge into the water. The platforms and curb will be covered with visqueen plastic sheeting to ensure containment of fine particles and liquids. The platforms will be left in place under the bridge overnight, but nothing will be left on the platforms unless it is securely attached to the platform. The scaffolding will be no larger than 7 feet long, 4 feet wide, and 4 feet high. Access to the platforms will be by boat, either a row boat or one with a small electric trolling motor. While work is being done, a visqueen bib-like shield will be attached to the pile below the section being worked on and will extend down to the platform. The shield will catch fine particles and direct them onto the platform and prevent material from falling into the water between the two platforms.

- No construction work will be done at night. Delivery of materials to the platforms will be done by lowering via cable by crane situated on the bridge. Placement of the crane will require lane closure of SR33, so to reduce impacts to traffic this activity will be done at night. A worker on the platform will maneuver and guide the

material being lowered under the bridge and onto the platform. The worker will access the platform by boat.

- No trees or shrubs will be removed as a result of Project implementation.

- Equipment staging will be located in a flat, open, disked parcel of land adjacent to the northeast quadrant of the bridge. A small portion of flat ground adjacent to the southwest quadrant of the bridge, between the Main Canal and a private business parcel to the south with ruderal vegetation will not be used for staging and will be excluded with Environmentally Sensitive Area (ESA) orange fencing.

- Equipment to be used will include: boom type bridge inspection truck, backhoe, bidwell and roller screeds, bobcat, bulldozer/loader, chainsaw, compressor, crane, dump truck, excavator, flatbed truck, fork lift, front-end loader, genie man lift, grader, haul trucks, motor grader, paint/spray truck, roller/compactor, scraper, and water truck.

PROJECT IMPACTS

The area in which work activities will occur is 0.96 acres. No permanent impacts will result from Project activities. The staging area will temporarily impact approximately 0.5 acres of bare, disced ground. Other potential impacts related to disturbance during Project implementation include but are not limited to those resulting from noise and vibration and from surface water contact with construction-related materials.

This Agreement is intended to avoid, minimize, and mitigate adverse impacts to the wildlife resources that occupy the Project area and adjacent habitat. Absent implementation of the Protective Measures required by this Agreement, the Federal endangered and State threatened San Joaquin kit fox (V*ulpes macrotis mutica*), the State threatened Swainson's hawk (*Buteo swainsoni*), the State and Federal threatened giant garter snake (*Thamnophis gigas*), and the State species of special concern Western pond turtle (*Actinemys marmorata*) as well as other birds, mammals, fish, reptiles, amphibians, invertebrates, and plants that compose the local ecosystem could potentially be impacted.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative Protective Measure described below.

1.1 Documentation at Project Site. Permittee shall make this Agreement, any extensions and amendments to this Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the Project site at all times and shall be presented to CDFW personnel or personnel from another State, Federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of this Agreement and any extensions and amendments to this Agreement to all persons who will be working on the Project at the Project site on behalf of Permittee, including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3 Notification of Conflicting Provisions. Permittee shall notify CDFW if Permittee determines or learns that a Protective Measure in this Agreement might conflict with a provision imposed on the Project by another local, State, or Federal agency. In that event, CDFW shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that CDFW personnel may enter the Project site at any time to verify compliance with this Agreement.

1.5 Legal Obligations. This Agreement does not exempt Permittee from complying with all other applicable local, State, and Federal law, or other legal obligations.

1.6 Unauthorized Take. This Agreement does not authorize the "take" (defined in Fish and Game Code §86 as to hunt, pursue, catch, capture, or kill; or attempt to hunt, pursue, catch, capture, or kill) of State- or Federally-listed threatened or endangered species. Any such take shall require separate permitting as may be required.

1.7 Property Not Owned by Permittee. To the extent that the Protective Measures of this Agreement provide for activities that require Permittee to enter on another owner's property, they are agreed to with the understanding that Permittee possesses the legal right to so enter.

1.8 Work Schedule. Permittee shall submit a work schedule to CDFW prior to beginning any activities covered by this Agreement. Permittee shall also notify CDFW upon the completion of the activities covered by this Agreement.

1.9 Training. Prior to starting Project activity, all employees and contractors who will be present during Project activities shall receive training from a qualified individual on the contents of this Agreement, the resources at stake, and the legal consequences of non-compliance. A training sign-in sheet for the employees and contractors, including the date of the training and who gave the training shall be submitted to CDFW within one (1) week of completing training.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each Protective Measure listed below.

2.1 Construction/Work Hours. All work activities shall be confined to daylight hours, with the exception night access to the platform by boat for a person to guide the delivery of materials to the platform via a crane on the bridge. For purposes of this

Agreement, "daylight hours" are defined as that daytime period between sunrise and sunset.

2.2 Flagging/Fencing. Prior to any activity within CDFW jurisdiction, Permittee shall identify the limits of the required access routes and encroachment into the stream. These "work area" limits shall be identified with brightly-colored flagging/fencing. Work completed under this Agreement shall be limited to this defined area only. Flagging/fencing shall be maintained in good repair for the duration of the Project. All CDFW jurisdictional areas beyond the identified work area limits shall be considered Environmentally Sensitive Areas (ESA) and shall not be disturbed.

2.3 Listed and Other Special Status Species.

(a) This Agreement does not allow for the take of any State- or Federally-listed threatened or endangered species. Liability for any take of such listed species remains the separate responsibility of Permittee for the duration of the Project.

(b) Permittee affirms that no take of listed species shall occur as a result of this Project and shall take prudent measures to ensure that all take is avoided. Permittee acknowledges and fully understands that it does not have State incidental take authority. If any State- or Federally-listed threatened or endangered species occur within the proposed work area or could be impacted by the work proposed, and thus taken as a result of Project activities, Permittee is responsible for obtaining and complying with required State and Federally threatened and endangered species permits or other written authorization before proceeding with this Project.

(c) Permittee shall immediately notify CDFW of the discovery of any such threatened or endangered species prior to and/or during Project implementation.

(d) Pre-activity surveys for potential listed and other special status species shall be conducted by a qualified biologist within 30 days prior to the commencement of Project. Surveys shall be conducted within the work area and all access routes to avoid and minimize incidental take, confirm previous observations, identify any areas occupied by listed or special status species, and clearly mark all resources to be avoided by Project activities. If any State- or Federally-listed threatened or endangered species are found or could be impacted by the work proposed, Permittee shall notify CDFW of the discovery prior to commencement of Project activity. An amended Agreement and/or State Incidental Take Permit may be necessary and a new CEQA analysis may need to be conducted, before work can begin.

(e) San Joaquin Kit Fox: Prior to the start of Project activities, a qualified biologist shall perform transect surveys of the Project work area and a 250-foot buffer, to identify potential dens and other kit fox sign. During

Project implementation, Permittee shall follow all requirements in the United States Fish and Wildlife Service (USFWS) "USFWS Standardized Recommendations for the Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance" (http://www.fws.gov/sacramento/es/Survey-Protocols-Guidelines/Documents/kitfox_standard_rec_2011.pdf). A qualified biologist shall be on-site during all Project-related activities that could impact the species. If kit fox are found on or within 250 feet of the Project site, all Project activity shall cease until a qualified biologist confirms that the individual(s) has left of its own volition.

If San Joaquin kit fox dens are found, they shall be avoided by appropriate distances (potential or atypical den = 50 feet; known den = 100 feet; pupping den = 250 feet minimum). During transect surveys the den shall be treated as a known den unless sign associated with natal/pupping activity is observed. If any occupied San Joaquin kit fox pupping dens are subsequently discovered, Permittee shall stop work and contact CDFW immediately for further guidance. Absolutely no disturbance to known San Joaquin kit fox dens shall occur and no work shall occur within the above buffers without contacting CDFW and obtaining prior written authorization to do so. Permittee is advised that a State Incidental Take Permit for San Joaquin kit fox may first be required for such activities.

(f) Swainson's Hawk: No Project-related activities shall be completed from March 1 through August 31 unless a qualified biologist conducts Swainson's hawk nesting surveys following the survey methodology developed by the Swainson's Hawk Technical Advisory Committee (http://www.dfg.ca.gov/wildlife/nongame/docs/swain_proto.pdf) prior to commencing Project-related activities. Additional pre-Project surveys for active nests within a 0.5-mile radius of the Project site shall be conducted by a qualified biologist no more than 10 days prior to the start of Project activities and during the appropriate time of day to maximize detectability. A minimum no disturbance buffer of 0.5 mile shall be delineated around active nests until the breeding season has ended or until a qualified biologist has determined and CDFW has confirmed in writing that the birds have fledged and are no longer reliant upon the nest or parental care for survival. Alternately, Permittee may apply for and acquire a State Incidental Take Permit for Swainson's hawk prior to initiating Project activities, in which case an Agreement amendment may be warranted.

(g) Western Pond Turtle: Any western pond turtles discovered at the site immediately prior to or during Project activities shall be allowed to move out of the area of their own volition. If this is not feasible, they shall be captured by a qualified biologist and relocated out of harm's way to the nearest suitable habitat at least 100 feet upstream or downstream from the Project site.

2.4 Fish and Wildlife.

(a) If any fish or wildlife is encountered during the course of Project implementation, said fish or wildlife shall be allowed to leave the Project area unharmed.

(b) Pursuant to FGC Sections 3503 and 3503.5, it is unlawful to take, possess, or destroy the nest or eggs of any bird or bird-of-prey. To protect nesting birds, no Project activity shall be completed from February 15 through August 31 unless the following avian nesting surveys are completed by a qualified biologist within 30 days prior to Project activity.

Separate avian survey and avoidance requirements are listed above for Swainson's hawk, due to its special status listing (see Avoidance and Minimization Measure 2.3(f)).

Raptor Species: Survey for nesting raptors within a 500-foot radius of the Project area. If any active nests are observed, these nests shall be designated an ESA and protected by a minimum 500-foot avoidance buffer until the breeding season has ended or until a qualified biologist has determined that the young have fledged and are no longer reliant upon the nest or parental care for survival.

Other Avian Species: Survey for nesting activity within a 250-foot radius of the defined work area. If any nesting activity is found, Permittee shall designate nests and nest substrate (trees, shrubs, ground, or burrows) as an ESA protected with a minimum 250-foot buffer until the young have fledged and are no longer reliant upon the nest or parental care for survival.

Swallows: If the Project will not be completed outside the avian nesting season, Permittee shall develop a Swallow Exclusion Plan for advance approval by CDFW prior to implementation. The plan shall include methods to prevent swallows from initiating nesting on the existing bridge prior to starting Project activity, and shall include maintenance of any screen or netting used to prevent swallows from accessing bridge structures suitable for nesting. If swallow nesting has already begun on the existing bridge structure, avoidance shall occur until fledging has been completed according to "Other Avian Species", above, and is confirmed and documented by a qualified biologist.

CDFW may consider variances from these buffers when there is a compelling biological or ecological reason to do so, such as when the Project area would be concealed from a nest site by topography.

2.5 Vegetation.

(a) No trees or shrubs shall be removed or disturbed during Project implementation.

(b) Removal and trimming of vegetation shall be limited to the minimal amount necessary to complete the Project.

(c) Vegetation or material removed from the Project site shall be disposed of at an appropriate and legal off-site location where the material cannot enter the stream channel. No such material shall be stockpiled in the streambed, banks, or channel, except that native vegetation removed from the channel may be chipped and the chips used as mulch for disturbed soil sites in or near the Project area.

(d) All invasive, exotic plant species that are disturbed by Project activities shall be bagged, removed from the Project site, and appropriately disposed of. Non-native species shall not be used in mulching, composting, or otherwise placed in or around the Project site.

(e) All equipment, including but not limited to vehicles, heavy equipment and other construction machinery shall be inspected for the presence of soil, seeds, vegetative matter or other debris that could contain seeds and cleaned prior to on-site use to reduce the risk of introducing exotic, invasive plant species into the Project site.

2.6 Vehicles and Equipment.

(a) Vehicles and equipment shall not be operated in areas where surface water is present other than from the floating platform and a boat with an electric motor to convey work crews from the shore to and from the floating platform.

(b) Vehicle access to the channel's banks and bed shall be limited to predetermined ingress and egress corridors on existing roads. All other areas adjacent to the work site shall be considered an ESA and shall remain off-limits to construction equipment.

(c) Any equipment or vehicles driven and/or operated within or adjacent to the channel shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic and terrestrial life.

(d) Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the channel and banks. Stationary equipment such as motors, pumps, generators, compressors and welders, located within or adjacent to the channel, shall be positioned over drip-pans. Vehicles shall be moved away from the channel prior to refueling and lubrication.

2.7 Structures. Permittee shall confirm that all structures and installed features are designed (i.e., size and alignment) and constructed such that they will not fail, will accommodate high flows, and will not cause long- term changes in water flows that adversely modify the existing upstream or downstream channel bed/bank contours, increase sediment deposition, or cause significant new erosion.

2.8 Fill/Spoil.

(a) Spoil storage sites shall not be located within the channel, where spoil could be washed into the channel, or where it will cover aquatic or riparian vegetation. Rock, gravel, and/or other materials shall not be imported into or moved within the bed or banks of the channel, except as otherwise addressed in this Agreement.

(b) Fill shall be limited to the minimal amount necessary to accomplish Project activities. Excess fill material shall be moved off-site at Project completion.

2.9 Erosion.

(a) No work within the banks of the channel shall be conducted during or within 24 hours following significant rainfall events (defined as ¼ inch of rain or more in any 24-hour period).

(b) All disturbed soils within the Project site shall be stabilized to reduce erosion potential during and following Project activities. Temporary erosion control devices, such as straw bales, silt fencing, and sand bags, may be used, as appropriate, to prevent siltation of the channel. To minimize the risk of ensnaring and strangling wildlife, coir rolls, erosion control mats or blankets, straw or fiber wattles, or similar erosion control products shall be composed entirely of natural-fiber, biodegradable materials. Permittee shall not use "photodegradable" or other plastic erosion control materials.

2.10 Pollution.

(a) Permittee and all contractors shall be subject to the water pollution regulations found in Fish and Game Code sections 5650 and 12015.

(b) Raw cement, concrete or washings thereof, asphalt, drilling fluids or lubricants, paint or other coating material, oil or other petroleum products, or any other substances that could be hazardous to fish or wildlife resulting from or disturbed by Project-related activities, shall be prevented from contaminating the soil and/or entering the "Waters of the State".

(c) An Emergency Response Plan shall be prepared and submitted to CDFW for approval prior to the start of Project activities, and kept on-site during all phases of the Project. The Plan shall identify the actions that shall be taken in the event of a spill of petroleum products, concrete, contaminated soil, or

other material harmful to fish, plants, or aquatic life. Emergency response materials shall be kept at the site and readily available to allow rapid containment and cleanup of any spilled material. In the event that a spill occurs, all Project activities shall immediately cease until cleanup of the spilled materials is completed. CDFW shall be notified immediately by Permittee of any spills. The Emergency Response Plan may be part of a document required by another permitting agency, such as a Water Pollution Control Program; however, the Emergency Response Plan shall be clearly identified and readily available to staff in the event of an emergency situation, and accessible during inspection of the site by CDFW personnel.

(d) No deleterious materials or substances shall remain on the floating platforms overnight or while Project workers are not otherwise present at the work site.

(e) All Project-generated debris, building materials, and rubbish shall be removed from the stream and from areas where such materials could be washed into the stream.

2.11 Decontamination of Watercraft. Prior to the first use of watercraft on the Project site and each subsequent use of watercraft if it has been used at another water body since its last use on the Project site, Permittee shall decontaminate watercraft too large to immerse in a hot water bath by pressure washing with hot water a minimum of 140°F at the point of contact or 155°F at the nozzle. Additionally, Permittee shall flush watercraft engines and all areas that could contain standing water (e.g., live wells, bilges, etc.) for a minimum of 10 minutes. Following the hot water wash, Permittee shall dry all watercraft as thoroughly as possible.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each Protective Measure listed below.

3.1 Revegetation/Restoration.

(a) Any exposed slopes or exposed areas created by Project activities shall be seeded (with weed-free straw or mulch) with a blend of a minimum of three (3) locally native grass species. One (1) or two (2) sterile non-native perennial grass species may be added to the seed mix provided that amount does not exceed 25 percent of the total seed mix by count. Locally native wildflower and/or shrub seeds may also be included in the seed mix. The seeding shall be completed as soon as possible, but no later than November 15 of the year construction ends or as otherwise approved in writing by CDFW. A seed mixture shall be submitted to CDFW for approval prior to application.

(b) Where suitable vegetation cannot be reasonably expected to become established, non-erodible materials shall be used for such stabilization. Any installation of non-erodible materials not described in the original Project description shall be coordinated with CDFW. Coordination may include the negotiation of additional Protective Measures for this activity.

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 Obligations of Permittee.

(a) Permittee shall have primary responsibility for monitoring compliance with all Protective Measures in this Agreement. Protective Measures must be implemented within the time periods indicated in this Agreement and the reporting program described below.

(b) Permittee (or Permittee's designee) shall ensure the implementation of the Protective Measures of this Agreement, and shall monitor the effectiveness of the Protective Measures.

4.2 Reports. Permittee shall submit the following Reports to CDFW:

- Work schedule, submitted to CDFW prior to commencing Project activities (Administrative Measure 1.8).
- A Training Sign-in Sheet, submitted to CDFW within one (1) week of completing training (Administrative Measure 1.9).
- Pre-activity survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(d)).
- Kit fox survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(e)).
- Results of nesting Swainson's hawk surveys, if Project activity occurs during their nesting season, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(f)).
- Results of surveys for nesting birds if any Project activities are scheduled during the avian nesting season, submitted to CDFW within one (1) week of the survey (Avoidance and Minimization Measure 2.4(b)).
- An Emergency Response Plan, submitted to CDFW at least two (2) weeks prior to the start of Project activities (Avoidance and Minimization Measure 2.10(d)).

- A seed mixture to be used to control erosion, submitted to CDFW for approval prior to application (Compensatory Measure 3.1(a)).
- A Final Project Report to be submitted within 30 days after work covered by this Agreement is completed. The final report shall summarize the Project, and address the implementation of each Protective Measure included in this Agreement. Before, during, and after photo documentation of each Project location shall be included in the report.

CONTACT INFORMATION

Any communication that Permittee or CDFW submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or CDFW specifies by written notice to the other. Permittee shall submit all schedules, survey results, reports, and/or plans required by this Agreement in hard copy to the address below; Permittee may also submit those materials electronically by email to the CDFW contact identified below (or subsequent contact) **and** to R4LSA@wildlife.ca.gov.

To Permittee:

California Department of Transportation (Caltrans)
David Johnson
855 M Street, Suite 200
Fresno, California 93721
Phone: (559) 445-6456
Fax: (559) 445-6260
david.johnson@dot.ca.gov

To CDFW:

California Department of Fish and Wildlife
Region 4 - Central Region
1234 East Shaw Avenue
Fresno, California 93710
Attn: Lake and Streambed Alteration Program – Laura Peterson-Diaz
Notification No. 1600-2015-0096-R4
Phone: (559) 243-4017 extension 225
Fax: (559) 243-4020
laura.peterson-diaz@wildlife.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of this Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the Project or any activity related to it that this Agreement authorizes.

This Agreement does not constitute CDFW's endorsement of, or require Permittee to proceed with the Project. The decision to proceed with the Project is Permittee's alone.

SUSPENSION AND REVOCATION

CDFW may suspend or revoke in its entirety this Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with this Agreement.

Before CDFW suspends or revokes this Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before CDFW suspends or revokes this

Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused CDFW to issue the notice.

ENFORCEMENT

Nothing in this Agreement precludes CDFW from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking this Agreement.

Nothing in this Agreement limits or otherwise affects CDFW's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from obtaining any other permits or authorizations that might be required under other Federal, State, or local laws or regulations before beginning the Project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in this Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

CDFW may amend this Agreement at any time during its term if CDFW determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend this Agreement at any time during its term, provided the amendment is mutually agreed to in writing by CDFW and Permittee. To request an amendment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Regs., Title 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of this Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter CDFW approves the transfer or assignment in writing.

The transfer or assignment of this Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one (1) extension of this Agreement, provided the request is made prior to the expiration of this Agreement's term. To request an extension, Permittee shall submit to CDFW a completed CDFW "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5). CDFW shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend this Agreement prior to its expiration, Permittee shall submit a new notification and notification fee before beginning or continuing the Project this Agreement covers (FGC § 1605, subd. (f)).

EFFECTIVE DATE

This Agreement becomes effective on the date of CDFW's signature, which shall be: 1) after Permittee's signature; 2) after CDFW complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.wildlife.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall remain in effect for two (2) years beginning on the date signed by CDFW, unless it is terminated or extended before then. All provisions in this Agreement shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after this Agreement expires or is terminated, as FGC section 1605(a) (2) requires.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) COMPLIANCE

In approving this Agreement, CDFW is independently required to assess the applicability of CEQA. The features of this Agreement shall be considered as part of the overall Project description.

Permittee's concurrence signature on this Agreement serves as confirmation to CDFW that the activities conducted under the terms of this Agreement are consistent with the Project as described in the CEQA Mitigated Negative Declaration prepared by California Department of Transportation as the Lead Agency for the Fresno, Kings, Madera Bridges Seismic Restoration (State Clearinghouse No. 2014081087), approved on March 13, 2015. A copy of the Mitigated Negative Declaration was provided to CDFW by Permittee.

CDFW, as a CEQA Responsible Agency, shall submit a Notice of Determination to the State Clearinghouse upon signing this Agreement.

EXHIBITS

The document listed below is included as exhibits to this Agreement and incorporated herein by reference.

Figure 1. Project Vicinity USGS Quad Map.

AUTHORITY

If the person signing this Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the Project described herein. If Permittee begins or completes a Project different from the Project this Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify CDFW in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all the provisions of this Agreement.

FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION

Javier Almaguer — 2/29/2016
Date

Branch Chief – Caltrans Central Region Biology

FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Julie A. Vance — 3/2/16
Date

Regional Manager – Central Region

Prepared by: Laura Peterson-Diaz
Environmental Scientist

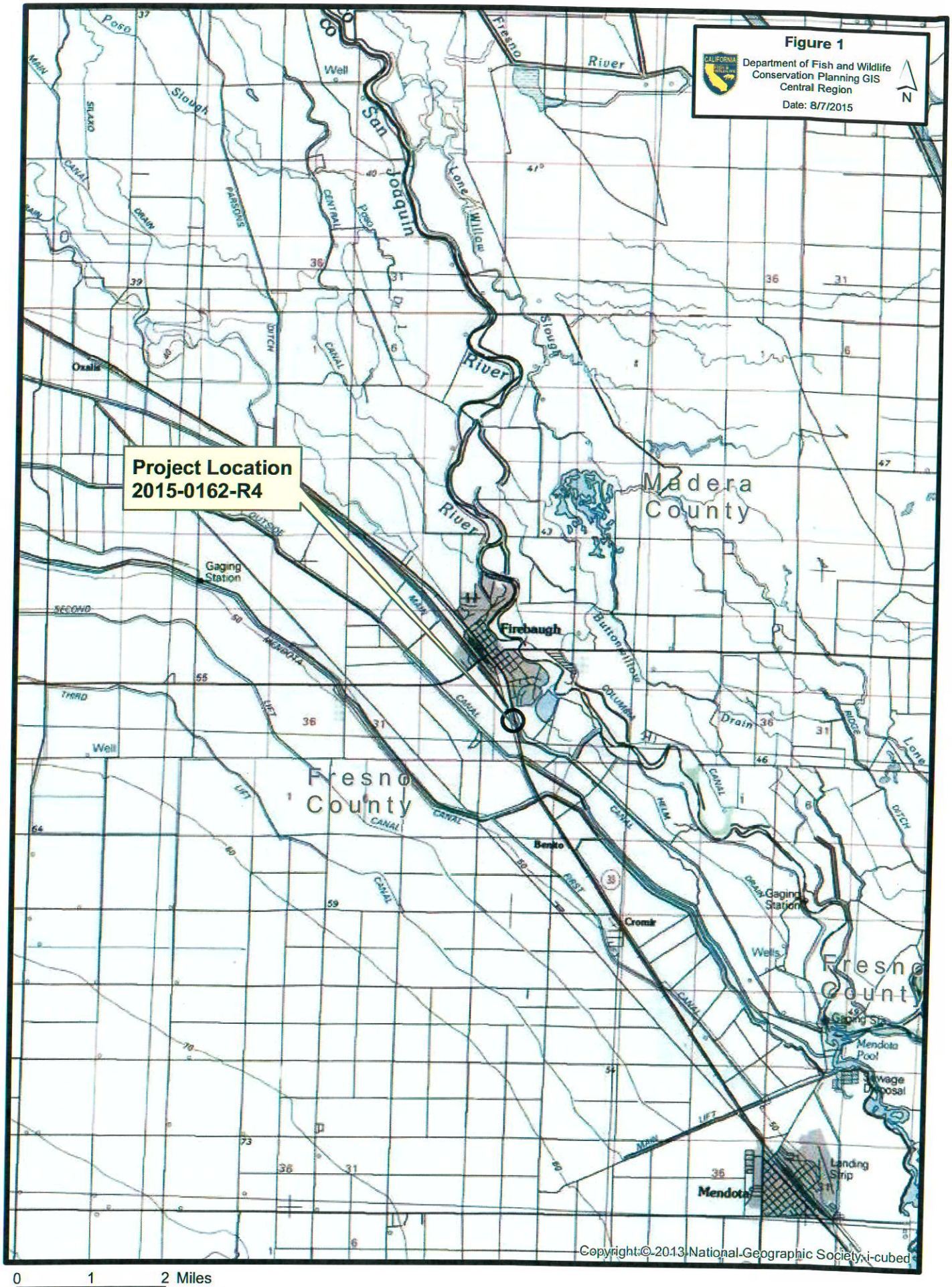
Figure 1
Department of Fish and Wildlife
Conservation Planning GIS
Central Region
Date: 8/7/2015
N
Project Location
2015-0162-R4
Madera
County
Fresno
County
Fresno
County
San
Joaquin
River
Fresno
River
Slough
Poso
Slough
Lone Willow
Slough
Oxalis
Gaging
Station
Firebaugh
Buttonwillow
Drain
Benito
Cromir
Gaging
Station
Wells
Mendota
Pool
Sewage
Disposal
Landing
Strip
Mendota
Well
Well
Copyright:© 2013 National Geographic Society, i-cubed

0 1 2 Miles

Figure 1

Exhibit A

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
REGION 4 - CENTRAL REGION
1234 EAST SHAW AVENUE
FRESNO, CALIFORNIA 93710

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2015-0138-R4
KINGS RIVER – KINGS COUNTY

CALIFORNIA DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 6
JAVIER ALMAGUER
855 M STREET, SUITE 200
FRESNO, CALIFORNIA 93721

KIN-41 KINGS RIVER BRIDGE NO. 45-0007 SEISMIC RESTORATION (PROJECT)

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Wildlife (CDFW) and the California Department of Transportation (referred to as Permittee), represented by Javier Almaguer.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) Section 1602, Permittee notified CDFW on July 13, 2015, that Permittee intends to complete the Project described herein.

WHEREAS, pursuant to FGC Section 1603, CDFW has determined that the Project could substantially adversely affect existing fish or wildlife resources and has included Protective Measures in this Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed this Agreement and accepts its terms and conditions, including the Protective Measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the Project in accordance with this Agreement.

PROJECT LOCATION

The Project is located on the Kings River on State Route (SR) 41 at Post Mile 32.26, southwest of the City of Stratford in Kings County, California; Township 20 S, Range 19 E, Section 19, United States Geological Survey (USGS) 7.5 Minute Quad Map Stratford, MDB& M; Latitude 36.18029 N, Longitude -119.83445 W (Figure 1).

PROJECT DESCRIPTION

The California Department of Transportation has identified Bridge 45-0007 on SR 41 over the Kings River as needing seismic restoration work. This will entail bent cap reinforcement at Bents 2 through 10 for stability and four seat extenders will be installed at the bridge deck hinge point (just north of Bent 6) to increase the flexibility of the bridge.

Geotechnical Test Boring: The Project includes six geotechnical borings within the bed of the Kings River. One boring will be located on the northeast shore of the Kings River adjacent to the abutment and the other five borings will extend directly through the bridge deck near the center of the spans (about halfway between piers). This will be done by first making a hole by taking a core through the bridge deck with a diameter that exceeds the 4-inch diameter of the drill casing to prevent vibrations from the drilling being transferred to the bridge. The drill rig truck mounted with CME 75 drilling equipment will also be located on the bridge deck. To prevent any accidental spills, a "diaper" system will be used, which includes laying plastic below the rig and mud tank. The drill casing will be driven through the deck and into the soils below until a seal is established (typically 10 to 20 feet deep). Once the seal is established, punch core drilling techniques will extend down through the casing and beyond to a depth of 200 feet for three of the six borings and 150 feet deep for the other three borings. The punch core technique will utilize bentonite mud, which is recirculated from a tank that will be located on the bridge deck surface. Upon completion, all borings will be backfilled with neat cement placed by the tremi method, which uses a pipe to place the concrete in the hole from bottom to top. Mud fluids, soil cuttings, concrete and debris from drilling operations will be contained in drums and hauled off site.

Seat Extenders: Portions of the hinge seat extenders will need to be installed on the underside of the bridge deck and will require access under the bridge. There will be four seat extenders along the deck hinge. Each seat extender will consist of the following: A bracket attached to the bottom of the bridge deck by nine anchor bolts that will be drilled through the bridge deck. A 0.5-foot by 1-foot by 4.6-foot support tube will be positioned between the 0.5-inch thick plate arms extending down from the bracket. The support tube will be held in place with a 3-inch diameter round bar, which in turn will be secured with two tack welded pins to prevent lateral movement. The support tube will have a 2-inch by 4-inch by 6-inch elastomeric bearing pad attached to the top at each end for cushioning.

Bent Cap Reinforcement: Steel channel sections, which resemble half an "I" beam, will be placed on either side of each bent cap to act as braces. Two sections will be used on each side and welded together to achieve the total length of approximately 49 feet. The channel sections are 18 inches high, 4.2 inches wide, and 0.7 inches thick. The channels will be held in place with 30-inch long, 1 inch diameter hex head bolts driven through the bent cap. Steel plates 0.5 inches thick and 2.75 feet wide will be attached to the underside of the bent cap in between the seven columns and will be bolted to the bottom edge of the channels with ¾-inch bolts. The specific length of each plate

depends on where it will be located and will be one of the following six lengths: 4 feet 1¼ inch, 7 feet 3¾ inch, 6 feet 9 inch, 6 feet 2⅞ inch, 5 feet 5 inch, or 2 feet 2⅜ inch.

Work will be done from two floating platforms so that no water diversion will be required. The floating platforms will be positioned on either side of the pile being worked on and will be tied in place under the bridge between the piers. The platforms will be approximately 200 square feet (approximately 10 feet by 20 feet) with 4-foot high rails, and the edges of the platforms will have a 6 inch high curb to prevent materials, tools and/or debris from rolling or sliding off the edge into the water. The platforms and curb will be covered with visqueen plastic sheeting to ensure containment of both fine particles and liquids. The platforms will be left in place under the bridge overnight, but nothing will be left on the platforms unless it is securely attached to the platform. The scaffolding will be no larger than 7 feet long, 4 feet wide, and 4 feet high. Access to the platforms will by boat, either a row boat or one with a small electric trolling motor. While work is being done, a visqueen bib like shield will be attached to the pile below the section being worked on and will extend down to the platform. The shield will catch fine particles and direct them onto the platform and preventing material from falling into the water between the two platforms.

No trees or shrubs will be removed as a result of Project implementation. Staging will occur on an unvegetated area at the northeast corner of the bridge.

Equipment staging areas may be located adjacent to the south bank of the water channel on the east sides of the bridge. Equipment to be used will include: boom type bridge inspection truck, backhoe, bidwell and roller screeds, bobcat, bulldozer/loader, chainsaw, compressor, concrete pump, concrete truck mixers, crane, dump truck, excavator, flatbed truck, fork lift, front-end loader, genie man lift, grader, haul trucks, motor grader, paint/spray truck, pile driver/drill rig, pump truck, redi-mix truck, roller/compactor, scraper, truck with seed spryer, water truck, vehicle/trailer-mounted mechanical drill rig and utility truck.

PROJECT IMPACTS

The area in which activities will occur is 1.3 acres. No permanent impacts will result from Project activities. The staging area will temporarily impact approximately 0.5 acres. Other potential impacts related to disturbance during Project implementation include but are not limited to those resulting from noise and vibration and from surface water contact with construction-related materials such as nuts, bolts, washers, or other small metallic objects with the potential to drop into the water.

This Agreement is intended to avoid, minimize, and mitigate adverse impacts to the wildlife resources that occupy the Project area and adjacent habitat. Absent implementation of the Protective Measures required by this Agreement, the Federal endangered and State threatened San Joaquin kit fox (*Vulpes macrotis mutica*) and western pond turtle (*Actinemys mormorata*) as well as other birds, mammals, fish, reptiles, amphibians, invertebrates, and plants that compose the local ecosystem could potentially be impacted.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative Protective Measure described below.

1.1 Documentation at Project Site. Permittee shall make this Agreement, any extensions and amendments to this Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the Project site at all times and shall be presented to CDFW personnel or personnel from another State, Federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of this Agreement and any extensions and amendments to this Agreement to all persons who will be working on the Project at the Project site on behalf of Permittee, including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3 Notification of Conflicting Provisions. Permittee shall notify CDFW if Permittee determines or learns that a Protective Measure in this Agreement might conflict with a provision imposed on the Project by another local, State, or Federal agency. In that event, CDFW shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that CDFW personnel may enter the Project site at any time to verify compliance with this Agreement.

1.5 Legal Obligations. This Agreement does not exempt Permittee from complying with all other applicable local, State, and Federal law, or other legal obligations.

1.6 Unauthorized Take. This Agreement does not authorize the "take" (defined in Fish and Game Code §86 as to hunt, pursue, catch, capture, or kill; or attempt to hunt, pursue, catch, capture, or kill) of State- or Federally-listed threatened or endangered species. Any such take shall require separate permitting as may be required.

1.7 Property Not Owned by Permittee. To the extent that the Protective Measures of this Agreement provide for activities that require Permittee to enter on another owner's property, they are agreed to with the understanding that Permittee possesses the legal right to so enter.

1.8 Work Schedule. Permittee shall submit a work schedule to CDFW prior to beginning any activities covered by this Agreement. Permittee shall also notify CDFW upon the completion of the activities covered by this Agreement.

1.9 Training. Prior to starting Project activity, all employees and contractors who will be present during Project activities shall receive training from a qualified individual on the contents of this Agreement, the resources at stake, and the legal

consequences of non-compliance. A training sign-in sheet for the employees and contractors, including the date of the training and who gave the training shall be submitted to CDFW within one (1) week of completing training.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each Protective Measure listed below.

2.1 Construction/Work Hours. All work activities shall be confined to daylight hours. For purposes of this Agreement, "daylight hours" are defined as that daytime period between sunrise and sunset.

2.2 Flagging/Fencing. Prior to any activity within CDFW jurisdiction, Permittee shall identify the limits of the required access routes and encroachment into the stream. These "work area" limits shall be identified with brightly-colored flagging/fencing. Work completed under this Agreement shall be limited to this defined area only. Flagging/fencing shall be maintained in good repair for the duration of the Project. All CDFW jurisdictional areas beyond the identified work area limits shall be considered Environmentally Sensitive Areas (ESA) and shall not be disturbed.

2.3 Listed and Other Special Status Species.

(a) This Agreement does not allow for the take of any State- or Federally-listed threatened or endangered species. Liability for any take of such listed species remains the separate responsibility of Permittee for the duration of the Project.

(b) Permittee affirms that no take of listed species shall occur as a result of this Project and shall take prudent measures to ensure that all take is avoided. Permittee acknowledges and fully understands that it does not have State incidental take authority. If any State- or Federally-listed threatened or endangered species occur within the proposed work area or could be impacted by the work proposed, and thus taken as a result of Project activities, Permittee is responsible for obtaining and complying with required State and Federally threatened and endangered species permits or other written authorization before proceeding with this Project.

(c) Permittee shall immediately notify CDFW of the discovery of any such threatened or endangered species prior to and/or during Project implementation.

(d) Pre-activity surveys for potential listed and other special status species shall be conducted by a qualified biologist within 30 days prior to the commencement of Project activities. Surveys shall be conducted within the work area and all access routes to avoid and minimize incidental take, confirm previous observations, identify any areas occupied by listed or

sensitive species, and clearly mark all resources to be avoided by Project activities. If any State- or Federally-listed threatened or endangered species are found or could be impacted by the work proposed, Permittee shall notify CDFW of the discovery prior to commencement of Project activity. An amended Agreement and/or State Incidental Take Permit may be necessary and a new CEQA analysis may need to be conducted, before work can begin.

(e) San Joaquin Kit Fox: Prior to the start of Project activities, a qualified biologist shall perform transect surveys of the Project work area and a 250-foot buffer, to identify potential dens and other kit fox sign. During Project implementation, Permittee shall follow all requirements in the United States Fish and Wildlife Service (USFWS) "USFWS Standardized Recommendations for the Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance" (http://www.fws.gov/sacramento/es/Survey-Protocols-Guidelines/Documents/kitfox_standard_rec_2011.pdf). A qualified biologist shall be on-site during all Project-related activities that could impact the species. If kit fox are found on or adjacent to the Project site, all Project activity shall cease until a qualified biologist confirms that the individual(s) has left of its own volition.

If San Joaquin kit fox dens are found, they shall be avoided by appropriate distances (potential or atypical den = 50 feet; known den = 100 feet; pupping den = 250 feet minimum). During transect surveys the den shall be treated as a known den unless sign associated with natal/pupping activity is observed. If any occupied San Joaquin kit fox pupping dens are subsequently discovered, Permittee shall stop work and contact CDFW immediately for further guidance. Absolutely no disturbance to known San Joaquin kit fox dens shall occur and no work shall occur within the above buffers without contacting CDFW and obtaining prior written authorization to do so. Permittee is advised that a State Incidental Take Permit for San Joaquin kit fox may first be required for such activities.

(f) Western Pond Turtle: Any western pond turtles discovered at the site immediately prior to or during Project activities shall be allowed to move out of the area of their own volition. If this is not feasible, they shall be captured by a qualified biologist and relocated out of harm's way to the nearest suitable habitat at least 100 feet upstream or downstream from the Project site.

2.4 Fish and Wildlife.

(a) If any fish or wildlife is encountered during the course of Project implementation, said fish or wildlife shall be allowed to leave the Project area unharmed.

(b) Pursuant to FGC Sections 3503 and 3503.5, it is unlawful to take, possess, or destroy the nest or eggs of any bird or bird-of-prey. To protect nesting birds,

no Project activity shall be completed from February 15 through August 31 unless the following avian nesting surveys are completed by a qualified biologist within 30 days prior to Project activity at each location.

Raptor Species: Survey for nesting raptors within a 500-foot radius of the Project area. If any active nests are observed, these nests shall be designated an ESA and protected by a minimum 500-foot avoidance buffer until the breeding season has ended or until a qualified biologist has determined that the young have fledged and are no longer reliant upon the nest or parental care for survival.

Other Avian Species: Survey for nesting activity within a 250-foot radius of the defined work area. If any nesting activity is found, Permittee shall designate nests and nest substrate (trees, shrubs, ground, or burrows) as an ESA protected with a minimum 250-foot buffer until the young have fledged and are no longer reliant upon the nest or parental care for survival.

Swallows: If the Project will not be completed outside the avian nesting season, Permittee shall develop a Swallow Exclusion Plan for advance approval by CDFW prior to implementation. The plan shall include methods to prevent swallows from initiating nesting on the existing bridge prior to starting Project activity, and shall include maintenance of any screen or netting used to prevent swallows from accessing bridge structures suitable for nesting. If swallow nesting has already begun on the existing bridge structure, avoidance shall occur until fledging has been completed according to "Other Avian Species", above, and is confirmed and documented by a qualified biologist.

CDFW may consider variances from these buffers when there is a compelling biological or ecological reason to do so, such as when the Project area would be concealed from a nest site by topography.

2.5 Vegetation.

(a) No trees or shrubs shall be removed or disturbed during Project implementation.

(b) Removal and trimming of vegetation shall be limited to the minimal amount necessary to complete the Project.

(c) Vegetation removed from the Project site shall be disposed of at an appropriate and legal off-site location where the material cannot enter the stream channel. No such material shall be stockpiled in the streambed, banks, or channel, except that native vegetation removed from the channel may be chipped and the chips used as mulch for disturbed soil sites in or near the Project area.

(d) All invasive, exotic plant species that are disturbed by Project activities shall be bagged, removed from the Project site, and appropriately disposed of. Non-native species shall not be used in mulching, composting, or otherwise placed in or around the Project site.

(e) All equipment, including but not limited to vehicles, heavy equipment and other construction machinery shall be inspected for the presence of soil, seeds, vegetative matter or other debris that could contain seeds and cleaned prior to on-site use to reduce the risk of introducing exotic, invasive plant species into the Project site.

2.6 Vehicles and Equipment.

(a) Vehicles and equipment shall not be operated in areas where surface water is present other than from the floating platform and a boat with an electric motor to convey work crews from the shore to and from the floating platform.

(b) Vehicle access to the channel's banks and bed shall be limited to predetermined ingress and egress corridors on existing roads. All other areas adjacent to the work site shall be considered an ESA and shall remain off-limits to construction equipment.

(c) Any equipment or vehicles driven and/or operated within or adjacent to the channel shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic and terrestrial life.

(d) Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the channel and banks. Stationary equipment such as motors, pumps, generators, compressors and welders, located within or adjacent to the channel, shall be positioned over drip-pans. Vehicles shall be moved away from the channel prior to refueling and lubrication.

2.7 Structures. Permittee shall confirm that all structures and installed features are designed (i.e., size and alignment) and constructed such that they will not fail, will accommodate high flows, and will not cause long- term changes in water flows that adversely modify the existing upstream or downstream channel bed/bank contours, increase sediment deposition, or cause significant new erosion.

2.8 Fill/Spoil.

(a) Spoil storage sites shall not be located within the channel, where spoil could be washed into the channel, or where it will cover aquatic or riparian vegetation. Rock, gravel, and/or other materials shall not be imported into or moved within the bed or banks of the channel, except as otherwise addressed in this Agreement.

(b) Fill shall be limited to the minimal amount necessary to accomplish Project activities. Excess fill material shall be moved off-site at Project completion.

2.9 Erosion.

(a) No work within the banks of the channel shall be conducted during or within 24 hours following significant rainfall events (defined as ¼ inch of rain or more in any 24-hour period).

(b) All disturbed soils within the Project site shall be stabilized to reduce erosion potential during and following Project activities. Temporary erosion control devices, such as straw bales, silt fencing, and sand bags, may be used, as appropriate, to prevent siltation of the channel. To minimize the risk of ensnaring and strangling wildlife, coir rolls, erosion control mats or blankets, straw or fiber wattles, or similar erosion control products shall be composed entirely of natural-fiber, biodegradable materials. Permittee shall not use "photodegradable" or other plastic erosion control materials.

2.10 Pollution.

(a) Permittee and all contractors shall be subject to the water pollution regulations found in Fish and Game Code sections 5650 and 12015.

(b) Permittee shall install the necessary containment structures (outside of forms used to shape concrete structures) to control the placement of wet concrete/cement and to prevent it from entering into the channel outside of those structures. No concrete or cement shall be poured below the top of bank if the 5-day weather forecast indicates any chance of rain. At all times when the Permittee is pouring or working with wet concrete or cement there shall be a designated monitor to inspect the containment structures and ensure that no concrete/cement or other debris enters into the channel outside of those structures. Poured concrete and cement shall be isolated from surface waters and allowed to dry/cure for a minimum of 30 days or until the pH as tested with tap water does not exceed 9.5. Any rain water that comes into contact with concrete or cement shall be contained and isolated from stream flows; the water pH shall be tested, and water shall be removed from the site and disposed of lawfully if the pH exceeds 9.5. Permittee shall submit to CDFW the methods and results of all pH testing, including measurements that demonstrate a pH at or below 9.5 as tested prior to removing the containment structures.

(c) Raw cement, concrete or washings thereof, asphalt, drilling fluids or lubricants, paint or other coating material, oil or other petroleum products, or any other substances that could be hazardous to fish or wildlife resulting from or disturbed by Project-related activities, shall be prevented from contaminating the soil and/or entering the "Waters of the State".

(d) An Emergency Response Plan shall be prepared and submitted to CDFW for approval prior to the start of Project activities, and kept on-site during all phases of the Project. The Plan shall identify the actions that shall be taken in the event of a spill of petroleum products, concrete, contaminated soil, or other material harmful to fish, plants, or aquatic life. Emergency response materials shall be kept at the site and readily available to allow rapid containment and cleanup of any spilled material. In the event that a spill occurs, all Project activities shall immediately cease until cleanup of the spilled materials is completed. CDFW shall be notified immediately by Permittee of any spills. The Emergency Response Plan may be part of a document required by another permitting agency, such as a Water Pollution Control Program; however, the Emergency Response Plan shall be clearly identified and readily available to staff in the event of an emergency situation, and accessible during inspection of the site by CDFW personnel.

(e) All Project-generated debris, building materials, and rubbish shall be removed from the stream and from areas where such materials could be washed into the stream.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each Protective Measure listed below.

3.1 Revegetation/Restoration.

(a) Any exposed slopes or exposed areas created by Project activities shall be seeded (with weed-free straw or mulch) with a blend of a minimum of three (3) locally native grass species. One (1) or two (2) sterile non-native perennial grass species may be added to the seed mix provided that amount does not exceed 25 percent of the total seed mix by count. Locally native wildflower and/or shrub seeds may also be included in the seed mix. The seeding shall be completed as soon as possible, but no later than November 15 of the year construction ends or as otherwise approved in writing by CDFW. A seed mixture shall be submitted to CDFW for approval prior to application.

(b) Where suitable vegetation cannot be reasonably expected to become established, non-erodible materials shall be used for such stabilization. Any installation of non-erodible materials not described in the original Project description shall be coordinated with CDFW. Coordination may include the negotiation of additional Protective Measures for this activity.

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 Obligations of Permittee.

(a) Permittee shall have primary responsibility for monitoring compliance with all Protective Measures in this Agreement. Protective Measures must be implemented within the time periods indicated in this Agreement and the reporting program described below.

(b) Permittee (or Permittee's designee) shall ensure the implementation of the Protective Measures of this Agreement, and shall monitor the effectiveness of the Protective Measures.

4.2 Reports. Permittee shall submit the following Reports to CDFW:

- Work schedule, submitted to CDFW prior to commencing Project activities (Administrative Measure 1.8).
- A Training Sign-in Sheet, submitted to CDFW within one (1) week of completing training (Administrative Measure 1.9).
- Pre-activity survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(d)).
- Kit fox survey results, submitted to CDFW at least one (1) week prior to the start of Project activities (Avoidance and Minimization Measure 2.3(e)).
- Results of surveys for nesting birds if any Project activities are scheduled during the avian nesting season, submitted to CDFW within one (1) week of the survey (Avoidance and Minimization Measure 2.4(b)).
- Methods and results of pH testing, if not waiting 30 days for concrete to cure, submitted to CDFW within one (1) week of testing (Avoidance and Minimization Measure 2.10(b)).
- An Emergency Response Plan, submitted to CDFW at least two (2) weeks prior to the start of Project activities (Avoidance and Minimization Measure 2.10(d)).
- A seed mixture to be used to control erosion, submitted to CDFW for approval prior to application (Compensatory Measure 3.1(a)).
- A Final Project Report to be submitted within 30 days after work covered by this Agreement is completed. The final report shall summarize the Project, and address the implementation of each Protective Measure included in this

Agreement. The report shall include a specific summary of when night work occurred. Before, during, and after photo documentation of each Project location shall be included in the report.

CONTACT INFORMATION

Any communication that Permittee or CDFW submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or CDFW specifies by written notice to the other. Permittee shall submit all schedules, survey results, reports, and/or plans required by this Agreement in hard copy to the address below; Permittee may also submit those materials electronically by email to the CDFW contact identified below (or subsequent contact) **and** to R4LSA@wildlife.ca.gov

To Permittee:

California Department of Transportation (Caltrans)
David Johnson
855 M Street, Suite 200
Fresno, California 93721
Phone: (559) 445-6260
Fax: (559) 445-6236
david.m.johnson@dot.ca.gov

To CDFW:

California Department of Fish and Wildlife
Region 4 - Central Region
1234 East Shaw Avenue
Fresno, California 93710
Attn: Lake and Streambed Alteration Program – Laura Peterson-Diaz
Notification No. 1600-2015-0096-R4
Phone: (559) 243-4017 extension 225
Fax: (559) 243-4020
laura.peterson-diaz@wildlife.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of this Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the Project or any activity related to it that this Agreement authorizes.

This Agreement does not constitute CDFW's endorsement of, or require Permittee to proceed with the Project. The decision to proceed with the Project is Permittee's alone.

SUSPENSION AND REVOCATION

CDFW may suspend or revoke in its entirety this Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with this Agreement.

Before CDFW suspends or revokes this Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before CDFW suspends or revokes this Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused CDFW to issue the notice.

ENFORCEMENT

Nothing in this Agreement precludes CDFW from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking this Agreement.

Nothing in this Agreement limits or otherwise affects CDFW's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from obtaining any other permits or authorizations that might be required under other Federal, State, or local laws or regulations before beginning the Project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in this Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

CDFW may amend this Agreement at any time during its term if CDFW determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend this Agreement at any time during its term, provided the amendment is mutually agreed to in writing by CDFW and Permittee. To request an amendment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Regs., Title 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of this Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter CDFW approves the transfer or assignment in writing.

The transfer or assignment of this Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one (1) extension of this Agreement, provided the request is made prior to the expiration of this Agreement's term. To request an extension, Permittee shall submit to CDFW a completed CDFW "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in CDFW's fee schedule at the time of the request (see Cal. Code Reg., Title 14, § 699.5). CDFW shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend this Agreement prior to its expiration, Permittee shall submit a new notification and notification fee before beginning or continuing the Project this Agreement covers (FGC § 1605, subd. (f)).

EFFECTIVE DATE

This Agreement becomes effective on the date of CDFW's signature, which shall be: 1) after Permittee's signature; 2) after CDFW complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.wildlife.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall remain in effect for two (2) years beginning on the date signed by CDFW, unless it is terminated or extended before then. All provisions in this Agreement

shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after this Agreement expires or is terminated, as FGC section 1605(a) (2) requires.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) COMPLIANCE

In approving this Agreement, CDFW is independently required to assess the applicability of CEQA. The features of this Agreement shall be considered as part of the overall Project description.

Permittee's concurrence signature on this Agreement serves as confirmation to CDFW that the activities conducted under the terms of this Agreement are consistent with the Project as described in the CEQA Mitigated Negative Declaration prepared by California Department of Transportation as the Lead Agency for the Fresno, Kings, Madera Bridges Seismic Restoration (State Clearinghouse No. 2014081087), approved on March 13, 2015. A copy of the Mitigated Negative Declaration was provided to CDFW by Permittee.

CDFW, as a CEQA Responsible Agency, shall submit a Notice of Determination to the State Clearinghouse upon signing this Agreement.

EXHIBITS

The document listed below is included as exhibits to this Agreement and incorporated herein by reference.

Figure 1. Project Vicinity USGS Quad Map.

AUTHORITY

If the person signing this Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the Project described herein. If Permittee begins or completes a Project different from the Project this Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify CDFW in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all the provisions of this Agreement.

FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION

Javier Almaguer — 1/8/16
Date

Branch Chief – Caltrans Central Region Biology

FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Julie A. Vance — 1/21/16
Date

Regional Manager – Central Region

Prepared by: Laura Peterson-Diaz
Environmental Scientist

Figure 1

Exhibit A

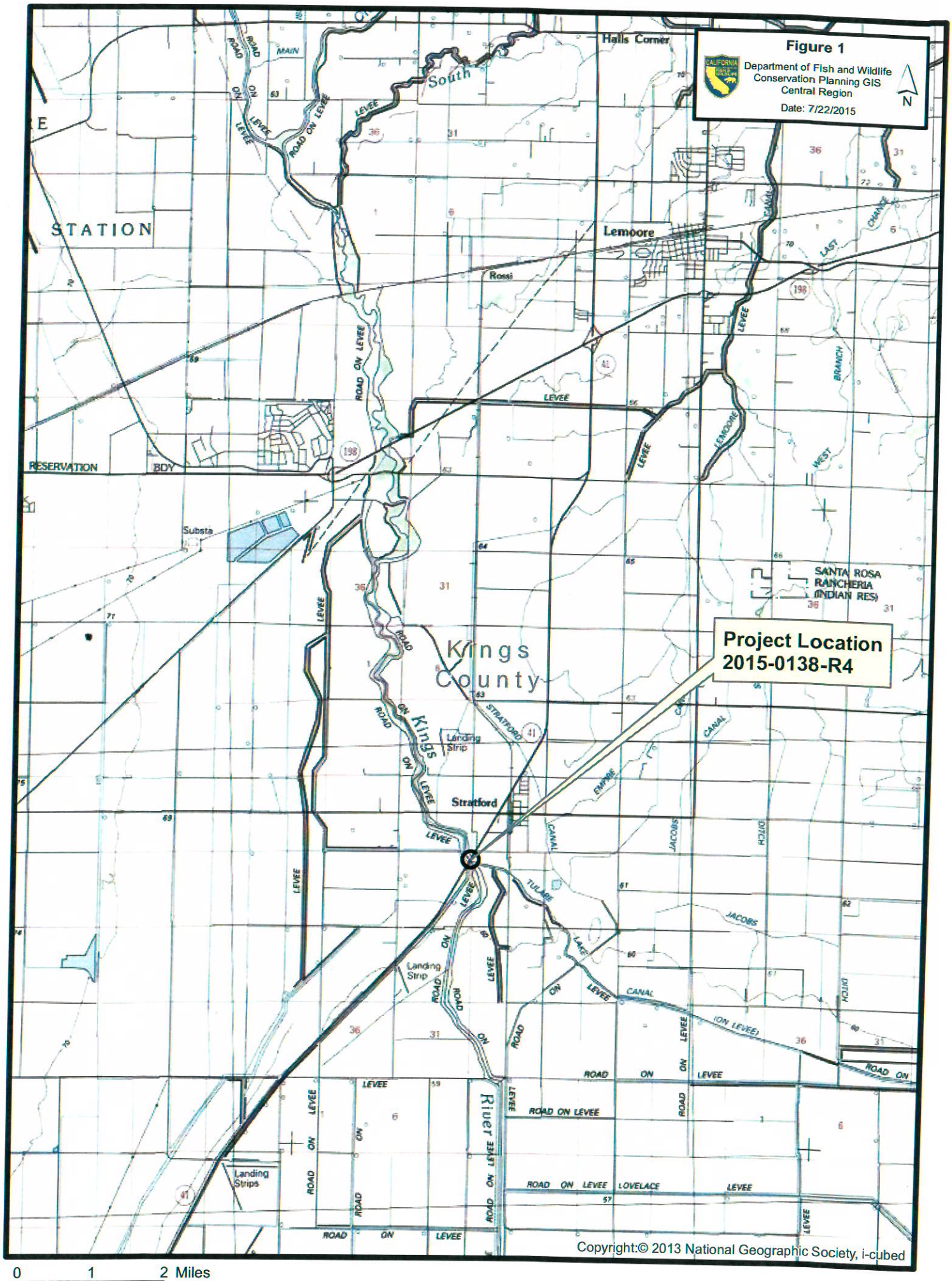
Figure 1
Department of Fish and Wildlife
Conservation Planning GIS
Central Region
Date: 7/22/2015
N
Project Location
2015-0138-R4
Halls Corner
Lemoore
Rossi
Stratford
Kings County
Kings River
South
STATION
RESERVATION
BDY
Substa
SANTA ROSA RANCHERIA (INDIAN RES)
Landing Strip
Landing Strips
ROAD ON LEVEE
LEVEE
CANAL
(ON LEVEE)
LOVELACE
STRATFORD
EMPIRE
TULARE
LAKE
JACOBS
DITCH
LAST CHANCE
WEST BRANCH
LEMOORE
MAIN
198
41
0 1 2 Miles
Copyright:© 2013 National Geographic Society, i-cubed

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **EDMUND G. BROWN JR.**, GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Rm. 151
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-2380 FAX: (916) 574-0682

January 19, 2016

Tom Fisher
California Department of Transportation (Caltrans)
2015 East Shields Avenue
Fresno, CA 93726

Re: Caltrans Bridge Retrofit (Kin-43-26.76, Br No. 45-0064) Project

Dear Mr. Fisher:

By encroachment permit application dated September 1, 2015 you are requesting to perform hinge retrofit, concrete encasement around original columns and reinstallation of rock embankment on 10th Avenue Bridge No. 45-0064 crossing the Dutch John Cut. The project is located on 10th Avenue crossing Dutch John Cut approximately 2.8 miles east of the City of Laton in Kings County. The scope of work consists of: performing hinge retrofit with seat extenders, excavation and installation of concrete encasement around original columns, removal of existing AC on deck and replacing it with polyester concrete overlay, and removal and reinstallation of rock embankment after installing rock slop protection (RSP) fabric authorized under Permit No. 16090.

Board staff has reviewed your request and concurs with the proposed work described in your encroachment permit application is considered maintenance. Therefore, per Title 23 California Code of Regulations (CCR), Article 3, Section 6 (d), an encroachment permit will not be required for the proposed work. Any modifications to the facilities permitted by Permit No. 16090 must comply with the conditions of the permit.

Please be advised that additional permits or authorizations may be required from other federal, state, or local agencies to perform this work.

If you have any questions, please contact Sungho Lee of my staff at (916) 574-2384, or by email at Sungho.Lee@water.ca.gov.

Sincerely,

Mitra Emami

Mitra Emami P.E.
Operations Branch Chief
Central Valley Flood Protection Board

Attachment: Encroachment Permit Application dated September 1, 2015

cc: Mr. Willoughby, Richard, DWR (via electronic copy)
Kings River Conservation District (via electronic copy)

APPLICATION FOR A CENTRAL VALLEY FLOOD PROTECTION BOARD ENCROACHMENT PERMIT

Application No. 19068
(For Office Use Only)

1. Description of proposed work being specific to include all items that will be covered under the issued permit.

The scope of work includes hinge retrofit with seat extenders, excavation and installation of concrete encasement around original columns, remove existing AC on deck and replace w/-polyester concrete overlay, and improve rock embankment . Existing rock embankment will be removed and reinstalled after installation of rock slope protection (RSP) fabric. The bridge(Kin-43-26.76,Br. No 45-0064)will require encroachment permits.

2. Project Location: Kings County, in Section SW 19

Township: 17S (N) (S), Range: 21E (E) (W), M. D. B. & M.

Latitude: 36.4349 Longitude: -119.63632

Stream : Kings River , Levee : Designated Floodway:

APN: See next page

3. Tom Fisher/Caltrans (Name of Applicant / Land *Owner*) of 2015 E. Shields Ave (Address)

Fresno (City) CA (State) 93726 (Zip Code) 559-243-3498 (Telephone Number)

tom.fisher@dot.ca.gov (E-mail)

4. Tom Fisher (Name of Applicant's Representative) of Caltrans (Company)

Fresno (City) CA (State) 93726 (Zip Code) 559-243-3498 (Telephone Number)

tom.fisher@dot.ca.gov (E-mail)

5. Endorsement of the proposed project from the Local Maintaining Agency (LMA):

We, the Trustees of Kings River Conservation District (Name of LMA) approve this plan, subject to the following conditions:

☐ Conditions listed on back of this form ☑ Conditions Attached ☐ No Conditions

Trustee 9/11/15 Date Trustee Date

Trustee Date Trustee Date

APPLICATION FOR A CENTRAL VALLEY FLOOD PROTECTION BOARD ENCROACHMENT PERMIT

6. Names and addresses of adjacent property owners sharing a common boundary with the land upon which the contents of this application apply. If additional space is required, list names and addresses on back of the application form or an attached sheet.

Name	Address	Zip Code
Paul Sihota (APN 002-120-018)	9910 Denver Ave, Laton, CA 93242	
JE Zumthurn (APN 002-130-005)	3802 E. Huntington Blvd, Fresno, CA 93702	
Lena Bettencourt (APN 002-120-007)	163 N. Irwin St Hanford, CA 93210	

7. Has an environmental determination been made of the proposed work under the California Environmental Quality Act of 1970? ☑ Yes ☐ No ☐ Pending

If yes or pending, give the name and address of the lead agency and State Clearinghouse Number:

Caltrans
2015 E. Sheilds Ave ste #100
Fresno, CA 93726
SCH No. 2014081087

8. When is the project scheduled for construction? March 2016

9. Please check exhibits accompanying this application.

A. ☑ Regional and vicinity maps showing the location of the proposed work.

B. ☑ Drawings showing plan view(s) of the proposed work to include map scale.

C. ☐ Drawings showing the cross section dimensions and elevations (vertical datum?) of levees, berms, stream banks, flood plain,

D. ☐ Drawings showing the profile elevations (vertical datum?) of levees, berms, flood plain, low flow, etc.

E. ☑ A minimum of four photographs depicting the project site.

Signature of Applicant — Date: 9/1/15

Include any additional information:
Hydraulics Report, Soils Report.

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Rm. 151
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-2380 FAX: (916) 574-0682

January 19, 2016

Tom Fisher
California Department of Transportation (Caltrans)
2015 East Shields Avenue
Fresno, CA 93726

Re: Caltrans Bridge Retrofit (Kin-41-32.26, Br No. 45-0007) Project

Dear Mr. Fisher:

By encroachment permit application dated September 1, 2015 you are requesting to perform hinge retrofit and strengthening of bent caps on Highway 41 Bridge No. 45-0007 crossing the Kings River. The project is located on Highway 41 crossing the Kings River approximately 0.9 miles southwest of the City of Stratford in Kings County. The scope of work consists of: performing hinge retrofit with seat extenders and strengthening of bent caps with steel sections authorized under Permit No. 14472.

Board staff has reviewed your request and concurs with the proposed work described in your encroachment permit application is considered maintenance. Therefore, per Title 23 California Code of Regulations (CCR), Article 3, Section 6 (d), an encroachment permit will not be required for the proposed work. Any modifications to the facilities permitted by Permit No. 14472 must comply with the conditions of the permit.

Please be advised that additional permits or authorizations may be required from other federal, state, or local agencies to perform this work.

If you have any questions, please contact Sungho Lee of my staff at (916) 574-2384, or by email at Sungho.Lee@water.ca.gov.

Sincerely,

Mitra Emami

Mitra Emami P.E.
Operations Branch Chief
Central Valley Flood Protection Board

Attachment: Encroachment Permit Application dated September 1, 2015

cc: Mr. Willoughby, Richard, DWR (via electronic copy)
Kings River Conservation District (via electronic copy)

APPLICATION FOR A CENTRAL VALLEY FLOOD PROTECTION BOARD
ENCROACHMENT PERMIT

Application No. 19067
(For Office Use Only)

1. Description of proposed work being specific to include all items that will be covered under the issued permit.

The scope of work includes hinge retrofit with seat extenders and strengthening of bent caps with steel sections. The following Kings County bridge (Kin-41-32.26, Br. No. 45-0007) will require Central Valley Flood Protection encroachment permits.

2. Project
Location: Kings County, in Section NE 19
Township: 20S (N) (S), Range: 20E (E) (W), M. D. B. & M.
Latitude: 36.18011 Longitude: -119.83463
Stream : Kings River , Levee : Designated Floodway:
APN: See additional information

3. Tom Fisher/Caltrans (Name of Applicant / Land *Owner*) of 2015 E. Shields Ave (Address)
Fresno (City) CA (State) 93726 (Zip Code) 559-243-3498 (Telephone Number)
tom.fisher@dot.ca.gov (E-mail)

4. Tom Fisher (Name of Applicant's Representative) of Caltrans (Company)
Fresno (City) CA (State) 93726 (Zip Code) 559-243-3498 (Telephone Number)
tom.fisher@dot.ca.gov (E-mail)

5. Endorsement of the proposed project from the Local Maintaining Agency (LMA):

We, the Trustees of Kings River Conservation District (Name of LMA) approve this plan, subject to the following conditions:

☐ Conditions listed on back of this form ☑ Conditions Attached ☐ No Conditions

Trustee 9/11/15 Date Trustee Date

Trustee Date Trustee Date

APPLICATION FOR A CENTRAL VALLEY FLOOD PROTECTION BOARD
ENCROACHMENT PERMIT

6. Names and addresses of adjacent property owners sharing a common boundary with the land upon which the contents of this application apply. If additional space is required, list names and addresses on back of the application form or an attached sheet.

Name	Address	Zip Code
Tony Rodrigues (APN 026-100-28)	P.O. Box 36 Stratford CA 93266	
Triple R Farms (APN 026-100-26)	P.O. Box 8 Stratford CA 93266	

7. Has an environmental determination been made of the proposed work under the California Environmental Quality Act of 1970? ☑ Yes ☐ No ☐ Pending

If yes or pending, give the name and address of the lead agency and State Clearinghouse Number:
Caltrans
2015 E. Sheilds Ave ste #100
Fresno, CA 93726
SCH No. 2014081087

8. When is the project scheduled for construction? March 2016

9. Please check exhibits accompanying this application.

A. ☑ Regional and vicinity maps showing the location of the proposed work.

B. ☑ Drawings showing plan view(s) of the proposed work to include map scale.

C. ☐ Drawings showing the cross section dimensions and elevations (vertical datum?) of levees, berms, stream banks, flood plain,

D. ☐ Drawings showing the profile elevations (vertical datum?) of levees, berms, flood plain, low flow, etc.

E. ☑ A minimum of four photographs depicting the project site.

Signature of Applicant 9/1/25 Date

Include any additional information:
Hydraulics Report, Soils Report.

14. Linear Transportation Projects. Activities required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., roads, highways, railways, trails, airport runways, and taxiways) in waters of the United States. For linear transportation projects in non-tidal waters, the discharge cannot cause the loss of greater than 1/2-acre of waters of the United States. For linear transportation projects in tidal waters, the discharge cannot cause the loss of greater than 1/3-acre of waters of the United States. Any stream channel modification, including bank stabilization, is limited to the minimum necessary to construct or protect the linear transportation project; such modifications must be in the immediate vicinity of the project.

This NWP also authorizes temporary structures, fills, and work necessary to construct the linear transportation project. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

This NWP cannot be used to authorize non-linear features commonly associated with transportation projects, such as vehicle maintenance or storage buildings, parking lots, train stations, or aircraft hangars.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) the loss of waters of the United States exceeds 1/10-acre; or (2) there is a discharge in a special aquatic site, including wetlands. (See general condition 31.) (Sections 10 and 404)

Note: Some discharges for the construction of farm roads or forest roads, or temporary roads for moving mining equipment, may qualify for an exemption under Section 404(f) of the Clean Water Act (see 33 CFR 323.4).

A. **Regional Conditions**

1. **Regional Conditions for California, excluding the Tahoe Basin**

http://www.spk.usace.army.mil/Portals/12/documents/regulatory/nwp/2012_nwps/2012-NWP-RC-CA.pdf

2. **Regional Conditions for Nevada, including the Tahoe Basin**

http://www.spk.usace.army.mil/Portals/12/documents/regulatory/nwp/2012_nwps/2012-NWP-RC-NV.pdf

3. **Regional Conditions for Utah**

http://www.spk.usace.army.mil/Portals/12/documents/regulatory/nwp/2012_nwps/2012-NWP-RC-UT.pdf

4. **Regional Conditions for Colorado**.

http://www.spk.usace.army.mil/Portals/12/documents/regulatory/nwp/2012_nwps//2012-NWP-RC-CO.pdf

B. **Nationwide Permit General Conditions**

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

☐ 1. **Navigation**.

☐ (a) No activity may cause more than a minimal adverse effect on navigation.

☐ (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

☐ (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters,

the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

☐ 2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

☐ 3. **Spawning Areas**. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

☐ 4. **Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

☐ 5. **Shellfish Beds**. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

☐ 6. **Suitable Material**. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

☐ 7. **Water Supply Intakes**. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

☐ 8. **Adverse Effects From Impoundments**. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

☐ 9. **Management of Water Flows**. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

☐ 10. **Fills Within 100-Year Floodplains**. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

☐ 11. **Equipment**. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

☐ 12. **Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

☐ 13. **Removal of Temporary Fills**. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

☐ 14. **Proper Maintenance**. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

☐ 15. **Single and Complete Project**. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

☐ 16. **Wild and Scenic Rivers**. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

☐ 17. **Tribal Rights**. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

☐ 18. **Endangered Species**.

☐ (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which “may affect” a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

☐ (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to

demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

☐ (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

☐ (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

☐ (e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

☐ (f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

☐ 19. **Migratory Birds and Bald and Golden Eagles**. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

☐ 20. **Historic Properties**.

☐ (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

☐ (b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

☐ (c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified

historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

☐ (d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non- Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

☐ (e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

☐ 21. **Discovery of Previously Unknown Remains and Artifacts**. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

☐ **22. Designated Critical Resource Waters**. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

☐ (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

☐ (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

☐ **23. Mitigation**. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

☐ (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

☐ (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

☐ (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

☐ (1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

☐ (2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

☐ (3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

☐ (4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

☐ (5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

☐ (d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

☐ (e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

☐ (f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

☐ (g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

☐ **24. Safety of Impoundment Structures**. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

☐ **25. Water Quality**. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

☐ **26. Coastal Zone Management**. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

☐ **27. Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

☐ **28. Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

☐ **29. Transfer of Nationwide Permit Verifications**. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

> "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."
>
> ----------
> (Transferee)
>
> ----------
> (Date)

☐ **30. Compliance Certification**. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

☐ (a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

☐ (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

☐ (c) The signature of the permittee certifying the completion of the work and mitigation.

☐ **31. Pre-Construction Notification**.

☐ (a) **Timing**. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

☐ (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

☐ (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2)..

☐ (b) <u>Contents of Pre-Construction Notification</u>: The PCN must be in writing and include the following information:

☐ (1) Name, address and telephone numbers of the prospective permittee;

☐ (2) Location of the proposed project;

☐ (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

☐ (4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

☐ (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

☐ (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

☐ (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

☐ (c) Form of Pre-Construction Notification: he standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

☐ (d) Agency Coordination:

☐ (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

☐ (2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where

there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

☐ (3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

☐ (4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

C. District Engineer's Decision

☐ 1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

☐ 2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10- acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

☐ 3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

D. **Further Information**

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

E. **Definitions**

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

I**ntermittent stream**: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States. If a jurisdictional wetland is adjacent – meaning bordering, contiguous, or neighboring – to a waterbody determined to be a water of the United States under 33 CFR 328.3(a)(1)-(6), that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

Final Sacramento District Nationwide Permit
Regional Conditions for California, excluding the Lake Tahoe Basin
(Effective March 19, 2012 until March 18, 2017)

1.* When pre-construction notification (PCN) is required, the permittee shall notify the U.S. Army Corps of Engineers, Sacramento District (Corps) in accordance with General Condition 31 using either the South Pacific Division Preconstruction Notification (PCN) Checklist or a signed application form (ENG Form 4345) with an attachment providing information on compliance with all of the General and Regional Conditions. In addition, the PCN shall include:

a. A written statement describing how the activity has been designed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States;

b. Drawings, including plan and cross-section views, clearly depicting the location, size and dimensions of the proposed activity, as well as the location of delineated waters of the U.S. on the site. The drawings shall contain a title block, legend and scale, amount (in cubic yards) and area (in acres) of fill in Corps jurisdiction, including both permanent and temporary fills/structures. The ordinary high water mark or, if tidal waters, the mean high water mark and high tide line, should be shown (in feet), based on National Geodetic Vertical Datum (NGVD) or other appropriate referenced elevation. All drawings for activities located within the boundaries of the Los Angeles District shall comply with the September 15, 2010 Special Public Notice: *Map and Drawing Standards for the Los Angeles District Regulatory Division*, (available on the Los Angeles District Regulatory Division website at: www.spl.usace.army.mil/regulatory/); and

c. Numbered and dated pre-project color photographs showing a representative sample of waters proposed to be impacted on the site, and all waters of the U.S. proposed to be avoided on and immediately adjacent to the project site. The compass angle and position of each photograph shall be identified on the plan-view drawing(s) required in subpart b of this Regional Condition.

2. For all Nationwide Permits (NWPs), the permittee shall submit a PCN in accordance with General Condition 31 and Regional Condition 1, in the following circumstances:

a. For all activities that would result in the discharge of fill material into any vernal pool;

b. For any activity in the Primary and Secondary Zones of the Legal Delta, the Sacramento River, the San Joaquin River, and the immediate tributaries of these waters;

c. For all crossings of perennial waters and intermittent waters;

d. For all activities proposed within 100 feet of the point of discharge of a known natural spring source, which is any location where ground water emanates from a point in the ground excluding seeps or other discharges which lack a defined channel; and

e.* For all activities located in areas designated as Essential Fish Habitat (EFH) by the Pacific Fishery Management Council (i.e., all tidally influenced areas - Federal Register dated March 12, 2007 (72 FR 11092)), in which case the PCN shall include an EFH assessment and extent of proposed impacts to EFH. Examples of EFH habitat assessments can be found at: http://www.swr.noaa.gov/efh.htm.

3. The permittee shall record the NWP verification with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records of title to or interest in real property for areas (1) designated to be preserved as part of compensatory mitigation for authorized impacts, including any associated covenants or restrictions, or (2) where boat ramps or docks, marinas, piers, and permanently moored vessels will be constructed or placed in or adjacent to navigable waters. The recordation shall also include a map showing the surveyed location of the preserved area or authorized structure.

* Regional Condition developed jointly between Sacramento District, Los Angeles District, and San Francisco District.

4. For all waters of the U.S. proposed to be avoided on a site, unless determined to be impracticable by the Corps, the permittee shall:

a. Establish and maintain, in perpetuity, a preserve containing all avoided waters of the U.S. to ensure that the functions of the aquatic environment are protected;

b. Place all avoided waters of the U.S. and any upland buffers into a separate parcel prior to discharging dredge or fill material into waters of the U.S., and

c. Establish permanent legal protection for all preserve parcels, following Corps approval of the legal instrument;

If the Corps determines that it is impracticable to require permanent preservation of the avoided waters, additional mitigation may be required in order to compensate for indirect impacts to the waters of the U.S.

5. For all temporary fills, the PCN shall include a description of the proposed temporary fill, including the type and amount of material to be placed, the area proposed to be impacted, and the proposed plan for restoration of the temporary fill area to pre-project contours and conditions, including a plan for the re-vegetation of the temporary fill area, if necessary. In addition, the PCN shall include the reason(s) why avoidance of temporary impacts is not practicable.

In addition, for all activities resulting in temporary fill within waters of the U.S., the permittee shall:

a. Utilize material consisting of clean and washed gravel. For temporary fills within waters of the U.S. supporting anadromous fisheries, spawning quality gravel shall be used, where practicable, as determined by the Corps, after consultation with appropriate Federal and state fish and wildlife agencies;

b. Place a horizontal marker (e.g. fabric, certified weed free straw, etc.) to delineate the existing ground elevation of the waters temporarily filled during construction; and

c. Remove all temporary fill within 30 days following completion of construction activities.

6. In addition to the requirements of General Condition 2, unless determined to be impracticable by the Corps, the following criteria shall apply to all road crossings:

a.* For all activities in waters of the U.S. that are suitable habitat for Federally-listed fish species, the permittee shall design all road crossings to ensure that the passage and/or spawning of fish is not hindered. In these areas, the permittee shall employ bridge designs that span the stream or river, including pier- or pile-supported spans, or designs that use a bottomless arch culvert with a natural stream bed;

b. Road crossings shall be designed to ensure that no more than minor impacts would occur to fish and wildlife passage or expected high flows, following the criteria listed in Regional Condition 6(a). Culverted crossings that do not utilize a bottomless arch culvert with a natural stream bed may be authorized for waters that do not contain suitable habitat for Federally listed fish species, if it can be demonstrated and is specifically determined by the Corps, that such crossing will result in no more than minor impacts to fish and wildlife passage or expected high flows;

c. No construction activities shall occur within standing or flowing waters. For ephemeral or intermittent streams, this may be accomplished through construction during the dry season. In perennial streams, this may be accomplished through dewatering of the work area. Any proposed dewatering plans must be approved, in writing, by the Corps prior to commencement of construction activities; and

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d. All bank stabilization activities associated with a road crossing shall comply with Regional Condition 19.

In no case shall stream crossings result in a reduction in the pre-construction bankfull width or depth of perennial streams or negatively alter the flood control capacity of perennial streams.

7.* For activities in which the Corps designates another Federal agency as the lead for compliance with Section 7 of the Endangered Species Act (ESA) of 1973 as amended, pursuant to 50 CFR Part 402.07, Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act (EFH), pursuant to 50 CFR 600.920(b) and/or Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, pursuant to 36 CFR 800.2(a)(2), the lead Federal agency shall provide all relevant documentation to the Corps demonstrating any previous consultation efforts, as it pertains to the Corps Regulatory permit area (for Section 7 and EFH compliance) and the Corps Regulatory area of potential effect (APE) (for Section 106 compliance). For activities requiring a PCN, this information shall be submitted with the PCN. If the Corps does not designate another Federal agency as the lead for ESA, EFH and/or NHPA, the Corps will initiate consultation for compliance, as appropriate.

8. For all NWPs which require a PCN, the permittee shall submit the following additional information with the compliance certificate required under General Condition 30:

a. As-built drawings of the work conducted on the project site and any on-site and/or off-site compensatory mitigation, preservation, and/or avoidance area(s). The as-builts shall include a plan-view drawing of the location of the authorized work footprint (as shown on the permit drawings), with an overlay of the work as constructed in the same scale as the permit drawings. The drawing shall show all areas of ground disturbance, wetland impacts, structures, and the boundaries of any on-site and/or off-site mitigation or avoidance areas. Please note that any deviations from the work as authorized, which result in additional impacts to waters of the U.S., must be coordinated with the appropriate Corps office prior to impacts; and

b. Numbered and dated post-construction color photographs of the work conducted within a representative sample of the impacted waters of the U.S., and within all avoided waters of the U.S. on and immediately adjacent to the proposed project area. The compass angle and position of all photographs shall be similar to the pre-construction color photographs required in Regional Condition 1(c) and shall be identified on the plan-view drawing(s) required in subpart a of this Regional Condition.

9. For all activities requiring permittee responsible mitigation, the permittee shall develop and submit to the Corps for review and approval, a final comprehensive mitigation and monitoring plan for all permittee responsible mitigation prior to commencement of construction activities within waters of the U.S. The plan shall include the mitigation location and design drawings, vegetation plans, including target species to be planted, and final success criteria, presented in the format of the *Sacramento District's Habitat Mitigation and Monitoring Proposal Guidelines*, dated December 30, 2004, and in compliance with the requirements of 33 CFR 332.

10.* The permittee shall complete the construction of any compensatory mitigation required by special condition(s) of the NWP verification before or concurrent with commencement of construction of the authorized activity, except when specifically determined to be impracticable by the Corps. When mitigation involves use of a mitigation bank or in-lieu fee program, the permittee shall submit proof of payment to the Corps prior to commencement of construction of the authorized activity.

11. The permittee is responsible for all authorized work and ensuring that all contractors and workers are made aware and adhere to the terms and conditions of the permit authorization. The permittee shall ensure

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that a copy of the permit authorization and associated drawings are available and visible for quick reference at the site until all construction activities are completed.

12. The permittee shall clearly identify the limits of disturbance in the field with highly visible markers (e.g. construction fencing, flagging, silt barriers, etc.) prior to commencement of construction activities within waters of the U.S. The permittee shall maintain such identification properly until construction is completed and the soils have been stabilized. The permittee is prohibited from any activity (e.g. equipment usage or materials storage) that impacts waters of the U.S. outside of the permit limits (as shown on the permit drawings).

13. For all activities in which a PCN is required, the permittee shall notify the appropriate district office of the start date for the authorized work within 10 days prior to initiation of construction activities.

14. The permittee shall allow Corps representatives to inspect the authorized activity and any mitigation areas at any time deemed necessary to determine compliance with the terms and conditions of the NWP verification. The permittee will be notified in advance of an inspection.

15. For all activities located in the Mather Core Recovery Area in Sacramento County, as identified in the U.S. Fish and Wildlife Service's *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* dated December 15, 2005, NWPs 14, 18, 23, 29, 39, 40, 42, 43 and 44 are revoked from use in vernal pools that may contain habitat for Federally-listed threatened and/or endangered vernal pool species.

16. For activities located in the Primary or Secondary Zone of the Legal Delta, NWPs 29 and 39 are revoked.

17. For all activities within the Secondary Zone of the Legal Delta, the permittee shall conduct compensatory mitigation for unavoidable impacts within the Secondary Zone of the Legal Delta.

18. For NWP 12: Permittees shall ensure the construction of utility lines does not result in the draining of any water of the U.S., including wetlands. This may be accomplished through the use of clay blocks, bentonite, or other suitable material (as approved by the Corps) to seal the trench. For utility line trenches, during construction, the permittee shall remove and stockpile, separately, the top 6 – 12 inches of topsoil. Following installation of the utility line(s), the permittee shall replace the stockpiled topsoil on top and seed the area with native vegetation. The permittee shall submit a PCN for utility line activities in the following circumstances:

a. The utility line crossing would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs;

b. The utility line activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.;

c. The utility line installation would include the construction of a temporary or permanent access road, substation or foundation within waters of the U.S.; or

d. The proposed activity would not involve the restoration of all utility line trenches to pre-project contours and conditions within 30 days following completion of construction activities.

19. For NWP 13 and 14: All bank stabilization activities shall involve either the sole use of native vegetation or other bioengineered design techniques (e.g. willow plantings, root wads, large woody debris, etc.), or a combination of hard-armoring (e.g. rip-rap) and native vegetation or bioengineered design

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techniques, unless specifically determined to be impracticable by the Corps. The permittee shall submit a PCN for any bank stabilization activity that involves hard-armoring or the placement of any non-vegetated or non-bioengineered technique below the ordinary high water mark or, if tidal waters, the high tide line of waters of the U.S. The request to utilize non-vegetated techniques must include information on why the sole use of vegetated techniques is not practicable.

20. For NWP 23: The permittee shall submit a PCN for all activities proposed for this NWP, in accordance with General Condition 31 and Regional Condition 1. The PCN shall include a copy of the signed Categorical Exclusion document and final agency determinations regarding compliance with ESA, EFH and NHPA, in accordance with General Conditions 18 and 20 and Regional Condition 7.

21. For NWP 27: The permittee shall submit a PCN for aquatic habitat restoration, establishment, and enhancement activities in the following circumstances:

a. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs; or

b. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.

22. For NWPs 29 and 39: The channelization or relocation of intermittent or perennial drainages is not authorized, except when, as determined by the Corps, the relocation would result in a net increase in functions of the aquatic ecosystem within the watershed.

23.* Any requests to waive the 300 linear foot limitation for intermittent and ephemeral streams for NWPs 21, 29, 39, 40, 42, 43, 44, 50, 51 and 52, or to waive the 500 linear foot limitation along the bank for NWP 13, must include the following:

a. A narrative description of the stream. This should include known information on: volume and duration of flow; the approximate length, width, and depth of the waterbody and characteristics observed associated with an Ordinary High Water Mark (e.g. bed and bank, wrack line or scour marks); a description of the adjacent vegetation community and a statement regarding the wetland status of the adjacent areas (i.e. wetland, non-wetland); surrounding land use; water quality; issues related to cumulative impacts in the watershed, and; any other relevant information;

b. An analysis of the proposed impacts to the waterbody, in accordance with General Condition 31 and Regional Condition 1;

c. Measures taken to avoid and minimize losses to waters of the U.S., including other methods of constructing the proposed activity(s); and

d. A compensatory mitigation plan describing how the unavoidable losses are proposed to be offset, in accordance with 33 CFR 332.

24. For NWPs 29, 39, 40, 42, and 43: The permittee shall establish and maintain upland vegetated buffers in perpetuity, unless specifically determined to be impracticable by the Corps, next to all preserved open waters, streams and wetlands including created, restored, enhanced or preserved waters of the U.S., consistent with General Condition 23(f). Except in unusual circumstances, as determined by the Corps, vegetated buffers shall be at least 50 feet in width.

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25. For NWP 46: The discharge shall not cause the loss of greater than 0.5 acres of waters of the United States or the loss of more than 300 linear feet of ditch, unless specifically waived in writing by the Corps.

26. All NWPs except 3, 6, 20, 27, 32, and 38 are revoked for activities in histosols, fens, bogs and peatlands and in wetlands contiguous with fens. Fens are defined as slope wetlands with a histic epipedon that are hydrologically supported by groundwater. Fens are normally saturated throughout the growing season, although they may not be during drought conditions. For NWPs 3, 6, 20, 27, 32, and 38, the permittee shall submit a PCN to the Corps in accordance with General Condition 31 and Regional Condition 1. This condition does not apply to NWPs 1, 2, 8, 9, 10, 11, 24, 28, 35 or 36, as these NWPs either apply to Section 10 only activities or do not authorize impacts to special aquatic sites.

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Final Sacramento District Nationwide Permit
Regional Conditions for California, excluding the Lake Tahoe Basin
(Effective March 19, 2012 until March 18, 2017)

1.* When pre-construction notification (PCN) is required, the permittee shall notify the U.S. Army Corps of Engineers, Sacramento District (Corps) in accordance with General Condition 31 using either the South Pacific Division Preconstruction Notification (PCN) Checklist or a signed application form (ENG Form 4345) with an attachment providing information on compliance with all of the General and Regional Conditions. In addition, the PCN shall include:

a. A written statement describing how the activity has been designed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States;

b. Drawings, including plan and cross-section views, clearly depicting the location, size and dimensions of the proposed activity, as well as the location of delineated waters of the U.S. on the site. The drawings shall contain a title block, legend and scale, amount (in cubic yards) and area (in acres) of fill in Corps jurisdiction, including both permanent and temporary fills/structures. The ordinary high water mark or, if tidal waters, the mean high water mark and high tide line, should be shown (in feet), based on National Geodetic Vertical Datum (NGVD) or other appropriate referenced elevation. All drawings for activities located within the boundaries of the Los Angeles District shall comply with the September 15, 2010 Special Public Notice: *Map and Drawing Standards for the Los Angeles District Regulatory Division*, (available on the Los Angeles District Regulatory Division website at: www.spl.usace.army.mil/regulatory/); and

c. Numbered and dated pre-project color photographs showing a representative sample of waters proposed to be impacted on the site, and all waters of the U.S. proposed to be avoided on and immediately adjacent to the project site. The compass angle and position of each photograph shall be identified on the plan-view drawing(s) required in subpart b of this Regional Condition.

2. For all Nationwide Permits (NWPs), the permittee shall submit a PCN in accordance with General Condition 31 and Regional Condition 1, in the following circumstances:

a. For all activities that would result in the discharge of fill material into any vernal pool;

b. For any activity in the Primary and Secondary Zones of the Legal Delta, the Sacramento River, the San Joaquin River, and the immediate tributaries of these waters;

c. For all crossings of perennial waters and intermittent waters;

d. For all activities proposed within 100 feet of the point of discharge of a known natural spring source, which is any location where ground water emanates from a point in the ground excluding seeps or other discharges which lack a defined channel; and

e.* For all activities located in areas designated as Essential Fish Habitat (EFH) by the Pacific Fishery Management Council (i.e., all tidally influenced areas - Federal Register dated March 12, 2007 (72 FR 11092)), in which case the PCN shall include an EFH assessment and extent of proposed impacts to EFH. Examples of EFH habitat assessments can be found at: http://www.swr.noaa.gov/efh.htm.

3. The permittee shall record the NWP verification with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records of title to or interest in real property for areas (1) designated to be preserved as part of compensatory mitigation for authorized impacts, including any associated covenants or restrictions, or (2) where boat ramps or docks, marinas, piers, and permanently moored vessels will be constructed or placed in or adjacent to navigable waters. The recordation shall also include a map showing the surveyed location of the preserved area or authorized structure.

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4. For all waters of the U.S. proposed to be avoided on a site, unless determined to be impracticable by the Corps, the permittee shall:

a. Establish and maintain, in perpetuity, a preserve containing all avoided waters of the U.S. to ensure that the functions of the aquatic environment are protected;

b. Place all avoided waters of the U.S. and any upland buffers into a separate parcel prior to discharging dredge or fill material into waters of the U.S., and

c. Establish permanent legal protection for all preserve parcels, following Corps approval of the legal instrument;

If the Corps determines that it is impracticable to require permanent preservation of the avoided waters, additional mitigation may be required in order to compensate for indirect impacts to the waters of the U.S.

5. For all temporary fills, the PCN shall include a description of the proposed temporary fill, including the type and amount of material to be placed, the area proposed to be impacted, and the proposed plan for restoration of the temporary fill area to pre-project contours and conditions, including a plan for the re-vegetation of the temporary fill area, if necessary. In addition, the PCN shall include the reason(s) why avoidance of temporary impacts is not practicable.

In addition, for all activities resulting in temporary fill within waters of the U.S., the permittee shall:

a. Utilize material consisting of clean and washed gravel. For temporary fills within waters of the U.S. supporting anadromous fisheries, spawning quality gravel shall be used, where practicable, as determined by the Corps, after consultation with appropriate Federal and state fish and wildlife agencies;

b. Place a horizontal marker (e.g. fabric, certified weed free straw, etc.) to delineate the existing ground elevation of the waters temporarily filled during construction; and

c. Remove all temporary fill within 30 days following completion of construction activities.

6. In addition to the requirements of General Condition 2, unless determined to be impracticable by the Corps, the following criteria shall apply to all road crossings:

a.* For all activities in waters of the U.S. that are suitable habitat for Federally-listed fish species, the permittee shall design all road crossings to ensure that the passage and/or spawning of fish is not hindered. In these areas, the permittee shall employ bridge designs that span the stream or river, including pier- or pile-supported spans, or designs that use a bottomless arch culvert with a natural stream bed;

b. Road crossings shall be designed to ensure that no more than minor impacts would occur to fish and wildlife passage or expected high flows, following the criteria listed in Regional Condition 6(a). Culverted crossings that do not utilize a bottomless arch culvert with a natural stream bed may be authorized for waters that do not contain suitable habitat for Federally listed fish species, if it can be demonstrated and is specifically determined by the Corps, that such crossing will result in no more than minor impacts to fish and wildlife passage or expected high flows;

c. No construction activities shall occur within standing or flowing waters. For ephemeral or intermittent streams, this may be accomplished through construction during the dry season. In perennial streams, this may be accomplished through dewatering of the work area. Any proposed dewatering plans must be approved, in writing, by the Corps prior to commencement of construction activities; and

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d. All bank stabilization activities associated with a road crossing shall comply with Regional Condition 19.

In no case shall stream crossings result in a reduction in the pre-construction bankfull width or depth of perennial streams or negatively alter the flood control capacity of perennial streams.

7.* For activities in which the Corps designates another Federal agency as the lead for compliance with Section 7 of the Endangered Species Act (ESA) of 1973 as amended, pursuant to 50 CFR Part 402.07, Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act (EFH), pursuant to 50 CFR 600.920(b) and/or Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, pursuant to 36 CFR 800.2(a)(2), the lead Federal agency shall provide all relevant documentation to the Corps demonstrating any previous consultation efforts, as it pertains to the Corps Regulatory permit area (for Section 7 and EFH compliance) and the Corps Regulatory area of potential effect (APE) (for Section 106 compliance). For activities requiring a PCN, this information shall be submitted with the PCN. If the Corps does not designate another Federal agency as the lead for ESA, EFH and/or NHPA, the Corps will initiate consultation for compliance, as appropriate.

8. For all NWPs which require a PCN, the permittee shall submit the following additional information with the compliance certificate required under General Condition 30:

a. As-built drawings of the work conducted on the project site and any on-site and/or off-site compensatory mitigation, preservation, and/or avoidance area(s). The as-builts shall include a plan-view drawing of the location of the authorized work footprint (as shown on the permit drawings), with an overlay of the work as constructed in the same scale as the permit drawings. The drawing shall show all areas of ground disturbance, wetland impacts, structures, and the boundaries of any on-site and/or off-site mitigation or avoidance areas. Please note that any deviations from the work as authorized, which result in additional impacts to waters of the U.S., must be coordinated with the appropriate Corps office prior to impacts; and

b. Numbered and dated post-construction color photographs of the work conducted within a representative sample of the impacted waters of the U.S., and within all avoided waters of the U.S. on and immediately adjacent to the proposed project area. The compass angle and position of all photographs shall be similar to the pre-construction color photographs required in Regional Condition 1(c) and shall be identified on the plan-view drawing(s) required in subpart a of this Regional Condition.

9. For all activities requiring permittee responsible mitigation, the permittee shall develop and submit to the Corps for review and approval, a final comprehensive mitigation and monitoring plan for all permittee responsible mitigation prior to commencement of construction activities within waters of the U.S. The plan shall include the mitigation location and design drawings, vegetation plans, including target species to be planted, and final success criteria, presented in the format of the *Sacramento District's Habitat Mitigation and Monitoring Proposal Guidelines*, dated December 30, 2004, and in compliance with the requirements of 33 CFR 332.

10.* The permittee shall complete the construction of any compensatory mitigation required by special condition(s) of the NWP verification before or concurrent with commencement of construction of the authorized activity, except when specifically determined to be impracticable by the Corps. When mitigation involves use of a mitigation bank or in-lieu fee program, the permittee shall submit proof of payment to the Corps prior to commencement of construction of the authorized activity.

11. The permittee is responsible for all authorized work and ensuring that all contractors and workers are made aware and adhere to the terms and conditions of the permit authorization. The permittee shall ensure

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that a copy of the permit authorization and associated drawings are available and visible for quick reference at the site until all construction activities are completed.

12. The permittee shall clearly identify the limits of disturbance in the field with highly visible markers (e.g. construction fencing, flagging, silt barriers, etc.) prior to commencement of construction activities within waters of the U.S. The permittee shall maintain such identification properly until construction is completed and the soils have been stabilized. The permittee is prohibited from any activity (e.g. equipment usage or materials storage) that impacts waters of the U.S. outside of the permit limits (as shown on the permit drawings).

13. For all activities in which a PCN is required, the permittee shall notify the appropriate district office of the start date for the authorized work within 10 days prior to initiation of construction activities.

14. The permittee shall allow Corps representatives to inspect the authorized activity and any mitigation areas at any time deemed necessary to determine compliance with the terms and conditions of the NWP verification. The permittee will be notified in advance of an inspection.

15. For all activities located in the Mather Core Recovery Area in Sacramento County, as identified in the U.S. Fish and Wildlife Service's *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* dated December 15, 2005, NWPs 14, 18, 23, 29, 39, 40, 42, 43 and 44 are revoked from use in vernal pools that may contain habitat for Federally-listed threatened and/or endangered vernal pool species.

16. For activities located in the Primary or Secondary Zone of the Legal Delta, NWPs 29 and 39 are revoked.

17. For all activities within the Secondary Zone of the Legal Delta, the permittee shall conduct compensatory mitigation for unavoidable impacts within the Secondary Zone of the Legal Delta.

18. For NWP 12: Permittees shall ensure the construction of utility lines does not result in the draining of any water of the U.S., including wetlands. This may be accomplished through the use of clay blocks, bentonite, or other suitable material (as approved by the Corps) to seal the trench. For utility line trenches, during construction, the permittee shall remove and stockpile, separately, the top 6 – 12 inches of topsoil. Following installation of the utility line(s), the permittee shall replace the stockpiled topsoil on top and seed the area with native vegetation. The permittee shall submit a PCN for utility line activities in the following circumstances:

a. The utility line crossing would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs;

b. The utility line activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.;

c. The utility line installation would include the construction of a temporary or permanent access road, substation or foundation within waters of the U.S.; or

d. The proposed activity would not involve the restoration of all utility line trenches to pre-project contours and conditions within 30 days following completion of construction activities.

19. For NWP 13 and 14: All bank stabilization activities shall involve either the sole use of native vegetation or other bioengineered design techniques (e.g. willow plantings, root wads, large woody debris, etc.), or a combination of hard-armoring (e.g. rip-rap) and native vegetation or bioengineered design

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techniques, unless specifically determined to be impracticable by the Corps. The permittee shall submit a PCN for any bank stabilization activity that involves hard-armoring or the placement of any non-vegetated or non-bioengineered technique below the ordinary high water mark or, if tidal waters, the high tide line of waters of the U.S. The request to utilize non-vegetated techniques must include information on why the sole use of vegetated techniques is not practicable.

20. For NWP 23: The permittee shall submit a PCN for all activities proposed for this NWP, in accordance with General Condition 31 and Regional Condition 1. The PCN shall include a copy of the signed Categorical Exclusion document and final agency determinations regarding compliance with ESA, EFH and NHPA, in accordance with General Conditions 18 and 20 and Regional Condition 7.

21. For NWP 27: The permittee shall submit a PCN for aquatic habitat restoration, establishment, and enhancement activities in the following circumstances:

a. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs; or

b. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.

22. For NWPs 29 and 39: The channelization or relocation of intermittent or perennial drainages is not authorized, except when, as determined by the Corps, the relocation would result in a net increase in functions of the aquatic ecosystem within the watershed.

23.* Any requests to waive the 300 linear foot limitation for intermittent and ephemeral streams for NWPs 21, 29, 39, 40, 42, 43, 44, 50, 51 and 52, or to waive the 500 linear foot limitation along the bank for NWP 13, must include the following:

a. A narrative description of the stream. This should include known information on: volume and duration of flow; the approximate length, width, and depth of the waterbody and characteristics observed associated with an Ordinary High Water Mark (e.g. bed and bank, wrack line or scour marks); a description of the adjacent vegetation community and a statement regarding the wetland status of the adjacent areas (i.e. wetland, non-wetland); surrounding land use; water quality; issues related to cumulative impacts in the watershed, and; any other relevant information;

b. An analysis of the proposed impacts to the waterbody, in accordance with General Condition 31 and Regional Condition 1;

c. Measures taken to avoid and minimize losses to waters of the U.S., including other methods of constructing the proposed activity(s); and

d. A compensatory mitigation plan describing how the unavoidable losses are proposed to be offset, in accordance with 33 CFR 332.

24. For NWPs 29, 39, 40, 42, and 43: The permittee shall establish and maintain upland vegetated buffers in perpetuity, unless specifically determined to be impracticable by the Corps, next to all preserved open waters, streams and wetlands including created, restored, enhanced or preserved waters of the U.S., consistent with General Condition 23(f). Except in unusual circumstances, as determined by the Corps, vegetated buffers shall be at least 50 feet in width.

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25. For NWP 46: The discharge shall not cause the loss of greater than 0.5 acres of waters of the United States or the loss of more than 300 linear feet of ditch, unless specifically waived in writing by the Corps.

26. All NWPs except 3, 6, 20, 27, 32, and 38 are revoked for activities in histosols, fens, bogs and peatlands and in wetlands contiguous with fens. Fens are defined as slope wetlands with a histic epipedon that are hydrologically supported by groundwater. Fens are normally saturated throughout the growing season, although they may not be during drought conditions. For NWPs 3, 6, 20, 27, 32, and 38, the permittee shall submit a PCN to the Corps in accordance with General Condition 31 and Regional Condition 1. This condition does not apply to NWPs 1, 2, 8, 9, 10, 11, 24, 28, 35 or 36, as these NWPs either apply to Section 10 only activities or do not authorize impacts to special aquatic sites.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
08ESMF00-
2014-I-0483

JAN 26 2015

Ms. Dena Gonzalez
Chief, Central Region Biology Branch
California Department of Transportation, District 6
855 M Street, Suite 200
Fresno, California 93721

Subject: Informal Consultation for the Seismic Restoration Project at Five Bridge Locations, Fresno, Kings, and Madera Counties, California (California Department of Transportation 06-FRE-33-PM 69.1; 06-FRE-41-PM 21.18; 06-KIN-41-PM 32.26; 06-KIN-43-PM 26.76; 06-MAD-233-PM 0.01; EA 06-0K800)

Dear Ms. Gonzalez:

This is the U.S. Fish and Wildlife Service's (Service) response to the California Department of Transportation's (Caltrans) request for concurrence on its action to construct the Seismic Restoration Project at Five Bridge Locations (project) on State Routes 33 and 41 in Fresno County, on State Routes 41 and 43 in Kings County, and on State Route 233 in Madera County, California.

The Moving Ahead for Progress in the 21st Century Act (MAP-21) was signed into law on July 16, 2012. Caltrans was approved to participate in the MAP-21 Surface Transportation Project Delivery Program through the National Environmental Policy Act (NEPA) assignment Memorandum of Understanding (MOU) between the Federal Highway Administration (FHWA) and Caltrans (effective October 1, 2012), as codified in 23 U.S.C. 327. The MOU allows Caltrans to assume the FHWA's responsibilities under NEPA as well as FHWA's consultation and coordination responsibilities under Federal environmental laws for the majority of transportation projects in California.

Your letter requesting informal consultation, dated August 22, 2014, was received in this office on August 25, 2014. In this letter you determined that the proposed project may affect, but is not likely to adversely affect either the federally-listed as endangered San Joaquin kit fox (*Vulpes macrotis mutica*) or the federally-listed as threatened giant garter snake (*Thamnophis gigas*). Caltrans therefore requests concurrence from the Service with its determinations. This document has been prepared in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*) (Act).

The findings and recommendations of this letter are based on: (1) Caltrans' August 22, 2014, letter, and the accompanying August 2014 *Seismic Restoration at Various Locations Biological Assessment* (BA), as prepared by Caltrans; (2) email correspondence between the Service and Caltrans; and (3) other information available to the Service.

Project Description

Caltrans proposes to conduct restoration work on five bridges in Fresno, Kings, and Madera Counties in order to meet current seismic standards:

1. Main Canal: Bridge No. 42-0134, Fresno County, State Route (SR) 33 at post-mile (PM) 69.1. This two-lane bridge is 170-feet (ft.) long by 55-ft. wide and is located at the southwest edge of the town of Firebaugh in a semi-rural setting. The construction footprint is approximately 0.96 acre (ac) and extends approximately 360 ft.

2. SR 41/SR 99 Connector: Bridge No. 42-0216, Fresno County, SR 41 at PM 21.18. This two-lane highway overpass is 840-ft. long by 48-ft. wide and connects southbound SR 41 to southbound SR 99 just south of downtown Fresno. The construction footprint is approximately 1.5 ac and extends approximately 840 ft.

3. Kings River: Bridge No. 45-0007, Kings County, SR 41 at PM 32.26. This two-lane bridge over the Kings River is 515-ft. long by 56-ft. wide and is located within agricultural and riparian land just southwest of the town of Stratford. The construction footprint is approximately 1.6 ac and extends approximately 600 ft.

4. Dutch John Cut: Bridge No. 45-0064, Kings County, SR 43 at PM 26.76. This two-lane bridge over the Dutch John Cut (a diversion channel of the Kings River) is 556-ft. long by 52-ft. wide and is located in agricultural and riparian land east of the town of Laton. The construction footprint is approximately 1.1 ac and extends approximately 480 ft.

5. SR 233/SR 152 Overpass: Bridge No. 41-0059E, Madera County, SR 233 at PM 0.01. This two-lane highway overpass is 360-ft. long by 62-ft. wide and is located in agricultural land southwest of the city of Chowchilla. The construction footprint is approximately 1.0 ac and extends approximately 315 ft.

Site 1, Main Canal. Caltrans proposes to install pipe hinge seat extenders, add a 5-ft. diameter Cast-in Steel Shell (CISS) pile on either side of the two existing bridge abutments (for a total of four piles), and connect each CISS pile to the existing abutment structure. The CISS piles will be installed by a crane(s) positioned in staging areas located in the northeast and southwest quadrants of the bridge. The crane(s) also will operate across the waterway to install piles on the opposite bank. Caltrans further proposes to retrofit the concrete slab-hinge on the underside of the bridge deck. This will be done using a floating platform if water is present in the canal. The scope of work will depend on the condition of the existing pile extensions, as determined by the findings of underwater investigations. Equipment staging may be established in a flat, open, disked parcel of land adjacent to the northeast quadrant of the bridge, as well as in a ruderal area in the southwest quadrant of the bridge.

Site 2, SR 41/SR 99 Connector. Caltrans proposes to install pipe hinge seat extenders, full-length steel casings around all three columns, and catcher blocks at both abutments. The hinges will be accessed from either the bridge deck above or the soffits below. Equipment staging may be established in an open median area adjacent to the northbound lanes of SR 99 and underneath the connector ramp.

Site 3, Kings River and Site 4, Dutch John Cut. At both sites, Caltrans proposes to retrofit the concrete-slab hinge on the underside of the bridge, and add 3-ft. diameter CISS piles to either side

of the existing bridge (Site 3: at abutment 1A and bents 2, 4, 6, 8, and 10 [for a total of 12 piles]; Site 4: at bents 3, 5, 7, 9, 20, 23, 14, and 16 [for a total of 16 piles]). The new piles will be connected to the abutment and to the bent caps at each bent. The number of bents and abutments expected to be retrofitted may change depending on the results of further seismic analysis. Pile-type may also change depending on whether water will be present in the channel at the time of construction. At Site 3, equipment staging may be established in an existing compacted dirt parking area in the northeast quadrant of the bridge, and potentially in a wetland area in the northwest quadrant. At Site 4, equipment staging may be established adjacent to the north bank of the waterway on both east and west sides of the bridge.

Site 5, SR 233/SR 152 Overpass. Caltrans proposes to install 3/8 inch-thick steel casing around two columns to a depth of 18-ft. below ground level. This will involve excavation, backfill, and potential shoring activities. Equipment staging may be established in the median between the east- and westbound lanes on SR 152, on the east side of the SR 233 overpass.

Construction at all five work sites is anticipated to begin on December 1, 2016. The contractor may not be able to work on all of the sites at the same time due to the cost and availability of the equipment. For that reason, the contactor is expected to complete work at one site before starting work at the next site. All work at all sites is expected to finish within one year, by December 2017. No night work is proposed. The bridge will remain open during construction; however, no specific method to control traffic on the bridge has been identified.

Concrete k-rail barriers potentially may be used during the course of construction as a temporary traffic control safety measure to separate the construction areas from the roadways and vehicle traffic. In the event they are used, the structures will be present for the duration of construction but will be removed once the project is completed. K-rail barriers are likely to be used only at Site 1.

The contractor will follow best management practices during construction. Dust control measures will be implemented as part of the project. Any imported fill material will come from an established borrow site; the contractor will be responsible for both selecting and meeting the environmental compliance of a given site prior to the start of construction activities.

Avoidance and Minimization Measures

Caltrans has identified Site 1 as the only site of the total five in which there may be effects to listed species. Caltrans therefore proposes to implement the following measures at Site 1 to minimize and avoid the potential for adverse effects to the San Joaquin kit fox and the giant garter snake.

San Joaquin kit fox

1. No more than 30 days prior to the start of construction, a qualified biologist(s) will conduct preconstruction surveys for the San Joaquin kit fox and its dens both in the project footprint and within 200 ft. of the footprint.

2. A qualified biologist(s) will conduct an environmental awareness training program for all construction personnel, covering the status of the San Joaquin kit fox, the importance of avoiding impacts to the species, and the penalties for not complying with minimization

measures. New construction personnel who are added to the project after the training is first conducted also will be required to take the training.

3. A qualified biologist(s) will be present on-site during initial ground-disturbing activities, as well as in the event that any potential or known dens are identified in the project area.

4. Potential and atypical dens that are located at least 50-ft. from construction will be protected with a 50-ft. zone. Known dens that are located at least 100-ft. from construction will be protected with a 100-ft. zone. In instances where 50-ft. or 100-ft. exclusion zones cannot be maintained, potential and/or known dens will be monitored; once these dens are verified to be unoccupied, they will be temporarily blocked (via sandbagging or installation of a one-way door) for the duration of the project.

    a. If a natal/pupping den is discovered either within the project footprint or within 200-ft. of the footprint, Caltrans will immediately notify the Service.

5. The contactor will inspect all pipes and culverts with a diameter greater than or equal to four inches prior to burying, capping, or other uses in order to determine if a San Joaquin kit fox has taken cover inside. If an individual is discovered during the inspection, the pipe or culvert will not be disturbed (other than to move it to a safe location if necessary) in order to allow the species to leave without harassment.

6. No pets or firearms will be allowed at the project site.

7. All food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed daily from the entire project site in order to reduce the potential for attracting predator species.

Giant Garter Snake

1. A Service-approved biologist(s) will conduct preconstruction surveys for the giant garter snake no more than 24 hours prior to the start of ground-breaking. If construction stops for a period of two weeks or longer, a new survey will be completed no more than 24 hours prior to the reinitiation of construction work.

2. A Service-approved biologist(s) will conduct environmental awareness training for all construction personnel prior to the start of ground-breaking. The training will cover life history of the giant garter snake, how to identify the species and its habitat, what to do if a giant garter snake is encountered during construction, and penalties for not complying with biological minimization requirements.

3. All construction work will be conducted during the giant garter snake active season (approximately May 1 to October 1).

4. The work area located within suitable giant garter snake habitat will be the smallest area practicable in which to safely accomplish the required activities. The work area also will be clearly delineated in order to avoid inadvertent effects to adjacent potential habitat. No plastic, monofilament, jute, or similar materials that could entangle the giant garter snake will be used to demarcate the work area.

5. A Service-approved biologist will be on-site to monitor initial ground disturbance within suitable giant garter snake habitat.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area is composed of the project footprint for each of the five bridge sites; each project footprint consists of portions of agricultural, ruderal, riparian, and urban lands, plus aquatic habitat, all of which will be impacted by construction activities and used for staging. The approximate size of each footprint is as follows: Site 1 - 0.96 ac; Site 2 - 1.5 ac; Site 3 - 1.6 ac; Site 4 - 1.1 ac; Site 5 - 1.0 ac. The action area also includes land extending approximately 200 ft. from the edge of each footprint which will experience further-reaching effects of construction activities such as noise and visual disturbance.

Effects Analysis

Caltrans has identified Site 1 as the only site of the total five at which there is potential for the San Joaquin kit fox and giant garter snake to occur because it contains potential habitat for both species. The following effects analysis focuses only on Site 1.

The Site 1 project footprint contains the Main Canal, which is a man-made feature that carries water year-round; portions of ruderal habitat associated with open areas located adjacent to SR 33 and along the banks of the canal; urban areas, which include an approximately 360 ft. segment of the SR 33 roadway and part of an auto repair shop in the southwest quadrant of the footprint; and a small patch of aquatic vegetation (sedges) located along the canal bank on the southwest side of the bridge.

San Joaquin kit fox

According to the California Natural Diversity Database (CNDDB, 2014)[1], there are no records of the San Joaquin kit fox within the Site 1 project footprint, but there is one record of the species in close proximity to the footprint located approximately one mile northwest of the Main Canal bridge. No protocol-level surveys were conducted for the San Joaquin kit fox, but biological reconnaissance surveys carried out by Caltrans in October and December of 2012, and again in March of 2013, did not detect any San Joaquin kit foxes or associated sign, such as dens, scat, or tracks. But given the presence of open ruderal lands on both sides of SR 33, in addition to several small mammal burrows, there may be a suitable prey base for the San Joaquin kit fox and therefore some limited potential for the San Joaquin kit fox to forage in the area and consequently move through the project footprint. It is unlikely that the species will den in the footprint since no potential or known dens were detected, and habitat quality within the footprint is impaired due to disturbance from vehicle access to the canal banks, as well as from ongoing maintenance associated with disking, mowing, and other vegetation management activities to reduce the rodent populations.

The proposed project will permanently remove 0.026 ac of potential San Joaquin kit fox habitat around the pier installation sites, as well as temporarily disturb 0.31 ac of open, disked ruderal land due to vehicle and equipment staging. Because the project is expected to affect only a minor amount of potential habitat for the species, it is unlikely that this loss and disturbance will adversely affect the San Joaquin kit fox. With the implementation of the proposed avoidance and

[1] California Natural Diversity Database. 2014. Natural Heritage Division, California Department of Fish and Wildlife. RareFind 5. Sacramento, California. Accessed December 11, 2014.

minimization measures such as preconstruction surveys and monitoring for the species during construction, it is not reasonably likely that any San Joaquin kit foxes moving through the footprint will be hit by project equipment or vehicles.

K-rail barriers are likely to be used at Site 1 for the duration of project construction as a means of temporary traffic control and safety. Although they are impermeable concrete features, their presence would be unlikely to adversely affect the San Joaquin kit fox because 1) the footprint of the project is small-scale, so any barriers used would be installed only within a very small area; and 2) habitat within the Site 1 project footprint consists predominantly of disturbed ruderal areas, along with aquatic and urban areas, which provide limited foraging and denning opportunities for the San Joaquin kit fox, so the species is less likely to occur in or use these areas. Furthermore, although the Site 1 project footprint is located within the Western Madera County satellite recovery area for the San Joaquin kit fox, this subpopulation unit of the species is presently presumed extirpated (Service, 2010).[2]

Giant Garter Snake

Although no CNDDB records of the giant garter snake exist within the Site 1 project footprint, the two closest historical records of the species are located along other segments of the Main Canal: one is approximately 3.5 miles northwest of the bridge site, and the other is approximately 6 miles southeast of the bridge site (2014)[1]. No protocol-level surveys were conducted for the species. No giant garter snakes were detected in or near the Site 1 footprint during biological reconnaissance surveys carried out by Caltrans in October 2012 and March 2013. Within 200 ft. of the project footprint, potential suitable habitat for the species is present in the form of a small area (0.13 ac) of aquatic vegetation along the canal on the southwest side of the bridge. The canal banks in the remaining bridge quadrants are mostly bare, or contain only a limited amount of ruderal vegetation. Surrounding upland areas are bare and continuously disked, so are not suitable for the giant garter snake. However, the small mammal burrows that were observed by Caltrans could provide potential winter refugia habitat for the species. These burrows (most like belonging to California ground squirrels and gophers) were sparse and were concentrated mainly around the margins of the open ruderal parcel located northeast of the bridge within approximately 200 ft. of the Site 1 footprint.

The proposed project will permanently remove 0.02 ac of potential aquatic vegetation habitat for the giant garter snake due to the installation of a 5-ft. diameter CISS pile adjacent to the bridge abutment and associated activities involving the use of a work area and equipment access route. No temporary effects to potential giant garter snake habitat have been identified or are anticipated. All potential giant garter snake habitat identified within the footprint is expected to be permanently affected. The footprint will be demarcated to prevent construction disturbances from encroaching on potential giant garter snake habitat located outside its boundaries. Pile installation will not involve dewatering the canal since the steel shell into which the concrete will be poured will act as a cofferdam directly at the site of installation. Since work on the other parts of the bridge will be conducted from a floating platform, this is not expected to disturb or degrade the canal substrate or restrict water flow; therefore, there will be no further loss of or disturbance to habitat.

Although some effects to potential giant garter snake habitat are expected to occur, the likelihood that the species uses the Site 1 project footprint is very low. The footprint is located approximately 33-35 air miles southeast of where the species is still known to occur in the Volta Wildlife Area and in Los Banos Creek (CNDDB, 2014)[1].

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[2] U.S. Fish and Wildlife Service. 2010. San Joaquin Kit Fox (*Vulpes macrotis mutica*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento California. 122 pp.

Determinations

San Joaquin kit fox

Caltrans has concluded that the project may affect, but is not likely to adversely affect the San Joaquin kit fox. This determination is based on the small-scale scope of work at Site 1; the impaired quality of potential foraging habitat; the minor extent of permanent and temporary effects to this potential foraging habitat; the lack of suitable denning habitat, as well as the lack of any potential dens; and the conservation measures proposed to minimize and avoid potential effects to the species.

Giant Garter Snake

Caltrans has concluded that the project may affect, but is not likely to adversely affect the giant garter snake. This determination is based on the location of the Site 1 project footprint relative to extant occurrences of the species; the small-scale scope of work; the minor extent of permanently affected potential habitat; and the conservation measures proposed to minimize and avoid potential effects to the species.

After reviewing Caltrans' letter and BA, and engaging in further correspondence with Caltrans, the Service concurs that it is reasonably likely that effects to individual San Joaquin kit foxes and giant garter snakes will be discountable, and that the loss of habitat for each species will be insignificant; the action, therefore, is not likely to adversely affect either species.

Closing Statement

This concludes the Service's review of Caltrans' action to construct the Seismic Restoration Project at Five Bridge Locations and the Service's consideration of the project's effects on the species. No further coordination with the Service under the Act is necessary at this time. Note that take of listed species is not exempted from the prohibitions described under section 9 of the Act. If conditions change so that the project may adversely affect listed species, initiation of formal consultation, as provided in 50 CFR § 402.14, is required.

If you have questions regarding this project, please contact Jen Schofield, Wildlife Biologist, or me, at (916) 414-6600.

Sincerely,

Thomas Leeman
Chief, San Joaquin Valley Division

cc:
Craig Bailey, California Department of Fish and Wildlife, Fresno, California

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
08ESMF00-
2014-I-0483

OCT 08 2015

Javier Almaguer
Chief, Central Region Biology Branch – Environmental Stewardship
California Department of Transportation, District 6
855 M Street Suite 200
Fresno, California 93721

Subject: Revisions to the Letter of Concurrence for the Seismic Restoration Project at Five Bridge Locations, Fresno, Kings, and Madera Counties, California (California Department of Transportation EA 06-0K800; 06-FRE-33-PM 69.1; 06-FRE-41-PM 21.18; 06-KIN-41-PM 32.26; 06-KIN-43-PM 26.76; 06-MAD-233-PM 0.01)

Dear Mr. Almaguer:

On January 26, 2015, the U.S. Fish and Wildlife Service (Service) concurred with the California Department of Transportation's (Caltrans) determination that its action to construct the Seismic Restoration Project at Five Bridge Locations (project) on State Routes 33 and 41 in Fresno County, on State Routes 41 and 43 in Kings County, and on State Route 233 in Madera County, California may affect, but is not likely to adversely affect either the federally-listed as endangered San Joaquin kit fox (*Vulpes macrotis mutica*) or the federally-listed as threatened giant garter snake (*Thamnophis gigas*) (Service file number 08ESMF00-2014-I-0483; concurrence letter). We received your August 26, 2015 letter in this office on September 2, 2015. In this letter, you stated that the project has undergone significant changes in design since 2014, resulting in less complex new designs. Therefore, you have requested to amend the letter of concurrence in order to remove one of the bridges from project construction (Site 5), update the project descriptions at two of the bridge locations (Sites 1 and 3), and introduce night work to the project schedule (Site 4). Caltrans has determined that these modifications will neither result in an increase in adverse effects to the San Joaquin kit fox or the giant garter snake, nor alter its original determination, namely, that the project may affect, but is not likely to adversely affect either of these two species.

On page 1 of our concurrence letter, the subject line is being modified as follows. Text removed from our concurrence letter is shown by a strikethrough line and new text is shown by an underline; this convention is used throughout the present letter.

> Informal Consultation for the Seismic Restoration Project at ~~Five~~ <u>Four</u> Bridge Locations, Fresno, Kings~~, and Madera~~ Counties, California (California Department of Transportation 06-FRE-33-PM 69.1; 06-FRE-41-PM 21.18; 06-KIN-41-PM 32.26; 06-KIN-43-PM 26.76; ~~06-MAD-233-PM 0.01~~; EA 06-0K800)

On page 2 of the concurrence letter, Site 5 is now removed from the **Project Description**. This bridge site is no longer part of the project, thereby reducing the project's scope to four locations.

On page 2 of our concurrence letter, the paragraph describing Site 1, Main Canal under the **Project Description** is being modified as follows:

> Site 1, Main Canal. Caltrans proposes to retrofit the hinge by installing ~~pipe~~ hinge seat extenders.~~, add a 5-ft. diameter Cast-in-Steel Shell (CISS) pile on either side of the two existing bridge abutments (for a total of four piles), and connect each CISS pile to the existing abutment structure~~. ~~The CISS piles will be installed by a crane(s) positioned in staging areas located in the northeast and southwest quadrants of the bridge. The crane(s) also will operate across the waterway to install piles on the opposite bank. Caltrans further proposes to retrofit the concrete slab hinge~~ Portions of these extenders will require installation on the underside of the bridge deck. This will be done using a floating platform if water is present in the canal. ~~The scope of work will depend on the condition of the existing pile extensions, as determined by the findings of underwater investigations.~~ Equipment staging may be established in a flat, open, disked parcel of land adjacent to the northeast quadrant of the bridge~~, as well as in a ruderal area in the southwest quadrant of the bridge~~.

On pages 2-3 of our concurrence letter, the paragraph describing Site 3, Kings River and Site 4, Dutch John Cut under the **Project Description** is being modified as follows. These modifications pertain only to Site 3; no changes are proposed to Site 4.

> Site 3, Kings River and Site 4, Dutch John Cut. At Site 3, Caltrans proposes to strengthen the existing bent caps at Bents 2, 3, 4, 5, 6, 7, 8, 9, and 10 by installing steel channel sections on both sides of each bent cap using through bolts and a steel plate at the bottom of the bent cap between the columns. The steel plate will be bolted to the channels along the length of the bent cap. Caltrans also proposes to retrofit the hinge by installing hinge seat extenders. Portions of these extenders will require installation on the underside of the bridge deck. Depending on the water elevation at the time of construction, work on the hinge seat extenders may need to be performed from a floating platform with scaffolding. At Site 4 ~~both sites~~, Caltrans proposes to retrofit the concrete-slab hinge on the underside of the bridge, and add 3-ft. diameter CISS piles to either side of the existing bridge (~~Site 3: at abutment 1A and bents 2, 4, 6, 8, and 10 [for a total of 12 piles]; Site 4:~~ at bents 3, 5, 7, 9, 20, 23, 14, and 16 [for a total of 16 piles]). The new piles will be connected to the ~~abutment and to the~~ bent caps at each bent. The number of bents ~~and abutments~~ expected to be retrofitted may change depending on the results of further seismic analysis. Pile-type may also change depending on whether water will be present in the channel at the time of construction. At Site 3, equipment staging may be established in an existing compacted dirt parking area in the northeast quadrant of the bridge~~, and potentially in a wetland area in the northwest quadrant~~. At Site 4, equipment staging may be established adjacent to the north bank of the waterway on both east and west sides of the bridge.

On page 3 of our concurrence letter, the paragraph describing Site 5, SR 233/SR 152 Overpass is now removed from the **Project Description**. This bridge site is no longer part of the scope of the project.

On page 3 of our concurrence letter, the first paragraph following the line break under the **Project Description** is being modified as follows:

> Construction at all ~~five~~ four work sites is anticipated to begin on December 1, 2016. The contractor may not be able to work on all of the sites at the same time due to the cost and availability of the equipment. For that reason, the contactor is expected to complete work at

one site before starting work at the next site. All work at all sites is expected to finish within one year, by December 2017. ~~No night work is proposed.~~ Caltrans proposes to conduct night work only at Site 4; a total of 10 nights are required in order to maintain worker safety, avoid traffic delays on SR 43, and set polyurethane overlay on the bridge deck. The bridges will remain open during construction; however, no specific method to control traffic on the bridges has been identified.

On page 3 of our concurrence letter, the first paragraph under the Avoidance and Minimization Measures is being modified as follows:

> Caltrans has identified Site 1 as the only site of the total ~~five~~ four in which there may be effects to listed species. Caltrans therefore proposes to implement the following measures at Site 1 to minimize and avoid the potential for adverse effects to the San Joaquin kit fox and the giant garter snake.

On page 5 of our concurrence letter, the Action Area is being modified as follows:

> The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area is composed of the project footprint for each of the ~~five~~ four bridge sites; each project footprint consists of portions of agricultural, ruderal, riparian, and urban lands, plus aquatic habitat, all of which will be impacted by construction activities and used for staging. The approximate size of each footprint is as follows: Site 1 - ~~0.96~~ 0.79 ac; Site 2 - 1.5 ac; Site 3 - ~~1.6~~ 1.36 ac; Site 4 - 1.1 ac~~; Site 5 - 1.0 ac~~. The action area also includes land extending approximately 200 ft. from the edge of each footprint which will experience further-reaching effects of construction activities such as noise and visual disturbance.

On pages 5-6 of our concurrence letter, the second paragraph under the *San Joaquin kit fox* heading in the **Effects Analysis** is being modified as follows:

> The proposed project will ~~permanently remove 0.026 ac of potential San Joaquin kit fox habitat around the pier installation sites, as well as~~ temporarily disturb ~~0.31~~ 0.23 ac of open, disked ruderal land due to vehicle and equipment staging. Because the project is expected to affect only a minor amount of potential habitat for the species, it is unlikely that this ~~loss and~~ disturbance will adversely affect the San Joaquin kit fox. With the implementation of the proposed avoidance and minimization measures such as preconstruction surveys and monitoring for the species during construction, it is not reasonably likely that any San Joaquin kit foxes moving through the footprint will be hit by project equipment or vehicles.

On page 6 of our concurrence letter, the second and third paragraphs under the *Giant Garter Snake* heading in the **Effects Analysis** are being modified as follows:

> ~~The proposed project will permanently remove 0.02 ac of potential aquatic vegetation habitat for the giant garter snake due to the installation of a 5-ft. diameter CISS pile adjacent to the bridge abutment and associated activities involving the use of a work area and equipment access route.~~ No permanent or temporary effects to potential giant garter snake habitat have been identified or are anticipated. ~~All potential giant garter snake habitat identified within the footprint is expected to be permanently affected.~~ The area of potential giant garter snake habitat within the project footprint will be marked as an Environmentally Sensitive Area; construction personnel will not be permitted to enter this area. The footprint will be demarcated to prevent construction disturbances from encroaching on

potential giant garter snake habitat located outside its boundaries. ~~Pile installation will not involve dewatering the canal since the steel shell into which the concrete will be poured will act as a cofferdam directly at the site of installation.~~ Since work on the other parts of the bridge will be conducted from a floating platform, this is not expected to disturb or degrade the canal substrate or restrict water flow; therefore, there will be no ~~further~~ loss of or disturbance to habitat.

~~Although some effects to potential giant garter snake habitat are expected to occur, t~~The likelihood that the species uses the Site 1 project footprint is very low. The footprint is located approximately 33-35 air miles southeast of where the species is still known to occur in the Volta Wildlife Area and in Los Banos Creek (CNDDB, 2014)[1].

On page 7 of our concurrence letter, the *San Joaquin kit fox* and *Giant Garter Snake* headings under the **Determinations** are being modified as follows:

San Joaquin kit fox

Caltrans has concluded that the project may affect, but is not likely to adversely affect the San Joaquin kit fox. This determination is based on the small-scale scope of work at Site 1; the impaired quality of potential foraging habitat; the minor extent of ~~permanent and~~ temporary effects to this potential foraging habitat; the lack of suitable denning habitat, as well as the lack of any potential dens; and the conservation measures proposed to minimize and avoid potential effects to the species.

Giant Garter Snake

Caltrans has concluded that the project may affect, but is not likely to adversely affect the giant garter snake. This determination is based on the location of the Site 1 project footprint relative to extant occurrences of the species; the small-scale scope of work; the absence of permanent and temporary effects to ~~minor extent of permanently affected~~ potential habitat; and the conservation measures proposed to minimize and avoid potential effects to the species.

The following section supplements the information presented in the **Determinations** on page 7 of our concurrence letter and pertains to the evaluation of effects on the San Joaquin kit fox and the giant garter snake from the proposed design changes and introduced night work.

Caltrans conducted additional biological reconnaissance surveys for the San Joaquin kit fox at all bridge sites in October and December of 2013. No individuals or associated sign were observed.

Caltrans originally identified Site 1 as the only site of the original five in which there may be effects to listed species. Caltrans therefore has concluded that the proposed removal of Site 5 from the project scope, the changes to the bridge design at Site 3, and the introduction of night work at Site 4 will not result in an increase in adverse effects to the San Joaquin kit fox or the giant garter snake. The proposed modifications to the bridge design at Site 1 are expected to eliminate all permanent effects to habitat for both species and to reduce temporary effects to habitat for the San Joaquin kit fox. Caltrans therefore has concluded that the proposed changes will not alter its original determination that the project may affect, but is not likely to adversely affect the San Joaquin kit fox or the giant garter snake. The Service concurs with Caltrans' conclusion.

Closing Statement

Caltrans' proposed modifications do not change the conclusion of our January 26, 2015, concurrence letter: the proposed project may affect, but is not likely to adversely affect the San Joaquin kit fox or the giant garter snake. No further coordination with the Service under section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*) is necessary at this time. This concludes the revision letter for the Seismic Restoration Project at Four Bridge Locations.

If you have any questions regarding this letter, please contact Jen Schofield, Wildlife Biologist (jen_schofield@fws.gov), (916) 414-6604, or me (thomas_leeman@fws.gov), (916) 414-6544, at the letterhead address, by phone, or by e-mail.

Sincerely,

Thomas Leeman
Chief, San Joaquin Valley Division

cc:
Craig Bailey, California Department of Fish and Wildlife, Fresno, California