Design Data Documentation and Geotechnical Evaluation of Anomalous CIDH Concrete Piles (Drilled Shafts)

To meet the limited time requirements specified in the Standard Specifications for evaluating the affect anomalies may have on the geotechnical capacity of Cast-in-Drilled-Hole (CIDH) piles (drilled shafts), the geotechnical design information must be readily accessible until construction is complete and the assessment must be in a timely manner. This document provides requirements for design data retention, and the procedure to evaluate the geotechnical impact of anomalies.

If groundwater is encountered (whether expected or unexpected) during construction and the contractor uses either the slurry displacement method to place concrete or temporary casing to aid in dewatering the drilled hole, the CIDH pile is inspected using the California Test (CT) 233, "*Method of Ascertaining the Homogeneity of Concrete in CIDH Piles Using the Gamma-Gamma Test Method*". To facilitate Gamma-Gamma Logging (GGL), PVC inspection pipes are attached to the inside of the pile (2-foot minimum diameter) reinforcing cage. Memo to Designers (MTD) 3-1 Attachment 2 specifies the number and placement of the inspection pipes to allow the concrete to flow around and through the reinforcing cage. Communication with Structure Design (SD) and Structure Construction (SC) during the design phase and attending the pre-construction CIDH pile meeting (see Bridge Construction Memo BCM 130-20) will provide the opportunity for discussion of potential pile constructability issues. This communication will increase the chances of building a pile without anomalies which may prevent costly delays and anomaly mitigations.

The Foundation Testing Branch (FTB) performs GGL and Cross-hole Sonic Logging (CSL) on CIDH piles together with other Quality Assurance (QA) procedures. The main objective of GGL is to investigate the uniformity of concrete density; anomalies may indicate significant reductions in density. CSL is used to detect the presence of anomalies in the concrete inside the reinforcing cage. GGL is the primary test in Caltrans. If anomalies are detected by the GGL the FTB recommends that SC reject the pile. CSL may then be performed to further evaluate the rejected pile to provide more detailed information about the location and size of anomalies identified using GGL and to determine if anomalies exist in the concrete inside the reinforcing cage. All, anomalies, whether detected by GGL, CSL, or combination, are reported in the *Pile Acceptance Report*.

When recommending CIDH piles requiring CT 233 testing the geoprofessional must:

1. Include specific design information in the Foundation Report (FR).
2. Complete and file the *CIDH Pile Design Information Form* (DIF), which documents where critical design information is retained.
3. Complete Part 2 of PDDF when requested by the SC Representative.
4. Support the SC Representative as needed throughout the decision making process, including participation in CIDH Pile Non-Standard Mitigation Meeting(s).

Design Information to be Included in the Foundation Report (FR)

The capacity of a CIDH pile is based on the combination of Skin Friction (Q_s) and End-Bearing (Q_b). Due to geological conditions, groundwater location, and anticipated construction methods, the geotechnical designer may base the calculated "Nominal Axial Resistance" (Q_n) of the pile on any one of the following combinations:

$Q_n = Q_s + Q_b$ (Combination of Skin friction and End-bearing)

$Q_n = Q_s$ (Skin friction only)

$Q_n = Q_b$ (End-bearing only)

Per the Foundation Report for Bridges reporting standard the FR must:

"State how the geotechnical capacities are derived, whether from skin friction and/or end bearing. If both, state how much capacity is derived from skin friction and end bearing. Present skin friction contributions along the pile length in the "CIDH Pile Skin Friction Zone Elevations" table…"

The following FR example text presents the zones of the CIDH piles used to develop the required "Nominal Axial Resistance" (Q_n) and the minimum required CIDH pile length.

Example

It is anticipated that concrete placement for the CIDH piles will require slurry displacement methods. The calculated "Nominal Axial Resistance" (Q_n) of all CIDH piles was based on skin friction, Q_s; end-bearing, Q_b, was not used. The zones used to calculate Q_s of the CIDH piles are shown in Table 1.

Table 1: CIDH Pile Skin Friction Zone Elevations

Support Locations	*Skin Friction Zone Start Elevation*	*Skin Friction Zone End Elevation*
Pier 7	*65.4 ft*	*51.4 ft*
Pier 8	*65.4 ft*	*53.4 ft*
Pier 9	*68.5 ft*	*56.0 ft*
Abutment 10 Piles 1, 2	*78.0 ft*	*71.5 ft*
Abutment 10 Piles 3, 4	*71.0 ft*	*67.0 ft*

To achieve sufficient compressive axial resistance through skin friction, the CIDH piles at Piers 7 through 9 and Abutment 10 require a minimum embedment into granitic rock (see Table 2). If the minimum embedment length is not achieved at the Specified Pile Tip Elevation (SPTE), the pile tip must be lowered until the minimum embedment is achieved and the pile reinforcement and GGL inspection pipes lengthened accordingly.

Table 2: CIDH Pile Rock Socket Embedment Length

Support Location	*Top of Skin Friction Zone Elevation*	*Specified Tip Elevation*	*Minimum Embedment Length*
Pier 7	*65.4 ft*	*48.4 ft*	*17.0 ft*
Pier 8	*65.4 ft*	*50.4 ft*	*15.0 ft*
Pier 9	*68.5 ft*	*53.0 ft*	*15.5 ft*
Abutment 10 Piles 1, 2	*78.0 ft*	*69.5 ft*	*8.5 ft*
Abutment 10 Piles 3, 4	*71.0 ft*	*65.0 ft*	*6.0 ft*

CIDH Pile Design Data Documentation and Retention

The following CIDH pile information must be retained and easily accessible during construction by the geoprofessional and Branch Chief.

- Foundation Report
- Log of test borings, (LOTB)
- Geological profile used for each CIDH pile design
- Soil and or rock strength parameters used in the design of each support/pile
- Calculations and/or computer / spread sheet outputs used to determine each pile SPTE

The Branch Chief must complete and sign the *CIDH Pile Design Information Form* (DIF, Attachment 1) and file it in a location accessible to office staff. The form must also be sent to the Office of Structure Construction, Resident Engineer's (RE) Pending File as a part of the Structures Plans, Specifications, and Estimates (SPS&E) package.

Pile Design Data Form (PDDF)

After the contractor has constructed a CIDH pile using slurry displacement or temporary casing the FTB will perform GGL, and possibly CSL. If a pile is rejected, the State has a limited time per Standard Specification section 49-3.02A(4)(d)(iv) *Rejected Piles*, to determine which of the following options is available to the contractor:

1. The pile must be supplemented or replaced.
2. The pile must be repaired.
3. The pile is adequate with the anomaly left in place.

The *Pile Design Data Form* (PDDF) is used by SC with input by the FTB, SD, GS, and Corrosion to quickly determine acceptable options for a rejected pile. The FTB will complete Part 1 of the PDDF (Attachment 2), which will identify the location and extent of the anomaly, and attach the PDDF to the *Pile Acceptance Report* that is sent to SC. A copy of the *Pile Acceptance Report* is sent to the geoprofessional and the Chair of the CIDH Pile

Mitigation Committee. SC will request that SD, GS and Corrosion complete their respective sections and return the PDDF to SC. The information completed by the FTB for Part 1 will be used by the geoprofessional to complete Part 2, SD to complete Part 3, and the Corrosion to complete Part 4 of the PDDF. See MTD 3-7 for details.

The FTB produces a plot on the PDDF (Part 1) which shows the top and the bottom of the anomaly and the percentage of the pile affected. The geoprofessional must calculate the area of the anomaly on the outside of the pile and determine the skin friction contribution of that area, or the area of the anomaly at the pile base and determine the end bearing contribution. If the required nominal resistance exceeds the anomaly-reduced nominal resistance, the pile is unacceptable. The geotechnical evaluation assumes that the anomaly does not affect the ability of the pile to transmit loads to the pile below the anomaly.

If the pile is determined to be adequate with the anomaly in place, then the contractor may either repair the pile and receive full payment or leave the anomaly in place and incur an administrative deduction as specified in the contract.

If the capacity of the pile is determined to be inadequate by either GS, SD or Corrosion, then the anomaly mitigation process must start where the FTB, SC, GS, and SD will determine if the pile can be repaired or if it must be supplemented or replaced. The standard repair techniques are excavation repair to replace the anomalous concrete and grouting repair. If the standard repair methods are not feasible, SC will hold a *CIDH Pile Non-Standard Mitigation Meeting*, per Bridge Construction Memo BCM 130-21 to determine an acceptable mitigation strategy.

<u>Attachments</u>

- Attachment 1: CIDH Pile Design Information Form (DIF)
- Attachment 2: Pile Design Data Form (PDDF)
- Appendix A: Example Calculations
  - Figure 1: Pile Design Data Form (Parts 1 and 2 completed)
  - Figure 2: Example Diagram
  - Figure 3: GGL Plot
  - Figure 4: Pile Nominal Resistance Plot
  - Figure 5: Log of Test Borings (LOTB)

CIDH Pile Design Information Form (DIF)

Project Information

District: ………..
County: ………..
Route: ………….
Bridge Name: ………………………………………………………………………..
Bridge Number: ……………..
Project EA Number: …………………..
Project EFIS Number: …………………
DES- Structure Design Office: …………………………….
Branch # ………….

Geotechnical Design Information

Foundation type, that is, Shaft Group, Type I/II Shaft, etc.:
………………………………………………………………………………………………
………………………………………………………………………………………………
Location of the Shaft(s), Support Number(s):
…………………………………………………………………………………………………
…………………………………………………………………………………………………
Design Data Saved (Geological Profile, Soil / Rock strength parameters, Ground Water information, Computer Program Output, etc.), List all that apply:
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
Files Saved, List File Name(s) and Storage Location(s):
…………………………………………………………………………………………………

Geotechnical Evaluation Contact Information

Geotechnical Designer of Record:
Name: …………………………
Phone/Cell: ……………………
Geotechnical Designer:
Name: ………………………….
Phone/Cell: …………………….

Geotechnical Design Branch Chief Approval

Design Branch Chief Name: ………………………………..
Design Branch Chief Signature: ……………………………
Date: ………………………

The completed form must be sent to the OSC (RE Pending File)

Pile Design Data Form (GGL/CSL) ATTACHMENT 2

1 Foundation Testing

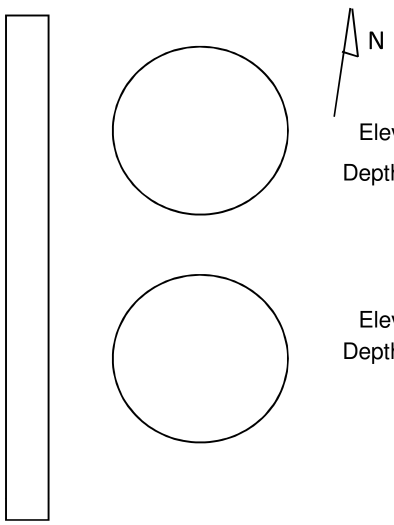
Name:
Phone:
Date:

Anomaly Overview

Testing Performed GGL CSL

Shaft Diameter:

Cutoff Elev.:



Section A - A
Elev:
Depth:

Section B - B
Elev:
Depth:

NOT TO SCALE

Tip Elev.:

Anomaly Description

Section A - A:

Section B - B:

2 Geotechnical

Name:
Phone:
Date:

Required Nominal Resistance of Pile (per contract plans):
Compression: ___________ kips Tension: ____________ kips

Groundwater Elevation: __________________

"As-Designed" nominal resistance over entire pile surface from the top to bottom elev. of anomaly / capacity loss within anomaly length (kips):

A-A: Compression:_____ / _____ Tension:______ / ______

Soil and/or Rock Type: _________________________________

Section is geotechnically: ☐ Acceptable ☐ Unacceptable

B-B: Compression:______ / _____ Tension:______ / _____

Soil and/or Rock Type: _________________________________

Section is geotechnically: ☐ Acceptable ☐ Unacceptable
Comments: ____
____

3 Structural

Name:
Phone:
Date:

As-Designed Capacity of Shaft

Section A-A: Shear: _________ Moment: ___________
Section B-B: Shear: _________ Moment: ___________

Maximum Demand of Shaft at Section A-A:
Shear: ______________ Moment: ______________
Shaft is structurally: ☐ Acceptable ☐ Unacceptable

Maximum Demand of Shaft at Section B-B:
Shear: ______________ Moment: ______________
Shaft is structurally: ☐ Acceptable ☐ Unacceptable

Comment ____
____
____
____

4 Corrosion

Name:
Phone: Date:

Consideration is ☐ Required ☐ Not Required

For anomalies between the top of pile and 3 feet below the groundwater level at the site, corrosion results listed in the Geotechnical report are used to assess the need for repair. For situations where results are not available, soil samples may be obtained adjacent to the anomaly and tested in accordance with California Test (CT) 643 (Parts 2, 3 and 4) and if necessary, CT 417 and CT 422 to determine soil corrosivity. For anomalies outside these limits, and where no stray current source can be identified, or for non-corrosive soil conditions, no consideration of corrosion potential is required.

Corrosion Potential at Section A-A: ______________________________
Corrosion Potential at Section B-B: ______________________________

5 Construction

Considering parts 2-4 of this form,

Structure Rep.:
Phone: Date:

Sec. A-A is: ☐ Acceptable with Administrative Deduction ☐ Unacceptable; Mitigation is Required
Sec. B-B is: ☐ Acceptable with Administrative Deduction ☐ Unacceptable; Mitigation is Required

Bridge:	Bridge No.:	Abut/Bent:
Dist-Co.-Rte:	EA:	Pile:
Structure Rep.:	Phone:	Fax:

APPENDIX A

Completing the Pile Design Data Form – Example Calculations

Steps to Complete the Geotechnical Portion of the Pile Design Data Form (PDDF)

The following are general steps for the geoprofessional to complete an analysis of the impact of an anomaly on a CIDH pile.

1. Assemble required information using the DIF to locate the design information, and the *Pile Acceptance Report*.
2. Report the Required Nominal Resistances shown in contract plans.
3. Report the groundwater elevation. This information can be obtained from the LOTBs or Foundation Report. This value is used by Corrosion Branch to determine corrosion potential for each anomalous section. *(It is not necessarily the "design" groundwater elevation; in some cases the geoprofessional may use the highest anticipated groundwater elevation for design. Corrosion uses the lowest anticipated groundwater elevation for their analysis. For corrosion purposes, perched water is ignored unless the perched water extends from the lowest measured groundwater elevation to below the pile tip).*
4. Determine the Remaining Required Nominal Resistance ($RRNR_{Ct}$ and $RRNR_{Tt}$) to be developed below the top of each anomalous section.
5. Determine the Remaining Required Nominal Resistance ($RRNR_{Cb}$ and $RRNR_{Tb}$) to be developed below the bottom of each anomalous section.
6. Determine and report the "as-designed" resistance over the entire pile surface from the top elevation to the bottom elevation of each anomaly.
7. Determine and report the calculated capacity loss in each of the anomalous lengths.
8. Report the soil and/or rock type.
9. Determine and report if each anomalous section is geotechnically acceptable.

   If a pile has multiple anomalies and various combinations exist in a manner that some anomalies could be marked either "acceptable" or "unacceptable", include a note in the *Comments* section of Part 2 of the PDDF that SD, GS, SC and Corrosion must discuss and develop a repair strategy.

   If additional sources of resistance are available, they should be considered to contribute to the available resistance. These include:

   - End bearing not included in the pile design.
   - Skin friction near the bottom of the pile not included in the pile design.
   - Increases due to reevaluation of the pile design calculations, e.g., the soil parameters may be reevaluated to see if using higher (but still realistic) values will result in increased nominal resistance.
   - The structural designer may also check the actual demand of the anomalous pile. In pile groups the actual demands for interior piles may be considerably less than what is shown on the plans.
   - The structural designer may accept additional settlement in lieu of the required capacity.

Definitions (Refer to Figure 2)

- R_{NC} = Nominal Resistance in compression.
- R_{NT} = Nominal Resistance in tension.
- SPTE = Specified Pile Tip Elevation.
- Z_t = Skin friction zone start elevation.
- Z_b = Skin friction zone end elevation.
- AE_t = Top of anomaly elevation.
- AE_b = Bottom of anomaly elevation.
- L = Length of design skin friction zone (Z_t - Z_b).
- $RRNR_{Ct}$ / $RRNR_{Tt}$ = Remaining Required Nominal Resistance at top of Anomaly for compression or tension, respectively
- $RRNR_{Cb}$ / $RRNR_{Tb}$ Remaining Required Nominal Resistance at bottom of Anomaly for compression or tension, respectively
- AF=Affected Pile Surface Area (%), see Part 1 of Pile Design Data Form.
- $Q_{s\text{-}add}$ = Pile nominal resistance below the skin friction zone.

Example Calculations

The following presents two methods for determining the reduced capacity of a CIDH pile resulting from the presence of anomalies.

Project Information

Bridge Name:	Deepwater Creek Bridge (Replace)
Bridge #:	53C-XXXX
Pile Diameter:	10 feet
Nominal Resistance:	R_{NC} = 6,600 kips
	R_{NT} = 0 kips
Pile Cutoff El.:	5.8 ft
Specified Pile Tip El.:	-133.0 ft
Ground Water El.:	2.31 ft

GGL Results (Figure 3)

Pile C at Bent 12 has two anomalous sections:

- Section A-A: Elevation 4.6 ft to 3.6 ft
- Section B-B: Elevation -10.8 ft to -16.0 ft

Geotechnical Design of Pile C at Bent 12

The Foundation reports states that:

- The geotechnical capacity of the CIDH pile is based on skin friction (Q_s) only.
- The geotechnical capacity was calculated from one pile diameter (10 ft) below the pile cutoff elevation to one pile diameter (10 ft) above the SPTE.

Analysis Method 1

Step 1: Assemble and Review Pertinent Information

- From the *Pile Acceptance Report* and/or the PDDF (Figure 1) determine the location and size of anomalous zones.
  - Section A-A: from El. 4.6 ft to 3.6 ft
  - Section B-B: from El. -10.8 ft to -16.0 ft.

- Review the Foundation Report and calculations to determine where and how the geotechnical capacity was obtained. In this example, the geotechnical capacity is from skin friction only:
  - Z_t = Pile Cutoff El. – One Pile Dia. = El. 5.8ft – 10ft = El. -4.2ft
  - Z_b = SPTE + One Pile Dia. = El. -123.0 ft

- Plot Remaining Required Nominal Resistance vs. Elevation using the design calculations (Figure 4).

Step 2: Report Required Nominal Resistances Shown in Contract Plans

- Compression, R_{NC} = 6,600 kips
- Tension, R_{NT} = 0 kips.

Step 3: Report the Groundwater Elevation

- From the LOTB (Figure 5): El. = 2.3’

Steps 4-7: Determine the “as-designed” nominal resistance over the entire pile surface from the top elevation to the bottom elevation of each anomaly and the calculated capacity loss within each anomaly length

(There is no tension demand in this example problem, therefore, there is no tension demand calculation shown.)

Anomaly A-A

Determine the “As-designed” Nominal Resistance as follows:

- $RRNR_{Ct} – RRNR_{Cb}$

  Where $RRNR_{Ct}$ = 6,600 Kips and $RRNR_{Cb}$ = 6,600 Kips (Figure 4)

- 6,600 kips - 6,600 kips = <u>0 kips</u>

Calculate the capacity loss as follows:

- $(RRNR_{Ct} – RRNR_{Cb})$ x AF/100

  Where AF = 2/12 = 17% (Part 1 of PDDF, 2 of 12 inspection tubes)

- (6,600 kips - 6,600 kips) x 17/100 = 0 kips

Anomaly A-A is above the design skin zone; therefore Anomaly A-A does not reduce the CIDH pile's nominal capacity.

Report the "as-designed" nominal resistance over the entire pile surface from the top elevation to the bottom elevation of each anomaly and the capacity loss within the anomaly length (kips), in Part 2 of the PDDF:

Section A-A: Compression: 0 / 0 Tension: 0 / 0

Anomaly B-B

Determine the "As-designed" Nominal Resistance as follows:

- $RRNR_{Ct} – RRNR_{Cb}$

Where $RRNR_{Ct}$ = 6,600 - 367 Kips = 6,233 kips (Figure 4)

$RRNR_{Cb}$ = 6,600 - 656 Kips = 5,944 kips (Figure 4)

- 6,233 kips – 5,944 kips = 289 kips

Calculate the capacity loss as follows:

- ($RRNR_{Ct} – RRNR_{Cb}$) x AF/100

Where AF = 100% (Part 1 of PDDF, 12 of 12 inspection tubes)

- (6,233 - 5,944) x 100/100 = 289 kips

Anomaly B-B is within the design skin zone; therefore Anomaly B-B reduces the CIDH pile's nominal capacity.

Report the "as-designed" nominal resistance over the entire pile surface from the top elevation to the bottom elevation of each anomaly and the capacity loss within the anomaly length (kips), in Part 2 of the PDDF:

Section B-B: Compression: 289 / 289 Tension: 0 / 0

Step 8: Report the soil and/or rock type

Using the LOTB (Figure 5), report the soil/rock type in the anomalous zone(s) in Part 2 of the PDDF:

Section A-A: Soil and/or Rock Type: Silty Sand (SM)

Section B-B: Soil and/or Rock Type: Silty Sand (SM) and Fat Clay (CH)

Step 9: Determine if each anomaly section is geotechnically acceptable

Anomaly A-A is located above the design skin friction zone and has no adverse impact on the geotechnical capacity of the CIDH pile. Check the appropriate boxes in the PDDF:

Section A-A: **Section is Geotechnically:** [X] **Acceptable** [ ] **Unacceptable**

Anomaly B-B results in a potential loss of 289 kips of skin friction. However, the geotechnical design of the pile did not include skin friction in the bottom 10 feet of the pile. This additional skin friction may be used to counter the capacity loss within the Anomaly B-B.

Determine the pile nominal resistance below the skin friction zone, from Elev. -123.0 ft to Elev. -133.0 ft, (Figure 4).

$$Q_{s\text{-}add} = (7155-6600) = 555 \text{ kips}$$

Because the excess of 555 kips is greater than the potential loss of 289 kips, the pile is considered to be acceptable. Check the appropriate boxes in the PDDF:

Section B-B: **Section is Geotechnically:** [X] **Acceptable** [ ] **Unacceptable**

Analysis Method 2

Using the same example pile as above at anomaly B-B:

1. Determine area of anomalies in resistance zones.
2. Determine "as-designed" resistance over the entire pile surface from the top elevation to the bottom elevation of each anomaly.
3. Determine the capacity loss(es) within the anomalous length(s).
4. Determine if each anomaly section is geotechnically acceptable.

A ten-foot diameter (D) pile has an anomaly from elevation -10.8 to -16.0 (Z) feet affecting 100% (AF) of the pile. Unit skin friction is 1.77 ksf (f_s) and in this example is uniform through the friction zone. The skin friction lost due to the anomaly is equal to the area of the anomaly times the unit skin friction:

- "as-designed" nominal resistance over the entire pile surface from the top elevation to the bottom elevation of anomaly (compression), Section B-B:
  - $\pi * D * Z * f_s$
  - $\pi * 10 * 5.2 * 1.77 =$ <u>289 kips</u>
- capacity loss within anomaly length (compression), Section B-B:
  - $\pi * D * Z * f_s * (AF/100\%)$
  - $\pi * 10 * 5.2 * 1.77/1 =$ <u>289 kips</u>

The geoprofessional subtracts the 289 kips from the pile's nominal resistance (R_{NC} = 6,600 kips) to determine the reduced available resistance of 6,311 kips. As the available resistance (6,311 kips) is less than the required nominal resistance (6,600 kips) the pile must be reanalyzed to determine if the available resistance can be accepted or modified. In this case, the pile has 555 kips of available skin friction (see previous example) in the bottom ten feet of the pile, therefore the Section B-B anomaly is marked as "acceptable".

<u>References</u>

- MTD 3-1 – Deep Foundations (June 2014)
- MTD 3-7 – Design Data Documentation and Evaluation of Anomalous Concrete Shafts (April 2012)
- BCM 130-10 – Testing of CIDH Piling (June 2014)
- BCM 130-20 – Cast-In-Drilled-Hole (CIDH) Pile Preconstruction Meeting (December 2011)
- BCM 130-21 – CIDH Pile Non-Standard Mitigation Meeting (June 2014)
- California Test (CT) 233 – Method of Ascertaining the Homogeneity of Concrete in Cast-In-Drilled-Hole (CIDH) Piles Using the Gamma-Gamma Test Method (November 2005)
- Foundation Reports for Bridges, Caltrans Geotechnical Manual, January 2009

Pile Design Data Form (GGL/CSL) Figure 1

1 Foundation Testing

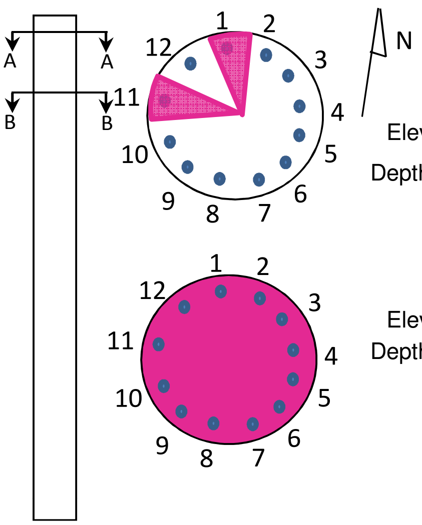
Name: GS-FTB Engr
Phone: 916-227-xxxx
Date: 5/24/2012

Anomaly Overview

Testing Performed X GGL CSL

Shaft Diameter: 10.0 ft

Cutoff Elev.: 5.75 ft



Section A - A
Elev: 4.6 to 3.6 ft
Depth: 1.2 to 2.2 ft

Section B - B
Elev: -10.8 to -16.0 ft
Depth: 16.6 to 21.8 ft

NOT TO SCALE

Tip Elev.: -133.00 ft

Anomaly Description

Section A - A: Anomaly was detected in two (2) GGL inspection pipes. May affect up to 17% of shaft cross-section at this location.

Section B - B: Overlapping anomaly was detected in all twelve (12) GGL inspection pipes. May affect up to 100% of shaft cross-section at this location.

2 Geotechnical

Name: GS
Phone: 916-227-xxxx
Date: mm/dd/yyyy

Required Nominal Resistance of Pile (per contract plans):
Compression: ____6,600_______ kips Tension: ____0___ kips

Groundwater Elevation: _____+2.31 ft__________

"As-Designed" nominal resistance over entire pile surface from the top to bottom elev. of anomaly / capacity loss within anomaly length (kips):

A-A: Compression:__0___ / __0__ Tension:___0__ / ___0__

Soil and/or Rock Type: ___Silty Sand (SM)_________________

Section is geotechnically: X Acceptable ☐ Unacceptable

B-B: Compression:__289__ / _289__ Tension:__0__ / _0__

Soil and/or Rock Type: __Silty Sand (SM) and Fat Clay (CH)_
Section is geotechnically: X Acceptable ☐ Unacceptable
Comments: __The additional skin friction below the design_______ ___zone compensates for the loss within the anomalous section__
____

3 Structural

Name:
Phone:
Date:

As-Designed Capacity of Shaft
Section A-A: Shear: _________ Moment: ___________
Section B-B: Shear: _________ Moment: ___________

Maximum Demand of Shaft at Section A-A:
Shear: ____________ Moment: ____________
Shaft is structurally: ☐ Acceptable ☐ Unacceptable

Maximum Demand of Shaft at Section B-B:
Shear: ____________ Moment: ____________
Shaft is structurally: ☐ Acceptable ☐ Unacceptable

Comment ____
____
____
____

4 Corrosion

Name:
Phone: Date:

Consideration is ☐ Required ☐ Not Required

For anomalies between the top of pile and 3 feet below the groundwater level at the site, corrosion results listed in the Geotechnical report are used to assess the need for repair. For situations where results are not available, soil samples may be obtained adjacent to the anomaly and tested in accordance with California Test (CT) 643 (Parts 2, 3 and 4) and if necessary, CT 417 and CT 422 to determine soil corrosivity. For anomalies outside these limits, and where no stray current source can be identified, or for non-corrosive soil conditions, no consideration of corrosion potential is required.

Corrosion Potential at Section A-A: ________________________________
Corrosion Potential at Section B-B: ________________________________

5 Construction

Considering parts 2-4 of this form,

Structure Rep.:
Phone: Date:

Sec. A-A is: ☐ Acceptable with Administrative Deduction ☐ Unacceptable; Mitigation is Required
Sec. B-B is: ☐ Acceptable with Administrative Deduction ☐ Unacceptable; Mitigation is Required

Bridge:	Deepwater Creek Br. (Replace)	Bridge No.:	53C-XXXX	Abut/Bent:	B12
Dist-Co.-Rte:	07-LA-47	EA:	07-XXXXXX	Pile:	C
Structure Rep.:	SC	Phone:		Fax:	

Example Typical Diagram

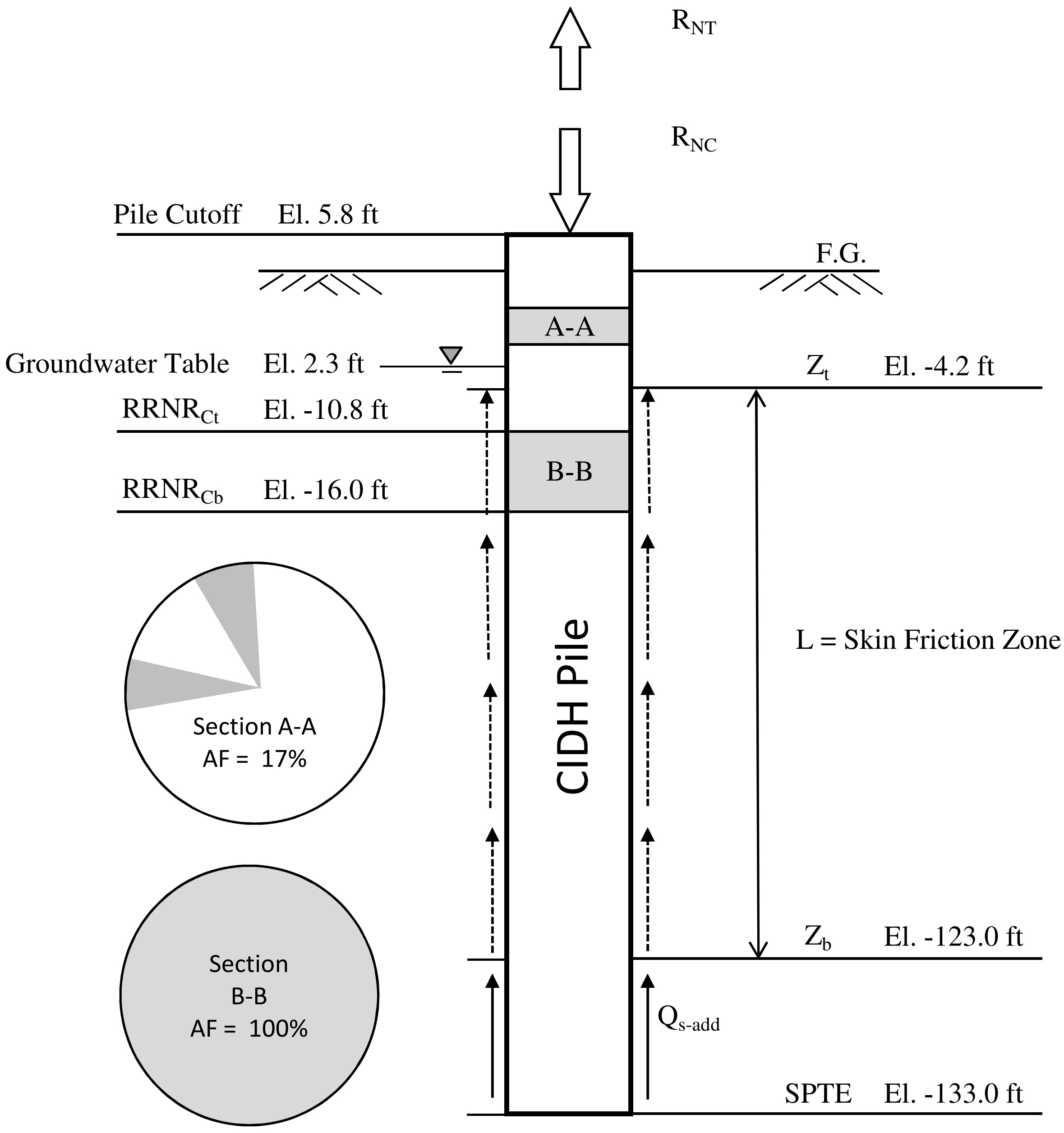
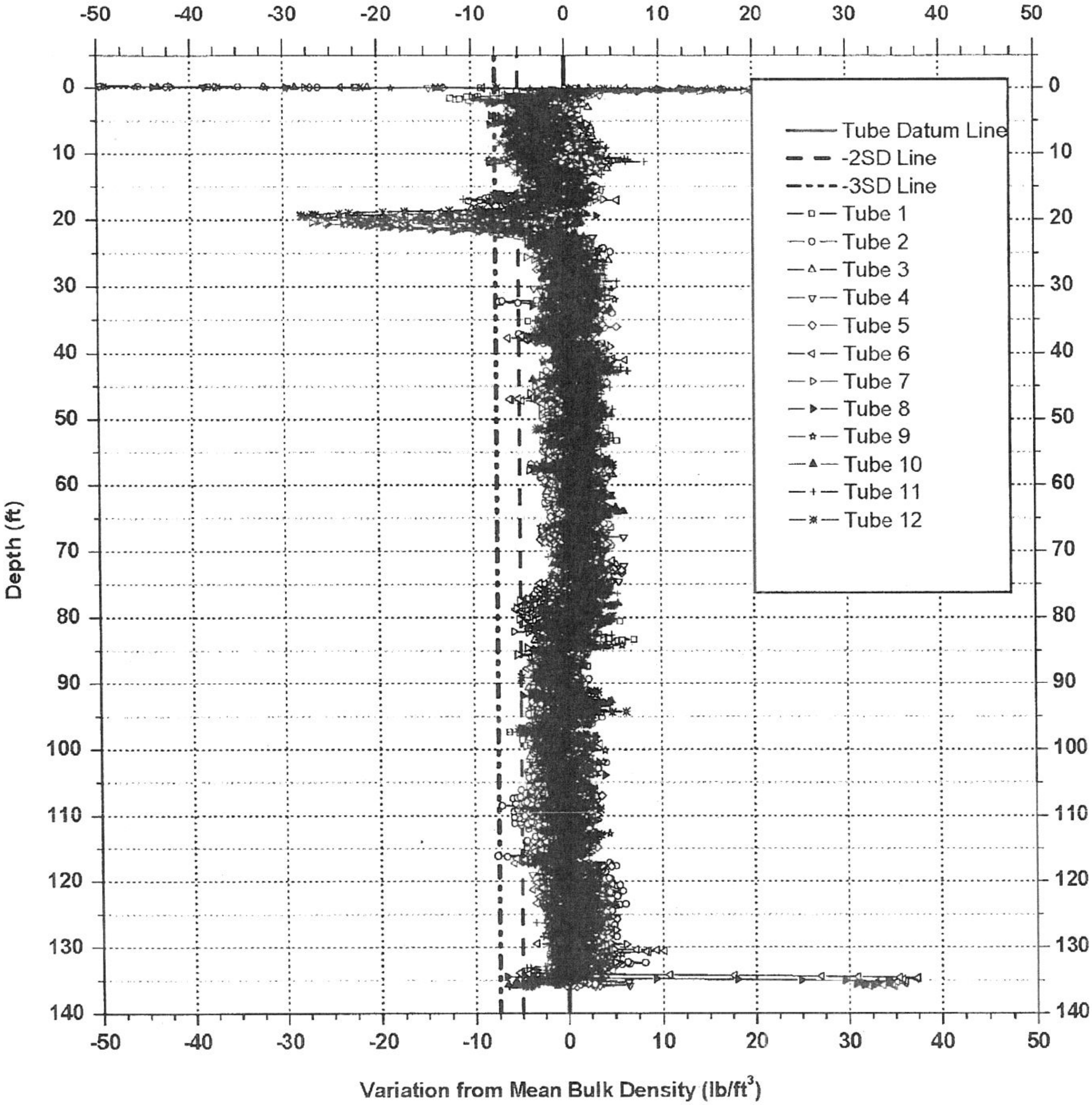


Figure 2



GAMMA-GAMMA LOGGING ACCEPTANCE TEST RESULTS

Deepwater Creek Bridge (Replace)

CIDH Pile C at Bent 12

EA 07-XXXX	10-ft dia. CIDH Pile
Bridge Number 53C-XXXX	Reported Top of Concrete Elev.= +5.75 ft
07-LA-47-	Reported Tip Elev.= -133.0 ft
Date Tested: 05/17/2012	Winch-Probe-Source Number: 1273-2575-568

The mean and standard deviation were calculated using density readings for all inspected tubes, excluding portions significantly impacted by reinforcement, anomalies, and water, as appropriate.

Figure 3

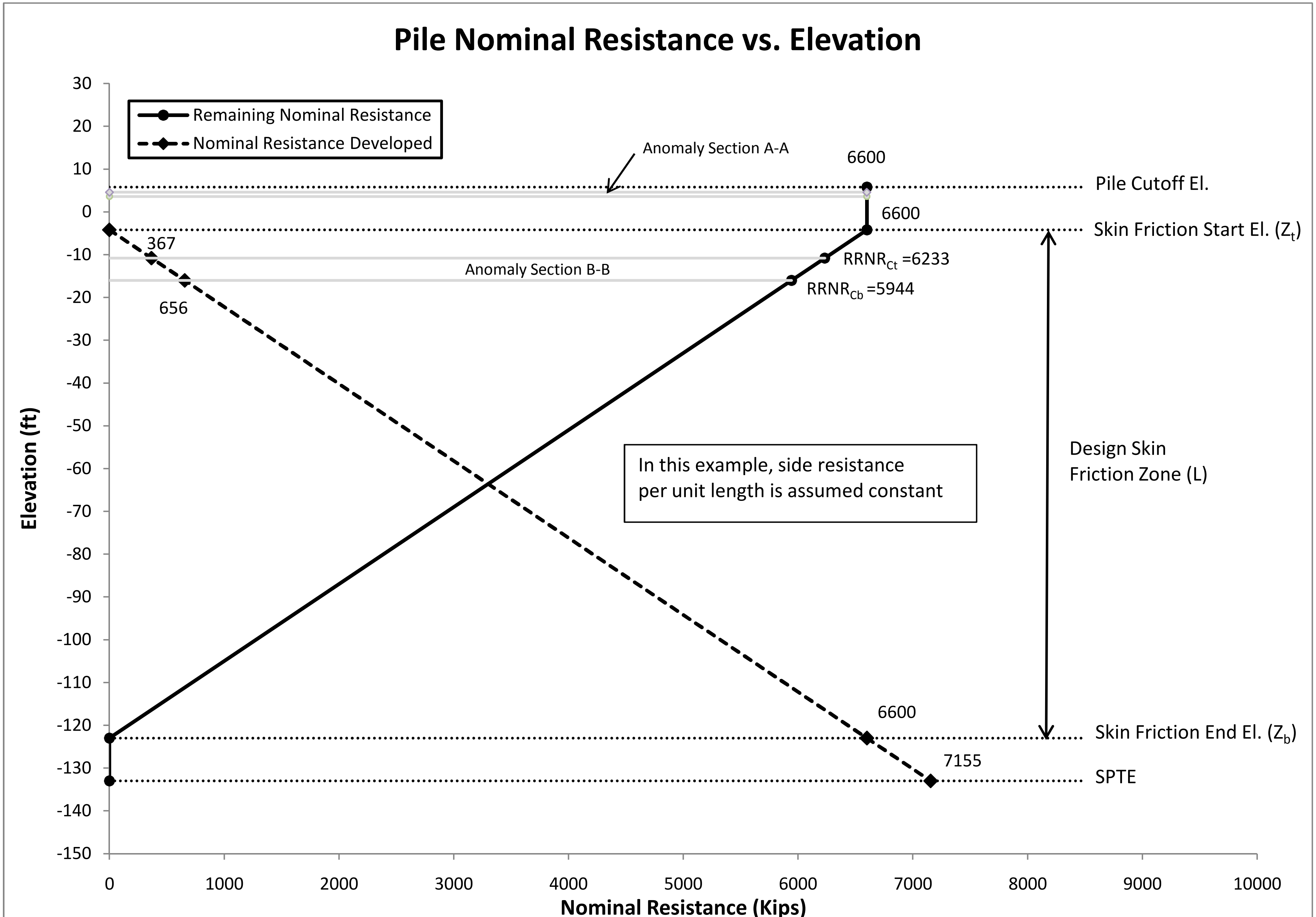
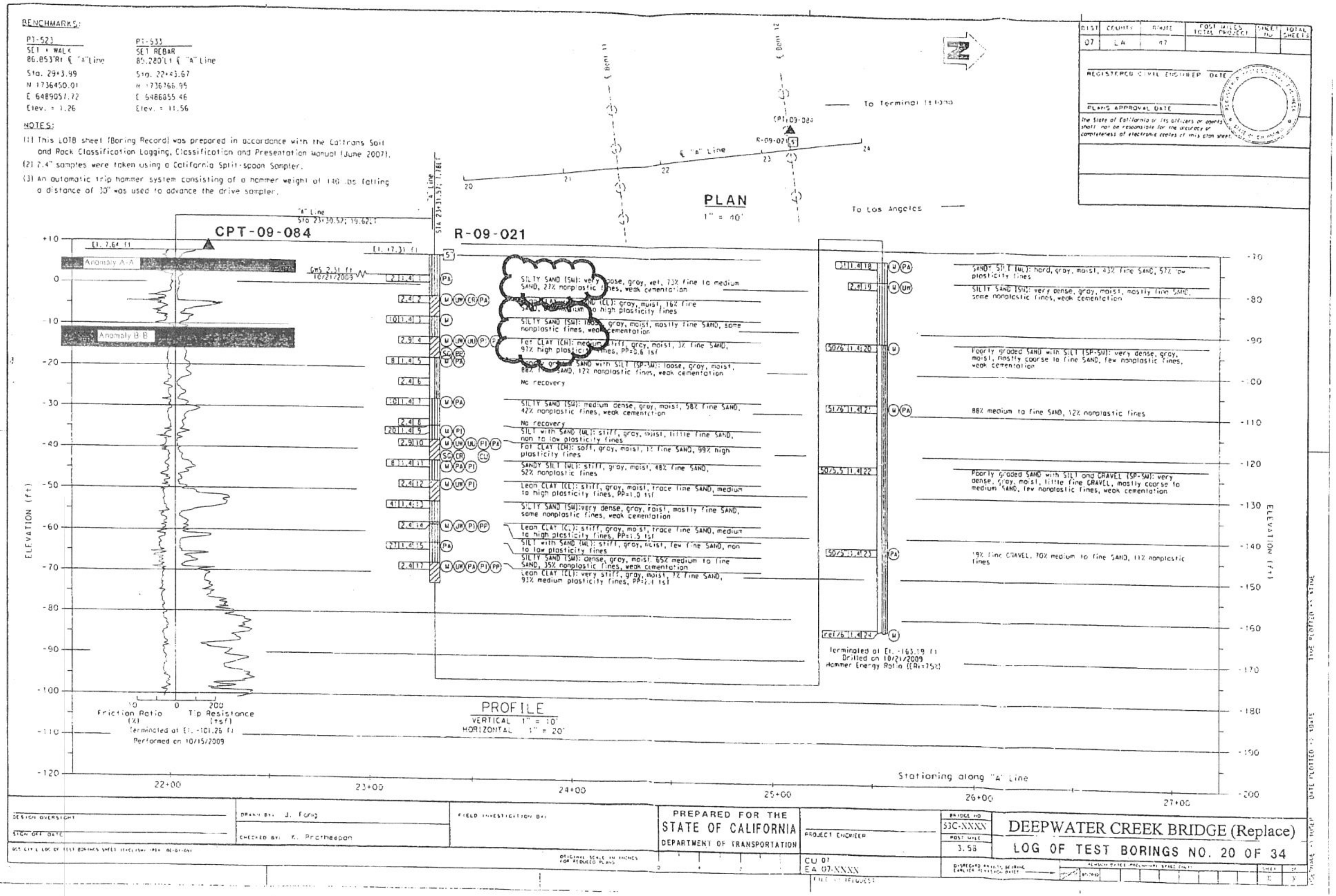

Pile Nominal Resistance vs. Elevation
Remaining Nominal Resistance
Nominal Resistance Developed
Anomaly Section A-A
6600
Pile Cutoff El.
6600
Skin Friction Start El. (Z_t)
367
$RRNR_{Ct}$ =6233
Anomaly Section B-B
$RRNR_{Cb}$ =5944
656
Design Skin
Friction Zone (L)
In this example, side resistance
per unit length is assumed constant
6600
Skin Friction End El. (Z_b)
7155
SPTE
Elevation (ft)
Nominal Resistance (Kips)
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

Figure 4



BENCHMARKS:
PT-523
SET + WALK
86.853'Rt ℄ "A" Line
Sta. 29+3.99
N 1736450.01
E 6489057.72
Elev. = 1.26
PT-533
SET REBAR
85.280'Lt ℄ "A" Line
Sta. 22+43.67
N 1736166.95
E 6486855.46
Elev. = 11.56
NOTES:
(1) This LOTB sheet (Boring Record) was prepared in accordance with the Caltrans Soil and Rock Classification Logging, Classification and Presentation Manual (June 2007).
(2) 2.4" samples were taken using a California Split-spoon Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
PLAN
1" = 40'
To Terminal Island
To Los Angeles
℄ "A" Line
CPT-09-084
R-09-021
Anomaly A-A
Anomaly B-B
PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'
Friction Ratio (%)
Tip Resistance (tsf)
Terminated at El. -101.26 ft
Performed on 10/15/2009
Terminated at El. -163.19 ft
Drilled on 10/21/2009
Hammer Energy Ratio (ER$_i$=75%)
ELEVATION (ft)
Stationing along "A" Line
22+00
23+00
24+00
25+00
26+00
27+00
PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DRAWN BY: J. Fong
CHECKED BY: K. Pratheepan
DEEPWATER CREEK BRIDGE (Replace)
LOG OF TEST BORINGS NO. 20 OF 34

Figure 5