# INFORMATION HANDOUT

**For Contract No. 07-3X3504**
**At 07-LA-105-R2.6**

**Identified by**
**Project ID 0712000166**

07-3X3504
07-LA-105-R2.6
Project ID 0712000166

## MATERIALS INFORMATION

Geotechnical Investigation Report

State of California | Business, Transportation and Housing Agency

# Memorandum

*Flex your power!*
*Be energy efficient!*

To: Mr. MARIO GUTIERREZ,
District 7 – Senior Transportation Engineer

Date: October 22, 2012

File: 07-LA-105-2.55
07-3X3501
Sinkhole Repair for
Embankment Slope

Attn: **Wilfredo Morales**

From: **DEPARTMENT OF TRANSPORTATION**
**DIVISION OF ENGINEERING SERVICES**
**Geotechnical Services**
**Office of Geotechnical Design – South 1**
**Branch C**

Subject: Geotechnical Investigation Report for Repair of Sinkholes on Embankment Slope on Route 105, PM R2.55

Per your request of July 26, 2012, Geotechnical Design South 1 Branch C has performed a geotechnical investigation for the above referenced project in order to provide remediation recommendations. The proposed project provides recommendations for the repair of three sinkholes adjacent to the westbound 105 right shoulder and their three exit points on the slope face. Figure 1 shows a Vicinity Map of the project location.

## 1.0 Background and Observations

### 1.1 Background

The sinkhole locations are within stations 66+00 and 66+40 (Connector C-4 Alignment) per the As-Built Plans provided to our office. The site is located in Los Angeles County, on the north side of Route 105, within the City of Inglewood. The embankment slope is a 30 foot high fill slope graded at an approximately 2:1 (H:V) slope. The sinkholes are located adjacent to the westbound paved shoulder in the unpaved top of slope.

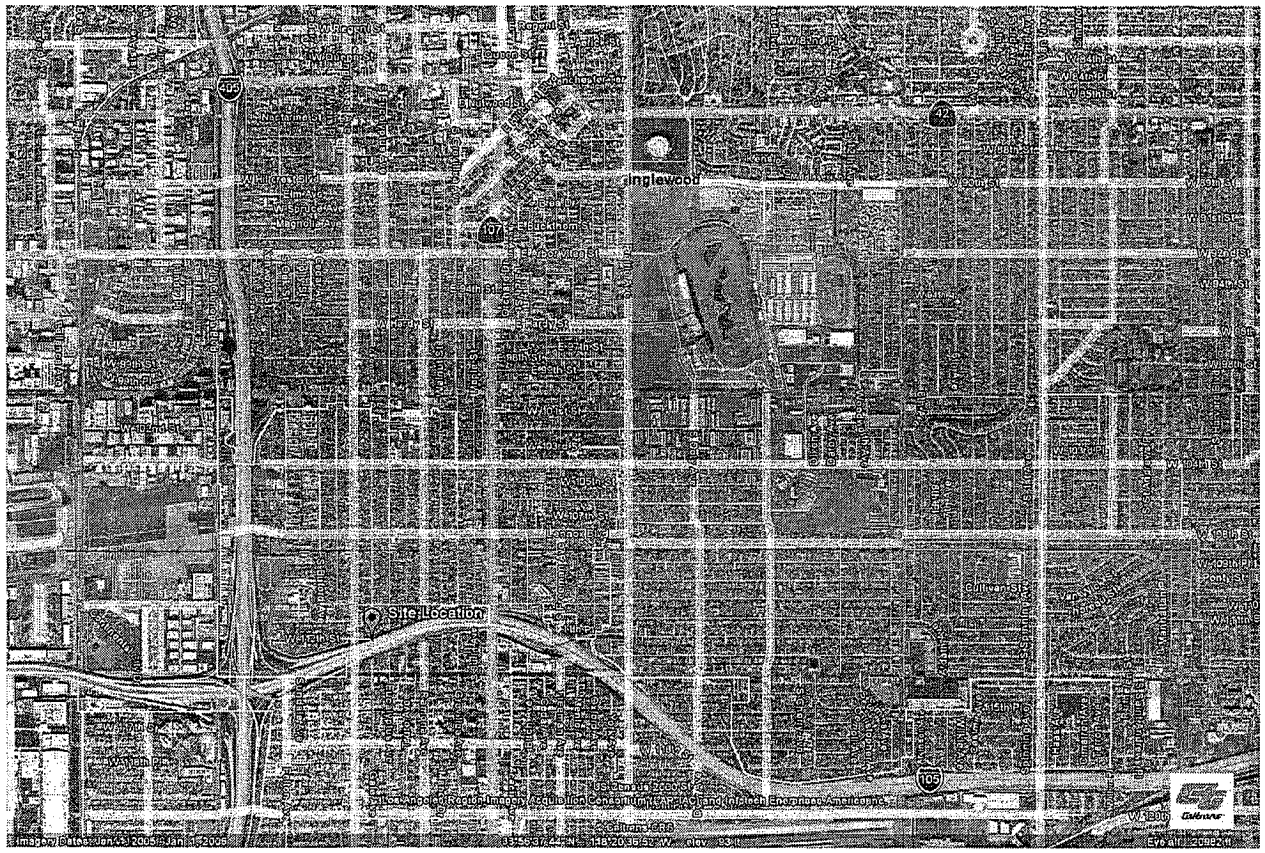
The sinkholes were first observed in March 2011. In June 2011, the irrigation lines used for the slope face, the edge drain and Corregated Metal Pipe (CMP) aligned parallel to the freeway and located under the shoulder were pressure checked for leakage and found to be intact.

### 1.2 Observations of Existing Conditions

The size openings of the sinkholes at the surface range from 2x2.5 to 3x10 square feet. However, in the hole furthest west the 2x2.5 square foot opening enlarges to approximately 6x10 feet at least.

The depth of the sinkholes was difficult to determine since two of the three adjacent to the shoulder are filled with debris. However, the westernmost hole was measured to have a depth of at least 11-12 feet. There are three outlet points within the slope face that appear to have been created by water coming from the sinkhole locations adjacent to the shoulder and exiting through these locations. Based on the locations of these outlets the other two sinkholes are estimated to be 6 to 10 feet deep. The locations of the sinkholes are shown on Figure 2.

**Figure 1 – Vicinity Map**




## 2.0 Geologic Considerations

### 2.1 Regional Geology

The subject site is located in the Torrance Plain, on the western side of the Los Angeles Basin. The Torrance Plain is a broad plain composed of older alluvium, which is generally dense silty sand.

The Los Angeles Basin is located within the Peninsular Ranges Geomorphic Province. Northwest trending mountain ranges and valleys associated with faults that are similar in nature to and associated with the San Andreas Fault characterize the Peninsular Ranges.

### 2.2 Site Geology

The subject site is located on 30 feet of embankment fill in relatively level terrain. The fill material at the site is silty and clayey sands. Native material is mapped as Late to Middle Pleistocene Old Alluvial Valley Deposits. The native alluvium was logged as clayey sand, silty sand, lean clay with sand, and sandy clay. The sand beds were generally medium dense, and the cohesive beds were very stiff to hard.

## 3.0 Ground Water

Ground water was not encountered during our field investigation. Our borings were drilled to 51.5' below roadway grade elevation. The State Water Resources Control Board's GeoTracker website was used to search for monitoring well records. Ground water records for a nearby gas station at Imperial Hwy. and Inglewood Ave. show ground water levels around 35' below ground surface, or an elevation of 40' above sea level.

## 4.0 Seismicity

The site is located in a seismically active area. The controlling deterministic faults in the area are the Compton-Los Alamitos Blind Thrust and the Newport-Inglewood Rose Canyon fault zone. The Compton-Los Alamitos Blind Thrust is a thrust fault with a $M_{max}$ of 6.8. The Newport-Inglewood Rose Canyon Fault is a strike-slip fault with a $M_{max}$ of 7.5. The controlling probabilistic data is the USGS 5% in 50 year hazard. A $V_{s30}$ of 320 m/s was used based on correlations with CPT data. Using the Caltrans ARS online website, a value of 0.5g was calculated for the peak ground acceleration at the site.

## 5.0 Liquefaction

Liquefaction may occur when loose sands and non-plastic silts are located below the water table and subjected to earthquake shaking. At the subject site, liquefaction is not considered to affect the project repair recommendations since groundwater was not encountered to the full depth explored for this project (51.5 feet below freeway grade).

## 6.0 Geotechnical Investigation Program

Field work consisted of mapping the sinkhole locations, drilling soil borings, and conducting Cone Penetration Tests (CPT's). The exploration program consisted of drilling two hollow stem auger soil borings on the 105 Westbound Travel Way surface during September 12th to 13th, 2012. The CPT's were also conducted from the travel way ground level on October 9th 2012. The borings and CPT's were drilled to determine the extent of the sinkhole areas and obtain subsurface information. The details of the CPT's and borings are summarized in Table 1. Boring and CPT locations are also shown on Figure 2 attached.

**Table 1 – Summary of Borings**

| Boring/CPT No. | Date Drilled | Station | Offset | Surface Elevation, (ft) | Depth Drilled (ft) | Ground water Elevation (ft) |
|---|---|---|---|---|---|---|
| A-12-001 | 9/12/12 | 66+10 | 11.2L | 91.2 | 51.5 | Not Encountered |
| A-12-002 | 9/13/12 | 66+27 | 11.2L | 92.5 | 51.5 | Not Encountered |
| CPT-12-001 | 10/9/12 | 66+36 | 13.1L | 91.2 | 51.0 | Not Encountered |
| CPT-12-002 | 10/9/12 | 66+18 | 13.1L | 92.2 | 26.5 | Not Encountered |
| CPT-12-003 | 10/9/12 | 66+05 | 13.1L | 93.5 | 17.5 | Not Encountered |

Notes: Stationing is based on Connector C-4 Alignment.
Stations, offsets and surface elevations were obtained from available topographic data provided by District 7 Design.

### 6.1 Subsurface Conditions

According to boring and CPT data drilled for this project, the Route 105 embankment fill adjacent to the sinkholes is composed of 30 feet of typically medium dense silty or clayey sand with few scattered wood fragments. The embankment fill is underlain by alluvial typically medium dense inter layered fine grained silty sands and clayey sands to the full depth explored (51.5 feet). Groundwater was not encountered in the borings. The boring and CPT logs are included in Appendix A and B, respectively.

## 7.0 Proposed Repair recommendations

The recommendations provided in this report consist of short term or immediate recommendations and long term or permanent recommendation. The goal of the short term recommendations are to prevent rainfall or runoff from entering the sinkholes and thus causing them to become larger and potentially endangering the 105 Westbound travel way. The long term recommendations are aimed at determining the cause of the sinkholes, eliminating that cause and rebuilding the embankment slope. The short term and long term recommendations are provided in the sections below.

7.1 Short Term Recommendations

Per our e-mail to District 7 dated 9/24/12, we recommended covering the six identified sinkhole openings with plastic sheeting anchored with stakes and/or sandbags in order to keep rainfall or runoff from entering the sinkhole openings. It is preferable to cover as much of the area in between the sinkholes as well. Plywood could also be placed over the sinkholes first with plastic sheeting cover. Stakes or warning signs along with cones should be placed by the sinkholes. Finally the sheeting placed on the sinkholes adjacent to the paved shoulder should be sloped toward the freeway curb so as to prevent water from accumulating on the sheeting. The three holes on the slope face may be covered individually with sheeting and sandbags and/or stakes.

This recommendation should be implemented as soon as possible to protect the sinkhole openings from upcoming rainfall.

7.2 Long Term Recommendations

Long term or permanent repair recommendations consist of excavating the embankment fill slope between stations 65+90 to 66+50 per the C-4 Connector Alignment (ramping for construction may extend beyond these limits as necessary). The excavation should extend 5 to 12 feet from the toe of the slope to the proposed location of temporary shoring, as depicted on the cross Sections A-A' through C-C' shown on Figures 2A through 2C, respectively. The location of the temporary shoring should be placed between the paved shoulder and adjacent travel way lane within the station limits previously mentioned.

Excavation should commence per the sections shown on Figures 2A through 2C, approximately to a depth of 13-20 feet adjacent to the shoring. It is anticipated that 20 foot deep excavations would be needed between stations 66+30 to 66+50 and at least 15 foot excavations between 65+90 and 66+30 (Although exact limits and excavation depths would need to be determined in the field). Furthermore, it may be prudent to assume 20 foot excavation along the whole length of the limits, stations 65+90 to 66+50.

It is important that a geologist and/or Engineer be onsite during excavation to help identify any potential causes of the sinkholes. Possible causes may be abandoned utilities or other similar sources. If abandoned utilities are the source of the sinkholes, it is possible that these are located underneath the existing storm drain (based on the measured depth of the sinkholes and the location of the outlet holes on the slope face). As such, any remnants of abandoned utility should be removed within the excavation limits and the ends permanently sealed.

The shoring may consist of temporary driven sheet piles or soldier piles with wood lagging. The sheet piles or soldier piles would be cantilevered for excavation depths up to 15 feet and anchored with a single row of tiebacks to excavation depths up to 20 feet deep or more. The embedment depths are based on a Factor of Safety of 1.2. Section 7.2.1 provides shoring parameters for use in design. If sheet piles are used these may need to be driven in stages or partially so as to allow an opening for any abandoned utilities aligned perpendicular to the freeway. For soldier piles

construction would need to be performed in "Top Down" fashion to allow for examination of any possible utility openings. 24-inch diameter holes may be drilled for the soldier pile beams. Although water may be as high as 40 feet elevation, (about 50 feet below freeway elevation) water should be expected if drilling approaches this depth. Final temporary shoring design must be submitted by the contractor to the Resident Engineer (RE) for review and approval.

For cost estimation purposes, for sheet piling, assume for a 15 foot high wall an embedment of sheet piling of 20 feet deep for cantilever shoring and for a 20 foot high wall, 10 feet embedment with an anchor system. The anchor would be located 6 feet below the roadway at 8 foot spacing. For soldier piles assume a 20 foot embedment for 15 foot high wall and 15 foot embedment with one row of tiebacks and 6 feet below the roadway at an angle of 20 degrees from horizontal for a 20 foot high wall. Tieback forces for soldier piles would also be at 8 foot spacing.

Care should be taken when excavating around existing utilities such as the storm drain and irrigation lines. These should be removed and replaced or relocated during excavation, after the sheet piles or H-piles for soldier piles have been driven.

Upon identifying and repairing the source of the sinkholes the excavated area should then be backfilled with fill material per the 2010 Standard Specifications, Sections 19-5 and 19-6. The fill material should be predominantly granular with an expansion index less than 50. The Landscaping Division should be consulted regarding replacement of suitable vegetation on the finished slope face.

7.2.1 Temporary Shoring Parameters

Temporary shoring should be based on a triangular shaped active pressure of 34H psf for granular fill soils (typically medium dense Silty Sand). The necessary penetration for sheet piles or soldier piles should be calculated using an ultimate passive pressure of 400 psf/foot of depth. The passive pressure is based on loose to dense silty or clayey sand with interbeds of sandy clay. Traffic surcharge should be taken as 240 psf. The wall can be designed based on the simplified lateral earth pressure diagram as shown in Fig. 5.5.5.6-1 of the 2010 Caltrans Bridge Design Specifications (BDS) A factor of safety of 1.2 should be built into the design of the shoring for temporary conditions.

## 8.0 Additional Construction Considerations

- Sheet Piles or soldier piles may not be able to be extracted after embankment fill is replaced. Therefore, it is recommended that shoring system be bid as unrecoverable.

- It is highly recommended that a geotechnical engineer or geologist from our office be onsite during excavation in order to assist in determining the cause of the sinkholes.

- We also highly recommend that plans and specifications be submitted for our review before finalization.

- For CIDH drilling, caving should be anticipated. A method to control caving such as the use of temporary casing, should be considered. As mentioned previously, water should be expected for drilling approaching 50 foot depths, relative to the freeway level.

If you have any questions or comments, please call Sam Sukiasian at (213) 620-2135 or Kristopher Barker at (213) 620-2334.

Prepared by: Date:

Supervised by: Date:



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Attachments:
Appendix A – Boring Logs
Appendix B – Cone Penetration Logs

cc: GS File room – gs_file_room@dot.ca.gov
Sharas Bangalore – District 7 Project Manager
GS Corporate – Shira Rajendra
District Construction RE Pending File
Kirsten Stahl – District 7 Materials Engineer

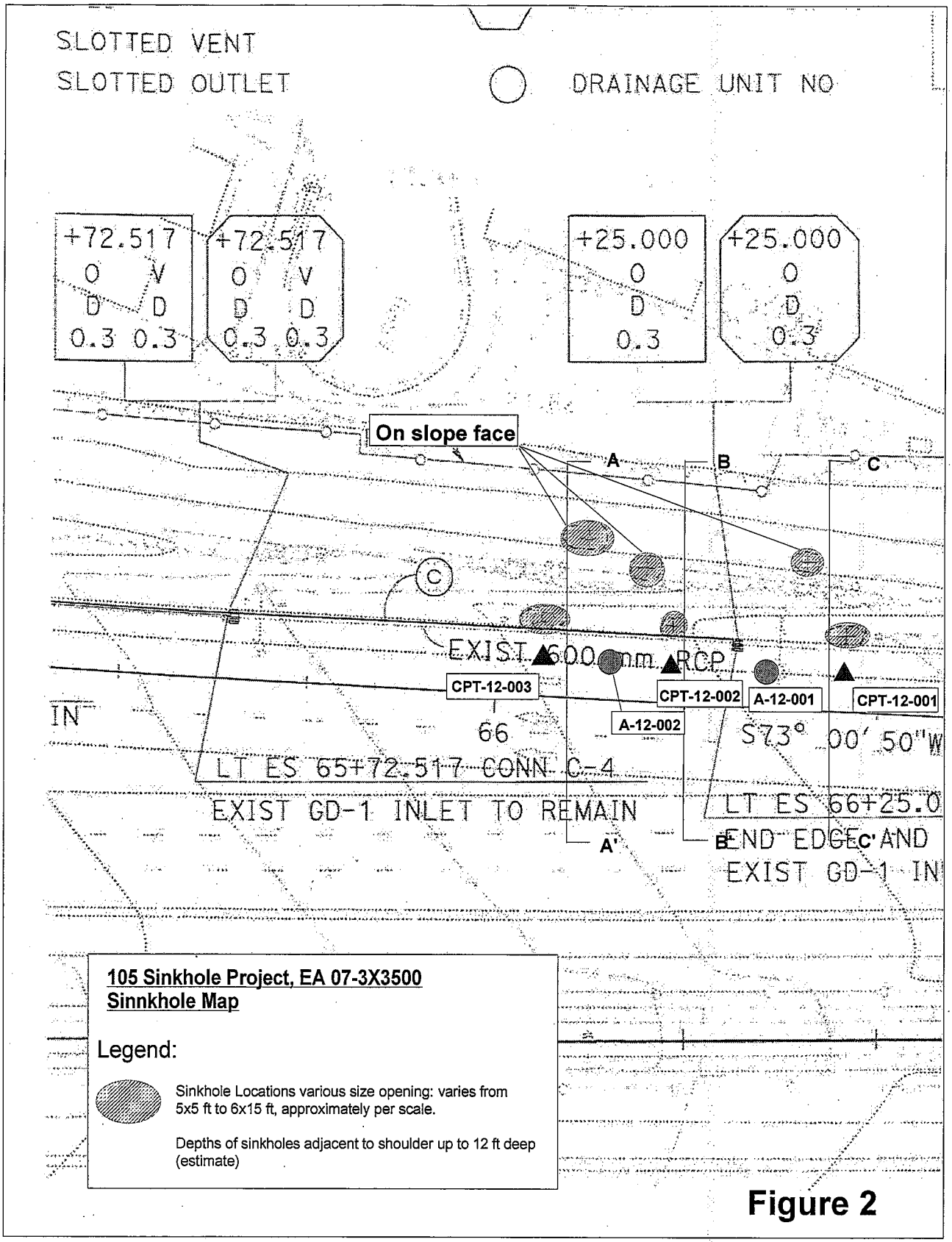

SLOTTED VENT
SLOTTED OUTLET
DRAINAGE UNIT NO
+72.517
O V
D D
0.3 0.3
+72.517
O V
D D
0.3 0.3
+25.000
O
D
0.3
+25.000
O
D
0.3
On slope face
A
B
C
EXIST 600 mm RCP
CPT-12-003
CPT-12-002
A-12-001
CPT-12-001
A-12-002
66
S73° 00' 50"W
LT ES 65+72.517 CONN C-4
EXIST GD-1 INLET TO REMAIN
LT ES 66+25.0
END EDGE AND
EXIST GD-1 IN
A'
B'
C'
105 Sinkhole Project, EA 07-3X3500
Sinnkhole Map
Legend:
Sinkhole Locations various size opening: varies from 5x5 ft to 6x15 ft, approximately per scale.
Depths of sinkholes adjacent to shoulder up to 12 ft deep (estimate)

**Figure 2**

Station 66+07
Section A-A'
Not to Scale

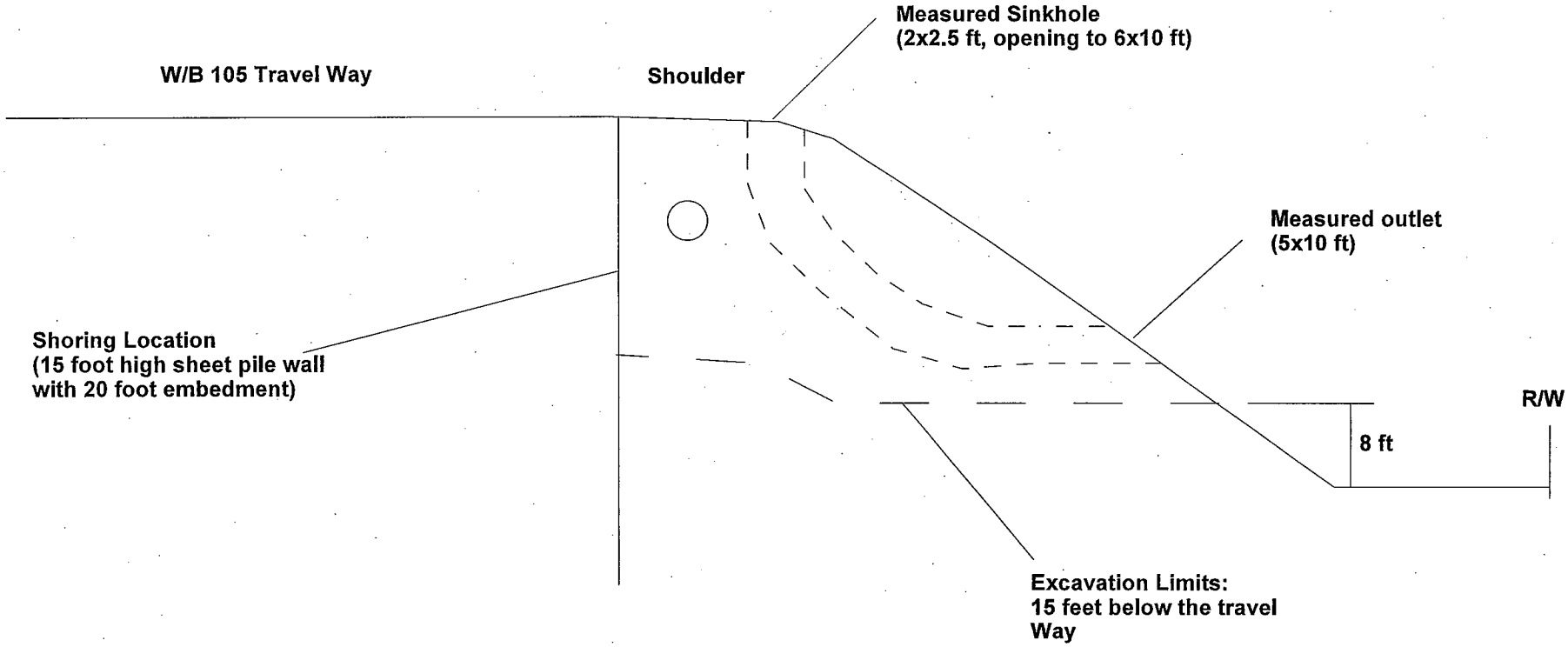



Figure 2A

Station 66+20
Section B-B'
Not to Scale

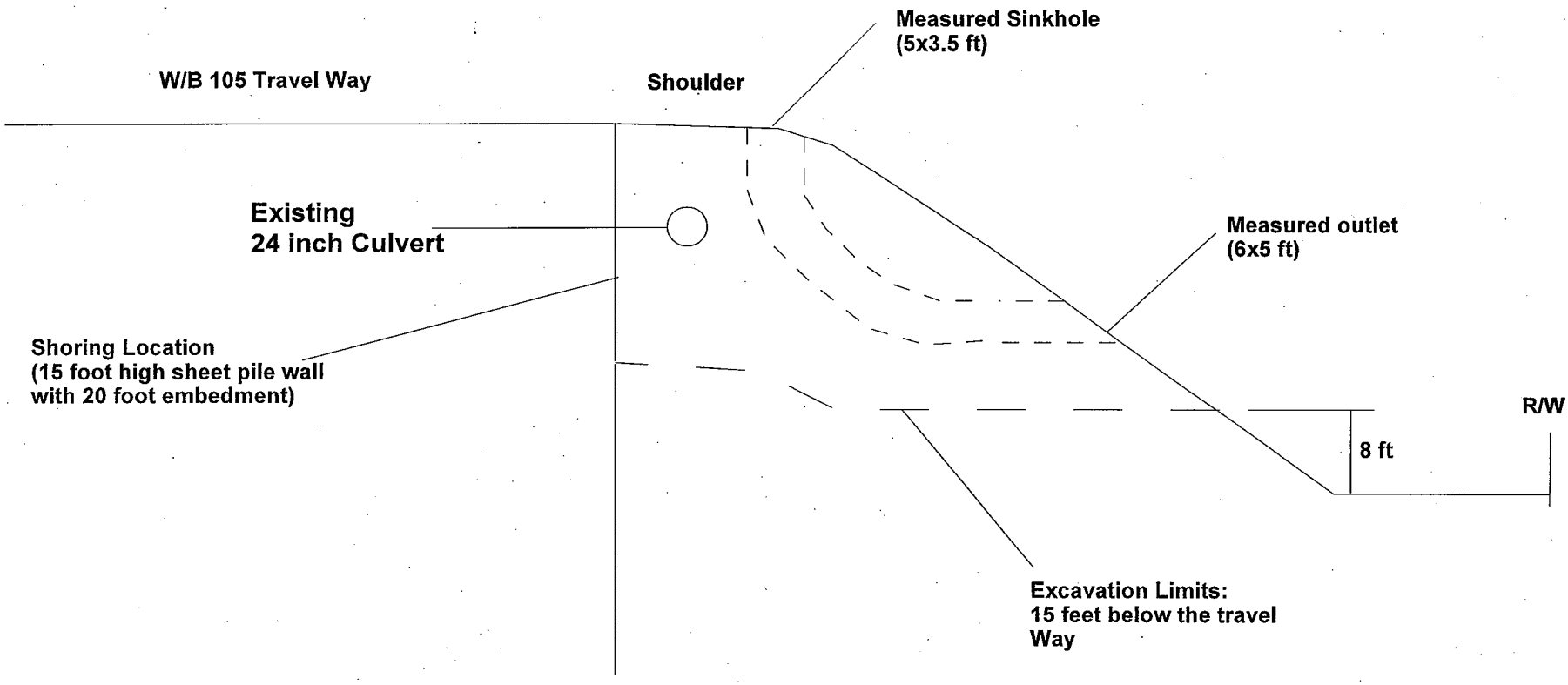



Figure 2B

Station 66+35
Section C-C'
Not to Scale

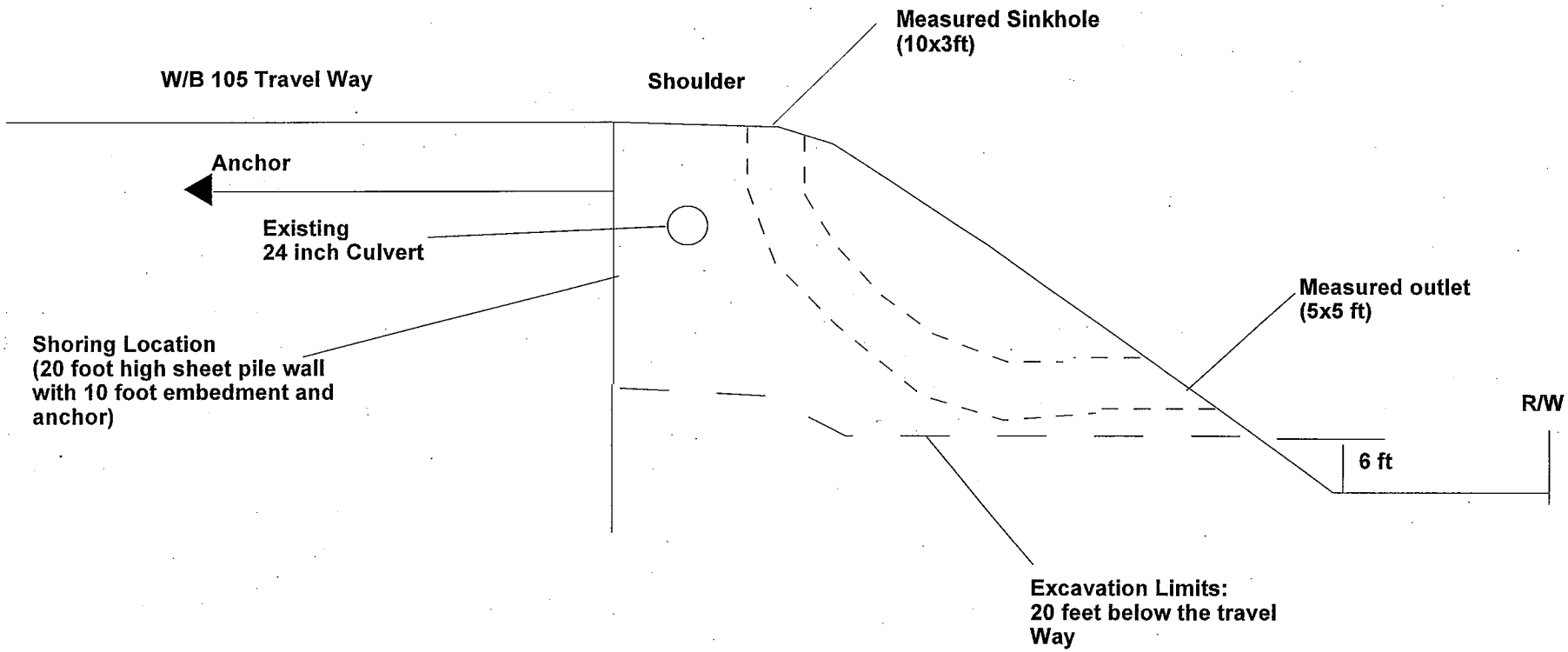



Figure 2C

# Appendix A
# Boring Logs

| LOGGED BY | BEGIN DATE | COMPLETION DATE | BOREHOLE LOCATION (Lat/Long or North/East and Datum) | HOLE ID |
|---|---|---|---|---|
| K. Barker | 9-12-12 | 9-12-12 | | A-12-001 |
| DRILLING CONTRACTOR | | | BOREHOLE LOCATION (Offset, Station, Line) | SURFACE ELEVATION |
| Caltrans | | | 11.2' Lt Sta 66+10 | 91.2 ft |
| DRILLING METHOD | | | DRILL RIG | BOREHOLE DIAMETER |
| Hollow-Stem Auger | | | CS 2000 (truck) | 6 in |
| SAMPLER TYPE(S) AND SIZE(S) (ID) | | | SPT HAMMER TYPE | HAMMER EFFICIENCY, ERi |
| SPT (1.4") | | | | 99% |
| BOREHOLE BACKFILL AND COMPLETION | | | GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) | TOTAL DEPTH OF BORING |
| cuttings | | | | 51.5 ft |

| ELEVATION (ft) | DEPTH (ft) | Material Graphics | DESCRIPTION | Sample Location | Sample Number | Blows per 6 in. | Blows per foot | Recovery (%) | RQD (%) | Moisture Content (%) | Dry Unit Weight (pcf) | Shear Strength (tsf) | Drilling Method | Casing Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | ASPHALT CONCRETE (10"). | | | | | | | | | | | | |
| | 1 | | AGGREGATE BASE (24"). | | | | | | | | | | | | |
| 89.20 | 2 | | | | | | | | | | | | | | |
| | 3 | | SILTY SAND (SM); very dense; olive; dry; fine sand thinly interbedded with medium sand SAND; some fines; few fine GRAVEL; PP>4.5; (FILL). | | | | | | | | | | | | |
| 87.20 | 4 | | | | | | | | | | | | | | |
| | 5 | | | | S-1 | 25<br>22<br>14 | 36 | | | | | | | | |
| 85.20 | 6 | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| 83.20 | 8 | | | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | | | |
| 81.20 | 10 | | - dense; no gravel; PP>4.5. | | S-2 | 14<br>9<br>14 | 23 | | | | | | | | |
| | 11 | | | | | | | | | | | | | | |
| 79.20 | 12 | | | | | | | | | | | | | | |
| | 13 | | | | | | | | | | | | | | |
| 77.20 | 14 | | | | | | | | | | | | | | |
| | 15 | | - dark olive gray; moist; PP>4.5. | | S-3 | 9<br>13<br>14 | 27 | | | | | | | | |
| 75.20 | 16 | | | | | | | | | | | | | | |
| | 17 | | | | | | | | | | | | | | |
| 73.20 | 18 | | | | | | | | | | | | | | |
| | 19 | | | | | | | | | | | | | | |
| 71.20 | 20 | | CLAYEY SAND (SC) moderately bedded with moderate interbeds of SILTY SAND (SM). CLAYEY SAND; medium dense; dark olive gray; moist; fine and medium SAND; some fines; scattered wood chips; PP>4.5. | | S-4 | 6<br>7<br>9 | 16 | | | | | | | | |
| | 21 | | | | | | | | | | | | | | |
| 69.20 | 22 | | SILTY SAND; dark olive gray; moist; fine and medium SAND; some fines. | | | | | | | | | | | | |
| | 23 | | | | | | | | | | | | | | |
| 67.20 | 24 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | | |

*(continued)*

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

| REPORT TITLE | | | | HOLE ID |
|---|---|---|---|---|
| BORING RECORD | | | | A-12-001 |
| DIST. | COUNTY | ROUTE | POSTMILE | PROJECT ID |
| 07 | LA | 105 | R2.6 | 07-3X350 |
| PROJECT OR BRIDGE NAME | | | | |
| 105 Sinkholes | | | | |
| BRIDGE NUMBER | PREPARED BY | | DATE | SHEET |
| | | | | 1 of 2 |

5 BR - STANDARD 105 SINKHOLES.GPJ DRAFT CALTRANS LIBRARY OCT 2011.GLB 10/23/12

| ELEVATION (ft) | DEPTH (ft) | Material Graphics | DESCRIPTION | Sample Location | Sample Number | Blows per 6 in. | Blows per foot | Recovery (%) | RQD (%) | Moisture Content (%) | Dry Unit Weight (pcf) | Shear Strength (tsf) | Drilling Method | Casing Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | | - dense; PP>4.5.<br>CLAYEY SAND (SC) *(continued)*. | | S-5 | 10<br>15<br>14 | 29 | | | | | | | | |
| 65.20 | 26 | | | | | | | | | | | | | | |
| | 27 | | | | | | | | | | | | | | |
| 63.20 | 28 | | | | | | | | | | | | | | |
| | 29 | | | | | | | | | | | | | | |
| 61.20 | 30 | | CLAYEY SAND (SC); dense; light olive brown; damp; fine SAND; some fines; rust stained; PP>4.5; (NATIVE). | | S-6 | 6<br>9<br>14 | 23 | | | | | | | | |
| | 31 | | | | | | | | | | | | | | |
| 59.20 | 32 | | | | | | | | | | | | | | |
| | 33 | | | | | | | | | | | | | | |
| 57.20 | 34 | | | | | | | | | | | | | | |
| | 35 | | - medium dense; PP=3.5. | | S-7 | 3<br>4<br>5 | 9 | | | | | | | | |
| 55.20 | 36 | | | | | | | | | | | | | | |
| | 37 | | | | | | | | | | | | | | |
| 53.20 | 38 | | | | | | | | | | | | | | |
| | 39 | | | | | | | | | | | | | | |
| 51.20 | 40 | | SILTY SAND (SM); dense; olive; damp; fine SAND; some fines; PP=2.5. | | S-8 | 11<br>11<br>9 | 20 | | | | | | | | |
| | 41 | | | | | | | | | | | | | | |
| 49.20 | 42 | | | | | | | | | | | | | | |
| | 43 | | | | | | | | | | | | | | |
| 47.20 | 44 | | | | | | | | | | | | | | |
| | 45 | | CLAYEY SAND (SC); dense; light olive brown; damp; fine SAND; some fines. | | S-9 | 9<br>13<br>17 | 30 | | | | | | | | |
| 45.20 | 46 | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | |
| 43.20 | 48 | | | | | | | | | | | | | | |
| | 49 | | | | | | | | | | | | | | |
| 41.20 | 50 | | PP=3.0. | | S-10 | 4<br>8<br>10 | 18 | | | | | | | | |
| | 51 | | | | | | | | | | | | | | |
| 39.20 | 52 | | Bottom of borehole at 51.5 ft bgs<br><br>Ground water was not encountered.<br><br>This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below. | | | | | | | | | | | | |
| | 53 | | | | | | | | | | | | | | |
| 37.20 | 54 | | | | | | | | | | | | | | |
| | 55 | | | | | | | | | | | | | | |

5 BR - STANDARD 105 SINKHOLES.GPJ DRAFT CALTRANS LIBRARY OCT 2011.GLB 10/23/12

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

| REPORT TITLE | | | | HOLE ID |
|---|---|---|---|---|
| **BORING RECORD** | | | | **A-12-001** |
| DIST. | COUNTY | ROUTE | POSTMILE | PROJECT ID |
| **07** | **LA** | **105** | **R2.6** | **07-3X350** |
| PROJECT OR BRIDGE NAME | | | | |
| **105 Sinkholes** | | | | |
| BRIDGE NUMBER | PREPARED BY | | DATE | SHEET |
| | | | | **2 of 2** |

| LOGGED BY | BEGIN DATE | COMPLETION DATE | BOREHOLE LOCATION (Lat/Long or North/East and Datum) | HOLE ID |
|---|---|---|---|---|
| K. Barker | 9-13-12 | 9-13-12 | | A-12-002 |
| DRILLING CONTRACTOR | | | BOREHOLE LOCATION (Offset, Station, Line) | SURFACE ELEVATION |
| Caltrans | | | 11.2' Lt Sta 66+27 | 91.5 ft |
| DRILLING METHOD | | | DRILL RIG | BOREHOLE DIAMETER |
| Hollow-Stem Auger | | | CS 2000 (truck) | 6 in |
| SAMPLER TYPE(S) AND SIZE(S) (ID) | | | SPT HAMMER TYPE | HAMMER EFFICIENCY, ERi |
| SPT (1.4") | | | | 99% |
| BOREHOLE BACKFILL AND COMPLETION | | | GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) | TOTAL DEPTH OF BORING |
| cuttings | | | | 51.5 ft |

| ELEVATION (ft) | DEPTH (ft) | Material Graphics | DESCRIPTION | Sample Location | Sample Number | Blows per 6 in. | Blows per foot | Recovery (%) | RQD (%) | Moisture Content (%) | Dry Unit Weight (pcf) | Shear Strength (tsf) | Drilling Method | Casing Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | ASPHALT CONCRETE (12"). | | | | | | | | | | | | |
| | 1 | | AGGREGATE BASE (12"). | | | | | | | | | | | | |
| 89.50 | 2 | | SILTY SAND (SM); dense; light yellowish brown; dry; fine SAND; some fines; (FILL). | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| 87.50 | 4 | | | | | | | | | | | | | | |
| | 5 | | PP>4.5. | | S-1 | 11<br>10<br>14 | 24 | | | | | | | | |
| 85.50 | 6 | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| 83.50 | 8 | | | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | | | |
| 81.50 | 10 | | PP>4.5. | | S-2 | 8<br>9<br>11 | 20 | | | | | | | | |
| | 11 | | | | | | | | | | | | | | |
| 79.50 | 12 | | | | | | | | | | | | | | |
| | 13 | | | | | | | | | | | | | | |
| 77.50 | 14 | | | | | | | | | | | | | | |
| | 15 | | PP>4.5. | | S-3 | 6<br>9<br>12 | 21 | | | | | | | | |
| 75.50 | 16 | | | | | | | | | | | | | | |
| | 17 | | | | | | | | | | | | | | |
| 73.50 | 18 | | | | | | | | | | | | | | |
| | 19 | | | | | | | | | | | | | | |
| 71.50 | 20 | | - medium dense; PP>4.5. | | S-4 | 8<br>6<br>5 | 11 | | | | | | | | |
| | 21 | | | | | | | | | | | | | | |
| 69.50 | 22 | | | | | | | | | | | | | | |
| | 23 | | | | | | | | | | | | | | |
| 67.50 | 24 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | | |

*(continued)*



Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

| REPORT TITLE | | | | HOLE ID |
|---|---|---|---|---|
| BORING RECORD | | | | A-12-002 |
| DIST. | COUNTY | ROUTE | POSTMILE | PROJECT ID |
| 07 | LA | 105 | R2.6 | 07-3X350 |
| PROJECT OR BRIDGE NAME | | | | |
| 105 Sinkholes | | | | |
| BRIDGE NUMBER | PREPARED BY | | DATE | SHEET |
| | | | | 1 of 2 |

| ELEVATION (ft) | DEPTH (ft) | Material Graphics | DESCRIPTION | Sample Location | Sample Number | Blows per 6 in. | Blows per foot | Recovery (%) | RQD (%) | Moisture Content (%) | Dry Unit Weight (pcf) | Shear Strength (tsf) | Drilling Method | Casing Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | | () very thickly bedded with thin interbeds of CLAYEY SAND (SC). ; very dense; PP>4.5. CLAYEY SAND; dense; dark gray; damp; fine SAND; some fines. SILTY SAND (SM) *(continued)*. | | S-5 | 9<br>20<br>25 | 45 | | | | | | | | |
| 65.50 | 26 | | | | | | | | | | | | | | |
| | 27 | | | | | | | | | | | | | | |
| 63.50 | 28 | | | | | | | | | | | | | | |
| | 29 | | | | | | | | | | | | | | |
| 61.50 | 30 | | - dense; PP>4.5. | | S-6 | 7<br>9<br>14 | 23 | | | | | | | | |
| | 31 | | Lean CLAY with SAND (CL); hard; olive to olive brown; damp; little fine SAND; PP>4.5; (NATIVE). | | | | | | | | | | | | |
| 59.50 | 32 | | | | | | | | | | | | | | |
| | 33 | | | | | | | | | | | | | | |
| 57.50 | 34 | | | | | | | | | | | | | | |
| | 35 | | PP=4.0. | | S-7 | 4<br>4<br>8 | 12 | | | | | | | | |
| 55.50 | 36 | | | | | | | | | | | | | | |
| | 37 | | | | | | | | | | | | | | |
| 53.50 | 38 | | | | | | | | | | | | | | |
| | 39 | | | | | | | | | | | | | | |
| 51.50 | 40 | | SILTY SAND (SM); medium dense; pale olive; dry; fine SAND; little fines. | | | | | | | | | | | | |
| | 41 | | | | | | | | | | | | | | |
| 49.50 | 42 | | | | | | | | | | | | | | |
| | 43 | | | | | | | | | | | | | | |
| 47.50 | 44 | | | | | | | | | | | | | | |
| | 45 | | - very stiff to hard; PP=3.0 to >4.5. | | S-9 | 7<br>8<br>9 | 17 | | | | | | | | |
| 45.50 | 46 | | | | | | | | | | | | | | |
| | 47 | | | | | | | | | | | | | | |
| 43.50 | 48 | | | | | | | | | | | | | | |
| | 49 | | | | | | | | | | | | | | |
| 41.50 | 50 | | SANDY lean CLAY (CL/SC); hard/dense; olive brown; moist; PP>4.5. | | S-10 | 3<br>8<br>11 | 19 | | | | | | | | |
| | 51 | | | | | | | | | | | | | | |
| 39.50 | 52 | | Bottom of borehole at 51.5 ft bgs<br><br>Ground water was not encountered.<br><br>This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below. | | | | | | | | | | | | |
| | 53 | | | | | | | | | | | | | | |
| 37.50 | 54 | | | | | | | | | | | | | | |
| | 55 | | | | | | | | | | | | | | |

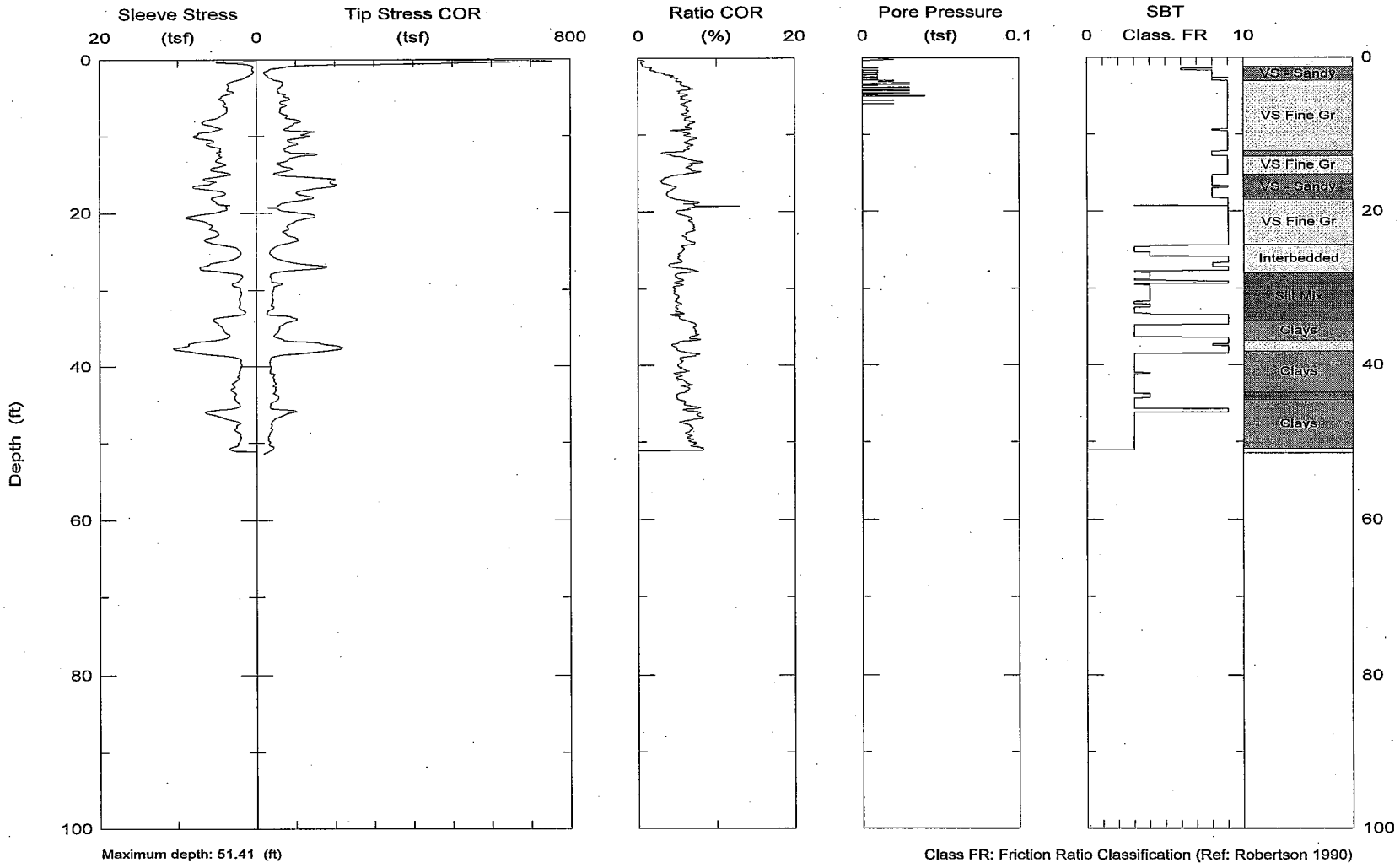
5 BR - STANDARD 105 SINKHOLES.GPJ DRAFT CALTRANS LIBRARY OCT 2011.GLB 10/23/12

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

| REPORT TITLE | | | | HOLE ID |
|---|---|---|---|---|
| **BORING RECORD** | | | | **A-12-002** |
| DIST. | COUNTY | ROUTE | POSTMILE | PROJECT ID |
| **07** | **LA** | **105** | **R2.6** | **07-3X350** |
| PROJECT OR BRIDGE NAME | | | | |
| **105 Sinkholes** | | | | |
| BRIDGE NUMBER | PREPARED BY | | DATE | SHEET |
| | | | | **2 of 2** |

# Appendix B:
# Cone Penetration Logs

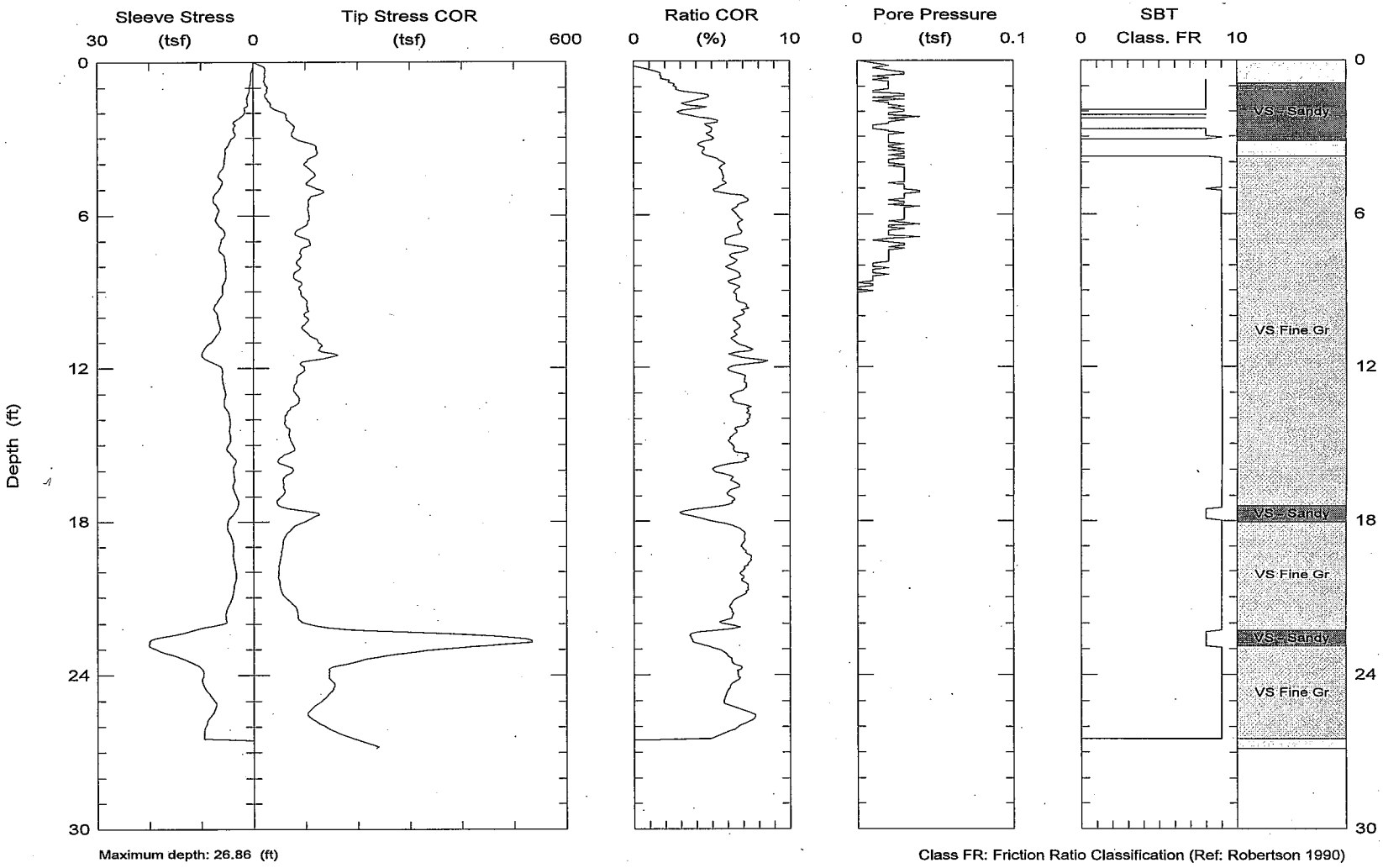
| | | |
|---|---|---|
| Division of Engineer Service<br>Geotechnical Service<br>5900 Folsom Blvd. Sac., CA 95819<br>www.dot.ca.gov | Lat:<br>Lon:<br>Elevation: | Date: 09/Oct/2012<br>Test ID: 09O02-01<br>Project: 0712000166 |
| | Customer: KRISTOPHER BARKER<br>Job Site: 105sinkholes | |




Maximum depth: 51.41 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

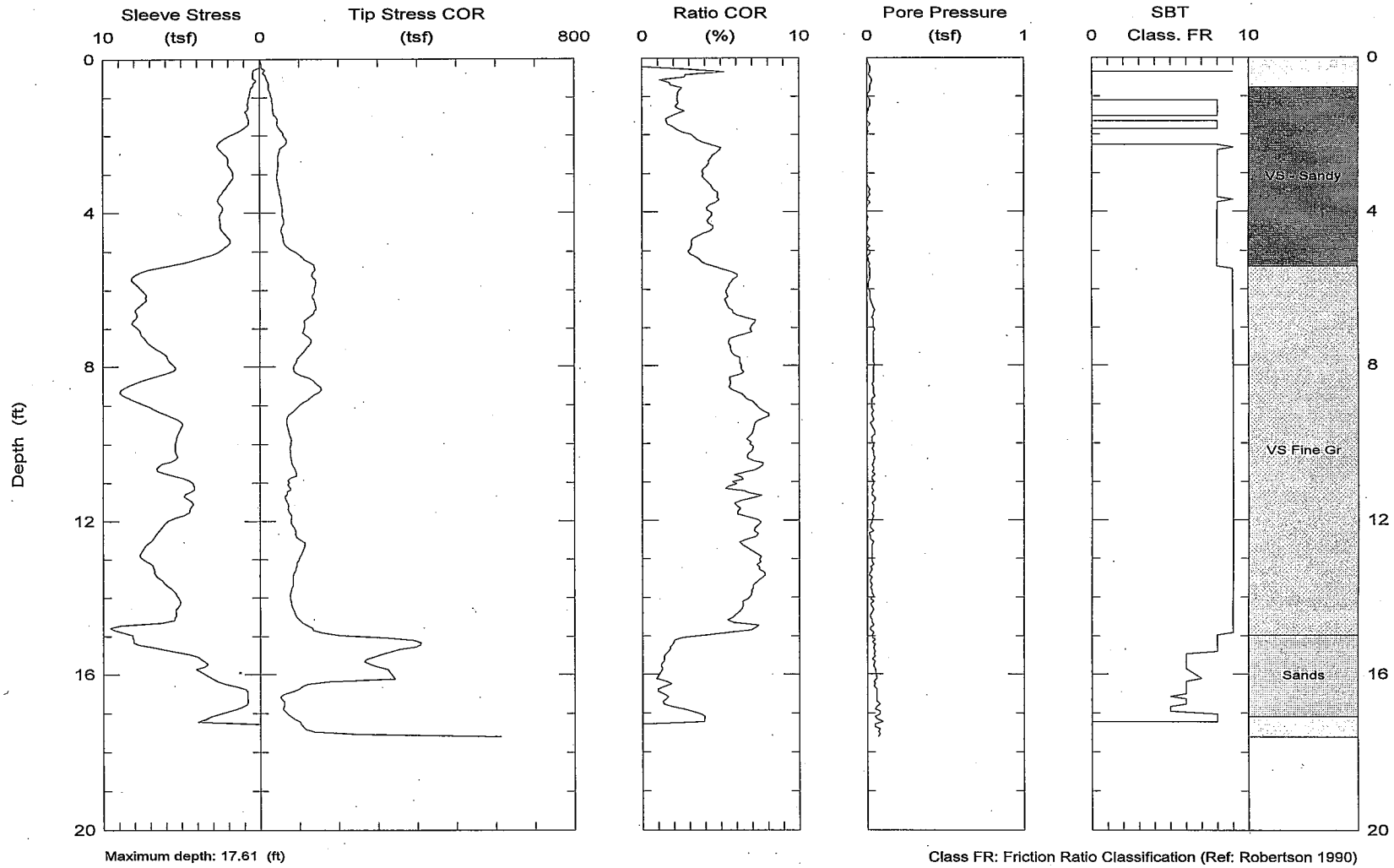
| | | |
|---|---|---|
| Division of Engineer Service<br>Geotechnical Service<br>5900 Folsom Blvd. Sac., CA 95819<br>www.dot.ca.gov | Lat:<br>Lon:<br>Elevation: | Date: 09/Oct/2012<br>Test ID: 09O03-02<br>Project: 0712000166 |
| | Customer: KRISTOPHER BARKER<br>Job Site: 105sinkholes | |




Maximum depth: 26.86 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

| | | |
|---|---|---|
| Division of Engineer Service<br>Geotechnical Service<br>5900 Folsom Blvd. Sac., CA 95819<br>www.dot.ca.gov | Lat:<br>Lon:<br>Elevation: | Date: 09/Oct/2012<br>Test ID: 09O04-03<br>Project: 0712000166 |
| | Customer: KRISTOPHER BARKER<br>Job Site: 105sinkholes | |




Maximum depth: 17.61 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)