INFORMATION HANDOUT

For Contract No. 11-085784
At 11-SD-163-4.1/4.9

Identified by
Project ID 1100000064

PERMITS

U.S. Fish and Wildlife Service -Informal Section 7, dated June 6, 2007

U.S. Fish and Wildlife Service - Informal Section 7 Amendment No. 1, Dated January 15, 2010

Department of the Army Nationwide Permit Verification, dated December 2, 2013

WATER QUALITY

California Regional Water Quality Control Board

Board Order No. 2003-017-DWQ

AGREEMENTS

California Department of Fish and Wildlife - 1602 Streambed Alteration Agreement, dated December 1, 2010

Notification No. 1600-2009-0381-R5
California Department of Fish and Wildlife - 1602 Streambed Alteration Agreement Extension, dated November 23, 2015

MATERIALS INFORMATION

Foundation Report for Friars Rd/State Route 163 Interchange Project Friars Rd Overcrossing (Widen) (Bridge No. 57-0595), dated November 30, 2012

Foundation Report for Friars Rd/State Route 163 Interchange Project West Ground Anchor Wall (Bridge No. 57E0126), dated November 30, 2012

Foundation Report - Memorandum No. 2 Friars Rd/State Route 163 Interchange Project West Ground Anchor Wall (Bridge No. 57E0126), dated May 22, 2015

Foundation Report for Friars Rd/State Route 163 Interchange Project East Ground Anchor Wall (Bridge No. 57E0127), dated November 30, 2012

Foundation Report for Soldier Pile Retaining Walls RW73 locations 1 and 2 and RW 245 Sta 10+00 to 10+88.5 SR-163/Friars Road Interchange, dated February29, 2016

Pavement Study Report Friars Road Widening SR 163/Friars Road Interchange Modification, dated August 14, 2012

Addendum Report RW 10 Station 10+00 to 10+88.5 SR-163/Friars Road Interchange Modification, dated September 30, 2013

Geotechnical Design Report SR 163/Friars Road Interchange Modification, dated February 28, 2013

Water Availability Letter from City of San Diego dated July 28, 2015

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92011

In Reply Refer To:
FWS-SDG-3406.3

JUN 6 2007

Mr. Robert James
California Department of Transportation
District 11
4050 Taylor Street
Environmental Division (MS-242)
San Diego, California 92110-2737

Subject: Informal Consultation on the State Route 163 Friars Road Interchange Project in San Diego, California

Dear Mr. James:

We are responding to your letter dated December 16, 2005, requesting our concurrence pursuant to the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), that the proposed State Route 163 (SR-163) Friars Road Interchange Project (Project) in San Diego, California may affect, but is not likely to adversely affect the coastal California gnatcatcher (*Polioptila californica californica*; gnatcatcher). The Service has concluded that adverse impacts would not occur to the least Bell's vireo (*Vireo bellii pusillus*; vireo) or the southwestern willow flycatcher (*Empidonax traillii extimus*; flycatcher) as a result of the Project. The Federal Highway Administration has designated the California Department of Transportation (Caltrans) as a non-Federal representative for this project. We have reviewed the October 2005 Biological Assessment for this Project (Helix Environmental Planning, Inc. 2005) and have exchanged additional related information through correspondence and meetings.

The proposed Project would take approximately two years to complete and would include: widening the Friars Road Bridge over SR-163 from six to ten lanes, which includes the addition of sidewalks along both sides of the bridge; replacing the existing northbound to eastbound diamond off-ramp to Friars Road (southeast quadrant) with a flopped partial cloverleaf configuration ramp in the northeast quadrant of the interchange, and vacating the existing northbound to eastbound diamond off-ramp; widening the existing northbound to westbound loop off-ramp from one lane to two lanes to accommodate traffic accessing both eastbound and westbound Friars Road; widening the existing northbound off-ramp from one lane to two lanes, with a four-lane terminus; removing the existing free-right turn lane from the northbound SR-163 off-ramp to eastbound Friars Road; widening the existing northbound diamond on-ramp to SR-163 from one lane to two lanes to accommodate increased traffic volumes; adding a southbound

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auxiliary lane from Genesee Avenue southerly, which becomes a collector distributor lane prior to crossing the Friars Road bridge/future Hazard Center Drive extension traversing under the elevated San Diego Trolley line, then bridging the San Diego River merging with Interstate 8 West/Hotel Circle North; and removing the existing westbound to southbound elongated loop on-ramp (northwest quadrant) from westbound Friars Road to the southbound SR-163.
The proposed project will permanently impact 40.42 acres and temporarily impact 21.24 acres as shown by the natural community type breakdown in Table 1.

Table 1. Habitat Types and Effects from the State Rout 163 Friars Road Interchange Project.

Natural Community	**Temporary**	**Permanent**	**Total**
Southern Willow Scrub	0	0.12	0.12
Southern Cottonwood-willow Riparian Forest	0.2	0.25	0.45
Diegan Coastal Sage Scrub	0	0.09	0.09
Non-native grassland	1.41	1.48	2.89
Non-native vegetation	8.77	9.71	18.48
Eucalyptus Woodland	3.63	3.06	6.69
Disturbed Habitat	1.38	0.54	1.92
Developed Land	5.85	25.17	31.02
Total	**21.24**	**40.42**	**61.66**

Protocol level surveys were conducted in the Project area for the vireo and flycatcher in 2003, both with negative results (Helix 2005). The limits of the surveys included 1,000 feet upstream and downstream of the SR-163 crossing of the San Diego River, as well as a small patch of disturbed southern willow scrub north of Friars Road and east of Ulric Street (Helix 2005). The Service database show no record of flycatcher in the San Diego river valley within 3.0 miles upstream or downstream of the Project area[1]. Five records of vireo were documented between 1999 and 2003. The vireo observations occurred within the San Diego river valley approximately 1.5 miles to the downstream and 1.75 miles to upstream of the Project area.

The determination that the effects of the Project would not adversely affect the flycatcher or vireo was made based on the lack of historical or present occupancy of either species within close proximity to the Project area and by the condition of the southern willow scrub and southern cottonwood forest. The riparian habitat in the Project area is sub-optimal vireo habitat as a structured forest consisting of dense cover (3-6 feet) and a dense stratified canopy is absent (Service 1998, Goldwasser 1980, Salata 1981 and 1983).

Protocol level gnatcatcher surveys were conducted within the Project area in 2003 and 2005. A gnatcatcher pair was observed during the 2003 protocol survey in the northwest quadrant of the Ulric Street and Friars Road interchange. Gnatcatchers were not observed during the 2005

[1] The database search for flycatcher and vireo was limited to approximately 3.0 miles downstream and 3.5 miles upstream of the Project area.

protocol survey. However, an anecdotal gnatcatcher observation was made in early July 2005 in coastal sage scrub habitat on the west side of SR-163, approximately 600 meters north of Friars Road. A narrow linear-mosaic of gnatcatcher habitat (coastal sage scrub and non-native grassland) is present along the western slope of SR-163, north of Friars Road. A separate and larger patch of gnatcatcher habitat is present northwest of the Ulric Street and Friars Road interchange. This patch is bisected (east to west) by Ulric Street.

Implementation of the Project would result in approximately 0.09 acre of permanent impact to native gnatcatcher habitat (undisturbed Diegan coastal sage scrub) and 2.89 acres (1.41 acres temporary and 1.48 acres permanent) of impact to exotic gnatcatcher habitat (non-native grassland). The vast majority of impacts to gnatcatcher habitat would occur along the west side of SR-163 north of Friars Road. Small isolated patches of non-native grassland (less than 0.5 acre) would be impacted south of Friars Road.

The following conservation measures are proposed to avoid all potential impacts to gnatcatchers and otherwise minimize impacts to biological resources:

1. A total of 0.09 acre of coastal sage scrub would be permanently impacted by the Project. Offsetting measures replace the acreage at a 1:1 ratio via payment into the City of San Diego's Habitat Acquisition Fund.

2. A total of 0.12 acre of southern willow scrub would be permanently impacted by the Project. Impacts would be offset at a 3:1 ratio consisting of 1:1 creation and 2:1 restoration/enhancement. A creation/restoration plan would be provided to the Service for approval prior to Project construction

3. A total of 0.25 acre of southern cottonwood-willow riparian forest would be permanently impacted and 0.2 acre temporarily impacted by the Project. Impacts would be offset at a 3:1 ratio consisting of 1:1 creation and 2:1 restoration/enhancement. A creation/restoration plan would be provided to the Service for approval prior to Project construction.

4. A total of 1.48 acres of non-native grassland would be permanently impacted and 1.41 acres temporarily impacted by the Project. Permanent impacts would be offset at a 0.5:1 ratio via payment into the City of San Diego's Habitat Acquisition Fund. Temporary impacts would be offset by revegetating the areas impacted with a native grassland and forb palette.

5. If vireo or flycatcher are observed within or adjacent to the Project area, the Service would be contacted and consultation should be re-initiated.

6. Surveys to determine breeding activity and nest locations for gnatcatcher would occur within the coastal sage scrub habitat west of SR-163 and north of Friars Road. Surveys would be performed by a Service-approved biologist and the results would immediately be reported to the Service (i.e., within one week).

If construction activities are initiated before the breeding season, the following survey schedule would be followed: 1) gnatcatcher habitat, as defined above, would be surveyed for breeding status and nest location(s) during the early part of the breeding season (between March 15 and April 30); 2) surveys would occur later in the breeding season (June 1 to August 31) to determine whether breeding adults or dispersing juveniles have moved into the habitat; and 3) during the second year of Project construction, the survey schedule identified in #1 and #2 would be followed.

If construction activities have not been initiated until after the breeding season has begun, the following survey schedule would be followed: 1) surveys for gnatcatcher breeding status and nest location(s) would occur during the week preceding initial Project construction activities (includes clearing and grubbing) if Project initiation occurs between February 15 and April 30; 2) surveys would occur later in the breeding season (June 1 to August 31) to determine whether breeding adults or dispersing juveniles have moved into the habitat; and 3) during the second year of Project construction, the survey schedule identified in #1 and #2 would be followed.

If it is determined that breeding activities are occurring (territorial defense, nest building, brooding), the location and/or perimeter of the territory and/or nest would be documented and the Service consulted. Project activities expected to adversely affect the gnatcatcher would immediately halt within 300 feet of the territory or nest. If gnatcatchers are observed within the Project impact area, consultation should be re-initiated.

7. Sensitive habitat outside the project footprint would be designated an Environmentally Sensitive Area (ESA) and depicted as such on project maps. All parties in conjunction with this operation would strictly avoid these areas. No construction activities, materials, or equipment would be permitted in the ESA. The boundary of the ESA would be fenced with orange plastic snow fencing. Construction work areas would be marked clearly in the field and confirmed by the project biologist prior to habitat clearing, with all marked boundaries maintained during the construction period.

8. All vegetation within the construction limits would be cleared outside the bird breeding season (February 15th to August 31st) to avoid impacts to migratory birds/raptors, including the gnatcatcher.

9. A qualified biologist would be made available for both the pre-construction and construction phases to review grading plans, address protection of sensitive biological resources, and monitor on-going work. The biologist would be familiar with the habitats, plants, and wildlife of the Project area, and maintain communications with the Resident Engineer, to ensure that issues relating to biological resources are appropriately and lawfully managed.

10. An employee education program would be developed. Each employee (including temporary contractors and subcontractors) would receive a training/awareness program

prior to working on the proposed Project. They would be advised of the potential impact to the listed species and the potential penalties for taking such species. At a minimum, the program would include the following topics: occurrence of the listed and sensitive species in the area, their general ecology, sensitivity of the species to human activities, legal reporting requirements, and Project features designed to reduce the impacts to these species and promote continued successful occupation of the Project area environment.

11. Any native areas temporarily impacted during Project construction would be reseeded with a native plant mix. The proposed seed palette would be reviewed and approved by the Project biologist prior to application in the field. The best methods of revegetation would be determined during design and could include saving duff, hydroseeding, planting, and/or possibly irrigation.

12. Typical erosion control measures and Best Management Practices (BMP's) would be employed in the vicinity of streams and adjacent native habitats. All equipment maintenance, staging, and dispensing of fuel, oil, and coolant, or any other such activities would occur in designated offsite areas. These designated areas would be located in such a manner as to prevent any runoff from entering adjacent water's of the United States, including wetlands.

13. Storage and staging areas would be placed as far from sensitive habitat as possible and kept free from trash and other waste. Staging areas for construction work would be located within previously disturbed sites and not adjacent to or within sensitive habitat.

14. During any nighttime construction, all project lighting (e.g., staging areas, equipment storage sites, roadway) would be directed onto the roadway or construction site and away from sensitive habitat. Light glare shields may also be used to reduce the extent of illumination into adjoining areas.

15. To avoid attracting predators of the gnatcatcher, the Project site would be kept as clean of debris as possible. All food related trash items would be placed in sealed containers and regularly removed from the site.

16. Pets of Project personnel would not be allowed on the Project site.

17. Invasive exotic plant species would not be seeded or planted adjacent to or near sensitive vegetation communities (e.g., coastal sage scrub, riparian habitats) or water's of the U.S. In compliance with Executive Order 13112, native impacted areas would be reseeded with plant species native to local habitat types, and project personnel would avoid the use of species in Table 1 & 2 of the California Exotic Pest Plant Council's list of Invasive Non-Native Plants that Threaten Wildlands in California, as of February 2006.

Provided the measures described above are implemented, we concur that the proposed Project may affect, but is not likely to adversely affect the gnatcatcher. Should Project plans change or if

additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered and formal consultation may be required.

Should you have any questions regarding this consultation or the consultation process in general, please call Kurt Roblek of my staff at (760) 431-9440, extension 308.

Sincerely,

Therese O'Rourke

Therese O'Rourke
Assistant Field Supervisor

Cc: Mr. Mark Koll, City of San Diego (Engineering and Capital Projects)
Mr. Robert Smith, Army Corps of Engineers
Mr. Dave Mayer, California Department of Fish and Game

Literature Cited

Goldwater, S.D., Gaines, and S. Wilbur. 1980. The least Bell's vireo in California: a de facto endangered race. American Birds 34:742-745

Helix Environmental Planning, Inc. 2005. Biological Assessment; State Route 163 and Friars Road Interchange Project. San Diego County. Unpublished report. La Mesa, CA

Salata, L. 1981. Least Bell's vireo research, Camp Pendleton Marine Corps Base, San Diego County, California, 1981. Unpublished Report, Natural Resources Office, Camp Pendleton.

Salata, L. 1983. Status of the least Bell's vireo on Camp Pendleton, California: report on research done in 1984. Unpublished report. U. S. Fish and Wildlife Service, Laguna Nigel, CA

U.S. Fish and Wildlife Service. 1998. Draft recovery plan for the least Bell's vireo. U.S. Fish and Wildlife Service, Portland, OR. 139 pp

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-SDG-10B0051-10I0094

Jan 15 2010

Mr. Robert James
California Department of Transportation
District 11
4050 Taylor Street
Environmental Division
San Diego, California 92110-2737

Subject: Amendment to Informal Consultation on the State Route 163 Friars Road Interchange Project, City and County of San Diego, California (FWS-SDG-3406.3)

Dear Mr. James:

This is in response to the California Department of Transportation's (Caltrans) October 12, 2009, electronic mail request, on behalf of the Federal Highway Administration, to amend the State Route 163 (SR-163) Friars Road Interchange Project informal consultation to include project modifications pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The City of San Diego (City) will build the project in association with the San Diego Association of Governments (SANDAG) and Caltrans. The project modifications are a result of refined engineering and design that slightly increased the temporary and permanent impact footprint for widening the SR-163 Bridge over the San Diego River, and on and off-ramps for the Friars Road Bridge over the SR-163. On June 6, 2007, the U.S. Fish and Wildlife Service (Service) determined that the project was not likely to adversely affect the federally threatened coastal California gnatcatcher (*Polioptila californica californica*; gnatcatcher), and that it will not affect the federally endangered least Bell's vireo (*Vireo bellii pusillus;* vireo) or the southwestern willow flycatcher (*Empidonax traillii extimus;* flycatcher)(FWS-SDG-3406.3). We have determined that modified project will still not affect the vireo.

Since the original consultation in 2007, a gnatcatcher was observed in a previously unoccupied patch of coastal sage scrub north of Friars Road, east of Ulric Street. The gnatcatcher observed may be one of the individuals previously observed on the west side of Ulric Street. Also, a banded, single male flycatcher was observed numerous times in the San Diego River between June and July 2009, approximately 0.1 mile east of the SR-163 Bridge (pers. comm. November 16, 2009, Mike Wellik, USGS).

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Proposed project modifications will result in an increase of: 0.17 acre and 0.02 acre of temporary and permanent impacts to gnatcatcher occupied coastal sage scrub; and 0.1 acre of temporary impacts to southern willow scrub (Table 1). Additional impacts to coastal sage scrub will occur on the east side of Uric Street and additional impacts to southern willow scrub will occur on the west side of the existing SR-163 Bridge over the San Diego River as the bridge is widened. Even with the additional sighting of gnatcatcher and flycatcher since the original consultation, the slight increases in impacts to coastal sage scrub and southern willow scrub are not anticipated to result in an appreciable impact to gnatcatchers and flycatchers in the project area.

Table 1. Changes in Previous and Current Habitat Impacts from the State Route 163 Friars Road Interchange Project (acres)

Natural Community	**Temporary (previous)**	**Temporary (current)**	**Permanent (previous)**	**Permanent (current)**	**Total (previous)**	**Total (current)**
Southern Willow Scrub	0	**0.1**	0.12	0.12	0.12	**0.22**
Coastal Sage Scrub	0	**0.17**	0.09	**0.11**	0.09	**0.28**

The following amended conservation measures are proposed to avoid and minimize potential impacts to gnatcatcher and flycatcher:

1. Permanent impacts to 0.11 acre of coastal sage scrub will be offset at a 1:1 ratio by payment into the City's Habitat Acquisition Fund established under its Multiple Species Conservation Program Subarea Plan. Temporary impacts to 0.17 acre of coastal sage scrub will be offset by in-kind restoration on-site. An on-site restoration plan will be provided to the Service for approval prior to initiating project construction.

2. Permanent impacts to 0.12 acre of southern willow scrub will be offset by creating and restoring 0.12 acre and 0.24 acres of southern willow scrub, respectively, at the Mast Park site, which includes multiple sites dedicated to offsetting impacts from different projects. The SANDAG has a total of 3.91 acres of area at the Mast Park available for offsetting impacts from transportation projects. Including impacts from these modifications, a total of 2.07 acres will be used and 1.84 acres will remain at the Mast Park site to offset future impacts from SANDAG transportation projects. Creation and restoration will be done according to the Mast Park Restoration Plan (Helix 2008). Temporary impacts to 0.1 acre of southern willow scrub will be offset by in-kind restoration on-site. An on-site restoration plan will be provided to the Service for approval prior to initiating project construction.

All other conservation measures given in the June 6, 2007, informal consultation (FWS-SDG-3406.3) will be implemented by the modified project as well.

Provided the measures described above are implemented, we concur that the proposed project may affect, but is not likely to adversely affect the gnatcatcher and flycatcher. Should Project

plans change or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered and formal consultation may be required.

Should you have any questions regarding this consultation or the consultation process in general, please call Kurt Roblek of my staff at (760) 431-9440, extension 308.

Sincerely,

for

Karen A. Goebel
Assistant Field Supervisor

cc: Mr. Mark Koll, City of San Diego (Engineering and Capital Projects)
Mr. Robert Smith, Army Corps of Engineers
Mr. Dave Mayer, California Department of Fish and Game

Literature Cited

Helix Environmental Planning, Inc. 2008. Mast Park Wetland Habitat Restoration Plan. Unpublished report.

DEPARTMENT OF THE ARMY
Los Angeles District Corps of Engineers
Regulatory Division, Carlsbad Field Office
5900 La Place Court, Suite 100
Carlsbad, CA 92008

REPLY TO
ATTENTION OF

December 2, 2013

Regulatory Division

Jeff Manchester
City of San Diego
Public Works Department
525 B Street, Suite 750, MS 908A
San Diego, California 92101

DEPARTMENT OF THE ARMY NATIONWIDE PERMIT VERIFICATION

Dear Mr. Manchester:

I am responding to your request (SPL-2010-00986-SAS) for a Department of the Army (DA) permit. Your proposed project, the State Route 163 (SR-163)/ Friars Road Interchange Project, is located within the San Diego River in the City of San Diego, San Diego County, California (Enclosures 1 and 2).

This project would result in a discharge of fill material into waters of the United States (U.S.). Therefore, pursuant to section 404 of the Clean Water Act (33 USC 1344; 33 CFR parts 323 and 330), your proposed project requires a DA permit.

I have determined construction of your proposed project would comply with Nationwide Permit (NWP) 14, *Linear Transportation Projects*, if constructed as described in your application.

Specifically, and as shown on Enclosures 4 and 5, you are authorized to conduct the following regulated activities:

1. Permanently impact no more than 0.05 acre (128 linear feet) of non-wetland waters of the U.S. with the construction of a pierwall/footing within the San Diego River floodplain adjacent to the existing bridge of SR-163 and improvements to the Ulric Street ramp.
2. Temporarily impact no more than 0.16 acre (136 linear feet) of non-wetland waters of the U.S. with the implementation of a temporary construction work area (i.e., construction vehicle access, falsework to construct the bents and the bridge deck, and incidental edge effects from permanent construction impacts) of no more than 40 feet beyond the limits of the bridge widening permanent footprint as well as temporary grading associated with the Ulric Street ramp improvements.

For this NWP verification letter to be valid, you must comply with all of the terms and conditions in Enclosure 3. Furthermore, you must comply with the non-discretionary Special Conditions listed below:

Mitigation

1. The Permittee has proposed to mitigate for impacts to waters of the U. S., through implementation of the draft conceptual mitigation plan: "Mast Park Wetland Habitat Restoration Plan" (dated August 2, 2013, and prepared by Helix Environmental Planning, Inc.). According to the draft mitigation plan, responsible parties would be as follows: a) Implementation: City of San Diego; b) Performance: City of San Diego; c) Long-term management: San Diego Habitat Conservancy (or another Corps-approved long-term land manager). More specifically, the final mitigation plan shall address the 0.05 acre of permanent and 0.16 acre of temporary impacts to non-wetland waters of the U.S. through establishment (creation) and enhancement of 0.46 acre of waters of the U.S. and additional riparian and upland buffer habitat, totaling 2.07 acres, as a part of a 10.84-acre creation/restoration/enhancement project, as described in the draft conceptual mitigation plan. The Permittee retains ultimate legal responsibility for meeting the requirements of the final mitigation plan. Detailed mitigation objectives, performance standards, and monitoring requirements are described in the above draft mitigation plan and will be updated per Corps recommendations and submitted for review and approval prior to implementation. Any requirements for financial assurances and/or long-term management provisions are also described in the above draft mitigation plan, as well as in Special Conditions 5-7 below.

2. Prior to initiating construction in waters of the U.S., the Permittee shall submit to the Corps a final mitigation plan prepared in accordance with the Corps' Los Angeles District Mitigation Guidelines and Monitoring Requirements, dated April 19, 2004 and the Mitigation Rule [33 CFR Part 332; 73 FR 19670-19687 (April 10, 2008)]. The final mitigation plan shall address the 0.05 acre of permanent and 0.16 acre of temporary impacts to non-wetland waters of the U.S. through establishment and enhancement of 0.46 acre of waters of the U.S. as a part of a 10.84-acre establishment/enhancement project currently under Corps review for a NWP 27 (File No. SPL-2011-00289-SAS). **The final plan shall also include a signed verification letter from the City of Santee confirming the City of San Diego can fulfill its compensatory mitigation obligations on City of Santee property and a copy of the executed Purchase and Sale Agreement with the City of Santee which shall identify, and set compensation for, the mitigation to occur on City of Santee land.** All maps and drawings shall be in compliance with the Final Map and Drawing Standards for the South Pacific Division Regulatory Program dated August 6, 2012 (http://www.spd.usace.army.mil/Portals/13/docs/regulatory/standards/map.pdf). No work in waters of the U.S. is authorized until the Permittee receives, in writing (by letter or e-mail), Corps approval of the final mitigation plan. The Permittee shall complete site preparation and planting and initiate monitoring as described in the final, approved mitigation plan prior to impacts to waters of the U.S. to ensure no net loss of aquatic resource functions and services. Your responsibility to complete the required compensatory mitigation as set forth in this Special Condition will not be considered fulfilled until you have demonstrated compensatory

mitigation project success for the entire 10.84-acre mitigation site and have received written verification of that success from the Corps.

MONITORING: You shall submit monitoring reports for all compensatory mitigation sites as described in the final, approved mitigation plan by October 1 of each year following the construction of mitigation. To assure compensatory mitigation success, you shall monitor the mitigation area for at least five (5) consecutive growing seasons after construction or until the Corps determines the final performance standards are met (monitoring shall be for a minimum of 5 years unless the Corps agrees earlier that success has been reached and maintained for a sufficient time period, or, if success is not demonstrated to the Corps' satisfaction after the 5th year of monitoring, additional monitoring may be required by the Corps as determined at that time). The monitoring period shall commence upon completion of the construction of the mitigation site. Additionally, you shall demonstrate continued success of the compensatory mitigation site, without human intervention, for at least two consecutive years during which interim and/or final performance standards are met. The compensatory mitigation project will not be deemed successful until this criterion has been met.

GIS DATA: Within 60 days following written Corps approval of the mitigation plan for this NWP authorization letter, you shall provide to this office GIS data (polygons only) depicting the boundaries of all compensatory mitigation sites, as authorized in the final mitigation plan referenced above. All GIS data and associated metadata shall be provided on a digital medium (CD or DVD) or via file transfer protocol (FTP), preferably using the Environmental Systems Research Institute (ESRI) shapefile format. GIS data for mitigation sites shall conform to the Mitigation_SPD.xlsx data table, as specified in the Final Map and Drawing Standards for the South Pacific Division Regulatory Program dated August 6, 2012 (http://www.spd.usace.army.mil/Portals/13/docs/regulatory/standards/map.pdf), and shall include a text file of metadata, including datum, projection, and mapper contact information. Within 60 days following completion of compensatory mitigation construction activities, if any deviations have occurred, you shall submit as-built GIS data (polygons only) accompanied by a narrative description listing and explaining each deviation.

3. At the conclusion of the project, all temporary fill shall be removed and the area shall be restored to pre-construction conditions (contours and vegetated condition) to the maximum extent practicable. The Permittee shall hydroseed the disturbed portions of the earthen stream banks with native non-invasive vegetation of facultative upland (FACU) or wetter species, as appropriate. The Permittee shall submit the proposed planting palette for review and approval by the Corps, prior to initiation of construction. The Permittee shall ensure the hydroseeded areas are maintained and monitored for a period of two years after completing the seeding activities, such that less than 10 percent of the areas disturbed by the project are vegetated by non-native and invasive plant species. Monitoring reports shall be submitted by the Permittee to the Corps, by May 15th annually, one and two years following hydroseeding, documenting the recovery of the restored areas.

4. Within 45 calendar days of complete installation of all mitigation, the Permittee shall submit to the Corps Regulatory Division two copies of a memo indicating the following:

a. Date(s) all mitigation was installed and monitoring was initiated;
b. Schedule for future mitigation monitoring, implementation, and reporting pursuant to final, Corps-approved HMMP;
c. Color photographs (including map of photopoints) taken at the mitigation site before and after installation such that correct installation per final, Corps-approved mitigation plan can be verified;
d. One copy of "as built" drawings for the entire project, including all mitigation sites. Electronic submittal (Adobe PDF format) is preferred. All sheets must be signed, dated, and to-scale. If submitting paper copies, sheets must be no larger than 11 x 17 inches; and
e. Summary of compliance status with each special condition of this permit (including any noncompliance that previously occurred or is currently occurring and corrective actions taken or proposed to achieve compliance).

5. In accordance with 33 CFR 332.7, the Permittee shall record site-protection mechanism, in a form approved by the Corps, which shall run with the land, obligating the Permittee, its successors, and assigns to protect and maintain the 10.84-acre mitigation area, as shown in Enclosure 5, as natural open space in perpetuity. The Permittee shall submit a draft site-protection mechanism for Corps approval for the mitigation site in advance of or concurrent with impacts within waters of the U.S.

   The site-protection mechanism shall preclude establishment of fuel modification zones, paved public trails, maintained public trails, maintenance access roads and/or future easements. Further, to the extent practicable, any such facilities outside the site-protection mechanism shall be sited to minimize indirect impacts on the avoided, established, re-established, and enhanced wetland and non-wetland waters of the U.S. The site-protection mechanism (document) must also provide for the long-term management of the mitigation sites under the direction and control of the land-management entity approved by the Corps. The Permittee shall receive written approval (by letter or e-mail) from the Corps' Regulatory Division of the draft site-protection mechanism prior to its execution and recordation. No later than 30 calendar days after receiving Corps Regulatory Division approval of the final draft site-protection instrument, the site-protection instrument shall be executed and recorded and a recorded copy furnished to the Corps Regulatory Division. Costs of the site-protection mechanism and any related documents, including state and/or federal environmental and legal documents and process costs, will be borne by the Permittee.

   GIS DATA: Within 60 days following recordation, you shall provide to this office GIS data (polygons only) depicting the Corps-approved site protection boundaries, as authorized by the Corps. All GIS data and associated metadata shall be provided on a digital medium (CD or DVD) or via file transfer protocol (FTP), preferably using the Environmental Systems Research Institute (ESRI) shapefile format. GIS data for compensatory mitigation site shall conform to the Mitigation_SPD.xlsx data table, as specified in the Final Map and Drawing Standards for the South Pacific Division Regulatory Program dated August 6, 2012 (http://www.spd.usace.army.mil/Portals/13/docs/regulatory/standards/map.pdf), and shall include a text file of metadata, including datum, projection, and mapper contact information.

6. Prior to initiating construction in waters of the U.S., the Permittee shall post financial assurance ("financial assurance") in a form approved by the Corps Regulatory Division for the estimated cost of implementing the approved HMMP (including a 20% contingency to be added to the total costs). The purpose of this financial assurance is to guarantee the successful implementation, maintenance and monitoring of the wetland and non-wetland waters creation, restoration, and enhancement work. Our preferred form of financial assurance is a Performance Bond, in which case, you shall post a Performance Bond for 120% of the anticipated cost of the mitigation and monitoring associated with the project, as indicated above. In addition,
    a. For a performance bond, the bonding company must appear on the Department of Treasury Circular 570, Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies. For a current list of Treasury-authorized companies, write or call the Surety Bond Branch, Financial Management Services, Department of the Treasury, Washington DC, 20227; (202) 874-6850 or at the following website: http://www.fms.treas.gov/c570/c570.html.Schedule for future mitigation monitoring, implementation, and reporting pursuant to final, Corps-approved HMMP;
    b. The performance bond shall be released only upon a determination by the Corps Regulatory Division that successful mitigation has been completed.
    c. Alternatively, the Corps Regulatory Division will accept an irrevocable letter of credit in the same amount in lieu of a Performance Bond. The terms of the irrevocable letter of credit are subject to Corps Regulatory Division approval.

7. The Permittee must provide monies in the form of a non-wasting endowment [endowment amount to be determined by a revised Property Analysis Record (PAR) or similar methodology as approved by the Corps, conducted by the Corps-approved land manager of the mitigation site] for review and approval for the purposes of fulfilling the land manager's and/or 3rd party easement holder's long-term responsibilities including maintenance activities (e.g., invasive non-native plant species and trash removal, restoration of areas disturbed or destroyed due to off-road vehicle use or other trespassing and vandalism, repairs and maintenance to fencing and signage, natural disaster remedial activities) agreed to under the site-protection mechanism required by Special Condition No. 4.

Pre-Construction

8. Prior to initiating construction in waters of the U.S., the Permittee shall submit to the Corps Regulatory Division a complete set of final detailed grading/construction plans showing all work and structures in waters of the U.S. All plans shall be in compliance with the Final Map and Drawing Standards for the South Pacific Division Regulatory Program dated August 6, 2012 (http://www.spd.usace.army.mil/Portals/13/docs/regulatory/standards/map.pdf). All plan sheets shall be signed, dated, and submitted on paper no larger than 11x 17 inches. No work in waters of the U.S. is authorized until the Permittee receives, in writing (by letter or e-mail), Corps Regulatory Division approval of the final detailed grading/construction plans. The Permittee shall ensure that the project is built in accordance with the Corps-approved plans.

9. The Permittee shall clearly mark the limits of the workspace with flagging or similar means to ensure mechanized equipment does not enter preserved waters of the U.S. and riparian wetland/habitat areas. Adverse impacts to waters of the U.S. beyond the Corps-approved construction footprint are not authorized. Such impacts could result in permit suspension and revocation, administrative, civil or criminal penalties, and/or substantial, additional, compensatory mitigation requirements.

10. Impacts to waters of the U.S. beyond the Corps-approved construction footprint are not authorized. Such impacts may result in permit suspension and revocation, administrative, and/or civil or criminal penalties. Unauthorized impacts to waters of the U.S. [including authorized temporary impacts to waters of the U.S. that are not successfully restored to pre-construction conditions and/or those temporary construction features] shall result in additional compensatory mitigation at a minimum of a 5:1 ratio; this additional mitigation may require the purchase of credits from an authorized mitigation bank or in-lieu fee program, if available, or through the establishment, re-establishment, rehabilitation, and/or enhancement of waters of the U.S. within the appropriate, impacted watershed(s) as approved by the Corps.

11. Seven (7) days prior to impacts within waters of the U.S., the Permittee shall provide written notification to the Corps. The notification shall include the following:
    a. Corps File Number (SPL-2010-00986-SAS);
    b. Name of company performing the work and on-site point of contact;
    c. Size and type of equipment that shall be performing the work; and
    d. Schedule for beginning and ending of construction activities.

12. The Permittee shall provide all on-site contractors, subcontractors, and forepersons a copy of this permit with General Conditions and Special Conditions. All of the above-listed personnel shall read, understand, agree to, and comply with all terms and conditions of the authorization. A copy of this authorization, with the General and Special Conditions, and enclosures shall be included in all bid packages for the project and shall be available at the work site at all times during periods of work and must be presented upon request by any Corps personnel. The Permittee shall provide the Corps written confirmation of this Special Condition prior to construction, including names, phone numbers, and addresses of all of the above personnel, including signatures indicating agreement with all General and Special Conditions of this authorization. Through construction of the project, all new personnel shall also comply with this condition. A copy of this permit, with General and Special Conditions, shall be on-site at all times during construction activities.

13. A qualified biological monitor shall be on-site during project grading and construction in the vicinity of waters of the U.S. to verify compliance with all requirements of this permit. The biological monitor shall have experience performing Corps jurisdictional delineations of waters of the U.S. including wetlands. The biological monitor shall document compliance with the General and Special Conditions for each construction phase. The Permittee shall submit the biologists' names, addresses, telephone numbers, email addresses (if available), and work schedules on the project to this office a minimum of fifteen (15) days prior to the planned date of initiating work within waters of the U.S. authorized by this permit. The

biologist/Permittee shall report any violation to Corps within one (1) business day of its occurrence.

Endangered Species Act

14. This Corps permit does not authorize you to take any threatened or endangered species, in particular the California gnatcatcher (*Polioptila californica californica*) and the southwestern willow flycatcher (*Empidonax traillii extimus*), or adversely modify their designated critical habitat. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (ESA) [e.g., ESA Section 10 permit, or a Biological Opinion (BO) under ESA Section 7, with "incidental take" provisions with which you must comply]. Pursuant to the U.S. Fish and Wildlife Service (USFWS) correspondence dated June 6, 2007 and amended on January 15, 2010, including the required avoidance and minimization measures, the Corps Regulatory Division has determined and the USFWS has concurred that your activity is not likely to adversely affect the above species. Your authorization under this Corps permit is conditional upon your compliance with all of the required avoidance and minimization measures, which are incorporated by reference in this permit. Failure to comply with the required avoidance and minimization measures would constitute non-compliance with your Corps permit. The USFWS is the appropriate authority to determine compliance with the terms and conditions of its BO and with the ESA.

Clean Water Act Section 401 Water Quality Certification

15. The Permittee shall comply with the terms and conditions of the CWA section 401 Water Quality Certification No. 09C-101, issued on July 22, 2011 by the Regional Water Quality Control Board, for your project.

Water Quality and Construction-Related Best Management Practices (BMPs)

16. All vehicle maintenance, staging, storage, and dispensing of fuel shall occur in designated upland areas. These designated upland areas shall be located in such a manner as to prevent any runoff from entering waters of the U.S.

17. No debris, soil, silt, sand, sawdust, rubbish, cement or concrete washings thereof, oil or petroleum products, from construction shall be allowed to enter into or be placed where it may be washed by rainfall or runoff into waters of the U.S. Therefore, the Permittee shall employ all Best Management Practices (BMPs) necessary to prevent toxic materials, silt, debris, or excessive erosion from entering waters of the U.S. during project construction. Upon completion of the activities authorized by this permit, any excess material or debris shall be removed from the work area and disposed of in an appropriate upland site.

Cultural Resources

18. Pursuant to 36 CFR section 800.13, in the event of any discoveries during construction of either human remains, archeological deposits, or any other type of historic property, the

Permittee shall notify the Corps' Archeology Staff (Steve Dibble at 213-452-3849 or John Killeen at 213-452-3861) and the Corps Regulatory Project Manager (Shanti Abichandani Santulli at 760-602-4834) within 24 hours. The Permittee shall immediately suspend all work in any area(s) where potential cultural resources are discovered. The Permittee shall not resume construction in the area surrounding the potential cultural resources until the Corps Regulatory Division re-authorizes project construction, per 36 CFR section 800.13.

Post-Construction

19. All temporarily impacted waters of the U.S. shall be restored to their pre-construction conditions (i.e., restoration of original elevations and contours and revegetation of appropriate native plan species if applicable) immediately following the time period necessary for the temporary impact area to minimize temporal loss of functions and services of these waters of the U.S.

20. The Permittee shall allow the Corps to inspect the authorized activities at any time deemed necessary to verify compliance with permit terms and conditions.

21. All correspondence and submittals shall reference the Corps project name SR 163/Friars Road Interchange Project and File No. SPL-2010-00986-SAS conspicuously on any transmittal letter and/or the first page/paragraph of the text, and on any graphics or photographs. All plans and photographs shall be labeled and dated. Failure to provide this information may cause the Corps to determine that the submittals are incomplete, or not submitted within the required timeframe, and therefore, not compliant with permit Special Conditions.

22. Within 45 calendar days of completion of authorized work in waters of the U.S., the Permittee shall submit to the Corps Regulatory Division a post-project implementation memo indicating the following:
    a. Date(s) work within waters of the U.S. was initiated and completed;
    b. Summary of compliance status with each special condition of this permit (including any noncompliance that previously occurred or is currently occurring and corrective actions taken or proposed to achieve compliance);
    c. Color photographs (including map of photopoints) taken at the project site before and after construction for those aspects directly associated with permanent impacts to waters of the U.S. such that the extent of authorized fills can be verified; A summary of all project activities which documents that authorized impacts to waters of the U.S. were not exceeded, and demonstrated compliance with all permit General and Special Conditions;
    d. One copy of "as built" drawings for the entire project. Electronic submittal (Adobe PDF format) is preferred. All sheets must be signed, dated, and to-scale. If submitting paper copies, sheets must be no larger than 11 x 17 inches; and
    e. Signed Certification of Compliance (attached as part of this permit package).

This verification is valid through March 18, 2017. If on March 18, 2017 you have commenced or are under contract to commence the permitted activity you will have an additional twelve (12) months to complete the activity under the present NWP terms and conditions. However, if I discover noncompliance or unauthorized activities associated with the permitted activity we can exercise discretionary authority and thereby modify, suspend, or revoke this specific verification at an earlier date in accordance with procedures in 33 CFR part 330.4(e) and 33 CFR part 330.5(c) or (d). At the national level the Chief of Engineers at any time prior to the expiration of a NWP may chose to modify, suspend, or revoke the nationwide use of a NWP after following procedures set forth in 33 CFR part 330.5. It is incumbent upon you to comply with all of the terms and conditions of this NWP verification and to remain informed of any change to the NWPs.

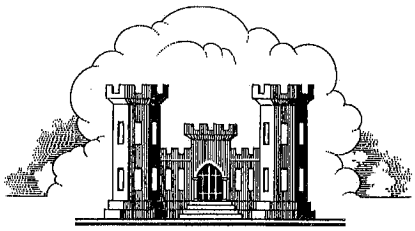
A NWP does not grant any property rights or exclusive privileges. Additionally, it does not authorize any injury to the property, rights of others, nor does it authorize interference with any existing or proposed Federal project. Furthermore, it does not obviate the need to obtain other Federal, state, or local authorizations required by law.

Thank you for participating in the regulatory program. If you have any questions, please contact Shanti Abichandani Santulli at 760-602-4834 or via e-mail at Shanti.A.Santulli@usace.army.mil. Please complete the customer survey form at http://per2.nwp.usace.army.mil/survey.html, which would help me to evaluate and improve the regulatory experience for others.

Sincerely,

Therese O'Rourke Bradford
Chief, South Coast Branch

Enclosures
Enclosure 1 - Regional Location Map
Enclosure 2 - Project Location Map
Enclosure 3 - NWP 14 and General Conditions
Enclosure 4 - San Diego River Bridge Detail
Enclosure 5 - Corps Jurisdictional Areas/Impacts
Enclosure 6 - Restoration Plan Map



LOS ANGELES DISTRICT
US ARMY CORPS OF ENGINEERS

CERTIFICATE OF COMPLIANCE WITH DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: *SPL-2010-00986-SAS*

Name of Permittee: *Jeff Manchester, City of San Diego, Public Works Department*

Date of Issuance: *December 2, 2013*

Upon completion of the activity authorized by this permit and the mitigation required by this permit, sign this certificate, and return it by **ONE** of the following methods;

1) Email a digital scan of the signed certificate to Shanti.A.Santulli@usace.army.mil

OR

2) Mail the signed certificate to

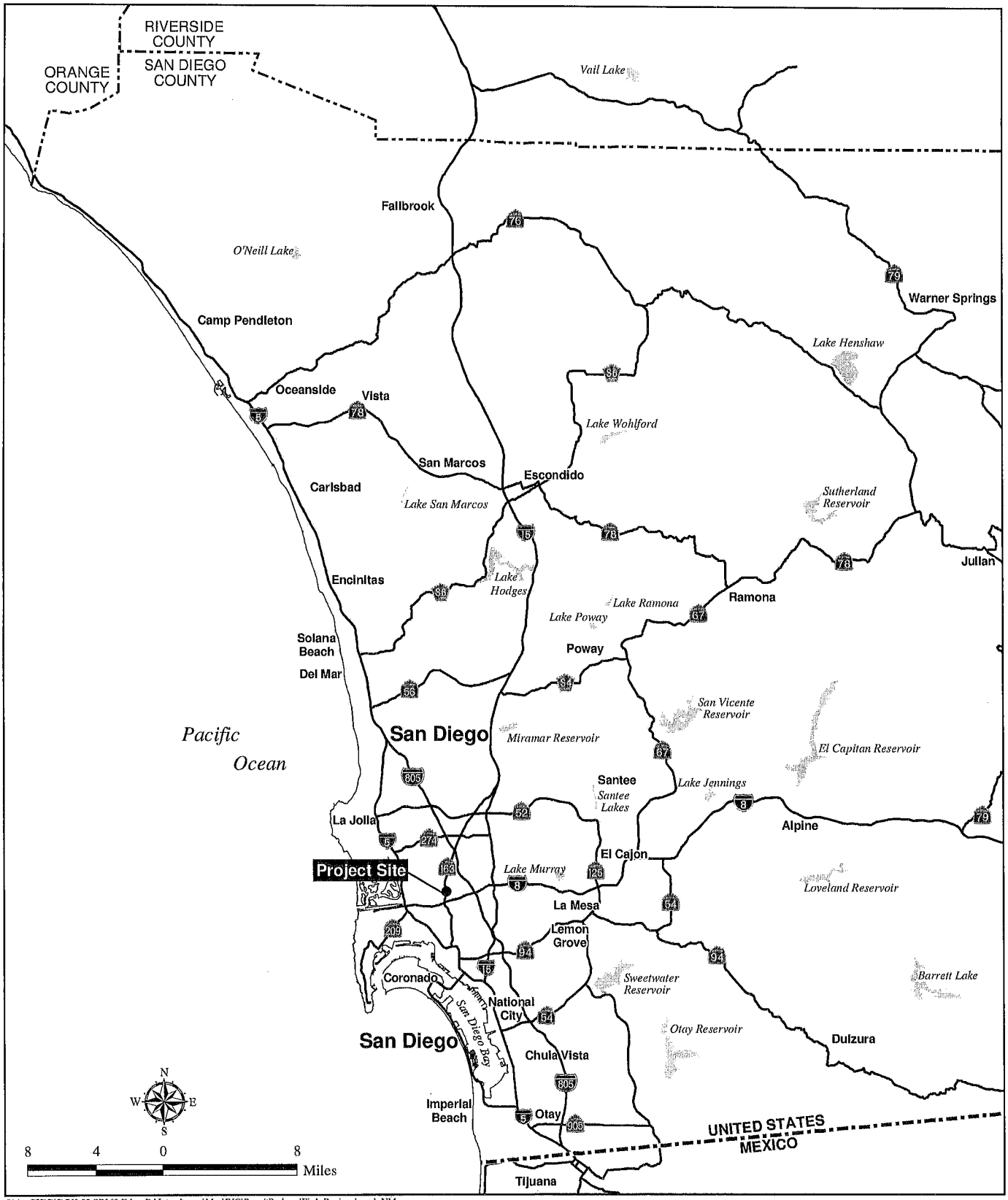
U.S. Army Corps of Engineers
ATTN: Regulatory Division SPL-2010-00986-SAS
Los Angeles District Corps of Engineers
Regulatory Division, Carlsbad Field Office
5900 La Place Court, Suite 100
Carlsbad, CA 92008

I hereby certify the authorized work and any required compensatory mitigation has been completed in accordance with the NWP authorization, including all general, regional, or activity-specific conditions. Furthermore, if credits from a mitigation bank or in-lieu fee program were used to satisfy compensatory mitigation requirements I have attached the documentation required by 33 CFR 332.3(l)(3) to confirm the appropriate number and resource type of credits have been secured.

_____ _____

Signature of Permittee Date

ENCLOSURE 1



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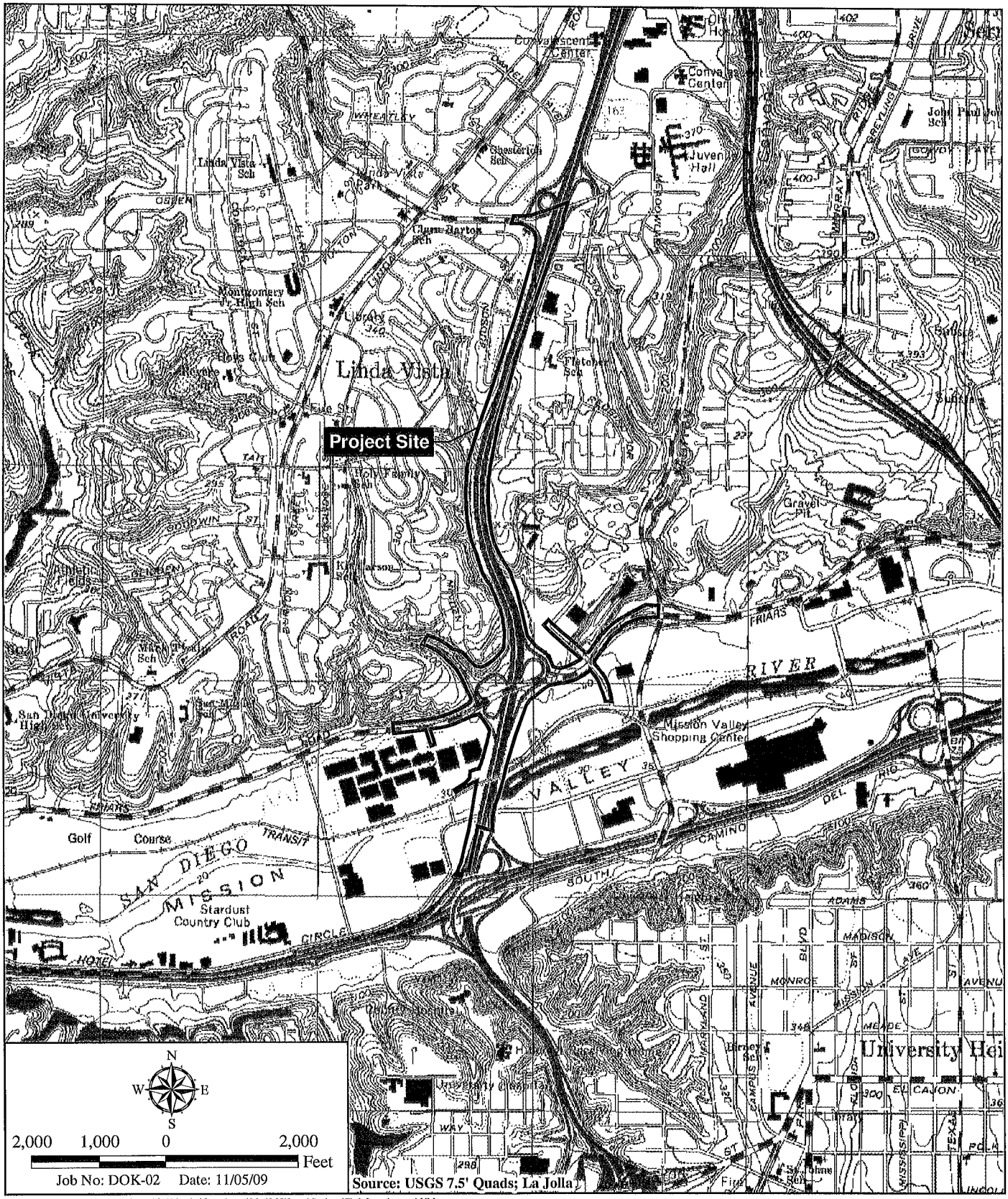
Regional Location Map

SR 163/FRIARS ROAD INTERCHANGE PROJECT

HELIX

Figure 1

ENCLOSURE 2



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Project Location Map

SR 163/FRIARS ROAD INTERCHANGE PROJECT

HELIX

Figure 2

Enclosure 3: NATIONWIDE PERMIT NUMBER 14 Linear Transportation Projects. TERMS AND CONDITIONS

1. Nationwide Permit (NWP) 14 Linear Transportation Projects. Terms:

Your activity is authorized under NWP 14, Linear Transportation Projects, subject to the following terms:

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 27.) (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).

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as appropriate, 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.

2. Nationwide Permit General Conditions: The following general conditions must be followed in order for any authorization by an NWP to be valid:

1. 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) Contents of Pre-Construction Notification: 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: The 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 e-mail, 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.

3. Regional Conditions for the Los Angeles District:

In accordance with General Condition Number 27, "Regional and Case-by-Case Conditions," the following Regional Conditions, as added by the Division Engineer, must be met in order for an authorization by any Nationwide to be valid:

1. 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, unless determined to be impracticable by the Corps.

2. Nationwide Permits (NWP) 3, 7, 12-15, 17-19, 21, 23, 25, 29, 35, 36, or 39-46, 48-52 cannot be used to authorize structures, work, and/or the discharge of dredged or fill material that would result in the "loss" of wetlands, mudflats, vegetated shallows or riffle and pool complexes as defined at 40 CFR Part 230.40-45. The definition of "loss" for this regional condition is the same as the definition of "loss of waters of the United States" used for the Nationwide Permit Program. Furthermore, this regional condition applies only within the State of Arizona and within the Mojave and Sonoran (Colorado) desert

regions of California. The desert regions in California are limited to four USGS Hydrologic Unit Code (HUC) accounting units (Lower Colorado -150301, Northern Mojave-180902, Southern Mojave-181001, and Salton Sea-181002).

3. When a pre-construction notification (PCN) is required, the appropriate U.S. Army Corps of Engineers (Corps) District shall be notified in accordance with General Condition 31 using either the South Pacific Division 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. The PCN Checklist and application form are available at: http://www.spl.usace.army.mil/regulatory. 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 projects located within the boundaries of the Los Angeles District shall comply with the most current version of the *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 project site, and all waters proposed to be avoided on and immediately adjacent to the project site. The compass angle and position of each photograph shall be documented on the plan-view drawing required in subpart b of this regional condition.

4. Submission of a PCN pursuant to General Condition 31 and Regional Condition 3 shall be required for all regulated activities in the following locations:
   a. All perennial waterbodies and special aquatic sites within the State of Arizona and within the Mojave and Sonoran (Colorado) desert regions of California, excluding the Colorado River in Arizona from Davis Dam to River Mile 261 (northern boundary of the Fort Mojave Indian Tribe Reservation). The desert region in California is limited to four USGS HUC accounting units (Lower Colorado -150301, Northern Mojave-180902, Southern Mojave-181001, and Salton Sea-181002).
   b. All 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.
   c. All watersheds in the Santa Monica Mountains in Los Angeles and Ventura counties bounded by Calleguas Creek on the west, by Highway 101 on the north and east, and by Sunset Boulevard and Pacific Ocean on the south.
   d. The Santa Clara River watershed in Los Angeles and Ventura counties, including but not limited to Aliso Canyon, Agua Dulce Canyon, Sand Canyon, Bouquet Canyon, Mint Canyon, South Fork of the Santa Clara River, San Francisquito Canyon, Castaic Creek, Piru Creek, Sespe Creek and the main-stem of the Santa Clara River.

5. Individual Permits shall be required for all discharges of fill material in jurisdictional vernal pools, with the exception that discharges for the purpose of restoration, enhancement, management or scientific study of vernal pools may be authorized under NWPs 5, 6, and 27 with the submission of a PCN in accordance with General Condition 31 and Regional Condition 3.

6. Individual Permits shall be required in Murrieta Creek and Temecula Creek watersheds in Riverside County for new permanent fills in perennial and intermittent watercourses otherwise authorized under NWPs 29, 39, 42 and 43, and in ephemeral watercourses for these NWPs for projects that impact greater than 0.1 acre of waters of the United States. In addition, when NWP 14 is used in conjunction with residential, commercial, or industrial developments the 0.1 acre limit would also apply.

7. Individual Permits (Standard Individual Permit or 404 Letter of Permission) shall be required in San Luis Obispo Creek and Santa Rosa Creek in San Luis Obispo County for bank stabilization projects, and in Gaviota Creek, Mission Creek and Carpinteria Creek in Santa Barbara County for bank stabilization projects and grade control structures.

8. In conjunction with the Los Angeles District's Special Area Management Plans (SAMPs) for the San Diego Creek Watershed and San Juan Creek/Western San Mateo Creek Watersheds in Orange County, California, the Corps' Division Engineer, through his discretionary authority has revoked the use of the following 26 selected NWPs within these SAMP watersheds: 03, 07, 12, 13, 14, 16, 17, 18, 19, 21, 25, 27, 29, 31, 33, 39, 40, 41, 42, 43, 44, 46, 49, and 50. Consequently, these NWPs are no longer available in those watersheds to authorize impacts to waters of the United States from discharges of dredged or fill material under the Corps' Clean Water Act section 404 authority.

9. Any requests to waive the 300 linear foot limitation for intermittent and ephemeral streams for NWPs 29, 39, 40 and 42, 43, 44, 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 characters 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 associated vegetation community (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 3;
   c. Measures taken to avoid and minimize losses, including other methods of constructing the proposed project; and
   d. A compensatory mitigation plan describing how the unavoidable losses are proposed to be compensated, in accordance with 33 CFR Part 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.

4. Further information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:
   ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
   (X) Section 404 of the Clean Water Act (33 U.S.C. 1344).
   ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.
   (a) This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.
   (b) This permit does not grant any property rights or exclusive privileges.
   (c) This permit does not authorize any injury to the property or rights of others.
   (d) This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:
   (a) Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   (b) Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
   (c) Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
   (d) Design or construction deficiencies associated with the permitted work.
   (e) Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:
   (a) You fail to comply with the terms and conditions of this permit.
   (b) The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).
   (c) Significant new information surfaces which this office did not consider in reaching the original public interest decision.

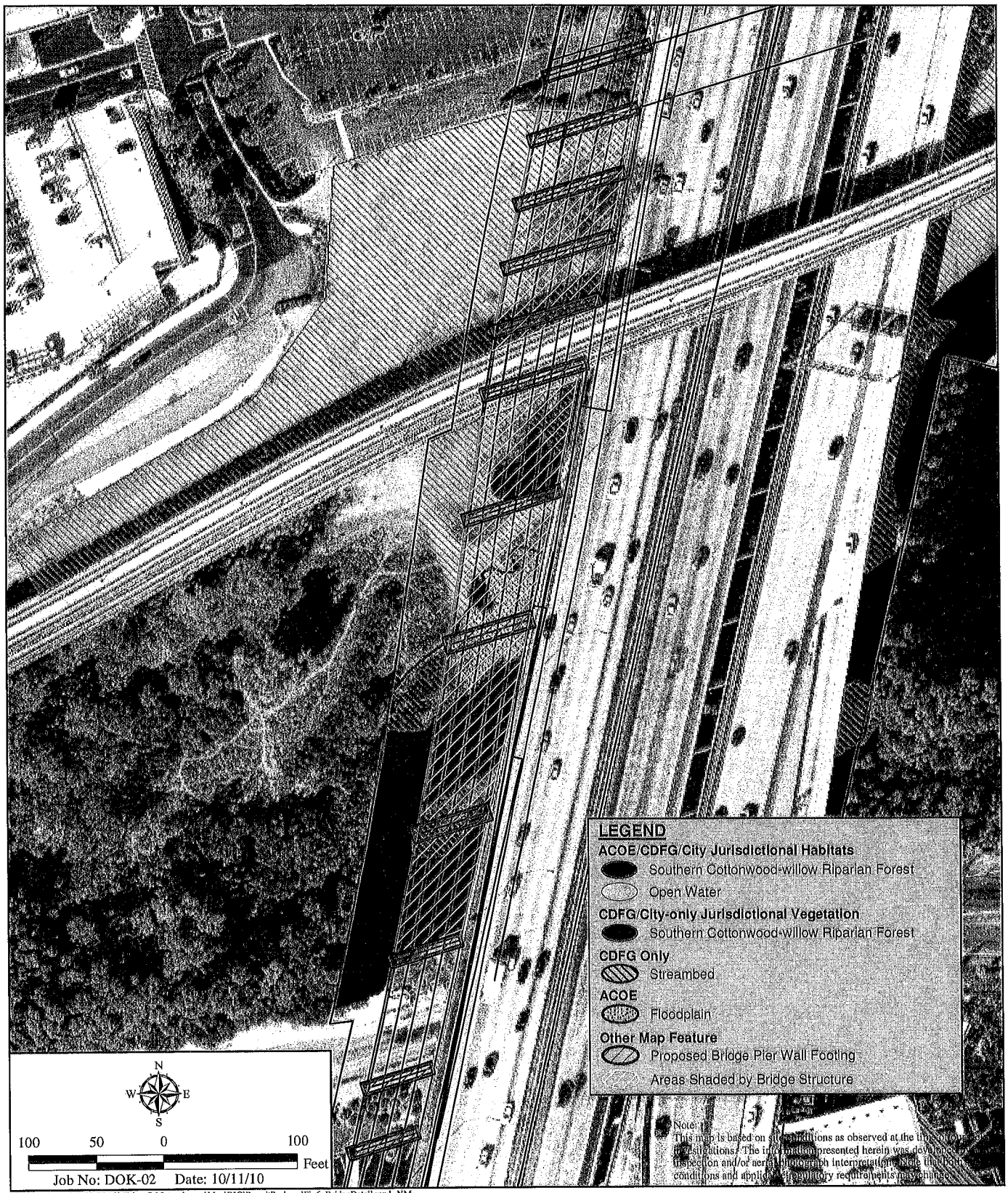
   Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 330.5 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measure ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. This letter of verification is valid for a period not to exceed two years unless the nationwide permit is modified, reissued, revoked, or expires before that time.

7. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition H below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

8. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished with the terms and conditions of your permit.

ENCLOSURE 4



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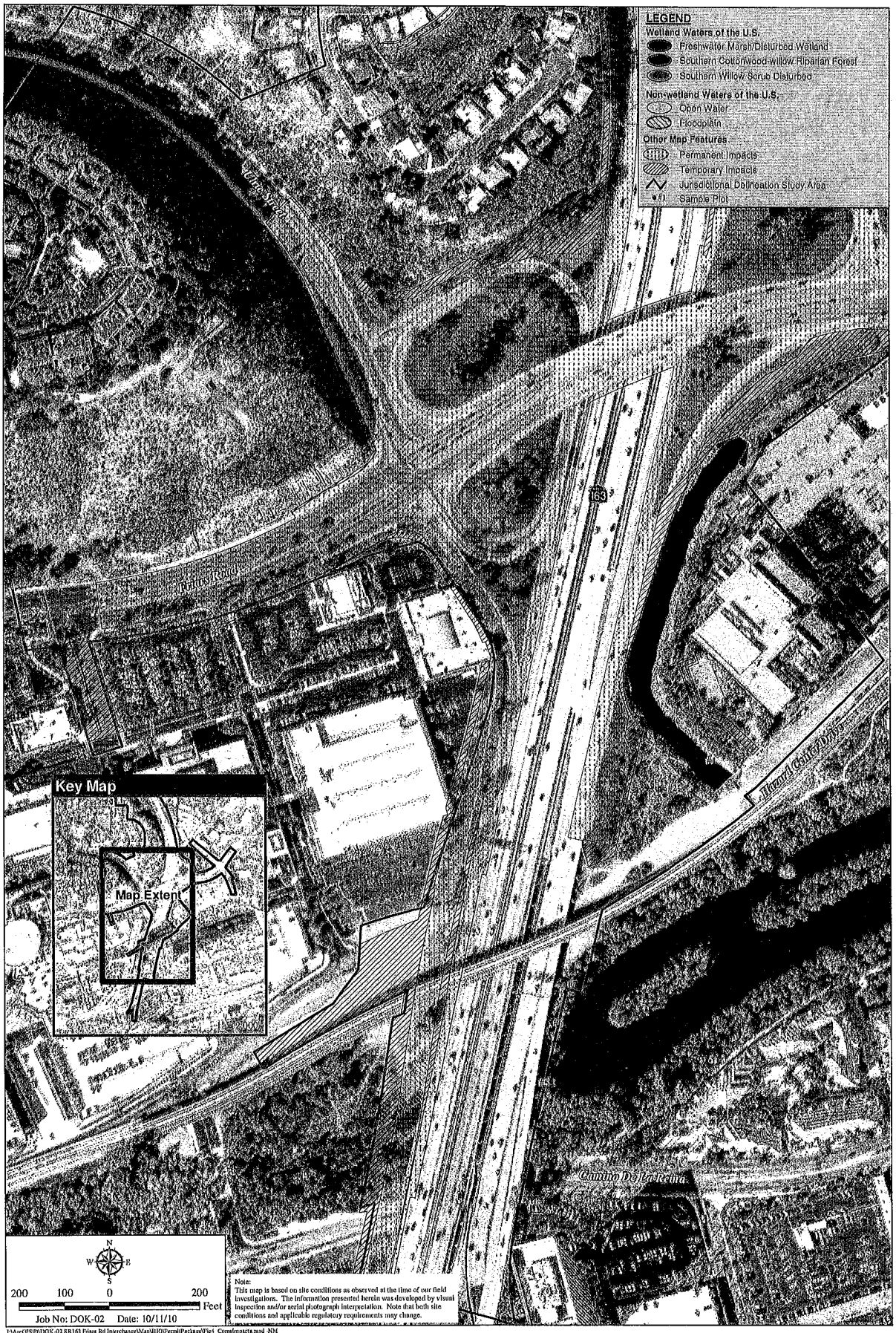
San Diego River Bridge Detail

SR 163/FRIARS ROAD INTERCHANGE PROJECT

Figure 6

ENCLOSURE 5

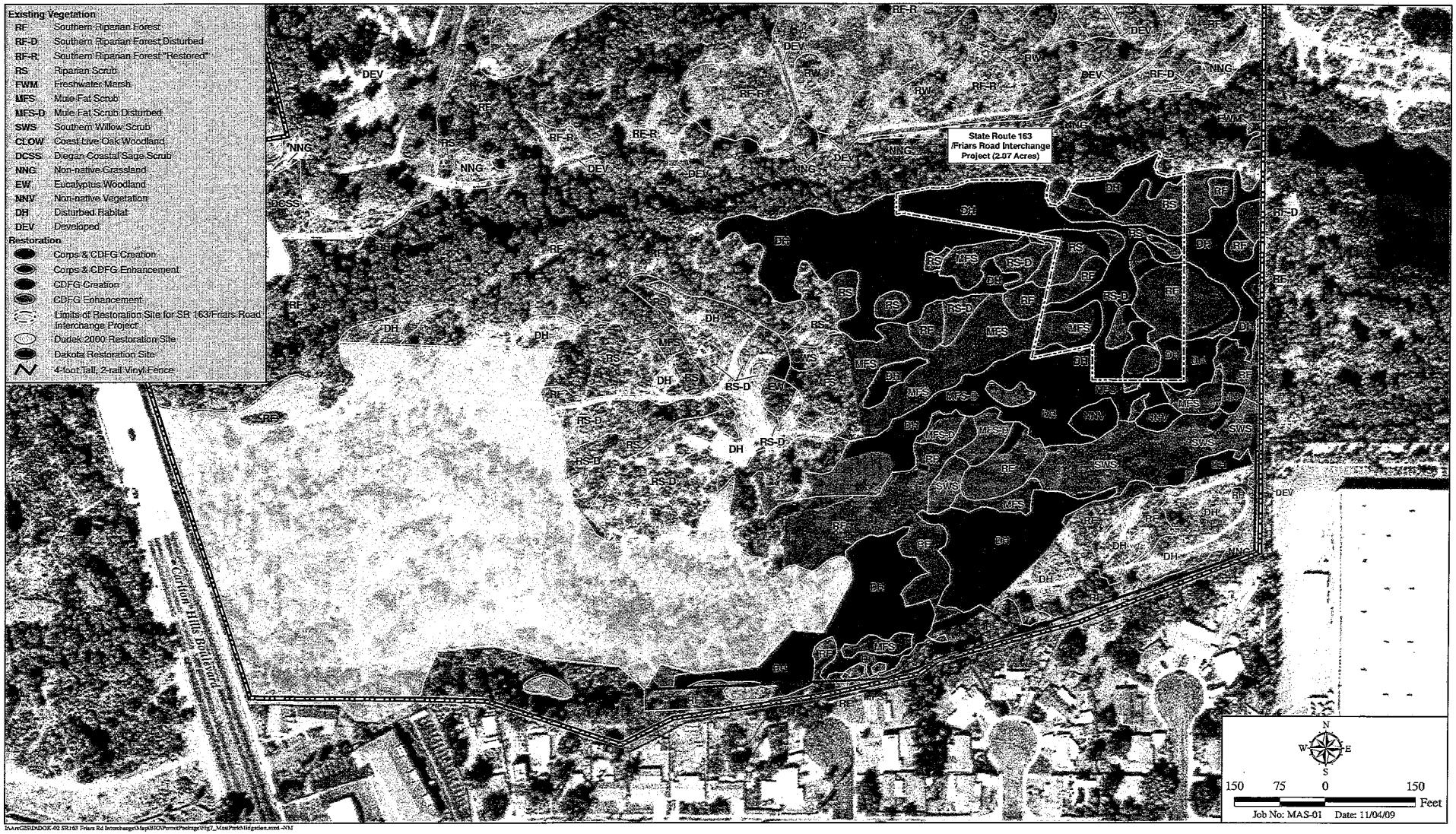


Corps Jurisdictional Delineation/Impacts

SR-163/FRIARS ROAD INTERCHANGE PROJECT

Figure 4

ENCLOSURE 6



I:\ArcGIS\DADOK-02 SR163 Friars Rd Interchange\Map\BIO\Permit Package\Fig7_MastParkMitigation.mxd -NM

Mast Park Wetland Mitigation Site

SR 163/FRIARS ROAD INTERCHANGE PROJECT

Figure 7

HELIX

Matt Rodriquez
Secretary for
Environmental Protection

California Regional Water Quality Control Board
San Diego Region

Over 50 Years Serving San Diego, Orange, and Riverside Counties
Recipient of the 2004 Environmental Award for Outstanding Achievement from U.S. EPA

9174 Sky Park Court, Suite 100, San Diego, California 92123-4353
(858) 467-2952 • Fax (858) 571-6972
http://www.waterboards.ca.gov/sandiego

Edmund G. Brown Jr.
Governor

July 22, 2011

In reply refer to:
748147: jebsen

Mark Koll
City of San Diego
600 B Street, Ste. 800/MS908A
San Diego, CA 92101

Dear: Mr. Koll

Subject: Action on Request for Clean Water Act Section 401 Water Quality Certification for the SR-163/Friars Road Interchange Project, Water Quality Certification No. 09C-101

Enclosed find Clean Water Act Section 401 Water Quality Certification (Certification) for discharge to Waters of the U.S. and acknowledgment of enrollment under State Water Resources Control Board Order No. 2003-017-DWQ for the SR-163/Friars Road Interchange Project. A description of the project and project location can be found in the project information sheet, location map, and site maps which are included as Attachments 1 through 5.

Any petition for reconsideration of this Certification must be filed with the State Water Resources Control Board within 30 days of certification action (23 CCR § 3867). If no petition is received, it will be assumed that you have accepted and will comply with all the conditions of this Certification.

Failure to comply with all conditions of this Certification may subject you to enforcement actions by the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board), including administrative enforcement orders requiring you to cease and desist from violations, or to clean up waste and abate existing or threatened conditions of pollution or nuisance; administrative civil liability in amounts of up to $10,000 per day per violation; referral to the State Attorney General for injunctive relief; and, referral to the District Attorney for criminal prosecution.

In the subject line of any response, please include the requested "In reply refer to:" information located in the heading of this letter. For questions pertaining to the subject matter, please contact Jody Ebsen at (858) 636-3146

Respectfully,

David W. Gibson
Executive Officer
San Diego Regional Water Quality Control Board

Enclosures: Clean Water Act Section 401 Water Quality Certification No. 09C-101 for SR 163/Friars Road Interchange Project, with four attachments.

cc: Refer to Attachment 2 of Certification 09C-101 for Distribution List.

Tech Staff Info & Use	
File No.	09C-101
WDID	9000002015
Reg. Measure ID	372485
Place ID	748147
Party ID	42977
Person ID	277050

California Regional Water Quality Control Board
San Diego Region

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Action on Request for
Clean Water Act Section 401 Water Quality Certification
and Waste Discharge Requirements
for Discharge of Dredged and/or Fill Materials

PROJECT: **SR-163/Friars Road Interchange Project, Certification Number 09C-101, WDID: 9 000002015**

CIWQS
Reg. Meas. ID: 372485
Place ID: 748147
Party ID: 42977

APPLICANT: **City of San Diego**
Engineering & Capital Projects Dept.
Attn: Mark Koll
600 B Street, Ste 800/MS908A
San Diego, CA 92101

ACTION:

☐ Order for Low Impact Certification	☐ Order for Denial of Certification
☑ Order for Technically-conditioned Certification	☐ Waiver of Waste Discharge Requirements
☑ Enrollment in SWRCB GWDR Order No. 2003-017 DWQ	☐ Enrollment in Isolated Waters Order No. 2004-004 DWQ

PROJECT DESCRIPTION:

The project is to make improvements to the SR-163 / Friars Road interchange and to adjacent roads. Major project elements include widening the bridge that crosses over the San Diego River for southbound SR-163 traffic, a new flyover bridge to connect Ulric Street to southbound SR-163, widening of Friars Road Bridge, and widening and/or restriping other roads. The project is located in the San Diego River Watershed (907.11). The project impacts are to the San Diego River and an unnamed tributary.

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I. STANDARD CONDITIONS:

The following three standard conditions apply to all Certification actions, except as noted under Condition 3 for denials (Action 3).

A. This Certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to section 13330 of the California Water Code and section 3867 of Title 23 of the California Code of Regulations (23 CCR).

B. This Certification action is not intended and must 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 subsection 3855(b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

C. The validity of any non-denial Certification action (Actions 1 and 2) must be conditioned upon total payment of the full fee required under 23 CCR section 3833, unless otherwise stated in writing by the certifying agency.

II. ADDITIONAL CONDITIONS: GENERAL

A. Water Quality Certification No. 09C-101 (Certification) is only valid if the project begins no later than 5 (five) years from the date of issuance. If the project has not begun within 5 years from the date of issuance, then this Certification expires.

B. City of San Diego must comply with the requirements of State Water Resources Control Board Water Quality Order No. 2078-0017-DWQ, *Statewide General Waste Discharge Requirements for Discharges of Dredged or Fill Material that have Received State Water Quality Certification*. These General Waste Discharge Requirements are accessible at: http://www.waterboards.ca.gov/water_issues/programs/cwa401/docs/generalorders/go_wdr401regulated_projects.pdf.

C. City of San Diego must comply with the requirements of State Water Resources Control Board Water Quality Order No. 2009-0009-DWQ, NPDES No. CAS000002 *General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities*.

D. City of San Diego must, at all times, fully comply with the engineering plans, specifications and technical reports submitted to the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board), to support this Certification and all subsequent submittals required as part of this Certification and as described in Attachment 1. The conditions within this Certification must supersede conflicting provisions within such plans submitted prior to the Certification action. Any modifications thereto, would require notification to the San Diego Water Board and reevaluation for individual Waste Discharge Requirements and/or Certification amendment.

E. During construction, City of San Diego must maintain a copy of this Certification at the project site so as to be available at all times to site personnel and agencies.

F. City of San Diego must permit the San Diego Water Board or its authorized representative at all times, upon presentation of credentials:

1. Entry onto project premises, including all areas on which wetland fill or wetland mitigation is located or in which records are kept.

2. Access to copy any records required to be kept under the terms and conditions of this Certification.

3. Inspection of any treatment equipment, monitoring equipment, or monitoring method required by this Certification.

4. Sampling of any discharge or surface water covered by this Order.

G. In the event of any violation or threatened violation of the conditions of this Certification, the violation or threatened violation must be subject to any remedies, penalties, process or sanctions as provided for under State law. For purposes of section 401(d) of the 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 assure compliance with the water quality standards and other pertinent requirements incorporated into this Certification.

H. In response to a suspected violation of any condition of this Certification, the San Diego Water Board may require the holder of any permit or license subject to this Certification to furnish, under penalty of perjury, any technical or monitoring reports the San Diego Water Board deems appropriate, provided that the burden, including costs, of the reports must bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports.

I. In response to any violation of the conditions of this Certification, the San Diego Water Board may add to or modify the conditions of this Certification as appropriate to ensure compliance.

III. ADDITIONAL CONDITIONS: CONSTRUCTION BEST MANAGEMENT PRACTICES

A. Prior to the start of the project, and annually thereafter, City of San Diego must educate all personnel on the requirements in this Certification, pollution prevention measures, spill response, and Best Management Practices (BMPs) implementation and maintenance.

B. City of San Diego must, at all times, maintain appropriate types and sufficient quantities of materials on-site to contain any spill or inadvertent release of materials that may cause a condition of pollution or nuisance if the materials reach waters of the United States and/or State.

C. City of San Diego must enroll in and comply with the requirements of State Water Resources Control Board Water Quality Order No. 2009-0009-DWQ, NPDES No. CAS000002, *General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities*.

D. The treatment, storage, and disposal of wastewater during the life of the project must be done in accordance with waste discharge requirements established by the San Diego Water Board pursuant to CWC § 13260.

E. Discharges of concentrated flow during construction or after completion must not cause downstream erosion or damage to properties or stream habitat.

F. Water containing mud, silt, or other pollutants from equipment washing or other activities, must not be discharged to waters of the United States and/or the State or placed in locations that may be subjected to storm flows. Pollutants discharged to areas within a stream diversion area must be removed at the end of each work day or sooner if rain is predicted.

G. All surface waters, including ponded waters, must be diverted away from areas undergoing grading, construction, excavation, vegetation removal, and/or any other activity which may result in a discharge to the receiving water. Diversion activities must not result in the degradation of beneficial uses or exceedance of water quality objectives of the receiving waters. Any temporary dam or other artificial obstruction constructed must only be built from materials such as clean gravel which will cause little or no

siltation. Normal flows must be restored to the affected stream immediately upon completion of work at that location.

H. All areas that will be left in a rough graded state must be stabilized no later than one week after completion of grading. City of San Diego and subsequent owner(s) are responsible for implementing and maintaining BMPs to prevent erosion of the rough graded areas to prevent flow from this area from causing negative impacts to beneficial uses. After completion of grading, all areas must be revegetated with native species appropriate for the area. The revegetation palette must not contain any plants listed on the California Invasive Plant Council Invasive Plant Inventory, which can be found online at: http://www.cal-ipc.org/ip/inventory/weedlist.php.

I. Substances hazardous to aquatic life including, but not limited to, petroleum products, raw cement/concrete, asphalt, and coating materials, must be prevented from contaminating the soil and/or entering waters of the United States and/or State. BMPs must be implemented to prevent such discharges during each project activity involving hazardous materials.

J. Removal of vegetation must occur by hand, mechanically, or using EPA approved herbicides deployed using applicable BMPs to prevent impacts to Beneficial Uses of waters of the State. Use of aquatic pesticides must be done in accordance with State Water Resources Control Board Water Quality Order No. 2004-0009-DWQ, and any subsequent reissuance as applicable. Removal of vegetation must occur outside of the avian nesting season (March 15- August 31).

K. All rough graded desilting basins must be designed, constructed and maintained, until all development on the project site is completed, according to the most recent California Stormwater Quality Association guidance for sediment basins.

IV. ADDITIONAL CONDITIONS: POST-CONSTRUCTION BEST MANAGEMENT PRACTICES

A. City of San Diego is prohibited from allowing post-construction discharges to cause onsite or offsite downstream erosion, damage to properties or damage to stream habitats in the San Diego River that will receive post-construction discharges from project site.

B. All storm drain inlet structures within the project boundaries must be stamped and/or stenciled (or equivalent) with appropriate language prohibiting non-storm water discharges.

C. All post-construction BMPs, including those described in the Project Specific Water Quality Technical Report for City of San Diego, *Water Quality Technical Report Friars Road / SR-163 Interchange Project,* Dokken Engineering, October 2009, and *Friars Road/State Route 163 Interchange Long Form – Storm Water Data Report,* Dokken Engineering, October 2009, must be sized to comply with the following numeric sizing criteria and treat 100 percent of the impervious surfaces associated with the project:

1. Volume
   Volume-based BMPs must be designed to mitigate (infiltrate, filter, or treat) either:

   a. The volume of runoff produced from a 24-hour 85th percentile storm event, as determined from the local historical rainfall record (0.6 inch approximate average for the San Diego County area); or

   b. The volume of runoff, as determined from the local historical rainfall record, that achieves approximately the same reduction in pollutant loads and flows as achieved by mitigation of the 85th percentile 24-hour runoff event; or

2. Flow
   Flow-based BMPs must be designed to mitigate (infiltrate, filter, or treat) either:

   a. The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour; or

   b. The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity, as determined from the local historical rainfall record, multiplied by a factor of two; or

   c. The maximum flow rate of runoff, as determined from the same reduction in pollutant loads and flows as achieved by mitigation of the 85th percentile hourly rainfall intensity multiplied by a factor of two.

D. For all post-construction BMPs, including but not limited to, vegetated slopes and an infiltration basin, as described in *Water Quality Technical Report Friars Road / SR-163 Interchange Project,* Dokken Engineering, October 2009, and *Friars Road/State Route 163 Interchange Long Form – Storm Water Data Report,* Dokken Engineering, October 2009; and storm water discharge points must:

1. Be regularly inspected and maintained for the life of the project per manufactures' specifications and industry standards;

2. No less than one time per year assess the performance of the systems on protection of the receiving waters and identify any necessary corrective measures;

3. Have all preventive and corrective maintenance performed;

4. Be inspected no less than one time per year, immediately prior to the commencement of the rainy season (October 1) and after every storm event exceeding 0.5 inches of precipitation; and

5. Maintain a log documenting all BMP inspections and maintenance activities.

V. ADDITIONAL CONDITIONS: COMPENSATORY MITIGATION

A. Mitigation for permanent impacts to 0.38 acres (340 linear feet) of wetland waters and/or riparian habitat of the United States and/or State, and temporary impacts to 0.31 acres (294 linear feet) of wetland waters and/or riparian habitat of the United States and/or State, and 0.31 acres (294 linear feet) of temporary impacts to wetland waters and/or must be achieved as described in the *Mast Park Wetland Habitat Restoration Plan,* prepared by Helix Environmental Planning, Inc., dated November 20, 2009 (and any subsequent versions/ additional memos reviewed by the San Diego Water Board). The **total mitigation area shall encompass 2.07 acres** for wetland waters and/or riparian habitat of the United State and/or State and must include:

   1. Establishment of a minimum of 0.69 acres, up to 1.32 acres of wetland waters and/or riparian habitat of the United States and/or State

   2. Enhancement of a minimum of 0.75 acres up to 1.38 acres of wetland waters and/or riparian habitat of the United States and/or State

B. The construction of proposed mitigation must be concurrent with project grading and completed no later than 9 months following the initial discharge of dredge or fill material into on-site waters. Delays in implementing mitigation must be compensated for by an increased mitigation implementation of 10 percent of the cumulative compensatory mitigation for each month of delay.

C. City of San Diego must restore all areas of temporary impacts and all other areas of temporary disturbance which could result in a discharge or a threatened discharge to waters of the United States/State. Restoration must include grading of disturbed areas to pre-project contours and revegetation with native species. City of San Diego must implement all necessary BMPs to control erosion and runoff from areas associated with this project.

D. City of San Diego must salvage leaf litter, coarse woody debris, and upper soil horizons from impacted jurisdictional water sites that are relatively free of invasive exotic species for use in on-site mitigation areas.

E. City of San Diego must also salvage large cuttings from appropriate tree species if they exist at the impact site and use them as pole plantings at the mitigation site.

F. The mitigation site must be designed and constructed to meet the following conditions:

1. Channels through the mitigation site are characterized by equilibrium conditions, with no evidence of severe aggradation or degradation;

2. As viewed along cross-sections, channels and buffers have a variety of slopes, or elevations, that are characterized by different moisture gradients. Each sub-slope contains physical patch types or features that contribute to irregularity in height, edges, or surface and to complex topography overall; and

3. The mitigation site has a well-developed plant community characterized by a high degree of horizontal and vertical interspersion among plant zones and layers.

G. Throughout the mitigation monitoring program mitigation areas must be maintained free of perennial exotic plant species including, but not limited to, pampas grass, giant reed, tamarisk, sweet fennel, tree tobacco, castor bean, and pepper tree. Annual exotic plant species must not occupy more than 5 percent of the on-site or off-site mitigation areas.

H. San Diego Water Board acceptance of the final mitigation plan applies only to the site and plan that mitigates for the SR-163/Friars Road Interchange Project and must not be construed as approval of the mitigation site or plan for use by other current or future projects that are planning to use additional acreage at the site for mitigation.

I. Any maintenance activities that do not contribute to the success of the mitigation site and enhancement of beneficial uses and ecological

functions and services are prohibited. Maintenance activities are limited to the removal of trash and debris, removal of exotic plant species, replacement of dead native plant species and remedial measures deemed necessary for the success of the restoration program.

J. If at any time during the implementation and establishment of the mitigation area(s), and prior to verification of meeting success criteria, a catastrophic natural event (e.g., fire, flood) occurs and impacts the mitigation area, City of San Diego is responsible for repair and replanting of the damaged area(s).

K. For the purpose of determining mitigation credit for the removal of exotic/invasive plant species, only the actual area occupied by exotic/invasive plant species must be quantified to comply with mitigation requirements.

L. For purposes of this Certification, establishment is defined as the creation of vegetated or unvegetated waters of the United States/State where the resource has never previously existed (e.g. conversion of nonnative grassland to a freshwater marsh). Restoration is divided into two activities, re-establishment and rehabilitation. Re-establishment is defined as the return of natural/historic functions to a site where vegetated or unvegetated waters of the United States/State previously existed (e.g., removal of fill material to restore a drainage). Rehabilitation is defined as the improvement of the general suite of functions of degraded vegetated or unvegetated waters of the United States/State (e.g., removal of a heavy infestation or monoculture of exotic plant species from jurisdictional areas and replacing with native species). Enhancement is defined as the improvement to one or two functions of existing vegetated or unvegetated waters of the United States/State (e.g., removal of small patches of exotic plant species from an area containing predominantly natural plant species). Preservation is defined as the acquisition and legal protection from future impacts in perpetuity of existing vegetated or unvegetated waters of the United States/State (e.g., conservation easement).

VI. MONITORING REQUIREMENTS:

A. Monitoring of the mitigation site must utilize a quantitative function-based assessment to establish baseline conditions, set success criteria, and assess mitigation site progress. The California Rapid Assessment Method (CRAM) or Hydrogeomorphic Assessment (HGM) must be utilized.

VII. NOTIFICATION REQUIREMENTS:

A. City of San Diego must notify the San Diego Water Board within **24 hours** of any unauthorized discharge, including hazardous or toxic materials, to waters of the United States and/or State; measures that were implemented to stop and contain the discharge; measures implemented to clean-up the discharge; the volume and type of materials discharged and recovered; and additional best management practices (BMPs) or other measures that will be implemented to prevent future discharges.

B. This Certification is not transferable in its entirety or in part to any person except after notice to the Executive Officer of the San Diego Water Board in accordance with the following terms.

1. Transfer of Property Ownership: City of San Diego must notify the San Diego Water Board of any change in ownership of the project area. Notification of change in ownership must include, but not be limited to, a statement that City of San Diego has provided the purchaser with a copy of the Section 401 Water Quality Certification and that the purchaser understands and accepts the certification requirements and the obligation to implement them or be subject to liability for failure to do so; the seller and purchaser must sign and date the notification and provide such notification to the Executive Officer of the San Diego Water Board **within 10 days of the transfer of ownership.**

2. Transfer of Mitigation Responsibility: Any notification of transfer of responsibilities to satisfy the mitigation requirements set forth in Section V and VII.E of this Certification must include a signed statement from an authorized representative of the new party (transferee) demonstrating acceptance and understanding of the responsibility to comply with and fully satisfy the mitigation conditions and agreement that failure to comply with the mitigation conditions and associated requirements may subject the transferee to enforcement by the San Diego Water Board under Water Code section 13385, subdivision (a). Notification of transfer of responsibilities meeting the above conditions must be provided to the San Diego Water Board **within 10 days of the transfer date.**

3. Transfer of Post-Construction BMP Maintenance Responsibility: City of San Diego assumes responsibility for the inspection and maintenance of all post-construction structural BMPs until such responsibility is legally transferred to another entity. At the time maintenance responsibility for post-construction BMPs is legally transferred City of San Diego must submit to the San Diego Water Board a copy of such

documentation and must provide the transferee with a copy of a long-term BMP maintenance plan that complies with manufacturer specifications.

Upon properly noticed transfers of responsibility, the transferee assumes responsibility for compliance with this Certification and references in this Certification to City of San Diego will be interpreted to refer to the transferee as appropriate. Transfer of responsibility does not necessarily relieve City of San Diego of this Certification in the event that a transferee fails to comply.

C. City of San Diego must notify the San Diego Water Board in writing **at least 5 days prior to** the actual commencement of dredge, fill, and discharge activities.

D. The City of San Diego must notify the San Diego Water Board in writing at least **5 days** prior to the actual commencement of mitigation installation, and completion of mitigation installation.

E. Prior to the start of construction, City of San Diego must provide the San Diego Water Board a draft preservation mechanism (e.g. deed restriction, conservation easement, etc.) that will protect all mitigation areas and their buffers in perpetuity. Within one year of the start of construction, the City of San Diego must submit proof of a completed preservation mechanism that will protect all mitigation areas and their buffers in perpetuity. Construction of the site must not be initiated until a completed preservation mechanism is received. The conservation easement, deed restriction, or other legal limitation on the mitigation property must be adequate to demonstrate that the site will be maintained without future development or encroachment on the site which could otherwise reduce the functions and values of the site for the variety of beneficial uses of waters of the United States that it supports. The legal limitation must prohibit, without exception, all residential, commercial, industrial, institutional, and transportation development, and any other infrastructure development that would not maintain or enhance the wetland and streambed functions and values of the site. The preservation mechanism must clearly prohibit activities that would result in soil disturbance or vegetation removal, other than the removal of non-native vegetation. Other infrastructure development to be prohibited includes, but is not limited to, additional utility lines, maintenance roads, and areas of maintained landscaping for recreation.

F. Prior to project construction, City of San Diego must submit to the San Diego Water Board a letter accepting full responsibility for the inspection and maintenance of all BMPs installed on all roads that are required to be improved as part of the project, including, but not limited to, SR 163, Friars

Road, Ulric Street and surrounding surface streets that are improved as part of this project.

G. The San Diego Water Board may be requested to review planned BMP implementation that clearly demonstrates to meet or exceed the performance standards herein. Such requests must be made 30 days prior to the planned BMP implementation.

VIII. REPORTING REQUIREMENTS:

A. City of San Diego must submit annual progress reports describing status of compliance with all requirements of this Certification to the San Diego Water Board prior to **August 1** of each year following the issuance of this Certification until the project has reached completion. City of San Diego must submit a Final Project Annual Report to the San Diego Water Board **prior to August 1 following completion of the project.** The reports must include the following:

1. Date of construction initiation.

2. Projected date of construction completion.

3. Status of BMPs for the project.

4. Final Project Report: As-built drawings no bigger than 11"X17."

B. Prior to initiation of mitigation activities, City of San Diego must conduct a quantitative function-based assessment to evaluate the condition of the mitigation site. The results of the functional assessment must be submitted to the San Diego Water Board in a report no later than **30 days** after the initiation of mitigation activities.

C. City of San Diego must develop and implement a five-year Receiving Waters Monitoring Plan to evaluate potential project impacts from pollutants/stressors to San Diego River. The Receiving Waters Monitoring Plan must be developed and submitted to the San Diego Water Board **prior to construction commencement.** The Receiving Waters Monitoring Plan must assess conditions before, during, and after impacts have occurred by measuring changes in benthic, macroinvertebrate community, and a functional assessment of the health of wetland and riparian habitats. The five year receiving water monitoring will begin prior to the start of project construction, and the data and analysis must be submitted with the Annual Progress Reports pursuant to Condition VIII.A of this certification.

1. **Benthic Macroinvertebrate Community Analysis**
   Bioassessment monitoring must be performed using the professional level non-point source protocol of the California Stream Bioassessment procedure[1] to assess effects of the project on the biological integrity of receiving waters. At a minimum, bioassessment monitoring must be performed at three sites (assessment stations) on the San Diego River (as flow permits) once per year, during the established "index period" for the San Diego River Watershed. The first assessment station is the reference station, which must be located upstream of the discharge from the project site on the San Diego River in a reference area; the second assessment station must be located immediately upstream of the discharge from the project site on the San Diego River, the third assessment station must be located immediately downstream of the discharge from the discharge from the project site on the San Diego River. The reference station upstream of the project discharge must be located and sampled concurrently with second and third assessment stations. The results of the Benthic Macroinvertebrate Community Analysis must be submitted each year **with the Annual Progress Report (see Condition V.III.A).**

2. **California Rapid Assessment Method**
   City of San Diego must conduct a quantitative function-based assessment of the health of wetland and riparian habitats in the San Diego River using the California Rapid Assessment Method (CRAM)[2] at the three assessment stations described above (in section C.1.a, 'Benthic Macroinvertebrate Community Analysis). The results of the CRAM assessment must be submitted each year **with the Annual Progress Reports (see Condition V.III.A).**

D. Procedures for the sampling, analysis, and quality assurance/quality control must be conducted in accordance with the Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (QAPrP)[33] for the State of California's Surface Water Ambient Monitoring Program, adopted by the State Water Resources Control Board.

E. The San Diego Water Board Executive Officer may make revisions to the Receiving Water monitoring program at any time during the five year monitoring term, and may include a reduction or increase in the number of

[1] Copies of the California Stream Bioassessment Procedure can be obtained at http://www.dfg.ca.gov/cabw/cabwhome.html. Additional Information on Stream bioassessment may be obtained at http://www.waterboards.ca.gov/rwqcb9/water_issues/programs/bioassessment/index.shtml

[2] Information on CRAM is available at the California Rapid Assessment Method homepage at http://www.cramwetlands.org/

[3] The Quality Assurance Program Plan is available on the State Water Board's SWAMP website at http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf

parameters to be monitored, locations monitored, the frequency of monitoring, or the number and size of samples collected.

F. Mitigation monitoring reports must be submitted annually until mitigation has been deemed successful. Annual monitoring reports must be submitted **prior to December 1 of each year**. Monitoring reports must include, but not be limited to, the following:

1. Names, qualifications, and affiliations of the persons contributing to the report;

2. Date of initiation of mitigation installation and date mitigation installation was completed.

3. Mitigation as-builts, including topography maps and planting locations.

4. Tables presenting the raw data collected in the field as well as analyses of the physical and biological data;

5. Topographic complexity characteristics at each mitigation site;

6. Upstream and downstream habitat and hydrologic connectivity;

7. Source of hydrology;

8. Width of native vegetation buffer around the entire mitigation site;

9. Qualitative and quantitative comparisons of current mitigation conditions with pre-construction conditions and previous mitigation monitoring results.

10. Stream Photodocumentation, including all areas of permanent and temporary impact, prior to and after project construction, and mitigation areas, including all areas of permanent and temporary impact, prior to and after project construction. Photo documentation must be conducted in accordance with guidelines posted at http://www.waterboards.ca.gov/sandiego/water_issues/programs/401_certification/docs/StreamPhotoDocSOP.pdf. In addition, photo documentation must include Geographic Positioning System (GPS) coordinates for each of the photo points referenced.

11. A Survey report documenting boundaries of mitigation area, including Geographic Information System (GIS) shape files (polygons) of the impact and mitigation areas (Two GPS readings (points) must be taken on each line of the polygon and the polygon must have a minimum of 10 points). GIS metadata must also be submitted.

G. In the event that the proposed mitigation either does not obtain the 3rd year or the 4th year success criteria milestones for mitigation, the applicants must provide the San Diego Water Board with a technical report detailing the actions that will be taken to bring the mitigation up to the success criteria. This report must also provide an evaluation of alternative mitigation opportunities within the San Diego Hydrologic Area to be utilized for additional mitigation, if portions of the required mitigation are unsuccessful after five years.

H. In the event that the proposed mitigation does not obtain full success with the 5th year success criteria the applicants must finalize the conceptual mitigation plan (see condition No.10) and submit the plan to the San Diego Water Board within 30 days of the 5th year monitoring report period. No later than 90 days following San Diego Water Board acceptance of the final mitigation plan, or 30 days after San Diego Water Board receipt of the plan, the applicants must begin implementation of the final mitigation plan. The plan must include additional mitigation at a ration of 2:1 for any portion of the mitigation that does not meet final success criteria.

I. All information requested in this Certification is pursuant to California Water Code (CWC) section 13267. Civil liability may be administratively imposed by the San Diego Water Board for failure to furnish requested information pursuant to CWC section 13268.

J. All reports and information submitted to the San Diego Water Board must be submitted in both hardcopy and electronic format. The preferred electronic format for each report submission is one file in PDF format that is also Optical Character Recognition (OCR) capable.

K. All applications, reports, or information submitted to the San Diego Water Board must be signed and certified as follows:

1. For a corporation, by a responsible corporate officer of at least the level of vice president.

2. For a partnership or sole proprietorship, by a general partner or proprietor, respectively.

3. For a municipality, or a state, federal, or other public agency, by either a principal executive officer or ranking elected official.

4. A duly authorized representative may sign applications, reports, or information if:

   a. The authorization is made in writing by a person described above.

b. The authorization specifies either an individual or position having responsibility for the overall operation of the regulated activity.

c. The written authorization is submitted to the San Diego Water Board Executive Officer.

L. All applications, reports, or information submitted to the San Diego Water Board must be signed and certified as follows:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

M. City of San Diego must submit reports required under this Certification, or other information required by the San Diego Water Board, to:

Executive Officer
California Regional Water Quality Control Board
San Diego Region
Attn: 401 Certification; Project No. 10C-094
9174 Sky Park Court, Suite 100
San Diego, California 92123

VIII. CEQA FINDINGS:

A. The City of San Diego is the lead agency under the California Environmental Quality Act (Public Resources Code section 21000, et seq., (CEQA)),and filed a Notice of Determination on July 7, 2010, for Environmental Impact Report and an addendum to Environmental Impact Report No. 90-0133 under CEQA Guidelines Title 14, California Code of Regulations. The City of San Diego has determined the project will not have a significant effect on the environment with adopted mitigation measures, monitoring, and reporting that were made a condition of the project.

B. The San Diego Water Board has reviewed the lead agency's Environmental Impact Report and also finds that the project as proposed will not have a significant effect on the environment with conditioned mitigation measures and therefore determines that issuance of this Certification is consistent with the Environmental Impact Report.

IX. PUBLIC NOTIFICATION OF PROJECT APPLICATION:

A. On January 5, 2010, receipt of the project application was posted on the San Diego Water Board web site to serve as appropriate notification to the public. No public comments were received.

X. SAN DIEGO WATER BOARD CONTACT PERSON:

Jody Ebsen
Sky Park Court, Suite 100
San Diego, CA 92123
858-636-3146
jebsen@waterboards.ca.gov

XI. WATER QUALITY CERTIFICATION:

I hereby certify that the proposed discharge from the SR-163/Friars Road Interchange Project (Project No. 09C-101) will comply with the applicable provisions of sections 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 Board Order No. 2003-0017-DWQ, "*Statewide General Waste Discharge Requirements for Dredged or Fill Discharges that have Received State Water Quality Certification (General WDRs)*," which requires compliance with all conditions of this Water Quality Certification. Please note that enrollment under Order No. 2003-017-DWQ is conditional and, should new information come to our attention that indicates a water quality problem, the San Diego Water Board may issue waste discharge requirements at that time.

Except insofar as may be modified by any preceding conditions, all Certification actions are contingent on (a) the discharge being limited and all proposed mitigation being completed in strict compliance with the applicants' project description and/or on the attached Project Information Sheet, and (b) on compliance with all applicable requirements of the Water Quality Control Plan for the San Diego Basin Region (9) (Basin Plan).

7-22-2011

DAVID W. GIBSON
Executive Officer
Regional Water Quality Control Board

Date

Attachments:

1. Project Information
2. Distribution List
3. Location Map
4. Site Maps a and b
5. Mitigation Map

ATTACHMENT 1
PROJECT INFORMATION

Applicant:	City of San Diego Engineering & Capital Projects Dept. Attention: Mark Koll 600 B Street, Ste 800/MS908A San Diego, CA 92101 Telephone: 619-533-4207 Email: mkoll@sandiego.gov
Applicant Representatives:	Helix Environmental Planning, Inc. Attention: Barry Jones 7578 El Cajon Blvd, Ste 200 La Mesa CA 91942 Telephone: 619-462-1515 Facsimile: 619-462-0552 Email: baryj@helixepi.com
Project Name:	SR-163 / Friars Road Interchange Project
Project Location:	Latitude: 32.7779 Longitude: -117.1628
Type of Project:	Road improvement project.
Need for Project:	To relieve existing traffic congestion and delays along the SR 163 / Friars Road interchange and surrounding local streets as well as enhance traffic safety.
Project Description:	The project is to make improvements to the SR-163 / Friars Road interchange and to adjacent streets. Major project elements include widening the bridge that crosses over the San Diego River for southbound SR-163 traffic, a new flyover bridge to connect Ulric Street to southbound SR-163, widening of Friars Road Bridge, and widening and/or restriping other roads. The project is located in the San Diego River Watershed (907.11). The receiving waters are the San Diego River and an unnamed tributary.
Federal Agency/Permit:	U.S. Army Corps of Engineers §404, NWP 27, Shanti Santulli U.S. Fish and Wildlife Service, Section 7 issued June 6, 2007.
Other Required Regulatory Approvals:	California Department of Fish and Game Streambed Alteration Agreement, Kelly Fisher

California Environmental Quality Act (CEQA) Compliance:	SR 163/Friars Road Interchange Project, Environmental Impact Report, March 2010, SCH# 2005111032, City of San Diego. Notice of Determination on July 7, 2010, for Environmental Impact Report and an addendum to Environmental Impact Report No. 90-0133 under CEQA Guidelines Title 14, California Code of Regulations
Receiving Water:	San Diego hydrologic unit, Lower San Diego hydrologic area, Mission San Diego hydrologic sub-area (907.11).
Affected Waters of the United States:	Temporary: Impacts to 0.31 acres (294 linear feet) of wetland waters and/or riparian habitat of the United States and/or State, and 0.31 acres (294 linear feet). Permanent: Impacts to 0.38 acres (340 linear feet) of wetland waters and/or riparian habitat of the United States and/or State
Compensatory Mitigation:	Mitigation must be achieved as described in the *Mast Park Wetland Habitat Restoration Plan,* prepared by Helix Environmental Planning, Inc., dated November 20, 2009 (and any subsequent versions/ additional memos reviewed by the San Diego Water Board). The **total mitigation area shall encompass 2.07 acres** for wetland waters and/or riparian habitat of the United State and/or State and must include: 1. Establishment of a minimum of 0.69 acres, up to 1.32 acres of wetland waters and/or riparian habitat of the United States and/or State 2. Enhancement of a minimum of 0.75 acres up to 1.38 acres of wetland waters and/or riparian habitat of the United States and/or State
Mitigation Location:	Latitude: 32.7779 Longitude: -117.1628
Best Management Practices (BMPs):	Post-construction BMPs include vegetated slopes and an infiltration basin, as described in *Water Quality Technical Report Friars Road / SR-163 Interchange Project,* Dokken Engineering, October 2009, and *Friars Road/State Route 163 Interchange Long Form – Storm Water Data Report,* Dokken Engineering, October 2009.

Public Notice:	B. On January 5, 2010, receipt of the project application was posted on the San Diego Water Board web site to serve as appropriate notification to the public. No public comments were received.
Fees:	Total Due: $640.00 Total Paid: (check No. 1025889)
CIWQS:	Regulatory Measure ID: 372485 Place ID: 748147 Party ID: 42977

ATTACHMENT 2
DISTRIBUTION LIST

Shanti Santulli
U.S. Army Corps of Engineers, Regulatory Branch
San Diego Field Office
Shanti.A.Santulli@usace.army.mil

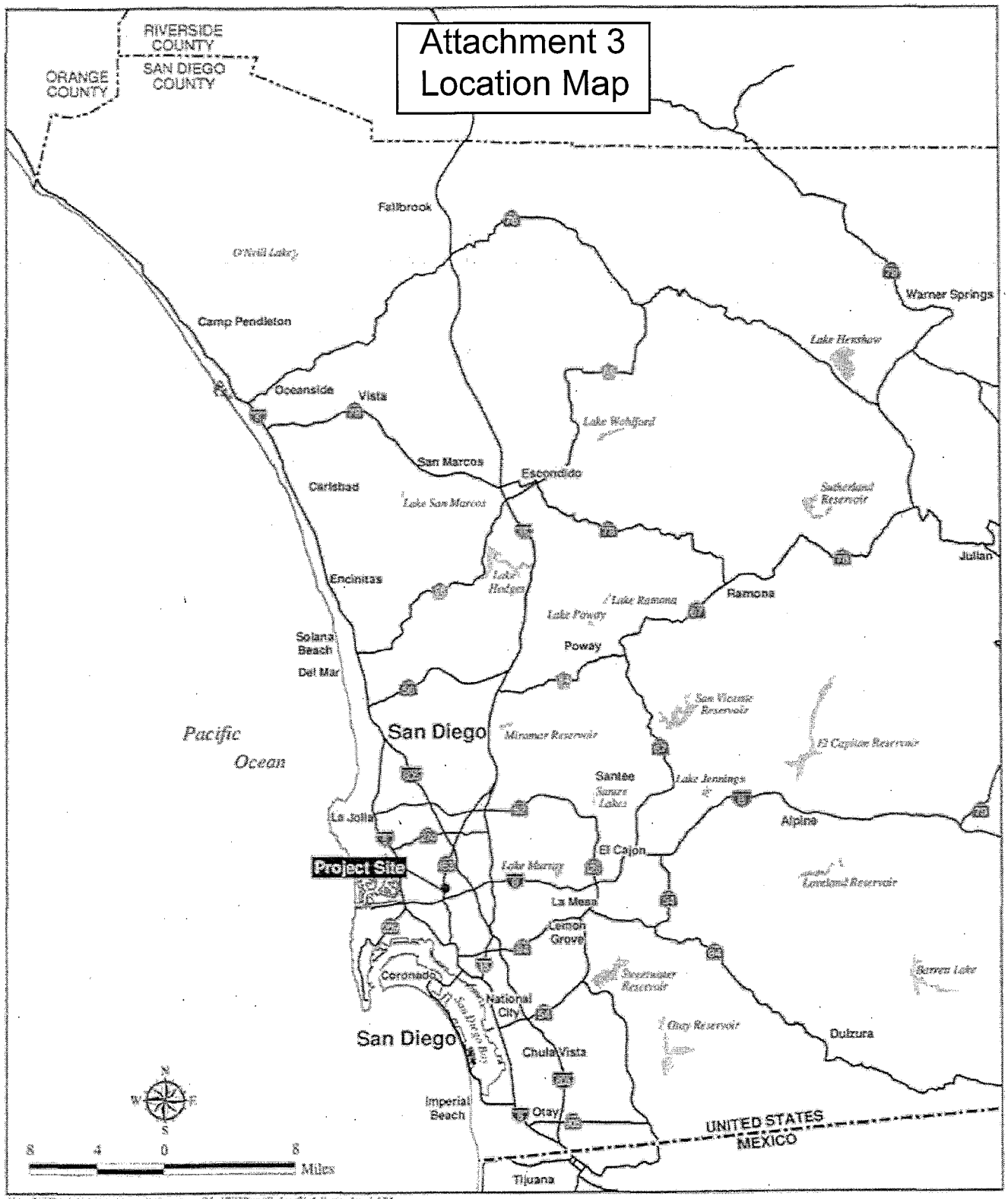
Kelly Fisher
California Department of Fish and Game
South Coast Region
Habitat Conservation Planning – South
KFisher@dfg.ca.gov

David Zoutendyk
U.S. Department of the Interior
Fish and Wildlife Service
david_zoutendyk@fws.gov

U.S. EPA, OWOW, Region 9
75 Hawthorne St.
San Francisco, CA 94105
R9-WTR8-Mailbox@epa.gov

State Water Resources Control Board, Division of Water Quality
401 Water Quality Certification and Wetlands Unit
P.O. Box 100
Sacramento, CA 95812-0100
Stateboard401@waterboards.ca.gov

Barry Jones
Helix Environmental Planning, Inc.,
7578 El Cajon Blvd, Ste, 200
La Mesa, CA 91942
Barryj@helixepi.com



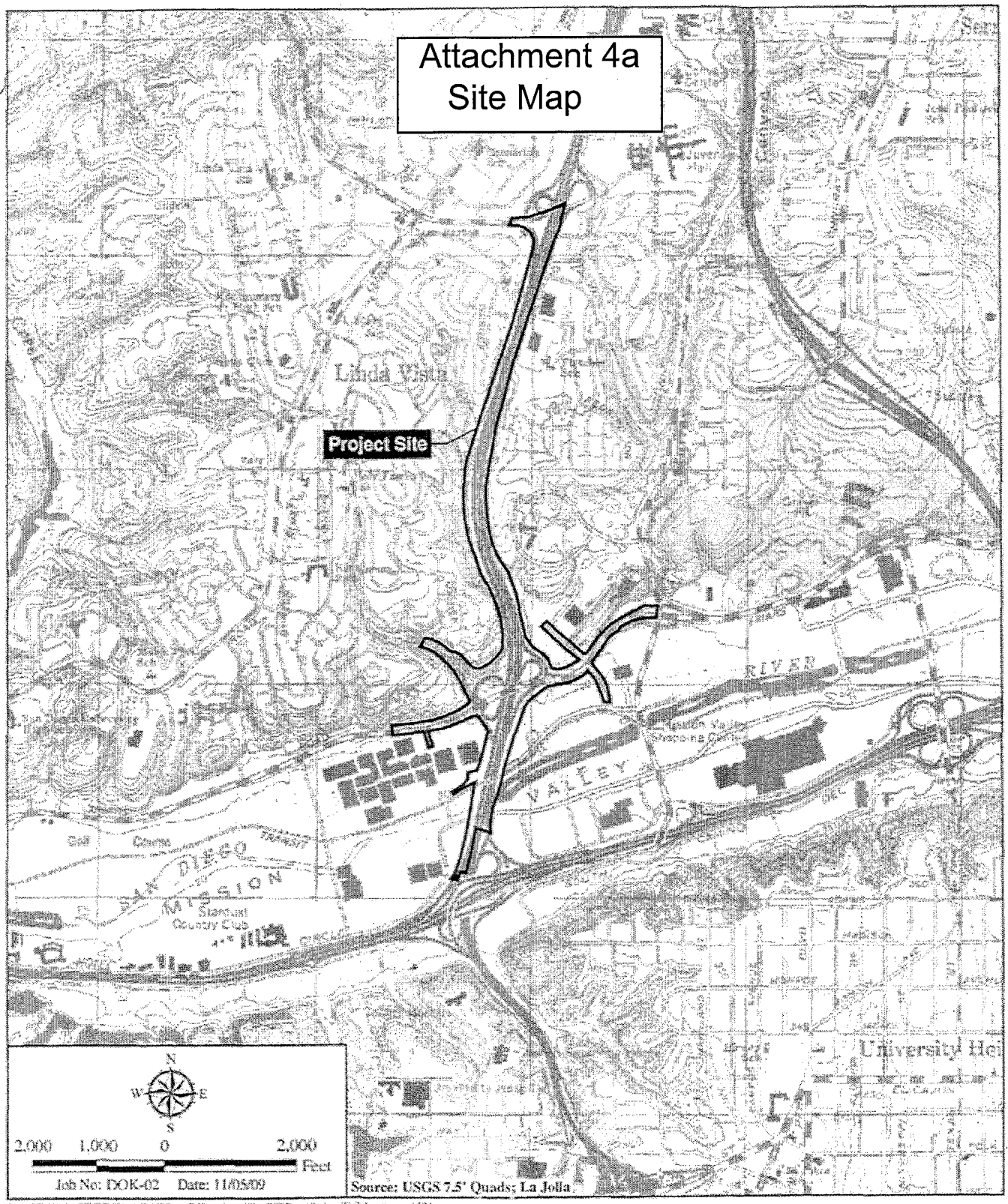
Regional Location Map

SR 163/FRIARS ROAD INTERCHANGE PROJECT

HELIX

Figure 1

Attachment 4a
Site Map



Project Location Map

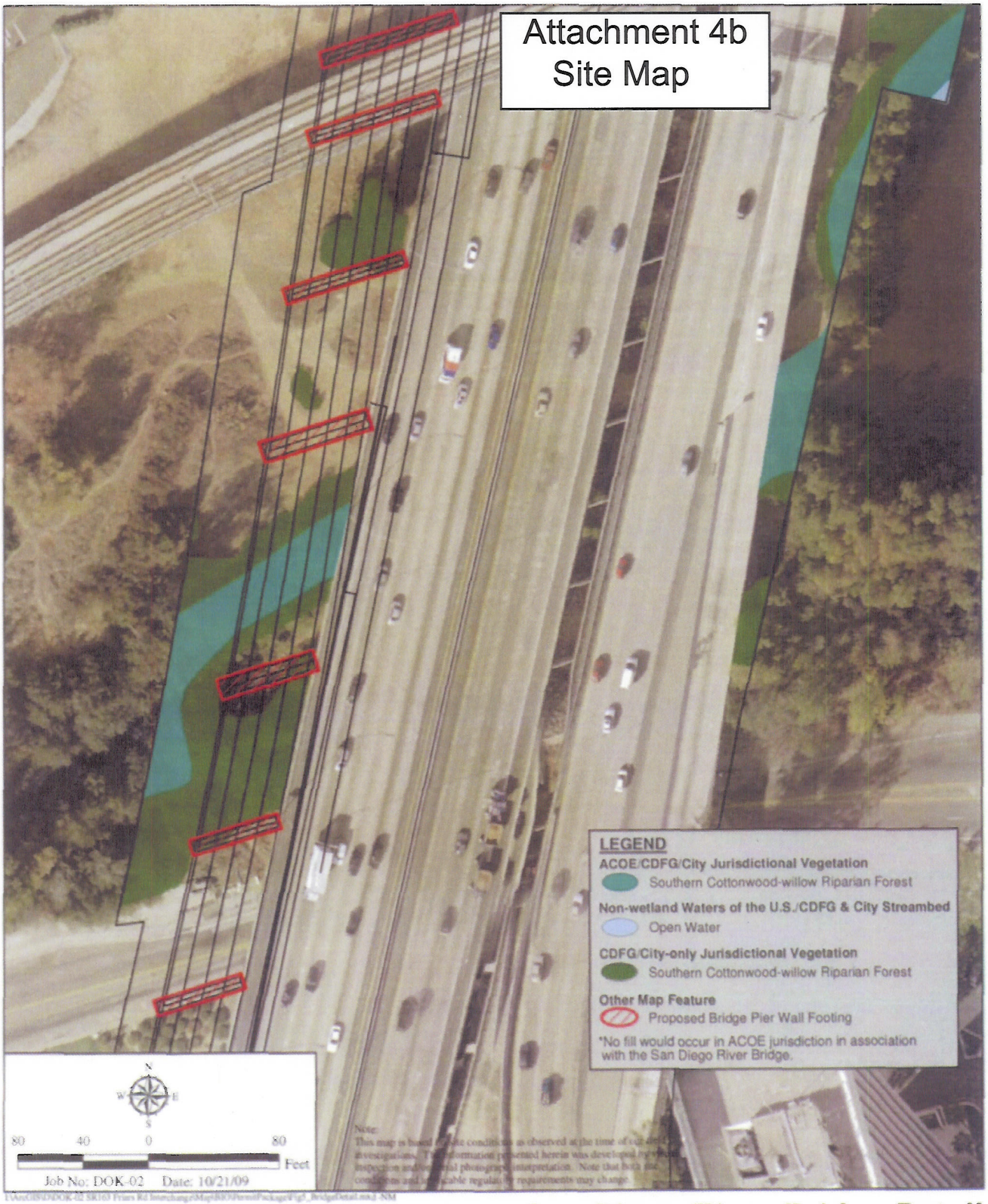
SR 163/FRIARS ROAD INTERCHANGE PROJECT

HELIX

Figure 2

12/29/2009

Attachment 4b
Site Map

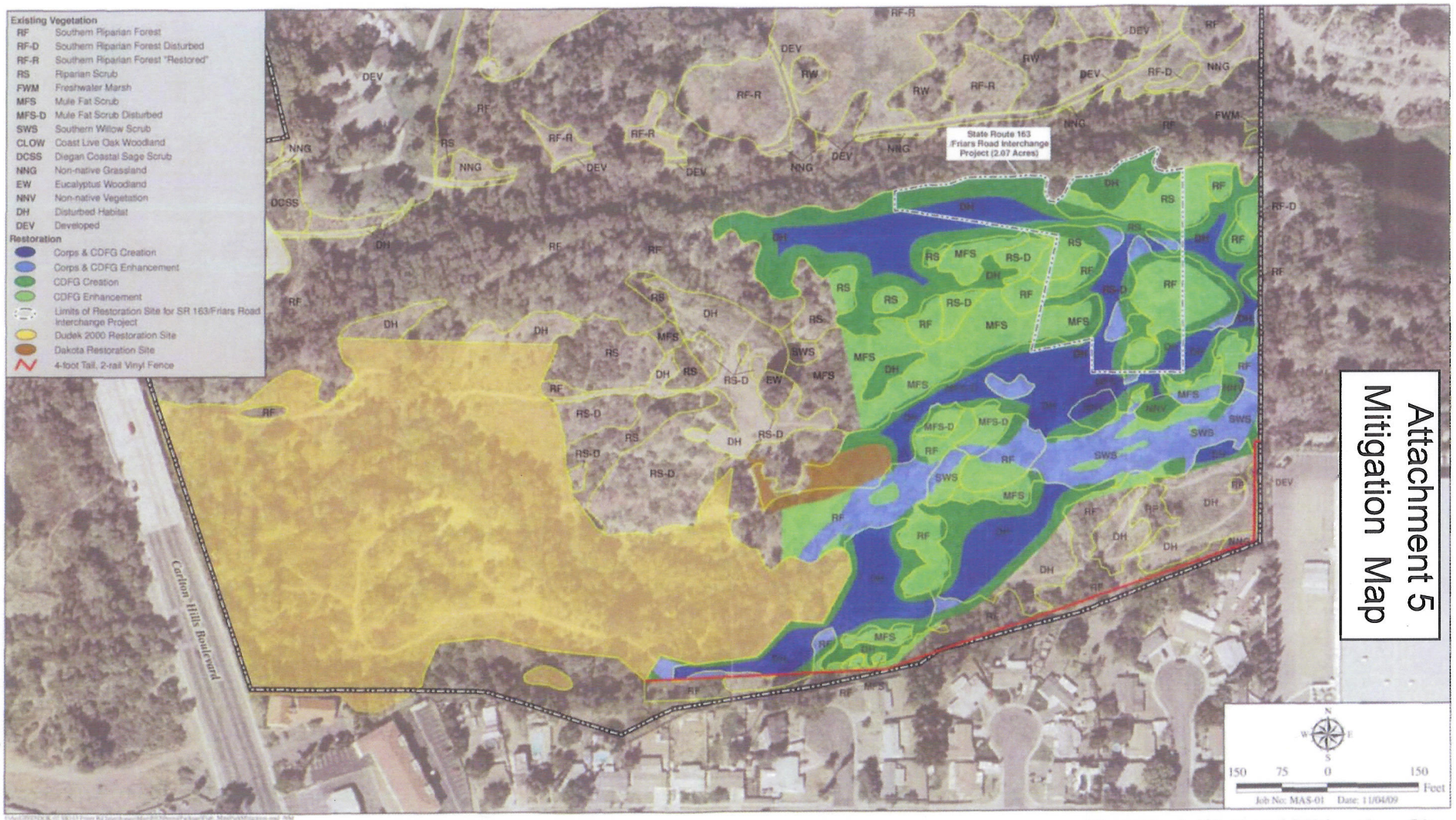


San Diego River Bridge Detail

SR 163/FRIARS ROAD INTERCHANGE PROJECT

Figure 5

12/29/2009



Attachment 5
Mitigation Map

Mast Park Wetland Mitigation Site

SR 163/FRIARS ROAD INTERCHANGE PROJECT

Figure 6

HELIX

California Natural Resources Agency
DEPARTMENT OF FISH AND GAME
South Coast Region
4949 Viewridge Avenue
San Diego, California 92123
(858) 467-4201
www.dfg.ca.gov

ARNOLD SCHWARZENEGGER, Governor
JOHN McCAMMAN, Director

December 1, 2010

Mr. Mark Koll
City of San Diego
Engineering & Capital Projects Department
600 B Street, Suite 800/MS908A
San Diego, California 92101

Subject: Final Lake or Streambed Alteration Agreement
Notification No. 1600-2009-0381-R5
SR 163/Friars Road Interchange Project

Dear Mr. Koll:

Enclosed is the final Streambed Alteration Agreement (Agreement) for the SR 163/Friars Road Interchange Project (Project). Before the Department of Fish and Game (Department) may issue an Agreement, it must comply with the California Environmental Quality Act (CEQA). In this case, the Department, acting as a responsible agency, filed a notice of determination (NOD) on the same date it signed the Agreement. The NOD was based on information contained in the Environmental Impact Report the lead agency prepared for the Project.

Under CEQA, filing a NOD starts a 30-day period within which a party may challenge the filing agency's approval of the project. You may begin your project before the 30-day period expires if you have obtained all necessary local, state, and federal permits or other authorizations. However, if you elect to do so, it will be at your own risk.

If you have any questions regarding this matter, please contact Ms. Kelly Fisher at (858) 467-4207 or kfisher@dfg.ca.gov.

Sincerely,

Stephen M. Juarez
Environmental Program Manager

CALIFORNIA DEPARTMENT OF FISH AND GAME
SOUTH COAST REGION
4949 VIEWRIDGE AVENUE
SAN DIEGO, CALIFORNIA 92123

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2009-0381-R5
SAN DIEGO RIVER

CITY OF SAN DIEGO - ENGINEERING & CAPITAL PROJECTS DEPARTMENT
SR 163/FRIARS ROAD INTERCHANGE PROJECT

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Game (DFG) and Mark Koll, representing City of San Diego - Engineering and Capital Projects Department (Permittee).

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) section 1602, Permittee notified DFG on December 28, 2009, that Permittee intends to complete the project described herein.

WHEREAS, pursuant to FGC section 1603, DFG has determined that the project could substantially adversely affect existing fish or wildlife resources and has included measures in the Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed the Agreement and accepts its terms and conditions, including the measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the project in accordance with the Agreement.

PROJECT LOCATION

The project is located within the bed, channel, bank, and associated wetland and/or riparian vegetation ("stream zone") of the San Diego River and an unnamed tributary thereto, in the County of San Diego, State of California; Township 16 South, Range 3 West, SBM; U.S. Geological Survey (USGS) map: La Jolla. More specifically, project activities will occur in an approximately 100-foot construction corridor within the stream zone of the San Diego River located immediately west of the existing SR163 bridge (Latitude 32.7671917 N, Longitude -117.1628722 W; Assessors Parcel Number 437-291-16 and 437-291-29) and within the stream zone of an unnamed tributary to the San Diego River located east of Ulrich Street and north of the existing southbound SR 163 onramp (Latitude 32.7719278 N, Longitude -117.1631028 W; Assessors Parcel Number 437-220-06 and 437-220-07).

PROJECT DESCRIPTION

The project is limited to the construction of a bridge crossing the San Diego River and the installation of fill in an unnamed tributary to the San Diego River to accommodate construction of a flyover bridge connecting Ulrich Street to southbound SR 163.

The new bridge crossing the San Diego River will be an independent structure just west of the existing bridges. It will be designed to pass 100-year flood events, and will be supported on pier walls (above-ground structures) and pile foundations (below-ground structures). Piles will be pounded into the ground to the appropriate depth, and will have footings approximately three feet deep and six feet wide constructed at the top of the below-ground piles. An excavation approximately 10 feet wide will be made for the pier footings, except that the footings for the two piers located on either side of the river's low-flow channel will be 10 feet wide with an excavation width of 12 feet. Pier walls for the spans over the river will be approximately two feet thick, and would range from 160 to 260 feet long (including the existing pier walls), parallel to the direction of river flow. The footings and piers will be constructed in line with the existing footings and piers on the existing bridge.

The flyover bridge will be constructed to cross over Friars Road and the southbound SR 163 connector lanes that exit to westbound I-8/Hotel Circle North. Grading for this structure will extend into the southern willow scrub located at the existing intersection. Temporary impacts to accommodate remedial grading, excavation equipment stationing, vehicle turn areas, and incidental edge effects also may occur. Temporary impacts to southern willow scrub along Ulrich Street will consist of temporary fill to allow for adjacent construction.

PROJECT IMPACTS

Existing fish or wildlife resources the project could substantially adversely affect include: AMPHIBIANS - western toad *(Bufo boreas)*, Pacific treefrog *(Hyla regilla)*; REPTILES - common side-blotched lizard *(Uta stansburiana)*, western fence lizard *(Sceloporus occidentalis)*, granite spiny lizard *(Sceloporus orcutti)*, orange-throated whiptail *(Aspidoscelis hyperytha)*, gopher snake *(Pituophis catenifer)*; BIRDS - double-crested cormorant *(Phalacrocorax auritus)*, great blue heron *(Ardea herodias)*, green heron *(Butorides virescens)*, great egret *(Ardea alba)*, turkey vulture *(Cathartes aura)*, mallard *(Anas platyrhynchos)*, red-shouldered hawk *(Buteo lineatus)*, red-tailed hawk *(Buteo jamaicensis)*, Cooper's hawk *(Accipiter cooperii)*, American kestrel *(Falco sparverius)*, California quail *(Callipepla californica)*, American coot *(Fulica americana)*, killdeer *(Charadrius vociferous)*, mourning dove *(Zenaida macroura)*, great horned owl *(Bubo virginianus)*, white-throated swift *(Aeronautes saxatalis)*, black-chinned hummingbird *(Archilochus alexandri)*, Costa's hummingbird *(Calypte costae)*, Anna's hummingbird *(Calypte anna)*, downy woodpecker *(Picoides pubescens)*, Nuttall's woodpecker *(Picoides nuttallii)*, ash-throated flycatcher *(Myiarchus cinerascens)*, Cassin's kingbird *(Tyrannus vociferans)*, western kingbird *(Tyrannus verticalis)*, western wood-pewee *(Contopus sordidulus)*, Pacific-slope flycatcher *(Empidonax difficilis)*, black phoebe

(Sayornis nigricans), Hutton's vireo *(Vireo huttoni)*, western scrub-jay *(Aphelocoma californica)*, common raven *(Corvus corax)*, American crow *(Corvus brachyrhynchos)*, cliff swallow *(Petrochelidon pyrrhonota)*, northern rough-winged swallow *(Stelgidopteryx serripennis)*, bushtit *(Psaltriparus minimus)*, house wren *(Troglodytes aedon)*, Bewick's wren *(Thryomanes bewickii)*, western bluebird *(Sialia mexicana)*, American robin *(Turdus migratorius)*, wrentit *(Chamaea fasciata)*, northern mockingbird *(Mimus polyglottos)*, phainopepla *(Phainopepla nitens)*, common yellowthroat *(Geothlypis trichas)*, Wilson's warbler *(Wilsonia pusilla)*, yellow-breasted chat *(Icteria virens)*, orange-crowned warbler *(Vermivora celata)*, yellow warbler *(Dendroica petechia)*, yellow-rumped warbler *(Dendroica coronata)*, song sparrow *(Melospiza melodia)*, spotted towhee *(Pipilo maculates)*, California towhee *(Pipilo crissalis)*, blue grosbeak *(Passerina caerulea)*, black-headed grosbeak *(Pheucticus melanocephalus)*, Bullock's oriole *(Icterus bullockii)*, hooded oriole *(Icterus cucullatus)*, brown-headed cowbird *(Molothrus ater)*, red-winged blackbird *(Agelaius phoeniceus)*, Brewer's blackbird *(Euphagus cyanocephalus)*, American goldfinch *(Carduelis tristis)*, lesser goldfinch *(Carduelis psaltria)*, house finch *(Carpodacus mexicanus)*; MAMMALS - desert cottontail *(Sylvilagus audubonii)*, San Diego black-tailed jackrabbit *(Lepus californicus bennettii)*, Belding's ground squirrel *(Spermophilus beldingi)*, California ground squirrel *(Spermophilus beecheyi)*, pocket gopher *(Thomomys* sp.*)*, woodrat *(Neotoma* sp.*)*, coyote *(Canis latrans)*, raccoon *(Procyon lotor)*, striped skunk *(Mephitis mephitis)*; and all other aquatic and wildlife resources in the project vicinity.

The adverse effects the project could have on the fish or wildlife resources identified above include: loss of habitat resulting from permanent impacts to 0.15 acre southern willow scrub, 0.23 acre southern cottonwood willow riparian forest, and 0.12 acre streambed and temporary impacts to 0.11 acre southern willow scrub, 0.20 acre southern cottonwood willow riparian forest, and 1.11 acre streambed.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative requirement described below.

1.1 Documentation at Project Site. Permittee shall make the Agreement, any extensions and amendments to the Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the project site at all times and shall present same to DFG 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 the Agreement and any extensions and amendments to the 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 DFG if Permittee determines or learns that a provision in the Agreement might conflict with a provision imposed on the project by another local, state, or federal agency. In that event, DFG shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that DFG personnel may enter the project site at any time to verify compliance with the Agreement.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each measure listed below.

2.1 Delineate Work Area. Work area boundaries shall be delineated by posting signs, staking, flagging, erecting temporary fencing, or otherwise clearly marking to minimize surface and vegetation disturbance. No paint or permanent discoloring agents shall be applied to rocks or vegetation to indicate limits of survey or construction activity where any sensitive biological resources occur. All temporary fencing and flagging shall be removed at the conclusion of construction activities.

2.2 Vegetation Removal Seasonal Restrictions. The Permittee shall not remove vegetation within the stream zone from January 15 to September 15 to avoid impacts to nesting birds. However, the Permittee may remove vegetation during this time if a qualified biologist conducts a survey for nesting birds within three days prior to the vegetation removal, and ensures no nesting birds shall be impacted by the project. Surveys for raptor nests shall include the areas within 500 feet of the edge of the proposed impact area(s). If active raptor nests are found, a fence barrier shall be erected a minimum 500 feet (radius) from the nest site. No habitat removal or any other work shall occur within the fenced nest zone even if the nest continues active beyond September 15. No work shall occur within the fenced zone until the young have fledged and are no longer being fed by the parents. The Permittee shall submit the mapped survey results to DFG for review and approval prior to vegetation removal to ensure full avoidance measures are in place.

2.3 Cover Trenches and Other Hazards. All steep-walled trenches or excavations used during the project shall be covered at all times except when being actively used, to prevent entrapment of wildlife (e.g. reptiles and small mammals). If trenches can not be covered, exclusion fencing shall be installed around the trench or excavation. Open trenches, or other excavations, shall be inspected by the qualified biologist immediately before backfilling. All employees, contractors, or visitors shall look under their vehicles and equipment before movement. If wildlife is observed, no vehicles or equipment would be moved until the animal has left the area voluntarily or can be moved by a qualified biologist.

2.4 Movement of Rock, Gravel and Other Materials. Rock, gravel, and/or other materials shall not be imported to, taken from or moved within the bed or banks of the stream except as otherwise addressed in this Agreement.

2.5 Temporary Fills. Temporary fills shall be constructed of nonerodible materials and shall be removed immediately upon work completion.

2.6 Authorized Structures. This Agreement does not authorize the construction of any temporary or permanent dam, structure, flow restriction or fill except as described in the Permittee's notification.

2.7 Impairment of Water Flow. Installation of bridges, culverts, dip crossings, or other structures shall be such that water flow is not impaired. Bottoms of temporary culverts shall be placed at stream channel grade and bottoms of permanent culverts shall be placed at or below stream channel grade.

2.8 Storm Drains and Culverts. Storm drain lines/culverts shall be adequately sized to carry peak storm flows for the drainage to outfall structures. The storm drain lines/culverts and the outfall structures shall be properly aligned within the stream and otherwise engineered, installed and maintained, to assure resistance to washout, and to erosion of the stream bed, stream banks and/or fill. Water velocity shall be dissipated at all outfalls, to reduce erosion.

2.9 Equipment and Vehicle Spills and Contaminants. Any equipment or vehicles driven and/or operated within or adjacent to the stream shall be checked and maintained daily, to prevent leaks of materials that if introduced to water could be deleterious to aquatic life. The Permittee shall maintain all vehicles and equipment in proper working condition to minimize fugitive emissions and accidental spills from motor oil, antifreeze, hydraulic fluid, grease, or other fluids or hazardous materials. All fuel or hazardous waste leaks, spills, or releases shall be stopped or repaired immediately and cleaned up at the time of occurrence. The Permittee shall be responsible for spill material removal and disposal to an approved offsite landfill and spill reporting to the permitting agencies. Service construction equipment shall be stored at designated areas only. Service/maintenance vehicles shall carry appropriate equipment and materials to isolate and remediate leaks or spills. A spill containment kit shall be available onsite for all fueling, maintenance, and construction activities.

2.10 Drip Pans. Stationary equipment such as cranes, motors, pumps, generators, and welders located within or adjacent to the stream shall be positioned over drip pans.

2.11 Keep Polluted Water from Entering Stream Zone. Water containing mud, silt, or other pollutants from aggregate washing or other activities shall not be allowed to enter a flowing stream or placed in locations that may be subject to high storm flows.

2.12 Keep Pollutants Out of Stream Zone. No debris, soil, silt, sand, bark, slash, sawdust, rubbish, construction waste, cement or concrete or washings thereof, asphalt, paint, oil or other petroleum products, or any other substances/materials associated with any project-related activity shall be allowed to contaminate the soil and/or enter into or be placed where they may be washed by rainfall or runoff into a stream or lake. Any of these substances/materials, placed within or where they may enter a stream or lake, by the Permittee or any party working under contract, or with the permission of the Permittee, shall be removed immediately upon observation of their presence. When operations are completed, any excess materials or debris shall be removed from the work area.

2.13 150-Foot High Water Mark. No rubbish shall be deposited within 150 feet of the high water mark of any stream.

2.14 Location of Storage/Staging Areas. Staging/storage areas for equipment and materials shall be located north of the existing trolley line, and any equipment and materials within this area shall be relocated during any storm event in which river flows encroach into this area.

2.15 No Equipment Maintenance in Stream Zone. No equipment maintenance shall be done within or near any stream/lake where petroleum products or other pollutants from the equipment may enter these areas under any flow.

2.16 Restoration of Stream Zone to Pre-Project Conditions. The Permittee shall restore all areas within the stream zone temporarily impacted by construction. If a stream channel has been altered during the operations, its low flow channel shall be returned as nearly as possible to pre-project conditions without creating a possible future bank erosion problem, or a flat wide channel or sluice-like area. Restoration shall include the revegetation of stripped or exposed areas with vegetation native to the area. No long-term maintenance or monitoring of the vegetation is required, beyond the initial 90-day installation period.

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 measure listed below.

3.1 Mitigation for Authorized Impacts. The Permittee shall mitigate the permanent impacts to 0.15 acre southern willow scrub and 0.23 acre southern cottonwood willow riparian forest and temporary impacts to 0.11 acre southern willow scrub and 0.20 acre southern cottonwood willow riparian forest at a 3:1 replacement-to-impact ratio (with a minimum 1:1 creation component) through the creation of 0.69 acre riparian scrub/forest habitat and the enhancement (or any combination of enhancement, restoration, and creation) of 1.38 acres riparian scrub/forest habitat at the Mast Park wetland mitigation site, located east of Carlton Hills Boulevard and north of Willow Grove Avenue in the City of Santee. The mitigation shall be

installed, maintained, and monitored as described in the *Mast Park Wetland Habitat Restoration Plan*, prepared by HELIX Environmental Planning, Inc. and dated November 20, 2009, and shall meet the success criteria therein. The reference site used to evaluate the success of the mitigation shall be approved by DFG.

3.2 Mitigation for Unauthorized Impacts. The Permittee shall mitigate at a minimum 5:1 ratio for impacts beyond those authorized in this Agreement. In the event that additional mitigation is required, the type of mitigation shall be determined by DFG and may include creation, restoration, enhancement and/or preservation.

3.3 Time Restrictions and Consequences. All mitigation shall be installed within nine months of project initiation. Any delay in the installation of mitigation will require an amendment to this Agreement and may result in the application of higher mitigation ratios than are currently required by this Agreement to offset the additional temporal loss of habitat function.

3.4 Release Criteria. The Permittee shall not be released from their maintenance and monitoring obligations until such time as the Permittee has requested and received written concurrence from DFG that the success criteria have been met.

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 Mitigation Site As-Built Report. The Permittee shall submit a report to DFG within 45 days of completion of site preparation and planting, acknowledging the completion of the installation phase and documenting the as-built status of the mitigation project. The report shall include a plan or map diagram showing the mitigation area and the final as-built locations of plantings, irrigation, and other installations. Photographs from representative vantage points shall also be included to document the final site conditions.

4.2 Annual Mitigation Monitoring Report. The Permittee shall submit an annual mitigation monitoring report to DFG by January 1 of each year for 5 years after the mitigation installation. This report shall include an evaluation of the site as compared to the success criteria, the number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters. Photographs from designated photograph stations shall be included.

CONTACT INFORMATION

Any communication that Permittee or DFG 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 DFG specifies by written notice to the other.

To Permittee:

Mark Koll
City of San Diego - Engineering & Capital Projects Department
600 B Street, Suite 800/MS 908A
San Diego, California 92101
mkoll@sandiego.gov

To DFG:

Department of Fish and Game
South Coast Region
4949 Viewridge Avenue
San Diego, California 92123
Attn: Lake and Streambed Alteration Program
Notification #1600-2009-0381-R5
Fax: (858) 467-4299

LIABILITY

Permittee shall be solely liable for any violations of the 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 the Agreement authorizes.

This Agreement does not constitute DFG'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

DFG may suspend or revoke in its entirety the 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 the Agreement.

Before DFG suspends or revokes the 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 DFG suspends or revokes the 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 DFG to issue the notice.

ENFORCEMENT

Nothing in the Agreement precludes DFG from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking the Agreement.

Nothing in the Agreement limits or otherwise affects DFG'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 the Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

DFG may amend the Agreement at any time during its term if DFG determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend the Agreement at any time during its term, provided the amendment is mutually agreed to in writing by DFG and Permittee. To request an amendment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of the 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 DFG approves the transfer or assignment in writing.

The transfer or assignment of the Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one extension of the Agreement, provided the request is made prior to the expiration of the Agreement's term. To request an extension, Permittee shall submit to DFG a completed DFG "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5). DFG shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend the Agreement prior to its expiration, Permittee must submit a new notification and notification fee before beginning or continuing the project the Agreement covers (Fish & G. Code, § 1605, subd. (f)). .

EFFECTIVE DATE

The Agreement becomes effective on the date of DFG's signature, which shall be: 1) after Permittee's signature; 2) after DFG 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.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall expire on October 31, 2015, unless it is terminated or extended before then. All provisions in the 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 the Agreement expires or is terminated, as FGC section 1605(a)(2) requires.

AUTHORITY

If the person signing the 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 the Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify DFG in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all provisions contained herein.

FOR CITY OF SAN DIEGO - ENGINEERING AND CAPITAL PROJECTS DEPARTMENT

Mark Koll — 11/16/10

Mark Koll
Date

Title: Project Manager

FOR DEPARTMENT OF FISH AND GAME

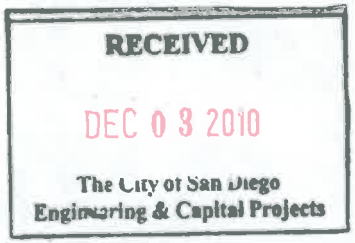
1 Dec 2010

Stephen M. Juarez
Date

Environmental Program Manager

Prepared by: Kelly Fisher
Environmental Scientist

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME
4949 VIEWRIDGE AVE.
SAN DIEGO, CA 92123-1662



City of San Diego
Attn: Mark Koll
600 B St., Ste. 800/MS908A
San Diego, CA 92101

FOR DEPARTMENT USE ONLY				
Date Received	Fee Enclosed	Approved?	Date Approved	Expiration Date
10/22/15	$245.50	✓ Yes ☐ No	11/23/15	10/31/2020

KELLY FISHER

STATE OF CALIFORNIA

DEPARTMENT OF FISH AND WILDLIFE

REQUEST TO EXTEND

LAKE OR STREAMBED ALTERATION AGREEMENT

Complete EACH field and attach additional pages if necessary. Please refer to the fee schedule and submit the correct fee with extension request.

1. APPLICANT REQUESTING EXTENSION

If the applicant is a business, agency, or utility, please include the name of the applicant's representative, who should be an employee of the applicant.

Name	Contact: Jeff Manchester		
Business/Agency	City of San Diego - Public Works Department, Right of Way Design		
Street Address	525 B Street, Suite 750/MS 908A		
City, State, Zip	San Diego, CA 92101		
Telephone	(619) 533-4661	Fax	
Email	jmanchester@sandiego.gov		

2. PROJECT INFORMATION

Agreement number	1600-2009-0381-R5
Original expiration date	October 31, 2015
New expiration date requested	October 31, 2020

Specify: 1) the work that has been completed; 2) the work that needs to be completed; and 3) the amount of time needed to complete the work.

(1) No work has been completed to date.
(2) Work to be completed includes construction of a bridge crossing the San Diego River and installation of fill in an unnamed tributary to the San Diego River to accommodate construction of a new flyover bridge to connect Ulric Street to southbound SR 163. The approximately 60-foot-wide bridge over the San Diego River would accommodate three southbound travel lanes, directing traffic to westbound I-8/Hotel Circle North. The proposed structure would be supported on pier walls (above-ground structures) and pile foundations (below-ground structures). The footings and piers will be constructed in line with the existing footings and piers on the existing bridge. Grading for the flyover bridge will extend into southern willow scrub adjacent to Ulric Street. Temporary impacts to accommodate remedial grading, excavation equipment stationing, vehicle turn areas, and incidental edge effects also may occur.
(3) Work is anticipated to be completed in fall of 2020.

Continued on additional page(s)

2. PROJECT INFORMATION, continued.

Specify the reason(s) for the extension request

An extension is being requested due to a delay in project implementation resulting from a funding shift. In early 2014, $12 million of TransNet funding was shifted from fiscal year 2014/2015 to fiscal year 2015/2016, causing a delay in projected construction. Project construction is now scheduled to begin in September 2016.

☐ Continued on additional page(s)

Note: The Department may not process this extension request until the extension fee has been received.

3. SIGNATURE

I hereby certify that to the best of my knowledge the information in this extension request ("request") is true and correct and that I am authorized to sign this request as, or on behalf of, the applicant. I understand that if any information in this request is found to be untrue or incorrect, the Department may suspend processing this request. I understand also that if any information in this request is found to be untrue or incorrect, I and/or the applicant may be subject to civil or criminal prosecution.

[redacted]

Signature of Applicant or Applicant's Authorized Representative

10/19/15

Date

Jeffrey Manchester, City of San Diego Public Works Department

Print Name

Note: If approved, a copy of this form must be available at the work site with the original agreement.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
South Coast Region
3883 Ruffin Road
San Diego, CA 92123
(858) 467-4201
www.wildlife.ca.gov

EDMUND G. BROWN, Jr., Governor
CHARLTON H. BONHAM, Director

November 23, 2015

Mr. Jeff Manchester
City of San Diego – Public Works Department, Right of Way Design
525 B Street, Suite 750/MS 908A
San Diego, California 92101

Subject: Extension of Lake or Streambed Alteration Agreement
Notification No. 1600-2009-0381-R5
SR 163/Friars Road Interchange Project

Dear Mr. Manchester:

The California Department of Fish and Wildlife (Department) received your request to extend Lake or Streambed Alteration Agreement (Agreement) and extension fee, for the above referenced agreement. The Department hereby grants your request to extend the Agreement expiration from October 31, 2015 to October 31, 2020. All other conditions in the original Agreement remain in effect.

Copies of the original Agreement and this letter must be readily available at project worksites and must be presented when requested by a Department representative or other agency with inspection authority.

If you have any questions regarding this matter, please contact Kelly Fisher at (858) 467-4207 or kelly.fisher@wildlife.ca.gov.

Sincerely,

Marilyn J. Fluharty
Senior Environmental Scientist

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

FOUNDATION REPORT

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT FRIARS ROAD OVERCROSSING (WIDEN) (BRIDGE NO. 57-0595) 11-SD-163-PM 4.4 CONTRACT NO. 11-085781 SAN DIEGO, CALIFORNIA

PREPARED FOR

DOKKEN ENGINEERING
SAN DIEGO, CALIFORNIA

NOVEMBER 30, 2012
REVISED JANUARY 16, 2014
PROJECT NO. G1447-52-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G1447-52-01
November 30, 2012
Revised January 16, 2014

Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Attention: Mr. Gerard Lumabas

Subject: FOUNDATION REPORT
FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
FRIARS ROAD OVERCROSSING (WIDEN)
(BRIDGE NO. 57-0595)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

In accordance with your request, we herein submit our Foundation Report (FR) for the proposed widening of the existing Friars Road Overcrossing at State Route 163 in the City of San Diego, California. The accompanying report presents the findings and conclusions from our study.

Please contact the undersigned at your convenience if you have any questions regarding this FR or if we may be of further service.

Very truly yours,

GEOCON CONSULTANTS, INC.

Joseph J. Vettel
GE 2401

Yong Wang
GE 2775

YW:JJV:dmc

(e-mail)

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FOUNDATION REPORT

1. INTRODUCTION

This Foundation Report (FR) was prepared for the proposed widening of the existing Friars Road Overcrossing (OC) at State Route (SR) 163 in the City of San Diego, California. The approximate site location is depicted on the Vicinity Map, Figure 1. This FR is based on subsurface exploration and laboratory tests performed by Southern California Soil and Testing (SCS&T), Inc. The purpose of the investigation was to evaluate general subsurface geologic and geotechnical conditions along the proposed OC widening and to provide geotechnical recommendations for use in preparing project plans and specifications.

The recommendations presented herein are based on our review of the subsurface and laboratory data obtained by SCS&T, engineering analyses, and our experience with similar soil and geologic conditions. The logs of test boring (LOTB) sheets in Caltrans format, as-built plans and LOTB sheets, laboratory test results, and analyses and calculations are presented as Appendices A, B, C, and D, respectively.

2. SCOPE OF SERVICES

We performed the following scope of services:

- Reviewed published geologic maps, aerial photographs, as-built plans, project plans, in-house documents, and other literature pertaining to the site to aid in evaluating geologic conditions and hazards that may be present.
- Reviewed as-built plans for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed as-built plans for Friars Road OC Earthquake Retrofit Project No. 272 prepared by the California Department of Transportation, dated December 9, 1997.
- Reviewed as-built LOTB sheet for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed the Geotechnical Design Report for SR 163/Friars Road Interchange Modification Project performed by SCS&T.
- Reviewed the Structure Foundation Investigation for Friars Road at SR 163 Interchange Project (Bridge No. 57-0595) prepared by SCS&T.
- Reviewed the project plans prepared by T. Y. Lin International for the Friars Road OC Widening project.
- Reviewed subsurface data and laboratory test results performed by SCS&T.

- Performed engineering analyses to evaluate liquefaction potential, seismic design criteria, and foundation design criteria.

- Prepared this FR in general accordance with Caltrans' *Foundation Report Preparation for Bridge Foundations*, December 2009.

SCS&T prepared a *Structure Foundation Investigation* for the project (Friars Road Overcrossing [Widen]) dated July 2009. This FR supersedes the Structure Foundation Investigation for the project.

3. PROJECT DESCRIPTION

3.1 Background and Site Description

The project site is located approximately ½ mile north of Interstate 8 on the SR 163 corridor in the City of San Diego, California. The approximate site coordinates are 32.771560° (latitude) and -117.161362° (longitude).

The proposed improvements are part of the Friars Road and SR 163 Interchange Improvements project. The Vicinity Map, Figure 1, shows the approximate location of the site with respect to surrounding improvements. Based on the current plans and project information, the existing OC structure will be widened.

3.2 Existing Structures

The SR 163 corridor is oriented in a north-south direction and Friars Road crosses over SR 163 in an east-west direction. At the existing OC structure, SR 163 is comprised of a divided highway with four northbound (NB) lanes and four southbound (SB) lanes. Based on the as-built plans, the existing Friars Road OC (Bridge No. 57-0595) is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments and intersects SR 163 at an approximate skew angle of 35°20'24". The bridge was constructed in 1970 and seismically retrofitted in 1996. The existing OC structure extends 390 feet from approximately Station (Sta.) 17+52 to approximately Sta. 21+42 along the original Friars Road centerline ('F' Line). The OC is approximately 114 feet wide and accommodates three 12-foot lanes, a 5-foot-wide outside shoulder in each direction, a 4-foot-wide sidewalk along the eastbound (EB) direction with metal railing, and a slightly raised concrete median with varying widths. The existing Abutments 1 and 3 are supported on a combination of vertical and battered driven steel H-piles (HP 10x57) with average pile tip elevations of 19.8 feet and 14.4 feet above mean sea level (MSL), respectively. The existing bent is supported on driven steel H-piles (HP 10x57) with an average pile tip elevation of 15.1 feet above MSL. However, the subsequent seismic retrofit consisted of increasing the size of the pile caps at Bent 2 and installing higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations were modified as part of the seismic retrofit.

All elevations used in this report are based on the current project plans that refer to the current datum of NAD83 and NAVD88. We understand that the as-built plans of this project were based on the original datum of NGVD29. According to conversations with Dokken Engineering, a vertical transformation of +2.10 feet should be applied to convert the original datum (NGVD29) of these as-built plans to the current datum (NAD83 and NAVD88).

3.3 Proposed Structure

Information regarding the proposed structure are based on the *Project Plans for 65% Unchecked Details on Friars Road OC (Widen)* prepared by T. Y. Lin International, dated March 2012, and subsequent communications. We understand the project consists of widening the existing OC approximately 12½ feet on the south side (eastbound direction) and 28½ feet on the north side (westbound direction) to accommodate four lanes in each direction with an approximate total width of 155 feet. The proposed OC widening will match the existing bridge at approximately 390 feet long from approximately Station (Sta.) 63+62 to approximately Sta. 67+51 along the new Friars Road centerline ('FR' Line). The proposed Friars Road OC (widening portions) will be supported by two abutments with associated wingwalls and one interior bent located in line with the existing structure supports. The widened abutments will be supported on Class 140 driven steel H-piles (HP 10x57) similar to the existing abutment foundations while the bent will be supported on 9-foot-diameter cast-in-drilled-hole (CIDH) piles.

Two proposed abutment walls (West Ground Anchor Wall and East Ground Anchor Wall) consisting of a combination of tieback walls and Caltrans Standard Plan Type 1 walls will be located in front of the abutments in order to accommodate the widening of SR 163 underneath the Friars Road OC. Geotechnical design recommendations for the proposed ground anchor walls will be provided in separate reports submitted under separate cover.

3.4 Pertinent Project Information

We reviewed the following documents related to the project:

1. California Department of Transportation, *As-built plans, Friars Road Overcrossing,* dated December 2, 1968.

2. California Department of Transportation, *As-built Log of Test Borings (LOTBs), Friars Road Overcrossing,* dated December 2, 1968.

3. Geocon Incorporated, *Preliminary Recommendation Letter, SR 163/ Friars Road Interchange Project, San Diego, California,* dated September 27, 2012 (Geocon Project No. G1447-52-01).

4. Geocon Incorporated, *Foundation Report, Friars Road / State Route 163 Interchange Project, Friars Road Overcrossing (Widen), (Bridge No. 57-0595), 11-SD-163-PM 3.8/5.5,*

EA 11225-085781, San Diego, California, dated November 30, 2012 (Geocon Project No. G1447-52-01).

5. Geocon Incorporated, *Foundation Report-Memorandum No. 1, Friars Road / State Route 163 Interchange Project, Friars Road Overcrossing (Widen), (Bridge No. 57-0595), 11-SD-163-PM 4.4, Contract No. 11-085781, San Diego, California*, dated January 14, 2014 (Geocon Project No. G1447-52-01).

6. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8*, dated July 23, 2012.

7. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8, Log of Test Borings (LOTBs) Sheets 1, 2, 3, 4, and 14 of 19* ,dated July 23, 2012.

8. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Friars Road at SR 163, Log of Test Borings (LOTBs) Sheet 1 of 1*, dated 2012.

9. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, East Tieback Wall Number 2, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California*, dated May 12, 2010.

10. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, West Tieback Wall Number 1, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California*, dated May 12, 2010.

11. Southern California Soil & Testing, Inc. (SCS&T No. 0311116), *Structure Foundation Investigation, Friars Road at SR163 Interchange, Bridge No. 57-595, 11-SD-163-RO69-84, EA No. 11-085780, San Diego, California* ,dated July 9, 2009.

12. Southern California Soil and Testing, Inc., *Structure Foundation Investigation, Friars Road at SR 163 Interchange (Bridge No. 57-0595),* dated July 9, 2009.

4. EXCEPTIONS TO POLICY

Unless otherwise stated in the report, this report was prepared in general conformance with Caltrans' current policy.

5. FIELD INVESTIGATION AND TESTING PROGRAM

The field investigation for this FR was performed by SCS&T on October 8 and 9, 2003 (Borings A-03-002 and A-03-003) and May 18 (Boring A-12-044), October 3 (Boring A-12-053), and 5 (Boring A-12-054), 2012. These exploratory borings were drilled by SCS&T along the proposed Friars Road OC widening alignment and associated improvements as depicted on the Site Plan, Figure 2. Table 5 is a summary of the field investigation information including approximate boring locations, surface elevations, and boring depths.

TABLE 5
SUMMARY OF BORINGS

Boring No.	Approximate Boring Location				Boring Depth (feet)
	Location in Structure	Station No. / Alignment	Offset (feet)	Elevation (feet)	
A-03-002	Bent 2	244+60 'FR' Line	0R	47.5	35.0
A-03-003	Abut 3	447+20 'FR' Line	185R	59.0	60.0
A-12-044	Abut 3	245+12 'SR 163' Line	176R	76.0	70.0
A-12-053	Bent 2	243+00 'SR 163' Line	4L	43.0	100.0
A-12-054	Abut 1	244+00 'SR 163' Line	200L	57.0	125.0

Five exploratory borings (A-03-002, A-03-003, A-12-044, A-12-053, and A-12-054) were performed by SCS&T to approximate depths of up to 125 feet using a mobile drill rig equipped with 8-inch-diameter, hollow-stem augers.

In-situ testing and sampling during drilling were performed in general conformance with current Caltrans' *Soil and Rock Logging, Classification and Presentation Manual* (2010 Edition). Soil samples were collected from near the ground surface and at approximately 2½- to 5-foot intervals to the total depths explored. Relatively undisturbed samples were obtained by driving a 3-inch outside-diameter (OD), 2.5-inch inside-diameter (ID) split-spoon sampler (Modified California sampler) into the "undisturbed" soil mass with blows from a 140-pound hammer (auto) falling 30 inches. The sampler was equipped with 6-inch-long by 2½-inch-diameter brass sample tubes to facilitate sample removal and laboratory testing. SPTs were performed by driving a 2-inch OD and a 1.4-inch ID split-spoon SPT sampler 18 inches in general accordance with ASTM D1586. The number of blows required to drive the samplers (blow counts) the last 12 inches of the 18-inch sample drive (or portion thereof) are reported on the LOTB sheets prepared by SCS&T (in Caltrans format), which are included in Appendix A.

6. LABORATORY TESTING PROGRAM

SCS&T performed laboratory tests on samples from borings (A-03-002, A-03-003, A-12-044, A-12-053, and A-12-054) in general conformance with California Test Methods (CTM) and generally accepted test methods of the American Society for Testing and Materials (ASTM). Pertinent

laboratory test results from these borings are presented and were used in design purposes within this FR. SCS&T performed the following laboratory tests:

- In-place dry density and moisture content: ASTM D2937 (CTM 226)
- Grain Size Distribution/Percent Passing No. 200 Sieve: ASTM D422
- pH and Resistivity: CTM 643
- Sulfate Content: CTM 417
- Chloride Content: CTM 422
- Consolidation: ASTM D2435
- Direct Shear: ASTM D3080

In-place dry density and moisture content laboratory test results are shown on the LOTBs presented in Appendix A. All other laboratory test results are presented in Appendix C of this report.

7. SITE GEOLOGY AND SUBSURFACE CONDITIONS

7.1 Topography and Geology

Private and commercial properties occupy the area surrounding the Friars Road/SR 163 Interchange. The general topography of the project location is relatively flat with a gentle slope descending from the northwest to the southeast. Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that an existing cut slope comprised of formational material commonly identified as Stadium Conglomerate is located northwest of the existing OC. The slope ranges between about 30 feet and 100 feet in height at inclinations of between about 1:1 (horizontal:vertical) and 1½:1 (horizontal:vertical). At the location of Friars Road/ SR 163 Interchange, embankments for Friars Road and the interchange ramps are raised above the surrounding area where runoff flows into the existing drainage systems. The existing drainage systems include swales, drainage inlets, and storm drains that collect offsite and surface runoff. Most of the existing drainage systems at the project site eventually discharge into the San Diego River, which is located near the southern portion of the project. The San Diego River flows from east to west.

A *Regional Geologic Map* is presented as Figure 3. The site is located in the Coastal Plains physiographic province of San Diego County and is underlain by the Tertiary Friars Formation (Tf), Tertiary Stadium Conglomerate (Tst), Quaternary very old paralic deposits (Qvop), alluvium (Qal), and artificial fill (Qaf) as mapped by Kennedy and Tan (2008). The approximate distribution of these materials at the proposed OC widening, as presented as Figure 4 (Geologic Cross-Section A-A'), is based on SCS&T's surface investigation, LOTBs, and our review of the local geologic and topographic maps.

Existing fill associated with the approach embankments are located on the east and west portions of the site. The thickness of the fill is estimated to be up to approximately 30 feet. Very old paralic deposits cap the mesas/hillsides in the northwestern portion of the project. These deposits consist of well-cemented, poorly sorted, cobble in siltstone and sandstone matrices. We expect that cobbles up to 12 inches in diameter exist within the very old paralic deposits. Quaternary alluvium associated with the San Diego River plain (Mission Valley) and the tributary drainage canyons that connect with the river plain underlie most of the site. The thickness of the alluvium is anticipated to exceed 80 feet toward the southern portion of the site and decreases near the hillsides. The alluvium consists of interbedded layers of sand, gravel, cobble, and clay. We expect that cobbles up to 12 inches in diameter also exist within the Quaternary alluvium. The Stadium Conglomerate is the primary bedrock unit underlying the very old paralic deposits in the north and alluvial deposits in the southern portion of the project. The conglomerate is exposed in cut slopes on the site. The Stadium Conglomerate is comprised of sandy cobble with cross-bedded lenses of medium to coarse sandstone. Boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate. Locally, the Stadium Conglomerate is moderately to well-cemented. The Friars Formation underlies the Stadium Conglomerate within the San Diego River Plain. The Friars Formation is comprised of non-marine and lagoonal sandstone interbedded with layers of siltstone and claystone. The Friars Formation contains zones of varying degrees of cementation. The Stadium Conglomerate and Friars Formation were not observed to outcrop on the site.

7.2 Types of Soil and Rock

Based on the results of the previous investigation performed by SCS&T, the study area is generally underlain by fill and alluvium overlying Stadium Conglomerate and Friars Formation. The LOTBs from SCS&T are in general agreement of the types of soil material encountered at the study area. The fill material generally consists of medium dense to very dense silty gravel, poorly-graded gravel, clayey sand, and silty sand with varying amounts of silt, sand, and cobbles. The alluvial soils generally consist of medium dense to very dense clayey sand, poorly-graded sand, clayey gravel, and silty sand with varying amounts of gravel and sand as well as stiff sandy lean clay overlying stadium conglomerate (sedimentary rock conglomerate) and friars formation (sedimentary rock sandstone and claystone).

Based on previous analyses performed by SCS&T (*Geotechnical Design Report*, July 2009), it was stated that well-cemented zones should be expected within the formational materials. Flowing sands, cobbles, and boulders should be expected during foundation drilling. Construction considerations for the following materials are further described in Section 14 of this report.

7.2.1 Previously Placed Fill and Alluvium

Onsite fill soils were likely placed over existing alluvium during the original construction of the approach embankments for the interchange. The previously placed fill was encountered in all borings (Borings A-03-002, A-03-003, A-12-044, A-12-053, and A-12-054) from the ground surface (approximate Elevations +43 to +76 feet MSL) to approximately 30 feet below ground surface (approximate Elevations +17 to +50.5 feet MSL). Alluvium was encountered in borings (Borings A-03-003, A-12-044, and A-12-053) from below the previously placed fill (approximate Elevations +17 to +50.5 feet MSL) to approximately 41 to 68 feet below ground surface (approximate Elevations -4 to +18 feet MSL). All borings were drilled at the existing Friars Road OC and near the existing embankments of the SR 163 NB loop off-ramp and SB loop on-ramp. The fill and alluvium consists primarily of tan to brown, medium dense to very dense, silty gravel, poorly-graded gravel, clayey sand, silty sand, poorly-graded sand, and clayey gravel with varying amounts of silt, sand, gravel, and cobbles as well as stiff sandy lean clay. We expect that cobbles up to 12 inches in diameter exist within the fill and alluvium material.

Previously placed fill is primarily located within the proposed abutment widening areas. Foundations for the new abutment widening will consist of driven steel H-piles that will extend through the existing fill (where present) and bear within the underlying alluvium and sedimentary bedrock (Stadium Conglomerate and Friars Formation). Therefore, extensive removals of existing fill are not considered necessary to provide suitable foundation support. The alluvium and underlying formational material are considered suitable for support of the proposed OC widening structure and associated wingwalls.

7.2.2 Stadium Conglomerate (Tst) and Friars Formation (Tf)

Stadium Conglomerate and Friars Formation consist of sedimentary rock and was encountered in borings conducted by SCS&T as underlying the fill/alluvial deposits. Stadium Conglomerate was encountered in borings (A-03-002, A-03-003, A-12-044, A-12-053, and A-12-054) from beneath the previously placed fill/alluvial deposits from approximately 14 to 68 feet below ground surface (approximate Elevations -4 to +43 feet MSL) to approximately 35 to 74 feet below ground surface (approximate Elevations -17 to +12.5 feet MSL) . Although boulders were not indicated on the LOTBs, boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate and should be anticipated. Friars Formation was encountered in borings (A-12-053 and A-12-054) underlying the Stadium Conglomerate from approximately 58 to 74 feet below ground surface (approximate Elevations -15 to -17 feet MSL) to maximum explored depths ranging from approximately 100 to 125 feet below ground surface (approximate Elevations -57 to -68 feet MSL).

The Stadium Conglomerate encountered in the borings consists primarily of massive cobble conglomerate and fine-grained massive sandstone. The Friars Formation encountered consists

primarily of fine-grained massive sandstone and massive claystone. These formations generally exhibit good bearing characteristics for support of the proposed OC widening. However, due to the encountered depth to rock of approximately 25 to 68 feet below ground surface at the proposed widening structure support locations, deep foundations will be required in order to provide adequate structural support into formational materials.

7.3 Pertinent Soil Conditions or Geologic Hazards

The following sections discuss other potential geologic hazards evaluated for the project including landslides, embankment failures, ground subsidence, expansive soils, and collapsible soils.

7.3.1 Landslides

Based on previous analyses performed by SCS&T (*Geotechnical Design Report*, July 2009) and the review of the Landslide Hazard Identification Map No. 33 (1995), the project site is located in Landslide Hazard Areas 1, 2, and Subarea 3-1. Area 1 is classified as Least Susceptible to slope instability. Landslides and other features related to slope instability are non-existent to very rare within this area due primarily to lack of steep slopes. Land within Area 1 will probably remain relatively stable unless the topography is radically modified. Area 2 is classified as Marginally Susceptible to slope instability. Area 2 includes gentle to moderate slopes, where slope angles are generally less than 15 degrees. This area includes low-lying bottoms of broad valleys and basins and large elevated surfaces of Pleistocene terrace deposits. Landslides and other slope failures are rare within this area, although slope hazards are possible on some steeper slopes within the area or along its borders. Subarea 3-1 is classified as Generally Susceptible to slope instability and may contain slopes that are at or near their stability limits due to a combination of weak materials and steep slopes. Although most slopes within Area 3-1 do not currently contain landslide deposits, they can be expected to fail, locally, when adversely modified.

No indications of gross, deep-seated, slope failures were noted during SCS&T's geotechnical investigations. The materials comprising the Stadium Conglomerate typically have relatively high shear strengths and are not known to have a potential for deep-seated, gross, slope failure. Thus, the potential for gross, deep-seated, slope failures to affect the proposed OC widening is considered low. However, shallow surficial failures where soil, gravel, and cobble erode from the faces of steep, sparsely vegetated slopes are quite common. The Landslide Hazards Map is presented as Figure 5.

7.3.2 Embankment Failures

No embankment failures were observed during the investigations performed by SCS&T.

7.3.3 Ground Subsidence

Ground subsidence occurs where underlying loose geologic units undergo a densification process. Subsidence can result from the extraction of mineral resources and/or groundwater, as well as the rapid settlement induced by seismic activity. The potential for ground subsidence is considered low at the site.

7.3.4 Expansive Soils

Expansive soils possess a high swelling or shrinking potential due to change in moisture content. The common materials associated with high expansion potential are clays. The majority of the onsite soil is medium- to coarse-grained with varying amounts of fines, gravels, and cobbles and are identified as relatively no to low plasticity. Proposed foundations will be supported below a depth where significant moisture variation is expected. Thus, the potential for expansive soils to affect the proposed foundations is considered low.

7.3.5 Collapsible Soils

Collapsible soils are unsaturated soils that undergo a large volume change upon saturation, even without increase in external loads. Soils that generally display collapsible potential are porous and have a low dry density. Generally no porous or honeycomb structure was reported previously. Surficial soils described as loose will be removed and recompacted as outlined in the recommendations of this report. Thus, the potential for collapsible soils onsite is considered low.

7.4 Depth to Bedrock

The depth to rock-like materials (Stadium Conglomerate and Friars Formation) varies from approximately 14 to 63 feet as illustrated on the LOTB sheets as shown in Appendix A.

7.5 Groundwater

Groundwater was observed in each of the borings at approximate elevations ranging from 18 to 29 feet MSL (approximately 17.5 to 58 feet below ground surface) during SCS&T's investigation. The As-Built LOTB shows groundwater at approximate elevations of 34 and 39 feet MSL. We expect the groundwater to be near the water levels mentioned in the borings at the approximate proposed locations of the bridge and associated wingwalls. The presence of groundwater should be considered and incorporated into the design and construction of proposed foundations.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors. Depth to groundwater can also vary significantly due to localized pumping, irrigation

practices, and seasonal fluctuations. Therefore, it is possible that groundwater may be higher or lower than the levels observed during our investigation.

8. SCOUR EVALUATION

The site is not located in the vicinity of flowing channels or any large bodies of water, so scour is not expected to affect the proposed improvements.

9. CORROSION EVALUATION

Corrosion parameter testing was performed by *SCS&T on seven samples obtained from Borings A-03-002, A-03-003, and A-12-044,* which were selected at random to represent surficial onsite soil for the proposed Friars Road OC widening project.

According to Caltrans' *Corrosion Guidelines* (Version 1.0, September 2003), a site is considered corrosive to foundation elements if chloride concentration is greater than 0.05 percent (%), or sulfate concentration greater than 0.2%, or the potential of hydrogen (pH) is 5.5 or less. Resistivity, pH, chlorides content, and soluble-sulfate content tests were performed on one sample selected at random to generally evaluate the corrosion potential to subsurface structures. These tests were performed in accordance with CTM. 643, CTM 417, and CTM 422. The results are summarized in Table 9, which indicates that the site need not be considered a corrosive environment in accordance with Caltrans criteria. The results are presented in Appendix C and should be considered for design of underground structures.

TABLE 9
SOIL CORROSION TEST SUMMARY

Boring No. / Sample No.	Sample Depth (feet)	Resistivity (ohm centimeters)	pH	Chloride Content (%)	Sulfate Content (%)
A-03-002/1-3.5	1 to 3.5	1,870	8.7	0.001	0.007
A-03-002/12.5	12.5	-	9	-	0.001
A-03-002/26-28	26 to 28	935	8.4	0.015	0.017
A-03-003/1-3.5	1 to 3.5	2,204	8.1	0.007	0.008
A-03-003/32-34	32 to 34	1,336	7.1	0.006	0.025
A-03-003/45	45	-	7.1	0.023	0.016
A-12-044/1-5	1 to 5	1,750	9.2	0.002	0.003

Note: (-) Represents negligible exposure.

Proposed improvements in contact with the ground should be designed and constructed in accordance with Caltrans' *Standard Specifications* and good construction practices. Geocon does not practice in

the field of corrosion engineering. If corrosion sensitive improvements are planned, we recommend that further evaluations by a corrosion engineer be performed to incorporate the necessary precautions to avoid premature corrosion on corrosion sensitive structures in direct contact with the soils.

10. SEISMIC RECOMMENDATIONS

10.1 Faulting

Much of Southern California, including the San Diego County area, is characterized by a series of Quaternary fault zones that typically consist of several individual en echelon faults generally striking in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as active while others are classified as potentially active according to the criteria of the California Geologic Survey. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). Potentially active faults have demonstrated movement during the Pleistocene Epoch (11,000 to 1.6 million years before the present), but no movement during Holocene time.

The fault most likely to have a significant impact on the site is the Newport-Inglewood-Rose Canyon fault (San Diego Section) located approximately 3.5 km southwest of the site.

10.2 Seismic Ground Motion and Design Response Spectrum

Design seismic recommendations including seismic ground motion of the site and the design response spectrum for the bridge widening were developed in accordance with Caltrans' *2009 Seismic Design Procedure*. This procedure is based on current Caltrans' *Seismic Design Criteria (Appendix B), Deterministic PGA Map, ARS Online Report, Geotechnical Services Design Manual,* and USGS probabilistic seismic hazard analysis and tools. Site-specific information used in the procedure included the latitude of 32.771560° and the longitude of -117.161362°.

Based on Caltrans' web-based ARS Online application (V1.0.4) and associated reports, the site is located approximately 3.5 kilometers (km) northeast of Newport-Inglewood-Rose Canyon fault zone, San Diego section (Caltrans Fault ID 224). A portion of the 2007 *Deterministic PGA Map* showing the site and nearby regional faults is presented as Figure 6, Regional Fault Map. Key information for the fault is summarized in Table 10.

TABLE 10
FAULT INFORMATION

Fault Name	Newport-Inglewood-Rose Canyon (San Diego Section)
Fault ID#	224
MMax	7.5
Fault Type	RLSS
Fault Dip	90°
Dip Direction	Vertical
Top of Rupture	0 km
Bottom of Rupture	13 km
R_{RUP}	3.5 km
$Z_{1.0}$	191 m & 241 m*
$Z_{2.5}$	2.0 km

*Z1.0 of 191 m for Vs30 of 420 m/sec, 241 m for Vs30 of 380 m/sec.

The site is not located within a deep sedimentary basin in accordance with Caltrans' *2009 Seismic Design Procedure*. Based on the currently available project plans and LOTB sheets prepared by T. Y. Lin International and SCS&T, respectively, the site is underlain by fill soils and/or alluvial soils over sedimentary formational materials (Stadium Conglomerate and Friars Formation). A shear wave velocity in the upper 30 meters (V_{s30}) of approximately 380 meters per second (m/sec) is considered appropriate for the soil profile at Bent 2 and Abutment 3 locations. For the soil Profile at Abutment 1 location, a V_{s30} of approximately 420 m/sec is considered appropriate.

Both the deterministic and probabilistic response spectrums of the site were estimated using Caltrans' Deterministic Response Spectrum Spreadsheet, Probabilistic Response Spectrum Spreadsheet (after USGS), 2008 USGS National Seismic Hazard Map, and the ARS Online web tools. The design response spectrum is the upper envelope of the spectral values of deterministic response spectrum and the probabilistic response spectrum, as well as the upper envelop of the results for V_{s30} of 380 m/sec and 420 m/sec in this case. The peak horizontal ground acceleration at the site is estimated as 0.48g. The recommended design response spectrum is shown on the Recommended Design Response Spectrum, Figure 7. The seismic analyses and calculations are presented in Appendix D.

10.3 Liquefaction

Liquefaction is a phenomenon in which loose, saturated, and relatively cohesionless soil deposits located beneath the groundwater table lose strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground accelerations, characteristics of the subsurface soil, in-situ stress conditions, and depth to groundwater.

Based on the City of San Diego Seismic Safety Map (2008) as shown on Figure 8, the proposed OC widening and associated wingwalls is located in Geologic Hazard Category 32. Hazard Category 32 represents areas with a low potential for liquefaction underlain by fluctuating groundwater with minor drainages. Based on the LOTBs prepared by SCS&T, the soil material at the site generally consisted of loose to very dense sands, clayey sands, silty sands, gravels, silty and clayey gravels, and stiff lean clay overlying moderately hard sedimentary bedrock (Stadium Conglomerate and Friars Formation). The loose clayey sand layer (approximately 7 feet thick) was only identified in Boring A-03-002 at approximately 6 feet below ground surface with no groundwater present until approximately 20 feet below ground surface. Groundwater in the other borings (A-03-003, A-12-044, A-12-053, and A-12-054) was encountered in dense to very dense clayey sand, silty sand, stiff sandy lean clay, and moderately hard sedimentary rock (Stadium Conglomerate).

We evaluated the potential for liquefaction at the site using methodology of Youd, *et al*. (2001), in general accordance with California Geologic Survey (CGS) *Special Publication 117A* (CGS, 2008). In accordance with Caltrans guidelines, we used the Maximum Credible Earthquake (MCE) Moment Magnitude of 7.5 and Peak Bedrock Acceleration (PBA) of 0.48g in our analysis. Based on the results of our analysis, the potential for liquefaction and associated impacts at the site is considered low.

10.4 Seismic-induced Settlement

As a result of strong ground motions, seismic-induced settlement may be expected in areas underlain by liquefiable soils, unconsolidated alluvial deposits, and/or loose granular soils. The potential for seismic-induced settlement at the site is considered very low due to the presence of primarily medium dense to very dense fill/alluvium over sedimentary bedrock (Stadium Conglomerate and Friars Formation) and the lack of liquefiable soil.

10.5 Tsunami

Tsunamis are large sea waves caused by submarine earthquakes, landslides, or volcanic eruptions. The potential of tsunamis to occur at the site is considered to be very low due to the relatively large distance from the coastline to the site.

10.6 Slope Stability

Planned earthwork will include fill slopes along portions of the approach embankments. Assuming that fill materials meet Caltrans' specifications for structure backfill, 2H:1V (horizontal to vertical) fill slopes should have an adequate factor of safety against deep-seated and shallow failures under static and seismic loading.

11. AS-BUILT FOUNDATION DATA

The existing Friars Road OC is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments. The abutments and bents are supported by driven steel H-piles (HP 10x57).

The existing OC extends approximately 390 linear feet with a typical width of approximately 114 feet. The relevant as-built data available to Geocon are listed below:

1. As-Built Plan, *Earthquake Retrofit Project No. 272, Friars Road Overcrossing, Bridge No. 57-0595,* dated July 29, 1996.

2. As-Built Plan, *General Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 1 of 15,* dated December 2, 1968.

3. As-Built Plan, *Foundation Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 3 of 15,* dated December 2, 1968.

4. As-Built Plan, *Log of Test Borings, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 15 of 15,* dated December 2, 1968.

5. As-Built Plan, *Log of Test Borings, Friars Road Overcrossing, Bridge No. 57-595, Sheet 8 of 8,* dated July 29, 1996.

Based on the available original as-built data, the abutments and bent for the existing OC structure are supported by 65-ton capacity driven steel HP 10x57 piles with average tip elevations of 19.8 feet (Abutment 1), 15.1 feet (Bent 2), and 14.4 feet (Abutment 3) MSL. Approximate pile lengths at Abutment 1 range from approximately 16.5 to 28 feet. Approximate pile lengths at Bent 2 range from approximately 21 to 23.5 feet. Approximate pile lengths at Abutment 3 range from approximately, and 40.5 to 47 feet.

The existing OC structure was seismically retrofitted in 1996 that consisted of increasing the size of all existing pile caps at Bent 2 support location supported on higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations required seismic retrofit modifications.

All elevations for the existing structures used in this report are based on the datum of the referenced as-built plans.

Groundwater was encountered during the original explorations at approximate elevations of 34 and 39 feet MSL. The referenced as-built plans including the LOTB sheets are included in Appendix B.

12. FOUNDATION RECOMMENDATIONS

According to Caltrans' guidelines selected by the project, foundation design for abutments and bents are based on Working Stress Design (WSD) and Load and Resistance Factor Design (LRFD), respectively. The available foundation design data is summarized in Table 12 below. Our recommendations are presented in the following sections based on the currently available project information. All data should be verified during final project design.

TABLE 12
FOUNDATION DESIGN DATA

Support No.	Foundation Type	Cut-Off Elevation (ft)	Design Loading (tons)
Abut 1 Right	Class 140, HP 10x57	49.0	70
Abut 1 Left	Class 140, HP 10x57	59.5	70
Bent 2 Right	9' CIDH	41.0	1,440
Bent 2 Left	9' CIDH	45.0	2,545
Abut 3 Right	Class 140, HP 10x57	58.0	70
Abut 3 Left	Class 140, HP 10x57	64.5	70

12.1 Shallow Foundations

Based on the subsurface conditions encountered in SCS&T borings, a shallow foundation system is not considered appropriate for the support of the proposed bridge due to large estimated settlements. Geotechnical recommendations regarding portions of wingwalls supported on shallow foundations, if any, are presented in Section 12.3 of this report.

12.2 Deep Foundations

Deep foundations are considered appropriate foundation types to mitigate the potential settlements and differential settlements associated with spread footings. The geotechnical capacities of pile foundations will be derived from both the skin friction along pile shaft and end bearing in dense formational materials at depth. Because the proposed bridge will be supported on piles with pile tips adequately embedded into dense granular soil, settlement of piles due to negative skin friction and/or downdrag loads is not expected. Foundation information and our recommendations are presented in Table 12. If pile spacing is at least 3 times the pile diameter, no reduction in axial capacity for group effects is considered necessary. We have assumed that the lateral load demands will not exceed the load that will result in a deflection of more than ¼ inch at the top of each pile.

Foundation information and our recommendations are presented in Tables 12.2.1, 12.2.2, and 12.2.3 in accordance with Caltrans' LRFD procedure for bridge foundations.

TABLE 12.2.1
FRIARS ROAD OC (WIDEN)
FOUNDATION RECOMMENDATIONS FOR ABUTMENTS

Support	Pile Type	Cut-off Elevation (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State Total Load per Pile (kips) (Compression)	Nominal Resistance (kips)	Design Tip Elevations (feet)	Specified Tip Elevation (feet)	Nominal Driving Resistance Required (kips)
			Total	Permanent					
Abut 1R	Class 140 HP10x57	49.0	790	647	140	280	22.0 (a) 25.0 (d)	22.0	300
Abut 1L	Class 140 HP10x57	59.5	1,407	1,173	140	280	28.5 (a) 35.5 (d)	28.5	300
Abut 3R	Class 140 HP10x57	58.0	712	576	140	280	11.5 (a) 28.0 (d)	11.5	300
Abut 3L	Class 140 HP10x57	64.5	1,297	1,073	140	280	14.0 (a) 34.5 (d)	14.0	300

Notes:

1. Design tip elevations are controlled by: (a) Compression, and (d) Lateral Load.
2. The nominal driving resistance required is equal to the nominal resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layers (very soft, liquefiable, scourable, etc.), if any, which do not contribute to the design resistance.
3. Design tip elevation for lateral load is provided by structure design.

TABLE 12.2.2
FRIARS ROAD OC (WIDEN)
FOUNDATION RECOMMENDATIONS FOR BENT

Support	Pile Type	Cut-off Elevation (feet)	Service-I Limit State Load per Support (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevations (feet)	Specified Tip Elevation (feet)
					Strength Limit		Extreme Limit			
					Comp. (φ=0.7)	Tension (φ =0.7)	Comp. (φ =1.0)	Tension (φ =1.0)		
Bent 2R	9' CIDH	41.0	2,040	1	2,877	0	1,883	0	-19.0 (a-I) -14.0 (a-II) -49.0 (d)	-49.0
Bent 2L	9' CIDH	45.0	3,696	1	5,086	0	3,194	0	-51.0 (a-I) -14.0 (a-II) -52.5 (d)	-52.5

Notes:

1. Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), and (d) Lateral Load.
2. The nominal driving resistance required is equal to the nominal resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layers (very soft, liquefiable, scourable, etc.), if any, which do not contribute to the design resistance.
3. Design tip elevation for lateral load is provided by structure design.

TABLE 12.2.3
FRIARS ROAD OC (WIDEN)
RECOMMENDED PILE DATA

Support No	Pile Type	Cut-off Elevation (feet)	Nominal Resistance (kips)		Design Tip Elevations (feet)	Specified Tip Elevation (feet)	Nominal Driving Resistance (kips)
			Compression	Tension			
Abut 1R	Class 140 HP10x57	49.0	280	0	22.0 (a) 25.0 (d)	22.0	300
Abut. 1L	Class 140 HP10x57	59.5	280	0	28.5 (a) 35.5 (d)	28.5	300
Bent 2R	9' CIDH	41.0	4,110	0	-19.0 (a) -49.0 (d)	-49.0	NA
Bent 2L	9' CIDH	45.0	7,270	0	-51.0 (a) -52.5 (d)	-52.5	NA
Abut 3R	Class 140 HP10x57	58.0	280	0	11.5 (a) 28.0 (d)	11.5	300
Abut 3L	Class 140 HP10x57	64.5	280	0	14.0 (a) 34.5 (d)	14.0	300

Notes:

1. Design tip elevations are controlled by: (a) compression, and (d) lateral load.
2. The specified tip elevation should not be raised above the design tip elevations for lateral load.
3. Design tip elevation for lateral load is provided by structure design.

Settlement of piles imposing the design load is expected to be approximately one inch. Settlements should be essentially complete shortly after completion of the bridge superstructure. If pile spacing is at least 3 times the pile diameter, no reduction in axial capacity for group effects is considered necessary.

We understand that the specified pile length should not be less than the critical length for which greater lengths do not results in a significant reduction in deflection at the pile top. Our recommended soil and pile parameters for LPILE analyses including the soil unit weights, soil friction angles, soil modulus, soil shear strength, and soil strain value are provided in Tables 12.2.4 through 12.2.9 below.

TABLE 12.2.4
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (ABUT 1R)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	49.0	40.0	0.0694	33	90
2	Sand	40.0	29.0	0.0362	36	100
3	Sand	29.0	-19.0	0.0362	40	100
4	Sand	-19.0	-44.0	0.0362	45	125
5	Sand	-44.0	---	0.0362	45	125

TABLE 12.2.5
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (ABUT 1L)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	59.5	41.5	0.0694	33	90
2	Sand	41.5	29.0	0.0694	36	100
3	Sand	29.0	-17.5	0.0362	40	100
4	Sand	-17.5	-42.5	0.0362	45	125
5	Sand	-42.5	---	0.0362	45	125

TABLE 12.2.6
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (BENT 2R)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	41.0	25.5	0.0694	33	95
2	Sand	25.5	-4.0	0.0362	36	100
3	Sand	-4.0	-14.0	0.0362	40	110
4	Sand	-14.0	-27.0	0.0362	45	125
5	Sand	-27.0	-57.0	0.0362	45	125
6	Sand	-57.0	---	0.0362	45	125

TABLE 12.2.7
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (BENT 2L)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	45.0	35.0	0.0694	33	95
2	Sand	35.0	25.5	0.0362	36	100
3	Sand	25.5	18.0	0.0362	40	110
4	Sand	18.0	8.0	0.0362	45	125
5	Sand	-8.0	-53.0	0.0362	45	125
6	Sand	-53.0	---	0.0362	45	125

TABLE 12.2.8
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (ABUT 3R)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	58.0	45.5	0.0694	29	80
2	Sand	45.5	28.5	0.0694	30	80
3	Sand	28.5	9.5	0.0694	32	80
4	Sand	9.5	18.0	0.0694	32	80
5	Sand	18.0	10.0	0.0362	32	60
6	Sand	10.0	---	0.0362	45	125

TABLE 12.2.9
FRIARS ROAD OC (WIDEN)
RECOMMENDED SOIL PARAMETERS FOR LPILE ANALYSIS (ABUT 3L)

Soil Layer	Soil Model (LPILE)	Elevation (feet)		Unit Weight (pci)	Friction Angle (°)	K (pci)
		Top	Bottom			
1	Sand	64.5	46.0	0.0694	29	80
2	Sand	46.0	29.0	0.0694	30	80
3	Sand	29.0	18.0	0.0694	32	80
4	Sand	18.0	10.0	0.0362	32	60
5	Sand	10.0	6.0	0.0362	45	125
6	Sand	6.0	---	0.0362	45	125

If multiple rows of pile are planned at support locations with a center-to-center spacing of 3- to 5-pile diameters, p-multipliers should be applied to account for reduced lateral resistance due to pile-soil-pile interaction per current AASHTO LRFD *Bridge Design Specification*.

12.2.1 Special Considerations for CIDH Piles

Excavations for CIDH piles should be possible with normal, dry and/or wet method drilling techniques. In general, sedimentary rock consisting of massive cobble conglomerate, sandstone, and claystone were encountered in the borings. Concretions or cemented zones are common in these sedimentary units. The contractor should be aware that difficult drilling could be encountered and should have appropriate excavating tools for drilling cemented sedimentary rock.

CIDH pile installations below the groundwater level will likely require pumping of water from the borehole and/or wet construction methods. If groundwater is encountered, the contractor should be prepared to use the wet construction methods for the CIDH piles, and the use of temporary casing may be required. Geocon should be contacted if permanent casing is proposed, since the geotechnical capacity may be affected. If casing is used, to prevent binding of the drilling tool, the casing diameter should be at least 8 inches greater than the CIDH pile. Because the CIDH piles will develop some support in end bearing, all loose material should be removed from the borehole prior to placement of reinforcing steel and concrete. Experience indicates that backspinning the auger does not sufficiently clean the borehole. A flat cleanout plate will be necessary. If boreholes are left open overnight or for extended periods of time, cleaning and/or re-drilling of the hole will be necessary. The concrete should be placed in such a way as to minimize segregation of the aggregate. Tremies should be utilized for concrete placed below groundwater. Initial set of the concrete should be achieved before an adjacent borehole is drilled. Casing, if used should be removed as concrete is placed. The level of the concrete should be maintained above the level of the bottom of the casing.

The standard specification that allows the contractor to revise specified pile tip elevations is intended for driven piles only. Tip elevation revision is generally not allowed for drilled shafts. An engineered length for skin friction resistance primarily controls the specified CIDH pile depth, and the drilling process has no inherent measurement (analogous to blow count) to verify the resistance.

The contract items for CIDH piles are as shown in Caltrans' 2005 *Bridge Design Aids*, Chapter 11. Standard sizes for CIDH augers and steel casings are also within *Bridge Design Aids* and Caltrans' LRFD 2008, *Memos to Designers, Section 3, Deep Foundations*. These sizes are preferred for CIDH piles with or without permanent casing. Because the contractor may own and reuse temporary casings, the indicated sizes are required whenever a temporary casing is expected.

12.2.2 Special Considerations for Driven Piles

Selected HP piles are the allowed alternatives to Caltrans Standard Plan Class piles for the subject design loads. Due to the presence of dense to very dense and hard layers and the possibility of difficult driving of the piles based upon the soils encountered in the borings, the contractor shall have all equipment available onsite to install the piles to the design tip elevation per the Caltrans Standard Specifications, Section 49-1.05. The piling contractor shall consider mitigation measures, including but not limited to predrilling and use of hydraulic hammer system, to reduce the pile driving noise at abutments. The predrilling, if performed, should not exceed one-half of pile embedment in length. The hole should have a diameter not greater than the smallest dimension of the pile cross section. For this project, jetting of piles is not an allowable method of pile installation.

12.2.3 Pile Load Testing

Due to the relatively uniform subsurface condition and limited number of piles expected for the project, a static pile load testing program to evaluate driven pile axial capacity is not considered necessary. However, a dynamic pile load testing program based on the wave equation analyses and CAPWAP to evaluate whether specified pile tip elevations are appropriate to meet design capacities is recommended. We recommended that the number of tests on driven piles, if any, should not be less than 5. The tests should be performed in accordance with Caltrans criteria and/or ASTM procedures, as appropriate. Both end of driving (EOD) and beginning of re-strike (BOR) data should be collected to assess how much soil setup or relaxation occurred after initial driving.

12.3 Wing Walls

The project designer should evaluate the design conditions of the retaining structures (restrained or non-restrained) and use the appropriate design parameters. Structures allowed to rotate more than 0.001H (where H equals the retained height of the wall) at the top of the wall are considered non-restrained. Non-restrained walls having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 36 pounds per cubic foot (pcf) in accordance with Caltrans' *Bridge Design Specifications Section 3.11.5.5*. Restrained walls should be designed for an equivalent fluid pressure of 55 pcf. Non-restrained walls supported 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf. Soil placed for wingwall backfill should meet the requirements outlined in Section 12.4 of this report.

The new wingwalls will be cantilever type retaining walls. An allowable bearing capacity of 2,000 pounds per square foot (psf) can be used provided the walls are at least 18 inches wide and founded 12 inches below adjacent grades bearing entirely in structural fill. Lateral loads can be resisted by an allowable passive earth pressure equivalent to a fluid density of 300 pcf for footings or shear keys poured neat against properly compacted fill soils with horizontal ground. The passive pressure should

be taken as 150 pcf for walls founded on a 2H:1V descending slope. The upper 12 inches of material not protected by floor slabs or pavement should not be included in the design for lateral resistance. An allowable friction coefficient of 0.40 may be used for resistance to sliding between soil and concrete. This friction coefficient may be combined with the allowable passive earth pressure when determining resistance to lateral loads. An earthquake surcharge of 0.24 times the total unit weight times the wall height may be used for seismic induced loading on the walls.

All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces. The drainage system should consist of weepholes or backdrains. The above recommendations assume a properly compacted granular backfill material with no hydrostatic forces. If conditions different than those described are anticipated, or if specific drainage details are desired, Geocon should be contacted for additional recommendations.

12.4 Wall Backfill and Approach Fill Earthwork

All grading should be performed in conformance with *Sections 6-3, 19-3, 19-5,* and *19-6* of the Caltrans Standard Specifications or equivalent. Backfill placed behind abutment walls, retaining walls and wing walls should have a very low- to low-expansion potential. The extent and placement of the low-expansive soils should conform to Caltrans Standard Specifications 19-5.03. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted.

Backfill placed within the full width of the embankment and within 150 feet of the abutment is considered structural backfill. All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216. All compaction on the project should be based on this test method. All other backfill should be compacted to a minimum of 90 percent relative compaction. Near surface, loose soils at abutment locations are not adequate for the support of new fill loads, and partial removal and recompaction will be necessary prior to the placement of structural backfill and foundation construction.

Surface settlements can be expected where substantial thicknesses of new fill will be placed. We have assumed up to 20 feet of new fill will be placed at the abutment locations. Settlements will occur both as a result of compression in alluvium beneath the new fill, and as a result of compression within the new fill itself. Total settlement of embankment fills within 150 feet of the abutments is estimated to be less than one inch assuming that new fills are granular in nature. Settlement is expected to be essentially complete shortly after placement. No settlement period is considered necessary.

Structural fill should be compacted in horizontal lifts not exceeding 8 inches (loose thickness) and brought to final design elevations. Each lift should be moisture-conditioned and compacted. New fill

should be benched into existing embankment fill as the fill is placed. Benches should extend at least 3 feet laterally into the existing embankment fill.

12.4.1 Additional Considerations

Consideration should be given to the use of surface treatments to minimize surficial erosion until adequate erosion-resistant vegetation can become established. All roadway drainage should be directed to appropriate collection and discharge facilities to prevent run-off from flowing over the tops of slopes.

13. GENERAL NOTES TO DESIGNER

This report is prepared based on the currently available project information including the proposed structures and foundations described herein. Geocon must be contacted for review and possible revised recommendations if the proposed structures and foundations are changed.

14. CONSTRUCTION CONSIDERATIONS

Areas to be developed should be cleared and stripped of obstructions, trees, bushes, grass, roots, and the upper few inches of soil containing organic debris. Soils/organics removed by stripping can be transported offsite or stockpiled for use in landscaping. Existing drainage and utility lines or other existing subsurface structures that are not to be utilized, if any, should be removed, destroyed or abandoned in compliance with applicable regulations.

Relevant specifications and important design criteria that were used in the geotechnical design of the foundations include:

- *Sections 6-3, 19-3, 19-5,* and *19-6* of Caltrans' *Standard Specifications*. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted. All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216.

- Remedial grading should be performed to provide a relatively uniform soil mat beneath the footing and no oversized rock (with a maximum dimension of 12 inches or greater) within 5 feet of the footing.

- Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 36 pcf in accordance with Caltrans' *Bridge Design Specifications* 3.20.1. Walls supporting 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf.

- All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces.

Excavation and trench depths greater than 5 feet will need to be sloped and shored in accordance with Cal-OSHA guidelines for the safety and stability of adjacent existing improvements. Existing fill and alluvium, if encountered, can be considered as OSHA Type B soil for excavation purposes (Type C where seepage is freely flowing). For temporary construction purposes, a slope ratio of 1H:1V may be used for cuts in existing fill or alluvium not exceeding 20 feet to a depth 5 feet above the water table. Formational materials can likely be considered a Type A soil with a slope ratio of ¾ H:1V. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing improvement should be shored in accordance with applicable OSHA codes and regulations.

Temporary excavations should be in compliance with applicable governing agency regulations. The Contractor should also execute a monitoring program for structures in proximity to deep excavations so that appropriate modifications to the excavation/shoring system can be implemented to minimize the surface deflection or structure damage in a timely manner, if warranted.

Excavation of the onsite materials can be accomplished using conventional heavy-duty excavation equipment. Excavation difficulty should be expected within the very dense and hard formational materials. Heavy ripping will generate oversize materials not suitable for backfill.

The existing bridge footings and structures should be protected and monitored during proposed bridge widening and site improvements.

Foundation excavations should be observed by a representative of Geocon prior to the placement of reinforcing steel and concrete. If unanticipated soil conditions are encountered, foundation modifications may be required.

Based on previous analyses performed by SCS&T (*Geotechnical Design Report*, July 2009), it was stated that subsurface well-cemented zones should be expected within the formational materials. These areas will require rock-breaking equipment. In addition, buried hard rock requiring special handling should be anticipated. Contract documents should specify that the contractor mobilize equipment capable of excavating, breaking, and drilling hard rock. Flowing sands, cobbles, and boulders should also be expected during drilling. Casing and/or drilling mud will most likely be needed to maintain open drilled shafts.

15. DISCLAIMER AND CONTACT INFORMATION

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by Dokken Engineering and T. Y. Lin International. If any changes are made during final project design, Geocon should review those

changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Mr. Joe Vettel, 858-558-6900, at the San Diego Office of Geocon.

16. CLOSURE

16.1 Foundation and Grading Plan Review

Geocon should review the grading plans and foundation plans prior to final design submittal to evaluate whether additional analysis and/or recommendations are required.

16.2 Limitations and Uniformity of Conditions

The recommendations of this report pertain only to the site investigated and are based upon the assumption that soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon.

This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years. Our professional services were performed in accordance with generally acceptable geotechnical engineering principles and practices in the site area at this time. No warranty is provided, express or implied.

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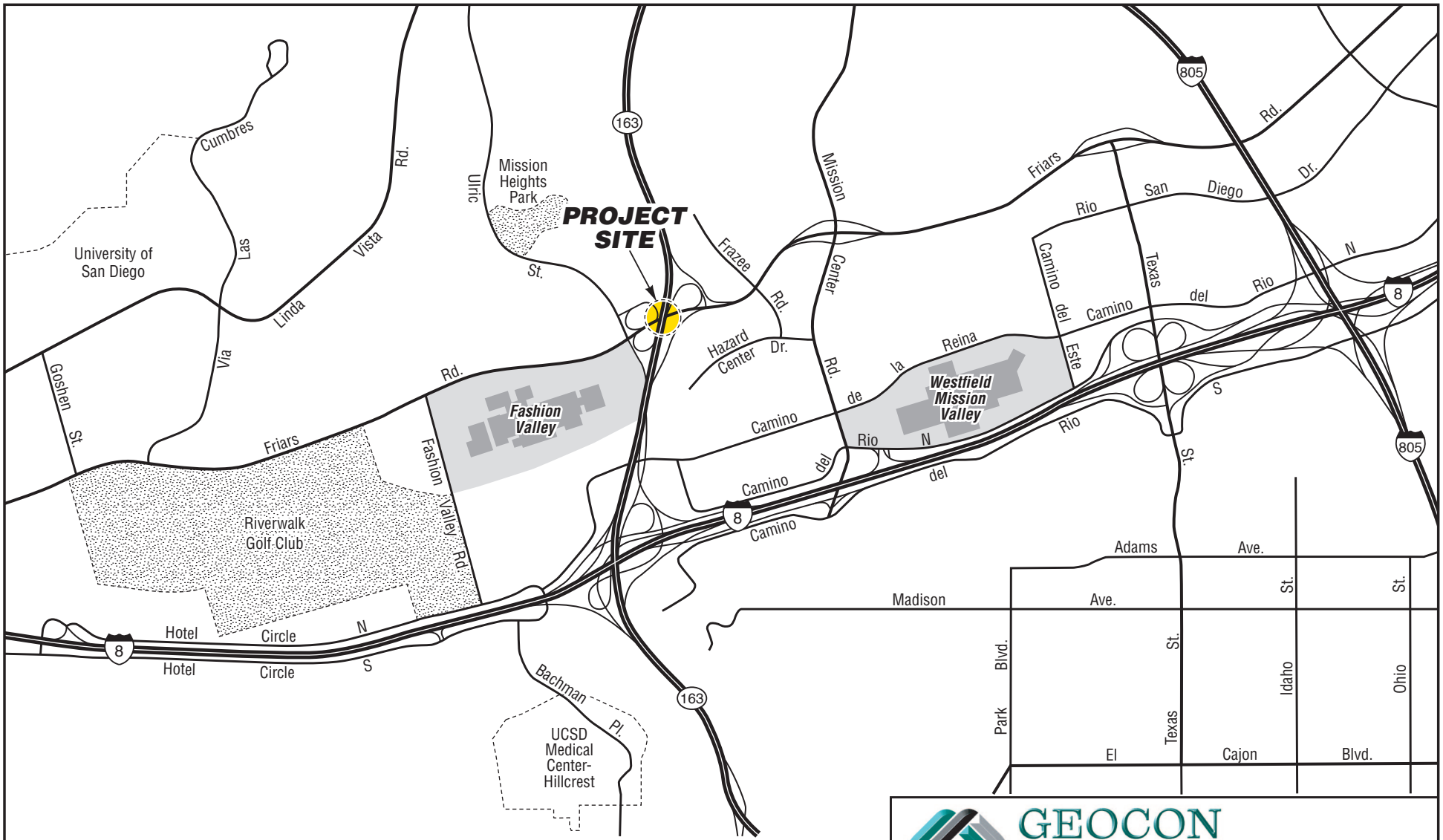

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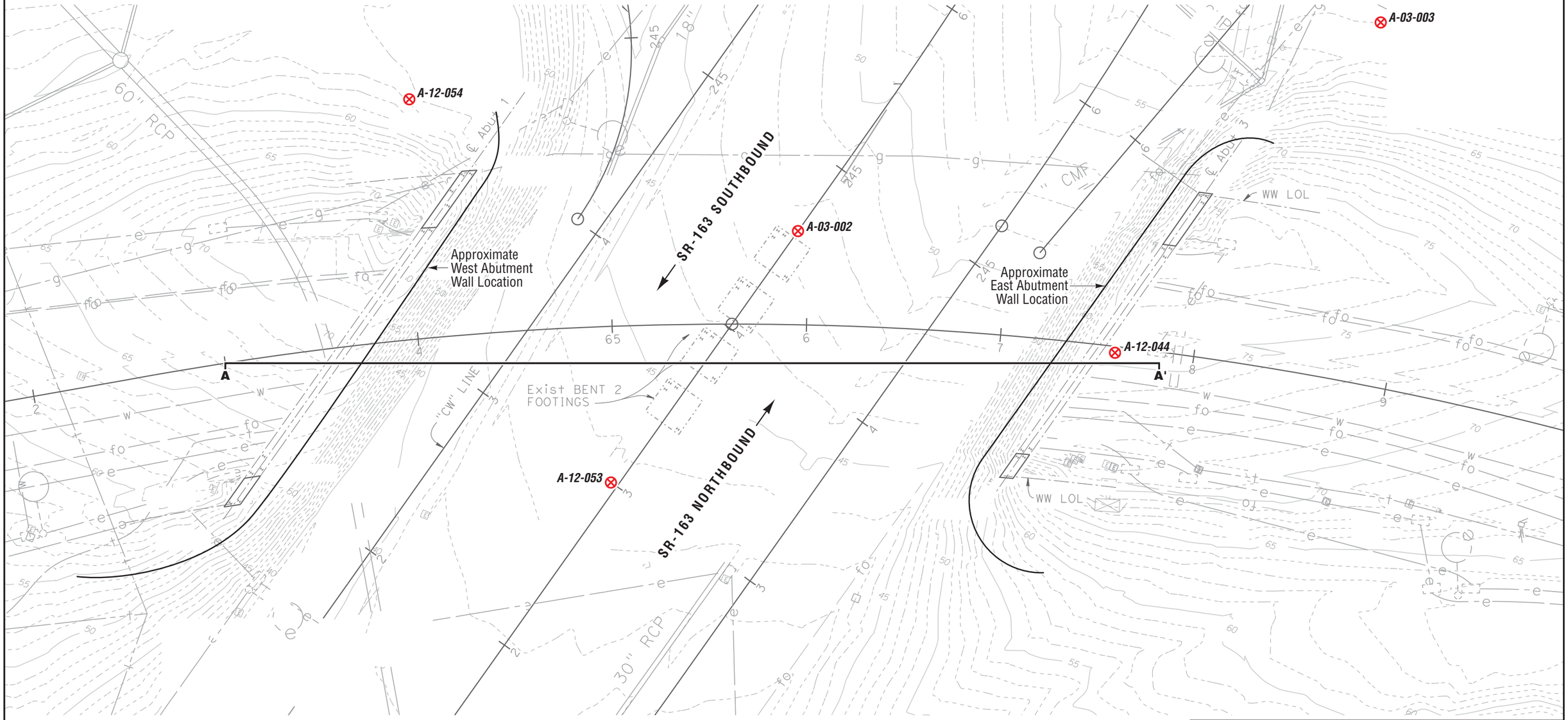
Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

VICINITY MAP

G1447-52-01	January 2014	Figure 1



LEGEND:

A-12-053 ⊗ Approximate Boring Location

A — A' Approximate Cross-Section Location

0 50

Scale in Feet

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

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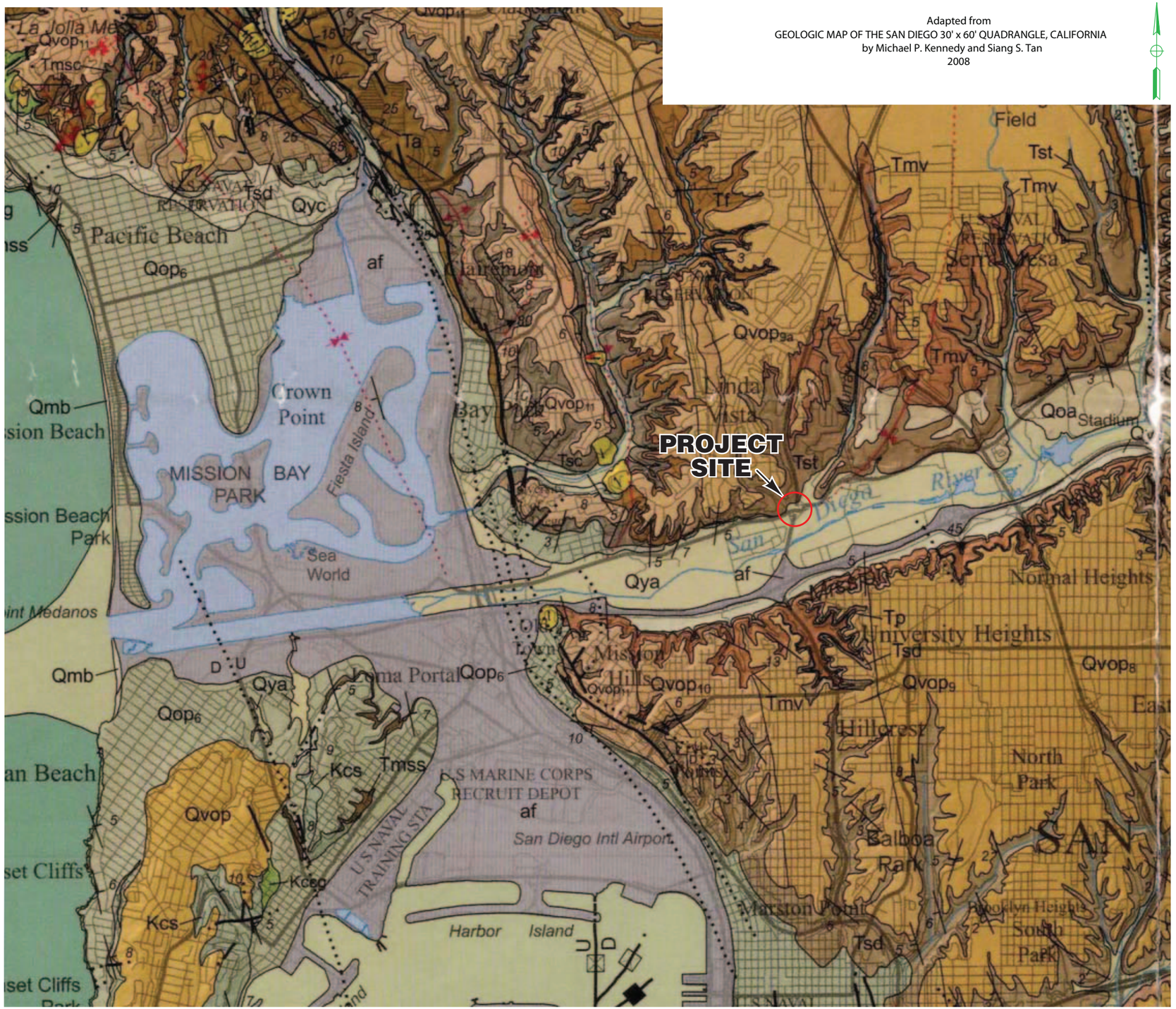
Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

SITE PLAN

G1447-52-01	January 2014	Figure 2

Adapted from
GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA
by Michael P. Kennedy and Siang S. Tan
2008



NO SCALE

ABBREVIATED EXPLANATION
Approximate stratigraphic relationships only:
see pamphlet and CMU (Plate 2) for more detailed information

MODERN SURFICIAL DEPOSITS
- af — Artificial fill (late Holocene)
- Qw — Wash deposits (late Holocene)
- Qls — Landslide deposits, undivided (Holocene and Pleistocene)
- Qmb — Marine beach deposits (late Holocene)
- Qpe — Paralic estuarine deposits (late Holocene)
- Qmo — Undivided marine deposits in offshore region (late Holocene)
- Qcf — Canyon fill deposits in offshore region (late Holocene)

YOUNG SURFICIAL DEPOSITS
- Qya — Young alluvial flood-plain deposits (Holocene and late Pleistocene)
- Qyc — Young colluvial deposits (Holocene and late Pleistocene)
- Qct — Undivided canyon terrace deposits in offshore region (Holocene and Pleistocene)

OLD SURFICIAL DEPOSITS
- Qoa — Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
- Qop — Old paralic deposits, undivided (late to middle Pleistocene)
  - Qop7 — Unit 7
  - Qop6 — Unit 6
  - Qop2-4 — Units 2-4, undivided

VERY OLD SURFICIAL UNITS
- Qvoa — Very old alluvial flood-plain deposits, undivided (middle to early Pleistocene)
- Qvop — Very old paralic deposits, undivided (middle to early Pleistocene)
  - Qvop7 — Unit 7
  - Qvop6 — Unit 6
  - Qvop5 — Unit 5
  - Qvop4 — Unit 4
  - Qvop3 — Unit 3
  - Qvop2 — Unit 2
  - Qvop1 — Unit 1
  - Qvop13 — Unit 13
  - Qvop12 — Unit 12
  - Qvop11 — Unit 11
  - Qvop10 — Unit 10
  - Qvop9 — Unit 9
  - Qvop8 — Unit 8
  - Qvop11a — Unit 11a
  - Qvop10a — Unit 10a
  - Qvop9a — Unit 9a
  - Qvop8a — Unit 8a

SEDIMENTARY AND VOLCANIC BEDROCK UNITS
- QTso — Undivided sediments and sedimentary rocks in offshore region (Holocene, Pleistocene, Pliocene and Miocene)
- Tsd — San Diego Formation (early Pliocene and late Pliocene)
  - Tsd - undivided
  - Tsdcg - transitional marine and nonmarine pebble and cobble conglomerate
  - Tsdss - marine sandstone
- Tba — Basaltic-andesite dike (Miocene)
- Tmo — Undivided sedimentary rocks in offshore region (Miocene)
- Tmvo — Undivided volcanic rocks in offshore region (Miocene)
- Tmsvo — Undivided volcanic and sedimentary rocks in offshore region (Miocene)
- To — Otay Formation (late Oligocene)
- Tp — Pomerado Conglomerate (middle Eocene)
  - Tpm - Miramar Sandstone Member
- Tmv — Mission Valley Formation (middle Eocene)
- Tst — Stadium Conglomerate (middle Eocene)
- Tf — Friars Formation (middle Eocene)
- Tsc — Scripps Formation (middle Eocene)
  - Tscu - upper unit
- Ta — Ardath Shale (middle Eocene)
- Tt — Torrey Sandstone (middle Eocene)
- Td — Delmar Formation (middle Eocene)
- Td+Tf — Delmar Formation and Friars Formation, undivided (middle Eocene)
- Tmsl — Mount Soledad Formation (middle Eocene)
  - Tmss - sandstone
  - Tmsc - cobble conglomerate
- Teo — Undivided Eocene rocks in offshore region (Eocene)
- Kcs — Cabrillo Formation (Upper Cretaceous)
  - Kcs - sandstone
  - Kccg - cobble conglomerate
- Kp — Point Loma Formation (Upper Cretaceous)
- Kl — Lusardi Formation (Upper Cretaceous)
- Kuc — Undivided rocks of the Rosario Group in the offshore area (Upper Cretaceous)

Ref: Southern California Soil & Testing, Inc., 6/28/12

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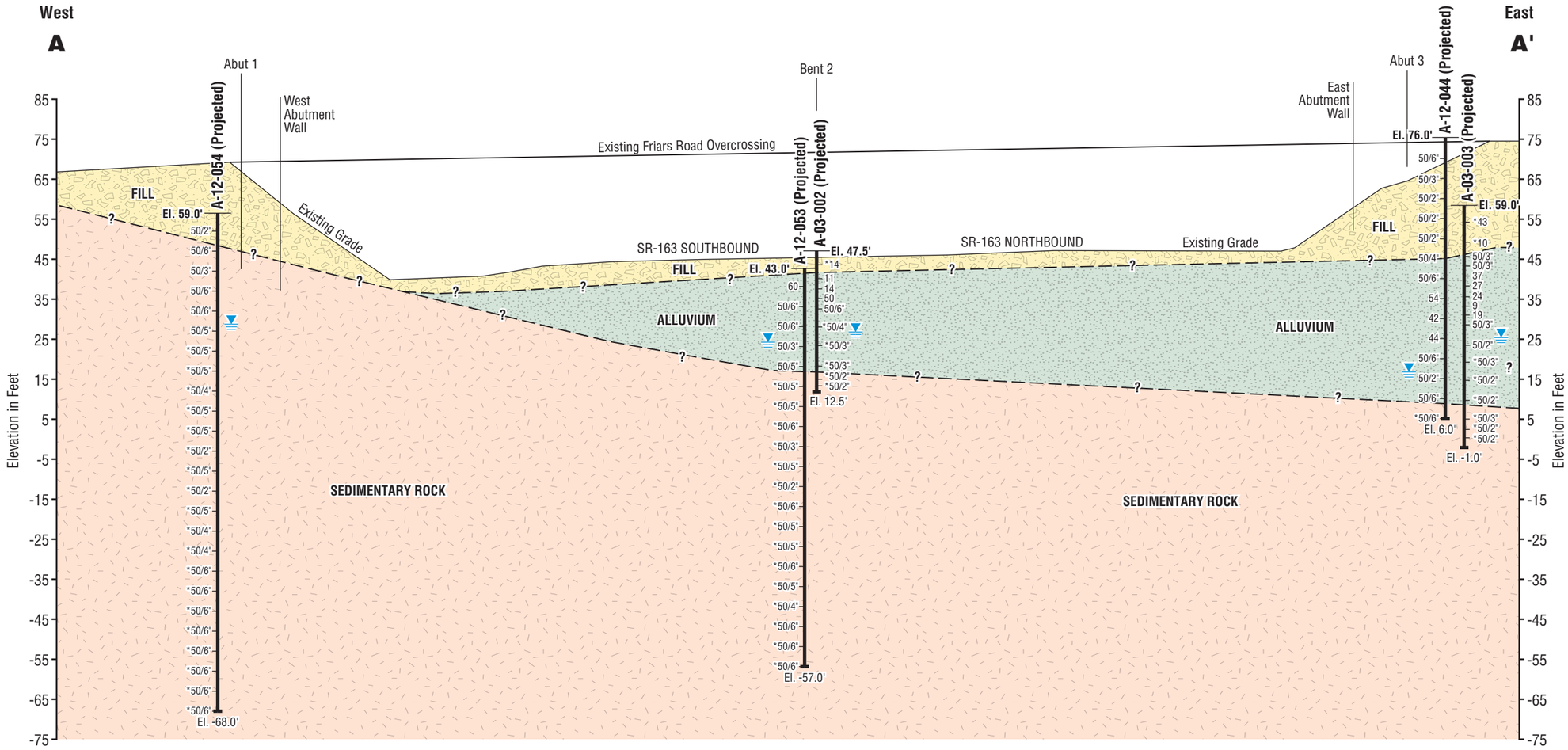
Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL GEOLOGIC MAP

G1447-52-01	January 2014	Figure 3



LEGEND:

A-03-002 (Projected) — Approximate Exploratory Boring Location

50/4" — Field Blow Count (California Modified Sampler/*SPT Sampler)

Groundwater Observed in Boring

? — — — — Approximate Geologic Contact (Queried Where Uncertain)

EXISTING FILL

ALLUVIUM

SEDIMENTARY ROCK
(Stadium Conglomerate & Friars Formation - Interbedded Sandstone & Claystone)

Vertical Scale in Feet: 30, 0

Horizontal Scale in Feet: 0, 40

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

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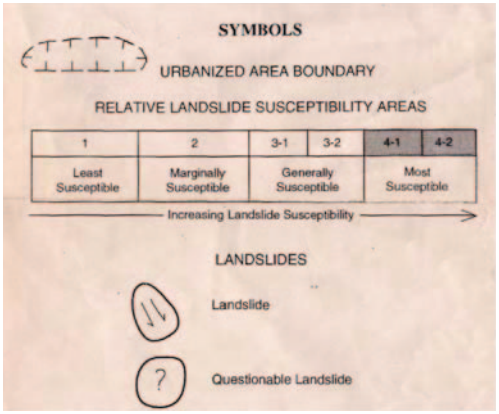
Friars Road Overcrossing (Widen)

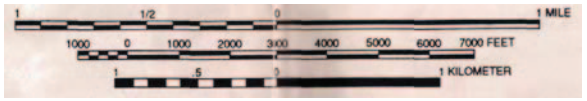
Friars Road/SR-163 Interchange Project
San Diego, California

GEOLOGIC CROSS-SECTION A – A'

G1447-52-01	January 2014	Figure 4



LANDSLIDE HAZARDS IN THE NORTHERN PART OF
THE SAN DIEGO METRPOLITAN AREA,
SAN DIEGO COUNTY, CALIFORNIA
By Siang S. Tan
1995
LA JOLLA QUADRANGLE



Ref: Southern California Soil & Testing, Inc., 6/29/12

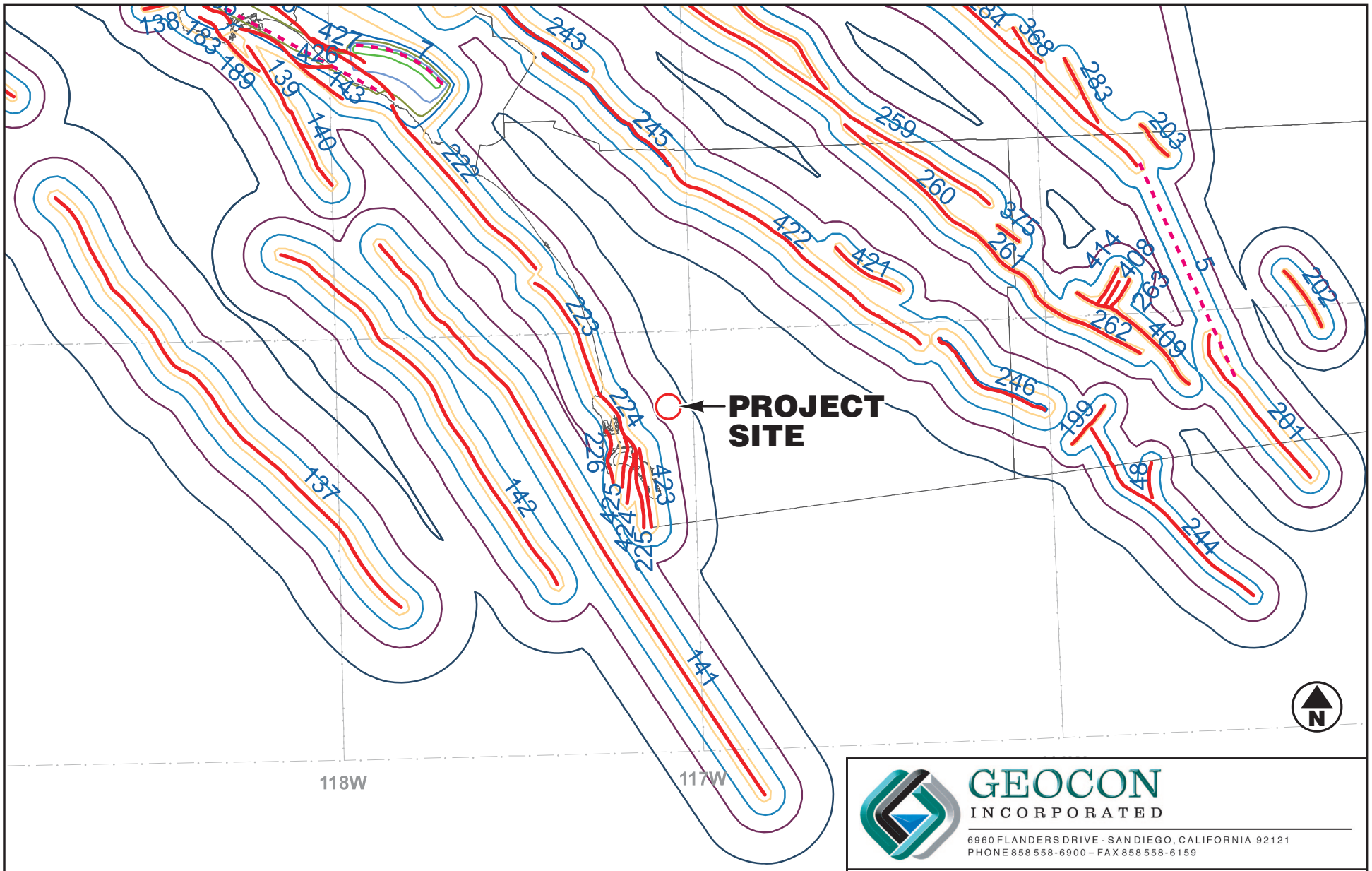
GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

LANDSLIDE HAZARD MAP

G1447-52-01	January 2014	Figure 5



Ref: 2007 Caltrans Deterministic PGA Map, September 2007

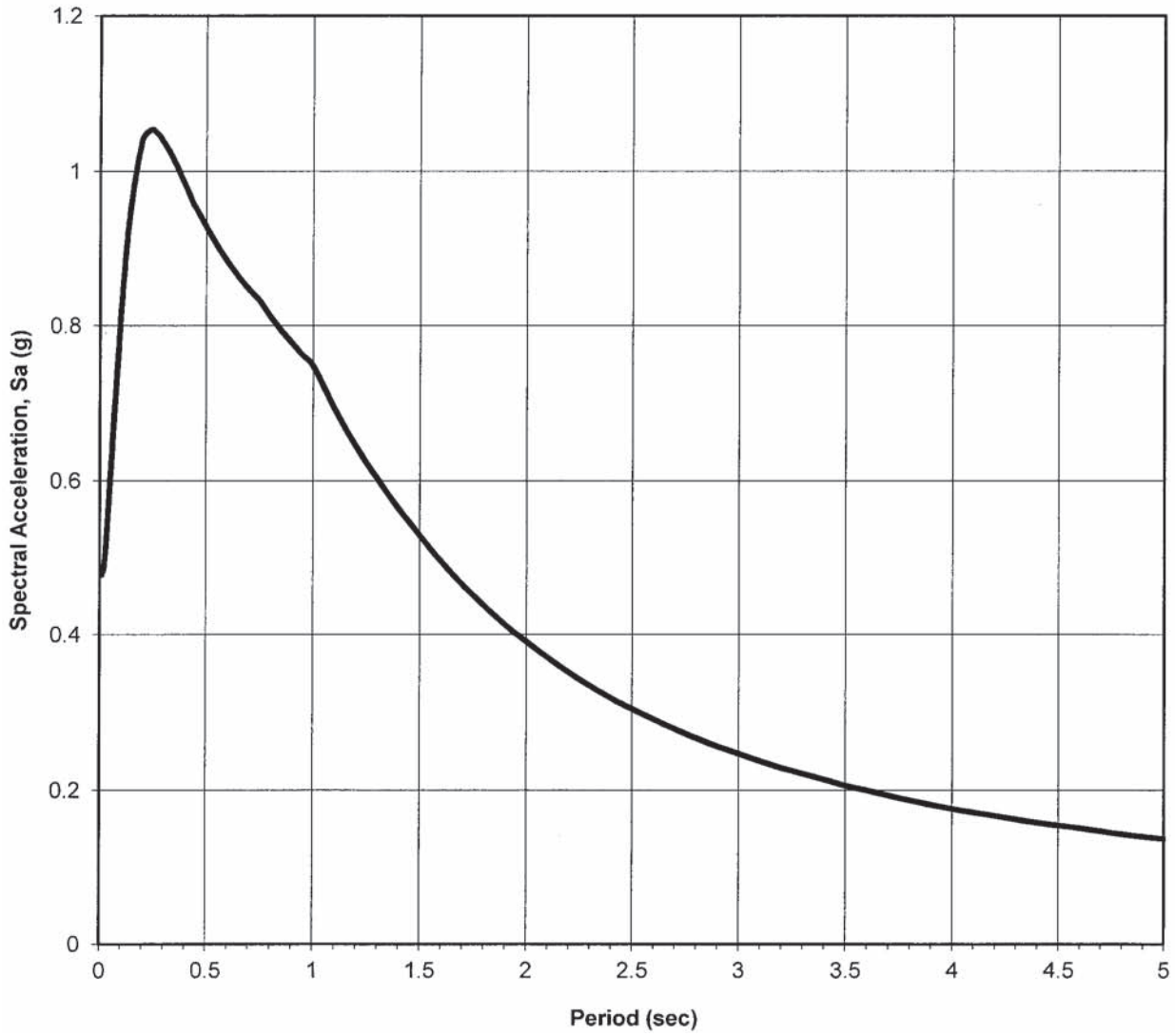
GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL FAULT MAP

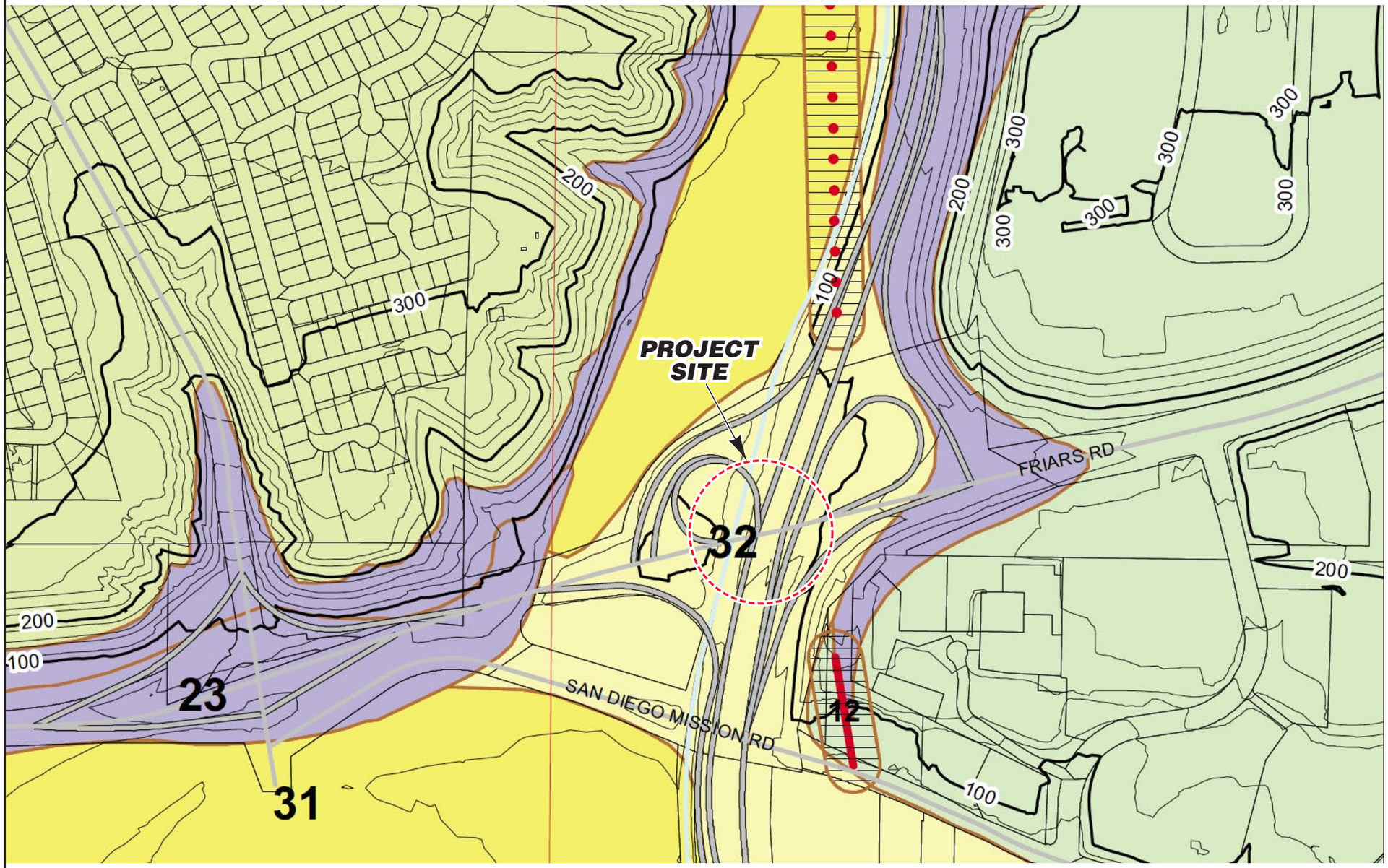
G1447-52-01	January 2014	Figure 6



RECOMMENDED DESIGN RESPONSE SPECTRUM

GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

Friars Road Overcrossing (Widen)		
Friars Road/SR-163 Interchange Project San Diego, California		
G1447-52-01	January 2014	Figure 7



Geologic Hazard Categories

FAULT ZONES

- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES

- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS

- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION

- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS

- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN

- 51 Level mesas -- underlain by terrace deposits and bedrock nominal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

N

0 1000

Scale in Feet

Ref: City of San Diego, *Seismic Safety Study Geologic Hazards and Faults*, 4/3/08

GEOCON INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

Friars Road Overcrossing (Widen)

Friars Road/SR-163 Interchange Project
San Diego, California

City of San Diego Seismic Safety Map

G1447-52-01	January 2014	Figure 8

APPENDIX A

APPENDIX A

LOG OF TEST BORINGS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
FRIARS ROAD OVERCROSSING (WIDEN)
(BRIDGE NO. 57-0595)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

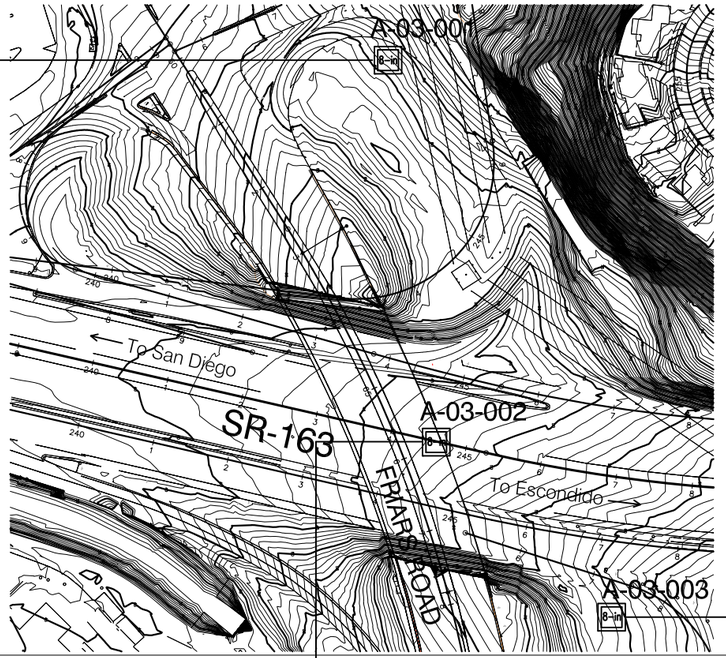
PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

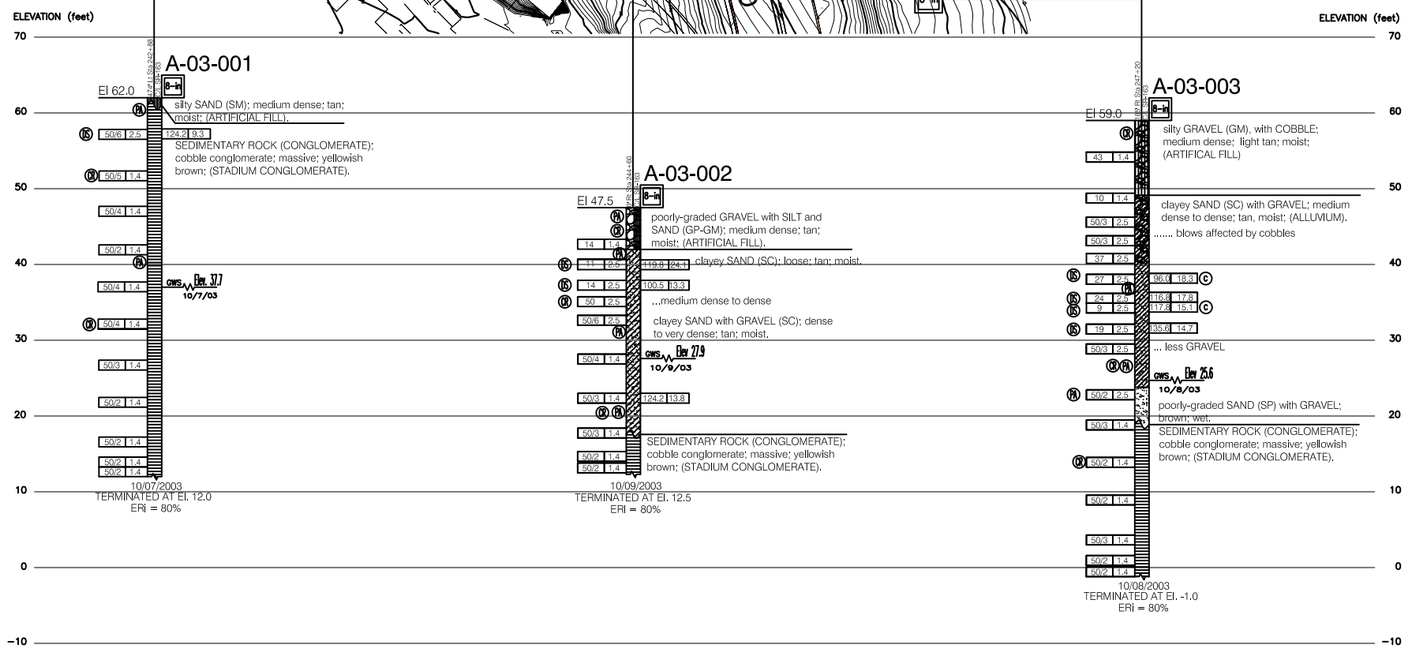
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120



PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

X DESIGN OVERSIGHT	DRAWN BY	Andrew K. Neuhaus, PG	Garrett B. Fountain, GE FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57-0595	FRIARS ROAD OC (WIDEN)
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 10/07/03 – 10/09/03			POST MILES 4.4	LOG OF TEST BORINGS (1 of 3)

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
X				25	29

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

PLANS APPROVAL DATE

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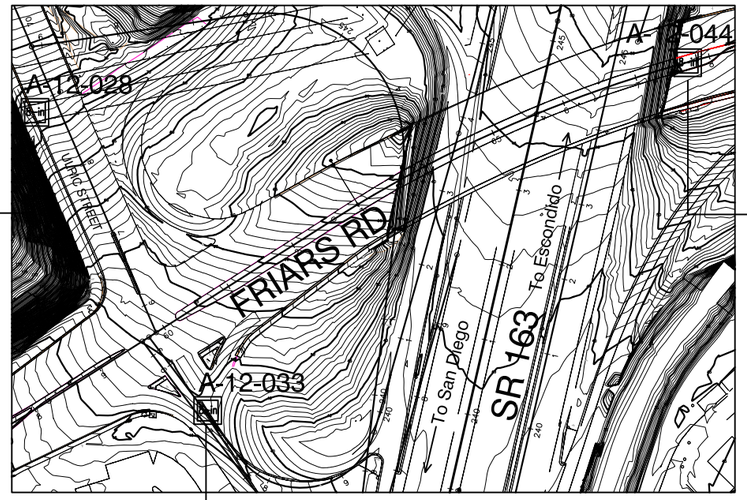
CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

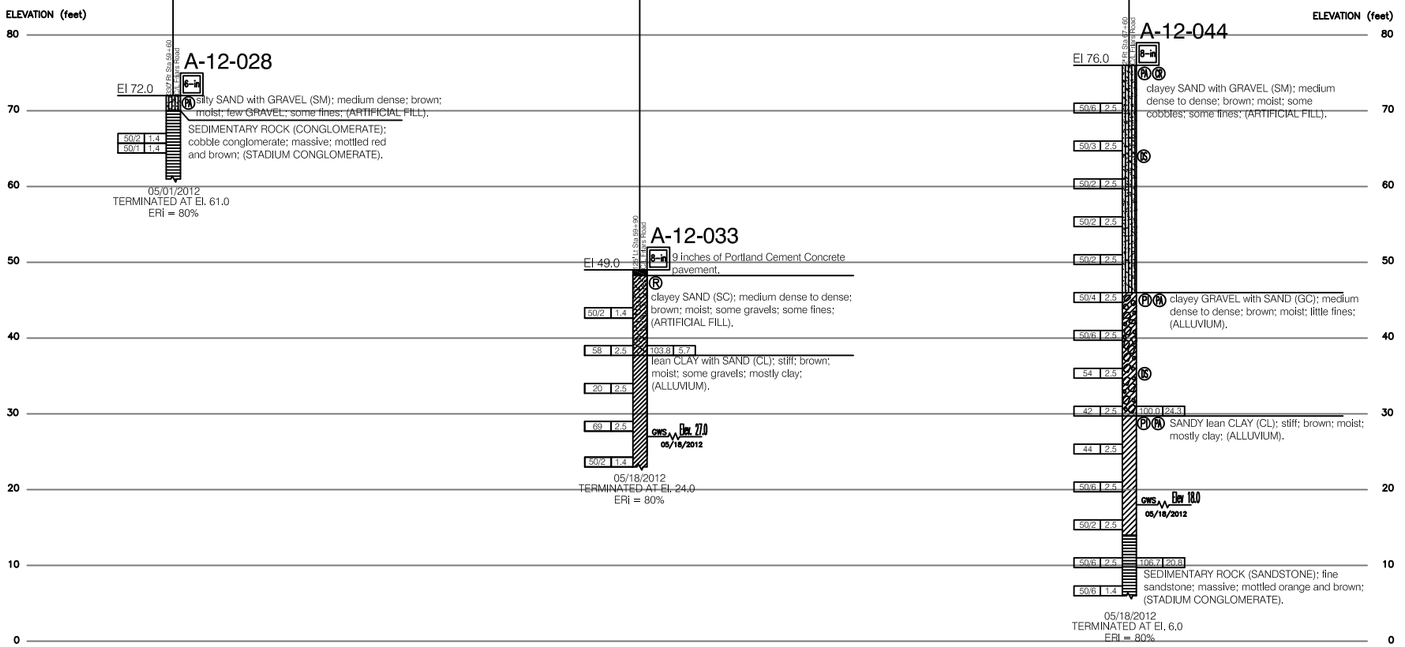
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120



PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

X DESIGN OVERSIGHT	DRAWN BY	Andrew K. Neuhaus, PG	Ray N. Butz, PG FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57-0595	FRIARS ROAD OC (WIDEN)
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 05/01/12 – 05/18/12			POST MILES 4.4	LOG OF TEST BORINGS (2 of 3)

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
X				26	29

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

PLANS APPROVAL DATE

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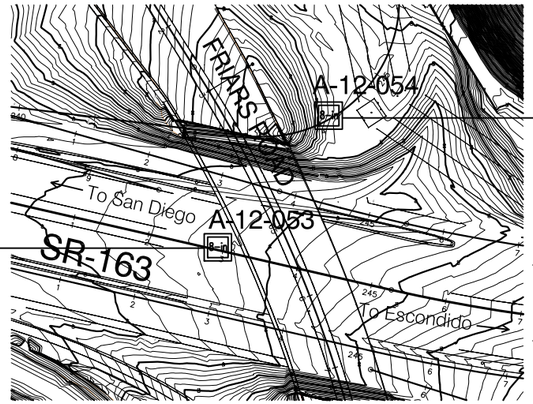
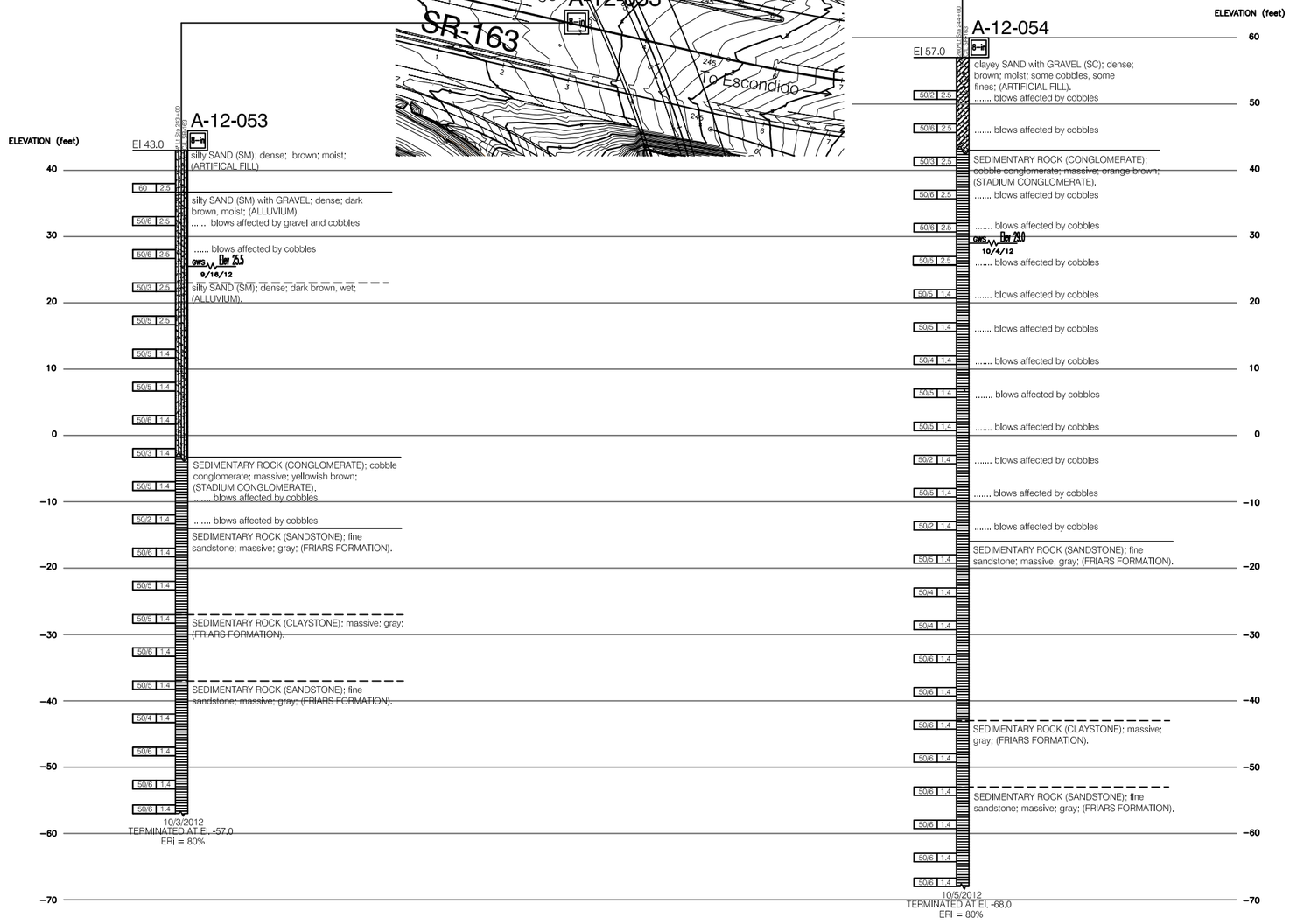
CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120

PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.

X DESIGN OVERSIGHT	DRAWN BY	Andrew K. Neuhaus, PG	Andrew K. Neuhaus, PG FIELD INVESTIGATION BY:		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57-0595
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 10/03/12 – 10/05/12				POST MILES 4.4

FRIARS ROAD OC (WIDEN)

LOG OF TEST BORINGS (3 of 3)

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: PROJECT NUMBER & PHASE: CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
X				27	29

FILE => $REQUEST

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

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	Sheet No.	Total Sheets
11	SD	163	4.1/4.9		

GEOTECHNICAL ENGINEER — DATE 1/15/2014

FRIARS ROAD OC (WIDEN)

LOG OF AS-BUILT TEST BORINGS (1 OF 2)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

UNITS

PROJECT NUMBER & PHASE

BRIDGE No.	Sheet	of
57-0595	28	29

PROFESSIONAL ENGINEER — TONG WANG — No. 2775 — Exp. 6/30/14 — GEOTECHNICAL — STATE OF CALIFORNIA

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

SUMMARY OF MATERIAL TESTS AND ENGINEERING CHARACTERISTICS

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

BM II-6
Conc. E. mon. 6' LT "SD" line
Sta. 30+09.2 Elev. 48.37

"A" 18+51.81 POC
"SD" 45+02.38 POT

"SD" LINE

"F" LINE

SEISMIC RETROFIT PROJECT NO. SR-272

DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163/805	4.4/7.0/20.3/20.7	136	192

3-15-96 — 7-29-96

FRIARS OVERCROSSING

LOG OF TEST BORINGS 1 OF 2

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

PLAN
1"=30'

PROFILE
Vert. 1"=10'
Horiz. 1"=30'

NO AS BUILT CHANGES

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-10
Document No. 20100787

FRIARS ROAD OVERCROSSING

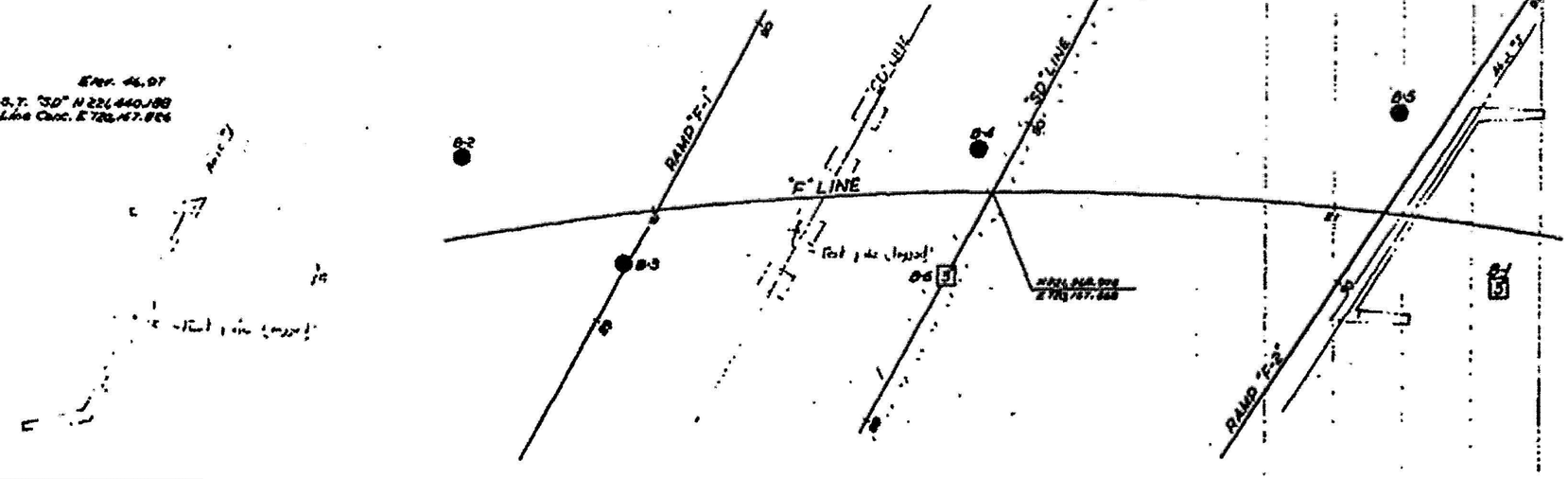
LOG OF TEST BORINGS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-12-	15	15

WO 037711
OB 11206
PIR-57595-2

SHEET 7 OF 8

BM E-8 Elev. 46.07
6' N 80+48.08 R.O.S.T. "SD" N 221,440.98
90+69.82 R.O.S.T "F" Line Chor. E 726,467.866
℄ Mon.



DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL ENGINEER — 1/15/2014 DATE

PROFESSIONAL ENGINEER — HONG LIANG — No. 2775 — Exp. 6/30/14 — GEOTECHNICAL — STATE OF CALIFORNIA

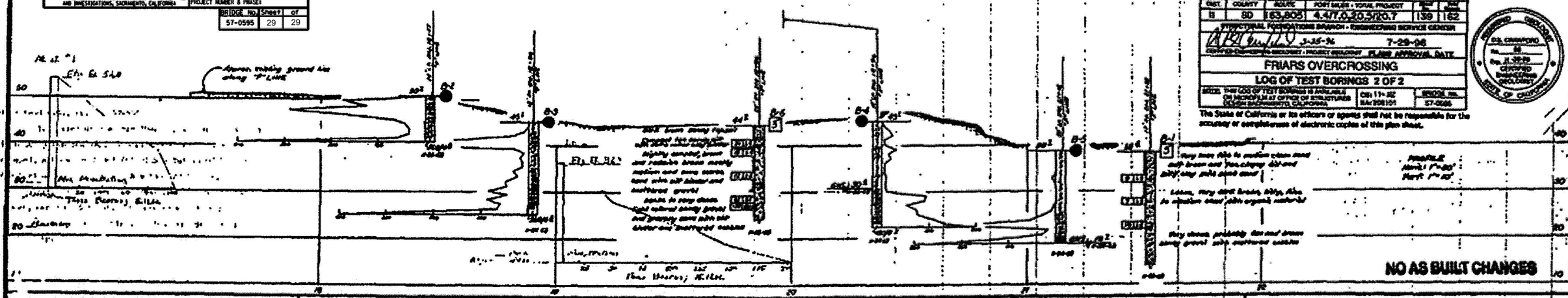
FRIARS ROAD OC (WIDEN)

LOG OF AS-BUILT TEST BORINGS (2 OF 2)

WHERE A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

UNIT/ PROJECT NUMBER & PHASE/

BRIDGE No.	Sheet	of
57-0595	29	29



NO AS BUILT CHANGES

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

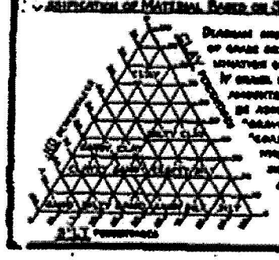


DIAGRAM SHOWING THE BASIS FOR SUBDIVISION OF GRAIN SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND." THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO DIVISIONS GRAIN SIZE LIMITS.

LEGEND OF EARTH MATERIALS

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY OR CLAYEY SAND
- SANDY SILT OR SILTY SAND
- SILTY CLAY OR CLAYEY SILT
- PEAT AND/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2½" CORE PENETRATION
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT

NOTE

Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply conditions beneath.

STATE OF CALIFORNIA — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 57-595 | FILE | DISTRICT

SHEET 6 OF 6

SEISMIC RETROFIT PROJECT NO. SR-272

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	163.805	4.4/7.0, 20.5/20.7	139	162

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

3-25-96 — 7-29-96

PROJECT ENGINEER - GEOLOGIST / PROJECT GEOLOGIST — FLARE APPROVAL DATE

FRIARS OVERCROSSING

LOG OF TEST BORINGS 2 OF 2

WHERE THIS LOG OF TEST BORINGS IS AVAILABLE ON MICROFILM AT OFFICE OF STRUCTURES DESIGN SACRAMENTO, CALIFORNIA — CON 11-162 MAR 208101 — BRIDGE No. 57-0595

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

REGISTERED GEOLOGIST — CA. CERTIFICATE No. — No. — Exp. — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

AS-BUILT

Contract No. 11-093714

Corrections by

Date 11-6-17

BRIDGE FILE DRAWING 65 T

PILE TYPE 12.80C / 12.80C / Steel Pile Points

DIAMETER TIP — BUTT —

TOTAL PRELIM. PILES 182

CONCR. FT. PILES, PLANS 6000

CONCR. FT. PILES, "AS BUILT" 5444

DRAWING Abut 1 Abut 2

DESIGNED BY 2 Abut 1 Abut 2 3 Viaduct Col

PLAN QUANTITY

9% Above Plan

2-20-18

APPENDIX B

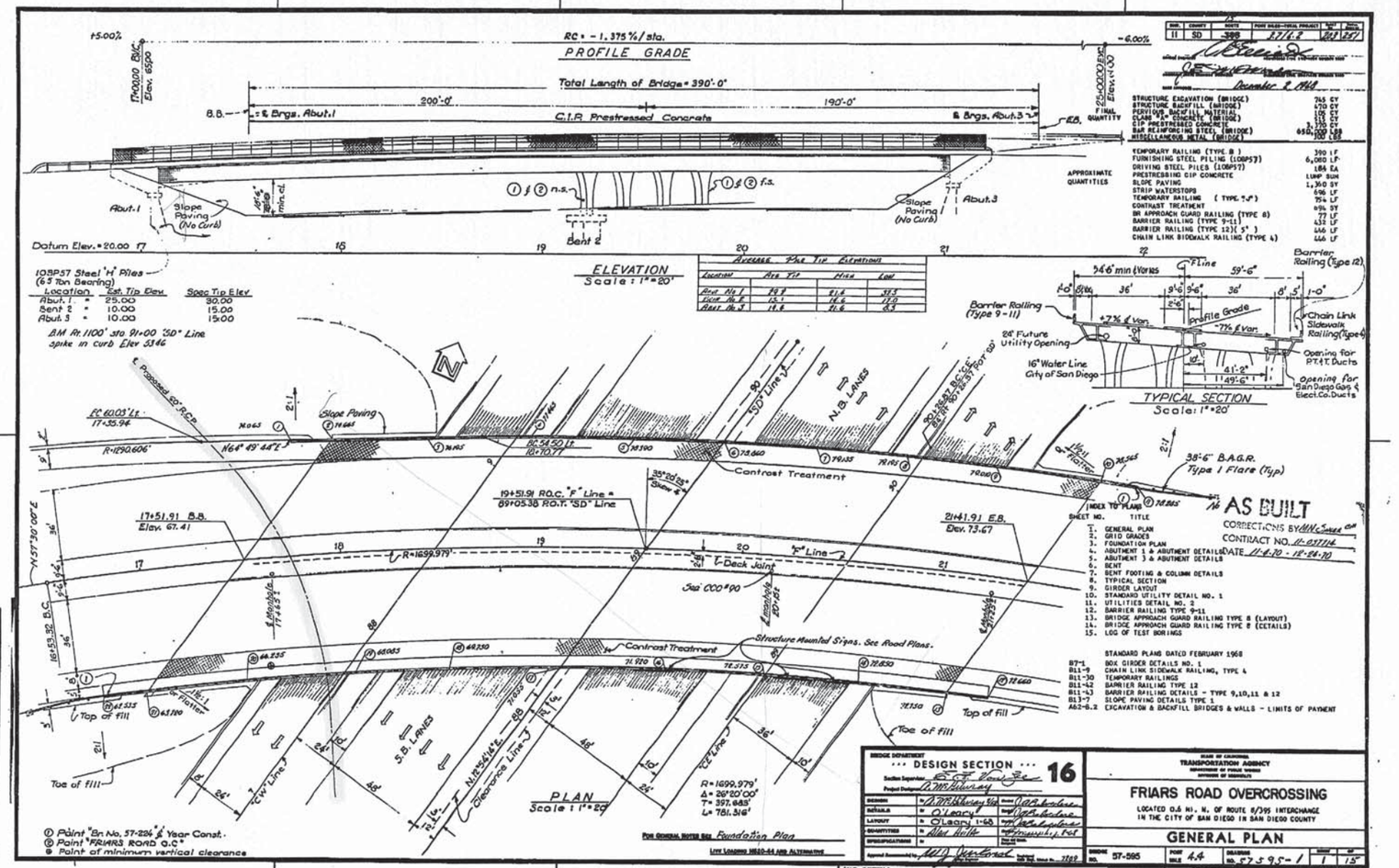
APPENDIX B

AS-BUILT PLANS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
FRIARS ROAD OVERCROSSING (WIDEN)
(BRIDGE NO. 57-0595)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



Location	Est. Tip Elev.	Spec Tip Elev
Abut. 1	25.00	30.00
Bent 2	10.00	15.00
Abut. 3	10.00	15.00

BM Rt. 1100' sta 91+00 "SD" Line spike in curb Elev 53.46

① Paint "Br. No. 57-224" & Year Const.
② Paint "FRIARS ROAD O.C."
③ Point of minimum vertical clearance

STRUCTURE EXCAVATION (BRIDGE)	745 CY		
STRUCTURE BACKFILL (BRIDGE)	470 CY		
PERVIOUS BACKFILL MATERIAL	105 CY		
CLASS "A" CONCRETE (BRIDGE)	111 CY		
CIP PRESTRESSED CONCRETE	3,770 CY		
BAR REINFORCING STEEL (BRIDGE)	650,000 LBS		
MISCELLANEOUS METAL (BRIDGE)	700 LBS		
TEMPORARY RAILING (TYPE 8)	390 LF		
FURNISHING STEEL PILING (10BP57)	6,080 LF		
DRIVING STEEL PILES (10BP57)	184 EA		
PRESTRESSING CIP CONCRETE	LUMP SUM		
SLOPE PAVING	1,360 SY		
STRIP WATERSTOPS	696 LF		
TEMPORARY RAILING (TYPE 7-F)	754 LF		
CONTRAST TREATMENT	694 SY		
BR APPROACH GUARD RAILING (TYPE 8)	77 LF		
BARRIER RAILING (TYPE 9-11)	432 LF		
BARRIER RAILING (TYPE 12)(5")	446 LF		
CHAIN LINK SIDEWALK RAILING (TYPE 4)	446 LF		

Average Pile Tip Elevations			
Location	Avg Tip	Min	Low
Abut No 1	29.8	21.4	33.5
Bent No 2	15.1	14.6	17.0
Abut No 3	14.6	21.6	8.5

SHEET NO.	TITLE
1.	GENERAL PLAN
2.	GRID GRADES
3.	FOUNDATION PLAN
4.	ABUTMENT 1 & ABUTMENT DETAILS
5.	ABUTMENT 3 & ABUTMENT DETAILS
6.	BENT
7.	BENT FOOTING & COLUMN DETAILS
8.	TYPICAL SECTION
9.	GIRDER LAYOUT
10.	STANDARD UTILITY DETAIL NO. 1
11.	UTILITIES DETAIL NO. 2
12.	BARRIER RAILING TYPE 9-11
13.	BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)
14.	BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)
15.	LOG OF TEST BORINGS

STANDARD PLANS DATED FEBRUARY 1968

B7-1	BOX GIRDER DETAILS NO. 1
B11-9	CHAIN LINK SIDEWALK RAILING, TYPE 4
B11-30	TEMPORARY RAILINGS
B11-42	BARRIER RAILING TYPE 12
B11-43	BARRIER RAILING DETAILS - TYPE 9,10,11 & 12
B13-7	SLOPE PAVING DETAILS TYPE 1
A62-6.2	EXCAVATION & BACKFILL BRIDGES & WALLS - LIMITS OF PAYMENT

DESIGN SECTION 16

STATE OF CALIFORNIA TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOCATED 0.6 MI. N. OF ROUTE 8/395 INTERCHANGE IN THE CITY OF SAN DIEGO IN SAN DIEGO COUNTY

GENERAL PLAN

BRIDGE NO. 57-595 | POST MILE 4.4 | DRAWING NO. 57595-1 | SHEET 1 OF 15

WO 037711
CU 11206

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A1000797

203

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

DIST.	COUNTY	ROUTE	POST MILE/KILO-POSTA PREFIX	SHEET NO.	TOTAL SHEETS
11	SD	395	31/12	204	397

E. F. Harrison
Licensed to Practice Civil Engineering in the State of California
DATE APPROVED December 8, 1970

'F' Line

72.15 72.53 72.88 73.23 73.55 73.87 74.18 74.48 74.78 75.06 75.33 75.59 75.83 76.07 76.28 76.49 76.68 76.86 77.02 77.17 77.30 77.43 77.53 77.63 77.71 77.78 77.82 77.87 77.92 77.92 77.92 77.89 77.86 77.81 77.76 77.69 77.60 77.50 77.39 77.27 77.13 76.97 76.81 76.63

65.97 66.44 66.89 67.33 67.75 68.16 68.56 68.94 69.31 69.67 70.01 70.34 70.65 70.95 71.84 71.51 71.77 72.02 72.25 72.47 72.67 72.86 73.04 73.20 73.35 73.49 73.61 73.72 73.81 73.89 73.96 74.01 74.05 74.08 74.09 74.09 74.07 74.04 74.02 73.98 73.92 73.87 73.79 73.69 73.59 73.45 73.31

17 18 19 20 21 22

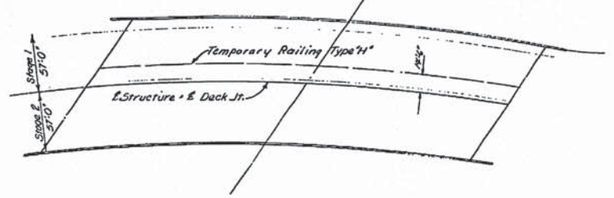
8.8'↑ 50 Lin.↑ 68'↑

Edge of Deck

60.37 60.78 61.09 61.45 61.82 62.19 62.56 62.92 63.30 63.67 64.04 64.41 64.78 65.18 65.50 65.85 66.17 66.49 66.79 67.08 67.35 67.61 67.85 68.09 68.30 68.51 68.70 68.88 69.04 69.19 69.32 69.45 69.55 69.65 69.74 69.80 69.85 69.89 69.91 69.93 69.92 69.91 69.88 69.83 69.78 69.71 69.62

Edge of Deck

Note:
Elevations are figured radially from profile line at 10' stations along 'F' Line.
These elevations do not include camber.



STAGE CONSTRUCTION

AS BUILT
CORRECTIONS BY M.W. Jones CM
CONTRACT NO. 037114
DATE 11-4-70 12-28-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

204

ENGINEERING DEPARTMENT
DESIGN SECTION 16
Project Engineer Orrie Hilburn
DESIGNED W. Orrie Hilburn 6/69
CHECKED Richard A.
DETAILS W. Chiaretti 3/70
CHECKED Dana Sanders
QUANTITIES W. J. Mike Bell
CHECKED Jerry Hill 7/68

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

GRID GRADES

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57-595-13	2	15

WO
CU

Changed plan bearing and/or revision dates → 11/4/70 12/28/70

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [illegible] TITLE Asst.

FILMPDF - www.fastfilm.com
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50' 0 200 400 600
SCALE 1" = 50' 0
SCALE 1" = 50'

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	2.7/6.2	205	351

December 2, 1968

BENCH MARKS

B.M. #61 — Elev. 36.84'
Conc. ℄ Mon. Sta. 78+00.00 P.O.T. "P"
N 220,221.206 E 719,888.557

B.M. # 8-8 — Elev. 46.97'
Conc. ℄ Mon. Sta. 90+50.77 B.C. "P"
N 221,440.168 E 720,167.826

NOTES

- Denotes spot elev.
For Abutment dimensions not shown see Abutment sheet
☼ Denotes electrolier.
+ = Plumb piles ; ‡ = Battered piles.
▭ Denotes Bottom of Footing Elevation.

205

GENERAL NOTES

DESIGN: A.A.S.H.O. DATED 1965 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.

LIVE LOADING: HS20-44 AND ALTERNATIVE

REINFORCED CONCRETE: f_s = 20,000 P.S.I., N = 10
f_c = 1,200 P.S.I.

AS BUILT
CORRECTIONS BY McIlwane
CONTRACT NO. 037714
DATE 11-4-70

CONTOURS CHECKED & VERIFIED IN FIELD
Date: 11/1/68
By: R.P. Davis

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

	DRAWN	CHECKED
DATE	2-28-68	2-28-68
BY	R. FUKUMORI	D.W. McHiluray

DESIGN SECTION 16

FRIARS ROAD OVERCROSSING

FOUNDATION PLAN

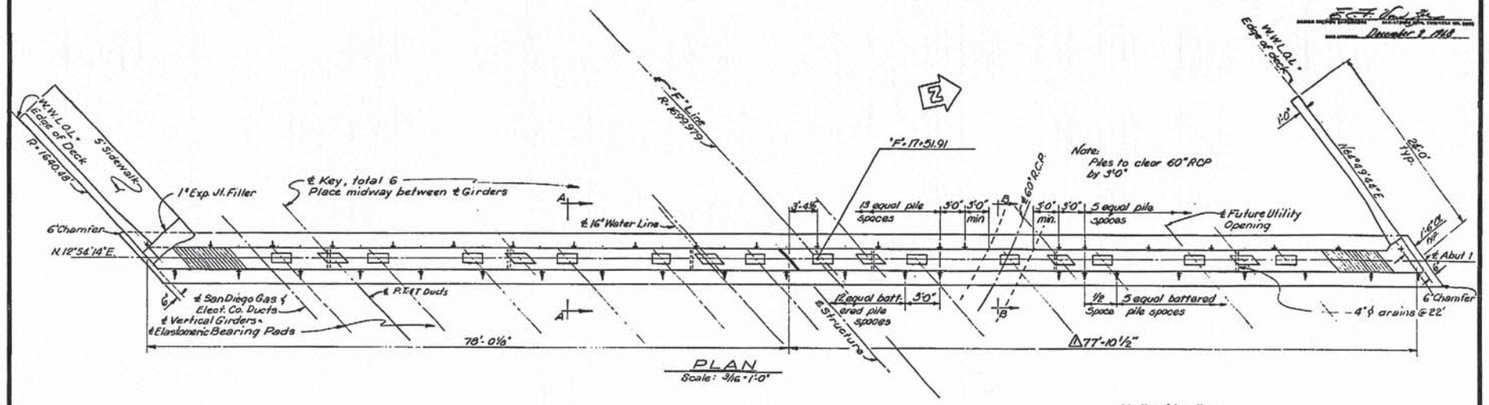
BRIDGE NO. 57-595 | POST MILE 4.4 | SCALE 1" = 20' | SHEET 3 OF 15

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [signature] TITLE H-to II

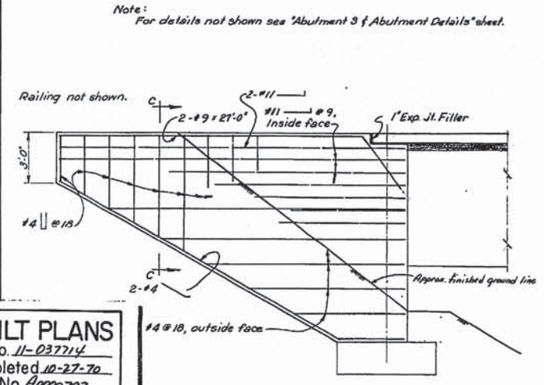
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST.	COUNTY	ROUTE	POST MILES—LOCAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37K.2	204	297

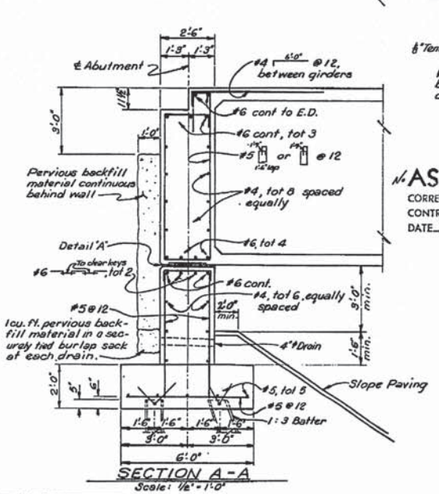
DESIGNED UNDER THE SUPERVISION OF ROBERT L. CONNELLY, REGISTERED CIVIL ENGINEER
DATE APPROVED December 2 1968



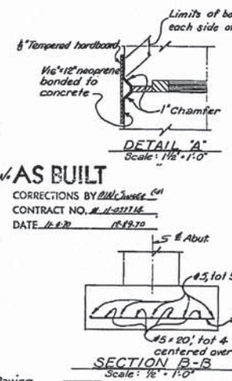
Note: For details not shown see "Abutment 3 & Abutment Details" sheet.



WINGWALL ELEVATION
Scale: 3/8" = 1'-0"

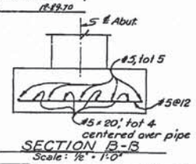


SECTION A-A
Scale: 1/2" = 1'-0"



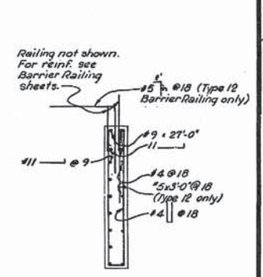
DETAIL "A"
Scale: 1 1/2" = 1'-0"

AS BUILT
CORRECTIONS BY Bill Swede Co
CONTRACT NO. 11-037714
DATE 11-6-70 12-18-70



SECTION B-B
Scale: 1/2" = 1'-0"

Railing not shown. For reinf. see Barrier Railing sheets.



SECTION C-C
Scale: 1/2" = 1'-0"

MARK	DATE	DESCRIPTION	BY	CHK
1	Wilco	Dimension Changed	DMG	EWE

REVISIONS

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

206

DESIGN SECTION 16

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 1 & ABUTMENT DETAILS

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		37595-14	4	13

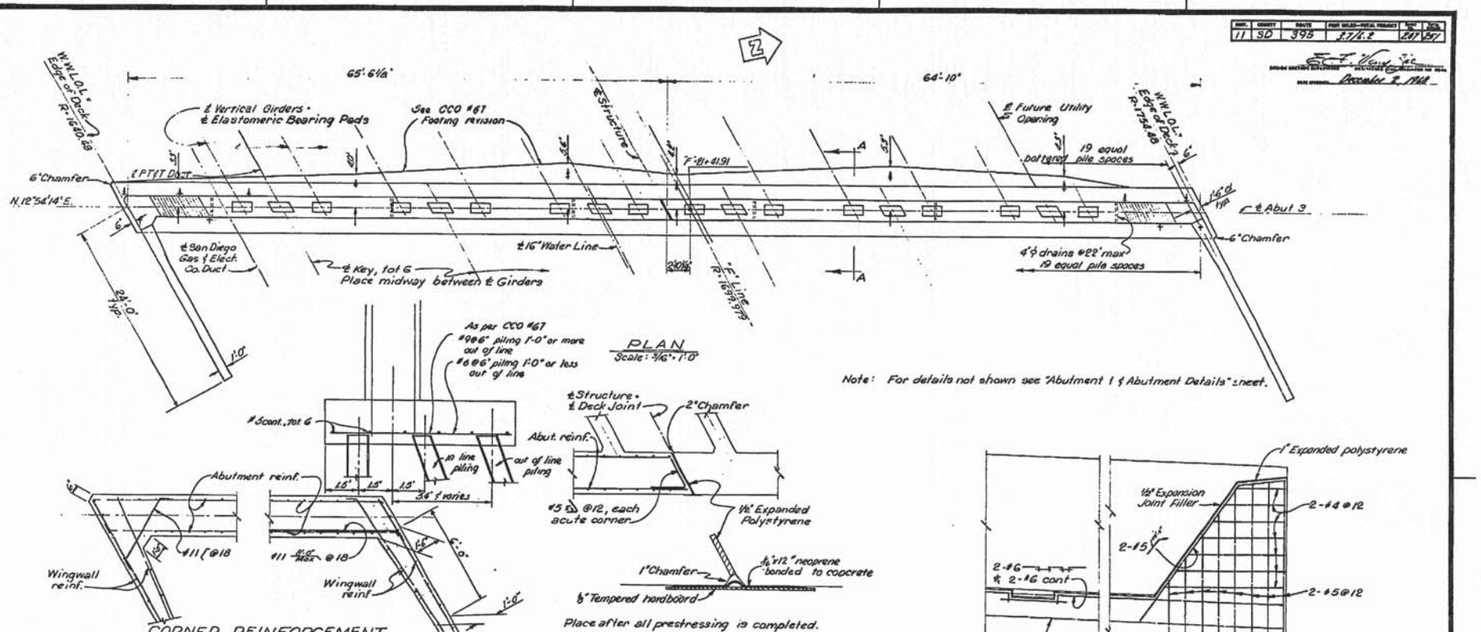
WO CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/01 SIGNATURE [illegible] TITLE [illegible]

DIST.	COUNTY	ROUTE	POST MILES—FISCAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	37/4.2	207	257

E. T. Wolf — Structure Engineer — December 2, 1968



Note: For details not shown see "Abutment 1 & Abutment Details" sheet.

AS BUILT PLANS
Contract No. 11-037214
Date Completed 10-27-70
Document No. A000787

AS BUILT
CORRECTIONS BY Wilsmeyer CM
CONTRACT NO. 11-037214
DATE 11-4-70 11-19-70

DESIGN SECTION 16

Project Engineer	Wm. Hellwig
CHANGES	W. M. Hellwig 9/68
DETAILS	J. Schneider 3/68
QUANTITIES	W. Allen Bullis Drawing 11/68

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 3 & ABUTMENT DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-695		37595-15	5	15

Merged prior bearing seat revision data

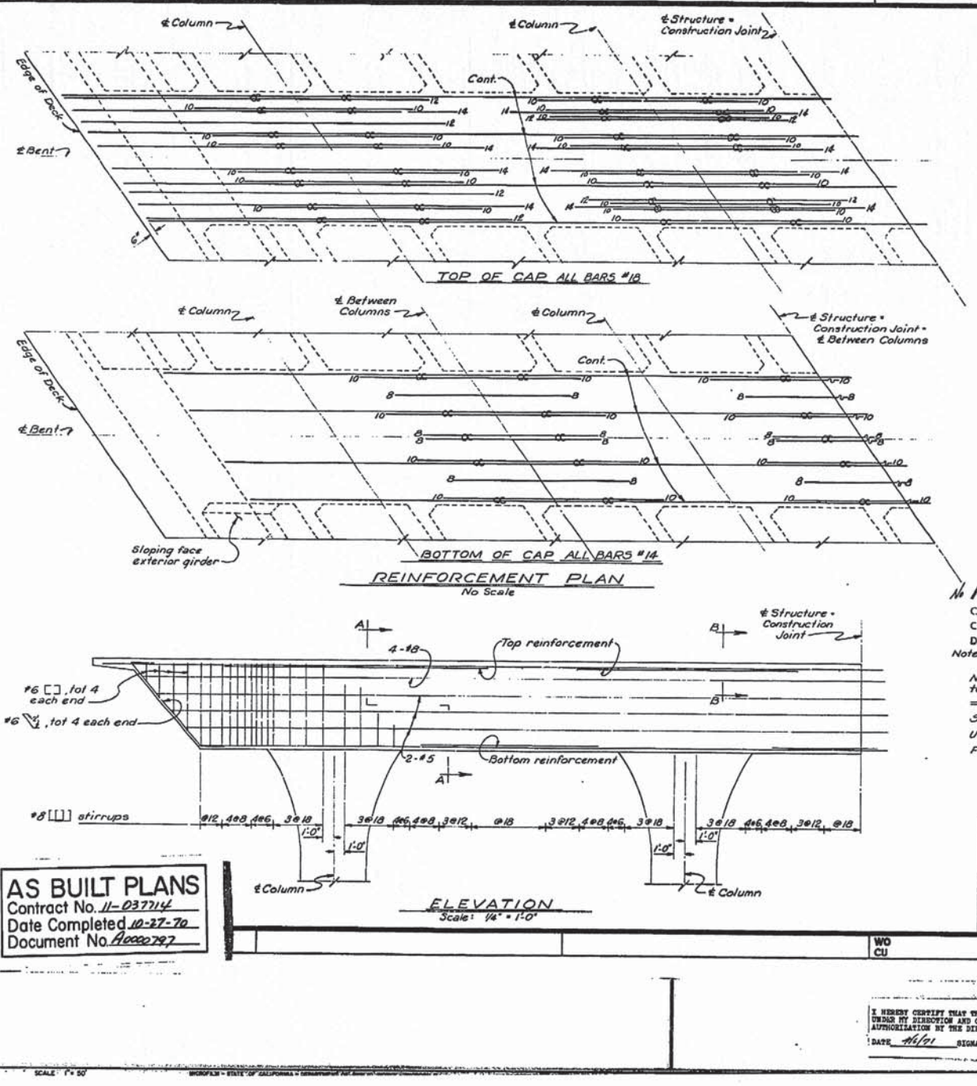
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

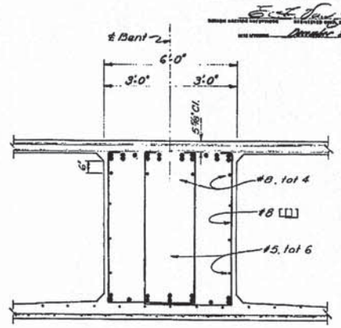
DATE 11/6/01 SIGNATURE [illegible] TITLE Admin

207

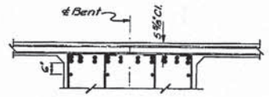
WO CU

SCALE 1" = 50' — SCALE 1" = 50'





SECTION A-A
Scale: 1/2" = 1'-0"



SECTION B-B
Scale: 1/2" = 1'-0"

AS BUILT
CONTRACTOR'S DBA All West Surface
CONTRACT NO. 11-037714
DATE 11-5-70 12-29-70

Note:

Numbers at end of bars indicate distance in feet from ℄ Column for top reinforcement, and from ℄ between Columns for bottom reinforcement.
~~CC~~ indicates bundled bars.
Stage 1 bridge shown; stage 2 bridge similar.
Utility openings not shown. For location see 'Typical Section' sheet.
For Footings and Columns see 'Footing and Column Details' sheet.

DIST.	COUNTY	ROUTE	POST MILE-TOTAL PROJECT	SHT. NO.	TOTAL SHTS.
11	SD	395	31.2/32.7	280	297

BRIDGE DEPARTMENT
DESIGN SECTION 16

Project Engineer	C.M.E. Kilkenny	
DESIGNED	by C.M.E. Kilkenny 6-67	
DETAILED	by Chris Johnson 4-68	
QUANTITIES	by Alan Lamb	
CHECKED	by [illegible] 7-69	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT

DRAWING NO.	37-595	POST MILE	BRIDGE NO.	SHEET	OF
			57585-S	6	15

RECORDED BY: [illegible]
SUBSTANTIAL APPROX. QUANTITY:

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

208

WO
CU

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DATE 4/6/01 SIGNATURE [illegible] TITLE Asst

SCALE: 1" = 50'

DIST.	COUNTY	ROUTE	POST MILE—KILOMETER PREFIX	TOTAL NO.	SHEET NO.
11	SD	395	2.7/4.2	159	160

December 2, 1970

1" polystyrene covered with 1/8" tempered hardboard

4'-0" / 2'-0" / 1'-0"

℄ Bent

#9 x 6'-6", tot 12

COLUMN KEY DETAIL
Scale: 3/8" = 1'-0"

12'-0"
6'-0" 6'-0"
℄ Column
High Point
Level
Soffit Line
10'-0"
B
R = 18'-2"
B.C.
A
2" Chamfer
4'-0"
32'-0" typ.

ELEVATION
Scale: 1/4" = 1'-0"

℄ Column
1'-6" x 3 1/16" key (typ)
3'-6"
#4 @ 6
#4 @ 12
#11 dowels, tot 24
3'-0"
5"

#9, tot 30
#11, tot 32
℄ Bent
15'-0"
7'-6"
7'-6"
7'-6"
15'-0"

FOOTING PLAN
Scale: 1/4" = 1'-0"

℄ Column
1'-0" min. lap
℄ Bent
#4
#11, tot 24

SECTION B-B
Scale: 1/2" = 1'-0"

℄ Column
2" Chamfer (typ.)
#4
℄ Bent
#11, tot 24
2'-0"
2'-0"
4'-0" typ.
3'-0" 3'-0"
6'-0"

SECTION A-A
Scale: 1/2" = 1'-0"

No AS BUILT
CORRECTIONS BY Hill Swan
CONTRACT NO. 11-037114
DATE 11-6-70 12-10-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

DESIGN DEPARTMENT
DESIGN SECTION 16

Project Engineer	Clyde Hilsaay	
DESIGN	In A. Hillsaay 8/68	
	Bridge Engr. W. Saunders	
DETAILED	Chief, Section Hills, Hunter 8/68	
	Bridge Engr. W. Saunders	
QUANTITIES	In C. Allen Hicks	
	Bridge Engr. C. Hilsaay 8/68	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT FOOTING & COLUMN DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	NO. OF SHEETS
57-595		37595-16	7	15

RECORD DATE 8/68 — Changed plan bearing number and date

OPERATING ENGINEER

201

WO
CU

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DATE 11/6/71 SIGNATURE A. J. Lacson TITLE Asst. Engr.

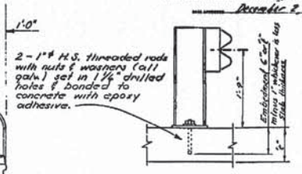
SCALE 1" = 50'

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50'

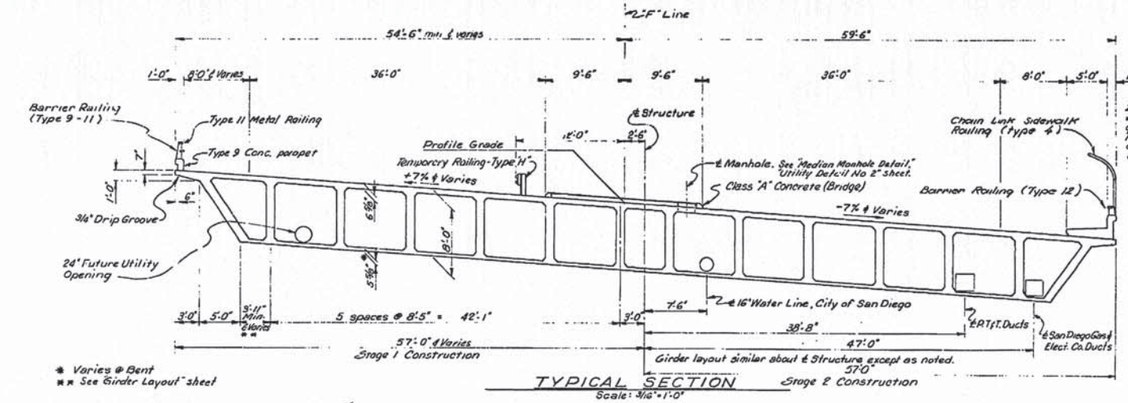
DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	TOTAL SHEETS	SHEET NO.
11	SD	395	37.1/41.2	218	217

Standard Plan No. S3-7 (Formerly Standard No. B3-7)
Dated December 2, 1960

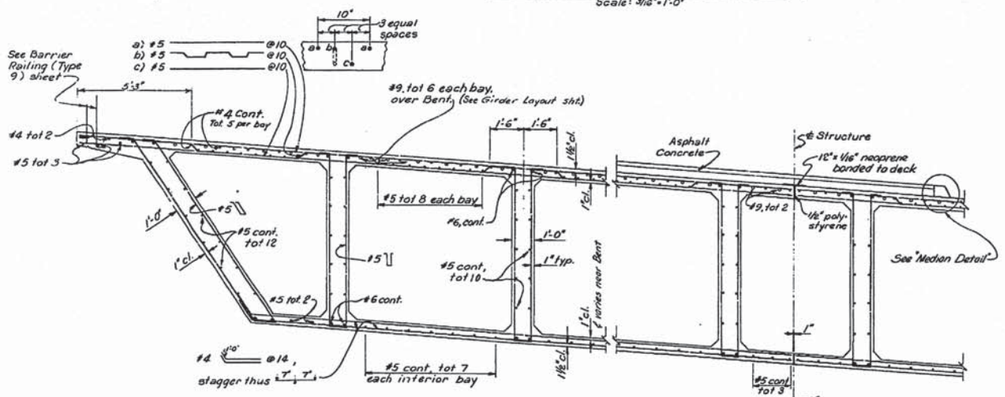


TEMPORARY RAILING - TYPE H
ATTACHMENT DETAIL
NO SCALE
SPECIAL DETAIL

Note
This detail supersedes the type H attachment detail as shown on sheet no. 1311-30 of Standard Plans dated Feb 1968.



TYPICAL SECTION
Scale: 3/16" = 1'-0"



PART SECTION
Scale: 1/2" = 1'-0"

MEDIAN DETAIL
No Scale

PRESTRESSING NOTES

"JACK 18,300 KIPS TOTAL PER 1/2 STRUCTURE (C.L. TO CENTER OF JT.) AT JACKING END.

$A_s = \frac{P_{JACK}}{0.75\ f'_s}$

CONCRETE f'c = 5,100 P.S.I. @ 28 DAYS; f'ci = 3,500 P.S.I. @ TIME OF STRESSING

PRESTRESSING STEEL: THE PRESTRESSING STEEL SHALL BE LOCATED IN THE GIRDER STEMS WITH AN EQUAL FORCE IN EACH STEM. AT THE CONTRACTOR'S OPTION THE PRESTRESSING FORCE MAY VARY TO ± 5% FROM THE THEORETICAL EQUAL FORCE PER GIRDER PROVIDED THE TOTAL P JACK IS OBTAINED AND THE FORCE IS DISTRIBUTED SYMMETRICALLY ABOUT THE ℄ OF THE TYPICAL SECTION. UNITS ARE TO BE TENSIONED A FEW AT A TIME IN EACH STEM IN ORDER TO MINIMIZE THE STRESS DIFFERENTIALS.

CLEARANCE: (1) HORIZONTAL CLEARANCE BETWEEN UNITS = 2 1/2" MIN.
(2) UNITS MAY BE BUNDLED VERTICALLY IN GROUPS OF 3 MAX.
(3) VERTICAL CLEARANCE BETWEEN BUNDLED UNITS = 3" MIN.

GENERAL: (1) P JACK SPECIFIED AT THE JACKING ENDS INCLUDES FRICTION LOSSES AND PROVISION FOR 25,000 P.S.I. LOSS IN STRESS. f's = ULTIMATE TENSILE STRENGTH OF PRESTRESSING STEEL.

(2) TENDONS TO BE JACKED TO 0.75 f's AND ANCHORED WITH AN AVERAGE ANCHORAGE SET OF 1/8" MAXIMUM.

(3) DESIGN IS BASED ON U = 0.25 AND K = 0.0002. CONTRACTOR TO SUBMIT ELONGATION AND JACKING CALCULATIONS BASED ON Uα + KL = 0.109 AND INITIAL STRESS AT @ = 0.896 TIMES JACKING STRESS.

(4) METALLIC ENCLOSURES TO BE GALVANIZED RIGID DUCT.

(5) ENCLOSURES TO BE VENTED THROUGH SLAB WITHIN 3' OF THE HIGH POINTS OF THE CABLE PATH.

(6) DURING STRESSING OPERATIONS, THE ELONGATION SHALL BE CONTINUOUSLY COMPARED WITH GAGE PRESSURE TO CHECK AGAINST TENDON BLOCKAGE AND EXCESSIVE FRICTION.

(7) BAR REINFORCEMENT INTERFERING WITH THE PRESTRESSING TENDON ALIGNMENT SHALL BE ADJUSTED AS DIRECTED BY THE ENGINEER.

AS BUILT
CORRECTIONS BY Mike Swaze CH
CONTRACT NO. 11-037714
DATE 11-6-70 12-28-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0090797

210

DESIGN SECTION 16
Project Engineer Orrie Hilvesey
DESIGN Orrie Hilvesey 4/68
DETAILS Mike Swaze 4/68
QUANTITIES Alex Sutter 4/68
Checked Joseph L. Flint 4/68

TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING
TYPICAL SECTION

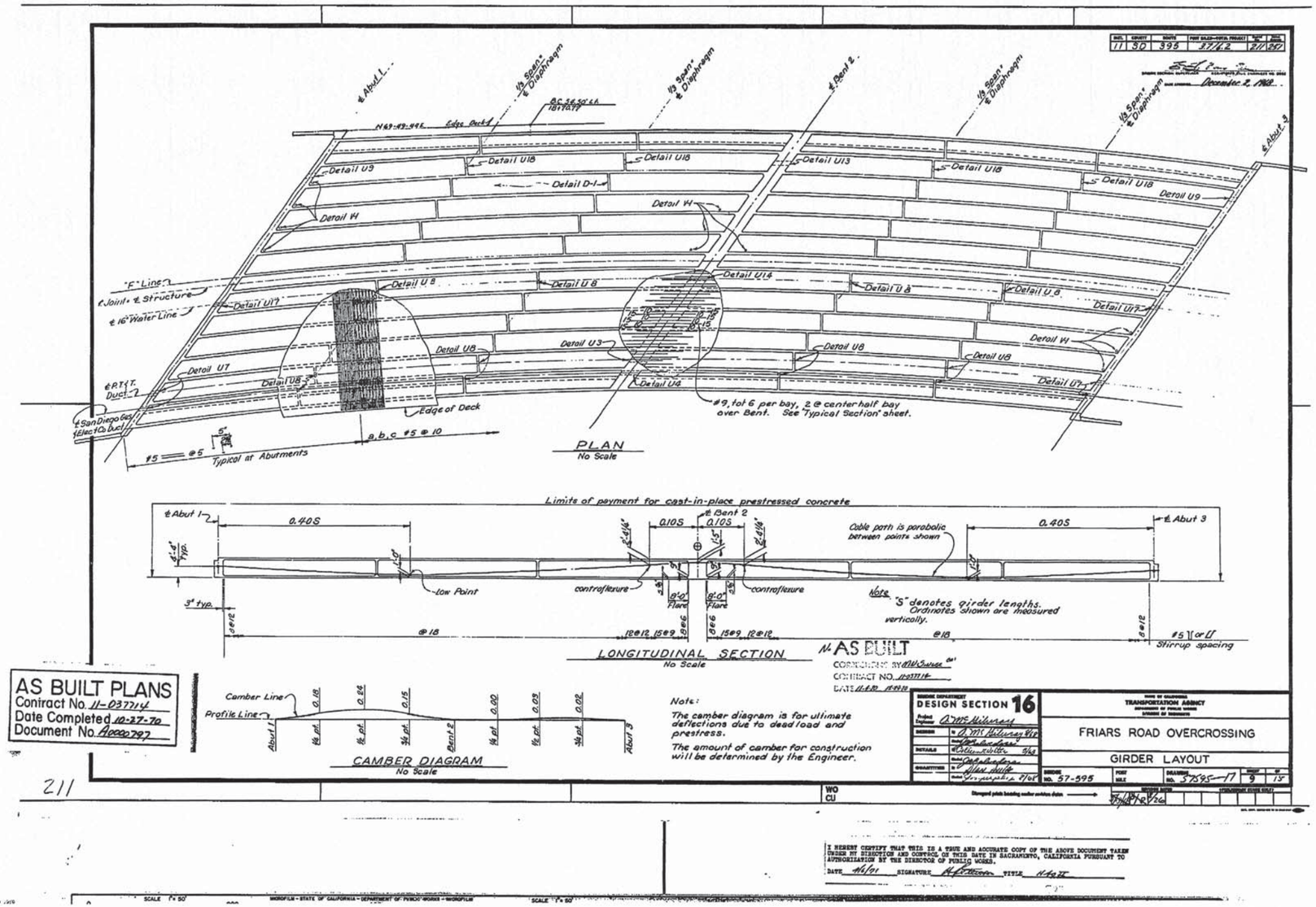
DISTRICT	ROUTE	DRAWING NO.	SHEET	OF
11	395	57595-4	8	15

DESIGNED UNDER THE SUPERVISION OF Orrie Hilvesey
DATE 4/68
REGISTERED CIVIL ENGINEER

WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [illegible] TITLE Assoc

FILMED - [illegible]
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

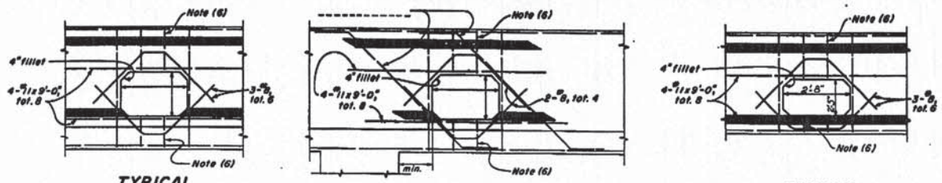


I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

DIST	COUNTY	ROUTE	POST MILE	TOTAL PROJECT	SHEET	DATE
11	SD	395	17.7/R.7		1/14	12/65

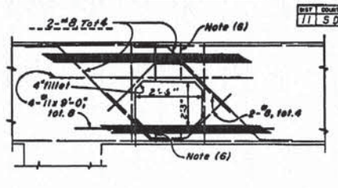
December 7, 1965



TYPICAL
DETAIL U1

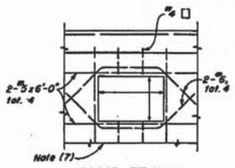
NEAR COLUMN
DETAIL U2

TYPICAL
DETAIL U3

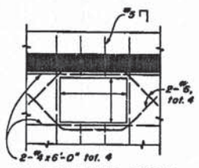


NEAR COLUMN
DETAIL U4

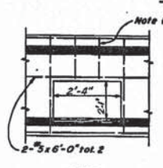
BENT CAP



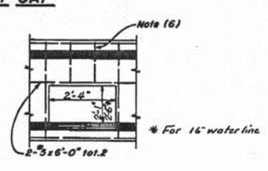
RIGID FRAME
DETAIL U5



CANTILEVER TYPE
DETAIL U6



END
DETAIL U7

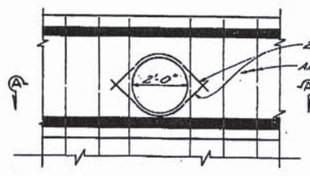


INTERMEDIATE
DETAIL U8

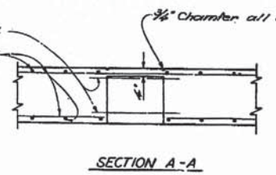
ABUTMENT BACKWALL

DIAPHRAGMS

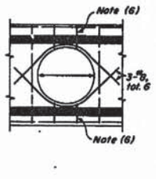
AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797



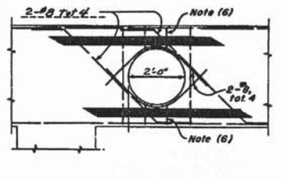
DETAIL U-9



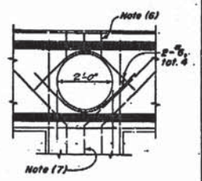
SECTION A-A



TYPICAL
DETAIL U12

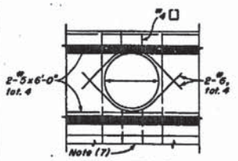


NEAR COLUMN
DETAIL U13

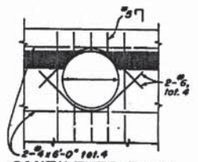


AT COLUMN
DETAIL U14

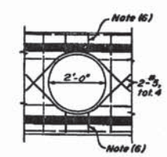
BENT CAP



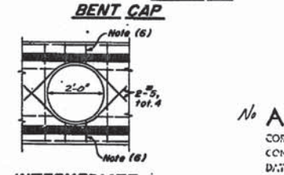
RIGID FRAME
DETAIL U15



CANTILEVER TYPE
DETAIL U16



END
DETAIL U17



INTERMEDIATE
DETAIL U18

ABUTMENT BACKWALL

DIAPHRAGMS

NOTES

(1) For exact location and direction of openings see other sheets.
(2) Location and size of utility openings may be modified as directed by the Engineer, provided minimum dimensions are maintained.
(3) Girders not shown, see other sheets.
(4) Seal around utilities at abutments to be of sufficient strength to withstand earth pressure.
(5) All reinforcement detailed to be placed in addition to reinforcement shown on other sheets.
(6) Stirrups are same size as adjacent stirrups shown on other sheets.
(7) Join reinforcement to clear opening as detailed on other sheets.

No AS BUILT
CORRECTIONS BY Williams Bros
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

MARK	DATE	REVISION	BY	CHK
1	12-6-66	Detail U-9 Added	MS	WC
		REVISED PILES		
		REV. JWS		

4/65

STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

XS 16-49

FRIARS ROAD OVERCROSSING

STANDARD UTILITY DETAIL NO.1 — BOX GIRDER

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	OF
57-595		57595-18	10	15

W.O.

Dropped prints belong under maroon date

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

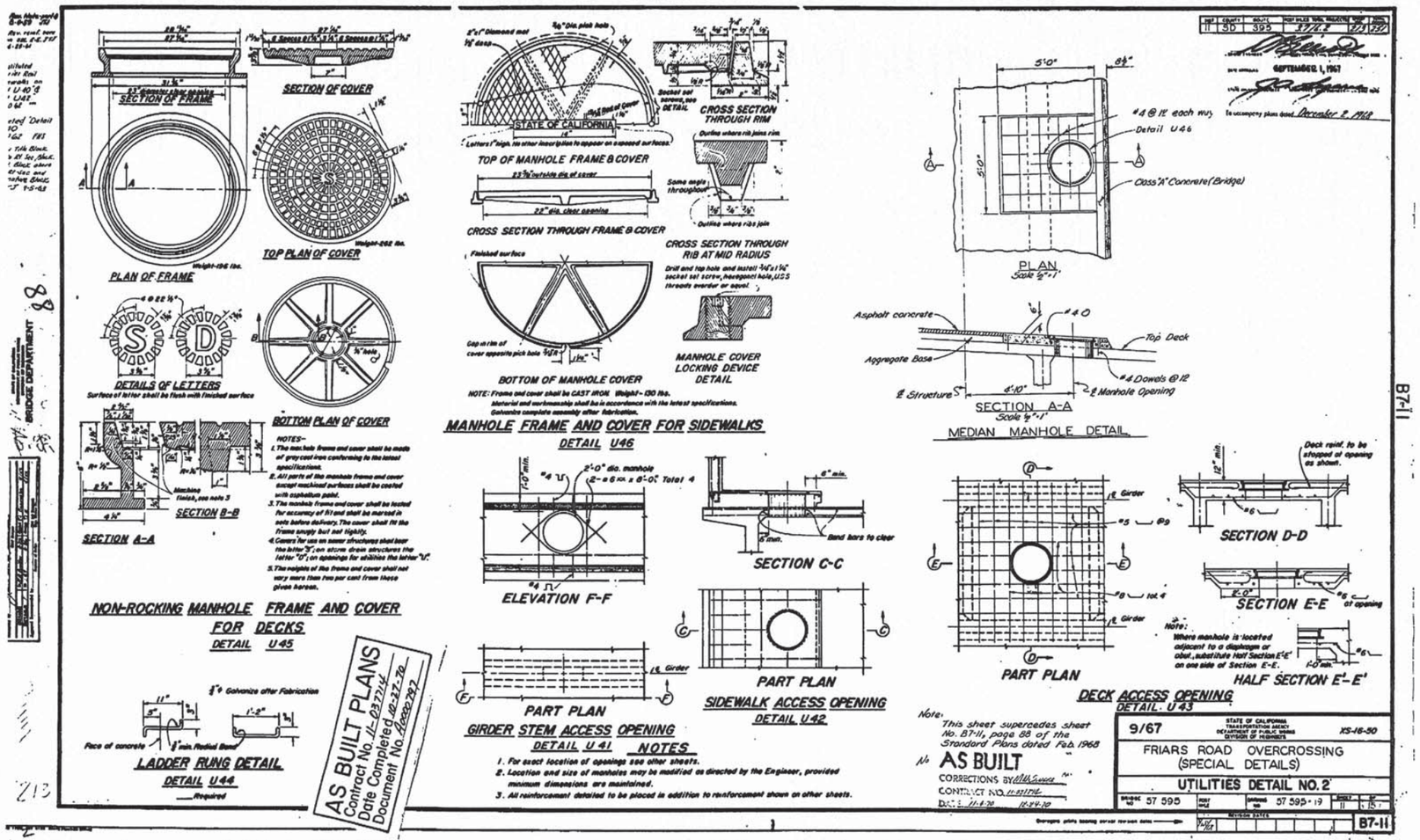
DATE 4/6/01 SIGNATURE [signature] TITLE Assoc

STANDARD DRAWING
Approved for Publication
Chief Engineer
Dec. 1965
Sheet 2 of 2 Sheets
Bridge Department

Alan J. Bell Associates
4/6/01 dp
Caution Retain Details
Detail No. "DETAIL U5, U6 and U8" SHEETS 2,3

212

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM



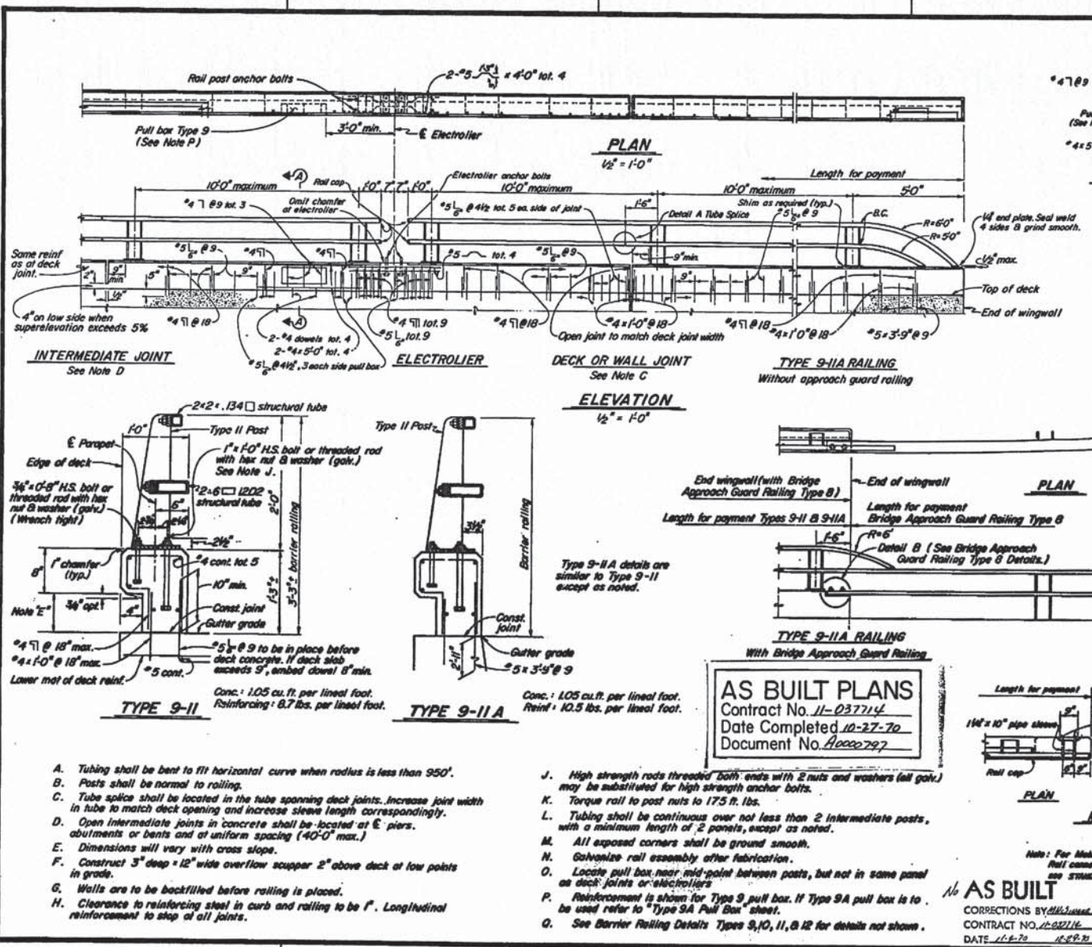
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/71 SIGNATURE [signature] TITLE [illegible]

B7-11

DIST	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	3.7/4.2	214	250

December 2, 1968



AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

A. Tubing shall be bent to fit horizontal curve when radius is less than 950'.
B. Posts shall be normal to railing.
C. Tube splice shall be located in the tube spanning deck joints. Increase joint width in tube to match deck opening and increase sleeve length correspondingly.
D. Open intermediate joints in concrete shall be located at ℄ piers, abutments or bents and at uniform spacing (40'-0" max.)
E. Dimensions will vary with cross slope.
F. Construct 3" deep x 12" wide overflow scupper 2" above deck at low points in grade.
G. Walls are to be backfilled before railing is placed.
H. Clearance to reinforcing steel in curb and railing to be 1". Longitudinal reinforcement to step at all joints.
J. High strength rods threaded both ends with 2 nuts and washers (all galv.) may be substituted for high strength anchor bolts.
K. Torque rail to post nuts to 175 ft. lbs.
L. Tubing shall be continuous over not less than 2 intermediate posts, with a minimum length of 2 panels, except as noted.
M. All exposed corners shall be ground smooth.
N. Galvanize rail assembly after fabrication.
O. Locate pull box near mid-point between posts, but not in same panel as deck joints or electroliers
P. Reinforcement is shown for Type 9 pull box. If Type 9A pull box is to be used refer to "Type 9A Pull Box" sheet.
Q. See Barrier Railing Details Types 9, 10, 11, & 12 for details not shown.

No AS BUILT
CORRECTIONS BY Miscellaneous
CONTRACT NO. 11-037114
DATE 11-6-70 11-29-71

STANDARD DRAWING
DEC. 1968
RS-1
Revised 1-1-69
Revised 1-1-70
Revised 1-1-71

214

7/68
STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS
XS-9-95

FRIARS ROAD OVERCROSSING

BARRIER RAILING TYPE 9-11

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-20	12	15

WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 11/1/71 SIGNATURE [illegible] TITLE [illegible]

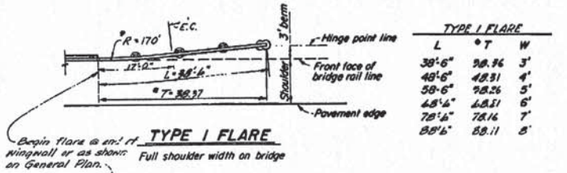
SCALE 1" = 50'
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37.4.2	2/6	2/7

December 2, 1969

TYPE 1 FLARE

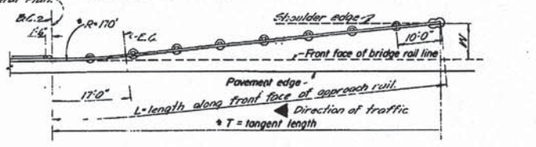
Full shoulder width on bridge



TYPE 1 FLARE		
L	T	W
38'-6"	38.36	3'
48'-6"	48.31	4'
58'-6"	58.26	5'
68'-6"	68.21	6'
78'-6"	78.16	7'
88'-6"	88.11	8'

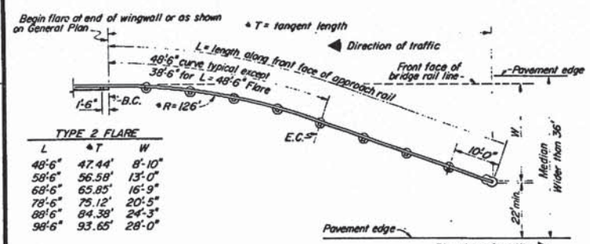
TYPE 1 FLARE

Reduced shoulder width on bridge (right or left)



TYPE 2 FLARE

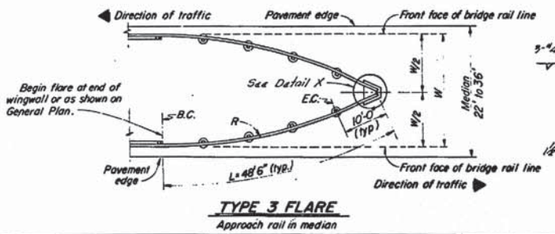
Approach rail in median

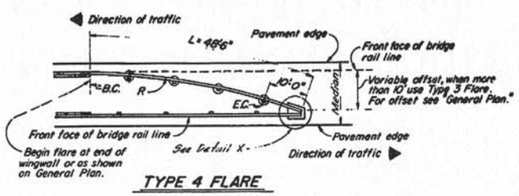


TYPE 2 FLARE		
L	T	W
48'-6"	47.44'	8'-10"
58'-6"	56.58'	13'-0"
68'-6"	65.85'	16'-9"
78'-6"	75.12'	20'-5"
89'-6"	84.38'	24'-3"
98'-6"	93.65'	28'-0"

TYPE 3 FLARE

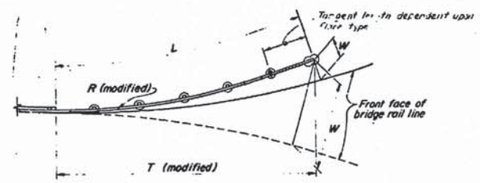
Approach rail in median





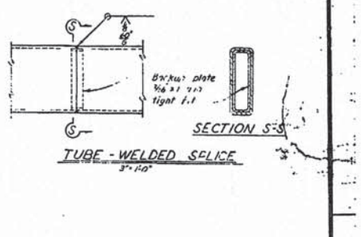
TYPE 4 FLARE

Approach rail in median



FLARE LAYOUT ON CURVED ROADWAY

Note: W is radial to front face of bridge rail line
Railing shown for roadway curve to left

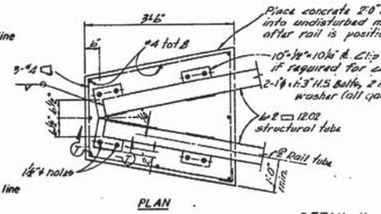


TUBE - WELDED SPLICE

3" I.D.

Notes:

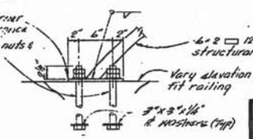
A. Tubing shall be shop bent or fabricated to fit horizontal curves of less than 950' radius.
B. Posts shall be vertical and spaced at 10'-0" c.c. max.
C. Top of rail elevations to be determined by the Engineer unless shown on the plans.
D. Torque rail to post nuts to 175 ft. lbs.
E. No more than one tube splice per panel is permitted.
F. All exposed edges shall be ground smooth.
G. Galvanize rail assembly after fabrication.
H. For details not shown see "Barrier Railing" sheet.
J. Front face of bridge rail line is parallel or concentric to pavement edge.
K. Dimensions marked ℄ are valid for tangent roadway alignment only. Modify for curved roadway.
L. R for Type 3 & 4 Flare must be calculated for each offset.



PLAN

DETAIL X

No Scale



SECTION T-T

AS BUILT
CONSTRUCTION BY Mid County Const.
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-87

FRIARS ROAD OVERCROSSING

BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-21	13	15

WORKING DATES

STANDARD DRAWING

215

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE Asst.

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50' SCALE 1"=20'

DIST	COUNTY	ROUTE	POST MILE/KILOMETER	SHEET NO.	TOTAL SHEETS
11	SD	395	7.7/12.4	216	267

December 2, 1968

DETAIL B
1½"=1'-0"

SECTION N-N

SECTION B-B
1½"=1'-0"

Top of rail grade to be adjusted to provide smooth railing profile

12'-6" post spacing (typ)

8"x6" tube

End of wingwall or as shown on General Plan

Top tube and cap with chain link fence (Type 6)

Approach rail curb to be used when there is no approach sidewalk or approach curb.

PLAN

Pay limit

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

10'-0" post (typ)

Tube splice detail

Pay limit Bridge Approach, Pay limit Type 11 (12), Guard Railing Type 8 (typ)

½" R seal weld & sides & grind smooth

R=3'-0"

Detail B

Match elevation

ELEVATION

CONNECT TO TYPE 11 (12)

See "End Anchorage Details"

L 4"x3"x½" structural tube

BRIDGE APPROACH GUARD RAILING TYPE 8
½"=1'-0"

L 4"x3"x½"x1'-1" long with 1⅛" ø holes

Tube

Cap end of tube

2-1"ø x 1'-0" Hex Bolts with hex nut and washer (galv.)

1⅛" x 1⅜" slotted holes in tube. Place on thin layer of grout

⅜" spiral @ 3" pitch with 3 turns @ top

⅜" tot. 8

2'-0"

2'-6"

2'-9"

2'-6"

2-1"ø H.S. Bolts, 2 hex nuts & washer (all galv.)

L 4"x3"x½" structural tube

1'-0"

1'-0"

Place concrete after rail is positioned

(8"x8"x½" R. washer (Typ)

ELEVATION

TYPE 1 & 2 FLARE
END ANCHORAGE DETAILS
1½"=1'-0"

9'-6"ø

8" R

8" Rail tube

⅝" mm. thickness

1⅛"ø hole

6"x4½"x1'-6" ℄'s

PLAN

SHIM DETAILS
1½"=1'-0"

1⅛" x 1⅜" slotted holes

⅝" R

Rolled bar 2"x6"x0'-8"

ELEVATION

SECTION H-H

RAIL POST DETAILS
1½"=1'-0"

SECTION D-D

1⅛"ø holes

End of wingwall or as shown on General Plan

Pay limit Type 10

Approach rail curb to be used when there is no approach sidewalk or approach curb

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

PLAN

Match elevation

ELEVATION

CONNECT TO TYPE 10

5'-0" Type 11 (12)
2'-0" Type 10

For tube to post connection details see "Barrier Railing Details" sheet

Match height of bridge curb

Approach rail curb

1'-4"x1'-4"x¾" bolt tot 3 with washer & hex nut (all galv.)

Anchor bolt template

⅜" spiral @ 3" pitch with 3 turns @ top

SECTION A-A
½"=1'-0"

End of wingwall or as shown on General Plan

PLAN

Pay limit Bridge Approach, Guard Railing Type 8

Pay limit Type 9

Detail B

ELEVATION

CONNECT TO TYPE 9

1'-0" R

48 Tot. 12

⅝" spiral @ 5" pitch with 3 turns @ top

1'-4"

1"x 9½" H.S. bolt with nut & 2 washers

Top of Railing Tube

ELEVATION

1⅛"ø holes

1⅛"x4" slotted hole in tube - bottom side only

VIEW L-L

PLATE - PLAN VIEW

TUBE SPLICE DETAILS
1½"=1'-0"

8"x 8½"x ⅝" thick with 1⅛"ø hole

⅝"ø rod

ANCHOR BOLT TEMPLATE
1½"=1'-0"

SECTION C-C
Scale: 3"=1'-0"

1/4 AS BUILT
CORRECTIONS BY Bill Sweet
CONTRACT NO. 11-037114
DATE 11-6-70 12-29-70

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-83	
FRIARS ROAD OVERCROSSING			
BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)			
DESIGNED 57-395	DRAWN	CHECKED 57595-22	16 / 15

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT DRAWN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

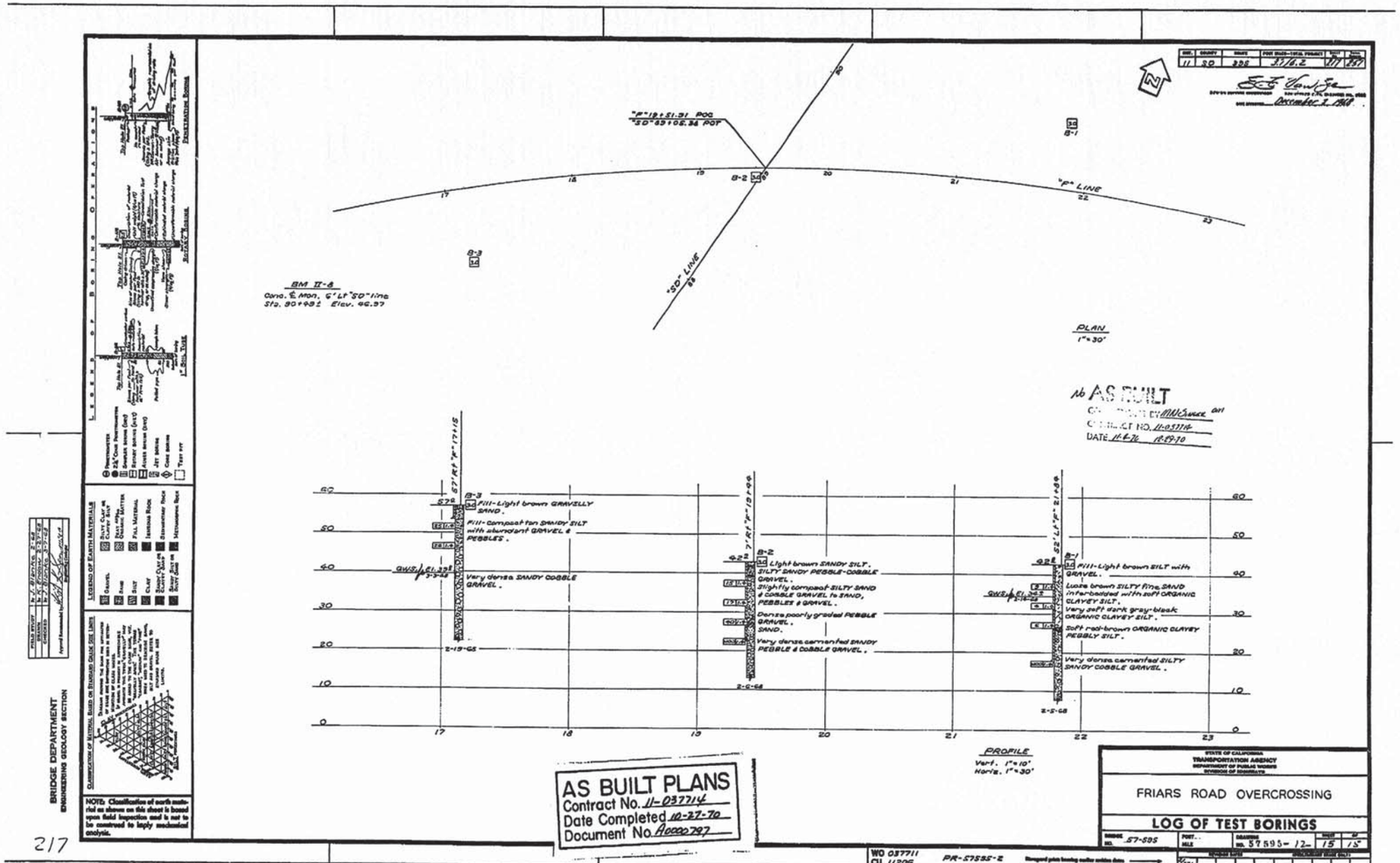
DATE 4/6/01 SIGNATURE M. E. Cooper TITLE Li-Aide

216

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50'

0 100 200 400 600



AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

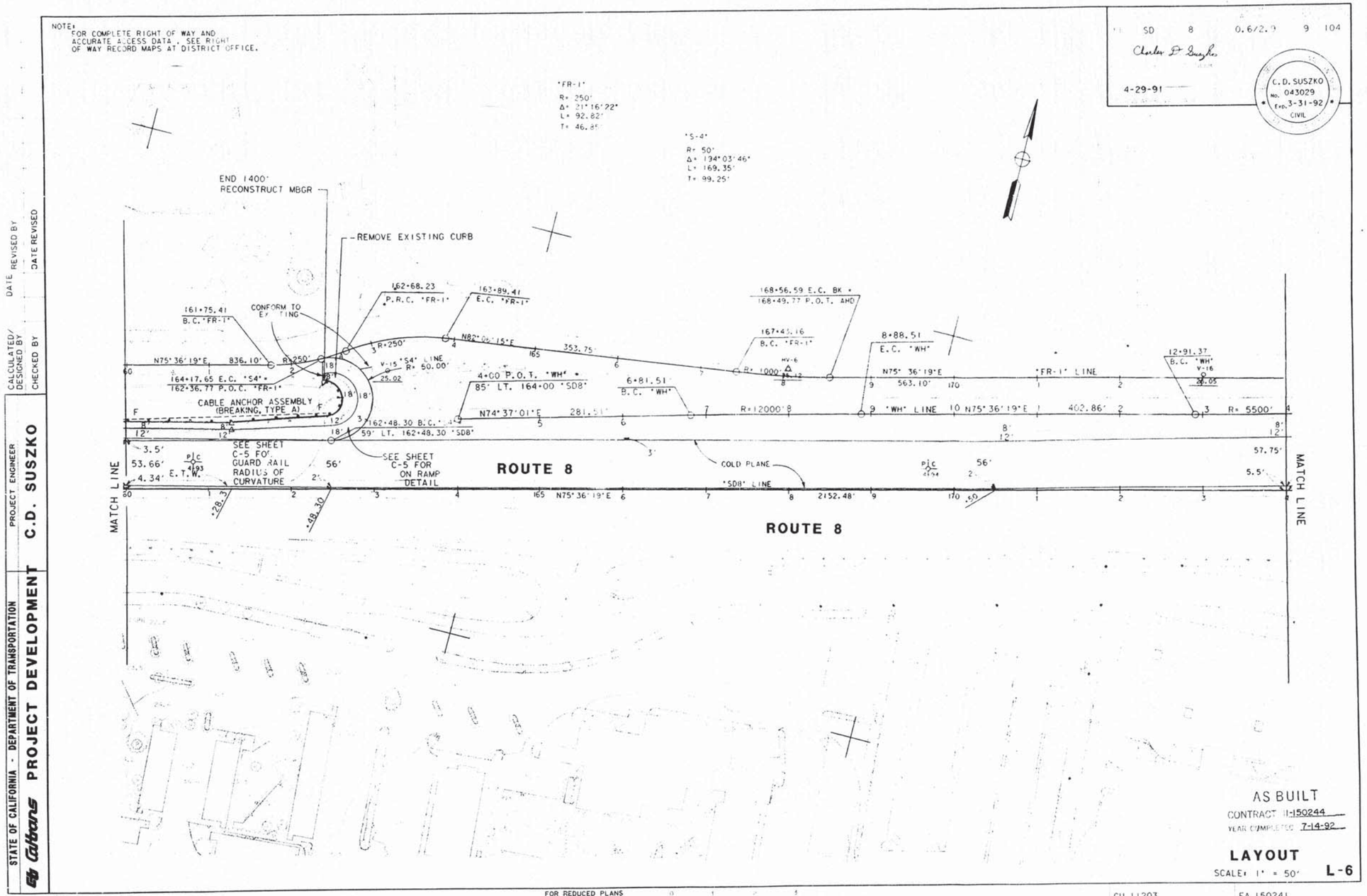
BRIDGE NO. 57-595 | DRAWING NO. 57595-12 | SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

217

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE HAgII



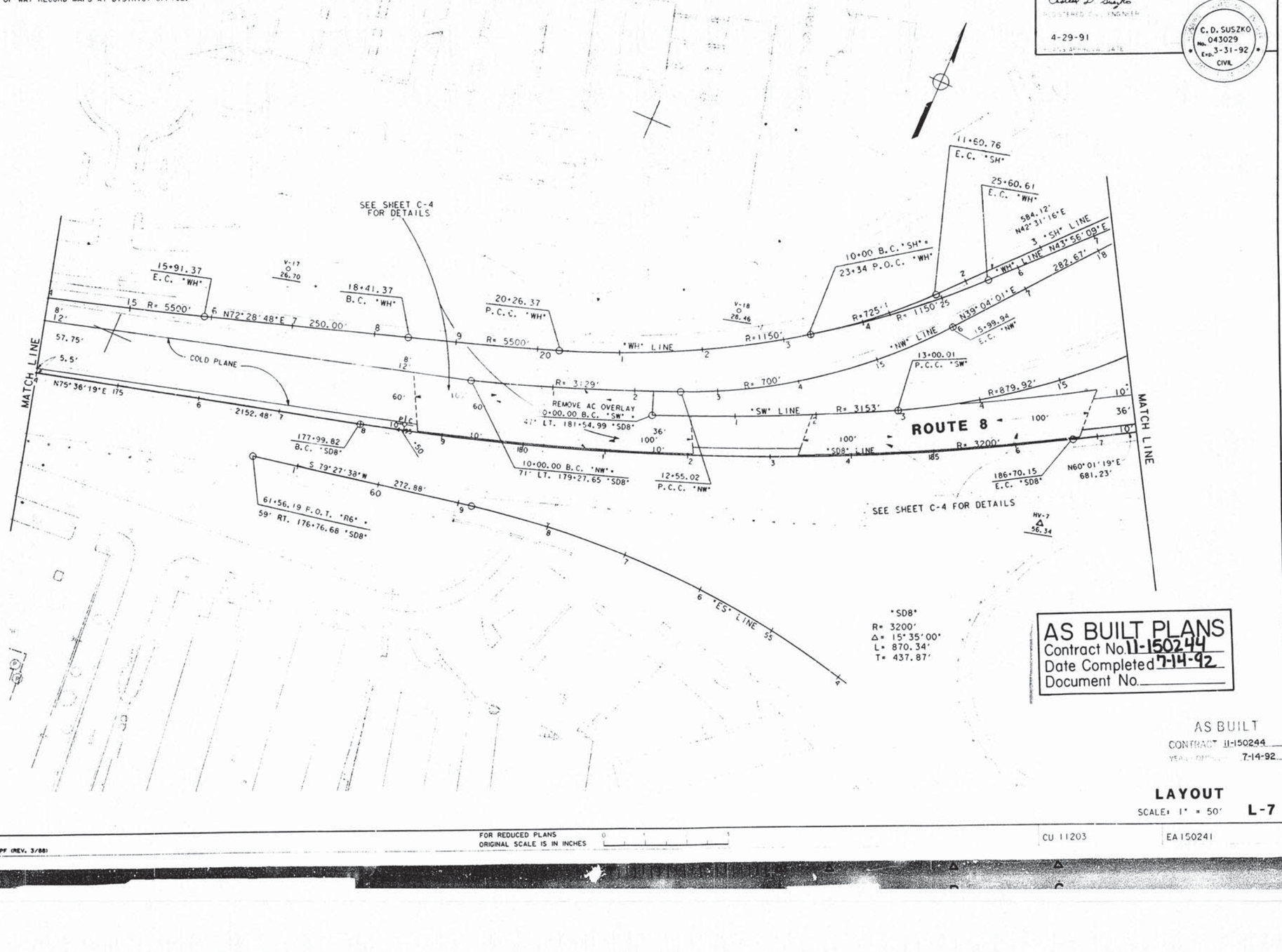
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11	SD	8	0.6/2.9	10	104

Charles D Suszko
REGISTERED CIVIL ENGINEER
4-29-91
DATE

C. D. SUSZKO
043029
No.
Exp. 3-31-92
CIVIL



AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
7-14-92

LAYOUT
SCALE: 1" = 50' **L-7**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans **PROJECT DEVELOPMENT**
PROJECT ENGINEER **C.D. SUSZKO**
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11 SD 8 0.6/2.9 11 104

Charles D Suszko

4-29-91

C. D. SUSZKO
No. 043029
Exp. 3-31-92
CIVIL

18+82.61 P.O.T. "NW"
12' RT. 27+80.29 P.O.T. "WH"

17+44.89
B.C. "SW"

28+33.87
B.C. "WH"

584.12'

"SW" LINE

R= 500'

N17°46'19"E

"SW" LINE

31+28.87
P.C.C. "WH"

R= 700'

19+89.19
E.C. "SW"

"WH" LINE

R= 1000'

34+10.01
E.C. "WH"

N42°31'16"E

N43°36'09"E

"NW"

N84°11'24"E 200.00'

35+68.25 P.O.T. "WH"
68+43.09 B.C. "R-1R"

36+10.01
B.C. "WH"

37+80.80
E.C. "WH"

R= 1000'

N74°24'16"E 9 "WH" LINE 40 395.63'

"WN" LINE 6 R= 500'

R= 879.92'

R= 600'

"WS" LINE

62+31.15
E.C. "WS"

N77°01'06"E

ROUTE 163

MATCH LINE

REMOVE AC OVERLAY

N60°01'19"E

"SD8" LINE 681.23'

COLD PLANE

193+51.38
B.C. "SD8"

ROUTE 8

R= 2500'

66+57.34 P.O.T. "WS"
47' LT. 198+20.01 P.O.C. "SD8"

199+68.09
E.C. "SD8"

N74°09'21"E

199+68.33 P.O.T. "SD8" BK.
1+99.50 P.O.T. "SD8" AHD.

MATCH LINE

SEE SHEET C-4 FOR DETAILS

"SD8"
R= 2500'
Δ= 14°08'02"
L= 616.71'
T= 309.93'

SEE SHEET C-4 FOR DETAILS

AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
YEAR COMPLETED 7-14-92

LAYOUT
SCALE: 1" = 50' L-8

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO

CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	132	162

Ramin Rasheda
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI, No. 37070, Exp. 6-30-98, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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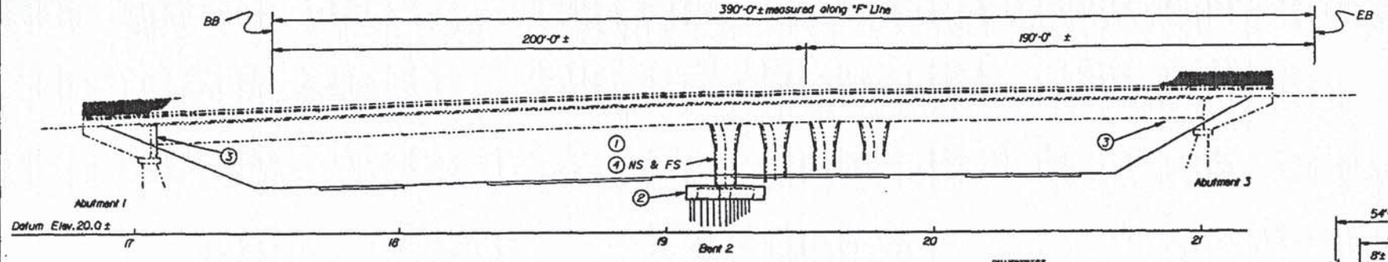


ELEVATION
1"=20'

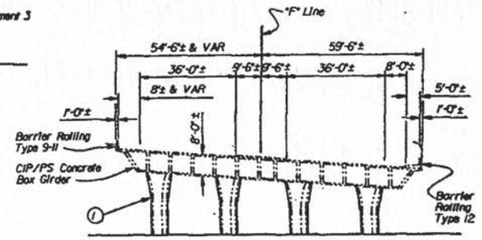
PILE DATA - STEEL HP PILES

Location/Type	Design Loading (Service)	Nominal Resistance		Design & Specified Tip Elevation
		Compression	Tension	
Bent 2/HP10x57	70 Tons	250 kips	130 kips	10.0 (1),(2)

Design Tip Elevation is controlled by the following demands: (1) Compression, (2) Tension.

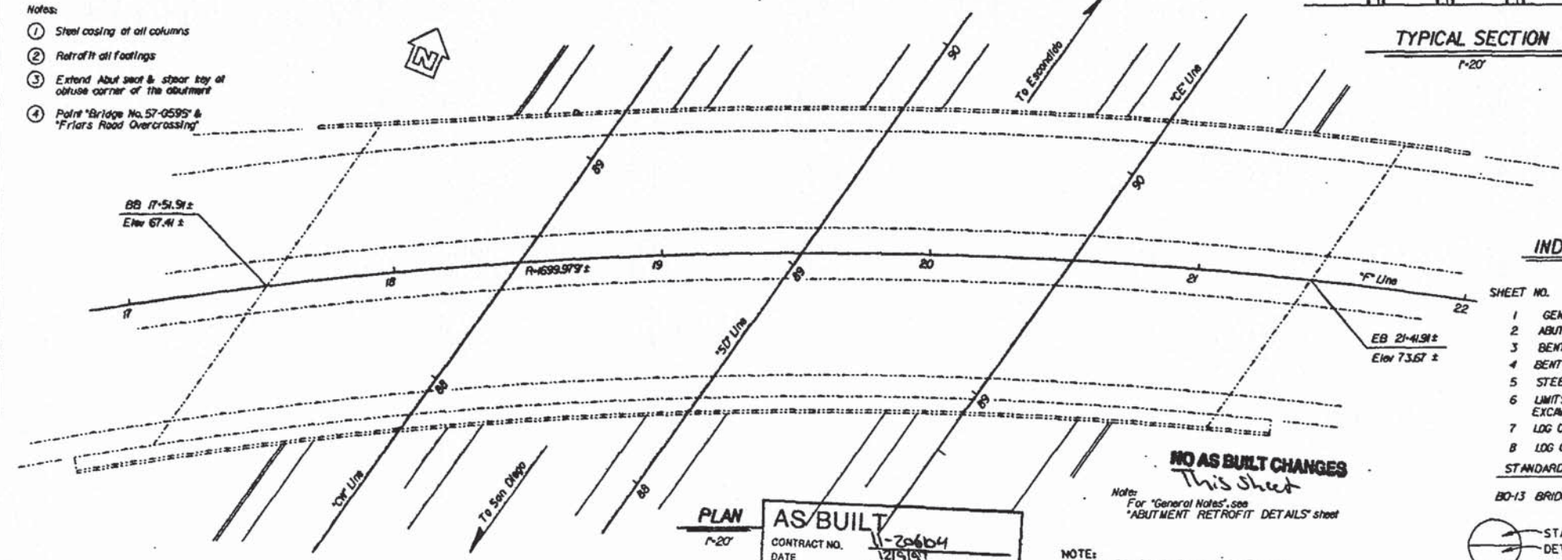
QUANTITIES

	LUMP SUM	
BRIDGE REMOVAL (PORTION), LOCATION C	LUMP SUM	
STRUCTURE EXCAVATION (BRIDGE)	572	CY
STRUCTURE BACKFILL (BRIDGE)	196	CY
FURNISH STEEL PILING (HP 10 X 57)	900	LF
DRIVE STEEL PILE (HP 10 X 57)	32	EA
STRUCTURAL CONCRETE, BRIDGE FOOTING	400	CY
STRUCTURAL CONCRETE, BRIDGE	15	CY
DRILL AND BOND DOWEL	1,460	LF
BAR REINFORCING STEEL, (BRIDGE)	94,900	LB
ASPHALT MEMBRANE WATERPROOFING	110	SQFT
COLUMN CASING	45,900	LB



TYPICAL SECTION
1"=20'

Notes:
1. Steel casing at all columns
2. Retrofit all footings
3. Extend Abut seat & shear key at obtuse corner of the abutment
4. Point "Bridge No. 57-0595" & "Friars Road Overcrossing"



INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN
2	ABUTMENT RETROFIT DETAILS
3	BENT RETROFIT DETAILS
4	BENT FOOTING RETROFIT DETAILS
5	STEEL COLUMN CASINGS
6	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS
7	LOG OF TEST BORINGS 1 OF 2
8	LOG OF TEST BORINGS 2 OF 2

STANDARD PLANS DATED JULY 1992

BD-13 BRIDGE DETAILS

STANDARD PLAN SHEET NO.
DETAIL NO.

PLAN
1"=20'

AS BUILT
CONTRACT NO. 11-206104
DATE 12/9/97
CORRECTIONS BY [signature] Smith-Emery Co. Contractors

NO AS BUILT CHANGES This Sheet

Note: For "General Notes", see "ABUTMENT RETROFIT DETAILS" sheet

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

DESIGN ENGINEER

DESIGN	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	LOAD FACTOR DESIGN			
DETAILS	BY Jim Murphy/E. Tapalla	CHECKED Elias Kurani	LAYOUT	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.Y. Le	SPECIFICATIONS	BY Jill Sewell	PLANS AND SPECS COMPARED Jill Sewell	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	POST MILE
57-0595	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

GENERAL PLAN

REVISION DATES (PRELIMINARY STAGE ONLY)								SHEET	OF
5-3-96	5-7-96	5-21-96	5-28-96	6-3-96	6-4-96	6-5-96	6-6-96	1	8

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DATE PLOTTED => 30-JAN-1996
TIME PLOTTED => 14:36

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	133	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER
RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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GENERAL NOTES
LOAD FACTOR DESIGN

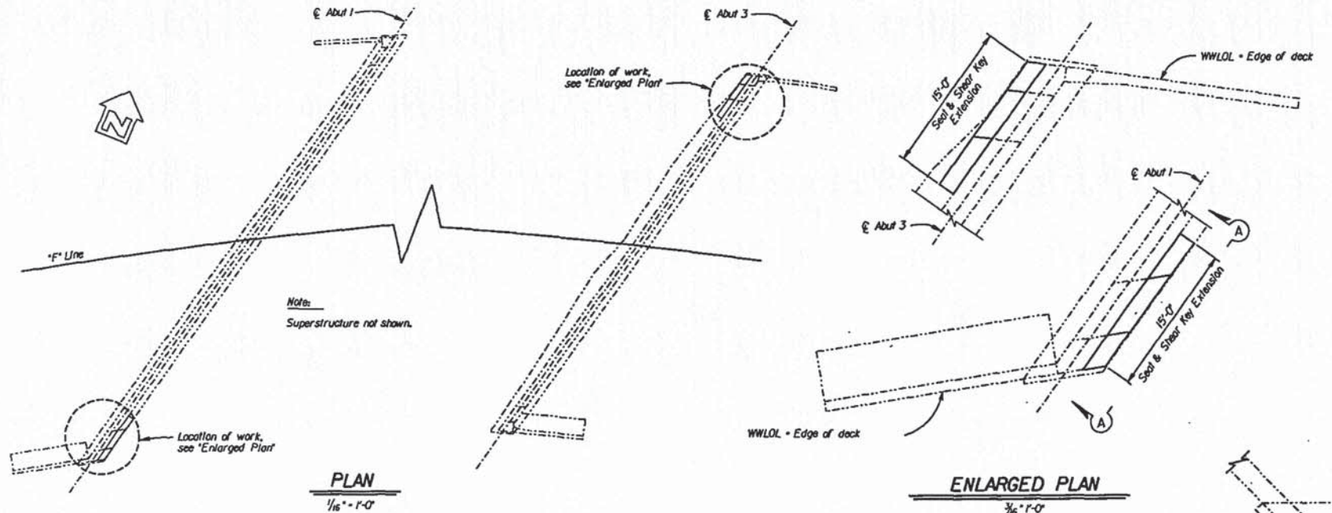
DESIGN: BRIDGE DESIGN SPECIFICATIONS (1983 AASHTO with Interims and Revisions by CALTRANS)

SEISMIC LOADING: Peak Rock Acceleration = 0.6 g
Depth of Alluvium 80-150 ft.

REINFORCED CONCRETE: (EXIST) f_y = 40,000 psi
f'_c = 5,000 psi (assumed)

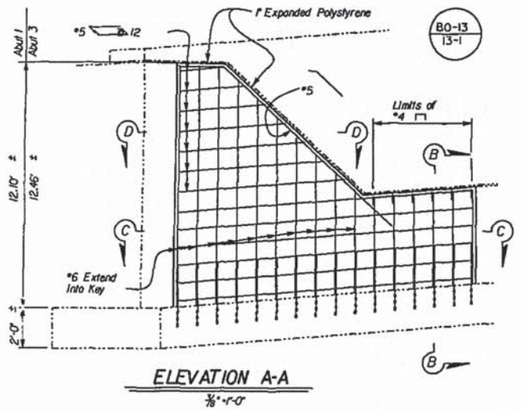
(NEW CONST) f_s = 60,000 psi
f'_c = 4,000 psi

STRUCTURAL STEEL: f_y = 36,000 psi



PLAN
1/16" = 1'-0"

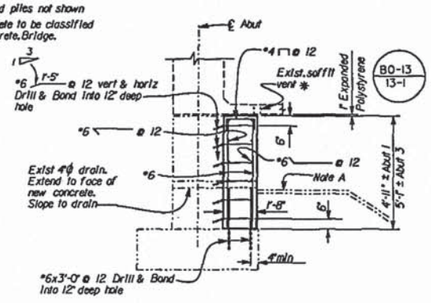
ENLARGED PLAN
3/16" = 1'-0"



ELEVATION A-A
3/8" = 1'-0"

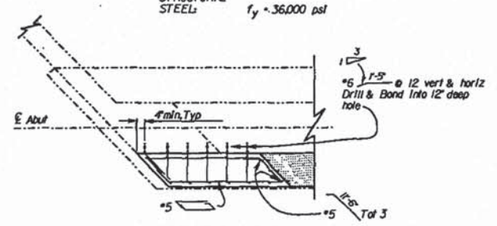
Notes:
*Elevation A-A (Abutment 1) shown, Abutment 3 similar
Barrier railing and piles not shown
All additional concrete to be classified as Structural Concrete, Bridge.

* For Vent Detail see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet.

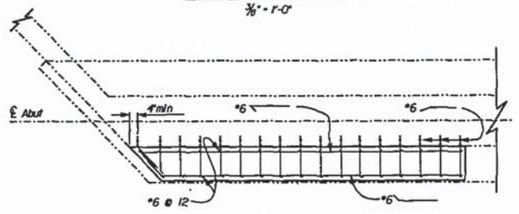


SECTION B-B
3/8" = 1'-0"

Note A:
Remove and replace slope paving. For details, see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet



SECTION D-D
3/8" = 1'-0"



SECTION C-C
3/8" = 1'-0"

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
ABUTMENT RETROFIT DETAILS

	BY	CHECKED
DESIGN	J. Casillari	H. Banakdar/E. Kuroni
DETAILS	K. Endow/D. Kubochi	H. Banakdar/E. Kuroni
QUANTITIES	J. Victor	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 2

DS 0130 2039 (CADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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28-JAN-1998 13:

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163.805	4.4/7.0, 20.5/20.7	134	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER RAMIN RASHEDI No. 37070 Exp. 6-30-08 CIVIL STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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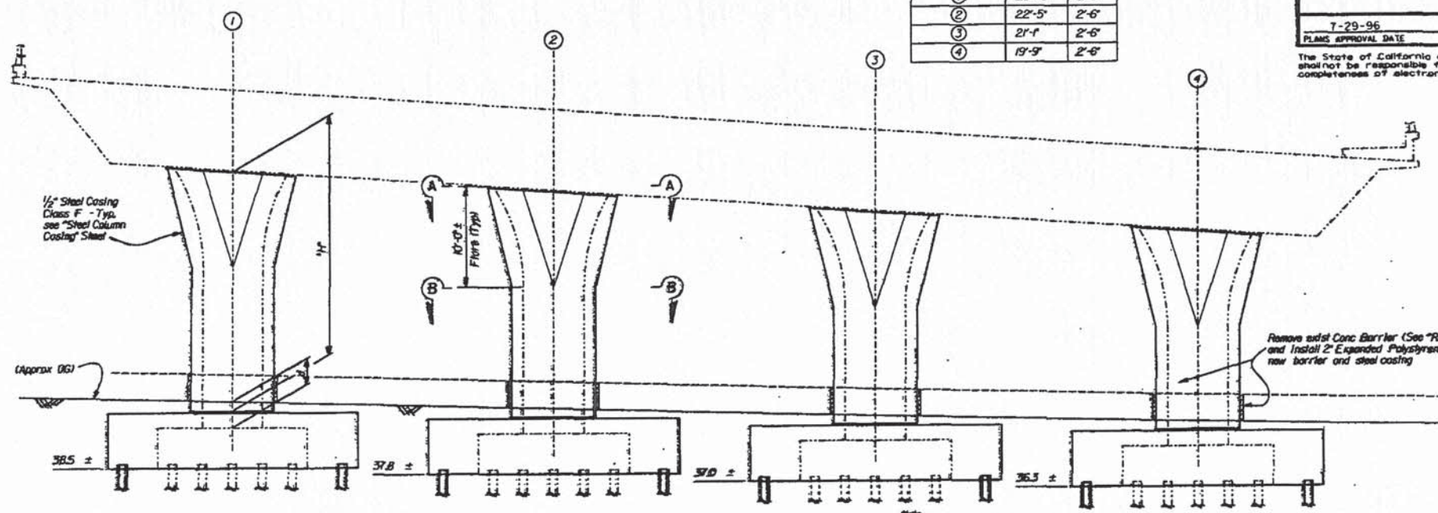
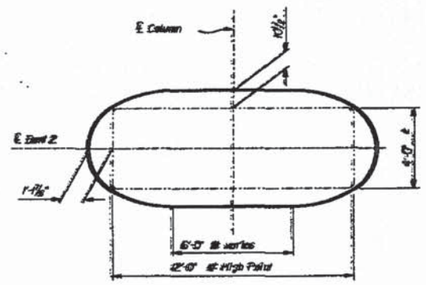
TABLE

COLUMN NO.	H±	d±
1	23'-10"	2'-8"
2	22'-5"	2'-6"
3	21'-1"	2'-6"
4	19'-9"	2'-6"

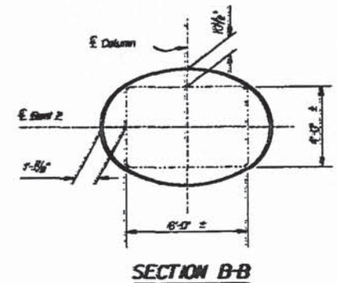


BENT ELEVATION
3/16" = 1'-0"

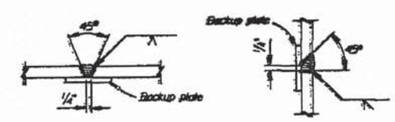
Note:
- For Concrete Barrier replacement, see "ROAD PLANS".
- Casing varies linearly between beginning and end of column flare



SECTION A-A
3/8" = 1'-0"



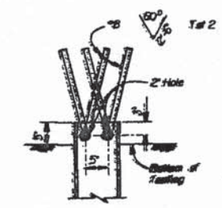
SECTION B-B
3/8" = 1'-0"



SINGLE VEE-GROOVE
SINGLE BEVEL-GROOVE

PILE WELDING DETAIL-BUTT JOINTS

Notes:
1. Single Vee-Groove permitted for all positions.
2. Single Bevel-Groove permitted for horizontal joints only.



STEEL PILE ANCHOR

NOTE:
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NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT RETROFIT DETAILS

DESIGN	BY J. Cavalieri	CHECKED H. Bonakdar/E. Kurani	
DETAILS	BY K. Endow/C. H. Mamerli	CHECKED H. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.T. Le	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 3 OF 8

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

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DATE PLOTTED => 28-Jul-1996
TIME PLOTTED => 14:40

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.1/0.0 20.5/20.7	135	162

Ramin Rasheed
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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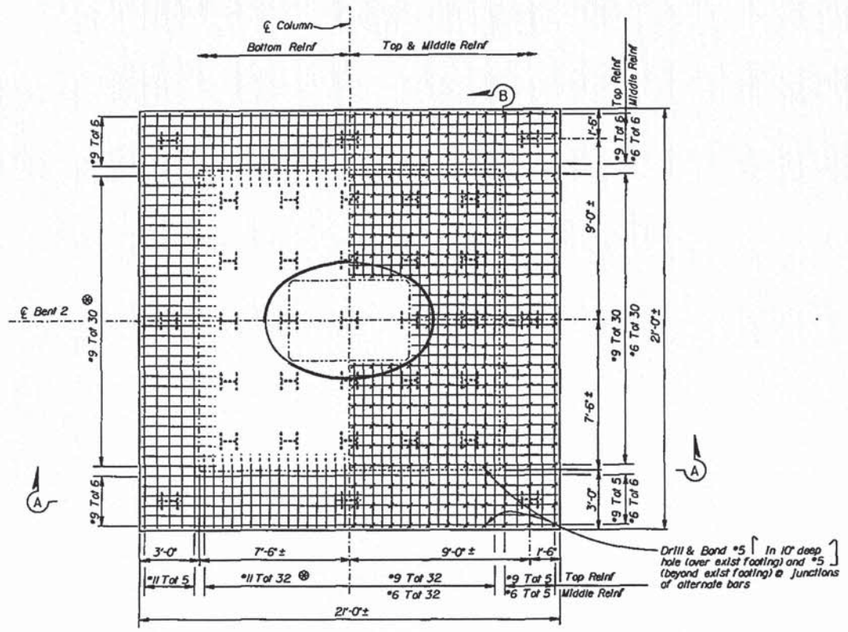
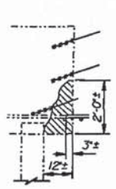
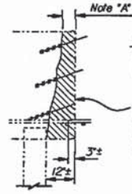


TYPICAL FOOTING PLAN
3/8" = 1'-0"

⊗ Butt weld to exist



ALTERNATIVE 1



ALTERNATIVE 2

DETAIL "A"
No Scale

Note "A"
Dimension may be increased up to 12" at Contractors option.

Remove portion of exist ftg to allow for extension of exist reinf by butt weld - do not remove beyond edge of exist piles

Notes:

All additional concrete around ftgs. is to be classified as Structural Concrete, Bridge Footing.

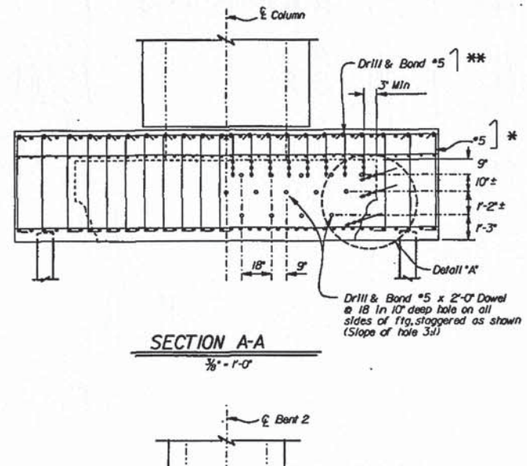
Footing reinforcement and dimensions symmetrical about ℄ Column and ℄ Bent.

Mechanical butt splices may be used in lieu of butt welds noted.

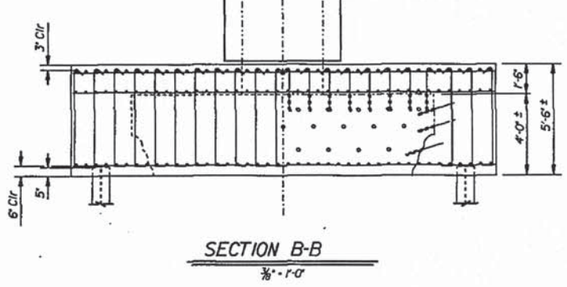
Roughen interface between existing and new footing concrete to an amplitude of 1/4"

For pile details, see "Bent Retrofit Details" Sheet.

* Hook outer bars
** If Alternative 2 of Detail "A" is used first row of drill & bond ties are to be replaced with full height ties similar those in ftg extension



SECTION A-A
3/8" = 1'-0"



SECTION B-B
3/8" = 1'-0"

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

NO AS BUILT CHANGES

DESIGN	BY J. Camilleri	CHECKED	H. Banakdar/E. Kurani
DETAILS	BY E. Endow/E. Tapalla	CHECKED	H. Banakdar/E. Kurani
QUANTITIES	BY J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	57-0595
POST MILE	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT FOOTING RETROFIT DETAILS

DS 050 2139 ICADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 4 OF 8

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DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 14:40

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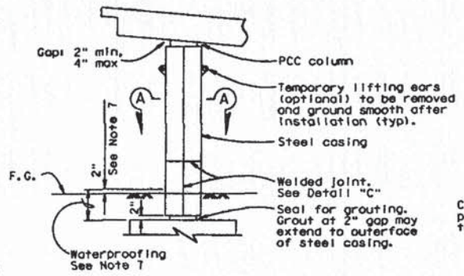
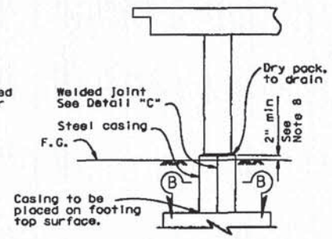
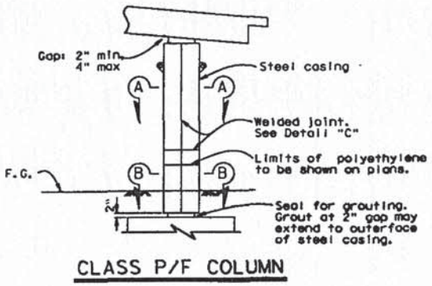
RELEASED 8-12-93



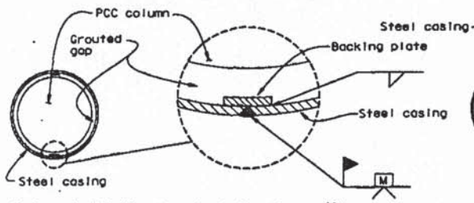
CLASS F COLUMN



CLASS P COLUMN

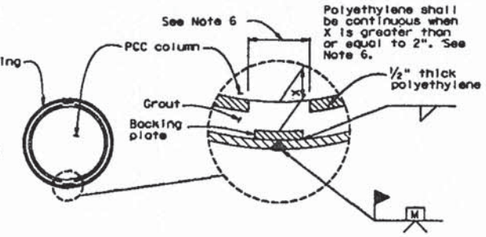


CLASS P/F COLUMN



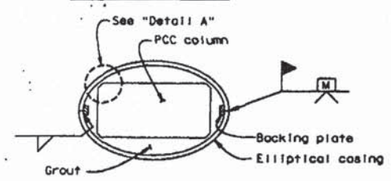
Minimum inside diameter of steel casing = 1½" greater than nominal column diameter for Class F and 2½" for Class P/F.

SECTION A-A
ROUND COLUMN



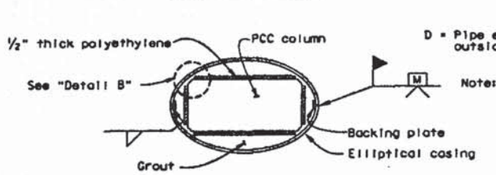
Minimum inside diameter of steel casing = 2½" greater than nominal column diameter for Class P and Class P/F.

SECTION B-B
ROUND COLUMN



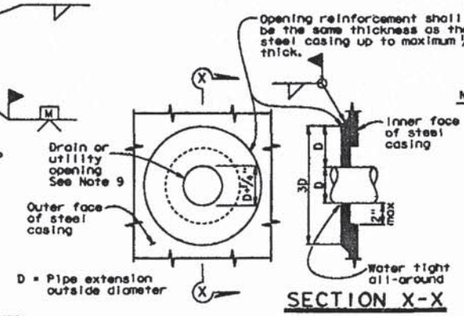
SECTION A-A
RECTANGULAR COLUMN

DETAIL A



SECTION B-B
RECTANGULAR COLUMN

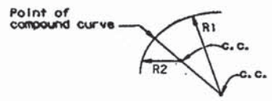
DETAIL B



SECTION X-X

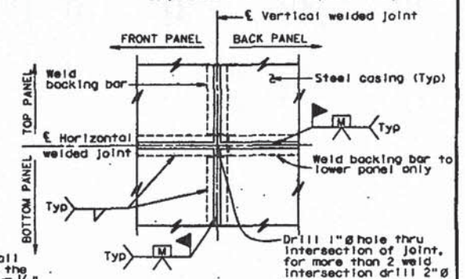
Note: Opening reinforcement required for drain or utility openings larger than 4".

CASING OPENING
No scale



Radii R1 & R2 to be determined by the Contractor subject to the approval of the Engineer.

ELLIPTICAL CASING DETAIL
CLASS P, F AND P/F COLUMN



(TWO WELDED INTERSECTION JOINT)
DETAIL C
No Scale

Notes:

1) For varying thickness steel casing inside surface to remain flush. Minimum clearance from PCC column to casing shall be maintained.
2) Appropriate injection nozzles to be provided on casing, but removed and ground flush following completion of grouting operation.
3) All voids between steel casing and polyethylene (Class P and Class P/F), and steel casing and PCC column (Class F) to be filled with grout.
4) Location and number of vertical and horizontal welds to be determined by the Contractor, and subject to the approval of the Engineer. The location of casing welds are for illustration. No skip welds allowed.
5) Circular steel casing to be ¼" thick minimum for casings with a 4'-4" diameter or less; all other steel casings to be ⅜" thick unless noted differently on contract plans. Backing plates to be the same thickness as casing up to maximum ½" thick.
6) Contractor shall remove 12" polyethylene strip behind backing plate if backing plate is closer than 1½" from polyethylene.
7) Waterproof limits for steel casings. Typical for Types "P", "F" and "P/F".
8) Minimum length of Types "P" and "F" casing shall be 1.50 times the largest dimension of prismatic section of column, or 2" above finished grade whichever is greater. Lengths other than the specified minimum shall be shown on Detail sheets.
9) For pipe extensions, opening shall be no more than ¼" greater than the pipe extension diameter. For other openings, the opening diameter to be determined by the Engineer.

NO AS BUILT CHANGES

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/1.0 20.5/20.7	136	162

Ronna Rabeder
REGISTERED ENGINEER - CIVIL
No. 37870 Exp. 6-30-98 CIVIL STATE OF CALIFORNIA
7-29-96
PLANS APPROVAL DATE

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

DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 16:45

EARTHQUAKE RETROFIT PROJECT NO. 272
FRIARS ROAD OVERCROSSING
STEEL COLUMN CASINGS

STANDARD DRAWING			
FILE NO. XS 12-77	DESIGN BY BRIAN MAHONEY	CHECKED R. J. ZELINSKI	APPROVED RECOMMENDED BY
DRAWING DATE 8/93	DETAILS BY K. CHRISTOPHER	CHECKED PAT HIPLEY	
	SUBMITTED BY R. J. ZELINSKI		

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO. 57-0595
POST MILE 4.4

OVERLEAF PRINTS BEARING EARLIER REVISION DATES ——— BY

REVISION DATES (PRELIMINARY STAGE ONLY)
2-96

SHEET 5 OF 8

USERNAME => TSDKD
S_steel_002143954

DS 050 DATA ICADD 10/89

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

ClibPDF - www.fastio.com

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	137	162

Ramin Rasheen
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER — RAMIN RASHEEN — No. 37070 — Exp. 6-30-00 — CIVIL — STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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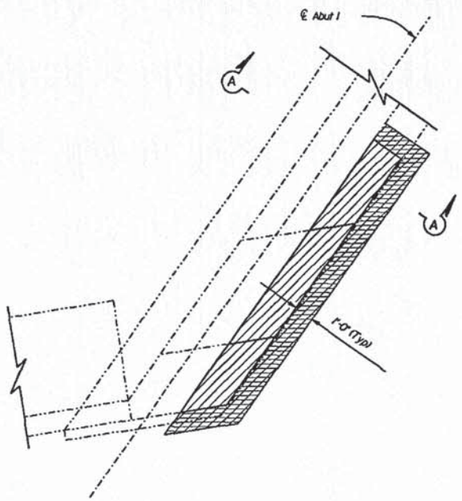
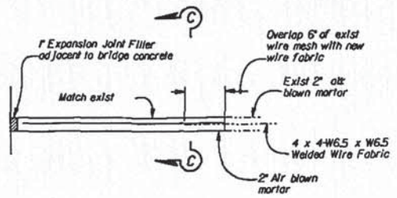


PLAN
SEAT & SHEAR KEY EXTENSION
3/8"=1'-0"

Note:
Abut 1 shown,
Abut 3 similar



SLOPE PAVEMENT REPLACEMENT DETAIL
1/2"=1'-0"

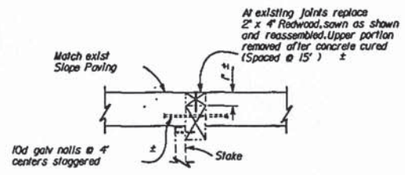
Note:
Limits for removal and replacement of slope paving shall be the same as horizontal limits shown for excavation and backfill for seat and shear key extension

LEGEND

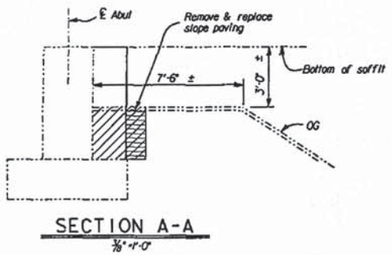
- Indicates Existing Structure
- Indicates New Construction
- Indicates Structure Excavation
- Indicates Structure Backfill

ABBREVIATIONS

OG	Original Ground
FS	Planned Finished Surface
GP	Planned Graded Plane

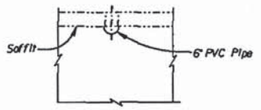


SECTION C-C
No Scale

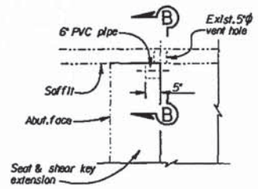


SECTION A-A
3/8"=1'-0"

Where seat & shear key extension interferes with existing vent holes, vent shall be maintained open with the installation of a 6"ϕ PVC pipe or similar device.

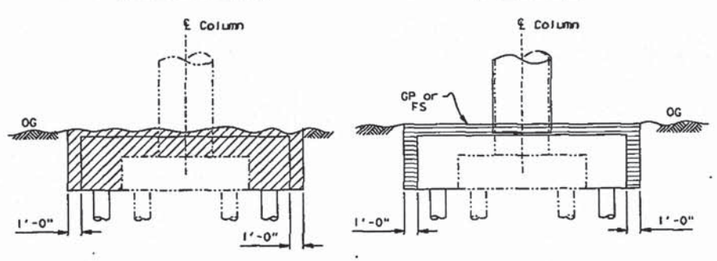


SECTION B-B
No Scale



VENT DETAIL
No Scale

EXCAVATION ——— BACKFILL



COLUMN CASING & FOOTING RETROFIT
NO SCALE

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS

DESIGN	J. Camilleri	CHECKED	H. Bonakdar/E. Kurani
DETAILS	Dale Kubochi	CHECKED	H. Bonakdar/E. Kurani
QUANTITIES	J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 6

DS 050 2331 (CADD 8/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

USERNAME => tsbxp
d_limits_a26144137

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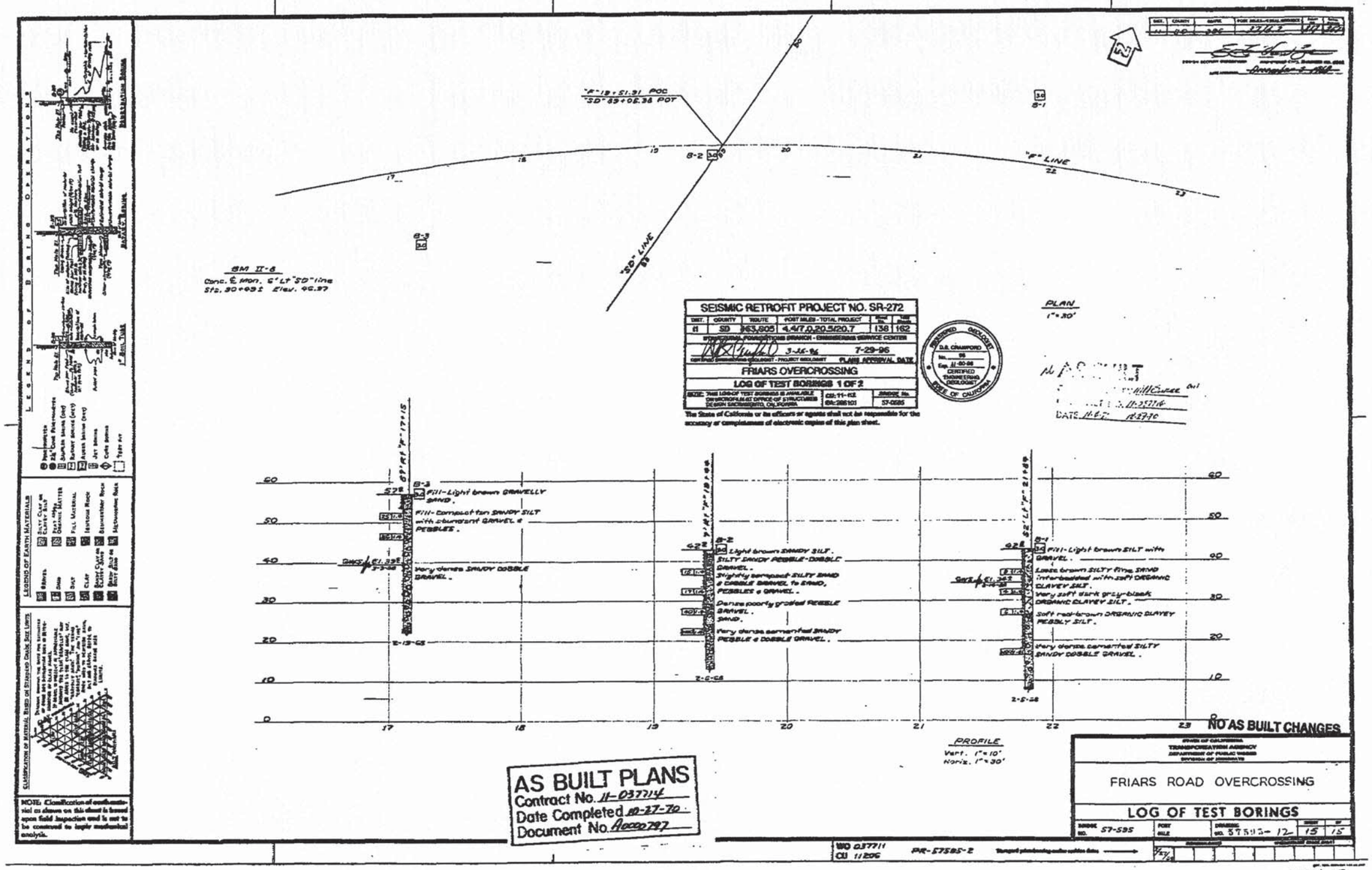

SEISMIC RETROFIT PROJECT NO. SR-272

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
11	SD	163,805	4.4/7.0,20.5/20.7	138	162

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

3-26-96 7-29-96

CERTIFIED ENGINEERING GEOLOGIST - PROJECT GEOLOGIST PLANS APPROVAL DATE

FRIARS OVERCROSSING

LOG OF TEST BORINGS 1 OF 2

NOTE: THIS LOG OF TEST BORINGS IS AVAILABLE ON MICROFILM AT OFFICE OF STRUCTURES DESIGN SACRAMENTO, CALIFORNIA

CU: 11-112 EA: 286101 BRIDGE No. 57-0585

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REGISTERED GEOLOGIST D.S. CRAWFORD No. 98 Exp. 11-30-96 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

AS BUILT

DATE 11-6-7 10-27-70

NO AS BUILT CHANGES

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

BRIDGE NO. 57-595 POST MILE DRAWING NO. 57595-12 SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

SHEET 7 OF 8

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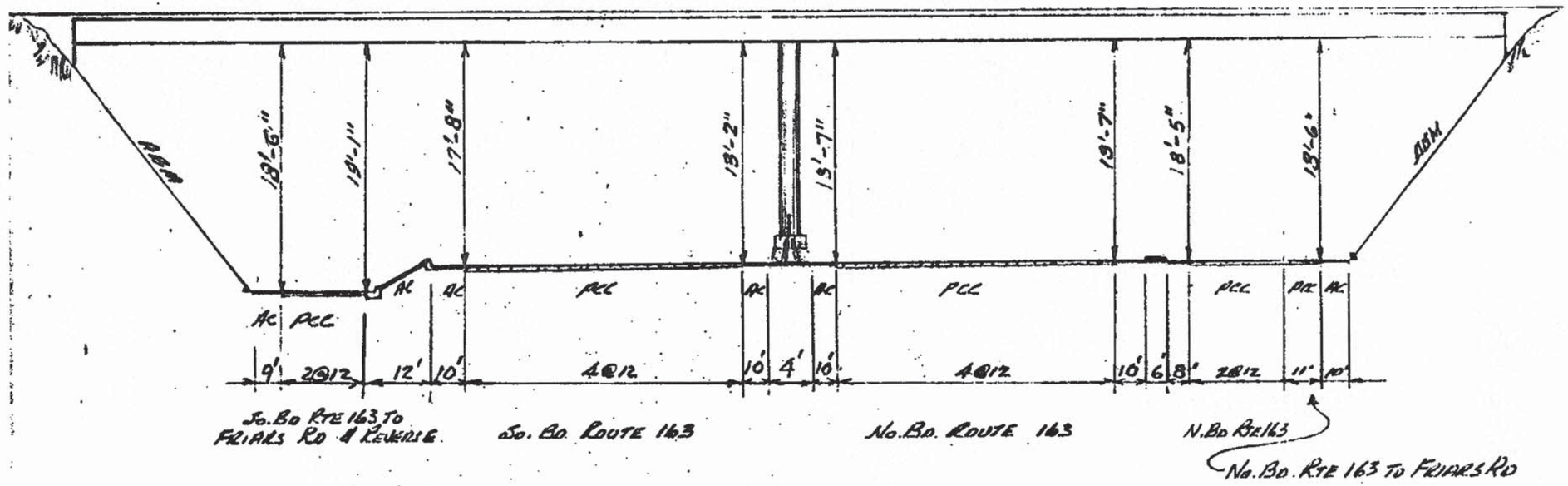
ClibPDF - www.fastio.com

ClibPDF - www.fastio.com

CLEARANCE DIAGRAM



LOOKING AHEAD (NORTH) ON ROUTE 163

FRIARS ROAD OVERCROSSING
11-SD-163-4.37-SD
Bu. No. 57-595

M. I. FOREL
* J. BORIK

Rev. AUG. 1978
Rev. 6/12/85

APPENDIX C

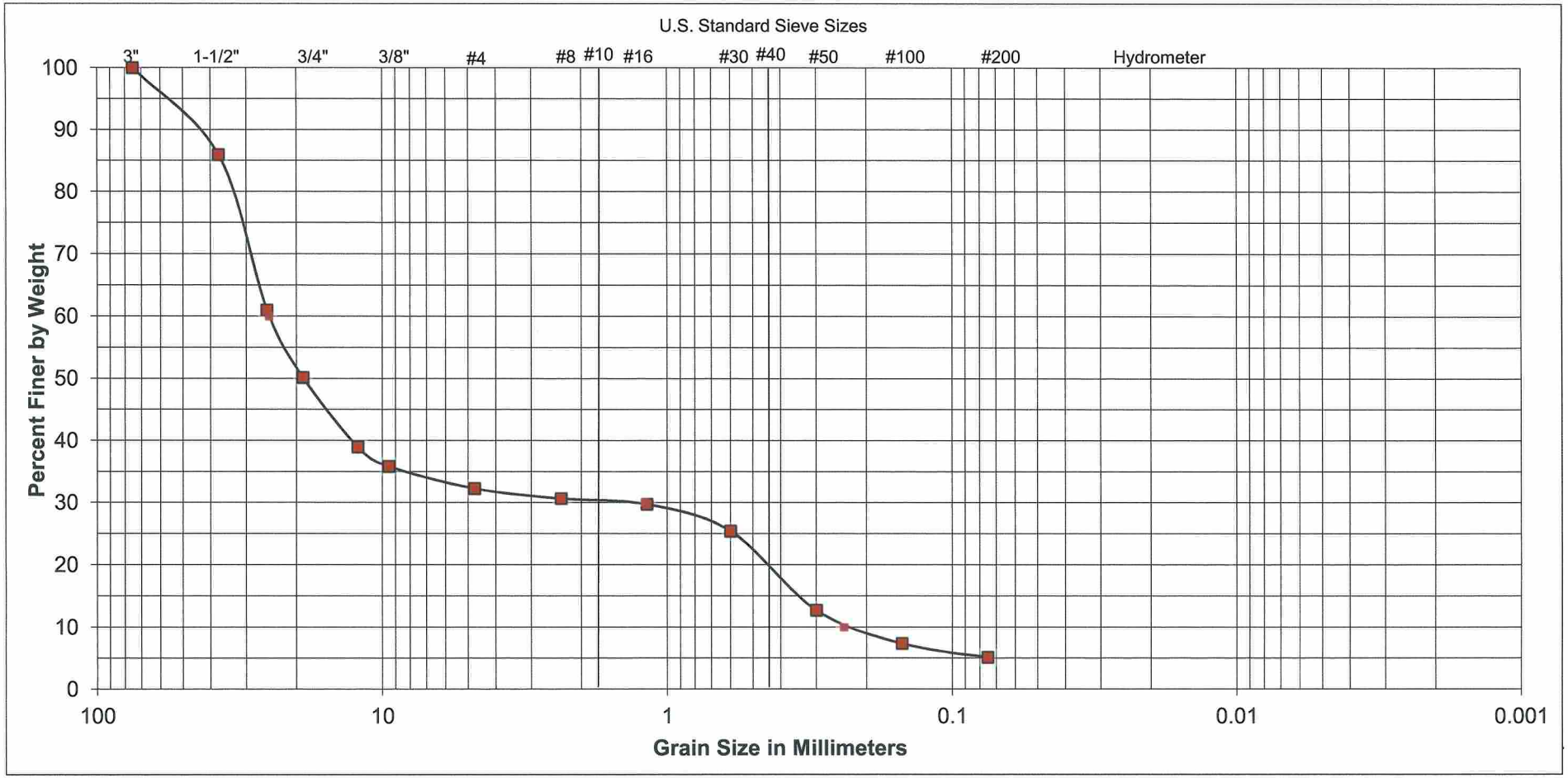
APPENDIX C

LABORATORY TEST RESULTS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
FRIARS ROAD OVERCROSSING (WIDEN)
(BRIDGE NO. 57-0595)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	1 foot to 3½ feet

UNIFIED SOIL CLASSIFICATION:	GP-GM
DESCRIPTION:	POORLY-GRADED GRAVEL with SILT and SAND

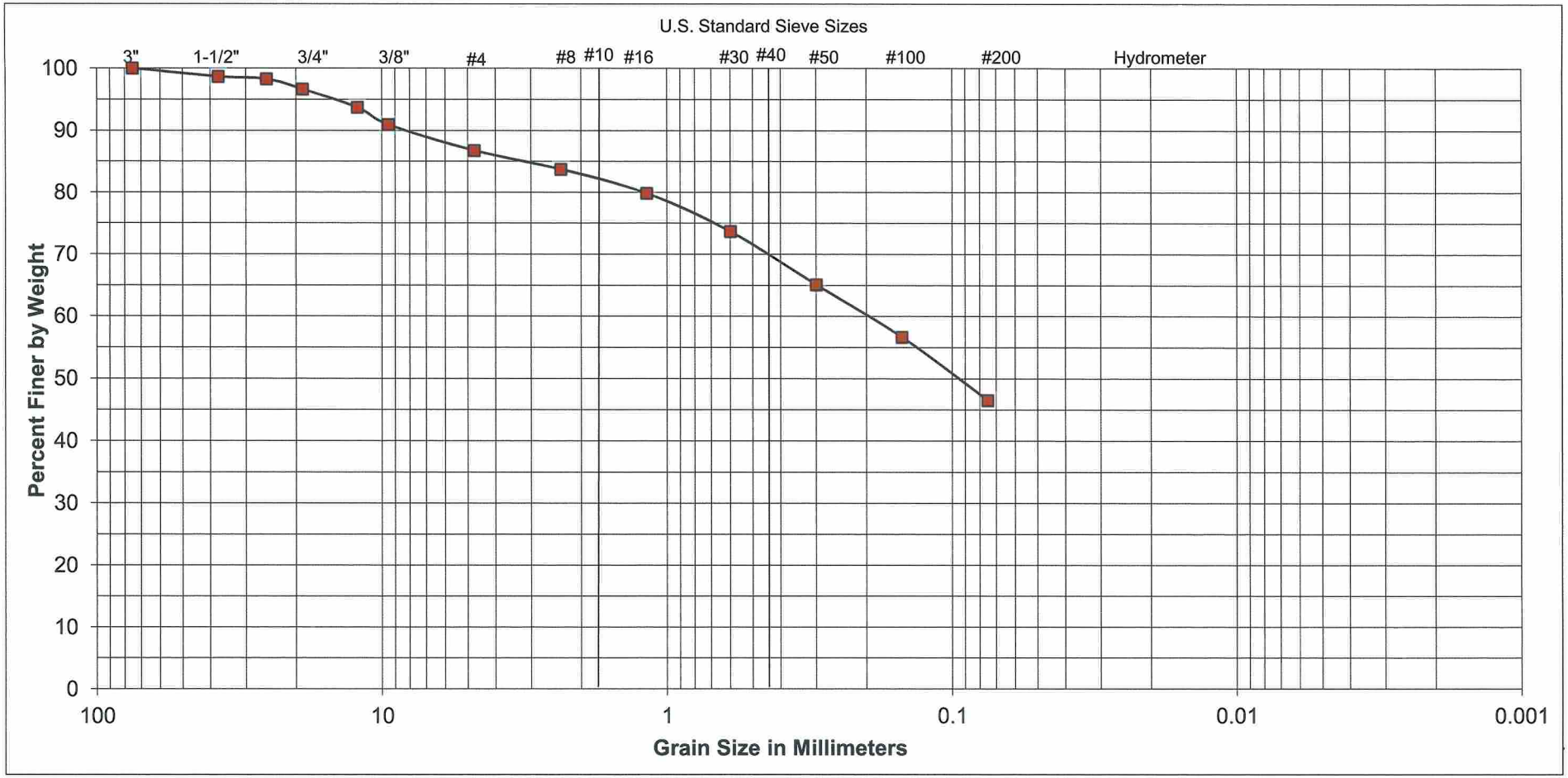
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-3

Figure C1



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	6 feet to 8 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

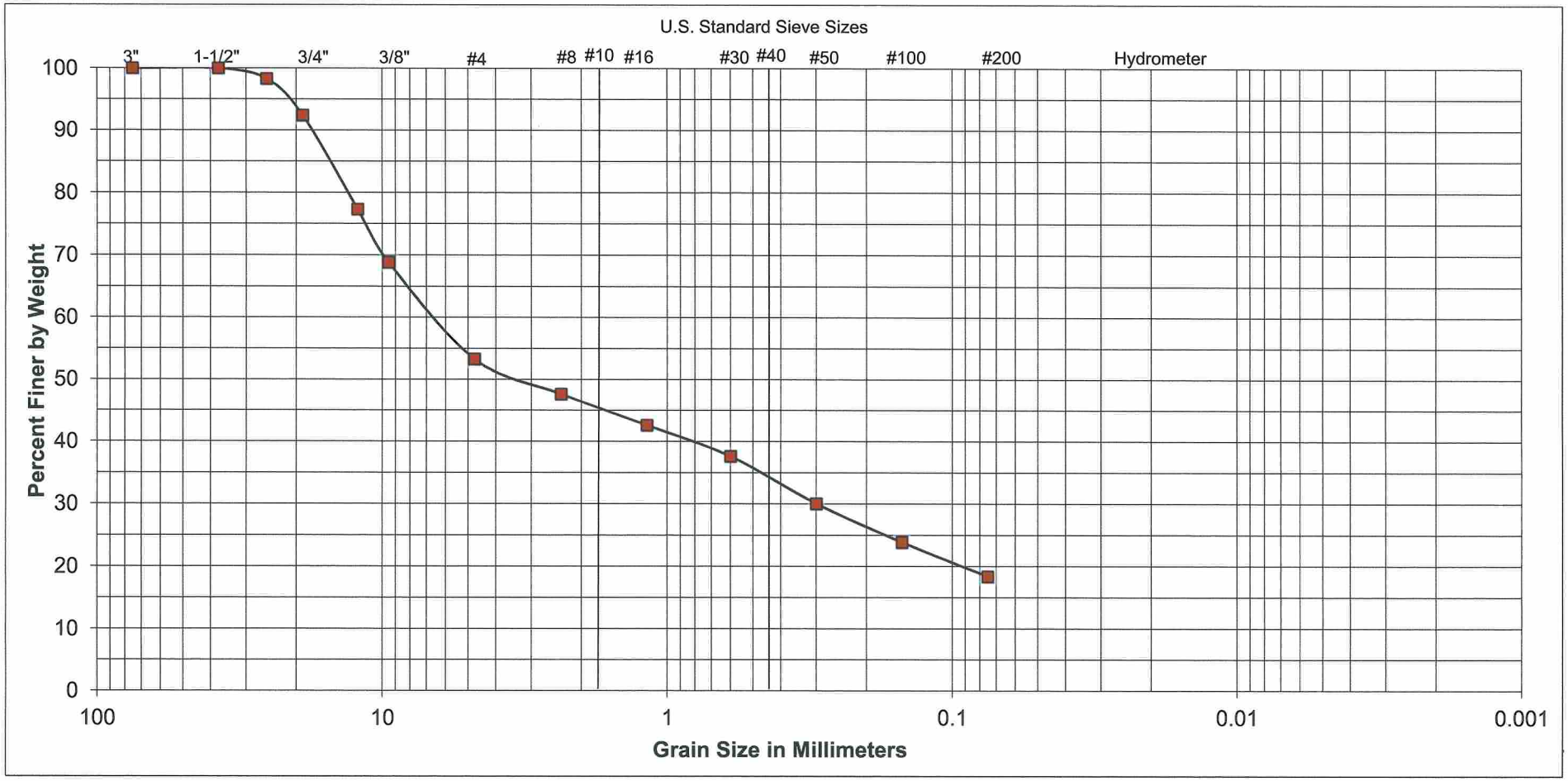
ATTERBERG LIMITS	
LIQUID LIMIT:	56
PLASTIC LIMIT:	24
PLASTICITY INDEX:	32

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-4

Figure C2



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	17 feet to 20 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

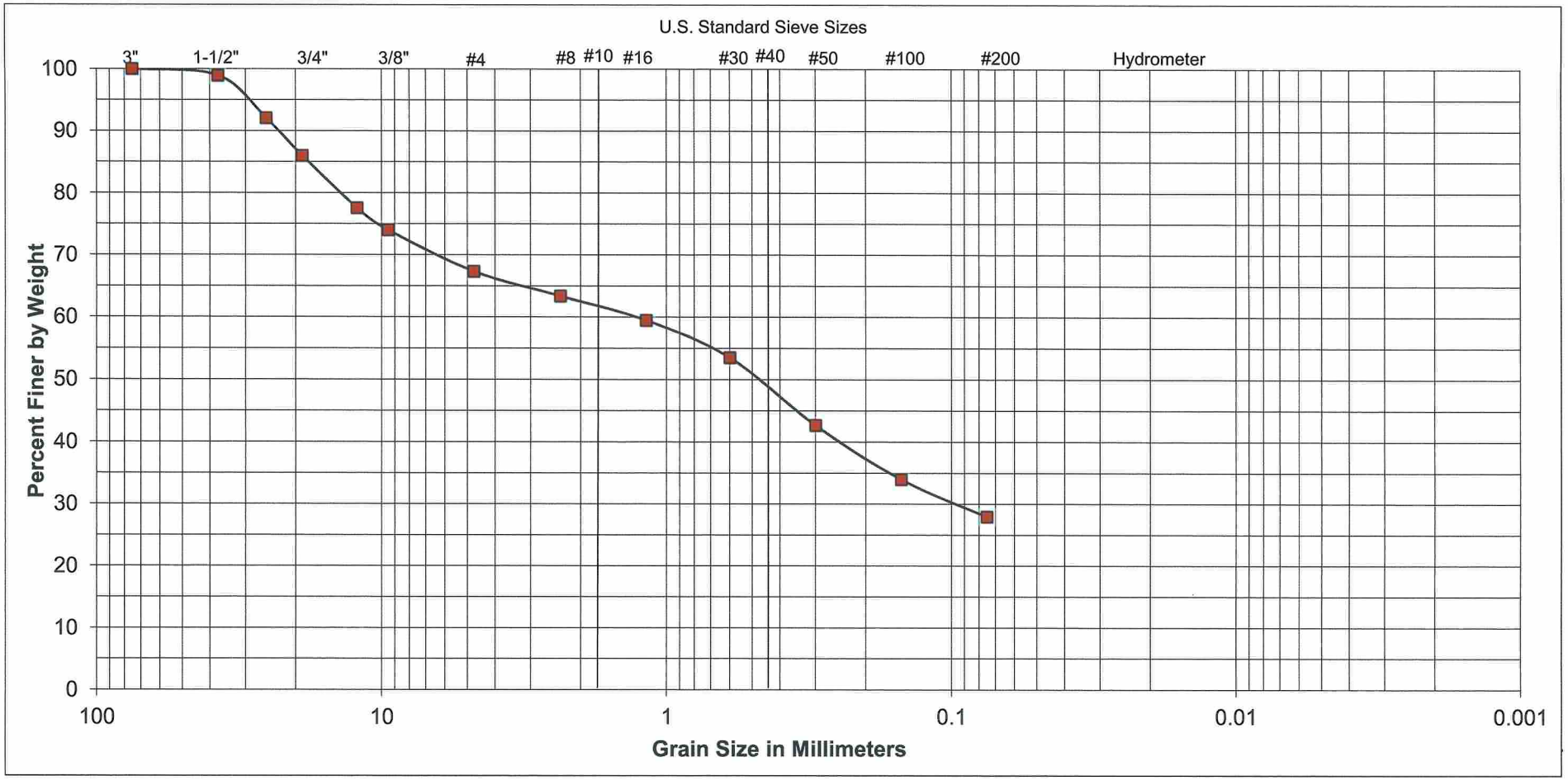
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-5

Figure C3



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	26 feet to 28 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

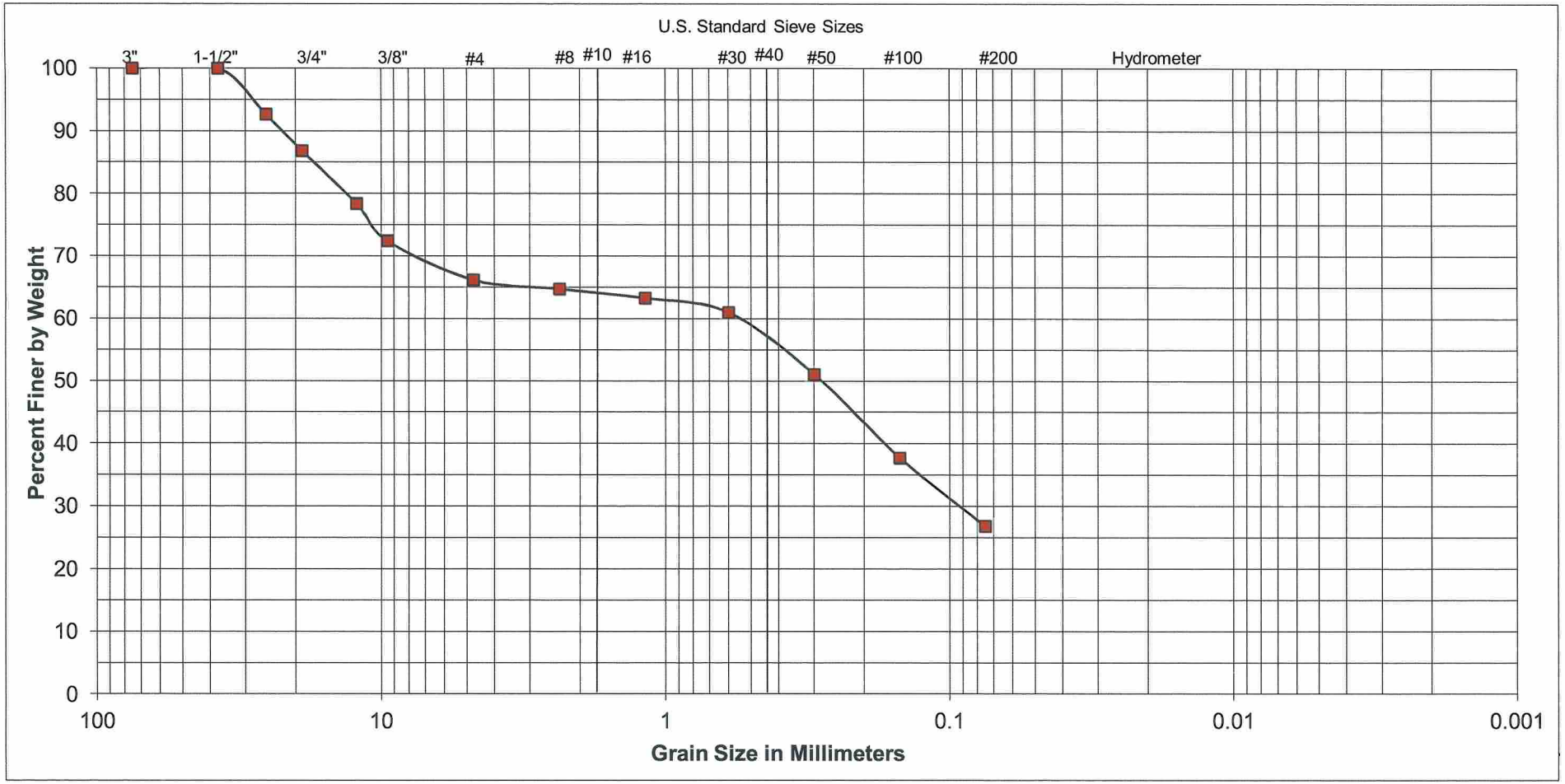
ATTERBERG LIMITS	
LIQUID LIMIT:	33
PLASTIC LIMIT:	21
PLASTICITY INDEX:	12

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE	V-6

Figure C4



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	21½ feet to 23 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

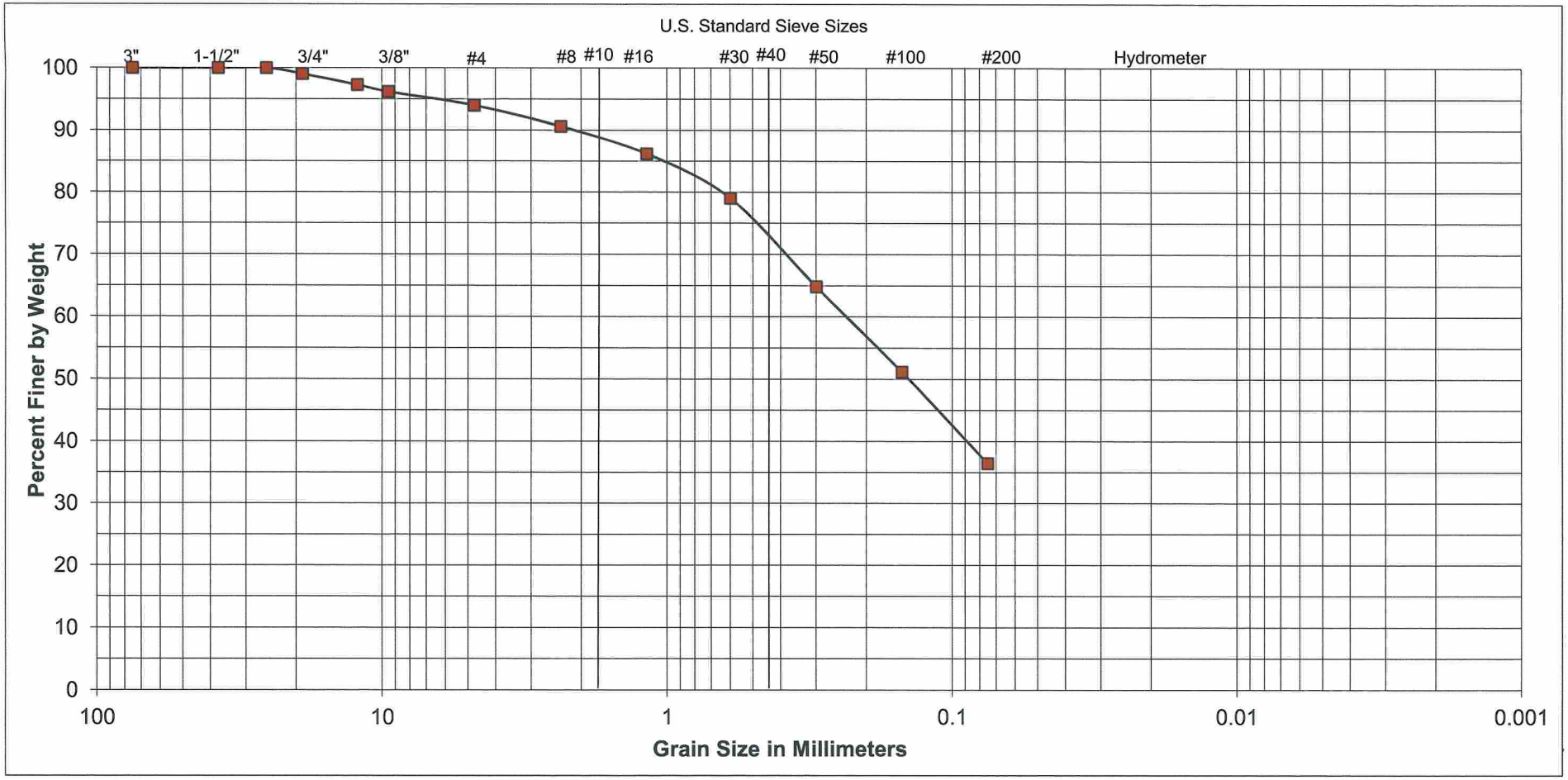
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-7

Figure C5



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	32½ f.t to 34½ ft.

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

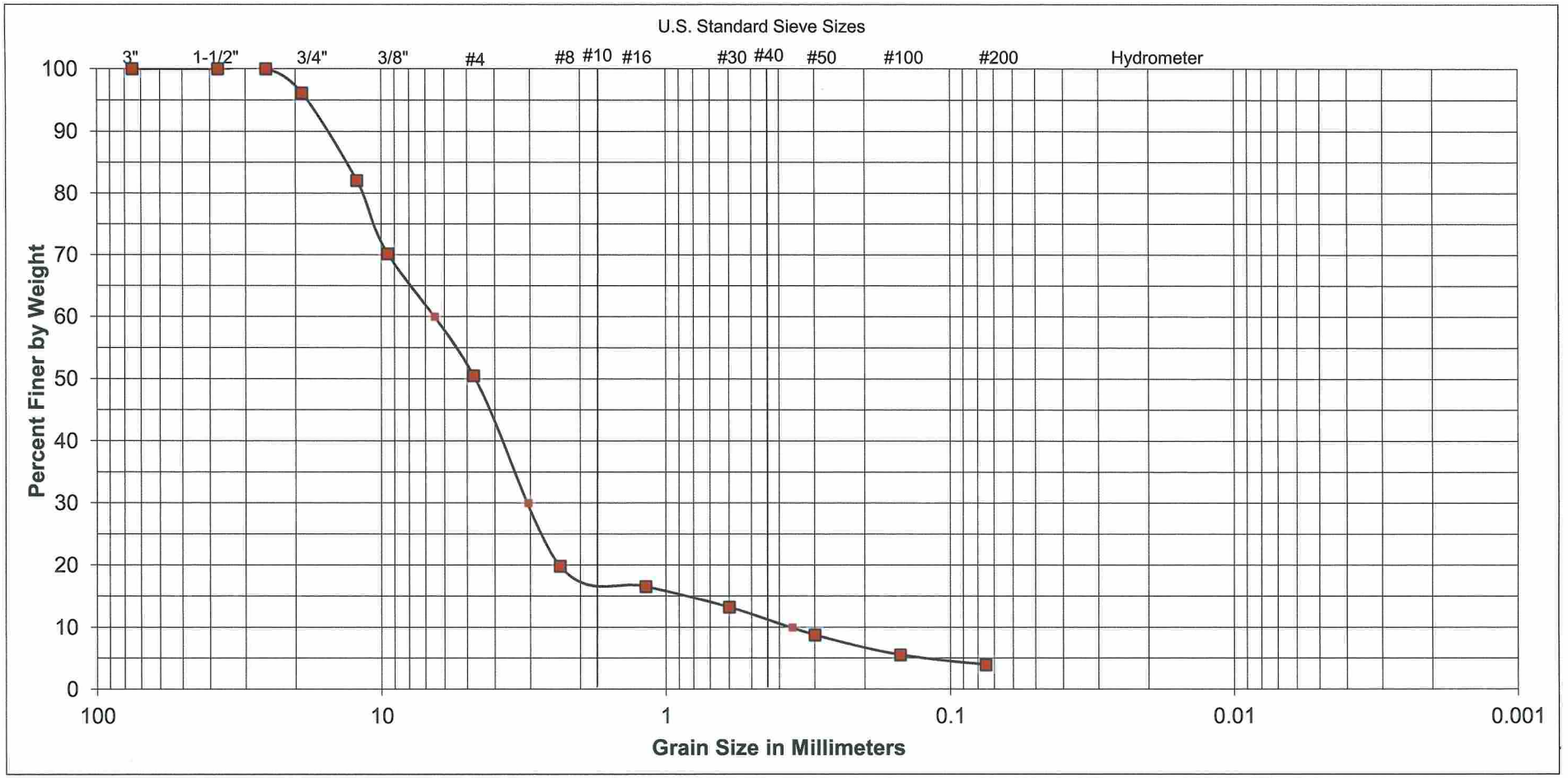
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-8

Figure C6



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	35½ feet

UNIFIED SOIL CLASSIFICATION:	SP
DESCRIPTION:	POORLY-GRADED SAND with GRAVEL

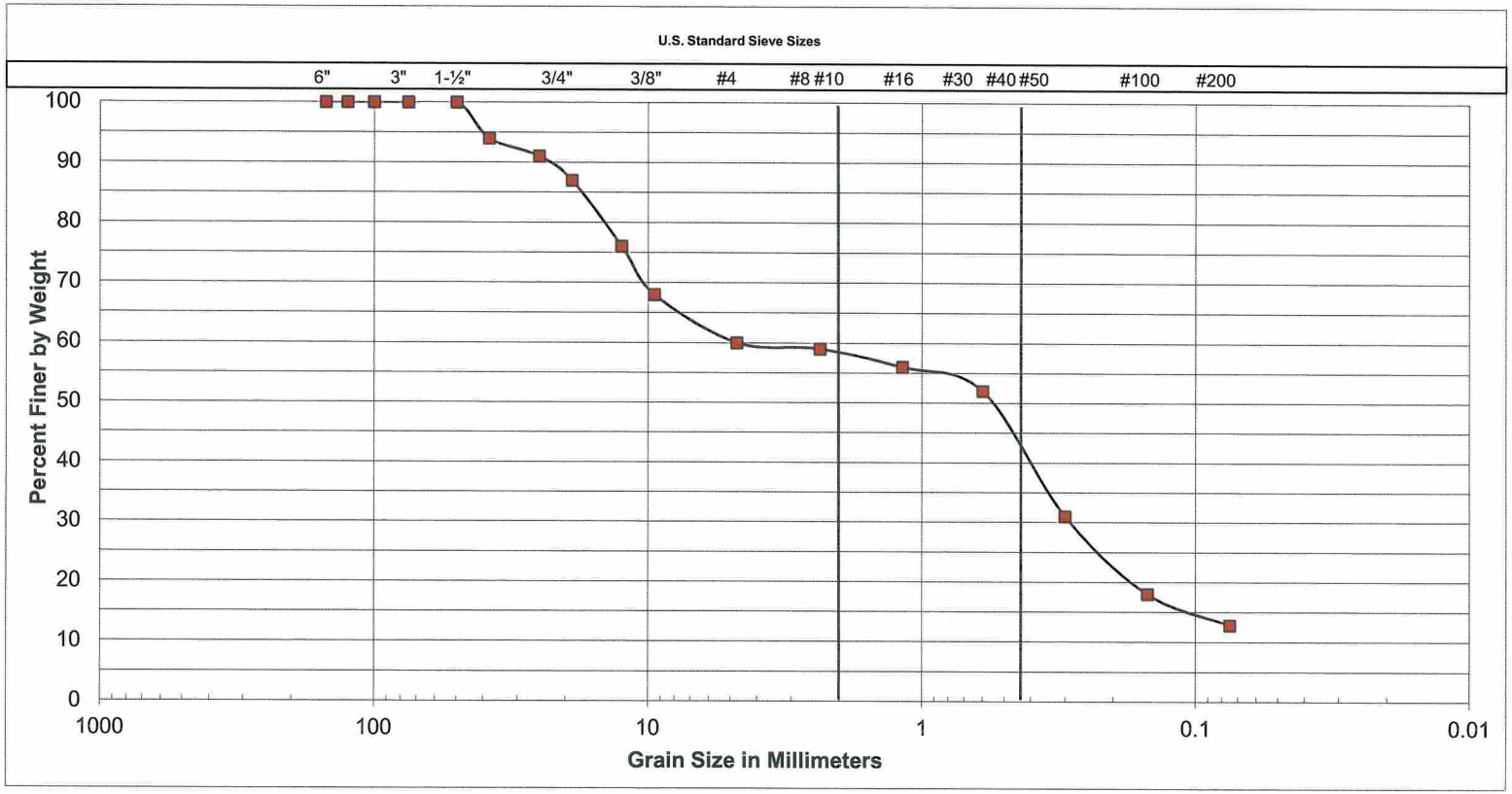
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-9

Figure C7



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 1 foot to 5 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

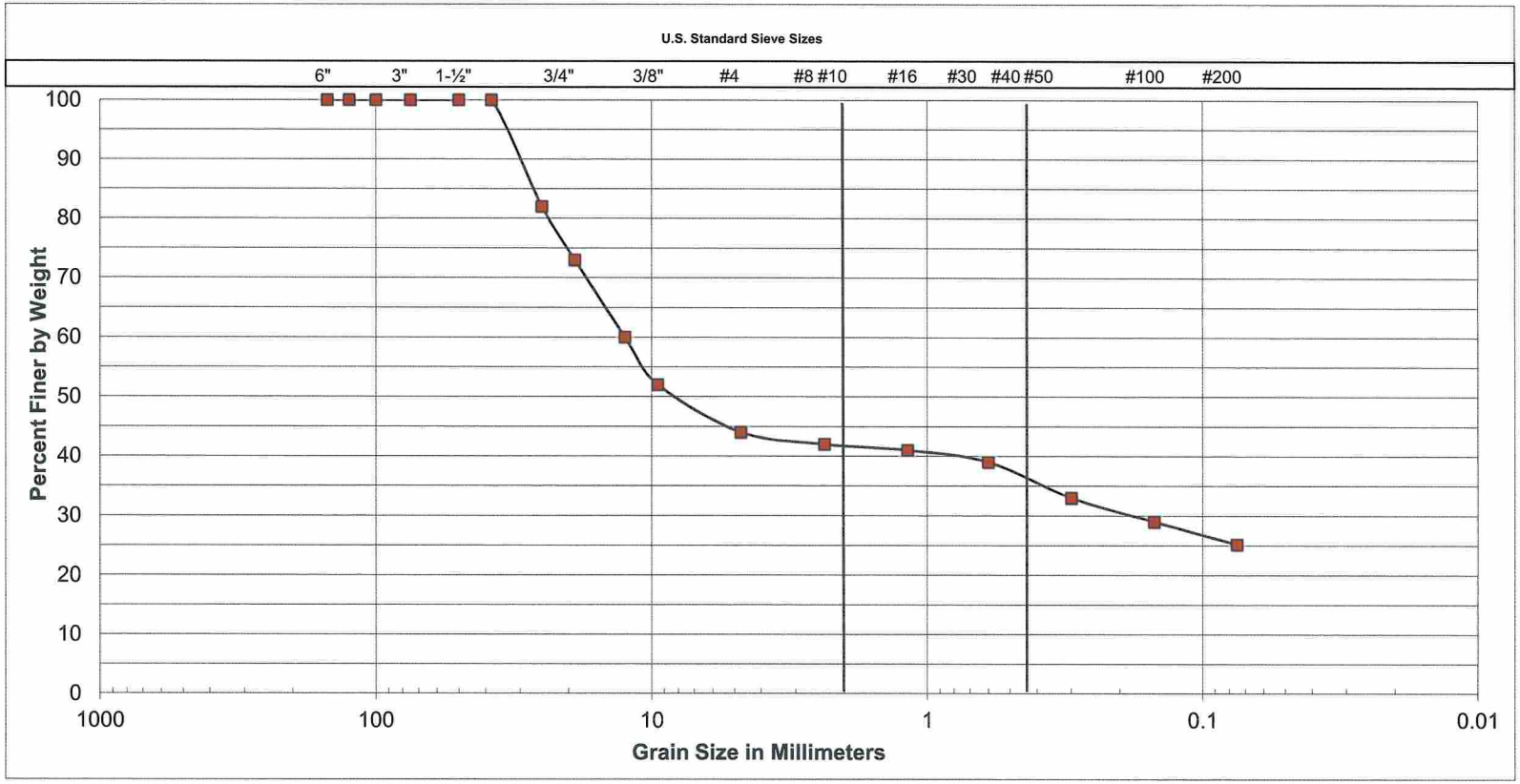
ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-60

Figure C8



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 30 feet 35 feet

UNIFIED SOIL CLASSIFICATION:	GC
DESCRIPTION	CLAYEY GRAVEL with SAND

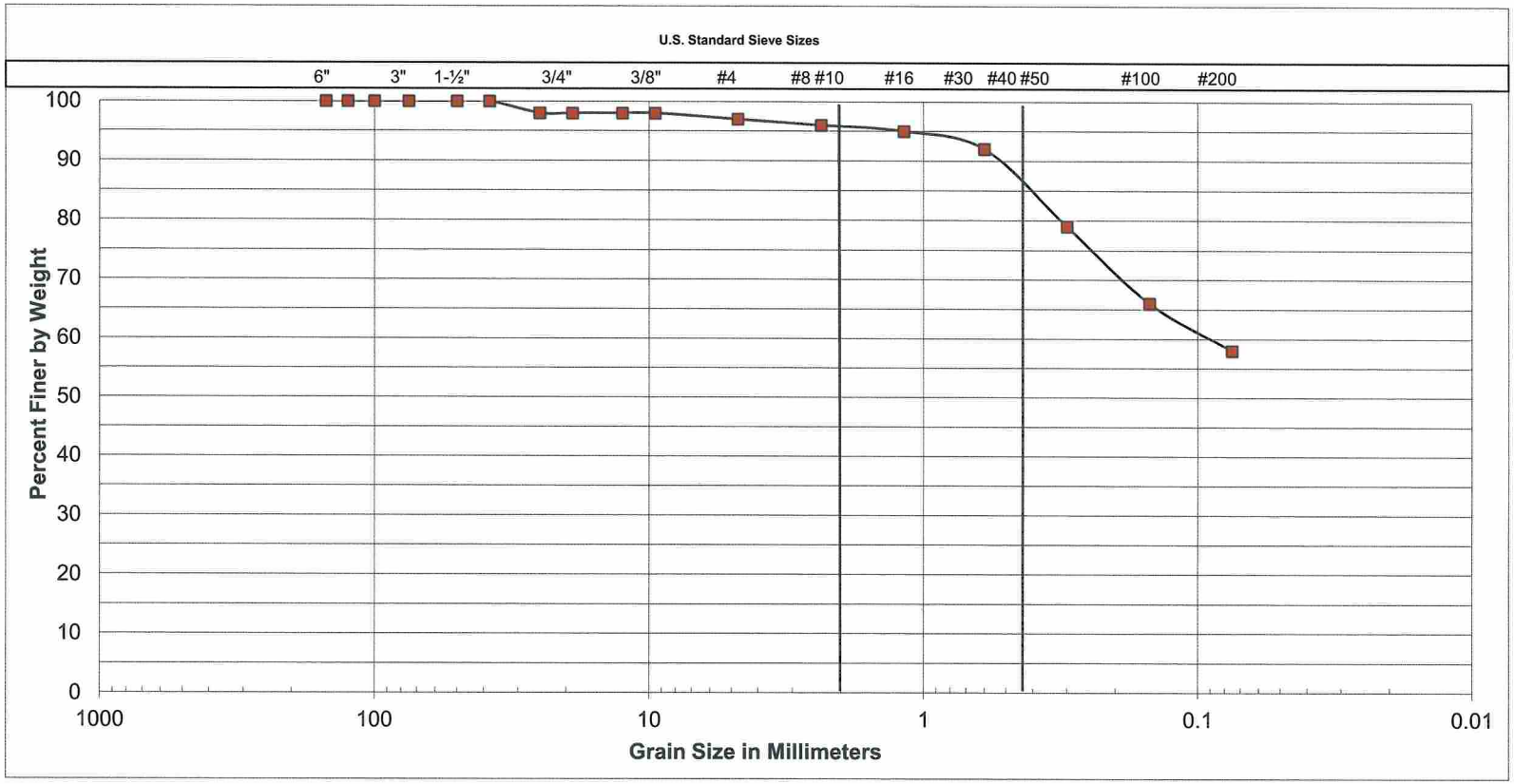
ATTERBERG LIMITS	
LIQUID LIMIT	49
PLASTIC LIMIT	20
PLASTICITY INDEX	29

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-61

Figure C9



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 45 feet to 50 feet

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY LEAN CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	45
PLASTIC LIMIT	19
PLASTICITY INDEX	26

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-62

Figure C10

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-03-001 at 10 feet	3100	6.7	0.001	0.002
A-03-001 at 30 feet	-	7.5	0.005	0.012
A-03-002 at 1 ft. to 3½ ft.	1870	8.7	0.007	0.001
A-03-002 at 12½ feet	-	9	0.001	-
A-03-002 at 26 ft. to 28 ft.	935	8.4	0.017	0.015
A-03-003 at 1 ft. to 3½ ft.	2204	8.1	0.008	0.007
A-03-003 at 32 ft. to 34 ft.	1336	7.7	0.025	0.006
A-03-003 at 45 feet	-	7.1	0.016	0.023
A-03-009 at 1 ft. to 3½ ft.	1536	8.8	0.007	0.003
A-03-012 at 1 ft. to 3½ ft.	1403	8.4	0.011	0.004
A-03-015 at 1 ft. to 3½ ft.	868	7.4	0.037	0.018
A-03-017 at 1 ft. to 3½ ft.	1136	8.9	0.049	0.003

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NUMBEF	1111191-1	FIGURE:	V-68

Figure C11

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-12-034 at 25 feet	1800	8.2	0.013	0.007
R-12-038 at 4 ft. to 9 ft.	2300	8.2	0.011	0.004
R-12-038 at 80 ft.	1500	8.8	0.017	0.005
R-12-041 at 10 ft.	1120	7.8	0.018	0.006
A-12-044 at 1 ft. to 5 ft.	1750	9.2	0.003	0.002

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

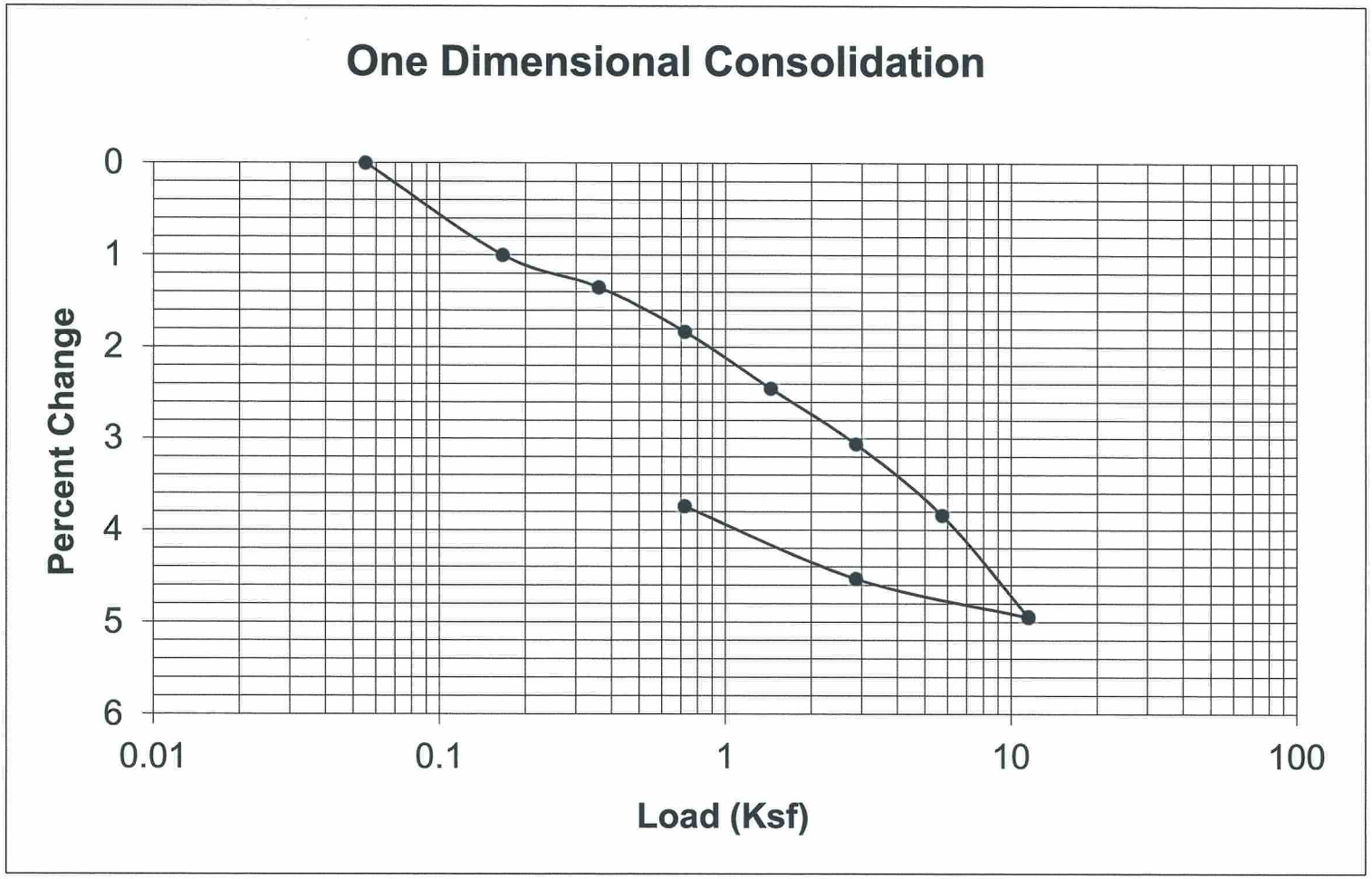
Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NO.:	1111191-1	FIGURE:	V-69

Figure C12

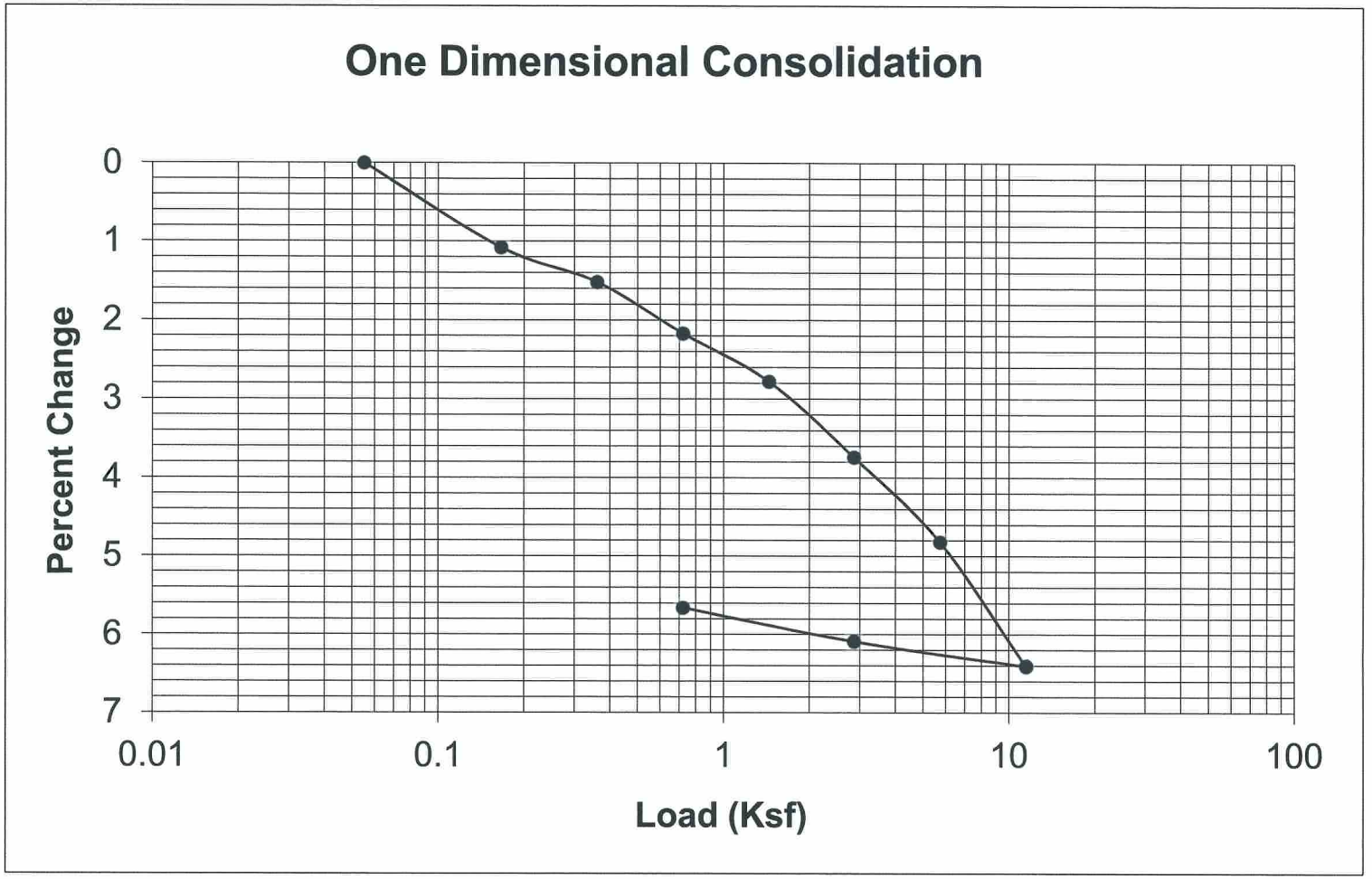
A-03-003 at 20 feet



SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163			
	BY:	AKN	DATE:	6/28/2012
	JOB NUMBER:	1111191-1	FIGURE:	V-70

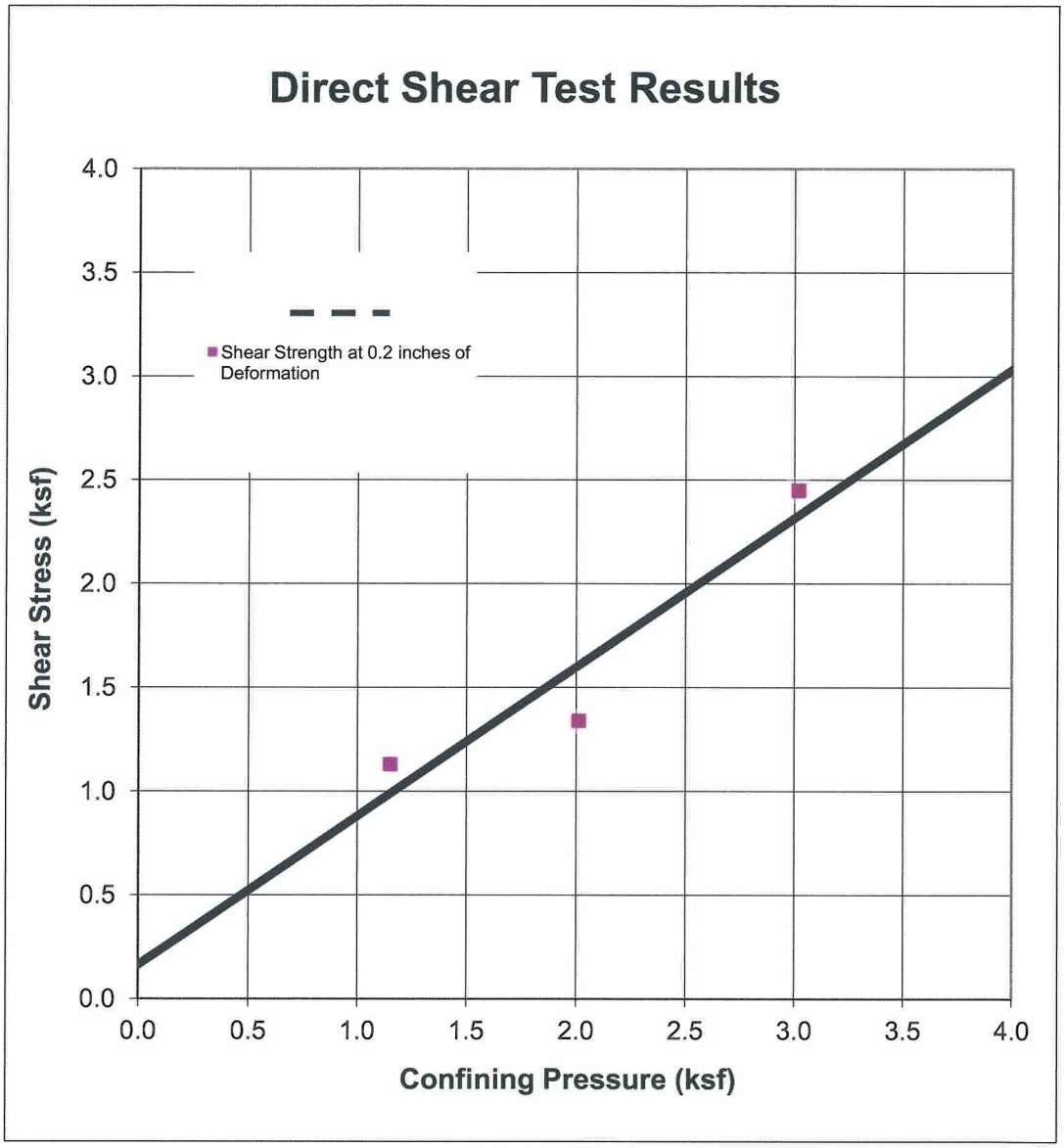
Figure C13

A-03-003 at 25 feet



SCST SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163			
	BY:	AKN	DATE:	6/28/2012
	JOB NUMBER:	1111191-1	FIGURE:	V-71

Figure C14



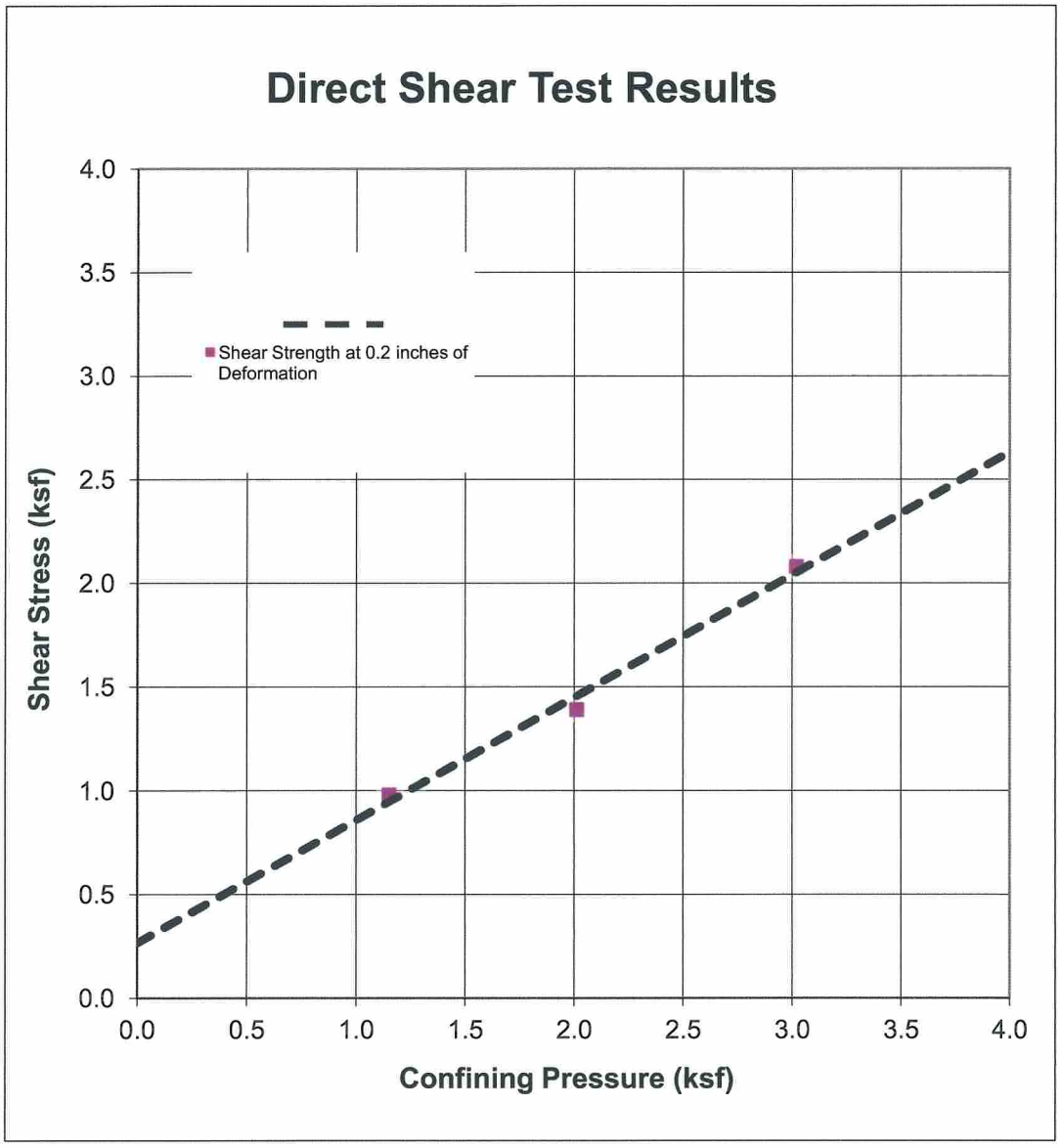
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 7.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		36	162

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-73

Figure C15



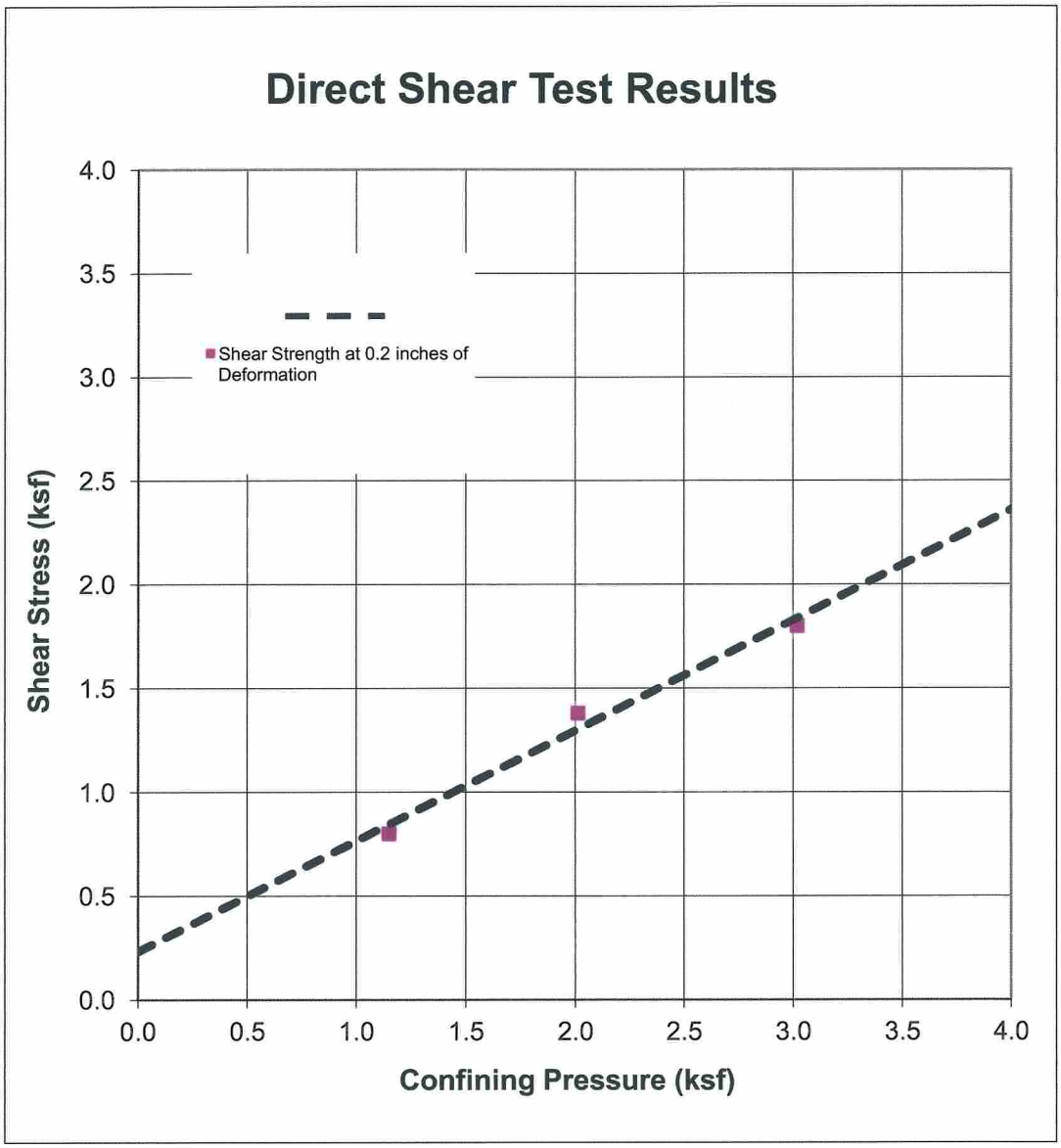
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 10 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	265

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-74

Figure C16



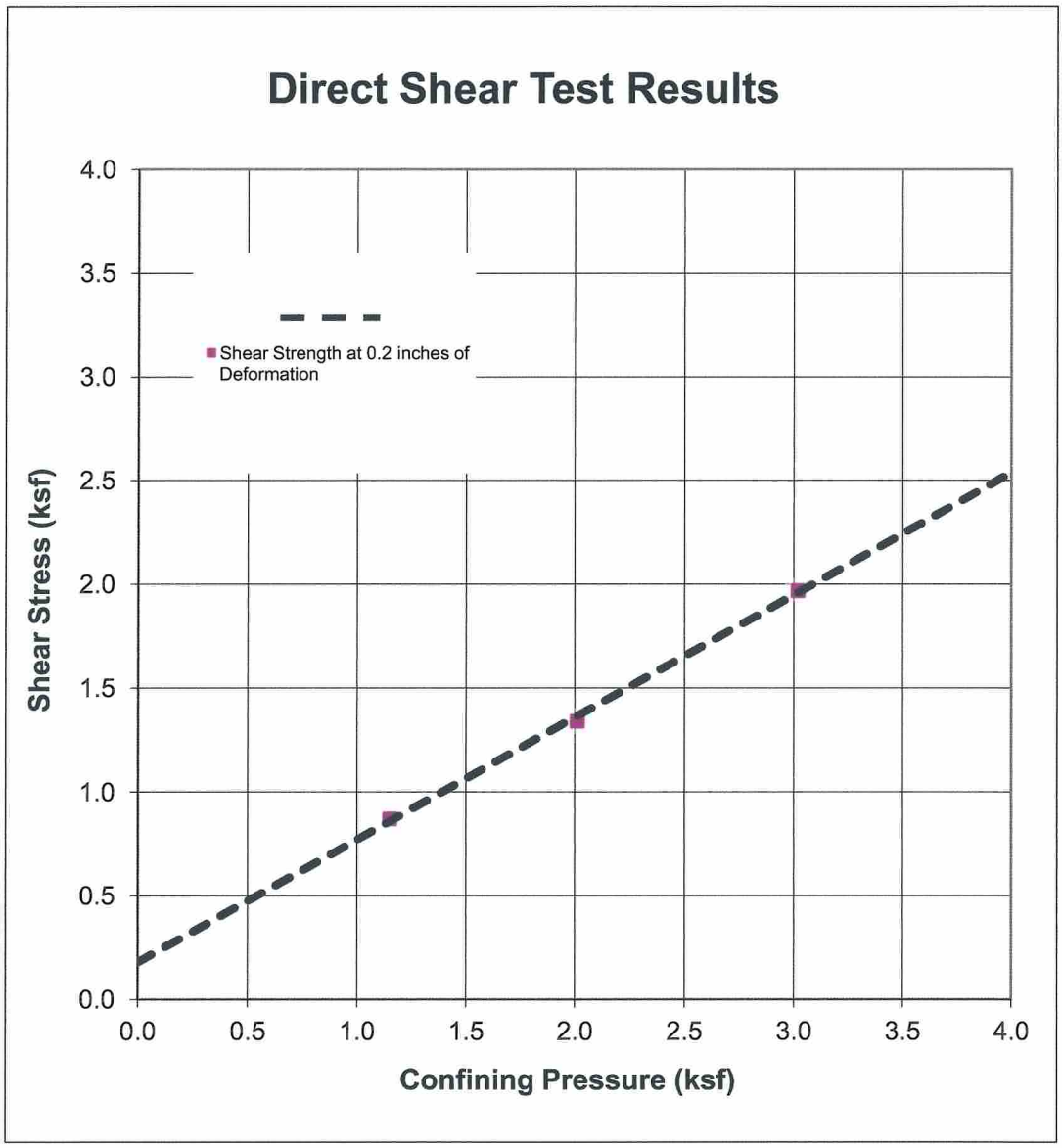
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 20 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		28	231

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-75

Figure C17



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 22 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	178

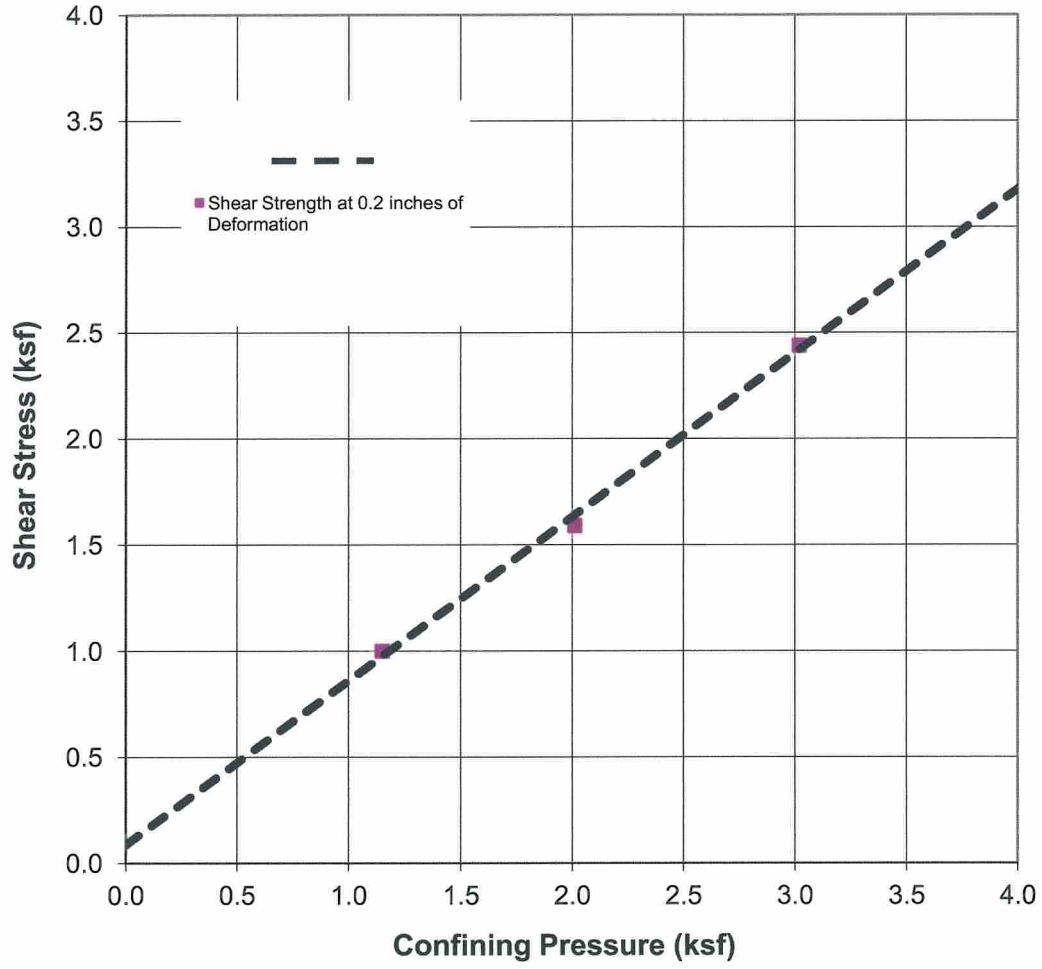
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-76

Figure C18

Direct Shear Test Results



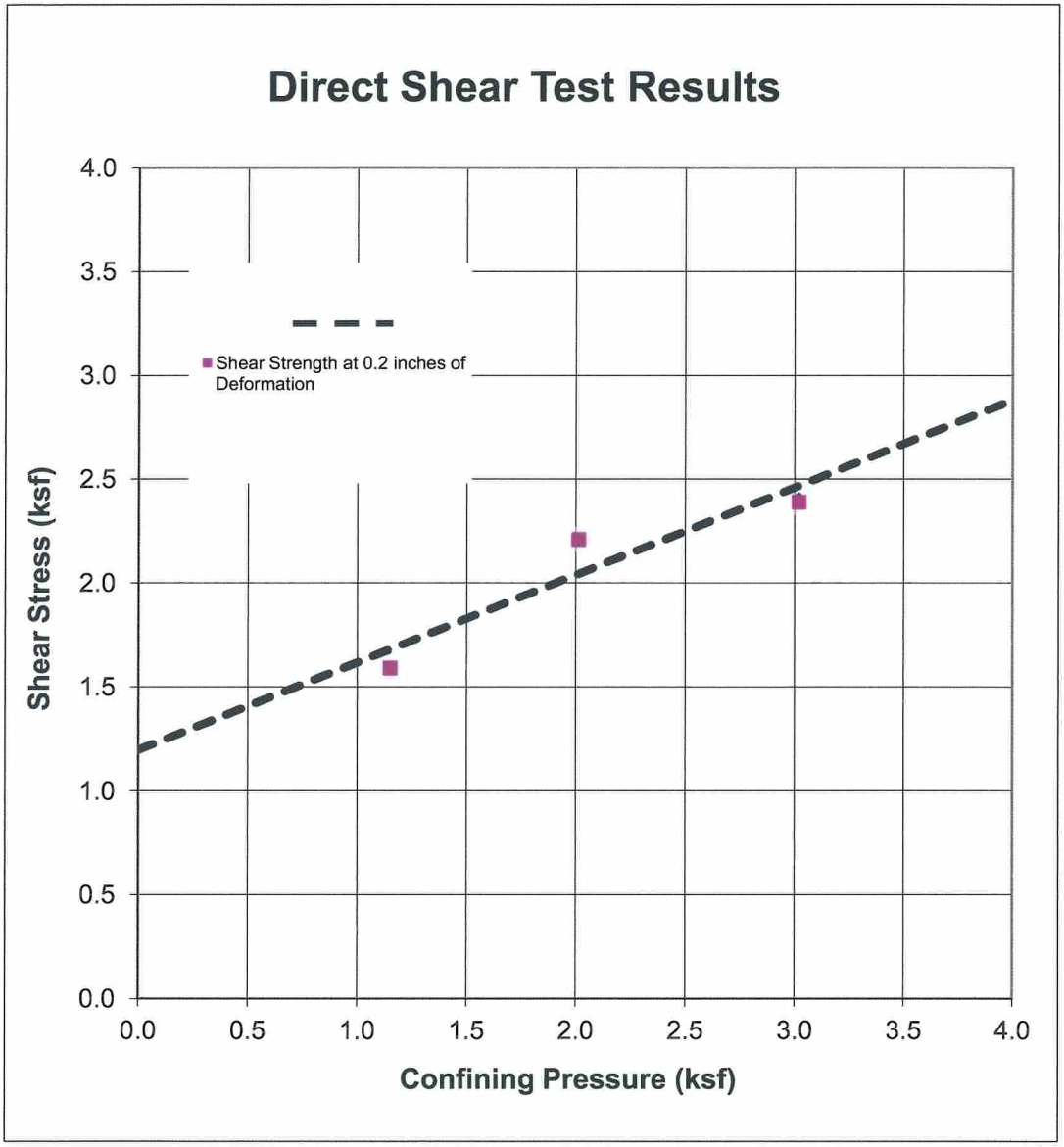
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 25 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		38	85

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-77

Figure C19



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 27.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		23	1196

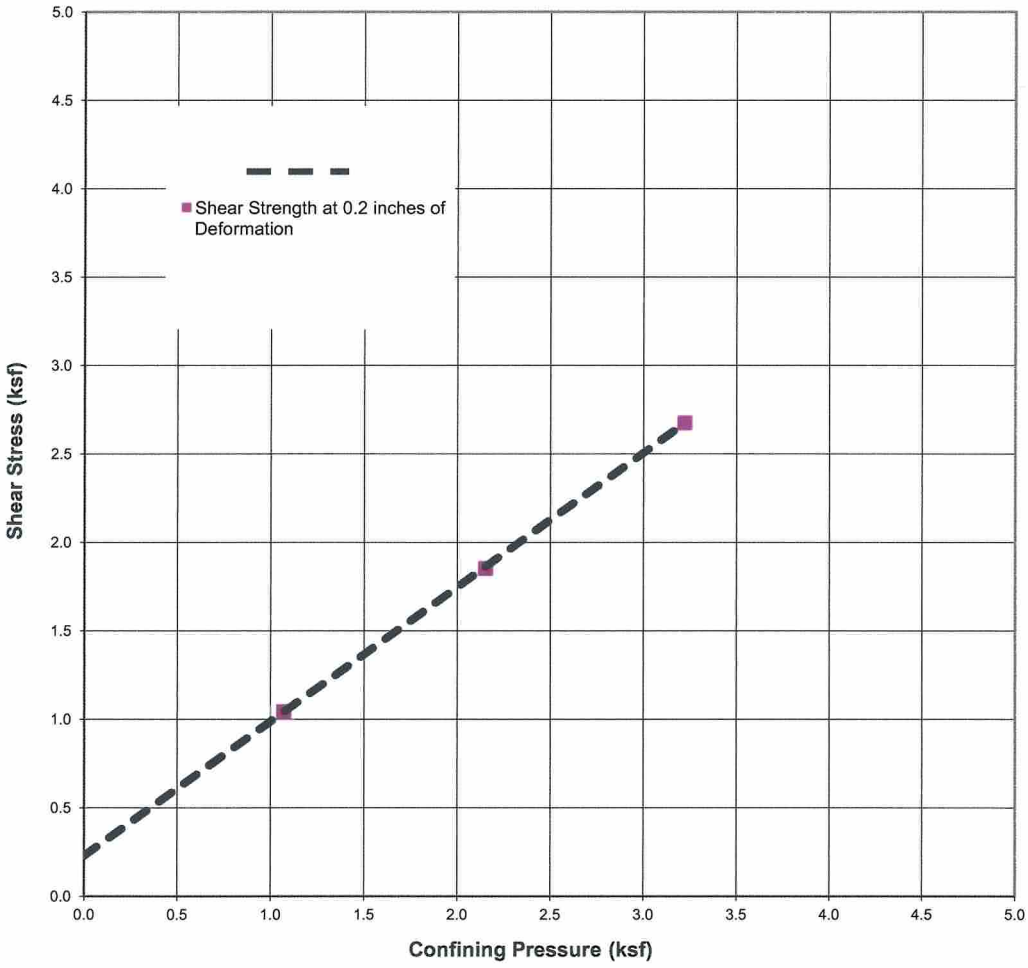
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-78

Figure C20

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 10 ft to 15 ft	silty SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		37	228

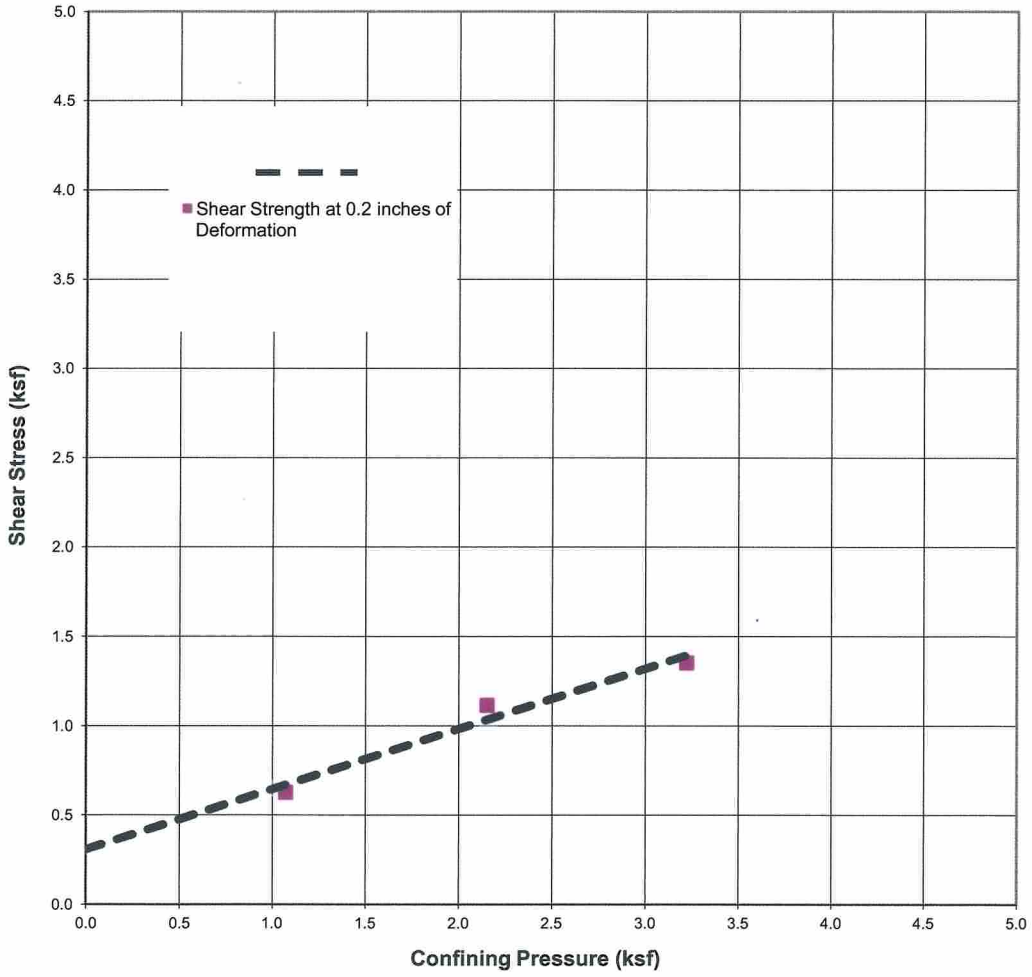
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-82

Figure C21

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 40 feet	clayey SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		19	307

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-83

Figure C22

APPENDIX D

APPENDIX D

ANALYSES AND CALCULATIONS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
FRIARS ROAD OVERCROSSING (WIDEN)
(BRIDGE NO. 57-0595)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

PROJECT NAME SR-163/Friars Rd OC (WIDEN) SEISMIC

PROJECT NO G1447-52-01
BY YW DATE 2/6/12
SHEET 1 OF 57

REVISIONS
BY ____ DATE ____
BY ____ DATE ____

BY ____ DATE ____
CHECKED BY ____

SEISMIC STUDY UPDATE

ITEM	DESCRIPTION	PAGE
1	FAULT & SITE DATA INPUT	2
2	ARS ONLINE (V_{S30} 420 & 380 m/s)	3 & 4
3	SHAKE RESULTS – V_{S30} = 420 m/s	5 ~ 12
4	SHAKE RESULTS – V_{S30} = 380 m/s	13 ~ 20
5	DETERMINISTIC RESULTS V_{S30} 420 & 380 m/s	21 ~ 24
6	PROBABILISTIC RESULTS V_{S30} 420 & 380 m/s	25 ~ 28
7	USGS DEAGGREATION RESULTS V_{S30} = 420 m/s	29 ~ 38
8	USGS DEAGGREGATION RESULTS V_{S30} = 380 m/s	39 ~ 48
9	DESIGN RESPONSE SPECTRUM CURVE	49
10	DESIGN RESPONSE SPECTRUM DATA	50 & 51
11	SPT N & V_{S30} ESTIMATE	52 ~ 57

GEOCON INCORPORATED

Fault & Site Data Input Sheet

The input sheet is to help the user organize the site data for developing the design response spectrum. Beta-Testers: If you fill out the fault and site information for each location, please provide this document and the *checker* to facilitate the QC/QA procedures listed in the 2009 Deterministic Fault Information & Seismic Procedures QC/QA checklist.

Project Information

Dist – EA: 11-085780 County: SD Route: 163 PM: 4.4

Bridge/Facility Name: Friars Rd OC (wide) Bridge/Facility No.: 57-0595

Latitude: 32.771560 Longitude: -117.161362

Fault Information (#1)

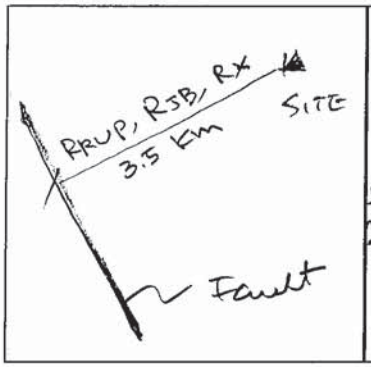
Fault Name: ~~fault CSO section~~ Newport Inglewood-Rose Canyon Fault ID#: 224

MMax: 7.5 Fault Type: RLSS

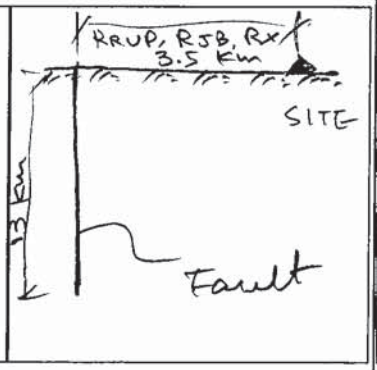
Fault Dip: 90° Dip Direction: V

Top of Rupture: 0 Bottom of Rupture: 13 km

Plan View



Elevation View



Calculated or Measure Distances

R_{RUP}: 3.5 km

R_{JB}: 3.5 km

R_X: 3.5 km

Determination of V_{S30}

V_{S30} (m/s): 420 (About 1), 380 (Best/About 3)

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): 191/241 (V_{S30} = 420/380 m/s)

$Z_{2.5}$ (km/s): 2 km

Notes:

Fault Information (#2)

Fault Name: _____ Fault ID#: _____

MMax: _____ Fault Type: _____

Fault Dip: _____ Dip Direction: _____

Top of Rupture: _____ Bottom of Rupture: _____

Plan View **Elevation View**

Calculated or Measure Distances

R_{RUP}: _____

R_{JB}: _____

R_X: _____

Determination of V_{S30}

V_{S30} (m/s): _____

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): _____

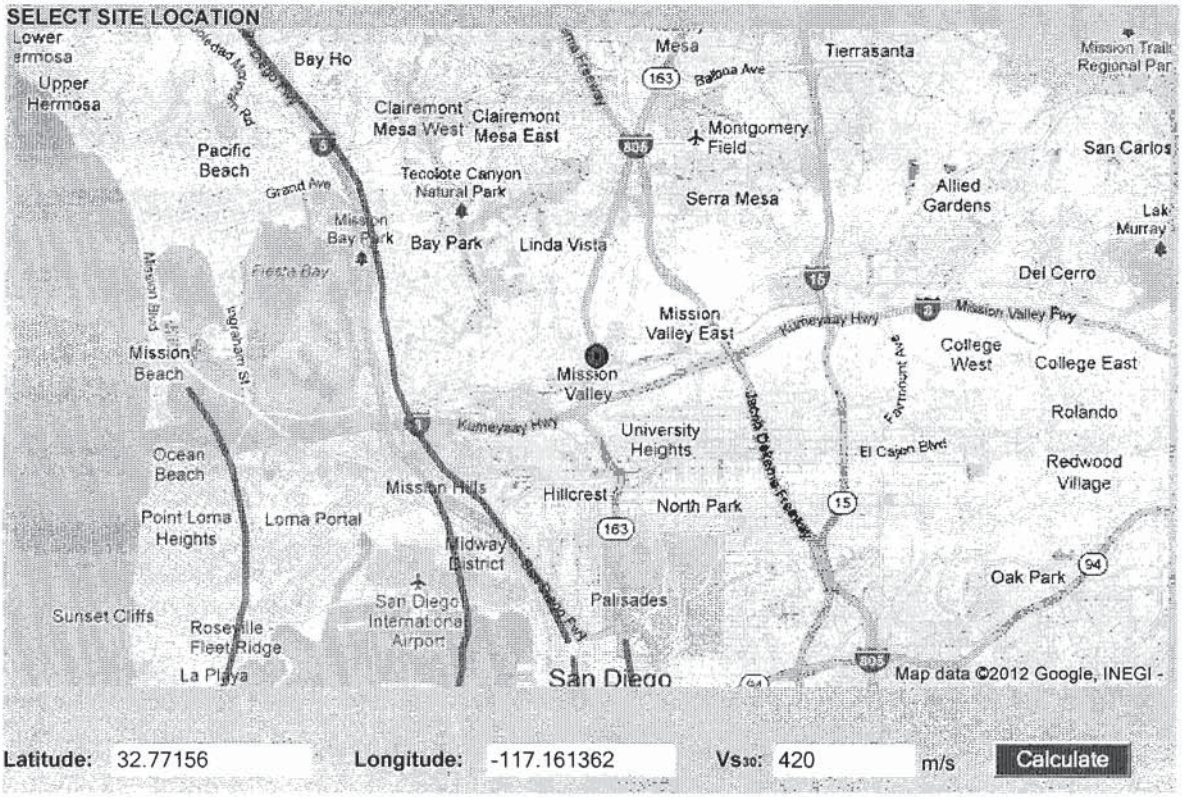
$Z_{2.5}$ (km/s): _____

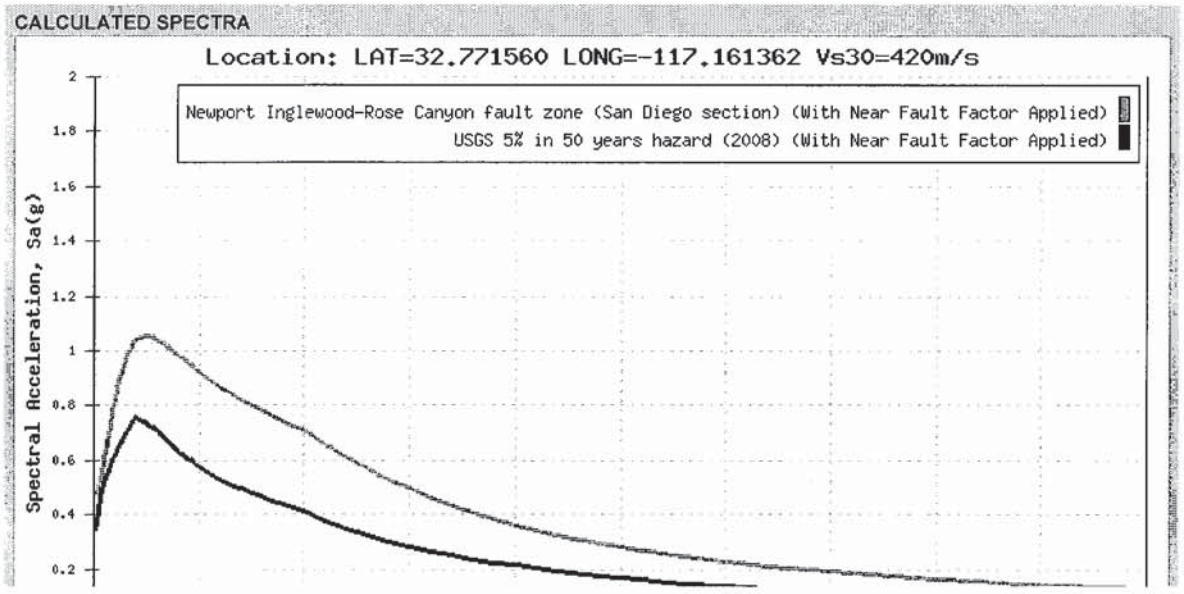
Notes:

CA.GOV CALIFORNIA DEPARTMENT OF TRANSPORTATION

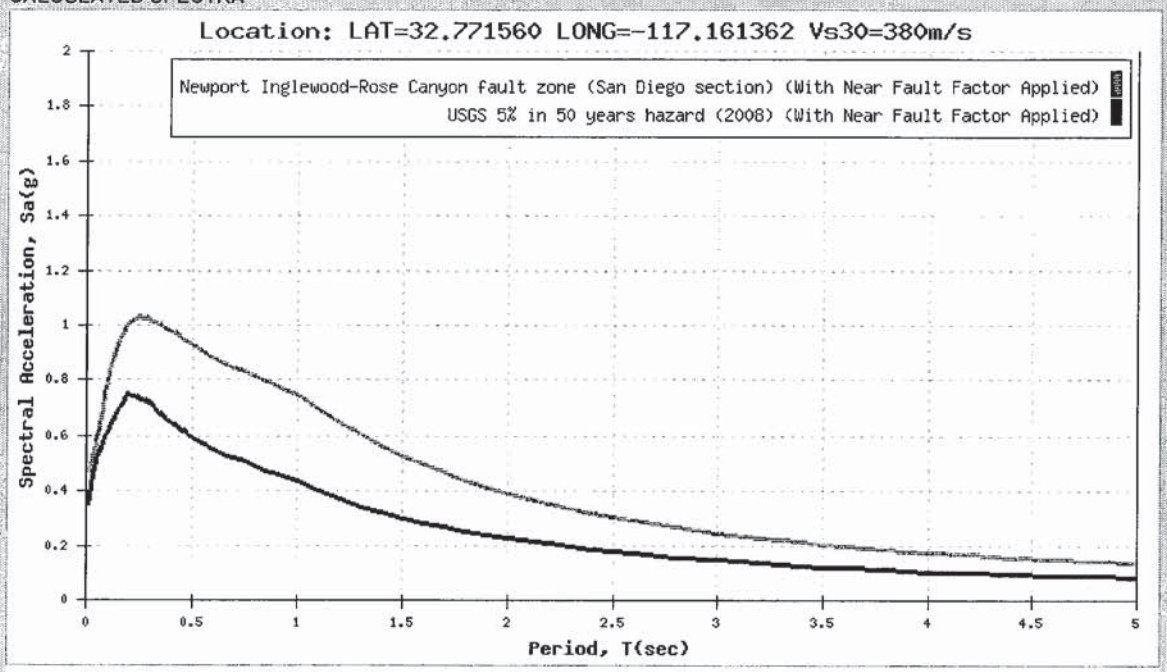
Caltrans ARS Online (v1.0.4)

This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in *Appendix B of Caltrans Seismic Design Criteria*. More...





CALCULATED SPECTRA



View Tabular Data | Show Envelope Only | Hide Near Fault Adjustment | Axis Scale | Printer Friendly View | Show Basin Factor

Apply Near Fault Adjustment To:

NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

☑ Deterministic Spectrum Using

3.50 Km Newport Inglewood-Rose Canyon fault zone (San Diego section)

☑ Probabilistic Spectrum Using

3.50 Km (Recommend Performing Deaggregation To Verify)

◉ Show Spectrum with Adjustment Only
○ Show Spectrum with and without near fault Adjustment

OK

SITE DATA

Shear Wave Velocity, Vs_{30}:	420 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	191 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.478	1.000	1.000	0.478
0.02	0.487	1.000	1.000	0.487
0.022	0.493	1.000	1.000	0.493
0.025	0.502	1.000	1.000	0.502
0.029	0.514	1.000	1.000	0.514
0.03	0.518	1.000	1.000	0.518
0.032	0.526	1.000	1.000	0.526
0.035	0.538	1.000	1.000	0.538
0.036	0.543	1.000	1.000	0.543
0.04	0.560	1.000	1.000	0.560
0.042	0.569	1.000	1.000	0.569
0.044	0.577	1.000	1.000	0.577
0.045	0.582	1.000	1.000	0.582
0.046	0.586	1.000	1.000	0.586
0.048	0.595	1.000	1.000	0.595

0.05	0.604	1.000	1.000	0.604
0.055	0.627	1.000	1.000	0.627
0.06	0.650	1.000	1.000	0.650
0.065	0.672	1.000	1.000	0.672
0.067	0.681	1.000	1.000	0.681
0.07	0.694	1.000	1.000	0.694
0.075	0.716	1.000	1.000	0.716
0.08	0.738	1.000	1.000	0.738
0.085	0.760	1.000	1.000	0.760
0.09	0.781	1.000	1.000	0.781
0.095	0.802	1.000	1.000	0.802
0.1	0.822	1.000	1.000	0.822
0.11	0.858	1.000	1.000	0.858
0.12	0.891	1.000	1.000	0.891
0.13	0.920	1.000	1.000	0.920
0.133	0.927	1.000	1.000	0.927
0.14	0.944	1.000	1.000	0.944
0.15	0.965	1.000	1.000	0.965
0.16	0.985	1.000	1.000	0.985
0.17	1.002	1.000	1.000	1.002
0.18	1.018	1.000	1.000	1.018
0.19	1.031	1.000	1.000	1.031
0.2	1.043	1.000	1.000	1.043
0.22	1.050	1.000	1.000	1.050
0.24	1.054	1.000	1.000	1.054
0.25	1.054	1.000	1.000	1.054
0.26	1.051	1.000	1.000	1.051
0.28	1.046	1.000	1.000	1.046
0.29	1.041	1.000	1.000	1.041
0.3	1.037	1.000	1.000	1.037
0.32	1.028	1.000	1.000	1.028
0.34	1.018	1.000	1.000	1.018
0.35	1.012	1.000	1.000	1.012
0.36	1.007	1.000	1.000	1.007
0.38	0.994	1.000	1.000	0.994
0.4	0.982	1.000	1.000	0.982
0.42	0.970	1.000	1.000	0.970
0.44	0.957	1.000	1.000	0.957
0.45	0.952	1.000	1.000	0.952
0.46	0.946	1.000	1.000	0.946
0.48	0.934	1.000	1.000	0.934
0.5	0.922	1.000	1.000	0.922
0.55	0.875	1.000	1.020	0.892
0.6	0.833	1.000	1.040	0.866
0.65	0.795	1.000	1.060	0.843
0.667	0.783	1.000	1.067	0.836

	0.761	1.000	1.080	0.822
0.75	0.731	1.000	1.100	0.804
0.8	0.698	1.000	1.120	0.782
0.85	0.668	1.000	1.140	0.762
0.9	0.641	1.000	1.160	0.744
0.95	0.616	1.000	1.180	0.727
1	0.592	1.000	1.200	0.711
1.1	0.547	1.000	1.200	0.656
1.2	0.507	1.000	1.200	0.609
1.3	0.472	1.000	1.200	0.567
1.4	0.441	1.000	1.200	0.529
1.5	0.413	1.000	1.200	0.495
1.6	0.385	1.000	1.200	0.462
1.7	0.361	1.000	1.200	0.433
1.8	0.339	1.000	1.200	0.407
1.9	0.319	1.000	1.200	0.383
2	0.302	1.000	1.200	0.362
2.2	0.270	1.000	1.200	0.324
2.4	0.244	1.000	1.200	0.293
2.5	0.233	1.000	1.200	0.280
2.6	0.223	1.000	1.200	0.268
2.8	0.205	1.000	1.200	0.246
3	0.189	1.000	1.200	0.227
3.2	0.175	1.000	1.200	0.210
3.4	0.163	1.000	1.200	0.196
3.5	0.158	1.000	1.200	0.189
3.6	0.153	1.000	1.200	0.183
3.8	0.143	1.000	1.200	0.172
4	0.135	1.000	1.200	0.162
4.2	0.128	1.000	1.200	0.153
4.4	0.121	1.000	1.200	0.145
4.6	0.115	1.000	1.200	0.138
4.8	0.110	1.000	1.200	0.132
5	0.105	1.000	1.200	0.126

To use above data in Excel, copy/paste:

```
0.01    0.478    1.000    1.000    0.478
0.02    0.487    1.000    1.000    0.487
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.344	1.000	1.000	0.344

0.02	0.410	1.000	1.000	0.410
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.451	1.000	1.000	0.451
0.03	0.454	1.000	1.000	0.454
0.032	0.462	1.000	1.000	0.462
0.035	0.473	1.000	1.000	0.473
0.036	0.476	1.000	1.000	0.476
0.04	0.489	1.000	1.000	0.489
0.042	0.495	1.000	1.000	0.495
0.044	0.501	1.000	1.000	0.501
0.045	0.504	1.000	1.000	0.504
0.046	0.507	1.000	1.000	0.507
0.048	0.512	1.000	1.000	0.512
0.05	0.518	1.000	1.000	0.518
0.055	0.530	1.000	1.000	0.530
0.06	0.542	1.000	1.000	0.542
0.065	0.553	1.000	1.000	0.553
0.067	0.558	1.000	1.000	0.558
0.07	0.564	1.000	1.000	0.564
0.075	0.574	1.000	1.000	0.574
0.08	0.583	1.000	1.000	0.583
0.085	0.592	1.000	1.000	0.592
0.09	0.601	1.000	1.000	0.601
0.095	0.609	1.000	1.000	0.609
0.1	0.618	1.000	1.000	0.618
0.11	0.635	1.000	1.000	0.635
0.12	0.651	1.000	1.000	0.651
0.13	0.667	1.000	1.000	0.667
0.133	0.671	1.000	1.000	0.671
0.14	0.682	1.000	1.000	0.682
0.15	0.696	1.000	1.000	0.696
0.16	0.709	1.000	1.000	0.709
0.17	0.722	1.000	1.000	0.722
0.18	0.734	1.000	1.000	0.734
0.19	0.746	1.000	1.000	0.746
0.2	0.757	1.000	1.000	0.757
0.22	0.746	1.000	1.000	0.746
0.24	0.735	1.000	1.000	0.735
0.25	0.731	1.000	1.000	0.731
0.26	0.726	1.000	1.000	0.726
0.28	0.718	1.000	1.000	0.718
0.29	0.714	1.000	1.000	0.714
0.3	0.710	1.000	1.000	0.710
0.32	0.692	1.000	1.000	0.692
0.34	0.675	1.000	1.000	0.675

	0.667	1.000	1.000	0.667
0.36	0.659	1.000	1.000	0.659
0.38	0.645	1.000	1.000	0.645
0.4	0.632	1.000	1.000	0.632
0.42	0.619	1.000	1.000	0.619
0.44	0.608	1.000	1.000	0.608
0.45	0.602	1.000	1.000	0.602
0.46	0.597	1.000	1.000	0.597
0.48	0.587	1.000	1.000	0.587
0.5	0.577	1.000	1.000	0.577
0.55	0.541	1.000	1.020	0.551
0.6	0.510	1.000	1.040	0.530
0.65	0.482	1.000	1.060	0.511
0.667	0.474	1.000	1.067	0.506
0.7	0.459	1.000	1.080	0.495
0.75	0.438	1.000	1.100	0.481
0.8	0.415	1.000	1.120	0.465
0.85	0.394	1.000	1.140	0.450
0.9	0.376	1.000	1.160	0.436
0.95	0.360	1.000	1.180	0.424
1	0.345	1.000	1.200	0.414
1.1	0.315	1.000	1.200	0.378
1.2	0.289	1.000	1.200	0.347
1.3	0.268	1.000	1.200	0.322
1.4	0.250	1.000	1.200	0.300
1.5	0.234	1.000	1.200	0.281
1.6	0.220	1.000	1.200	0.264
1.7	0.207	1.000	1.200	0.249
1.8	0.196	1.000	1.200	0.236
1.9	0.187	1.000	1.200	0.224
2	0.178	1.000	1.200	0.213
2.2	0.160	1.000	1.200	0.192
2.4	0.145	1.000	1.200	0.174
2.5	0.138	1.000	1.200	0.166
2.6	0.132	1.000	1.200	0.159
2.8	0.122	1.000	1.200	0.146
3	0.113	1.000	1.200	0.135
3.2	0.104	1.000	1.200	0.125
3.4	0.097	1.000	1.200	0.117
3.5	0.094	1.000	1.200	0.113
3.6	0.091	1.000	1.200	0.109
3.8	0.085	1.000	1.200	0.102
4	0.080	1.000	1.200	0.096
4.2	0.077	1.000	1.200	0.092
4.4	0.073	1.000	1.200	0.088
4.6	0.070	1.000	1.200	0.084

	0.068	1.000	1.200	0.081	
5	0.065	1.000	1.200	0.078	

To use above data in Excel, copy/paste:

```
0.01    0.344    1.000    1.000    0.344
0.02    0.410    1.000    1.000    0.410
```

Envelope Data

Period	SA
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.560
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.650
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.760
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.920
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018

0.19	1.031
0.2	1.043
0.22	1.050
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982
0.42	0.970
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.280
2.6	0.268

2.8	0.246
3	0.227
3.2	0.210
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126
To use above data in Excel, copy/paste:	0.01 0.478 0.02 0.487

SITE DATA

Shear Wave Velocity, Vs_{30}:	380 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	241 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.474	1.000	1.000	0.474
0.02	0.483	1.000	1.000	0.483
0.022	0.489	1.000	1.000	0.489
0.025	0.497	1.000	1.000	0.497
0.029	0.508	1.000	1.000	0.508
0.03	0.511	1.000	1.000	0.511
0.032	0.519	1.000	1.000	0.519
0.035	0.530	1.000	1.000	0.530
0.036	0.534	1.000	1.000	0.534
0.04	0.550	1.000	1.000	0.550
0.042	0.558	1.000	1.000	0.558
0.044	0.565	1.000	1.000	0.565
0.045	0.570	1.000	1.000	0.570
0.046	0.574	1.000	1.000	0.574
0.048	0.582	1.000	1.000	0.582

0.05	0.590	1.000	1.000	0.590
0.055	0.610	1.000	1.000	0.610
0.06	0.631	1.000	1.000	0.631
0.065	0.651	1.000	1.000	0.651
0.067	0.659	1.000	1.000	0.659
0.07	0.671	1.000	1.000	0.671
0.075	0.691	1.000	1.000	0.691
0.08	0.711	1.000	1.000	0.711
0.085	0.732	1.000	1.000	0.732
0.09	0.752	1.000	1.000	0.752
0.095	0.771	1.000	1.000	0.771
0.1	0.790	1.000	1.000	0.790
0.11	0.825	1.000	1.000	0.825
0.12	0.856	1.000	1.000	0.856
0.13	0.884	1.000	1.000	0.884
0.133	0.891	1.000	1.000	0.891
0.14	0.907	1.000	1.000	0.907
0.15	0.928	1.000	1.000	0.928
0.16	0.948	1.000	1.000	0.948
0.17	0.966	1.000	1.000	0.966
0.18	0.982	1.000	1.000	0.982
0.19	0.996	1.000	1.000	0.996
0.2	1.008	1.000	1.000	1.008
0.22	1.019	1.000	1.000	1.019
0.24	1.026	1.000	1.000	1.026
0.25	1.028	1.000	1.000	1.028
0.26	1.027	1.000	1.000	1.027
0.28	1.025	1.000	1.000	1.025
0.29	1.022	1.000	1.000	1.022
0.3	1.019	1.000	1.000	1.019
0.32	1.013	1.000	1.000	1.013
0.34	1.006	1.000	1.000	1.006
0.35	1.001	1.000	1.000	1.001
0.36	0.997	1.000	1.000	0.997
0.38	0.987	1.000	1.000	0.987
0.4	0.977	1.000	1.000	0.977
0.42	0.967	1.000	1.000	0.967
0.44	0.957	1.000	1.000	0.957
0.45	0.953	1.000	1.000	0.953
0.46	0.948	1.000	1.000	0.948
0.48	0.938	1.000	1.000	0.938
0.5	0.928	1.000	1.000	0.928
0.55	0.886	1.000	1.020	0.904
0.6	0.849	1.000	1.040	0.883
0.65	0.815	1.000	1.060	0.864
0.667	0.804	1.000	1.067	0.858

	0.784	1.000	1.080	0.847
0.75	0.756	1.000	1.100	0.832
0.8	0.725	1.000	1.120	0.812
0.85	0.697	1.000	1.140	0.794
0.9	0.670	1.000	1.160	0.778
0.95	0.646	1.000	1.180	0.762
1	0.623	1.000	1.200	0.748
1.1	0.578	1.000	1.200	0.693
1.2	0.538	1.000	1.200	0.645
1.3	0.502	1.000	1.200	0.603
1.4	0.470	1.000	1.200	0.564
1.5	0.441	1.000	1.200	0.529
1.6	0.413	1.000	1.200	0.495
1.7	0.388	1.000	1.200	0.465
1.8	0.365	1.000	1.200	0.438
1.9	0.344	1.000	1.200	0.413
2	0.326	1.000	1.200	0.391
2.2	0.293	1.000	1.200	0.351
2.4	0.265	1.000	1.200	0.318
2.5	0.253	1.000	1.200	0.304
2.6	0.242	1.000	1.200	0.291
2.8	0.223	1.000	1.200	0.267
3	0.206	1.000	1.200	0.247
3.2	0.191	1.000	1.200	0.229
3.4	0.178	1.000	1.200	0.214
3.5	0.172	1.000	1.200	0.206
3.6	0.166	1.000	1.200	0.200
3.8	0.156	1.000	1.200	0.187
4	0.147	1.000	1.200	0.176
4.2	0.139	1.000	1.200	0.167
4.4	0.132	1.000	1.200	0.158
4.6	0.125	1.000	1.200	0.151
4.8	0.120	1.000	1.200	0.143
5	0.114	1.000	1.200	0.137

To use above data in Excel, copy/paste:

```
0.01    0.474    1.000    1.000    0.474
0.02    0.483    1.000    1.000    0.483
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.346	1.000	1.000	0.346

0.02	0.411	1.000	1.000	0.411
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.450	1.000	1.000	0.450
0.03	0.454	1.000	1.000	0.454
0.032	0.461	1.000	1.000	0.461
0.035	0.471	1.000	1.000	0.471
0.036	0.475	1.000	1.000	0.475
0.04	0.487	1.000	1.000	0.487
0.042	0.493	1.000	1.000	0.493
0.044	0.499	1.000	1.000	0.499
0.045	0.501	1.000	1.000	0.501
0.046	0.504	1.000	1.000	0.504
0.048	0.509	1.000	1.000	0.509
0.05	0.515	1.000	1.000	0.515
0.055	0.527	1.000	1.000	0.527
0.06	0.538	1.000	1.000	0.538
0.065	0.549	1.000	1.000	0.549
0.067	0.553	1.000	1.000	0.553
0.07	0.559	1.000	1.000	0.559
0.075	0.569	1.000	1.000	0.569
0.08	0.578	1.000	1.000	0.578
0.085	0.587	1.000	1.000	0.587
0.09	0.595	1.000	1.000	0.595
0.095	0.603	1.000	1.000	0.603
0.1	0.610	1.000	1.000	0.610
0.11	0.628	1.000	1.000	0.628
0.12	0.645	1.000	1.000	0.645
0.13	0.660	1.000	1.000	0.660
0.133	0.665	1.000	1.000	0.665
0.14	0.675	1.000	1.000	0.675
0.15	0.689	1.000	1.000	0.689
0.16	0.703	1.000	1.000	0.703
0.17	0.715	1.000	1.000	0.715
0.18	0.728	1.000	1.000	0.728
0.19	0.740	1.000	1.000	0.740
0.2	0.751	1.000	1.000	0.751
0.22	0.743	1.000	1.000	0.743
0.24	0.735	1.000	1.000	0.735
0.25	0.732	1.000	1.000	0.732
0.26	0.729	1.000	1.000	0.729
0.28	0.722	1.000	1.000	0.722
0.29	0.719	1.000	1.000	0.719
0.3	0.717	1.000	1.000	0.717
0.32	0.700	1.000	1.000	0.700
0.34	0.685	1.000	1.000	0.685

	0.678	1.000	1.000	0.678
0.36	0.671	1.000	1.000	0.671
0.38	0.658	1.000	1.000	0.658
0.4	0.646	1.000	1.000	0.646
0.42	0.634	1.000	1.000	0.634
0.44	0.624	1.000	1.000	0.624
0.45	0.619	1.000	1.000	0.619
0.46	0.614	1.000	1.000	0.614
0.48	0.604	1.000	1.000	0.604
0.5	0.596	1.000	1.000	0.596
0.55	0.561	1.000	1.020	0.572
0.6	0.531	1.000	1.040	0.552
0.65	0.505	1.000	1.060	0.535
0.667	0.497	1.000	1.067	0.530
0.7	0.482	1.000	1.080	0.520
0.75	0.461	1.000	1.100	0.507
0.8	0.438	1.000	1.120	0.491
0.85	0.417	1.000	1.140	0.476
0.9	0.399	1.000	1.160	0.462
0.95	0.382	1.000	1.180	0.451
1	0.367	1.000	1.200	0.440
1.1	0.335	1.000	1.200	0.402
1.2	0.309	1.000	1.200	0.371
1.3	0.287	1.000	1.200	0.344
1.4	0.268	1.000	1.200	0.321
1.5	0.251	1.000	1.200	0.301
1.6	0.236	1.000	1.200	0.283
1.7	0.223	1.000	1.200	0.268
1.8	0.212	1.000	1.200	0.254
1.9	0.201	1.000	1.200	0.241
2	0.192	1.000	1.200	0.230
2.2	0.173	1.000	1.200	0.207
2.4	0.157	1.000	1.200	0.188
2.5	0.150	1.000	1.200	0.180
2.6	0.143	1.000	1.200	0.172
2.8	0.132	1.000	1.200	0.159
3	0.122	1.000	1.200	0.147
3.2	0.113	1.000	1.200	0.136
3.4	0.106	1.000	1.200	0.127
3.5	0.102	1.000	1.200	0.122
3.6	0.099	1.000	1.200	0.118
3.8	0.093	1.000	1.200	0.111
4	0.087	1.000	1.200	0.105
4.2	0.083	1.000	1.200	0.100
4.4	0.080	1.000	1.200	0.096
4.6	0.076	1.000	1.200	0.092

	0.073	1.000	1.200	0.088	
5	0.071	1.000	1.200	0.085	

To use above data in Excel, copy/paste:

```
0.01    0.346    1.000    1.000    0.346
0.02    0.411    1.000    1.000    0.411
```

Envelope Data

Period	SA
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.530
0.036	0.534
0.04	0.550
0.042	0.558
0.044	0.565
0.045	0.570
0.046	0.574
0.048	0.582
0.05	0.590
0.055	0.610
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.790
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982

0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977
0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291

2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.200
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137
To use above data in Excel, copy/paste:	0.01 0.474 0.02 0.483

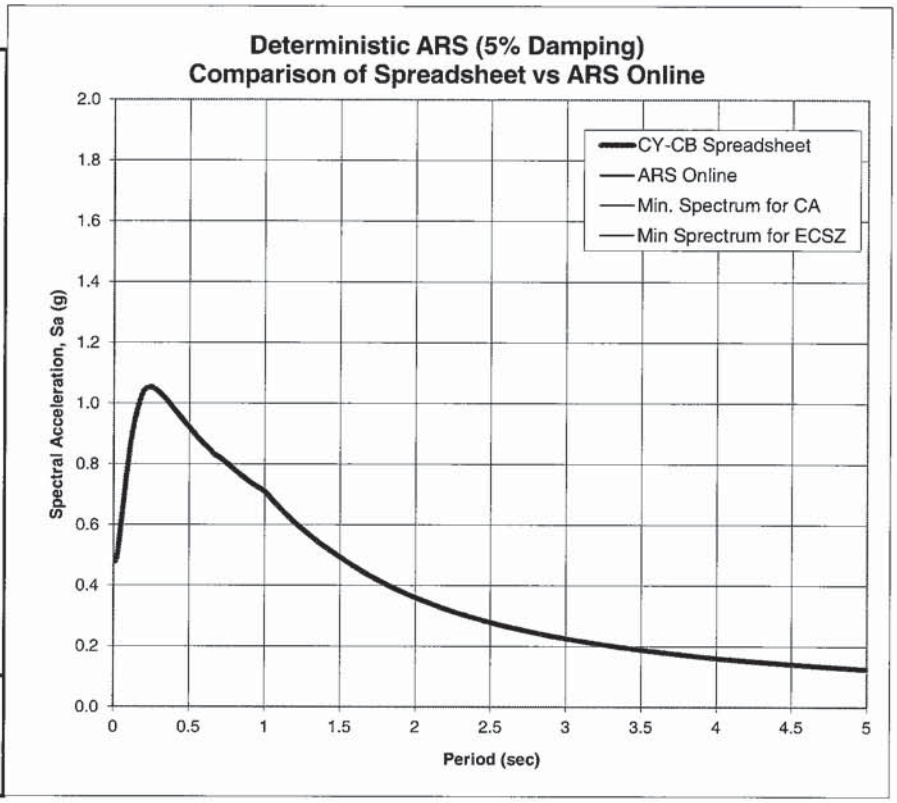
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	420	(270 to 1500 m/s)
$Z_{1.0}$ (m)	191	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 1%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47789
0.020	0.48686
0.022	0.49308
0.025	0.50248
0.029	0.51423
0.030	0.51759
0.032	0.52590
0.035	0.53849
0.036	0.54284
0.040	0.55973
0.042	0.56862
0.044	0.57722
0.045	0.58182
0.046	0.58628
0.048	0.59508
0.050	0.60406
0.055	0.62681
0.060	0.64992
0.065	0.67218
0.067	0.68124
0.070	0.69413
0.075	0.71578
0.080	0.73787
0.085	0.75998
0.090	0.78110
0.095	0.80197
0.100	0.82221
0.110	0.85852
0.120	0.89139
0.130	0.91999
0.133	0.92734
0.140	0.94388
0.150	0.96504
0.160	0.98526
0.170	1.00230

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.478	1	1	0.478	0%
0.02	0.487	1	1	0.487	0%
0.022	0.493	1	1	0.493	0%
0.025	0.502	1	1	0.502	0%
0.029	0.514	1	1	0.514	0%
0.03	0.518	1	1	0.518	0%
0.032	0.526	1	1	0.526	0%
0.035	0.538	1	1	0.538	0%
0.036	0.543	1	1	0.543	0%
0.04	0.56	1	1	0.56	0%
0.042	0.569	1	1	0.569	0%
0.044	0.577	1	1	0.577	0%
0.045	0.582	1	1	0.582	0%
0.046	0.586	1	1	0.586	0%
0.048	0.595	1	1	0.595	0%
0.05	0.604	1	1	0.604	0%
0.055	0.627	1	1	0.627	0%
0.06	0.65	1	1	0.65	0%
0.065	0.672	1	1	0.672	0%
0.067	0.681	1	1	0.681	0%
0.07	0.694	1	1	0.694	0%
0.075	0.716	1	1	0.716	0%
0.08	0.738	1	1	0.738	0%
0.085	0.76	1	1	0.76	0%
0.09	0.781	1	1	0.781	0%
0.095	0.802	1	1	0.802	0%
0.1	0.822	1	1	0.822	0%
0.11	0.858	1	1	0.858	0%
0.12	0.891	1	1	0.891	0%
0.13	0.92	1	1	0.92	0%
0.133	0.927	1	1	0.927	0%
0.14	0.944	1	1	0.944	0%
0.15	0.965	1	1	0.965	0%
0.16	0.985	1	1	0.985	0%
0.17	1.002	1	1	1.002	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

0.180	1.01786

0.18	1.018	1	1	1.018	0%

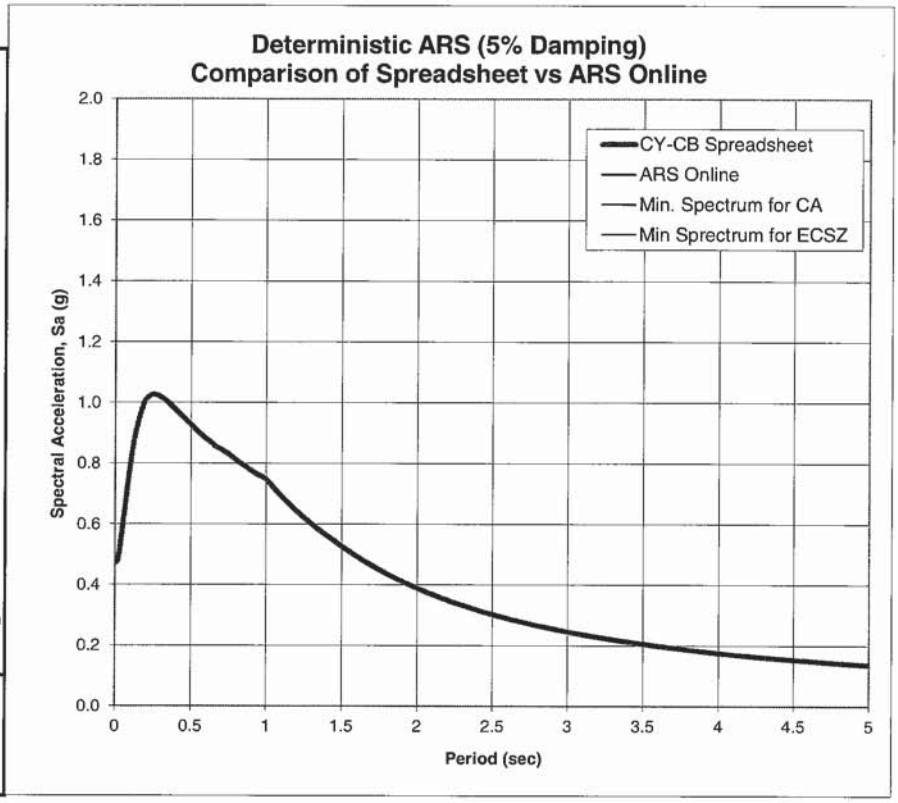
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	380	(270 to 1500 m/s)
$Z_{1.0}$ (m)	241	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 0%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47415
0.020	0.48287
0.022	0.48875
0.025	0.49754
0.029	0.50835
0.030	0.51146
0.032	0.51908
0.035	0.53054
0.036	0.53448
0.040	0.54968
0.042	0.55771
0.044	0.56547
0.045	0.56963
0.046	0.57367
0.048	0.58160
0.050	0.58968
0.055	0.61012
0.060	0.63092
0.065	0.65105
0.067	0.65928
0.070	0.67103
0.075	0.69080
0.080	0.71131
0.085	0.73186
0.090	0.75164
0.095	0.77123
0.100	0.79029
0.110	0.82488
0.120	0.85639
0.130	0.88404
0.133	0.89123
0.140	0.90735
0.150	0.92813
0.160	0.94846
0.170	0.96587

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.474	1	1	0.474	0%
0.02	0.483	1	1	0.483	0%
0.022	0.489	1	1	0.489	0%
0.025	0.497	1	1	0.497	0%
0.029	0.508	1	1	0.508	0%
0.03	0.511	1	1	0.511	0%
0.032	0.519	1	1	0.519	0%
0.035	0.53	1	1	0.53	0%
0.036	0.534	1	1	0.534	0%
0.04	0.55	1	1	0.55	0%
0.042	0.558	1	1	0.558	0%
0.044	0.565	1	1	0.565	0%
0.045	0.57	1	1	0.57	0%
0.046	0.574	1	1	0.574	0%
0.048	0.582	1	1	0.582	0%
0.05	0.59	1	1	0.59	0%
0.055	0.61	1	1	0.61	0%
0.06	0.631	1	1	0.631	0%
0.065	0.651	1	1	0.651	0%
0.067	0.659	1	1	0.659	0%
0.07	0.671	1	1	0.671	0%
0.075	0.691	1	1	0.691	0%
0.08	0.711	1	1	0.711	0%
0.085	0.732	1	1	0.732	0%
0.09	0.752	1	1	0.752	0%
0.095	0.771	1	1	0.771	0%
0.1	0.79	1	1	0.79	0%
0.11	0.825	1	1	0.825	0%
0.12	0.856	1	1	0.856	0%
0.13	0.884	1	1	0.884	0%
0.133	0.891	1	1	0.891	0%
0.14	0.907	1	1	0.907	0%
0.15	0.928	1	1	0.928	0%
0.16	0.948	1	1	0.948	0%
0.17	0.966	1	1	0.966	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

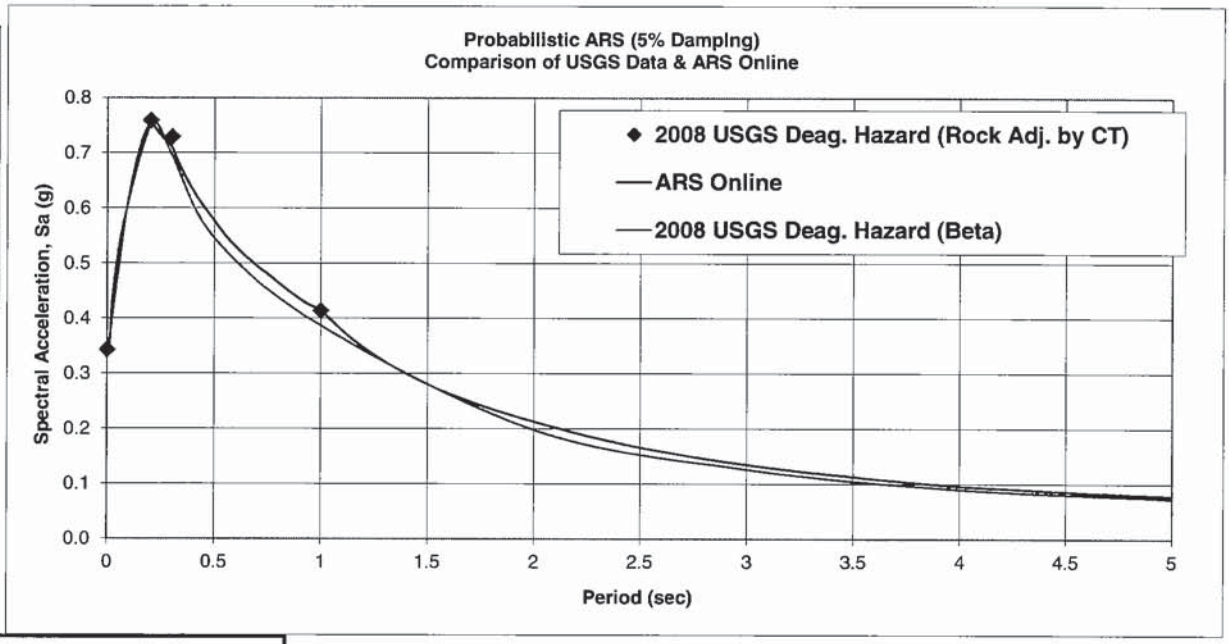
0.180	0.98191

0.18	0.982	1	1	0.982	0%

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	420
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	191
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.344	1	1	0.344
0.02	0.41	1	1	0.41
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.451	1	1	0.451
0.03	0.454	1	1	0.454
0.032	0.462	1	1	0.462
0.035	0.473	1	1	0.473
0.036	0.476	1	1	0.476
0.04	0.489	1	1	0.489
0.042	0.495	1	1	0.495
0.044	0.501	1	1	0.501
0.045	0.504	1	1	0.504
0.046	0.507	1	1	0.507
0.048	0.512	1	1	0.512
0.05	0.518	1	1	0.518
0.055	0.53	1	1	0.53
0.06	0.542	1	1	0.542
0.065	0.553	1	1	0.553
0.067	0.558	1	1	0.558
0.07	0.564	1	1	0.564
0.075	0.574	1	1	0.574
0.08	0.583	1	1	0.583
0.085	0.592	1	1	0.592
0.09	0.601	1	1	0.601
0.095	0.609	1	1	0.609
0.1	0.618	1	1	0.618
0.11	0.635	1	1	0.635
0.12	0.651	1	1	0.651
0.13	0.667	1	1	0.667
0.133	0.671	1	1	0.671
0.14	0.682	1	1	0.682
0.15	0.696	1	1	0.696
0.16	0.709	1	1	0.709

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.116	1.000	0.343	0.344	-0.2%
0.2	0.722	1.000	1.052	1.000	0.760	0.757	0.4%
0.3	0.597	1.000	1.222	1.000	0.730	0.71	2.7%
1	0.226	1.200	1.528	1.000	0.414	0.414	0.0%

Max % Difference = 2.7%

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3306	1.000	1.000	0.331	0.344	3.9%
0.1	0.6232	1.000	1.000	0.623	0.618	0.8%
0.2	0.7568	1.000	1.000	0.757	0.757	0.0%
0.3	0.696	1.000	1.000	0.696	0.71	2.0%
0.5	0.5454	1.000	1.000	0.545	0.577	5.8%
1	0.3227	1.200	1.000	0.387	0.414	6.9%
2	0.1652	1.200	1.000	0.198	0.213	7.4%
3	0.1054	1.200	1.000	0.126	0.135	6.7%
4	0.07516	1.200	1.000	0.090	0.096	6.4%
5	0.06116	1.200	1.000	0.073	0.078	6.3%

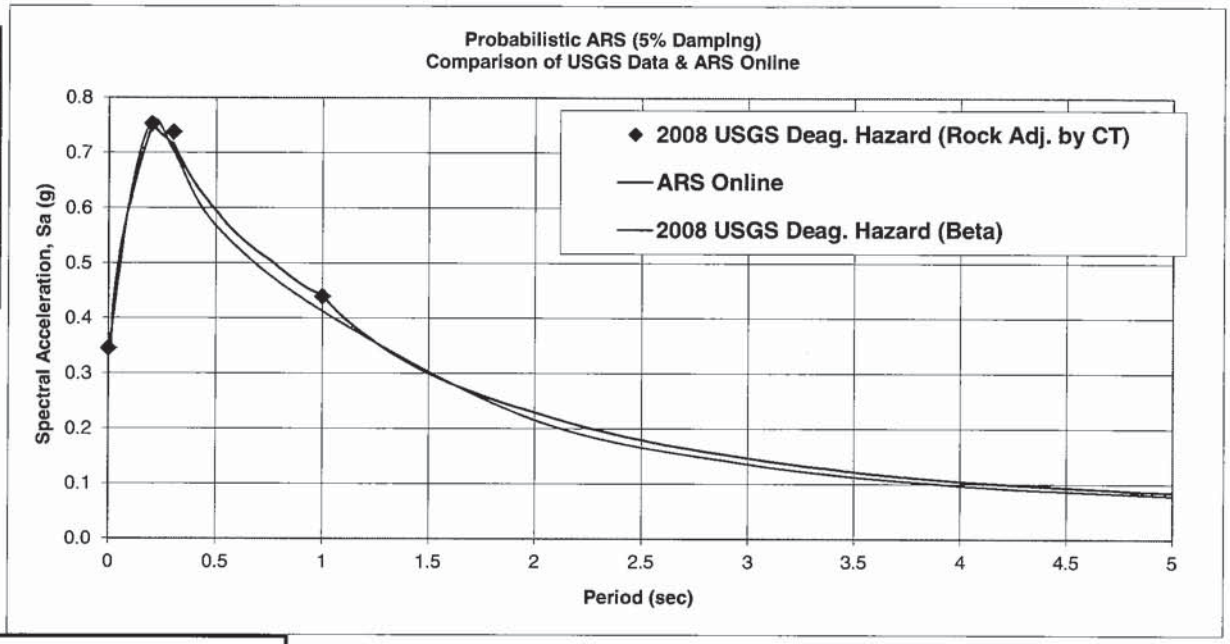
Max % Difference = 7.4%

0.17	0.722	1	1	0.722
0.18	0.734	1	1	0.734
0.19	0.746	1	1	0.746
0.2	0.757	1	1	0.757
0.22	0.746	1	1	0.746
0.24	0.735	1	1	0.735
0.25	0.731	1	1	0.731

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	380
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	241
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.346	1	1	0.346
0.02	0.411	1	1	0.411
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.45	1	1	0.45
0.03	0.454	1	1	0.454
0.032	0.461	1	1	0.461
0.035	0.471	1	1	0.471
0.036	0.475	1	1	0.475
0.04	0.487	1	1	0.487
0.042	0.493	1	1	0.493
0.044	0.499	1	1	0.499
0.045	0.501	1	1	0.501
0.046	0.504	1	1	0.504
0.048	0.509	1	1	0.509
0.05	0.515	1	1	0.515
0.055	0.527	1	1	0.527
0.06	0.538	1	1	0.538
0.065	0.549	1	1	0.549
0.067	0.553	1	1	0.553
0.07	0.559	1	1	0.559
0.075	0.569	1	1	0.569
0.08	0.578	1	1	0.578
0.085	0.587	1	1	0.587
0.09	0.595	1	1	0.595
0.095	0.603	1	1	0.603
0.1	0.61	1	1	0.61
0.11	0.628	1	1	0.628
0.12	0.645	1	1	0.645
0.13	0.66	1	1	0.66
0.133	0.665	1	1	0.665
0.14	0.675	1	1	0.675
0.15	0.689	1	1	0.689
0.16	0.703	1	1	0.703

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.124	1.000	0.346	0.346	-0.1%
0.2	0.722	1.000	1.043	1.000	0.754	0.751	0.4%
0.3	0.597	1.000	1.237	1.000	0.739	0.717	2.9%
1	0.226	1.200	1.625	1.000	0.440	0.44	0.1%

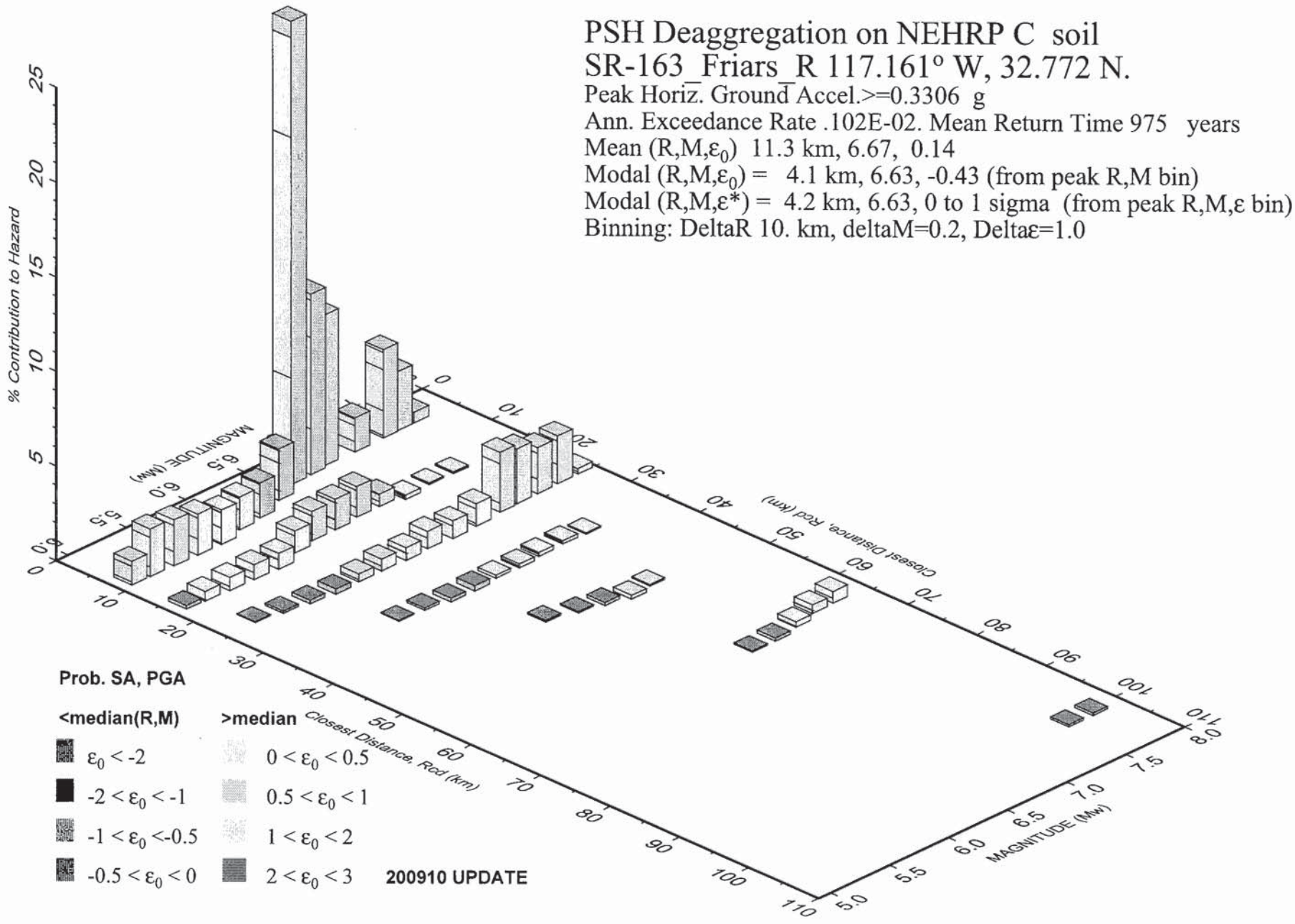
Max % Difference = **2.9%**

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3376	1.000	1.000	0.338	0.346	2.5%
0.1	0.6205	1.000	1.000	0.621	0.61	1.7%
0.2	0.759	1.000	1.000	0.759	0.751	1.1%
0.3	0.705	1.000	1.000	0.705	0.717	1.7%
0.5	0.5681	1.000	1.000	0.568	0.596	4.9%
1	0.3446	1.200	1.000	0.414	0.44	6.4%
2	0.18	1.200	1.000	0.216	0.23	6.5%
3	0.11364	1.200	1.000	0.136	0.147	7.8%
4	0.08119	1.200	1.000	0.097	0.105	7.8%
5	0.06605	1.200	1.000	0.079	0.085	7.2%

Max % Difference = **7.8%**

0.17	0.715	1	1	0.715
0.18	0.728	1	1	0.728
0.19	0.74	1	1	0.74
0.2	0.751	1	1	0.751
0.22	0.743	1	1	0.743
0.24	0.735	1	1	0.735
0.25	0.732	1	1	0.732



GMT 2012 Jul 5 23:31:17 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6232 g

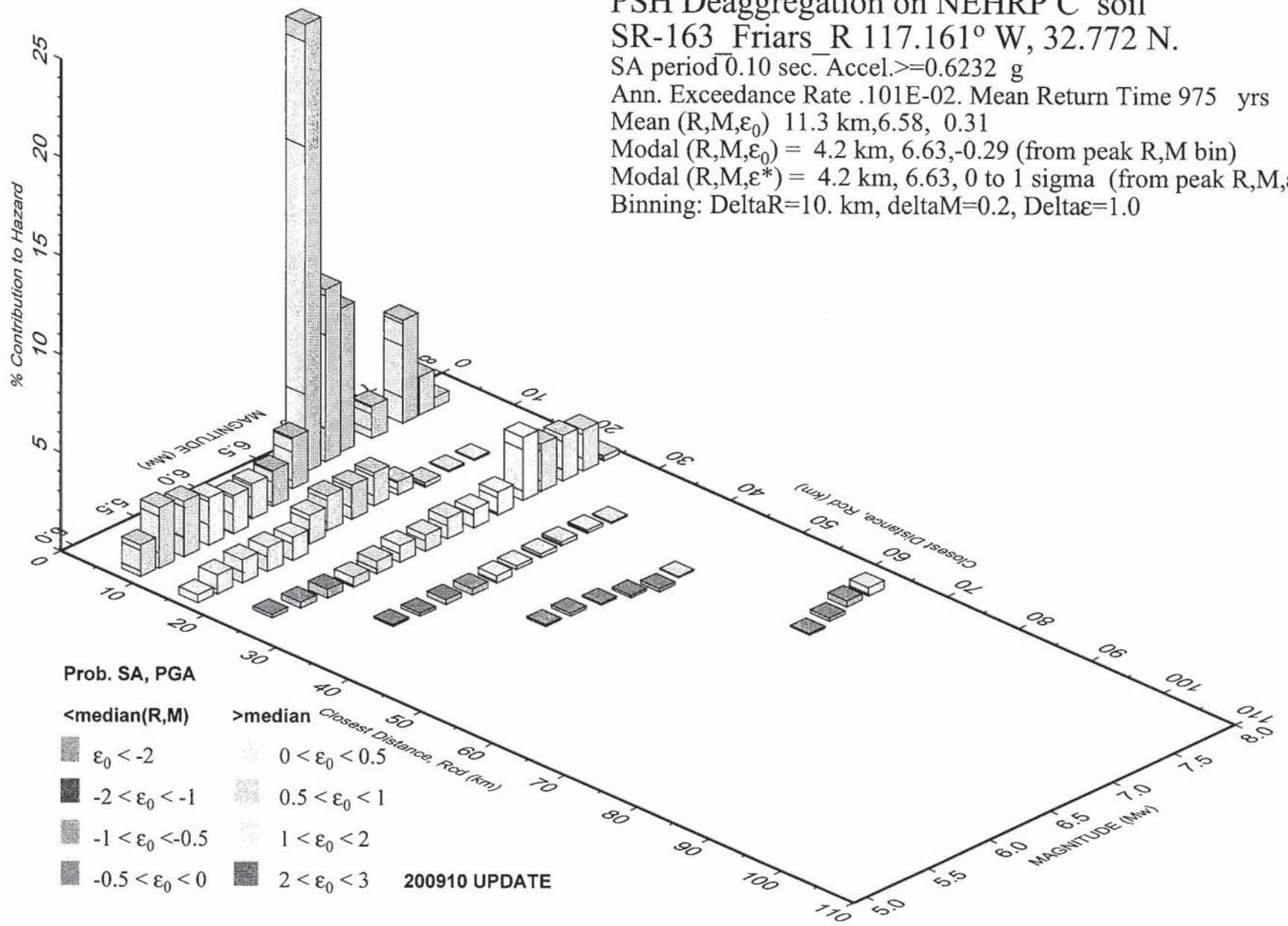
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 11.3 km,6.58, 0.31

Modal (R,M,ε_0) = 4.2 km, 6.63,-0.29 (from peak R,M bin)

Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

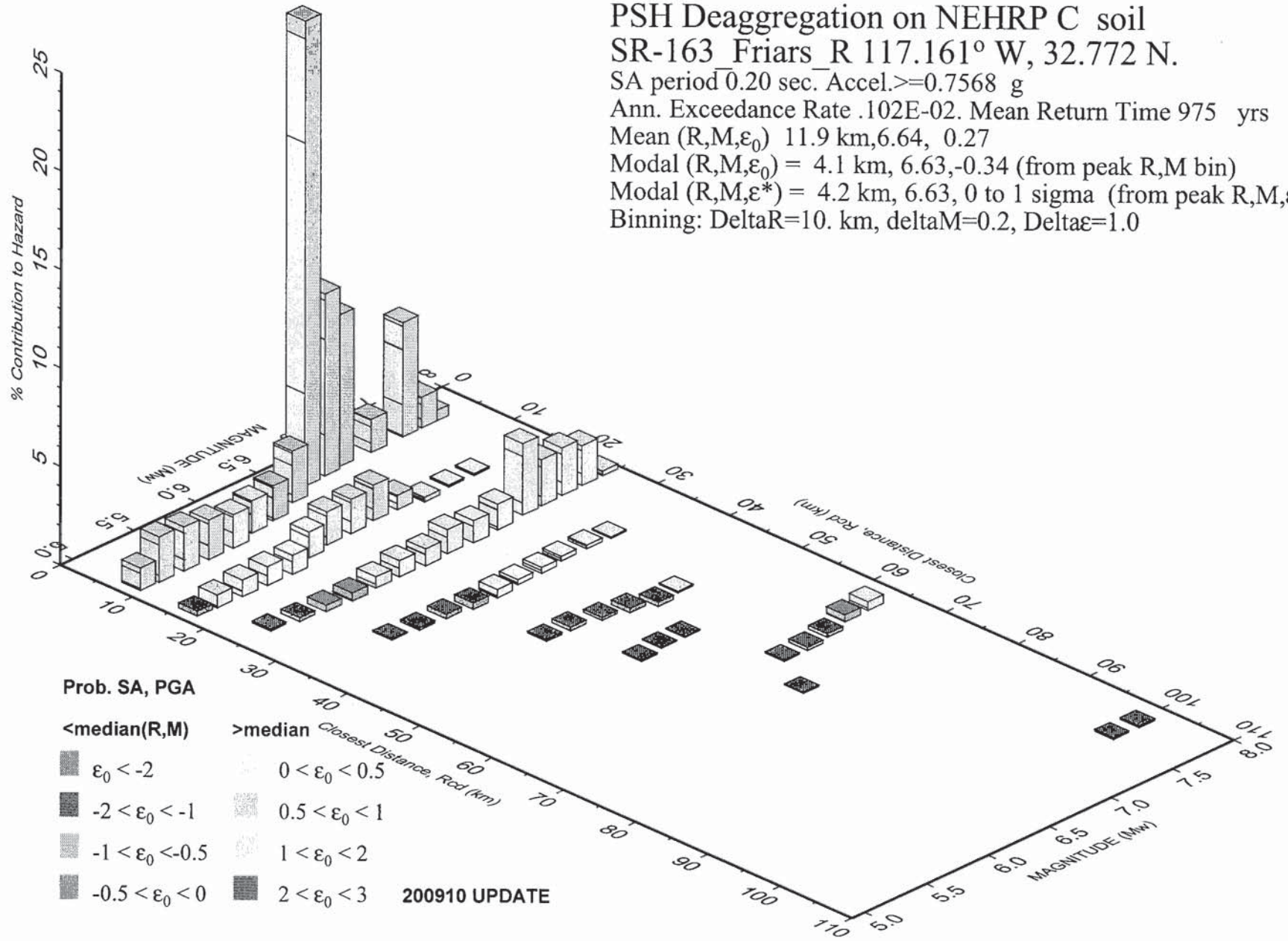
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:34:04 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

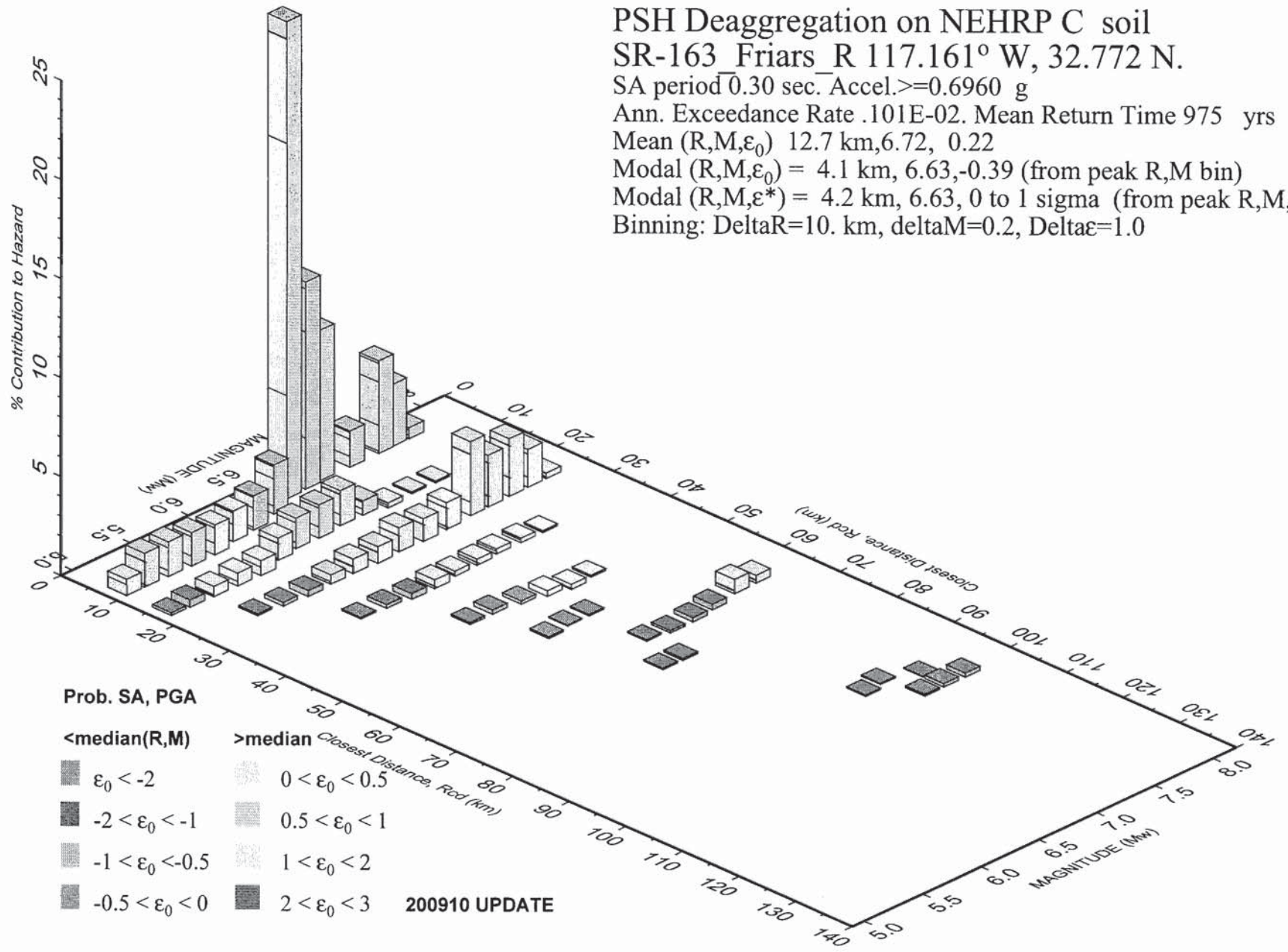
SA period 0.20 sec. Accel.>=0.7568 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.9 km,6.64, 0.27
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:36:42 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

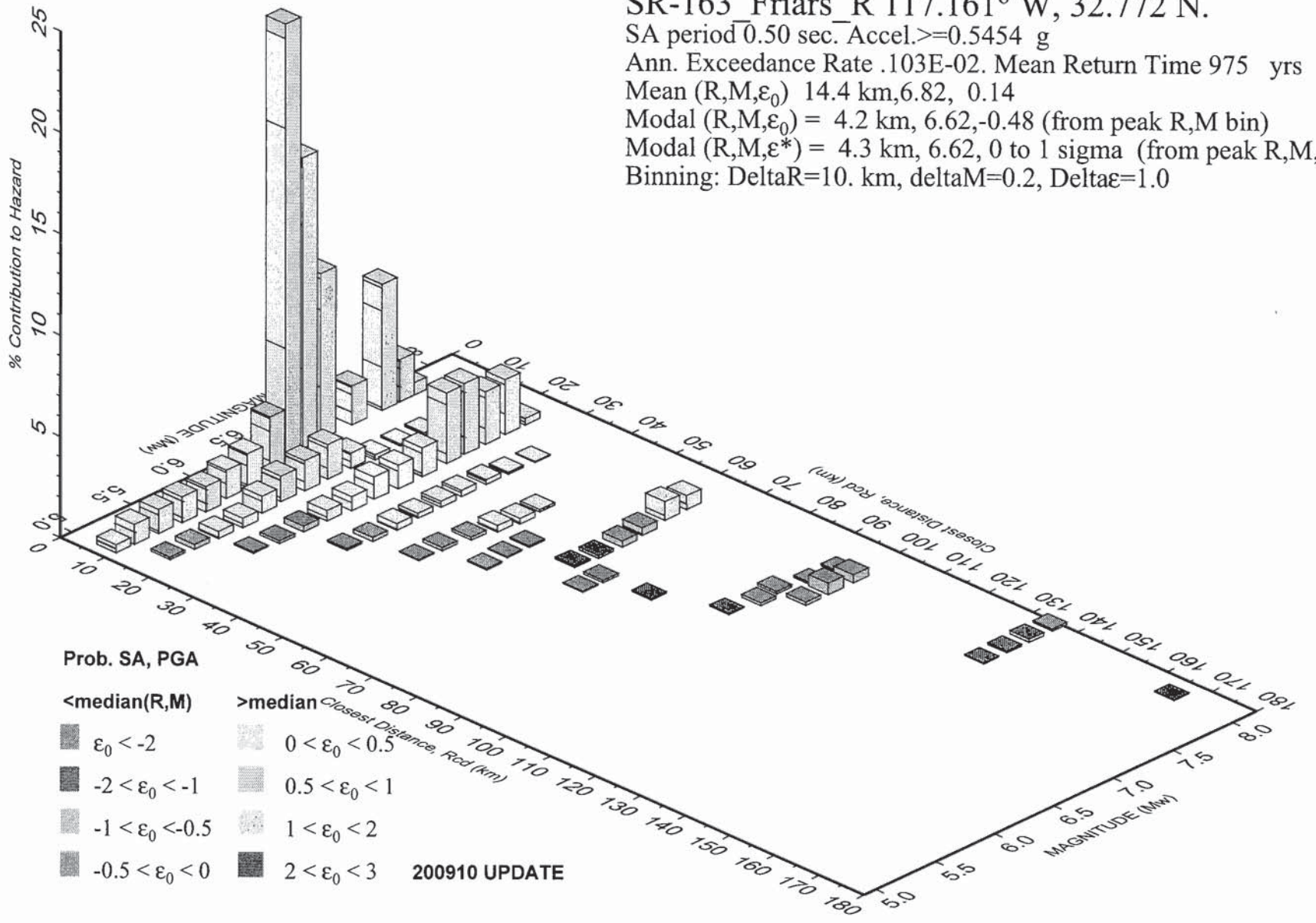
SA period 0.30 sec. Accel.>=0.6960 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.7 km,6.72, 0.22
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.39 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:39:24 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

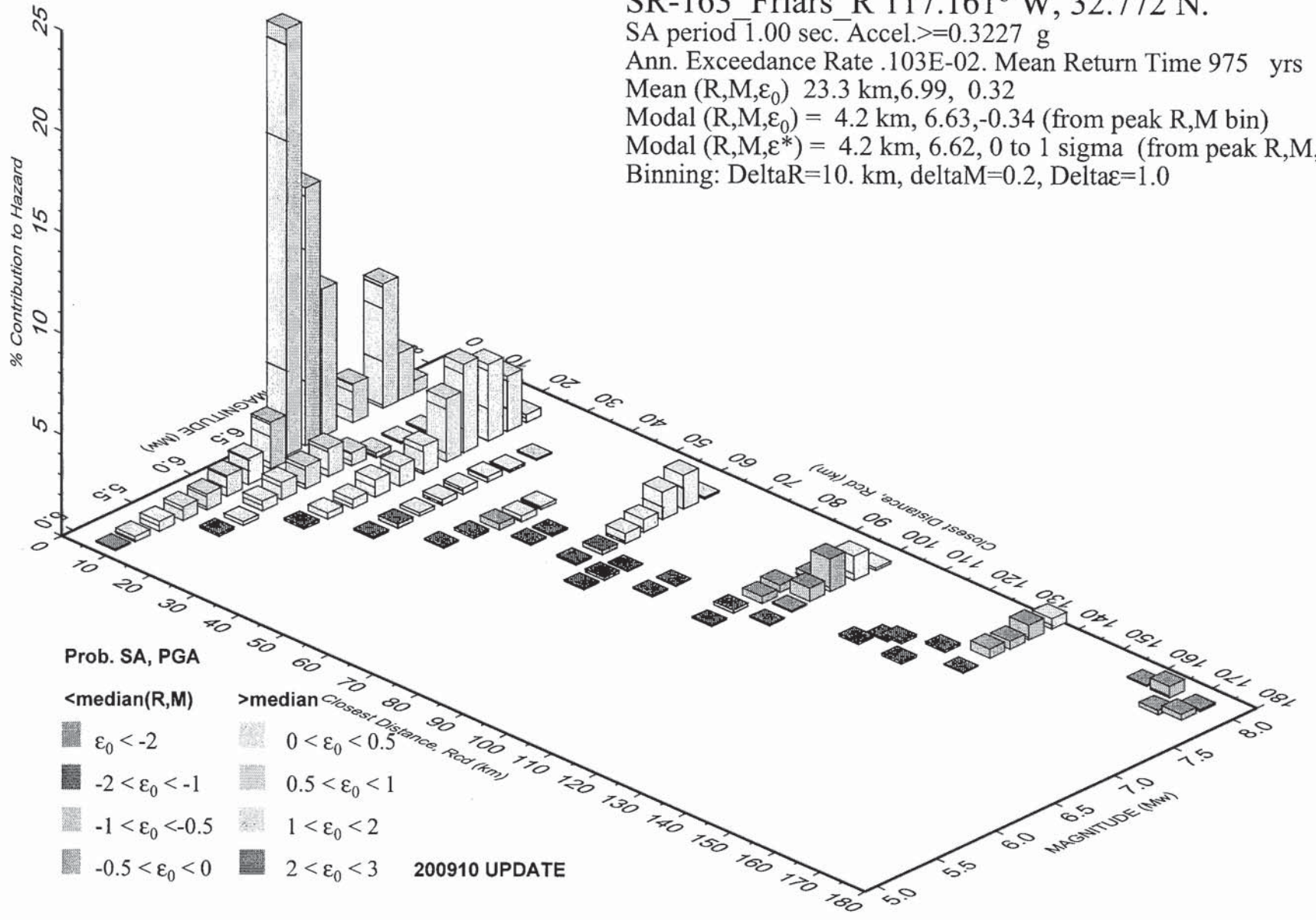
SA period 0.50 sec. Accel.>=0.5454 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.4 km,6.82, 0.14
Modal (R,M,ε_0) = 4.2 km, 6.62,-0.48 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:41:05 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

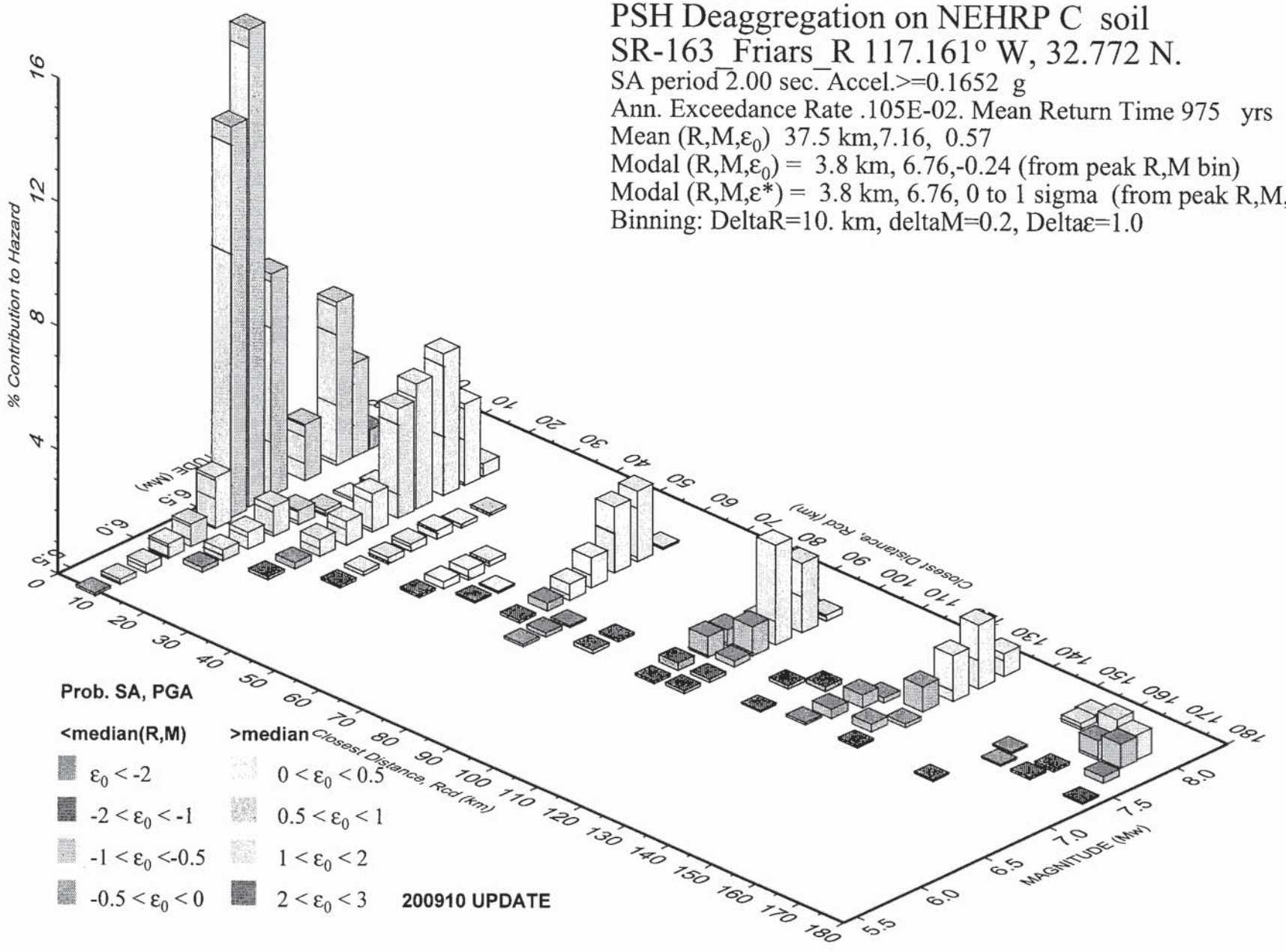
SA period 1.00 sec. Accel.>=0.3227 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.3 km,6.99, 0.32
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:46:44 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

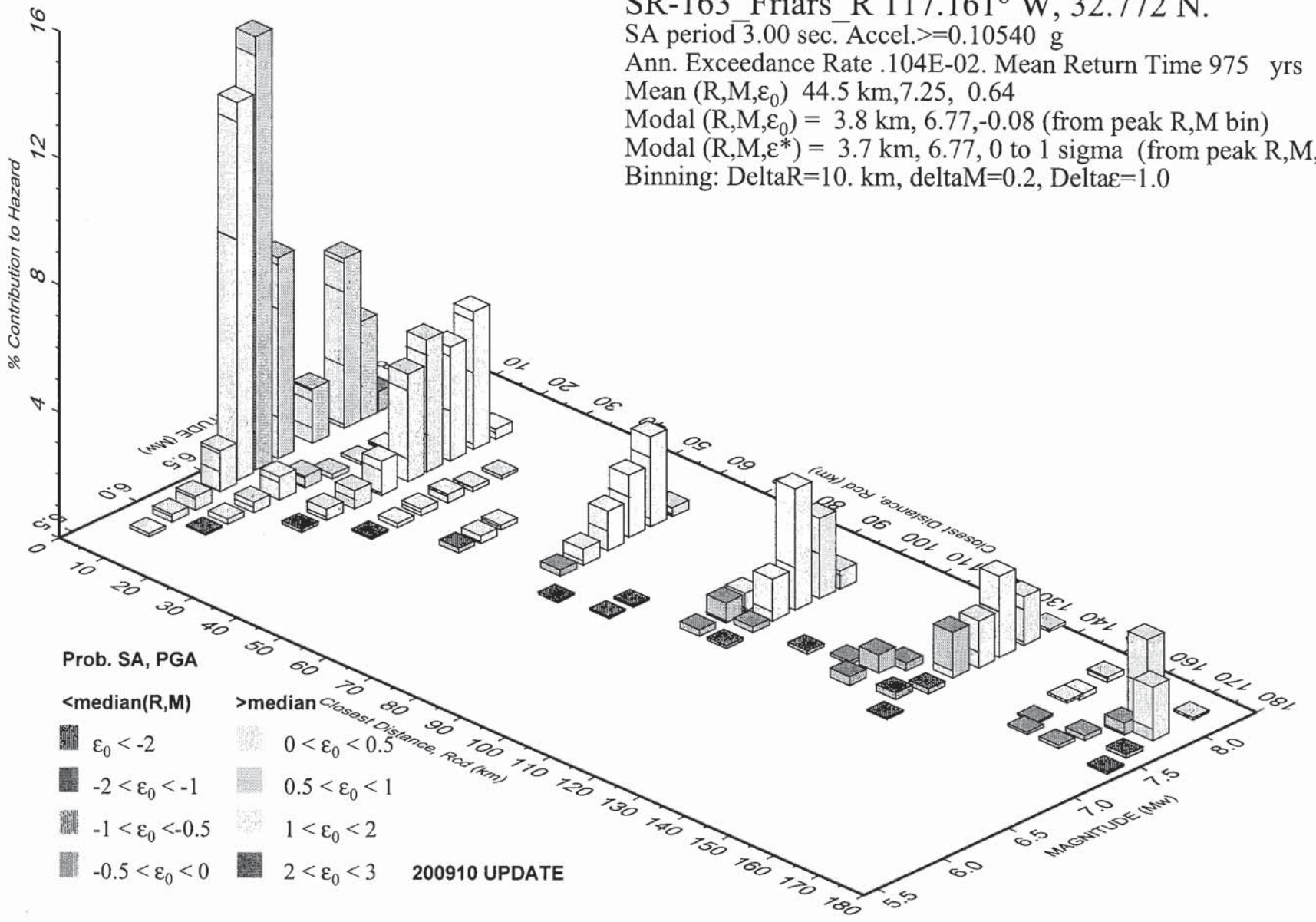
SA period 2.00 sec. Accel.>=0.1652 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.5 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.24 (from peak R,M bin)
Modal (R,M,ε*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:48:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 3.00 sec. Accel.>=0.10540 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.5 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.07516 g

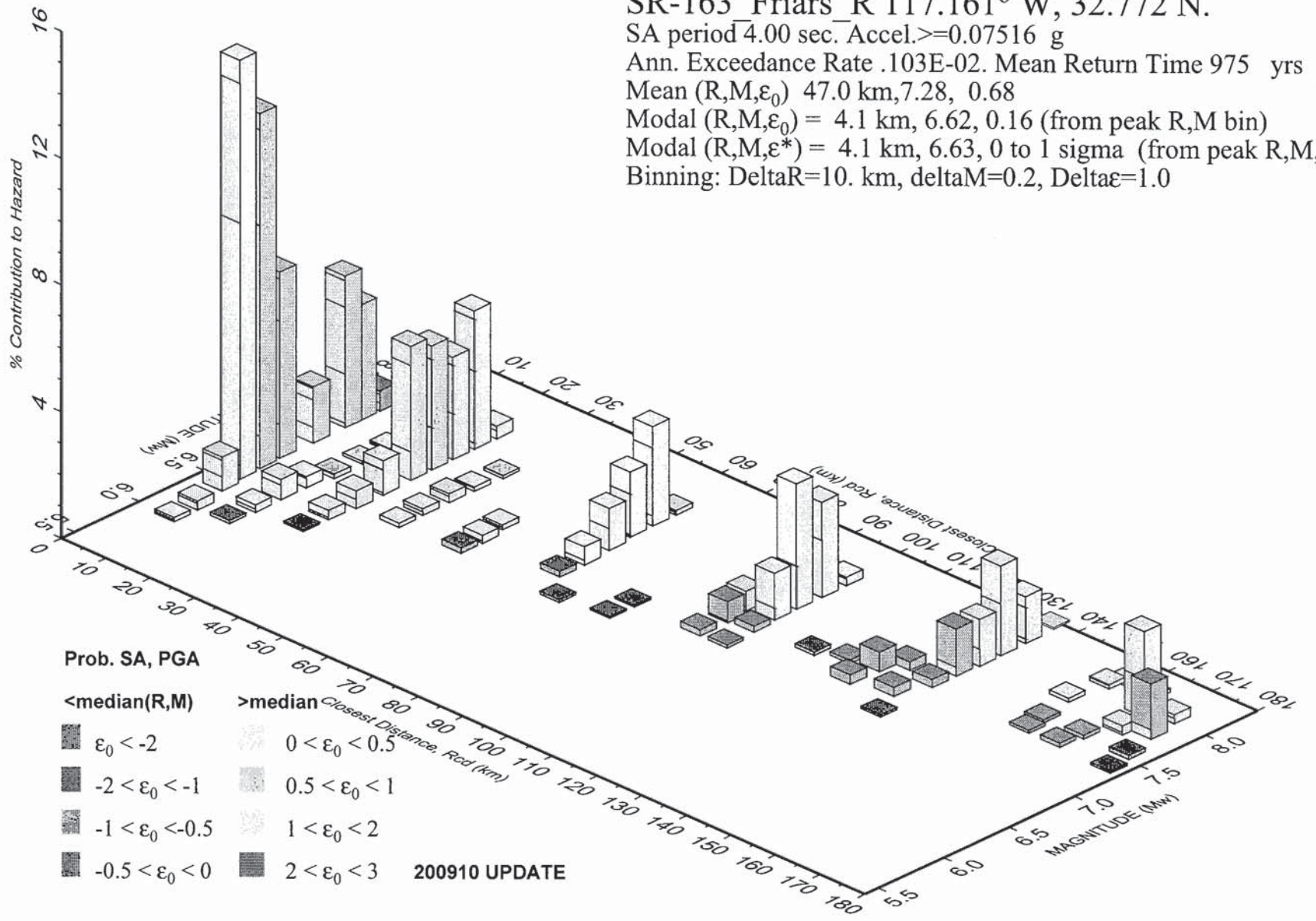
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 47.0 km,7.28, 0.68

Modal (R,M,ε_0) = 4.1 km, 6.62, 0.16 (from peak R,M bin)

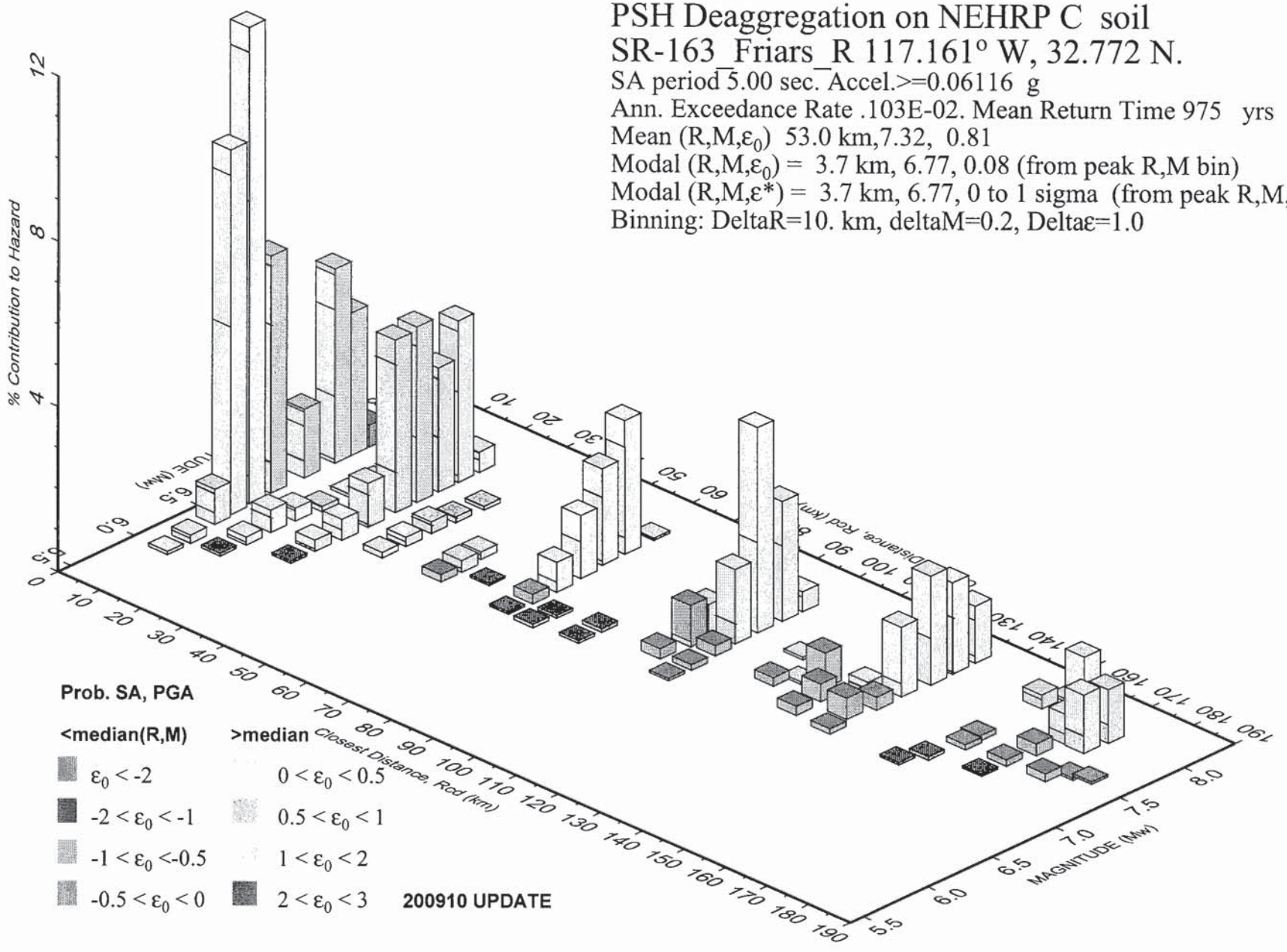
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

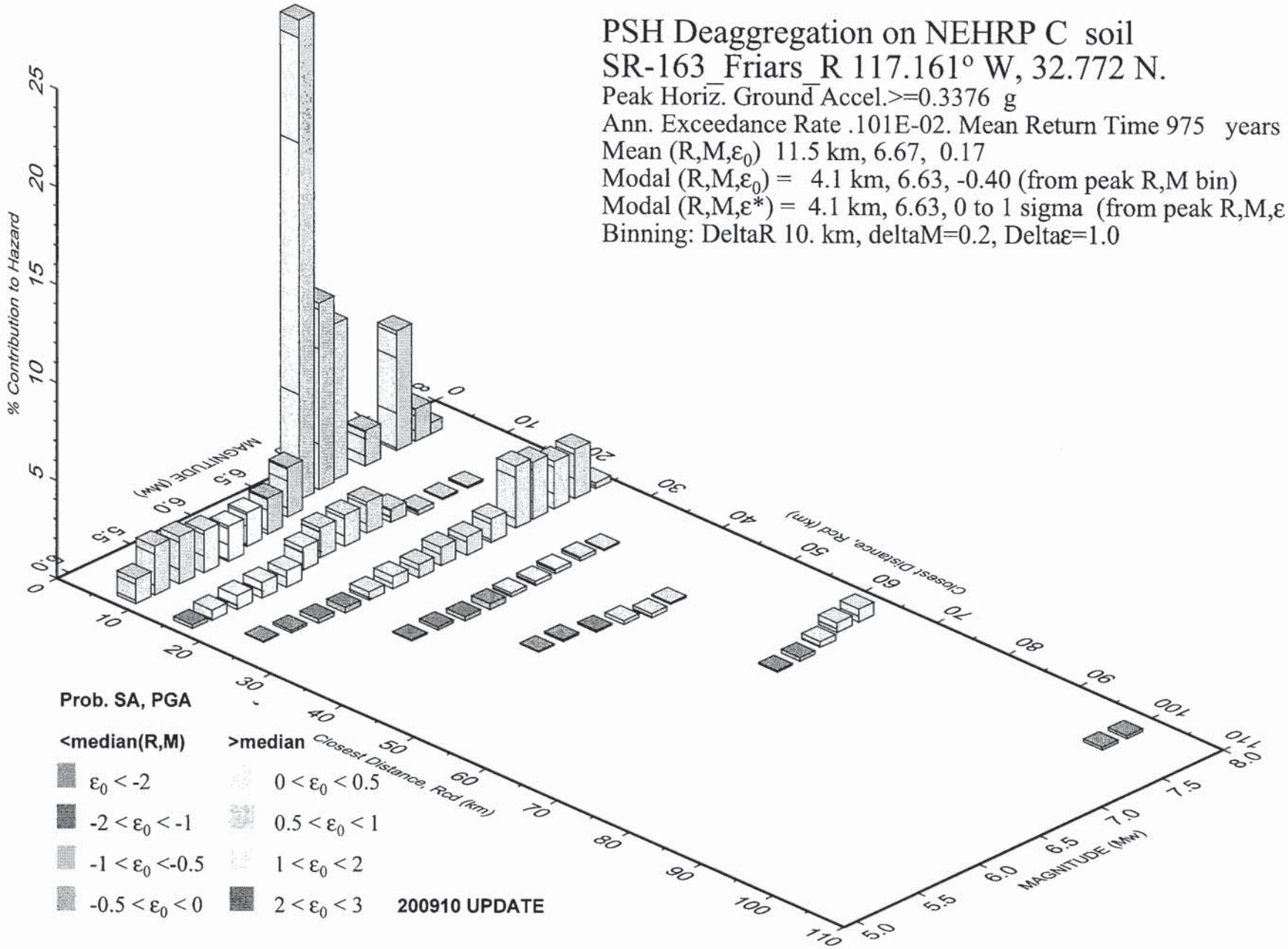


PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 5.00 sec. Accel.>=0.06116 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 53.0 km,7.32, 0.81
Modal (R,M,ε_0) = 3.7 km, 6.77, 0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



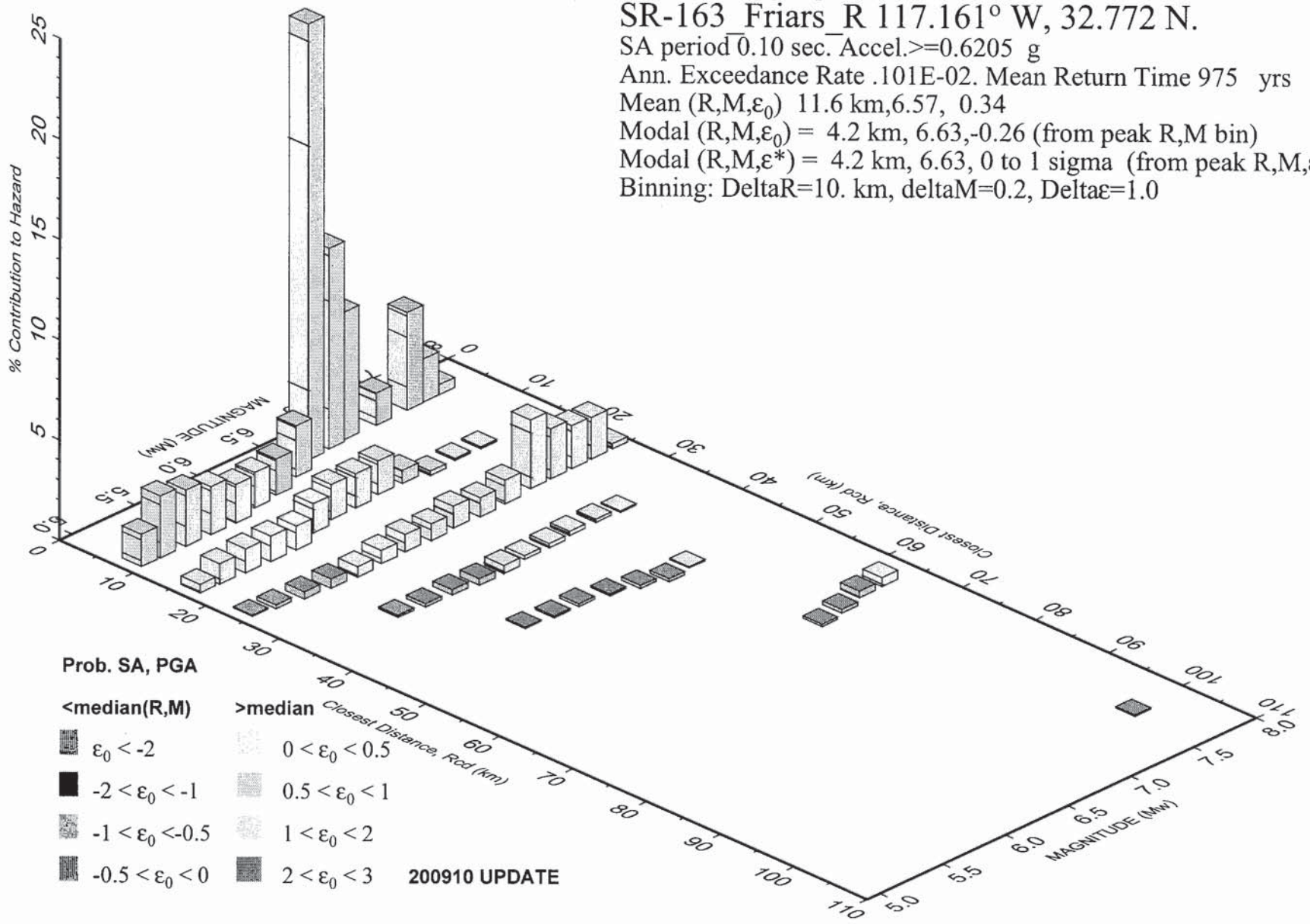
GMT 2012 Jul 5 23:54:48 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted



GMT 2012 Jul 5 23:57:26 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

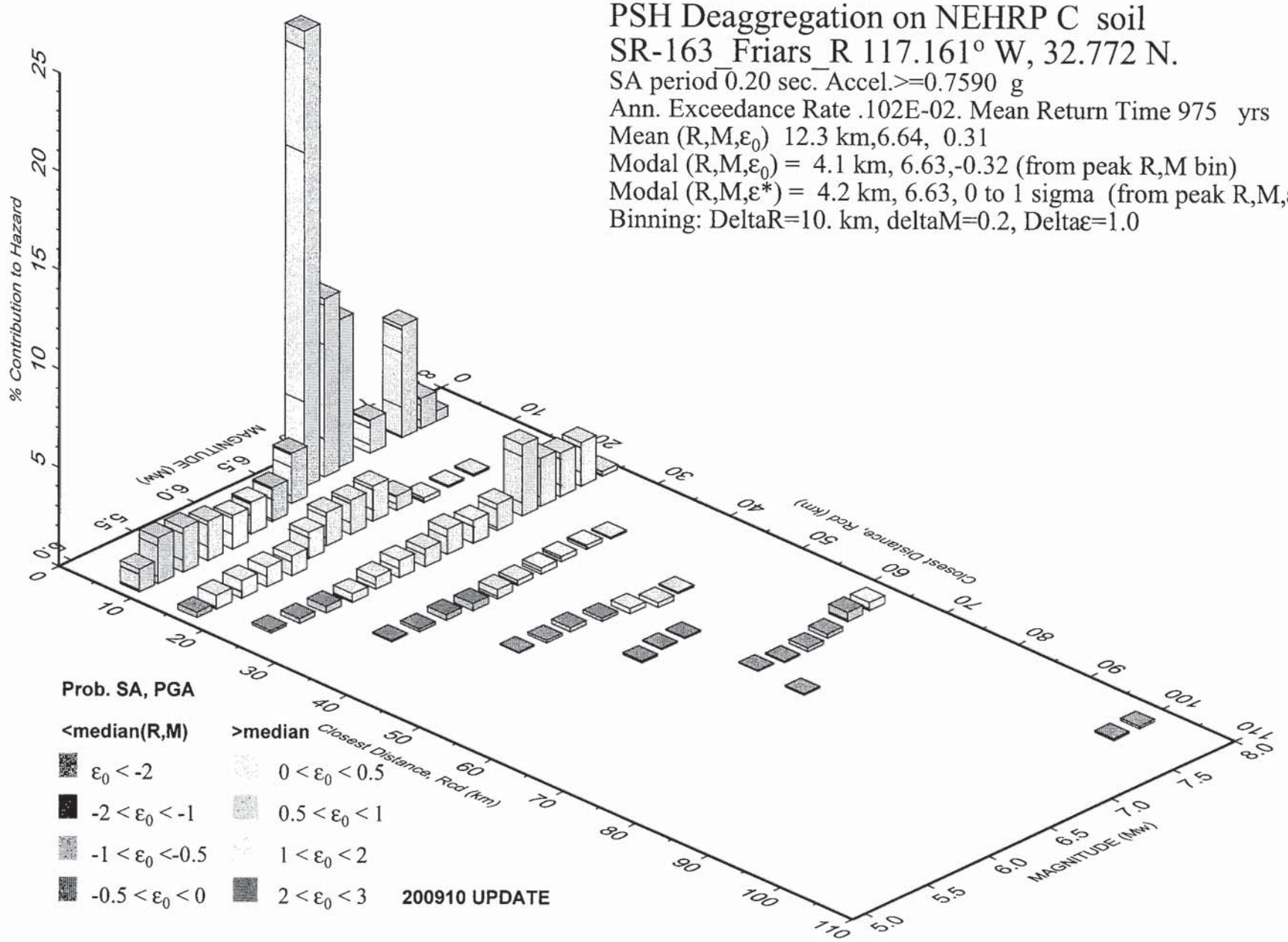
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6205 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.6 km,6.57, 0.34
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.26 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

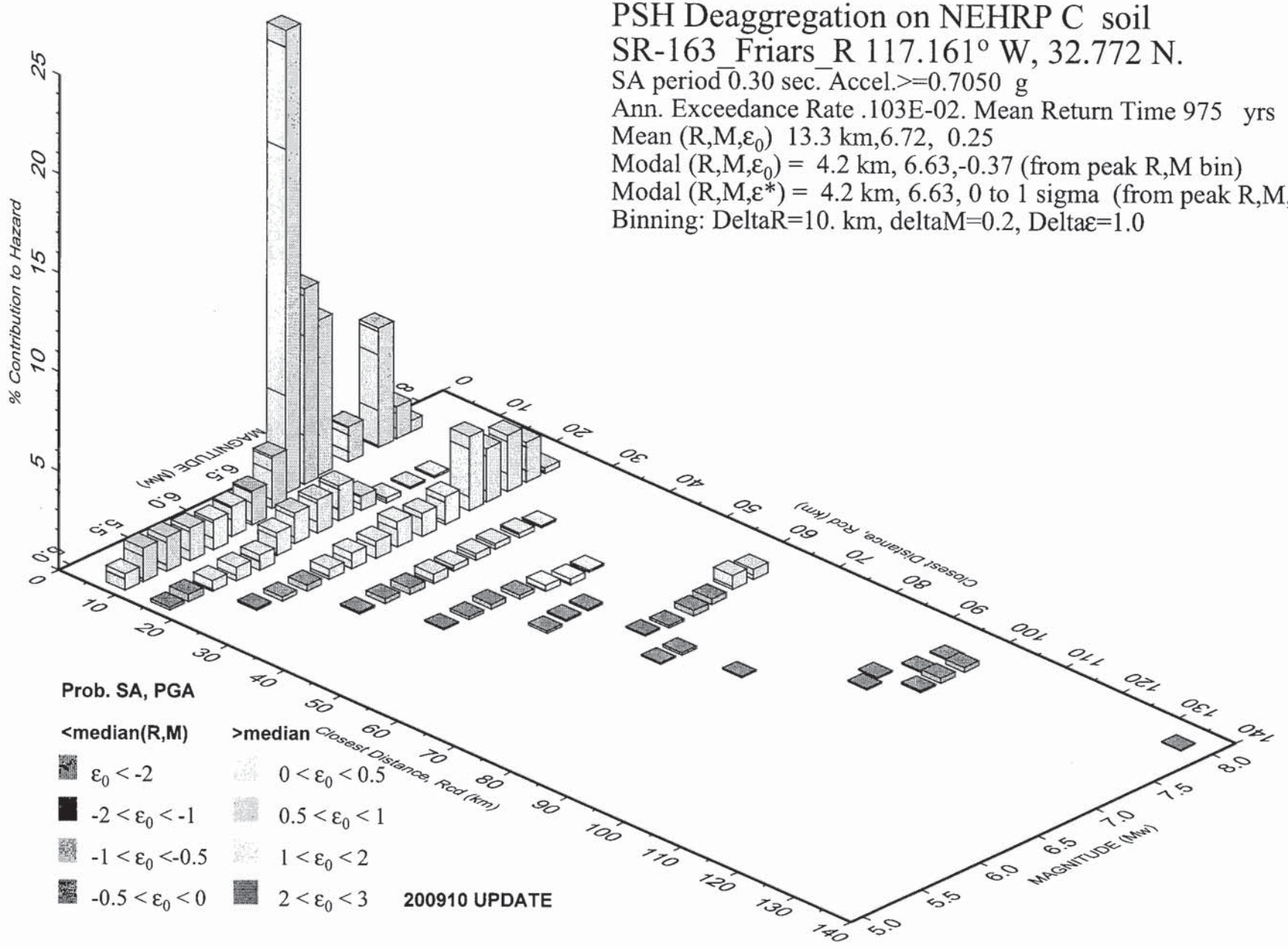
SA period 0.20 sec. Accel.>=0.7590 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.3 km,6.64, 0.31
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.32 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:00:19 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

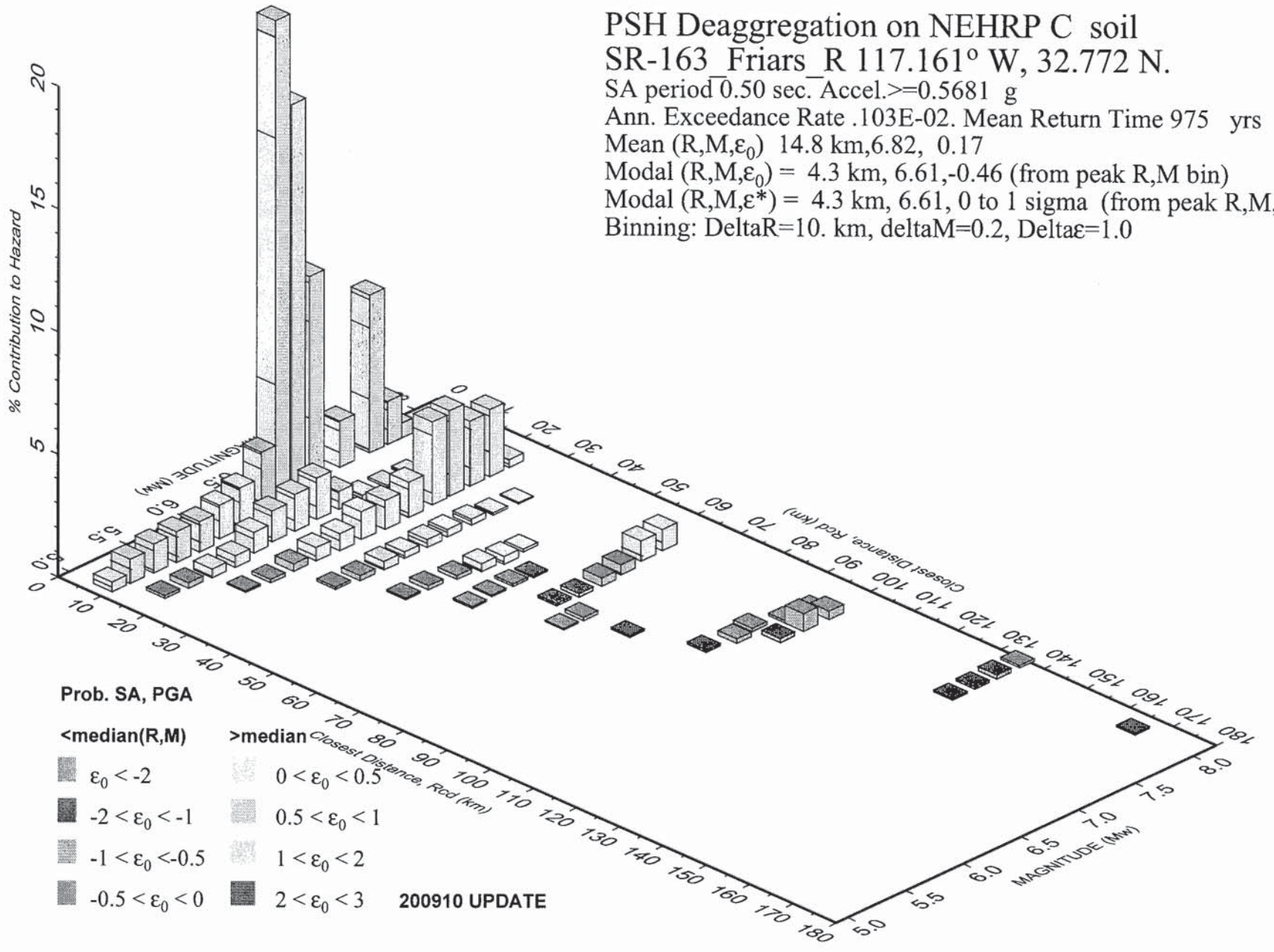
SA period 0.30 sec. Accel.>=0.7050 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 13.3 km,6.72, 0.25
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.37 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:01:39 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.50 sec. Accel.>=0.5681 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.8 km,6.82, 0.17
Modal (R,M,ε_0) = 4.3 km, 6.61,-0.46 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.61, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

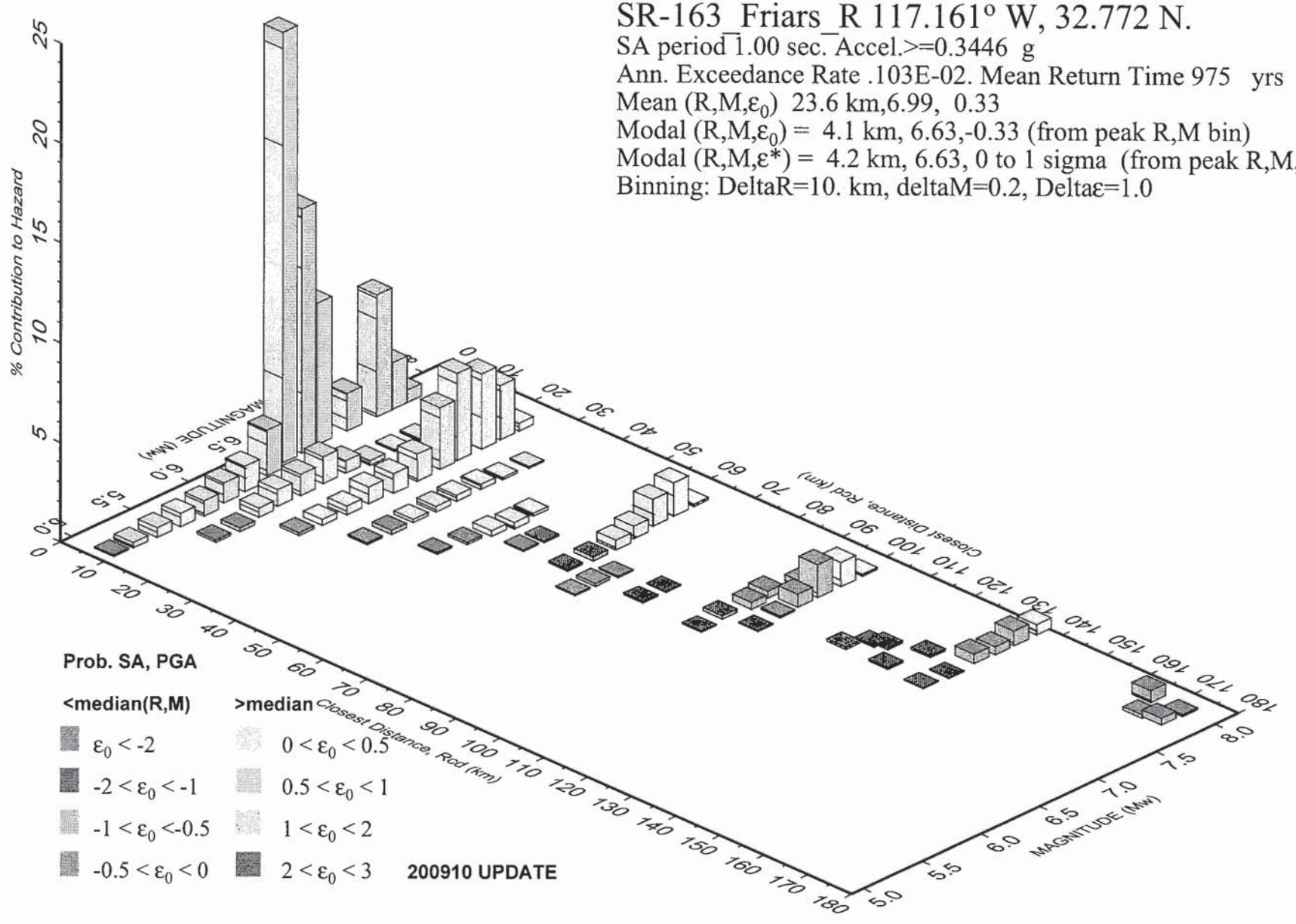


GMT 2012 Jul 6 00:04:36 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

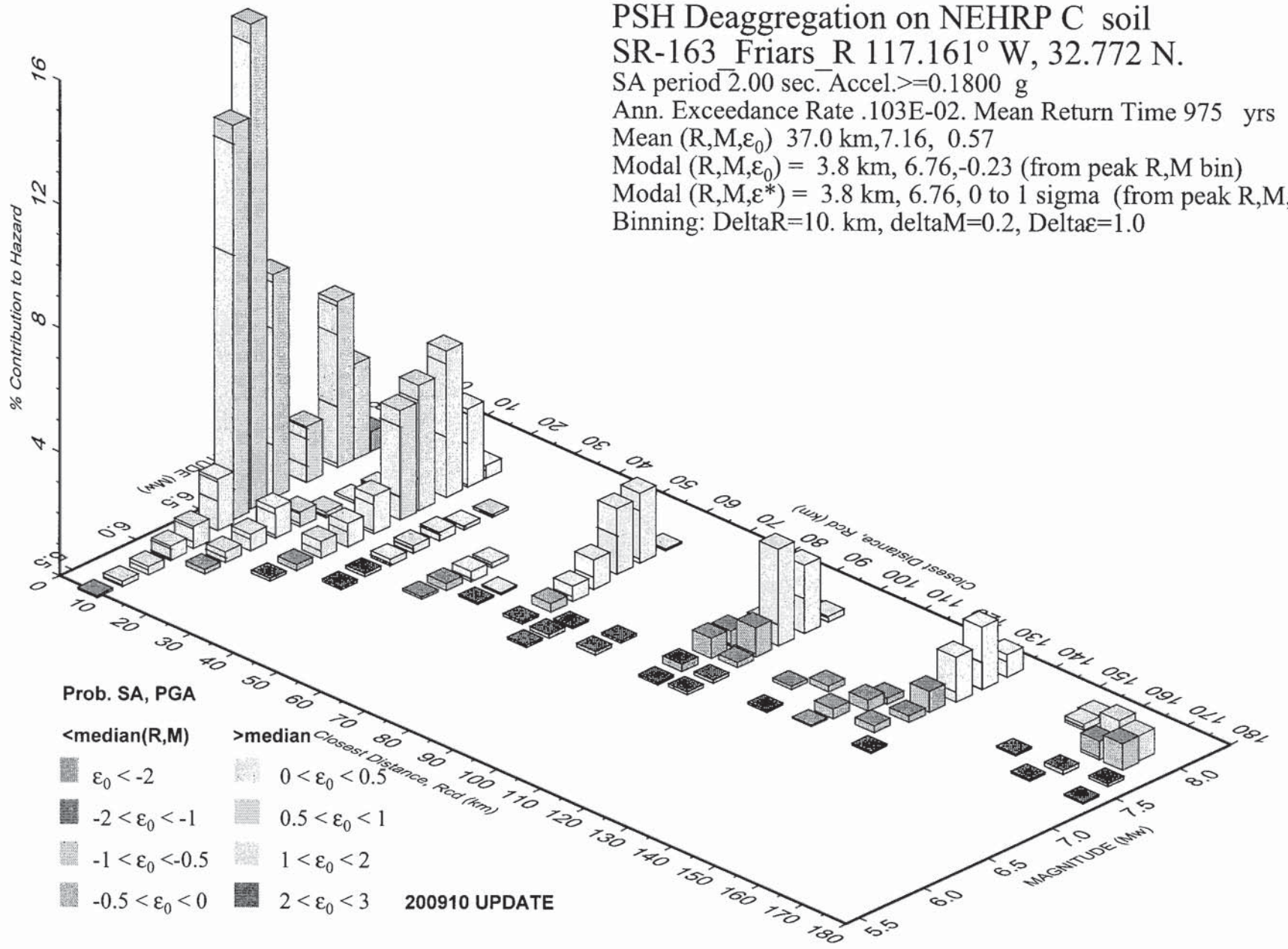
SA period 1.00 sec. Accel.>=0.3446 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.6 km,6.99, 0.33
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.33 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:05:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

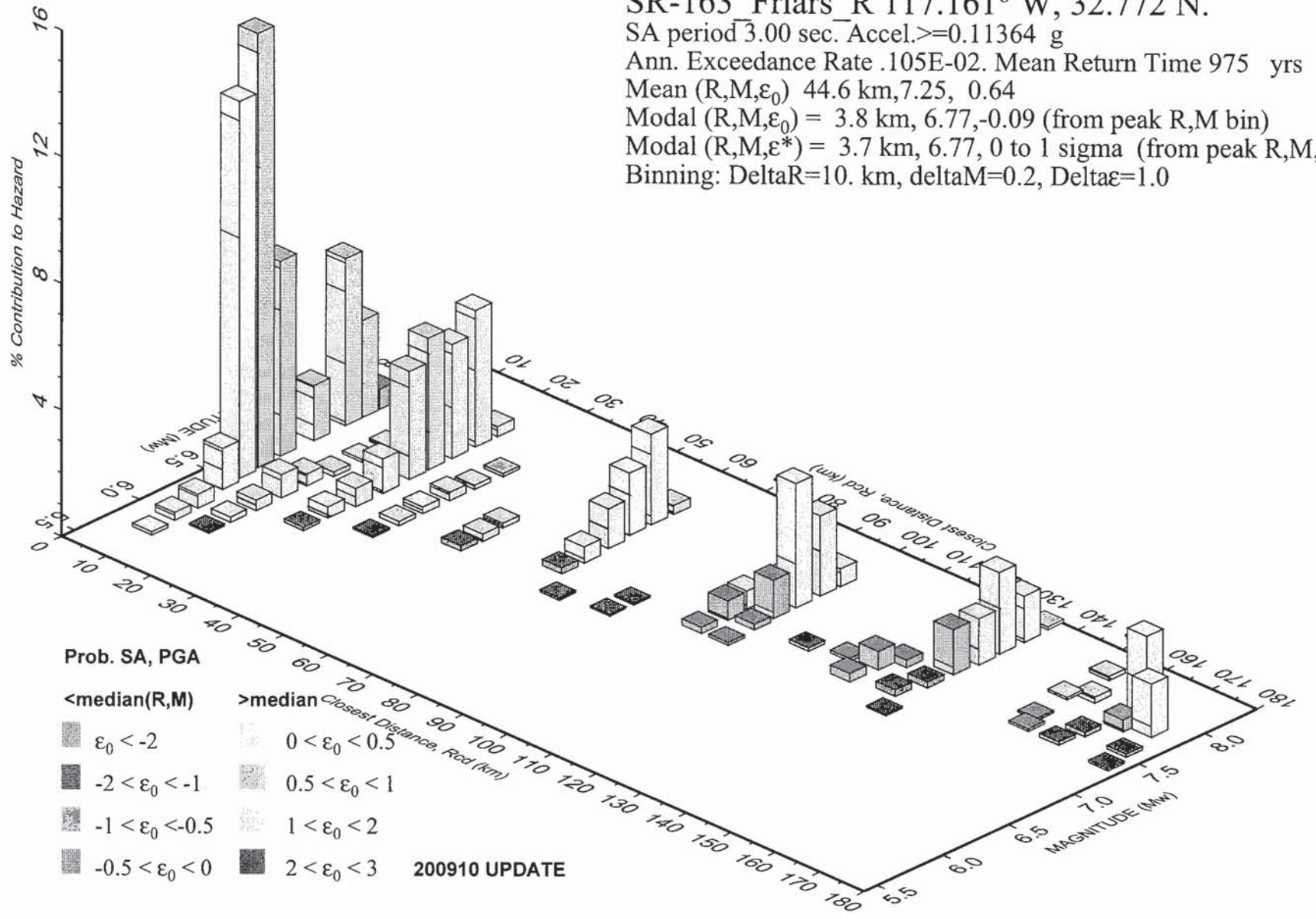
SA period 2.00 sec. Accel.>=0.1800 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.0 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.23 (from peak R,M bin)
Modal (R,M,ε^*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:07:37 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

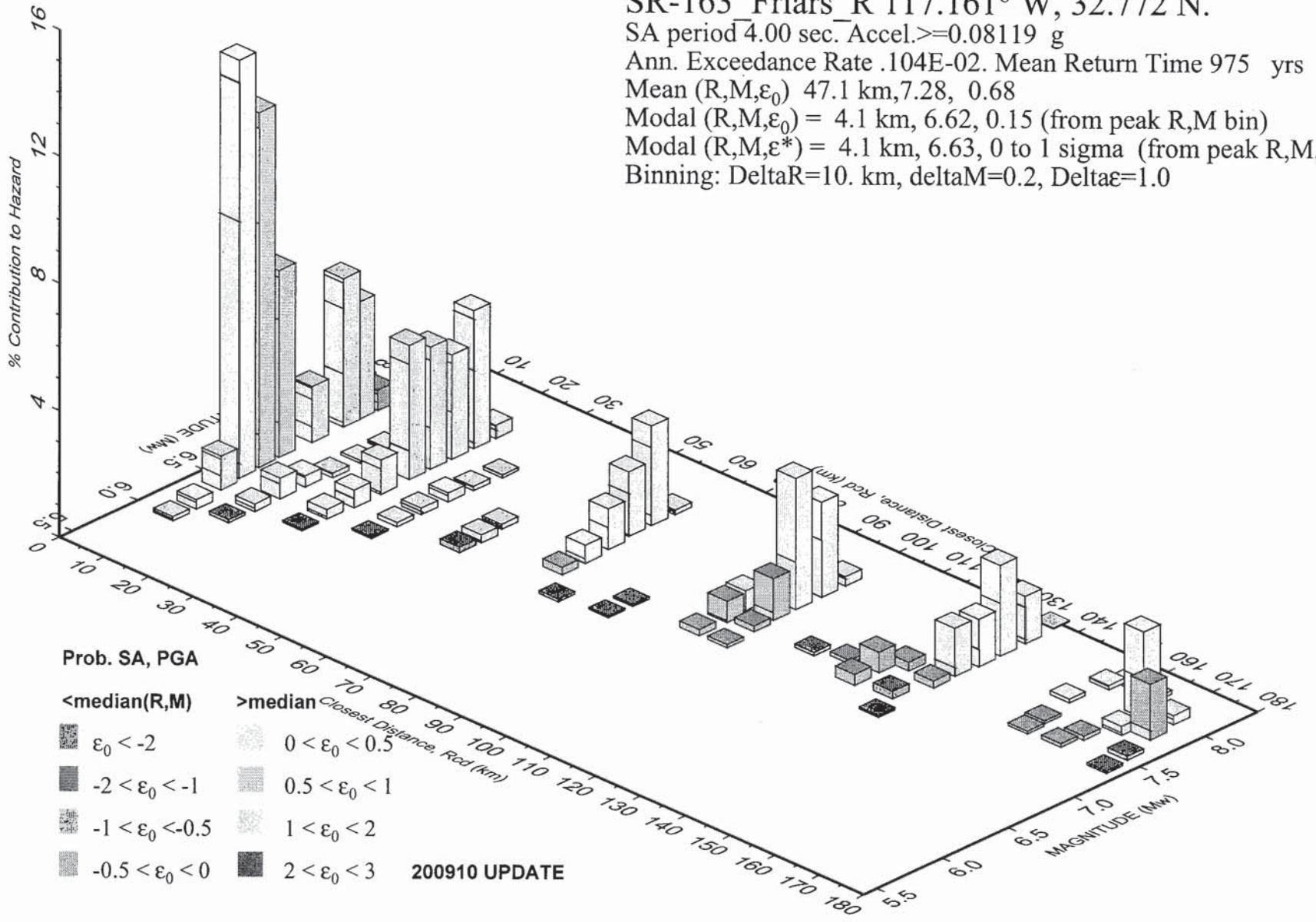
SA period 3.00 sec. Accel.>=0.11364 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.6 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.09 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

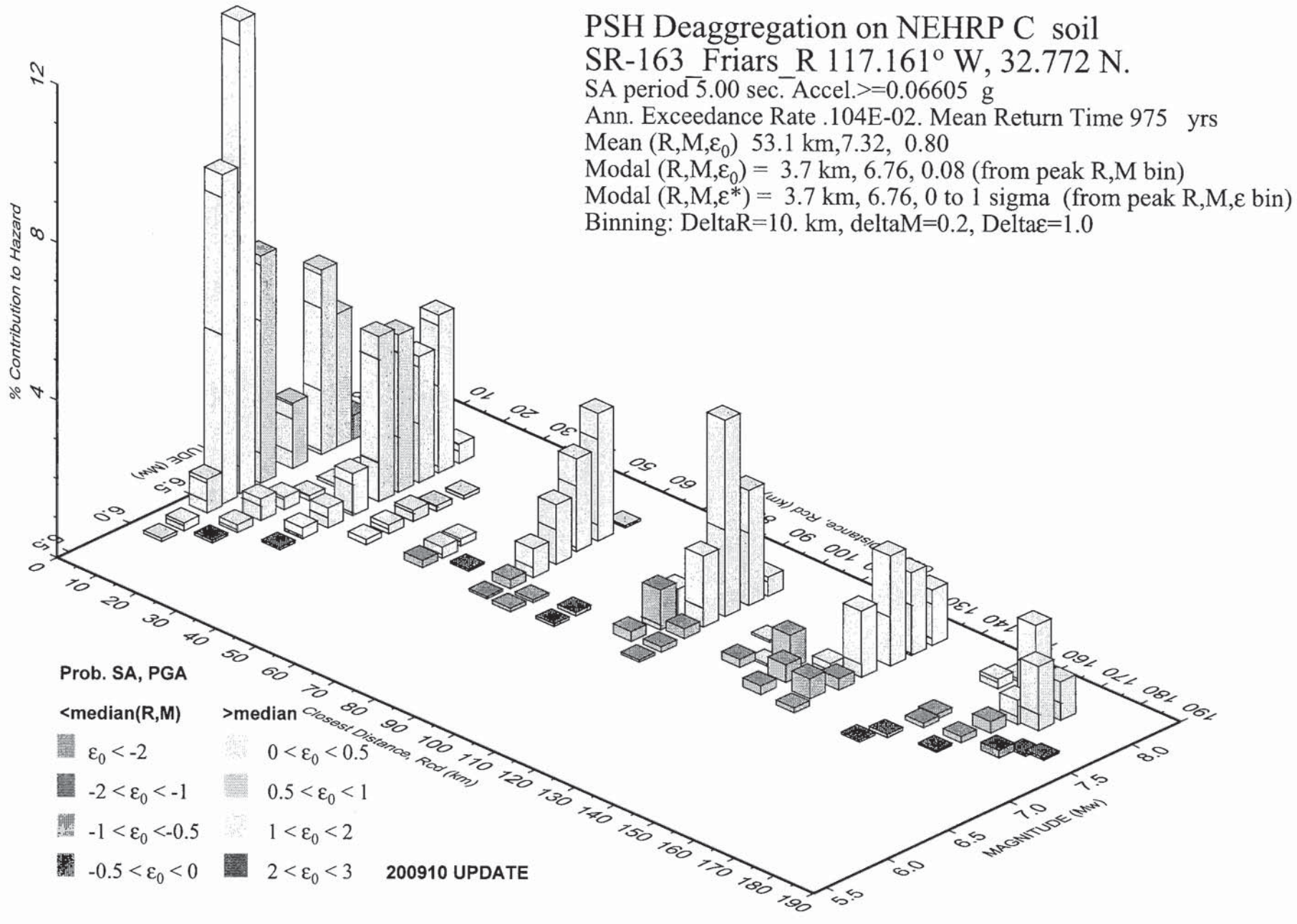


GMT 2012 Jul 6 00:08:54 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

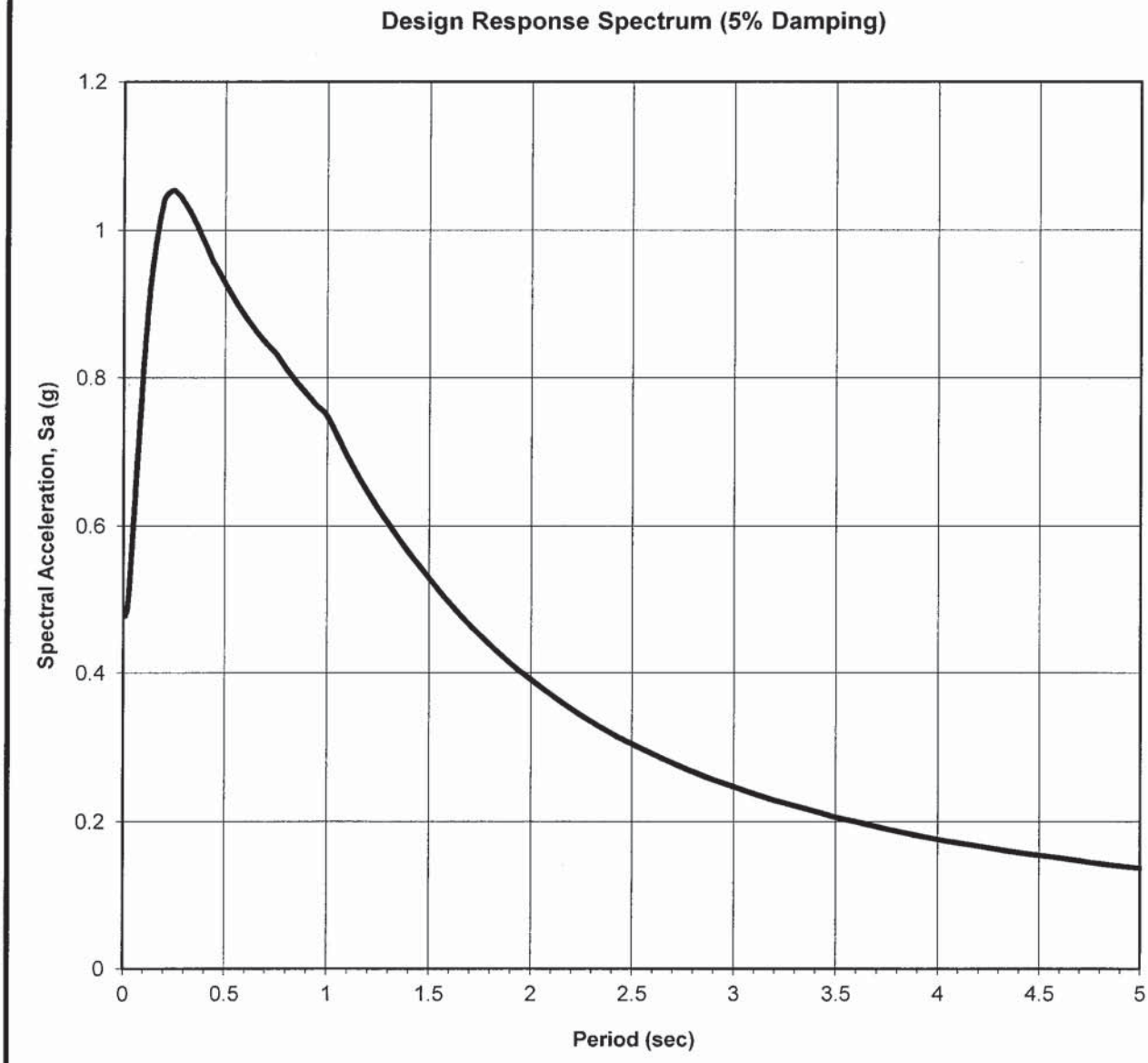
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.08119 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 47.1 km,7.28, 0.68
Modal (R,M,ε_0) = 4.1 km, 6.62, 0.15 (from peak R,M bin)
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0





GMT 2012 Jul 6 00:11:50 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted


Design Response Spectrum (5% Damping)
Spectral Acceleration, Sa (g)
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Period (sec)

Vs30 = 380 m/s	
T (sec)	Design Envelop S (a)
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.53
0.036	0.534
0.04	0.55
0.042	0.558
0.044	0.565
0.045	0.57
0.046	0.574
0.048	0.582
0.05	0.59
0.055	0.61
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.79
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982
0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977

Vs30 = 420 m/s	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

Envelope Data	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

0.42	0.97
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.28
2.6	0.268
2.8	0.246
3	0.227
3.2	0.21
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126

0.42	0.97
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

Abut 1

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B3 (1968)			A-B-5 (2003)																										Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	25		25	100		100																									63	0.08	333.4	0.015		
5	10	5	26		26	100		100																									63	0.08	334.18	0.01496		
10	15	5	100		100	100		100																									100	0.05	382.09	0.01309		
15	20	5	100		100	100		100																									100	0.05	382.09	0.01309		
20	25	5	100		100	100		100																									100	0.05	382.09	0.01309		
25	30	5	100		100	100		100																									100	0.05	382.09	0.01309		
30	35	5	100		100	100		100																									100	0.05	382.09	0.01309		
35	40	5	100		100	100		100																									100	0.05	382.09	0.01309		
40	45	5	100		100	100		100																									100	0.05	382.09	0.01309		
45	50	5	100		100	100		100																									100	0.05	382.09	0.01309		
50	55	5	100		100	100		100																									100	0.05	382.09	0.01309		
55	60	5	100		100	100		100																									100	0.05	382.09	0.01309		
60	65	5	100		100	100		100																									100	0.05	382.09	0.01309		
65	70	5	100		100	100		100																									100	0.05	382.09	0.01309		
70	75	5	100		100	100		100																									100	0.05	382.09	0.01309		
75	80	5	100		100	100		100																									100	0.05	382.09	0.01309		
80	85	5	100		100	100		100																									100	0.05	382.09	0.01309		
85	90	5	100		100	100		100																									100	0.05	382.09	0.01309		
90	95	5	100		100	100		100																									100	0.05	382.09	0.01309		
95	100	5	100		100	100		100																									100	0.05	382.09	0.01309		
	sum	100																															Weighted Avg N	94.40	V_{s30}	377		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 421 m/s

Say 420 m/s

Bent 2

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B6 (1963)			B2 (1968)			A-B-2 (2003)																								Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	24		24	15		15	14		14																						18	0.28	231.1	0.02163		
5	10	5	15		15	17		17		11	8																						13	0.38	212.54	0.02352		

VI

10	15	5	12		12	40		40		14	10																					21	0.24	241.65	0.02069		
15	20	5	100		100	100		100		50	35																					78	0.06	355.97	0.01405		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
35	40	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
40	45	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
45	50	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
50	55	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	100																														Weighted Avg N	56.58	V_{s30}	346		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 384 m/s

Say 380 m/s

Abut 3

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B1 (1963)			B1 (1968)			A-B-44 (2012)																								Cohesionless Soils					
																																	SPT			CP		
From	To	DI	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	5		5	5		5		100	100																					37	0.14	285.6	0.01751		
5	10	5	7		7	4		4		100	100																					37	0.14	286.38	0.01746		
10	15	5	50		50	6		6		100	100																					52	0.10	316.09	0.01582		
15	20	5	100		100	20		20		100	100																					73	0.07	349.22	0.01432		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		

35	40	5	100		100	100		100		54	38																					79	0.06	357.19	0.014		
40	45	5	100		100	100		100		42	29																					76	0.07	353.49	0.01414		
45	50	5	100		100	100		100		44	31																					77	0.06	354.11	0.01412		
50	55	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	**100**																														**Weighted Avg N**	**78.17**	V_{s30}	**360**		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 402 m/s

Say **380** m/s

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	344.4	0.0145	407.7	0.012264724
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	345.3	0.0145	408.7	0.012233589
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	396	V_{s30}	466
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	226.1	0.0221	272.4	0.018352752
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	205.4	0.0243	248.4	0.020124774

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	238.0	0.021	286.1	0.017475108
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	371.3	0.0135	438.1	0.011412336
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	358	V_{s30}	423
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS D		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
T		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	288.4	0.0173	343.9	0.014539214
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	289.2	0.0173	344.9	0.014497301
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	323.9	0.0154	384.4	0.013005841
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	363.2	0.0138	429.0	0.011655002
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	372.7	0.0134	439.8	0.011369297
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	368.3	0.0136	434.8	0.011500478
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	369.1	0.0135	435.6	0.011478178
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	376	V_{s30}	444
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

GEOCON

Hammer Energy Correction Factors

Reference: Youd, et al, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Environmental Engineering, October, 2001, Vol. 127, No. 10

Project Name: Friars Road/SR 163 Date: 11/6/2012

Project Number: G1447-52-01

Hole Diameter, Inches:	8	Hole Diameter Correction, C_B: 1.15
Average Unit Weight, γ (pcf):	120	
Adjustment Factor for 350 LB Hammer Above Groundwater	1.00	<-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples
Adjustment Factor for 350 LB Hammer Below Groundwater	1.00	<-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples
Approximate Depth to Groundwater	20	

*Auto, Cathead, or Downhole Hammer

					Adjust for each GWT Level		Energy Correction, C_E (1.0 Safe-T-Driver/Cathead, 1.3 Automatic)				
Sample	Depth, Feet	Field Blow Count (per Foot)	Type of Sampler (MC or SPT)	Hammer Type* (A/C/D)	Equiv. SPT Blow Count, N	σ'_v, psf	Overburden Pressure Correction, C_N	Energy Ratio Correction, C_E	Rod Length Correction, C_R	Sampling Correction, C_S	N1|60 Blowcounts (Pror to Fines)
A-03-002: 5	5.0	14	SPt	a	14.0	600.0	1.70	1.3	0.75	1.10	29.35
A-03-002: 7	7.0	11	MC	a	7.3	840.0	1.54	1.3	0.80	1.00	13.53
A-03-002: 10.5	10.5	14	MC	a	9.3	1260.0	1.26	1.3	0.85	1.00	14.94
A-03-002: 13	13.0	50	MC	a	33.3	1560.0	1.13	1.3	0.85	1.00	47.96
A-03-002: 15	15.0	100	MC	a	66.7	1800.0	1.05	1.3	0.85	1.00	89.30
A-03-002: 20	20.0	100	SPT	a	100.0	2400.0	0.91	1.3	0.95	1.10	100.00
A-03-002: 25	25.0	100	SPT	a	100.0	2688.0	0.86	1.3	0.95	1.10	100.00
A-03-002: 30	30.0	100	SPT	a	100.0	2976.0	0.82	1.3	1.00	1.10	100.00
A-03-002: 33	33.0	100	SPT	a	100.0	3148.8	0.80	1.3	1.00	1.10	100.00
A-03-002: 34.5	34.5	100	SPT	a	100.0	3235.2	0.79	1.3	1.00	1.10	100.00

Liquefaction Analysis Using SPT

Project Name: Friars Road/SR 163
Project Number: G1447-52-01
Boring: A-03-002

a_{max}/g: 0.48
Magnitude: 7.50
Groundwater Depth, Ft: 20.0
Reference Pressure, p_a: 2000
Unit Weight of Water: 62.4
Soil Unit Weight, pcf: 120

Include Kσ (Y/N): N
Use NCEER $CRR_{7.5}$ (1) or Rauch $CRR_{7.5}$ (2): 2
Minimum Factor of Safety for Liquefaction: 1

MWF Idriss(1997) = $(M)^{2.56}/10^{2.24}$ From Graph

Depth, ft	N_1[60]	Fines Content, FC (%)	N_1[60], Adj. for Fines	σ, psf	σ', psf	r_d	K_σ	NCEER $CRR_{7.5}$	RAUCH $CRR_{7.5}$	CSR M=7.5	Liquefaction Potential	Factor of Safety	Volumetric Strain, %	Settlement, in.
1	29	15	32.9	120.0	120.0	1.00	1.00	0.800	0.800	0.312	Above GWT	2.564		
2	29	15	32.9	240.0	240.0	1.00	1.00	0.800	0.800	0.311	Above GWT	2.570		
3	29	15	32.9	360.0	360.0	0.99	1.00	0.800	0.800	0.311	Above GWT	2.576		
4	29	15	32.9	480.0	480.0	0.99	1.00	0.800	0.800	0.310	Above GWT	2.582		
5	29	15	32.9	600.0	600.0	0.99	1.00	0.800	0.800	0.309	Above GWT	2.588		
6	14	35	21.8	720.0	720.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.776		
7	14	35	21.8	840.0	840.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.777		
8	15	35	23.0	960.0	960.0	0.98	1.00	0.255	0.257	0.307	Above GWT	0.837		
9	15	35	23.0	1080.0	1080.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.839		
10	15	35	23.0	1200.0	1200.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.841		
11	15	35	23.0	1320.0	1320.0	0.98	1.00	0.255	0.257	0.305	Above GWT	0.843		
12	50	35	65.0	1440.0	1440.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.629		
13	50	35	65.0	1560.0	1560.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.635		
14	89	35	111.8	1680.0	1680.0	0.97	1.00	0.800	0.800	0.303	Above GWT	2.641		
15	89	35	111.8	1800.0	1800.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.646		
16	89	35	111.8	1920.0	1920.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.652		
17	89	35	111.8	2040.0	2040.0	0.96	1.00	0.800	0.800	0.301	Above GWT	2.659		
18	89	35	111.8	2160.0	2160.0	0.96	1.00	0.800	0.800	0.300	Above GWT	2.665		
19	89	35	111.8	2280.0	2280.0	0.96	1.00	0.800	0.800	0.299	Above GWT	2.672		
20	89	35	111.8	2400.0	2400.0	0.96	1.00	0.800	0.800	0.299	NL	2.679		
21	100	35	125.0	2520.0	2457.6	0.95	1.00	0.800	0.800	0.305	NL	2.620		
22	100	35	125.0	2640.0	2515.2	0.95	1.00	0.800	0.800	0.312	NL	2.567		
23	100	35	125.0	2760.0	2572.8	0.95	1.00	0.800	0.800	0.318	NL	2.519		
24	100	35	125.0	2880.0	2630.4	0.95	1.00	0.800	0.800	0.323	NL	2.477		
25	100	35	125.0	3000.0	2688.0	0.94	1.00	0.800	0.800	0.328	NL	2.439		
26	100	35	125.0	3120.0	2745.6	0.94	1.00	0.800	0.800	0.333	NL	2.404		
27	100	35	125.0	3240.0	2803.2	0.93	1.00	0.800	0.800	0.337	NL	2.374	0.75	0.09
28	100	35	125.0	3360.0	2860.8	0.93	1.00	0.800	0.800	0.341	NL	2.347	0.75	0.09
29	100	35	125.0	3480.0	2918.4	0.93	1.00	0.800	0.800	0.344	NL	2.323	0.75	0.09
30	100	35	125.0	3600.0	2976.0	0.92	1.00	0.800	0.800	0.348	NL	2.302	0.75	0.09
31	100	0	100.0	3720.0	3033.6	0.92	1.00	0.800	0.800	0.350	NL	2.284	0.75	0.09
32	100	0	100.0	3840.0	3091.2	0.91	1.00	0.800	0.800	0.353	NL	2.268	0.75	0.09
33	100	0	100.0	3960.0	3148.8	0.90	1.00	0.800	0.800	0.355	NL	2.255		
34	100	0	100.0	4080.0	3206.4	0.90	1.00	0.800	0.800	0.356	NL	2.245		
35	100	0	100.0	4200.0	3264.0	0.89	1.00	0.800	0.800	0.358	NL	2.237		

Total Settlement, S_{LIQ} (in.) = 0.54
Total Liquifiable Layers = 6

Friars Rd OC

Driven Pile Based on NAVFAC/AASHTO LRFD pp 10-67

Location	Abut 1L		PILE	HP 10x57
Ref Boring	A-12-054/B3		D, diameter	0.8 ft
Pile Cut-Off El	62	ft	At, base area	0.7 sq ft
GW El	29	ft	S, surface area	3.3 sq ft/ft
GS El	62	ft		
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120
Tot Unit Weight 2	120	pcf	Eff Unit W 2	120
Tot Unit Weight 3	125	pcf	Eff Unit W 3	62.6
Tot Unit Weight 4	125	pcf	Eff Unit W 4	62.6
Tot Unit Weight 5	125	pcf	Eff Unit W 5	62.6
Tot Unit Weight 6	125	pcf	Eff Unit W 6	62.6
Tot Unit Weight 7		pcf	Eff Unit W 7	
Top of Soil 1 El	62	ft		
Top of Soil 2 El	42	ft		
Top of Soil 3 El	29	ft		
Top of Soil 4 El	-17	ft		
Top of Soil 5 El	-42	ft		
Top of Soil 6 El	-53	ft		
Top of Soil 7 El		ft		

Design Profile GS EL 62 ft

Depth ft	Ele ft	γ_t pcf	γ'_t pcf	Design Profile, N	ϕ °	
0	62	120	120	35	33	
20	42	120	120	35	33	
20	42	120	120	50	36	
33	29	125	62.6	50	36	
33	29	125	62.6	70	40	
79	-17	125	62.6	70	40	
79	-17	125	62.6	70	45	
104	-42	125	62.6	70	45	
104	-42	125	62.6	70	45	
115	-53	125	62.6	70	45	
			Avg N			

Depth below Pile Cap	Elev	γ'	σ'	ϕ	N	N_{corr}	Side Resistance			Tip Resistance			Resistance (kips)		
							q_s (disp)	q_s (nondis)	Qs	$q_t=3N_{corr}$	q_p	Qp	Nominal	LRFD Factored	WSD Factored
ft	ft	pcf	ksf	°			tsf	tsf	ton	(sand/silt)	tsf	ton	Resistance	(ϕ = 0.7)	FS = 2.0
0	61.5	120		33	35	0	0.7	0.4	0.00	0.0	0.0	0.00	0.00	0.00	0.00
1	60.5	120	0.18	33	35	63	0.7	0.4	1.17	189.7	30.4	21.08	44.50	31.15	22.25
2	59.5	120	0.30	33	35	57	0.7	0.4	2.33	171.8	55.0	38.18	81.02	56.72	40.51
3	58.5	120	0.42	33	35	53	0.7	0.4	3.50	160.0	76.8	53.33	113.66	79.56	56.83
4	57.5	120	0.54	33	35	50	0.7	0.4	4.67	151.2	96.7	67.18	143.70	100.59	71.85
5	56.5	120	0.66	33	35	48	0.7	0.4	5.83	144.1	115.3	80.06	171.80	120.26	85.90
6	55.5	120	0.78	33	35	46	0.7	0.4	7.00	138.3	132.7	92.17	198.33	138.83	99.17
7	54.5	120	0.90	33	35	44	0.7	0.4	8.17	133.2	133.2	92.52	201.37	140.96	100.68
8	53.5	120	1.02	33	35	43	0.7	0.4	9.33	128.8	128.8	89.47	197.60	138.32	98.80
9	52.5	120	1.14	33	35	42	0.7	0.4	10.50	124.9	124.9	86.75	194.51	136.16	97.25
10	51.5	120	1.26	33	35	40	0.7	0.4	11.67	121.4	121.4	84.31	191.96	134.37	95.98
11	50.5	120	1.38	33	35	39	0.7	0.4	12.83	118.2	118.2	82.10	189.86	132.90	94.93
12	49.5	120	1.50	33	35	38	0.7	0.4	14.00	115.3	115.3	80.06	188.12	131.69	94.06
13	48.5	120	1.62	33	35	38	0.7	0.4	15.17	112.6	112.6	78.19	186.70	130.69	93.35
14	47.5	120	1.74	33	35	37	0.7	0.4	16.33	110.1	110.1	76.44	185.55	129.89	92.78
15	46.5	120	1.86	33	35	36	0.7	0.4	17.50	107.7	107.7	74.82	184.63	129.24	92.32
16	45.5	120	1.98	33	35	35	0.7	0.4	18.67	105.5	105.5	73.29	183.92	128.74	91.96
17	44.5	120	2.10	33	35	34	0.7	0.4	19.83	103.5	103.5	71.86	183.38	128.37	91.69
18	43.5	120	2.22	33	35	34	0.7	0.4	21.00	101.5	101.5	70.50	183.01	128.10	91.50
19	42.5	120	2.34	33	35	33	0.7	0.4	22.17	99.7	99.7	69.22	182.77	127.94	91.39
20	41.5	120	2.46	36	50	47	1.0	0.5	23.83	139.9	139.9	97.14	241.95	169.37	120.98
21	40.5	120	2.58	36	50	46	1.0	0.5	25.50	137.5	137.5	95.48	241.97	169.38	120.98
22	39.5	120	2.70	36	50	45	1.0	0.5	27.17	135.2	135.2	93.90	242.13	169.49	121.07
23	38.5	120	2.82	36	50	44	1.0	0.5	28.83	133.0	133.0	92.38	242.44	169.71	121.22
24	37.5	120	2.94	36	50	44	1.0	0.5	30.50	130.9	130.9	90.93	242.87	170.01	121.43
25	36.5	120	3.06	36	50	43	1.0	0.5	32.17	128.9	128.9	89.54	243.41	170.39	121.71
26	35.5	120	3.18	36	50	42	1.0	0.5	33.83	127.0	127.0	88.20	244.07	170.85	122.03
27	34.5	120	3.30	36	50	42	1.0	0.5	35.50	125.1	125.1	86.91	244.82	171.37	122.41
28	33.5	120	3.42	36	50	41	1.0	0.5	37.17	123.4	123.4	85.67	245.66	171.96	122.83
29	32.5	120	3.54	36	50	41	1.0	0.5	38.83	121.6	121.6	84.46	246.59	172.62	123.30
30	31.5	120	3.66	36	50	40	1.0	0.5	40.50	120.0	120.0	83.30	247.61	173.32	123.80
31	30.5	120	3.78	36	50	39	1.0	0.5	42.17	118.3	118.3	82.18	248.69	174.08	124.35
32	29.5	120	3.90	36	50	39	1.0	0.5	43.83	116.8	116.8	81.09	249.85	174.89	124.92
33	28.5	62.6	3.96	40	70	54	1.4	0.7	46.17	162.4	162.4	112.75	317.83	222.48	158.92
34	27.5	62.6	4.03	40	70	54	1.4	0.7	48.50	161.3	161.3	111.99	320.97	224.68	160.49
35	26.5	62.6	4.09	40	70	53	1.4	0.7	50.83	160.2	160.2	111.23	324.13	226.89	162.07
36	25.5	62.6	4.15	40	70	53	1.4	0.7	53.17	159.1	159.1	110.49	327.32	229.12	163.66

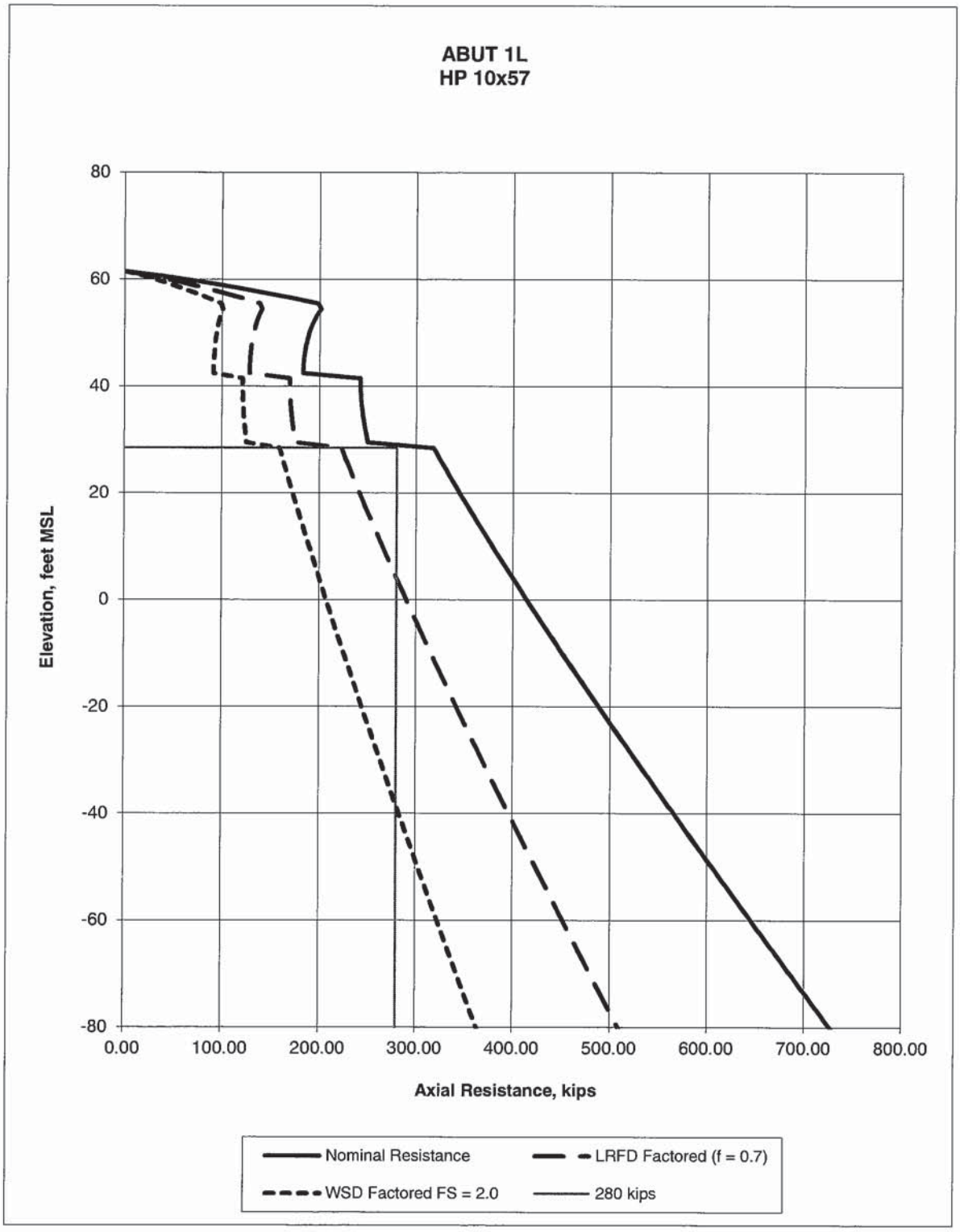
37	24.5	62.6	4.21	40	70	53	1.4	0.7	55.50	158.1	158.1	109.76	330.52	231.37	165.26
38	23.5	62.6	4.28	40	70	52	1.4	0.7	57.83	157.0	157.0	109.04	333.75	233.63	166.88
39	22.5	62.6	4.34	40	70	52	1.4	0.7	60.17	156.0	156.0	108.33	337.00	235.90	168.50
40	21.5	62.6	4.40	40	70	52	1.4	0.7	62.50	155.0	155.0	107.63	340.27	238.19	170.13
41	20.5	62.6	4.46	40	70	51	1.4	0.7	64.83	154.0	154.0	106.95	343.56	240.49	171.78
42	19.5	62.6	4.53	40	70	51	1.4	0.7	67.17	153.0	153.0	106.27	346.87	242.81	173.43
43	18.5	62.6	4.59	40	70	51	1.4	0.7	69.50	152.1	152.1	105.60	350.19	245.14	175.10
44	17.5	62.6	4.65	40	70	50	1.4	0.7	71.83	151.1	151.1	104.94	353.54	247.48	176.77
45	16.5	62.6	4.71	40	70	50	1.4	0.7	74.17	150.2	150.2	104.28	356.90	249.83	178.45
46	15.5	62.6	4.78	40	70	50	1.4	0.7	76.50	149.2	149.2	103.64	360.28	252.20	180.14
47	14.5	62.6	4.84	40	70	49	1.4	0.7	78.83	148.3	148.3	103.01	363.68	254.57	181.84
48	13.5	62.6	4.90	40	70	49	1.4	0.7	81.17	147.4	147.4	102.38	367.09	256.96	183.55
49	12.5	62.6	4.96	40	70	49	1.4	0.7	83.50	146.5	146.5	101.76	370.52	259.36	185.26
50	11.5	62.6	5.03	40	70	49	1.4	0.7	85.83	145.7	145.7	101.15	373.96	261.77	186.98
51	10.5	62.6	5.09	40	70	48	1.4	0.7	88.17	144.8	144.8	100.55	377.42	264.20	188.71
52	9.5	62.6	5.15	40	70	48	1.4	0.7	90.50	143.9	143.9	99.95	380.90	266.63	190.45
53	8.5	62.6	5.21	40	70	48	1.4	0.7	92.83	143.1	143.1	99.36	384.39	269.07	192.19
54	7.5	62.6	5.28	40	70	47	1.4	0.7	95.17	142.2	142.2	98.78	387.89	271.52	193.94
55	6.5	62.6	5.34	40	70	47	1.4	0.7	97.50	141.4	141.4	98.20	391.41	273.98	195.70
56	5.5	62.6	5.40	40	70	47	1.4	0.7	99.83	140.6	140.6	97.63	394.94	276.46	197.47
57	4.5	62.6	5.47	40	70	47	1.4	0.7	102.17	139.8	139.8	97.07	398.48	278.94	199.24
58	3.5	62.6	5.53	40	70	46	1.4	0.7	104.50	139.0	139.0	96.52	402.03	281.42	201.02
59	2.5	62.6	5.59	40	70	46	1.4	0.7	106.83	138.2	138.2	95.97	405.60	283.92	202.80
60	1.5	62.6	5.65	40	70	46	1.4	0.7	109.17	137.4	137.4	95.43	409.18	286.43	204.59
61	0.5	62.6	5.72	40	70	46	1.4	0.7	111.50	136.6	136.6	94.89	412.78	288.94	206.39
62	-0.5	62.6	5.78	40	70	45	1.4	0.7	113.83	135.9	135.9	94.36	416.38	291.47	208.19
63	-1.5	62.6	5.84	40	70	45	1.4	0.7	116.17	135.1	135.1	93.83	420.00	294.00	210.00
64	-2.5	62.6	5.90	40	70	45	1.4	0.7	118.50	134.4	134.4	93.31	423.62	296.54	211.81
65	-3.5	62.6	5.97	40	70	45	1.4	0.7	120.83	133.6	133.6	92.80	427.26	299.08	213.63
66	-4.5	62.6	6.03	40	70	44	1.4	0.7	123.17	132.9	132.9	92.29	430.91	301.64	215.45
67	-5.5	62.6	6.09	40	70	44	1.4	0.7	125.50	132.2	132.2	91.78	434.57	304.20	217.28
68	-6.5	62.6	6.15	40	70	44	1.4	0.7	127.83	131.5	131.5	91.29	438.24	306.77	219.12
69	-7.5	62.6	6.22	40	70	44	1.4	0.7	130.17	130.7	130.7	90.79	441.92	309.34	220.96
70	-8.5	62.6	6.28	40	70	43	1.4	0.7	132.50	130.0	130.0	90.30	445.61	311.92	222.80
71	-9.5	62.6	6.34	40	70	43	1.4	0.7	134.83	129.3	129.3	89.82	449.31	314.51	224.65
72	-10.5	62.6	6.40	40	70	43	1.4	0.7	137.17	128.6	128.6	89.34	453.01	317.11	226.51
73	-11.5	62.6	6.47	40	70	43	1.4	0.7	139.50	128.0	128.0	88.87	456.73	319.71	228.37
74	-12.5	62.6	6.53	40	70	42	1.4	0.7	141.83	127.3	127.3	88.40	460.46	322.32	230.23
75	-13.5	62.6	6.59	40	70	42	1.4	0.7	144.17	126.6	126.6	87.93	464.19	324.94	232.10
76	-14.5	62.6	6.65	40	70	42	1.4	0.7	146.50	126.0	126.0	87.47	467.94	327.56	233.97
77	-15.5	62.6	6.72	40	70	42	1.4	0.7	148.83	125.3	125.3	87.01	471.69	330.18	235.85
78	-16.5	62.6	6.78	40	70	42	1.4	0.7	151.17	124.6	124.6	86.56	475.45	332.82	237.73
79	-17.5	62.6	6.84	45	70	41	1.4	0.7	153.50	124.0	124.0	86.11	479.22	335.46	239.61
80	-18.5	62.6	6.90	45	70	41	1.4	0.7	155.83	123.4	123.4	85.67	483.00	338.10	241.50
81	-19.5	62.6	6.97	45	70	41	1.4	0.7	158.17	122.7	122.7	85.23	486.79	340.75	243.39
82	-20.5	62.6	7.03	45	70	41	1.4	0.7	160.50	122.1	122.1	84.79	490.58	343.41	245.29
83	-21.5	62.6	7.09	45	70	40	1.4	0.7	162.83	121.5	121.5	84.36	494.39	346.07	247.19
84	-22.5	62.6	7.16	45	70	40	1.4	0.7	165.17	120.9	120.9	83.93	498.20	348.74	249.10
85	-23.5	62.6	7.22	45	70	40	1.4	0.7	167.50	120.2	120.2	83.51	502.01	351.41	251.01
86	-24.5	62.6	7.28	45	70	40	1.4	0.7	169.83	119.6	119.6	83.09	505.84	354.09	252.92
87	-25.5	62.6	7.34	45	70	40	1.4	0.7	172.17	119.0	119.0	82.67	509.67	356.77	254.83
88	-26.5	62.6	7.41	45	70	39	1.4	0.7	174.50	118.4	118.4	82.25	513.51	359.46	256.75
89	-27.5	62.6	7.47	45	70	39	1.4	0.7	176.83	117.9	117.9	81.84	517.35	362.15	258.68
90	-28.5	62.6	7.53	45	70	39	1.4	0.7	179.17	117.3	117.3	81.44	521.21	364.84	260.60
91	-29.5	62.6	7.59	45	70	39	1.4	0.7	181.50	116.7	116.7	81.03	525.06	367.55	262.53
92	-30.5	62.6	7.66	45	70	39	1.4	0.7	183.83	116.1	116.1	80.63	528.93	370.25	264.47
93	-31.5	62.6	7.72	45	70	39	1.4	0.7	186.17	115.5	115.5	80.23	532.80	372.96	266.40
94	-32.5	62.6	7.78	45	70	38	1.4	0.7	188.50	115.0	115.0	79.84	536.68	375.68	268.34
95	-33.5	62.6	7.84	45	70	38	1.4	0.7	190.83	114.4	114.4	79.45	540.57	378.40	270.28
96	-34.5	62.6	7.91	45	70	38	1.4	0.7	193.17	113.8	113.8	79.06	544.46	381.12	272.23
97	-35.5	62.6	7.97	45	70	38	1.4	0.7	195.50	113.3	113.3	78.68	548.36	383.85	274.18
98	-36.5	62.6	8.03	45	70	38	1.4	0.7	197.83	112.7	112.7	78.30	552.26	386.58	276.13
99	-37.5	62.6	8.09	45	70	37	1.4	0.7	200.17	112.2	112.2	77.92	556.17	389.32	278.08
100	-38.5	62.6	8.16	45	70	37	1.4	0.7	202.50	111.7	111.7	77.54	560.08	392.06	280.04
101	-39.5	62.6	8.22	45	70	37	1.4	0.7	204.83	111.1	111.1	77.17	564.00	394.80	282.00
102	-40.5	62.6	8.28	45	70	37	1.4	0.7	207.17	110.6	110.6	76.80	567.93	397.55	283.97
103	-41.5	62.6	8.34	45	70	37	1.4	0.7	209.50	110.1	110.1	76.43	571.86	400.30	285.93

104	-42.5	62.6	8.41	45	70	37	1.4	0.7	211.83	109.5	109.5	76.07	575.80	403.06	287.90
105	-43.5	62.6	8.47	45	70	36	1.4	0.7	214.17	109.0	109.0	75.71	579.74	405.82	289.87
106	-44.5	62.6	8.53	45	70	36	1.4	0.7	216.50	108.5	108.5	75.35	583.69	408.59	291.85
107	-45.5	62.6	8.59	45	70	36	1.4	0.7	218.83	108.0	108.0	74.99	587.65	411.35	293.82
108	-46.5	62.6	8.66	45	70	36	1.4	0.7	221.17	107.5	107.5	74.64	591.61	414.12	295.80
109	-47.5	62.6	8.72	45	70	36	1.4	0.7	223.50	107.0	107.0	74.28	595.57	416.90	297.78
110	-48.5	62.6	8.78	45	70	35	1.4	0.7	225.83	106.5	106.5	73.94	599.54	419.68	299.77
111	-49.5	62.6	8.85	45	70	35	1.4	0.7	228.17	106.0	106.0	73.59	603.51	422.46	301.76
112	-50.5	62.6	8.91	45	70	35	1.4	0.7	230.50	105.5	105.5	73.25	607.49	425.24	303.75
113	-51.5	62.6	8.97	45	70	35	1.4	0.7	232.83	105.0	105.0	72.90	611.47	428.03	305.74
114	-52.5	62.6	9.03	45	70	35	1.4	0.7	235.17	104.5	104.5	72.56	615.46	430.82	307.73
115	-53.5	62.6	9.10	45	70	35	1.4	0.7	237.50	104.0	104.0	72.23	619.46	433.62	309.73
116	-54.5	62.6	9.16	45	70	35	1.4	0.7	239.83	103.5	103.5	71.89	623.45	436.42	311.73
117	-55.5	62.6	9.22	45	70	34	1.4	0.7	242.17	103.0	103.0	71.56	627.46	439.22	313.73
118	-56.5	62.6	9.28	45	70	34	1.4	0.7	244.50	102.6	102.6	71.23	631.46	442.02	315.73
119	-57.5	62.6	9.35	45	70	34	1.4	0.7	246.83	102.1	102.1	70.90	635.47	444.83	317.74
120	-58.5	62.6	9.41	45	70	34	1.4	0.7	249.17	101.6	101.6	70.58	639.49	447.64	319.74
121	-59.5	62.6	9.47	45	70	34	1.4	0.7	251.50	101.2	101.2	70.25	643.51	450.46	321.75
122	-60.5	62.6	9.53	45	70	34	1.4	0.7	253.83	100.7	100.7	69.93	647.53	453.27	323.77
123	-61.5	62.6	9.60	45	70	33	1.4	0.7	256.17	100.2	100.2	69.61	651.56	456.09	325.78
124	-62.5	62.6	9.66	45	70	33	1.4	0.7	258.50	99.8	99.8	69.30	655.59	458.92	327.80
125	-63.5	62.6	9.72	45	70	33	1.4	0.7	260.83	99.3	99.3	68.98	659.63	461.74	329.82
126	-64.5	62.6	9.78	45	70	33	1.4	0.7	263.17	98.9	98.9	68.67	663.67	464.57	331.84
127	-65.5	62.6	9.85	45	70	33	1.4	0.7	265.50	98.4	98.4	68.36	667.72	467.40	333.86
128	-66.5	62.6	9.91	45	70	33	1.4	0.7	267.83	98.0	98.0	68.05	671.77	470.24	335.88
129	-67.5	62.6	9.97	45	70	33	1.4	0.7	270.17	97.5	97.5	67.74	675.82	473.07	337.91
130	-68.5	62.6	10.03	45	70	32	1.4	0.7	272.50	97.1	97.1	67.44	679.87	475.91	339.94
131	-69.5	62.6	10.10	45	70	32	1.4	0.7	274.83	96.7	96.7	67.13	683.93	478.75	341.97
132	-70.5	62.6	10.16	45	70	32	1.4	0.7	277.17	96.2	96.2	66.83	688.00	481.60	344.00
133	-71.5	62.6	10.22	45	70	32	1.4	0.7	279.50	95.8	95.8	66.53	692.07	484.45	346.03
134	-72.5	62.6	10.29	45	70	32	1.4	0.7	281.83	95.4	95.4	66.23	696.14	487.30	348.07
135	-73.5	62.6	10.35	45	70	32	1.4	0.7	284.17	95.0	95.0	65.94	700.21	490.15	350.11
136	-74.5	62.6	10.41	45	70	32	1.4	0.7	286.50	94.5	94.5	65.64	704.29	493.00	352.14
137	-75.5	62.6	10.47	45	70	31	1.4	0.7	288.83	94.1	94.1	65.35	708.37	495.86	354.19
138	-76.5	62.6	10.54	45	70	31	1.4	0.7	291.17	93.7	93.7	65.06	712.46	498.72	356.23
139	-77.5	62.6	10.60	45	70	31	1.4	0.7	293.50	93.3	93.3	64.77	716.55	501.58	358.27
140	-78.5	62.6	10.66	45	70	31	1.4	0.7	295.83	92.9	92.9	64.49	720.64	504.45	360.32
141	-79.5	62.6	10.72	45	70	31	1.4	0.7	298.17	92.4	92.4	64.20	724.73	507.31	362.37
142	-80.5	62.6	10.79	45	70	31	1.4	0.7	300.50	92.0	92.0	63.92	728.83	510.18	364.42
143	-81.5	62.6	10.85	45	70	31	1.4	0.7	302.83	91.6	91.6	63.63	732.93	513.05	366.47
144	-82.5	62.6	10.91	45	70	30	1.4	0.7	305.17	91.2	91.2	63.35	737.04	515.93	368.52
145	-83.5	62.6	10.97	45	70	30	1.4	0.7	307.50	90.8	90.8	63.07	741.15	518.80	370.57
146	-84.5	62.6	11.04	45	70	30	1.4	0.7	309.83	90.4	90.4	62.80	745.26	521.68	372.63
147	-85.5	62.6	11.10	45	70	30	1.4	0.7	312.17	90.0	90.0	62.52	749.38	524.56	374.69
148	-86.5	62.6	11.16	45	70	30	1.4	0.7	314.50	89.6	89.6	62.25	753.49	527.45	376.75
149	-87.5	62.6	11.22	45	70	30	1.4	0.7	316.83	89.2	89.2	61.97	757.62	530.33	378.81
150	-88.5	62.6	11.29	45	70	30	1.4	0.7	319.17	88.9	88.9	61.70	761.74	533.22	380.87
151	-89.5	62.6	11.35	45	70	29	1.4	0.7	321.50	88.5	88.5	61.43	765.87	536.11	382.93
152	-90.5	62.6	11.41	45	70	29	1.4	0.7	323.83	88.1	88.1	61.17	770.00	539.00	385.00
153	-91.5	62.6	11.47	45	70	29	1.4	0.7	326.17	87.7	87.7	60.90	774.13	541.89	387.06
154	-92.5	62.6	11.54	45	70	29	1.4	0.7	328.50	87.3	87.3	60.63	778.27	544.79	389.13
155	-93.5	62.6	11.60	45	70	29	1.4	0.7	330.83	86.9	86.9	60.37	782.40	547.68	391.20
156	-94.5	62.6	11.66	45	70	29	1.4	0.7	333.17	86.6	86.6	60.11	786.55	550.58	393.27
157	-95.5	62.6	11.73	45	70	29	1.4	0.7	335.50	86.2	86.2	59.85	790.69	553.48	395.35
158	-96.5	62.6	11.79	45	70	29	1.4	0.7	337.83	85.8	85.8	59.59	794.84	556.39	397.42
159	-97.5	62.6	11.85	45	70	28	1.4	0.7	340.17	85.4	85.4	59.33	798.99	559.29	399.49
160	-98.5	62.6	11.91	45	70	28	1.4	0.7	342.50	85.1	85.1	59.07	803.14	562.20	401.57
161	-99.5	62.6	11.98	45	70	28	1.4	0.7	344.83	84.7	84.7	58.82	807.30	565.11	403.65
162	-100.5	62.6	12.04	45	70	28	1.4	0.7	347.17	84.3	84.3	58.56	811.45	568.02	405.73
163	-101.5	62.6	12.10	45	70	28	1.4	0.7	349.50	84.0	84.0	58.31	815.62	570.93	407.81
164	-102.5	62.6	12.16	45	70	28	1.4	0.7	351.83	83.6	83.6	58.06	819.78	573.85	409.89
165	-103.5	62.6	12.23	45	70	28	1.4	0.7	354.17	83.2	83.2	57.81	823.94	576.76	411.97
166	-104.5	62.6	12.29	45	70	28	1.4	0.7	356.50	82.9	82.9	57.56	828.11	579.68	414.06
167	-105.5	62.6	12.35	45	70	28	1.4	0.7	358.83	82.5	82.5	57.31	832.28	582.60	416.14
168	-106.5	62.6	12.41	45	70	27	1.4	0.7	361.17	82.2	82.2	57.06	836.46	585.52	418.23
169	-107.5	62.6	12.48	45	70	27	1.4	0.7	363.50	81.8	81.8	56.82	840.63	588.44	420.32
170	-108.5	62.6	12.54	45	70	27	1.4	0.7	365.83	81.5	81.5	56.57	844.81	591.37	422.41

171	-109.5	62.6	12.60	45	70	27	1.4	0.7	368.17	81.1	81.1	56.33	848.99	594.30	424.50
172	-110.5	62.6	12.66	45	70	27	1.4	0.7	370.50	80.8	80.8	56.09	853.18	597.22	426.59
173	-111.5	62.6	12.73	45	70	27	1.4	0.7	372.83	80.4	80.4	55.85	857.36	600.15	428.68
174	-112.5	62.6	12.79	45	70	27	1.4	0.7	375.17	80.1	80.1	55.61	861.55	603.09	430.78
175	-113.5	62.6	12.85	45	70	27	1.4	0.7	377.50	79.7	79.7	55.37	865.74	606.02	432.87
176	-114.5	62.6	12.91	45	70	26	1.4	0.7	379.83	79.4	79.4	55.13	869.93	608.95	434.97
177	-115.5	62.6	12.98	45	70	26	1.4	0.7	382.17	79.1	79.1	54.90	874.13	611.89	437.06
178	-116.5	62.6	13.04	45	70	26	1.4	0.7	384.50	78.7	78.7	54.66	878.33	614.83	439.16
179	-117.5	62.6	13.10	45	70	26	1.4	0.7	386.83	78.4	78.4	54.43	882.53	617.77	441.26
180	-118.5	62.6	13.16	45	70	26	1.4	0.7	389.17	78.0	78.0	54.20	886.73	620.71	443.36

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	29
280	29
280	(80)


ABUT 1L
HP 10x57
80
60
40
20
0
-20
-40
-60
-80
Elevation, feet MSL
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
280 kips

Friars Rd OC

Driven Pile Based on NAVFAC/AASHTO LRFD pp 10-67

Location	Abut 1R		PILE	HP 10x57	
Ref Boring	A-12-054/B3		D, diameter	0.8	ft
Pile Cut-Off El	48	ft	At, base area	0.7	sq ft
GW El	29	ft	S, surface area	3.3	sq ft/ft
GS El	48	ft			
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120	
Tot Unit Weight 2	120	pcf	Eff Unit W 2	120	
Tot Unit Weight 3	125	pcf	Eff Unit W 3	62.6	
Tot Unit Weight 4	125	pcf	Eff Unit W 4	62.6	
Tot Unit Weight 5	125	pcf	Eff Unit W 5	62.6	
Tot Unit Weight 6	125	pcf	Eff Unit W 6	62.6	
Tot Unit Weight 7		pcf	Eff Unit W 7		
Top of Soil 1 El	48	ft			
Top of Soil 2 El	40	ft			
Top of Soil 3 El	27	ft			
Top of Soil 4 El	-19	ft			
Top of Soil 5 El	-44	ft			
Top of Soil 6 El	-55	ft			
Top of Soil 7 El		ft			

Design Profile GS EL 48 ft

Depth ft	Ele ft	γt pcf	$\gamma' t$ pcf	Design Profile, N	ϕ °	
0	48	120	120	35	33	
8	40	120	120	35	33	
8	40	120	120	50	36	
21	27	125	62.6	50	36	
21	27	125	62.6	70	40	
67	-19	125	62.6	70	40	
67	-19	125	62.6	70	45	
92	-44	125	62.6	70	45	
92	-44	125	62.6	70	45	
103	-55	125	62.6	70	45	
			Avg N			

Depth below Pile Cap	Elev	γ'	σ'	ϕ	N	N_{corr}	Side Resistance			Tip Resistance			Resistance (kips)		
							q_s (disp)	q_s (nondis)	Qs	$q_t=3N_{corr}$	q_p	Qp	Nominal	LRFD Factored	WSD Factored
ft	ft	pcf	ksf	°			tsf	tsf	ton	(sand/silt)	tsf	ton	Resistance	(ϕ = 0.7)	FS = 2.0
0	48	120		32	20	0	0.4	0.2	0.00	0.0	0.0	0.00	0.00	0.00	0.00
1	47	120	0.12	33	35	68	0.7	0.4	1.17	204.0	32.6	22.66	47.66	33.36	23.83
2	46	120	0.24	33	35	60	0.7	0.4	2.33	179.6	57.5	39.92	84.51	59.15	42.25
3	45	120	0.36	33	35	55	0.7	0.4	3.50	165.4	79.4	55.13	117.27	82.09	58.63
4	44	120	0.48	33	35	52	0.7	0.4	4.67	155.3	99.4	69.02	147.38	103.16	73.69
5	43	120	0.60	33	35	49	0.7	0.4	5.83	147.5	118.0	81.92	175.51	122.86	87.76
6	42	120	0.72	33	35	47	0.7	0.4	7.00	141.1	135.4	94.04	202.08	141.46	101.04
7	41	120	0.84	33	35	45	0.7	0.4	8.17	135.6	135.6	94.20	204.73	143.31	102.37
8	40	120	0.96	33	35	44	0.7	0.4	9.33	131.0	131.0	90.94	200.56	140.39	100.28
9	39	120	1.08	36	50	60	1.0	0.5	11.00	181.2	181.2	125.82	273.64	191.54	136.82
10	38	120	1.20	36	50	59	1.0	0.5	12.67	175.9	175.9	122.15	269.63	188.74	134.81
11	37	120	1.32	36	50	57	1.0	0.5	14.33	171.1	171.1	118.83	266.32	186.43	133.16
12	36	120	1.44	36	50	56	1.0	0.5	16.00	166.7	166.7	115.80	263.59	184.52	131.80
13	35	120	1.56	36	50	54	1.0	0.5	17.67	162.7	162.7	113.01	261.35	182.95	130.68
14	34	120	1.68	36	50	53	1.0	0.5	19.33	159.0	159.0	110.43	259.52	181.66	129.76
15	33	120	1.80	36	50	52	1.0	0.5	21.00	155.6	155.6	108.02	258.05	180.63	129.02
16	32	120	1.92	36	50	51	1.0	0.5	22.67	152.3	152.3	105.78	256.88	179.82	128.44
17	31	120	2.04	36	50	50	1.0	0.5	24.33	149.3	149.3	103.66	255.99	179.20	128.00
18	30	120	2.16	36	50	49	1.0	0.5	26.00	146.4	146.4	101.67	255.35	178.74	127.67
19	29	120	2.28	36	50	48	1.0	0.5	27.67	143.7	143.7	99.79	254.91	178.44	127.46
20	28	120	2.40	36	50	47	1.0	0.5	29.33	141.1	141.1	98.00	254.67	178.27	127.34
21	27	62.6	2.46	36	50	47	1.0	0.5	31.00	139.8	139.8	97.11	256.21	179.35	128.11
22	26	62.6	2.53	40	70	65	1.4	0.7	33.33	194.0	194.0	134.72	336.11	235.28	168.06
23	25	62.6	2.59	40	70	64	1.4	0.7	35.67	192.3	192.3	133.53	338.39	236.87	169.20
24	24	62.6	2.65	40	70	64	1.4	0.7	38.00	190.6	190.6	132.36	340.73	238.51	170.36
25	23	62.6	2.71	40	70	63	1.4	0.7	40.33	189.0	189.0	131.23	343.12	240.18	171.56
26	22	62.6	2.78	40	70	62	1.4	0.7	42.67	187.4	187.4	130.11	345.56	241.89	172.78
27	21	62.6	2.84	40	70	62	1.4	0.7	45.00	185.8	185.8	129.03	348.05	243.64	174.03
28	20	62.6	2.90	40	70	61	1.4	0.7	47.33	184.3	184.3	127.96	350.59	245.41	175.29
29	19	62.6	2.96	40	70	61	1.4	0.7	49.67	182.8	182.8	126.92	353.17	247.22	176.59
30	18	62.6	3.03	40	70	60	1.4	0.7	52.00	181.3	181.3	125.90	355.80	249.06	177.90
31	17	62.6	3.09	40	70	60	1.4	0.7	54.33	179.9	179.9	124.90	358.47	250.93	179.24
32	16	62.6	3.15	40	70	59	1.4	0.7	56.67	178.4	178.4	123.92	361.18	252.83	180.59
33	15	62.6	3.21	40	70	59	1.4	0.7	59.00	177.1	177.1	122.96	363.93	254.75	181.96
34	14	62.6	3.28	40	70	59	1.4	0.7	61.33	175.7	175.7	122.02	366.71	256.70	183.36
35	13	62.6	3.34	40	70	58	1.4	0.7	63.67	174.4	174.4	121.10	369.53	258.67	184.77
36	12	62.6	3.40	40	70	58	1.4	0.7	66.00	173.1	173.1	120.19	372.39	260.67	186.19

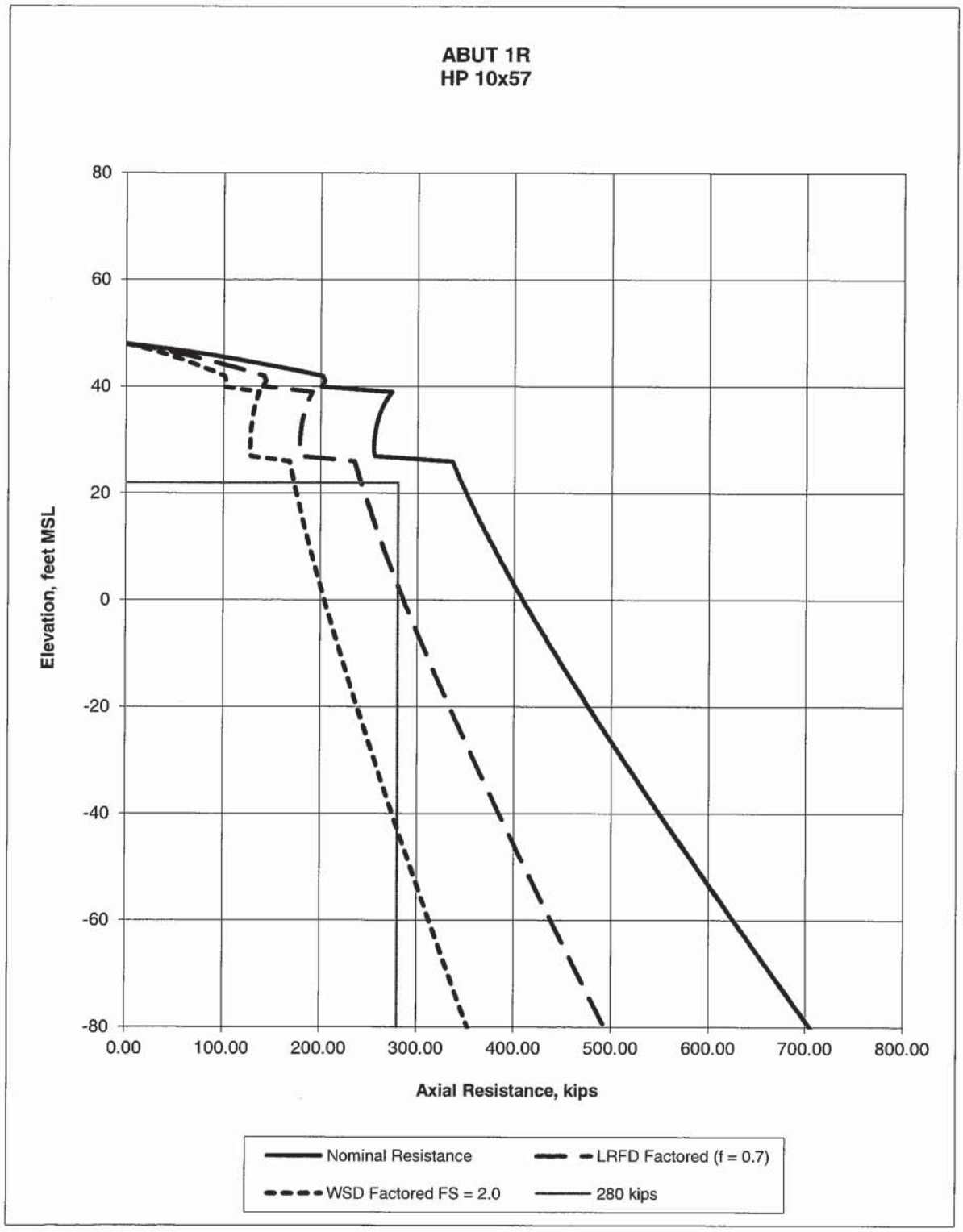
37	11	62.6	3.46	40	70	57	1.4	0.7	68.33	171.8	171.8	119.31	375.28	262.69	187.64
38	10	62.6	3.53	40	70	57	1.4	0.7	70.67	170.5	170.5	118.43	378.20	264.74	189.10
39	9	62.6	3.59	40	70	56	1.4	0.7	73.00	169.3	169.3	117.57	381.15	266.80	190.57
40	8	62.6	3.65	40	70	56	1.4	0.7	75.33	168.1	168.1	116.73	384.13	268.89	192.06
41	7	62.6	3.71	40	70	56	1.4	0.7	77.67	166.9	166.9	115.90	387.14	271.00	193.57
42	6	62.6	3.78	40	70	55	1.4	0.7	80.00	165.7	165.7	115.09	390.17	273.12	195.09
43	5	62.6	3.84	40	70	55	1.4	0.7	82.33	164.6	164.6	114.28	393.24	275.27	196.62
44	4	62.6	3.90	40	70	54	1.4	0.7	84.67	163.4	163.4	113.50	396.33	277.43	198.16
45	3	62.6	3.97	40	70	54	1.4	0.7	87.00	162.3	162.3	112.72	399.44	279.61	199.72
46	2	62.6	4.03	40	70	54	1.4	0.7	89.33	161.2	161.2	111.96	402.58	281.81	201.29
47	1	62.6	4.09	40	70	53	1.4	0.7	91.67	160.1	160.1	111.20	405.74	284.02	202.87
48	0	62.6	4.15	40	70	53	1.4	0.7	94.00	159.1	159.1	110.46	408.93	286.25	204.46
49	-1	62.6	4.22	40	70	53	1.4	0.7	96.33	158.0	158.0	109.73	412.13	288.49	206.07
50	-2	62.6	4.28	40	70	52	1.4	0.7	98.67	157.0	157.0	109.01	415.36	290.75	207.68
51	-3	62.6	4.34	40	70	52	1.4	0.7	101.00	156.0	156.0	108.31	418.61	293.03	209.31
52	-4	62.6	4.40	40	70	52	1.4	0.7	103.33	155.0	155.0	107.61	421.88	295.32	210.94
53	-5	62.6	4.47	40	70	51	1.4	0.7	105.67	154.0	154.0	106.92	425.17	297.62	212.59
54	-6	62.6	4.53	40	70	51	1.4	0.7	108.00	153.0	153.0	106.24	428.48	299.94	214.24
55	-7	62.6	4.59	40	70	51	1.4	0.7	110.33	152.0	152.0	105.57	431.81	302.27	215.90
56	-8	62.6	4.65	40	70	50	1.4	0.7	112.67	151.1	151.1	104.91	435.16	304.61	217.58
57	-9	62.6	4.72	40	70	50	1.4	0.7	115.00	150.1	150.1	104.26	438.52	306.96	219.26
58	-10	62.6	4.78	40	70	50	1.4	0.7	117.33	149.2	149.2	103.62	441.90	309.33	220.95
59	-11	62.6	4.84	40	70	49	1.4	0.7	119.67	148.3	148.3	102.98	445.30	311.71	222.65
60	-12	62.6	4.90	40	70	49	1.4	0.7	122.00	147.4	147.4	102.35	448.71	314.10	224.35
61	-13	62.6	4.97	40	70	49	1.4	0.7	124.33	146.5	146.5	101.74	452.14	316.50	226.07
62	-14	62.6	5.03	40	70	49	1.4	0.7	126.67	145.6	145.6	101.13	455.58	318.91	227.79
63	-15	62.6	5.09	40	70	48	1.4	0.7	129.00	144.8	144.8	100.52	459.04	321.33	229.52
64	-16	62.6	5.15	40	70	48	1.4	0.7	131.33	143.9	143.9	99.93	462.52	323.76	231.26
65	-17	62.6	5.22	40	70	48	1.4	0.7	133.67	143.0	143.0	99.34	466.01	326.21	233.00
66	-18	62.6	5.28	40	70	47	1.4	0.7	136.00	142.2	142.2	98.76	469.51	328.66	234.76
67	-19	62.6	5.34	40	70	47	1.4	0.7	138.33	141.4	141.4	98.18	473.03	331.12	236.51
68	-20	62.6	5.40	45	70	47	1.4	0.7	140.67	140.6	140.6	97.61	476.56	333.59	238.28
69	-21	62.6	5.47	45	70	47	1.4	0.7	143.00	139.8	139.8	97.05	480.10	336.07	240.05
70	-22	62.6	5.53	45	70	46	1.4	0.7	145.33	139.0	139.0	96.50	483.66	338.56	241.83
71	-23	62.6	5.59	45	70	46	1.4	0.7	147.67	138.2	138.2	95.95	487.23	341.06	243.61
72	-24	62.6	5.66	45	70	46	1.4	0.7	150.00	137.4	137.4	95.40	490.81	343.57	245.40
73	-25	62.6	5.72	45	70	46	1.4	0.7	152.33	136.6	136.6	94.87	494.40	346.08	247.20
74	-26	62.6	5.78	45	70	45	1.4	0.7	154.67	135.8	135.8	94.34	498.01	348.60	249.00
75	-27	62.6	5.84	45	70	45	1.4	0.7	157.00	135.1	135.1	93.81	501.62	351.14	250.81
76	-28	62.6	5.91	45	70	45	1.4	0.7	159.33	134.3	134.3	93.29	505.25	353.67	252.62
77	-29	62.6	5.97	45	70	45	1.4	0.7	161.67	133.6	133.6	92.78	508.89	356.22	254.44
78	-30	62.6	6.03	45	70	44	1.4	0.7	164.00	132.9	132.9	92.27	512.54	358.78	256.27
79	-31	62.6	6.09	45	70	44	1.4	0.7	166.33	132.1	132.1	91.76	516.20	361.34	258.10
80	-32	62.6	6.16	45	70	44	1.4	0.7	168.67	131.4	131.4	91.27	519.87	363.91	259.93
81	-33	62.6	6.22	45	70	44	1.4	0.7	171.00	130.7	130.7	90.77	523.55	366.48	261.77
82	-34	62.6	6.28	45	70	43	1.4	0.7	173.33	130.0	130.0	90.28	527.24	369.06	263.62
83	-35	62.6	6.34	45	70	43	1.4	0.7	175.67	129.3	129.3	89.80	530.93	371.65	265.47
84	-36	62.6	6.41	45	70	43	1.4	0.7	178.00	128.6	128.6	89.32	534.64	374.25	267.32
85	-37	62.6	6.47	45	70	43	1.4	0.7	180.33	127.9	127.9	88.85	538.36	376.85	269.18
86	-38	62.6	6.53	45	70	42	1.4	0.7	182.67	127.3	127.3	88.38	542.09	379.46	271.04
87	-39	62.6	6.59	45	70	42	1.4	0.7	185.00	126.6	126.6	87.91	545.83	382.08	272.91
88	-40	62.6	6.66	45	70	42	1.4	0.7	187.33	125.9	125.9	87.45	549.57	384.70	274.79
89	-41	62.6	6.72	45	70	42	1.4	0.7	189.67	125.3	125.3	87.00	553.32	387.33	276.66
90	-42	62.6	6.78	45	70	42	1.4	0.7	192.00	124.6	124.6	86.54	557.09	389.96	278.54
91	-43	62.6	6.84	45	70	41	1.4	0.7	194.33	124.0	124.0	86.10	560.86	392.60	280.43
92	-44	62.6	6.91	45	70	41	1.4	0.7	196.67	123.3	123.3	85.65	564.64	395.25	282.32
93	-45	62.6	6.97	45	70	41	1.4	0.7	199.00	122.7	122.7	85.21	568.42	397.90	284.21
94	-46	62.6	7.03	45	70	41	1.4	0.7	201.33	122.1	122.1	84.78	572.22	400.55	286.11
95	-47	62.6	7.10	45	70	40	1.4	0.7	203.67	121.5	121.5	84.34	576.02	403.21	288.01
96	-48	62.6	7.16	45	70	40	1.4	0.7	206.00	120.8	120.8	83.91	579.83	405.88	289.91
97	-49	62.6	7.22	45	70	40	1.4	0.7	208.33	120.2	120.2	83.49	583.65	408.55	291.82
98	-50	62.6	7.28	45	70	40	1.4	0.7	210.67	119.6	119.6	83.07	587.47	411.23	293.74
99	-51	62.6	7.35	45	70	40	1.4	0.7	213.00	119.0	119.0	82.65	591.30	413.91	295.65
100	-52	62.6	7.41	45	70	39	1.4	0.7	215.33	118.4	118.4	82.24	595.14	416.60	297.57
101	-53	62.6	7.47	45	70	39	1.4	0.7	217.67	117.8	117.8	81.83	598.99	419.29	299.49
102	-54	62.6	7.53	45	70	39	1.4	0.7	220.00	117.2	117.2	81.42	602.84	421.99	301.42
103	-55	62.6	7.60	45	70	39	1.4	0.7	222.33	116.7	116.7	81.02	606.70	424.69	303.35

104	-56	62.6	7.66	45	70	39	1.4	0.7	224.67	116.1	116.1	80.62	610.57	427.40	305.28
105	-57	62.6	7.72	45	70	39	1.4	0.7	227.00	115.5	115.5	80.22	614.44	430.11	307.22
106	-58	62.6	7.78	45	70	38	1.4	0.7	229.33	114.9	114.9	79.83	618.32	432.82	309.16
107	-59	62.6	7.85	45	70	38	1.4	0.7	231.67	114.4	114.4	79.44	622.20	435.54	311.10
108	-60	62.6	7.91	45	70	38	1.4	0.7	234.00	113.8	113.8	79.05	626.10	438.27	313.05
109	-61	62.6	7.97	45	70	38	1.4	0.7	236.33	113.3	113.3	78.66	629.99	441.00	315.00
110	-62	62.6	8.03	45	70	38	1.4	0.7	238.67	112.7	112.7	78.28	633.90	443.73	316.95
111	-63	62.6	8.10	45	70	37	1.4	0.7	241.00	112.2	112.2	77.90	637.81	446.46	318.90
112	-64	62.6	8.16	45	70	37	1.4	0.7	243.33	111.6	111.6	77.53	641.72	449.21	320.86
113	-65	62.6	8.22	45	70	37	1.4	0.7	245.67	111.1	111.1	77.15	645.64	451.95	322.82
114	-66	62.6	8.28	45	70	37	1.4	0.7	248.00	110.6	110.6	76.78	649.57	454.70	324.78
115	-67	62.6	8.35	45	70	37	1.4	0.7	250.33	110.0	110.0	76.42	653.50	457.45	326.75
116	-68	62.6	8.41	45	70	37	1.4	0.7	252.67	109.5	109.5	76.05	657.44	460.21	328.72
117	-69	62.6	8.47	45	70	36	1.4	0.7	255.00	109.0	109.0	75.69	661.38	462.97	330.69
118	-70	62.6	8.53	45	70	36	1.4	0.7	257.33	108.5	108.5	75.33	665.33	465.73	332.67
119	-71	62.6	8.60	45	70	36	1.4	0.7	259.67	108.0	108.0	74.98	669.29	468.50	334.64
120	-72	62.6	8.66	45	70	36	1.4	0.7	262.00	107.5	107.5	74.62	673.25	471.27	336.62
121	-73	62.6	8.72	45	70	36	1.4	0.7	264.33	107.0	107.0	74.27	677.21	474.05	338.60
122	-74	62.6	8.79	45	70	35	1.4	0.7	266.67	106.4	106.4	73.92	681.18	476.82	340.59
123	-75	62.6	8.85	45	70	35	1.4	0.7	269.00	105.9	105.9	73.58	685.15	479.61	342.58
124	-76	62.6	8.91	45	70	35	1.4	0.7	271.33	105.5	105.5	73.23	689.13	482.39	344.57
125	-77	62.6	8.97	45	70	35	1.4	0.7	273.67	105.0	105.0	72.89	693.12	485.18	346.56
126	-78	62.6	9.04	45	70	35	1.4	0.7	276.00	104.5	104.5	72.55	697.10	487.97	348.55
127	-79	62.6	9.10	45	70	35	1.4	0.7	278.33	104.0	104.0	72.22	701.10	490.77	350.55
128	-80	62.6	9.16	45	70	35	1.4	0.7	280.67	103.5	103.5	71.88	705.10	493.57	352.55
129	-81	62.6	9.22	45	70	34	1.4	0.7	283.00	103.0	103.0	71.55	709.10	496.37	354.55
130	-82	62.6	9.29	45	70	34	1.4	0.7	285.33	102.6	102.6	71.22	713.10	499.17	356.55
131	-83	62.6	9.35	45	70	34	1.4	0.7	287.67	102.1	102.1	70.89	717.12	501.98	358.56
132	-84	62.6	9.41	45	70	34	1.4	0.7	290.00	101.6	101.6	70.57	721.13	504.79	360.57
133	-85	62.6	9.47	45	70	34	1.4	0.7	292.33	101.1	101.1	70.24	725.15	507.61	362.58
134	-86	62.6	9.54	45	70	34	1.4	0.7	294.67	100.7	100.7	69.92	729.18	510.42	364.59
135	-87	62.6	9.60	45	70	33	1.4	0.7	297.00	100.2	100.2	69.60	733.20	513.24	366.60
136	-88	62.6	9.66	45	70	33	1.4	0.7	299.33	99.8	99.8	69.29	737.24	516.07	368.62
137	-89	62.6	9.72	45	70	33	1.4	0.7	301.67	99.3	99.3	68.97	741.27	518.89	370.64
138	-90	62.6	9.79	45	70	33	1.4	0.7	304.00	98.9	98.9	68.66	745.31	521.72	372.66
139	-91	62.6	9.85	45	70	33	1.4	0.7	306.33	98.4	98.4	68.35	749.36	524.55	374.68
140	-92	62.6	9.91	45	70	33	1.4	0.7	308.67	98.0	98.0	68.04	753.41	527.39	376.70
141	-93	62.6	9.97	45	70	33	1.4	0.7	311.00	97.5	97.5	67.73	757.46	530.22	378.73
142	-94	62.6	10.04	45	70	32	1.4	0.7	313.33	97.1	97.1	67.43	761.52	533.06	380.76
143	-95	62.6	10.10	45	70	32	1.4	0.7	315.67	96.7	96.7	67.12	765.58	535.90	382.79
144	-96	62.6	10.16	45	70	32	1.4	0.7	318.00	96.2	96.2	66.82	769.64	538.75	384.82
145	-97	62.6	10.23	45	70	32	1.4	0.7	320.33	95.8	95.8	66.52	773.71	541.60	386.85
146	-98	62.6	10.29	45	70	32	1.4	0.7	322.67	95.4	95.4	66.22	777.78	544.45	388.89
147	-99	62.6	10.35	45	70	32	1.4	0.7	325.00	94.9	94.9	65.93	781.86	547.30	390.93
148	-100	62.6	10.41	45	70	32	1.4	0.7	327.33	94.5	94.5	65.63	785.93	550.15	392.97
149	-101	62.6	10.48	45	70	31	1.4	0.7	329.67	94.1	94.1	65.34	790.02	553.01	395.01
150	-102	62.6	10.54	45	70	31	1.4	0.7	332.00	93.7	93.7	65.05	794.10	555.87	397.05
151	-103	62.6	10.60	45	70	31	1.4	0.7	334.33	93.3	93.3	64.76	798.19	558.73	399.10
152	-104	62.6	10.66	45	70	31	1.4	0.7	336.67	92.8	92.8	64.47	802.28	561.60	401.14
153	-105	62.6	10.73	45	70	31	1.4	0.7	339.00	92.4	92.4	64.19	806.38	564.47	403.19
154	-106	62.6	10.79	45	70	31	1.4	0.7	341.33	92.0	92.0	63.91	810.48	567.33	405.24
155	-107	62.6	10.85	45	70	31	1.4	0.7	343.67	91.6	91.6	63.62	814.58	570.21	407.29
156	-108	62.6	10.91	45	70	30	1.4	0.7	346.00	91.2	91.2	63.34	818.69	573.08	409.34
157	-109	62.6	10.98	45	70	30	1.4	0.7	348.33	90.8	90.8	63.06	822.79	575.96	411.40
158	-110	62.6	11.04	45	70	30	1.4	0.7	350.67	90.4	90.4	62.79	826.91	578.83	413.45
159	-111	62.6	11.10	45	70	30	1.4	0.7	353.00	90.0	90.0	62.51	831.02	581.72	415.51
160	-112	62.6	11.16	45	70	30	1.4	0.7	355.33	89.6	89.6	62.24	835.14	584.60	417.57
161	-113	62.6	11.23	45	70	30	1.4	0.7	357.67	89.2	89.2	61.96	839.26	587.48	419.63
162	-114	62.6	11.29	45	70	30	1.4	0.7	360.00	88.8	88.8	61.69	843.39	590.37	421.69
163	-115	62.6	11.35	45	70	29	1.4	0.7	362.33	88.4	88.4	61.42	847.51	593.26	423.76
164	-116	62.6	11.41	45	70	29	1.4	0.7	364.67	88.1	88.1	61.15	851.64	596.15	425.82
165	-117	62.6	11.48	45	70	29	1.4	0.7	367.00	87.7	87.7	60.89	855.78	599.04	427.89
166	-118	62.6	11.54	45	70	29	1.4	0.7	369.33	87.3	87.3	60.62	859.91	601.94	429.96
167	-119	62.6	11.60	45	70	29	1.4	0.7	371.67	86.9	86.9	60.36	864.05	604.84	432.03
168	-120	62.6	11.66	45	70	29	1.4	0.7	374.00	86.5	86.5	60.10	868.19	607.74	434.10
169	-121	62.6	11.73	45	70	29	1.4	0.7	376.33	86.2	86.2	59.84	872.34	610.64	436.17
170	-122	62.6	11.79	45	70	29	1.4	0.7	378.67	85.8	85.8	59.58	876.49	613.54	438.24

171	-123	62.6	11.85	45	70	28	1.4	0.7	381.00	85.4	85.4	59.32	880.64	616.44	440.32
172	-124	62.6	11.92	45	70	28	1.4	0.7	383.33	85.0	85.0	59.06	884.79	619.35	442.39
173	-125	62.6	11.98	45	70	28	1.4	0.7	385.67	84.7	84.7	58.81	888.94	622.26	444.47
174	-126	62.6	12.04	45	70	28	1.4	0.7	388.00	84.3	84.3	58.55	893.10	625.17	446.55
175	-127	62.6	12.10	45	70	28	1.4	0.7	390.33	83.9	83.9	58.30	897.26	628.08	448.63
176	-128	62.6	12.17	45	70	28	1.4	0.7	392.67	83.6	83.6	58.05	901.43	631.00	450.71
177	-129	62.6	12.23	45	70	28	1.4	0.7	395.00	83.2	83.2	57.80	905.59	633.91	452.80
178	-130	62.6	12.29	45	70	28	1.4	0.7	397.33	82.9	82.9	57.55	909.76	636.83	454.88
179	-131	62.6	12.35	45	70	28	1.4	0.7	399.67	82.5	82.5	57.30	913.93	639.75	456.97
180	-132	62.6	12.42	45	70	27	1.4	0.7	402.00	82.2	82.2	57.05	918.11	642.67	459.05

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	22
280	22
280	(80)


ABUT 1R
HP 10x57
80
60
40
20
0
-20
-40
-60
-80
Elevation, feet MSL
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
280 kips

Friars Rd OC

Driven Pile Based on NAVFAC/AASHTO LRFD pp 10-67

Location	Abut 3L		PILE	HP 10x57
Ref Boring	A-B-44/A-B-3		D, diameter	0.8 ft
Pile Cut-Off El	65	ft	At, base area	0.7 sq ft
GW El	18	ft	S, surface area	3.3 sq ft/ft
GS El	65	ft		
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120
Tot Unit Weight 2	120	pcf	Eff Unit W 2	120
Tot Unit Weight 3	125	pcf	Eff Unit W 3	125
Tot Unit Weight 4	125	pcf	Eff Unit W 4	62.6
Tot Unit Weight 5	125	pcf	Eff Unit W 5	62.6
Tot Unit Weight 6		pcf	Eff Unit W 6	
Tot Unit Weight 7		pcf	Eff Unit W 7	
Top of Soil 1 El	65	ft		
Top of Soil 2 El	46	ft		
Top of Soil 3 El	29	ft		
Top of Soil 4 El	10	ft		
Top of Soil 5 El	6	ft		
Top of Soil 6 El		ft		
Top of Soil 7 El		ft		

Design Profile GS EL 65 ft

Depth ft	Ele ft	γ pcf	γ' pcf	Design Profile, N	ϕ °	
0	65	120	120	35	29	
19	46	120	120	35	29	
19	46	120	120	35	30	
36	29	120	120	35	30	
36	29	120	120	55	32	
55	10	120	57.6	55	32	
55	10	125	62.6	70	37	
59	6	125	62.6	70	37	
59	6	125	62.6	70	45	
100	-35	125	62.6	70	45	
			Avg N			

Depth below Pile Cap	Elev	γ'	σ'	ϕ	N	N_{corr}	Side Resistance			Tip Resistance			Resistance (kips)		
							q_s (disp)	q_s (nondis)	Qs	$q_t=3N_{corr}$	q_p	Qp	Nominal	LRFD Factored	WSD Factored
ft	ft	pcf	ksf	°			tsf	tsf	ton	(sand/silt)	tsf	ton	Resistance	(ϕ = 0.7)	FS = 2.0
0	65	120		32	20	0	0.4	0.2	0.00	0.0	0.0	0.00	0.00	0.00	0.00
1	64	120	0.12	29	35	68	0.7	0.4	1.17	204.0	32.6	22.66	47.66	33.36	23.83
2	63	120	0.24	29	35	60	0.7	0.4	2.33	179.6	57.5	39.92	84.51	59.15	42.25
3	62	120	0.36	29	35	55	0.7	0.4	3.50	165.4	79.4	55.13	117.27	82.09	58.63
4	61	120	0.48	29	35	52	0.7	0.4	4.67	155.3	99.4	69.02	147.38	103.16	73.69
5	60	120	0.60	29	35	49	0.7	0.4	5.83	147.5	118.0	81.92	175.51	122.86	87.76
6	59	120	0.72	29	35	47	0.7	0.4	7.00	141.1	135.4	94.04	202.08	141.46	101.04
7	58	120	0.84	29	35	45	0.7	0.4	8.17	135.6	135.6	94.20	204.73	143.31	102.37
8	57	120	0.96	29	35	44	0.7	0.4	9.33	131.0	131.0	90.94	200.56	140.39	100.28
9	56	120	1.08	29	35	42	0.7	0.4	10.50	126.8	126.8	88.07	197.14	138.00	98.57
10	55	120	1.20	29	35	41	0.7	0.4	11.67	123.1	123.1	85.50	194.34	136.04	97.17
11	54	120	1.32	29	35	40	0.7	0.4	12.83	119.8	119.8	83.18	192.03	134.42	96.01
12	53	120	1.44	29	35	39	0.7	0.4	14.00	116.7	116.7	81.06	190.12	133.08	95.06
13	52	120	1.56	29	35	38	0.7	0.4	15.17	113.9	113.9	79.11	188.55	131.98	94.27
14	51	120	1.68	29	35	37	0.7	0.4	16.33	111.3	111.3	77.30	187.26	131.09	93.63
15	50	120	1.80	29	35	36	0.7	0.4	17.50	108.9	108.9	75.62	186.23	130.36	93.12
16	49	120	1.92	29	35	36	0.7	0.4	18.67	106.6	106.6	74.04	185.42	129.79	92.71
17	48	120	2.04	29	35	35	0.7	0.4	19.83	104.5	104.5	72.56	184.80	129.36	92.40
18	47	120	2.16	29	35	34	0.7	0.4	21.00	102.5	102.5	71.17	184.34	129.04	92.17
19	46	120	2.28	29	35	34	0.7	0.4	22.17	100.6	100.6	69.85	184.04	128.83	92.02
20	45	120	2.40	30	35	33	0.7	0.4	23.33	98.8	98.8	68.60	183.87	128.71	91.94
21	44	120	2.52	30	35	32	0.7	0.4	24.50	97.1	97.1	67.41	183.82	128.68	91.91
22	43	120	2.64	30	35	32	0.7	0.4	25.67	95.4	95.4	66.28	183.89	128.72	91.94
23	42	120	2.76	30	35	31	0.7	0.4	26.83	93.9	93.9	65.19	184.05	128.84	92.03
24	41	120	2.88	30	35	31	0.7	0.4	28.00	92.4	92.4	64.16	184.31	129.02	92.16
25	40	120	3.00	30	35	30	0.7	0.4	29.17	91.0	91.0	63.16	184.65	129.26	92.33
26	39	120	3.12	30	35	30	0.7	0.4	30.33	89.6	89.6	62.20	185.08	129.55	92.54
27	38	120	3.24	30	35	29	0.7	0.4	31.50	88.2	88.2	61.28	185.57	129.90	92.78
28	37	120	3.36	30	35	29	0.7	0.4	32.67	87.0	87.0	60.40	186.13	130.29	93.06
29	36	120	3.48	30	35	29	0.7	0.4	33.83	85.7	85.7	59.54	186.75	130.72	93.37
30	35	120	3.60	30	35	28	0.7	0.4	35.00	84.5	84.5	58.71	187.43	131.20	93.71
31	34	120	3.72	30	35	28	0.7	0.4	36.17	83.4	83.4	57.92	188.16	131.71	94.08
32	33	120	3.84	30	35	27	0.7	0.4	37.33	82.3	82.3	57.14	188.95	132.26	94.47
33	32	120	3.96	30	35	27	0.7	0.4	38.50	81.2	81.2	56.39	189.78	132.85	94.89
34	31	120	4.08	30	35	27	0.7	0.4	39.67	80.2	80.2	55.66	190.66	133.46	95.33
35	30	120	4.20	30	35	26	0.7	0.4	40.83	79.1	79.1	54.96	191.58	134.11	95.79
36	29	125	4.33	30	35	26	0.7	0.4	42.00	78.1	78.1	54.24	192.48	134.74	96.24

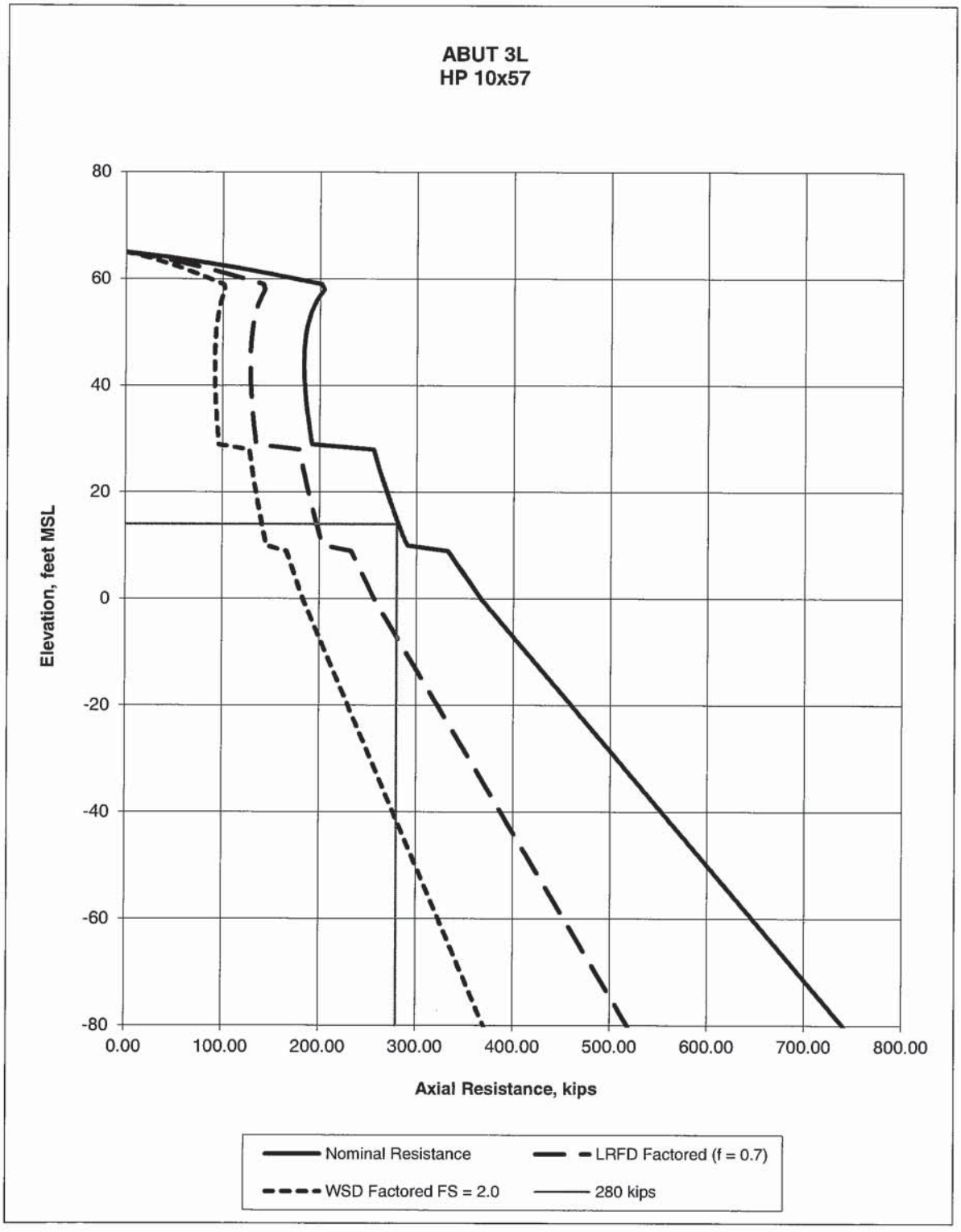
37	28	125	4.45	32	55	40	1.1	0.6	43.83	121.2	121.2	84.14	255.95	179.17	127.98
38	27	125	4.58	32	55	40	1.1	0.6	45.67	119.6	119.6	83.08	257.50	180.25	128.75
39	26	125	4.70	32	55	39	1.1	0.6	47.50	118.2	118.2	82.05	259.10	181.37	129.55
40	25	125	4.83	32	55	39	1.1	0.6	49.33	116.7	116.7	81.04	260.75	182.53	130.38
41	24	125	4.95	32	55	38	1.1	0.6	51.17	115.3	115.3	80.06	262.46	183.72	131.23
42	23	125	5.08	32	55	38	1.1	0.6	53.00	113.9	113.9	79.11	264.22	184.95	132.11
43	22	125	5.20	32	55	38	1.1	0.6	54.83	112.6	112.6	78.18	266.02	186.21	133.01
44	21	125	5.33	32	55	37	1.1	0.6	56.67	111.3	111.3	77.27	267.87	187.51	133.93
45	20	125	5.45	32	55	37	1.1	0.6	58.50	110.0	110.0	76.38	269.75	188.83	134.88
46	19	125	5.58	32	55	36	1.1	0.6	60.33	108.7	108.7	75.51	271.68	190.18	135.84
47	18	125	5.70	32	55	36	1.1	0.6	62.17	107.5	107.5	74.66	273.65	191.55	136.82
48	17	125	5.83	32	55	35	1.1	0.6	64.00	106.3	106.3	73.83	275.65	192.96	137.83
49	16	125	5.95	32	55	35	1.1	0.6	65.83	105.1	105.1	73.01	277.69	194.39	138.85
50	15	125	6.08	32	55	35	1.1	0.6	67.67	104.0	104.0	72.22	279.77	195.84	139.88
51	14	125	6.20	32	55	34	1.1	0.6	69.50	102.9	102.9	71.44	281.87	197.31	140.94
52	13	125	6.33	32	55	34	1.1	0.6	71.33	101.8	101.8	70.67	284.01	198.81	142.00
53	12	125	6.45	32	55	34	1.1	0.6	73.17	100.7	100.7	69.92	286.18	200.32	143.09
54	11	125	6.58	32	55	33	1.1	0.6	75.00	99.6	99.6	69.19	288.37	201.86	144.19
55	10	62.6	6.64	32	55	33	1.1	0.6	76.83	99.1	99.1	68.82	291.31	203.92	145.66
56	9	62.6	6.70	37	70	42	1.4	0.7	79.17	125.5	125.5	87.14	332.60	232.82	166.30
57	8	62.6	6.76	37	70	42	1.4	0.7	81.50	124.8	124.8	86.68	336.36	235.45	168.18
58	7	62.6	6.83	37	70	41	1.4	0.7	83.83	124.2	124.2	86.23	340.13	238.09	170.07
59	6	62.6	6.89	37	70	41	1.4	0.7	86.17	123.5	123.5	85.79	343.91	240.74	171.95
60	5	62.6	6.95	37	70	41	1.4	0.7	88.50	122.9	122.9	85.35	347.69	243.38	173.85
61	4	62.6	7.01	37	70	41	1.4	0.7	90.83	122.3	122.3	84.91	351.48	246.04	175.74
62	3	62.6	7.08	37	70	41	1.4	0.7	93.17	121.6	121.6	84.48	355.28	248.70	177.64
63	2	62.6	7.14	37	70	40	1.4	0.7	95.50	121.0	121.0	84.05	359.09	251.36	179.55
64	1	62.6	7.20	37	70	40	1.4	0.7	97.83	120.4	120.4	83.62	362.91	254.03	181.45
65	0	62.6	7.26	37	70	40	1.4	0.7	100.17	119.8	119.8	83.20	366.73	256.71	183.36
66	-1	0	7.26	37	70	40	1.4	0.7	102.50	119.8	119.8	83.20	371.40	259.98	185.70
67	-2	0	7.26	37	70	40	1.4	0.7	104.83	119.8	119.8	83.20	376.06	263.24	188.03
68	-3	0	7.26	37	70	40	1.4	0.7	107.17	119.8	119.8	83.20	380.73	266.51	190.36
69	-4	0	7.26	37	70	40	1.4	0.7	109.50	119.8	119.8	83.20	385.40	269.78	192.70
70	-5	0	7.26	37	70	40	1.4	0.7	111.83	119.8	119.8	83.20	390.06	273.04	195.03
71	-6	0	7.26	37	70	40	1.4	0.7	114.17	119.8	119.8	83.20	394.73	276.31	197.36
72	-7	0	7.26	37	70	40	1.4	0.7	116.50	119.8	119.8	83.20	399.40	279.58	199.70
73	-8	0	7.26	37	70	40	1.4	0.7	118.83	119.8	119.8	83.20	404.06	282.84	202.03
74	-9	0	7.26	37	70	40	1.4	0.7	121.17	119.8	119.8	83.20	408.73	286.11	204.36
75	-10	0	7.26	37	70	40	1.4	0.7	123.50	119.8	119.8	83.20	413.40	289.38	206.70
76	-11	0	7.26	37	70	40	1.4	0.7	125.83	119.8	119.8	83.20	418.06	292.64	209.03
77	-12	0	7.26	37	70	40	1.4	0.7	128.17	119.8	119.8	83.20	422.73	295.91	211.36
78	-13	0	7.26	37	70	40	1.4	0.7	130.50	119.8	119.8	83.20	427.40	299.18	213.70
79	-14	0	7.26	37	70	40	1.4	0.7	132.83	119.8	119.8	83.20	432.06	302.44	216.03
80	-15	0	7.26	37	70	40	1.4	0.7	135.17	119.8	119.8	83.20	436.73	305.71	218.36
81	-16	0	7.26	37	70	40	1.4	0.7	137.50	119.8	119.8	83.20	441.40	308.98	220.70
82	-17	0	7.26	37	70	40	1.4	0.7	139.83	119.8	119.8	83.20	446.06	312.24	223.03
83	-18	0	7.26	37	70	40	1.4	0.7	142.17	119.8	119.8	83.20	450.73	315.51	225.36
84	-19	0	7.26	37	70	40	1.4	0.7	144.50	119.8	119.8	83.20	455.40	318.78	227.70
85	-20	0	7.26	37	70	40	1.4	0.7	146.83	119.8	119.8	83.20	460.06	322.04	230.03
86	-21	0	7.26	37	70	40	1.4	0.7	149.17	119.8	119.8	83.20	464.73	325.31	232.36
87	-22	0	7.26	37	70	40	1.4	0.7	151.50	119.8	119.8	83.20	469.40	328.58	234.70
88	-23	0	7.26	37	70	40	1.4	0.7	153.83	119.8	119.8	83.20	474.06	331.84	237.03
89	-24	0	7.26	37	70	40	1.4	0.7	156.17	119.8	119.8	83.20	478.73	335.11	239.36
90	-25	0	7.26	37	70	40	1.4	0.7	158.50	119.8	119.8	83.20	483.40	338.38	241.70
91	-26	0	7.26	37	70	40	1.4	0.7	160.83	119.8	119.8	83.20	488.06	341.64	244.03
92	-27	0	7.26	37	70	40	1.4	0.7	163.17	119.8	119.8	83.20	492.73	344.91	246.36
93	-28	0	7.26	37	70	40	1.4	0.7	165.50	119.8	119.8	83.20	497.40	348.18	248.70
94	-29	0	7.26	37	70	40	1.4	0.7	167.83	119.8	119.8	83.20	502.06	351.44	251.03
95	-30	0	7.26	37	70	40	1.4	0.7	170.17	119.8	119.8	83.20	506.73	354.71	253.36
96	-31	0	7.26	37	70	40	1.4	0.7	172.50	119.8	119.8	83.20	511.40	357.98	255.70
97	-32	0	7.26	37	70	40	1.4	0.7	174.83	119.8	119.8	83.20	516.06	361.24	258.03
98	-33	0	7.26	37	70	40	1.4	0.7	177.17	119.8	119.8	83.20	520.73	364.51	260.36
99	-34	0	7.26	37	70	40	1.4	0.7	179.50	119.8	119.8	83.20	525.40	367.78	262.70
100	-35	0	7.26	37	70	40	1.4	0.7	181.83	119.8	119.8	83.20	530.06	371.04	265.03
101	-36	0	7.26	37	70	40	1.4	0.7	184.17	119.8	119.8	83.20	534.73	374.31	267.36
102	-37	0	7.26	37	70	40	1.4	0.7	186.50	119.8	119.8	83.20	539.40	377.58	269.70
103	-38	0	7.26	37	70	40	1.4	0.7	188.83	119.8	119.8	83.20	544.06	380.84	272.03

104	-39	0	7.26	37	70	40	1.4	0.7	191.17	119.8	119.8	83.20	548.73	384.11	274.36
105	-40	0	7.26	37	70	40	1.4	0.7	193.50	119.8	119.8	83.20	553.40	387.38	276.70
106	-41	0	7.26	37	70	40	1.4	0.7	195.83	119.8	119.8	83.20	558.06	390.64	279.03
107	-42	0	7.26	37	70	40	1.4	0.7	198.17	119.8	119.8	83.20	562.73	393.91	281.36
108	-43	0	7.26	37	70	40	1.4	0.7	200.50	119.8	119.8	83.20	567.40	397.18	283.70
109	-44	0	7.26	37	70	40	1.4	0.7	202.83	119.8	119.8	83.20	572.06	400.44	286.03
110	-45	0	7.26	37	70	40	1.4	0.7	205.17	119.8	119.8	83.20	576.73	403.71	288.36
111	-46	0	7.26	37	70	40	1.4	0.7	207.50	119.8	119.8	83.20	581.40	406.98	290.70
112	-47	0	7.26	37	70	40	1.4	0.7	209.83	119.8	119.8	83.20	586.06	410.24	293.03
113	-48	0	7.26	37	70	40	1.4	0.7	212.17	119.8	119.8	83.20	590.73	413.51	295.36
114	-49	0	7.26	37	70	40	1.4	0.7	214.50	119.8	119.8	83.20	595.40	416.78	297.70
115	-50	0	7.26	37	70	40	1.4	0.7	216.83	119.8	119.8	83.20	600.06	420.04	300.03
116	-51	0	7.26	37	70	40	1.4	0.7	219.17	119.8	119.8	83.20	604.73	423.31	302.36
117	-52	0	7.26	37	70	40	1.4	0.7	221.50	119.8	119.8	83.20	609.40	426.58	304.70
118	-53	0	7.26	37	70	40	1.4	0.7	223.83	119.8	119.8	83.20	614.06	429.84	307.03
119	-54	0	7.26	37	70	40	1.4	0.7	226.17	119.8	119.8	83.20	618.73	433.11	309.36
120	-55	0	7.26	37	70	40	1.4	0.7	228.50	119.8	119.8	83.20	623.40	436.38	311.70
121	-56	0	7.26	37	70	40	1.4	0.7	230.83	119.8	119.8	83.20	628.06	439.64	314.03
122	-57	0	7.26	37	70	40	1.4	0.7	233.17	119.8	119.8	83.20	632.73	442.91	316.36
123	-58	0	7.26	37	70	40	1.4	0.7	235.50	119.8	119.8	83.20	637.40	446.18	318.70
124	-59	0	7.26	37	70	40	1.4	0.7	237.83	119.8	119.8	83.20	642.06	449.44	321.03
125	-60	0	7.26	37	70	40	1.4	0.7	240.17	119.8	119.8	83.20	646.73	452.71	323.36
126	-61	0	7.26	37	70	40	1.4	0.7	242.50	119.8	119.8	83.20	651.40	455.98	325.70
127	-62	0	7.26	37	70	40	1.4	0.7	244.83	119.8	119.8	83.20	656.06	459.24	328.03
128	-63	0	7.26	37	70	40	1.4	0.7	247.17	119.8	119.8	83.20	660.73	462.51	330.36
129	-64	0	7.26	37	70	40	1.4	0.7	249.50	119.8	119.8	83.20	665.40	465.78	332.70
130	-65	0	7.26	37	70	40	1.4	0.7	251.83	119.8	119.8	83.20	670.06	469.04	335.03
131	-66	0	7.26	37	70	40	1.4	0.7	254.17	119.8	119.8	83.20	674.73	472.31	337.36
132	-67	0	7.26	37	70	40	1.4	0.7	256.50	119.8	119.8	83.20	679.40	475.58	339.70
133	-68	0	7.26	37	70	40	1.4	0.7	258.83	119.8	119.8	83.20	684.06	478.84	342.03
134	-69	0	7.26	37	70	40	1.4	0.7	261.17	119.8	119.8	83.20	688.73	482.11	344.36
135	-70	0	7.26	37	70	40	1.4	0.7	263.50	119.8	119.8	83.20	693.40	485.38	346.70
136	-71	0	7.26	37	70	40	1.4	0.7	265.83	119.8	119.8	83.20	698.06	488.64	349.03
137	-72	0	7.26	37	70	40	1.4	0.7	268.17	119.8	119.8	83.20	702.73	491.91	351.36
138	-73	0	7.26	37	70	40	1.4	0.7	270.50	119.8	119.8	83.20	707.40	495.18	353.70
139	-74	0	7.26	37	70	40	1.4	0.7	272.83	119.8	119.8	83.20	712.06	498.44	356.03
140	-75	0	7.26	37	70	40	1.4	0.7	275.17	119.8	119.8	83.20	716.73	501.71	358.36
141	-76	0	7.26	37	70	40	1.4	0.7	277.50	119.8	119.8	83.20	721.40	504.98	360.70
142	-77	0	7.26	37	70	40	1.4	0.7	279.83	119.8	119.8	83.20	726.06	508.24	363.03
143	-78	0	7.26	37	70	40	1.4	0.7	282.17	119.8	119.8	83.20	730.73	511.51	365.36
144	-79	0	7.26	37	70	40	1.4	0.7	284.50	119.8	119.8	83.20	735.40	514.78	367.70
145	-80	0	7.26	37	70	40	1.4	0.7	286.83	119.8	119.8	83.20	740.06	518.04	370.03
146	-81	0	7.26	37	70	40	1.4	0.7	289.17	119.8	119.8	83.20	744.73	521.31	372.36
147	-82	0	7.26	37	70	40	1.4	0.7	291.50	119.8	119.8	83.20	749.40	524.58	374.70
148	-83	0	7.26	37	70	40	1.4	0.7	293.83	119.8	119.8	83.20	754.06	527.84	377.03
149	-84	0	7.26	37	70	40	1.4	0.7	296.17	119.8	119.8	83.20	758.73	531.11	379.36
150	-85	0	7.26	37	70	40	1.4	0.7	298.50	119.8	119.8	83.20	763.40	534.38	381.70
151	-86	0	7.26	37	70	40	1.4	0.7	300.83	119.8	119.8	83.20	768.06	537.64	384.03
152	-87	0	7.26	37	70	40	1.4	0.7	303.17	119.8	119.8	83.20	772.73	540.91	386.36
153	-88	0	7.26	37	70	40	1.4	0.7	305.50	119.8	119.8	83.20	777.40	544.18	388.70
154	-89	0	7.26	37	70	40	1.4	0.7	307.83	119.8	119.8	83.20	782.06	547.44	391.03
155	-90	0	7.26	37	70	40	1.4	0.7	310.17	119.8	119.8	83.20	786.73	550.71	393.36
156	-91	0	7.26	37	70	40	1.4	0.7	312.50	119.8	119.8	83.20	791.40	553.98	395.70
157	-92	0	7.26	37	70	40	1.4	0.7	314.83	119.8	119.8	83.20	796.06	557.24	398.03
158	-93	0	7.26	37	70	40	1.4	0.7	317.17	119.8	119.8	83.20	800.73	560.51	400.36
159	-94	0	7.26	37	70	40	1.4	0.7	319.50	119.8	119.8	83.20	805.40	563.78	402.70
160	-95	0	7.26	37	70	40	1.4	0.7	321.83	119.8	119.8	83.20	810.06	567.04	405.03
161	-96	0	7.26	37	70	40	1.4	0.7	324.17	119.8	119.8	83.20	814.73	570.31	407.36
162	-97	0	7.26	37	70	40	1.4	0.7	326.50	119.8	119.8	83.20	819.40	573.58	409.70
163	-98	0	7.26	37	70	40	1.4	0.7	328.83	119.8	119.8	83.20	824.06	576.84	412.03
164	-99	0	7.26	37	70	40	1.4	0.7	331.17	119.8	119.8	83.20	828.73	580.11	414.36
165	-100	0	7.26	37	70	40	1.4	0.7	333.50	119.8	119.8	83.20	833.40	583.38	416.70
166	-101	0	7.26	37	70	40	1.4	0.7	335.83	119.8	119.8	83.20	838.06	586.64	419.03
167	-102	0	7.26	37	70	40	1.4	0.7	338.17	119.8	119.8	83.20	842.73	589.91	421.36
168	-103	0	7.26	37	70	40	1.4	0.7	340.50	119.8	119.8	83.20	847.40	593.18	423.70
169	-104	0	7.26	37	70	40	1.4	0.7	342.83	119.8	119.8	83.20	852.06	596.44	426.03
170	-105	0	7.26	37	70	40	1.4	0.7	345.17	119.8	119.8	83.20	856.73	599.71	428.36

171	-106	0	7.26	37	70	40	1.4	0.7	347.50	119.8	119.8	83.20	861.40	602.98	430.70
172	-107	0	7.26	37	70	40	1.4	0.7	349.83	119.8	119.8	83.20	866.06	606.24	433.03
173	-108	0	7.26	37	70	40	1.4	0.7	352.17	119.8	119.8	83.20	870.73	609.51	435.36
174	-109	0	7.26	37	70	40	1.4	0.7	354.50	119.8	119.8	83.20	875.40	612.78	437.70
175	-110	0	7.26	37	70	40	1.4	0.7	356.83	119.8	119.8	83.20	880.06	616.04	440.03
176	-111	0	7.26	37	70	40	1.4	0.7	359.17	119.8	119.8	83.20	884.73	619.31	442.36
177	-112	0	7.26	37	70	40	1.4	0.7	361.50	119.8	119.8	83.20	889.40	622.58	444.70
178	-113	0	7.26	37	70	40	1.4	0.7	363.83	119.8	119.8	83.20	894.06	625.84	447.03
179	-114	0	7.26	37	70	40	1.4	0.7	366.17	119.8	119.8	83.20	898.73	629.11	449.36
180	-115	0	7.26	37	70	40	1.4	0.7	368.50	119.8	119.8	83.20	903.40	632.38	451.70

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	14
280	14
280	(80)


ABUT 3L
HP 10x57
Elevation, feet MSL
80
60
40
20
0
-20
-40
-60
-80
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
280 kips

Friars Rd OC

Driven Pile Based on NAVFAC/AASHTO LRFD pp 10-67

Location	Abut 3R		PILE	HP 10x57	
Ref Boring	A-B-44/B-1		D, diameter	0.8	ft
Pile Cut-Off El	58	ft	At, base area	0.7	sq ft
GW El	18	ft	S, surface area	3.3	sq ft/ft
GS El	57.5	ft			
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120	
Tot Unit Weight 2	120	pcf	Eff Unit W 2	120	
Tot Unit Weight 3	125	pcf	Eff Unit W 3	125	
Tot Unit Weight 4	125	pcf	Eff Unit W 4	62.6	
Tot Unit Weight 5	125	pcf	Eff Unit W 5	62.6	
Tot Unit Weight 6		pcf	Eff Unit W 6		
Tot Unit Weight 7		pcf	Eff Unit W 7		
Top of Soil 1 El	58	ft			
Top of Soil 2 El	46	ft			
Top of Soil 3 El	29	ft			
Top of Soil 4 El	10	ft			
Top of Soil 5 El	6	ft			
Top of Soil 6 El		ft			
Top of Soil 7 El		ft			

Design Profile GS EL 57.5 ft

Depth ft	Ele ft	γ_t pcf	$\gamma't$ pcf	Design Profile, N	ϕ °	
0	58	120	120	35	29	
12	46	120	120	35	29	
12	46	120	120	35	30	
29	29	120	120	35	30	
29	29	120	120	55	32	
48	10	120	57.6	55	32	
48	10	125	62.6	70	37	
52	6	125	62.6	70	37	
52	6	125	62.6	70	45	
93	-36	125	62.6	70	45	
			Avg N			

Depth below Pile Cap	Elev	γ'	σ'	ϕ	N	N_{corr}	Side Resistance			Tip Resistance			Resistance (kips)		
							q_s (disp)	q_s (nondis)	Qs	$q_t=3N_{corr}$	q_p	Qp	Nominal	LRFD Factored	WSD Factored
ft	ft	pcf	ksf	°			tsf	tsf	ton	(sand/silt)	tsf	ton	Resistance	(ϕ = 0.7)	FS = 2.0
0	57.5	120	[redacted]	32	20	0	0.4	0.2	0.00	0.0	0.0	0.00	0.00	0.00	0.00
1	56.5	120	0.12	29	35	68	0.7	0.4	1.17	204.0	32.6	22.66	47.66	33.36	23.83
2	55.5	120	0.24	29	35	60	0.7	0.4	2.33	179.6	57.5	39.92	84.51	59.15	42.25
3	54.5	120	0.36	29	35	55	0.7	0.4	3.50	165.4	79.4	55.13	117.27	82.09	58.63
4	53.5	120	0.48	29	35	52	0.7	0.4	4.67	155.3	99.4	69.02	147.38	103.16	73.69
5	52.5	120	0.60	29	35	49	0.7	0.4	5.83	147.5	118.0	81.92	175.51	122.86	87.76
6	51.5	120	0.72	29	35	47	0.7	0.4	7.00	141.1	135.4	94.04	202.08	141.46	101.04
7	50.5	120	0.84	29	35	45	0.7	0.4	8.17	135.6	135.6	94.20	204.73	143.31	102.37
8	49.5	120	0.96	29	35	44	0.7	0.4	9.33	131.0	131.0	90.94	200.56	140.39	100.28
9	48.5	120	1.08	29	35	42	0.7	0.4	10.50	126.8	126.8	88.07	197.14	138.00	98.57
10	47.5	120	1.20	29	35	41	0.7	0.4	11.67	123.1	123.1	85.50	194.34	136.04	97.17
11	46.5	120	1.32	29	35	40	0.7	0.4	12.83	119.8	119.8	83.18	192.03	134.42	96.01
12	45.5	120	1.44	29	35	39	0.7	0.4	14.00	116.7	116.7	81.06	190.12	133.08	95.06
13	44.5	120	1.56	30	35	38	0.7	0.4	15.17	113.9	113.9	79.11	188.55	131.98	94.27
14	43.5	120	1.68	30	35	37	0.7	0.4	16.33	111.3	111.3	77.30	187.26	131.09	93.63
15	42.5	120	1.80	30	35	36	0.7	0.4	17.50	108.9	108.9	75.62	186.23	130.36	93.12
16	41.5	120	1.92	30	35	36	0.7	0.4	18.67	106.6	106.6	74.04	185.42	129.79	92.71
17	40.5	120	2.04	30	35	35	0.7	0.4	19.83	104.5	104.5	72.56	184.80	129.36	92.40
18	39.5	120	2.16	30	35	34	0.7	0.4	21.00	102.5	102.5	71.17	184.34	129.04	92.17
19	38.5	120	2.28	30	35	34	0.7	0.4	22.17	100.6	100.6	69.85	184.04	128.83	92.02
20	37.5	120	2.40	30	35	33	0.7	0.4	23.33	98.8	98.8	68.60	183.87	128.71	91.94
21	36.5	120	2.52	30	35	32	0.7	0.4	24.50	97.1	97.1	67.41	183.82	128.68	91.91
22	35.5	120	2.64	30	35	32	0.7	0.4	25.67	95.4	95.4	66.28	183.89	128.72	91.94
23	34.5	120	2.76	30	35	31	0.7	0.4	26.83	93.9	93.9	65.19	184.05	128.84	92.03
24	33.5	120	2.88	30	35	31	0.7	0.4	28.00	92.4	92.4	64.16	184.31	129.02	92.16
25	32.5	120	3.00	30	35	30	0.7	0.4	29.17	91.0	91.0	63.16	184.65	129.26	92.33
26	31.5	120	3.12	30	35	30	0.7	0.4	30.33	89.6	89.6	62.20	185.08	129.55	92.54
27	30.5	120	3.24	30	35	29	0.7	0.4	31.50	88.2	88.2	61.28	185.57	129.90	92.78
28	29.5	120	3.36	30	35	29	0.7	0.4	32.67	87.0	87.0	60.40	186.13	130.29	93.06
29	28.5	125	3.49	30	35	29	0.7	0.4	33.83	85.7	85.7	59.51	186.68	130.68	93.34
30	27.5	125	3.61	32	55	44	1.1	0.6	35.67	132.7	132.7	92.16	255.65	178.96	127.83
31	26.5	125	3.74	32	55	44	1.1	0.6	37.50	130.8	130.8	90.86	256.71	179.70	128.36
32	25.5	125	3.86	32	55	43	1.1	0.6	39.33	129.0	129.0	89.59	257.86	180.50	128.93
33	24.5	125	3.99	32	55	42	1.1	0.6	41.17	127.3	127.3	88.37	259.08	181.36	129.54
34	23.5	125	4.11	32	55	42	1.1	0.6	43.00	125.6	125.6	87.19	260.38	182.27	130.19
35	22.5	125	4.24	32	55	41	1.1	0.6	44.83	123.9	123.9	86.04	261.75	183.22	130.87
36	21.5	125	4.36	32	55	41	1.1	0.6	46.67	122.3	122.3	84.93	263.19	184.23	131.59

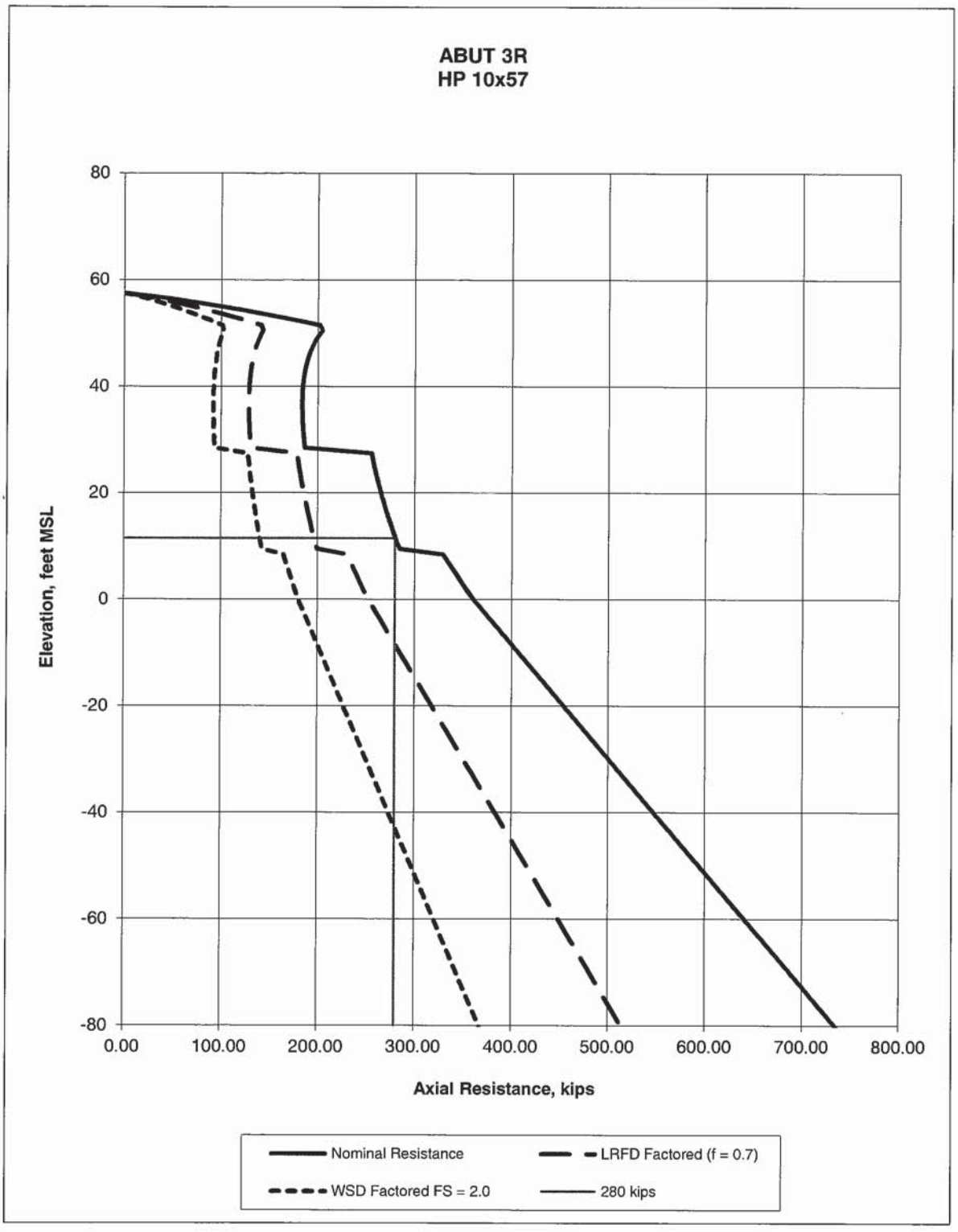
37	20.5	125	4.49	32	55	40	1.1	0.6	48.50	120.7	120.7	83.84	264.69	185.28	132.34
38	19.5	125	4.61	32	55	40	1.1	0.6	50.33	119.2	119.2	82.79	266.25	186.37	133.12
39	18.5	125	4.74	32	55	39	1.1	0.6	52.17	117.7	117.7	81.77	267.86	187.51	133.93
40	17.5	125	4.86	32	55	39	1.1	0.6	54.00	116.3	116.3	80.77	269.53	188.67	134.77
41	16.5	125	4.99	32	55	38	1.1	0.6	55.83	114.9	114.9	79.79	271.25	189.88	135.63
42	15.5	125	5.11	32	55	38	1.1	0.6	57.67	113.5	113.5	78.85	273.02	191.12	136.51
43	14.5	125	5.24	32	55	37	1.1	0.6	59.50	112.2	112.2	77.92	274.84	192.39	137.42
44	13.5	125	5.36	32	55	37	1.1	0.6	61.33	110.9	110.9	77.01	276.70	193.69	138.35
45	12.5	125	5.49	32	55	37	1.1	0.6	63.17	109.6	109.6	76.13	278.60	195.02	139.30
46	11.5	125	5.61	32	55	36	1.1	0.6	65.00	108.4	108.4	75.27	280.54	196.38	140.27
47	10.5	125	5.74	32	55	36	1.1	0.6	66.83	107.2	107.2	74.42	282.51	197.76	141.26
48	9.5	62.6	5.80	32	55	36	1.1	0.6	68.67	106.6	106.6	74.01	285.35	199.74	142.67
49	8.5	62.6	5.86	37	70	45	1.4	0.7	71.00	134.9	134.9	93.67	329.34	230.53	164.67
50	7.5	62.6	5.92	37	70	45	1.4	0.7	73.33	134.1	134.1	93.15	332.97	233.08	166.48
51	6.5	62.6	5.99	37	70	44	1.4	0.7	75.67	133.4	133.4	92.64	336.61	235.62	168.30
52	5.5	62.6	6.05	37	70	44	1.4	0.7	78.00	132.7	132.7	92.13	340.26	238.18	170.13
53	4.5	62.6	6.11	37	70	44	1.4	0.7	80.33	131.9	131.9	91.63	343.92	240.74	171.96
54	3.5	62.6	6.17	37	70	44	1.4	0.7	82.67	131.2	131.2	91.13	347.59	243.32	173.80
55	2.5	62.6	6.24	37	70	44	1.4	0.7	85.00	130.5	130.5	90.64	351.28	245.89	175.64
56	1.5	62.6	6.30	37	70	43	1.4	0.7	87.33	129.8	129.8	90.15	354.97	248.48	177.48
57	0.5	62.6	6.36	37	70	43	1.4	0.7	89.67	129.1	129.1	89.67	358.67	251.07	179.34
58	-0.5	0	6.36	37	70	43	1.4	0.7	92.00	129.1	129.1	89.67	363.34	254.34	181.67
59	-1.5	0	6.36	37	70	43	1.4	0.7	94.33	129.1	129.1	89.67	368.00	257.60	184.00
60	-2.5	0	6.36	37	70	43	1.4	0.7	96.67	129.1	129.1	89.67	372.67	260.87	186.34
61	-3.5	0	6.36	37	70	43	1.4	0.7	99.00	129.1	129.1	89.67	377.34	264.14	188.67
62	-4.5	0	6.36	37	70	43	1.4	0.7	101.33	129.1	129.1	89.67	382.00	267.40	191.00
63	-5.5	0	6.36	37	70	43	1.4	0.7	103.67	129.1	129.1	89.67	386.67	270.67	193.34
64	-6.5	0	6.36	37	70	43	1.4	0.7	106.00	129.1	129.1	89.67	391.34	273.94	195.67
65	-7.5	0	6.36	37	70	43	1.4	0.7	108.33	129.1	129.1	89.67	396.00	277.20	198.00
66	-8.5	0	6.36	37	70	43	1.4	0.7	110.67	129.1	129.1	89.67	400.67	280.47	200.34
67	-9.5	0	6.36	37	70	43	1.4	0.7	113.00	129.1	129.1	89.67	405.34	283.74	202.67
68	-10.5	0	6.36	37	70	43	1.4	0.7	115.33	129.1	129.1	89.67	410.00	287.00	205.00
69	-11.5	0	6.36	37	70	43	1.4	0.7	117.67	129.1	129.1	89.67	414.67	290.27	207.34
70	-12.5	0	6.36	37	70	43	1.4	0.7	120.00	129.1	129.1	89.67	419.34	293.54	209.67
71	-13.5	0	6.36	37	70	43	1.4	0.7	122.33	129.1	129.1	89.67	424.00	296.80	212.00
72	-14.5	0	6.36	37	70	43	1.4	0.7	124.67	129.1	129.1	89.67	428.67	300.07	214.34
73	-15.5	0	6.36	37	70	43	1.4	0.7	127.00	129.1	129.1	89.67	433.34	303.34	216.67
74	-16.5	0	6.36	37	70	43	1.4	0.7	129.33	129.1	129.1	89.67	438.00	306.60	219.00
75	-17.5	0	6.36	37	70	43	1.4	0.7	131.67	129.1	129.1	89.67	442.67	309.87	221.34
76	-18.5	0	6.36	37	70	43	1.4	0.7	134.00	129.1	129.1	89.67	447.34	313.14	223.67
77	-19.5	0	6.36	37	70	43	1.4	0.7	136.33	129.1	129.1	89.67	452.00	316.40	226.00
78	-20.5	0	6.36	37	70	43	1.4	0.7	138.67	129.1	129.1	89.67	456.67	319.67	228.34
79	-21.5	0	6.36	37	70	43	1.4	0.7	141.00	129.1	129.1	89.67	461.34	322.94	230.67
80	-22.5	0	6.36	37	70	43	1.4	0.7	143.33	129.1	129.1	89.67	466.00	326.20	233.00
81	-23.5	0	6.36	37	70	43	1.4	0.7	145.67	129.1	129.1	89.67	470.67	329.47	235.34
82	-24.5	0	6.36	37	70	43	1.4	0.7	148.00	129.1	129.1	89.67	475.34	332.74	237.67
83	-25.5	0	6.36	37	70	43	1.4	0.7	150.33	129.1	129.1	89.67	480.00	336.00	240.00
84	-26.5	0	6.36	37	70	43	1.4	0.7	152.67	129.1	129.1	89.67	484.67	339.27	242.34
85	-27.5	0	6.36	37	70	43	1.4	0.7	155.00	129.1	129.1	89.67	489.34	342.54	244.67
86	-28.5	0	6.36	37	70	43	1.4	0.7	157.33	129.1	129.1	89.67	494.00	345.80	247.00
87	-29.5	0	6.36	37	70	43	1.4	0.7	159.67	129.1	129.1	89.67	498.67	349.07	249.34
88	-30.5	0	6.36	37	70	43	1.4	0.7	162.00	129.1	129.1	89.67	503.34	352.34	251.67
89	-31.5	0	6.36	37	70	43	1.4	0.7	164.33	129.1	129.1	89.67	508.00	355.60	254.00
90	-32.5	0	6.36	37	70	43	1.4	0.7	166.67	129.1	129.1	89.67	512.67	358.87	256.34
91	-33.5	0	6.36	37	70	43	1.4	0.7	169.00	129.1	129.1	89.67	517.34	362.14	258.67
92	-34.5	0	6.36	37	70	43	1.4	0.7	171.33	129.1	129.1	89.67	522.00	365.40	261.00
93	-35.5	0	6.36	37	70	43	1.4	0.7	173.67	129.1	129.1	89.67	526.67	368.67	263.34
94	-36.5	0	6.36	37	70	43	1.4	0.7	176.00	129.1	129.1	89.67	531.34	371.94	265.67
95	-37.5	0	6.36	37	70	43	1.4	0.7	178.33	129.1	129.1	89.67	536.00	375.20	268.00
96	-38.5	0	6.36	37	70	43	1.4	0.7	180.67	129.1	129.1	89.67	540.67	378.47	270.34
97	-39.5	0	6.36	37	70	43	1.4	0.7	183.00	129.1	129.1	89.67	545.34	381.74	272.67
98	-40.5	0	6.36	37	70	43	1.4	0.7	185.33	129.1	129.1	89.67	550.00	385.00	275.00
99	-41.5	0	6.36	37	70	43	1.4	0.7	187.67	129.1	129.1	89.67	554.67	388.27	277.34
100	-42.5	0	6.36	37	70	43	1.4	0.7	190.00	129.1	129.1	89.67	559.34	391.54	279.67
101	-43.5	0	6.36	37	70	43	1.4	0.7	192.33	129.1	129.1	89.67	564.00	394.80	282.00
102	-44.5	0	6.36	37	70	43	1.4	0.7	194.67	129.1	129.1	89.67	568.67	398.07	284.34
103	-45.5	0	6.36	37	70	43	1.4	0.7	197.00	129.1	129.1	89.67	573.34	401.34	286.67

104	-46.5	0	6.36	37	70	43	1.4	0.7	199.33	129.1	129.1	89.67	578.00	404.60	289.00
105	-47.5	0	6.36	37	70	43	1.4	0.7	201.67	129.1	129.1	89.67	582.67	407.87	291.34
106	-48.5	0	6.36	37	70	43	1.4	0.7	204.00	129.1	129.1	89.67	587.34	411.14	293.67
107	-49.5	0	6.36	37	70	43	1.4	0.7	206.33	129.1	129.1	89.67	592.00	414.40	296.00
108	-50.5	0	6.36	37	70	43	1.4	0.7	208.67	129.1	129.1	89.67	596.67	417.67	298.34
109	-51.5	0	6.36	37	70	43	1.4	0.7	211.00	129.1	129.1	89.67	601.34	420.94	300.67
110	-52.5	0	6.36	37	70	43	1.4	0.7	213.33	129.1	129.1	89.67	606.00	424.20	303.00
111	-53.5	0	6.36	37	70	43	1.4	0.7	215.67	129.1	129.1	89.67	610.67	427.47	305.34
112	-54.5	0	6.36	37	70	43	1.4	0.7	218.00	129.1	129.1	89.67	615.34	430.74	307.67
113	-55.5	0	6.36	37	70	43	1.4	0.7	220.33	129.1	129.1	89.67	620.00	434.00	310.00
114	-56.5	0	6.36	37	70	43	1.4	0.7	222.67	129.1	129.1	89.67	624.67	437.27	312.34
115	-57.5	0	6.36	37	70	43	1.4	0.7	225.00	129.1	129.1	89.67	629.34	440.54	314.67
116	-58.5	0	6.36	37	70	43	1.4	0.7	227.33	129.1	129.1	89.67	634.00	443.80	317.00
117	-59.5	0	6.36	37	70	43	1.4	0.7	229.67	129.1	129.1	89.67	638.67	447.07	319.34
118	-60.5	0	6.36	37	70	43	1.4	0.7	232.00	129.1	129.1	89.67	643.34	450.34	321.67
119	-61.5	0	6.36	37	70	43	1.4	0.7	234.33	129.1	129.1	89.67	648.00	453.60	324.00
120	-62.5	0	6.36	37	70	43	1.4	0.7	236.67	129.1	129.1	89.67	652.67	456.87	326.34
121	-63.5	0	6.36	37	70	43	1.4	0.7	239.00	129.1	129.1	89.67	657.34	460.14	328.67
122	-64.5	0	6.36	37	70	43	1.4	0.7	241.33	129.1	129.1	89.67	662.00	463.40	331.00
123	-65.5	0	6.36	37	70	43	1.4	0.7	243.67	129.1	129.1	89.67	666.67	466.67	333.34
124	-66.5	0	6.36	37	70	43	1.4	0.7	246.00	129.1	129.1	89.67	671.34	469.94	335.67
125	-67.5	0	6.36	37	70	43	1.4	0.7	248.33	129.1	129.1	89.67	676.00	473.20	338.00
126	-68.5	0	6.36	37	70	43	1.4	0.7	250.67	129.1	129.1	89.67	680.67	476.47	340.34
127	-69.5	0	6.36	37	70	43	1.4	0.7	253.00	129.1	129.1	89.67	685.34	479.74	342.67
128	-70.5	0	6.36	37	70	43	1.4	0.7	255.33	129.1	129.1	89.67	690.00	483.00	345.00
129	-71.5	0	6.36	37	70	43	1.4	0.7	257.67	129.1	129.1	89.67	694.67	486.27	347.34
130	-72.5	0	6.36	37	70	43	1.4	0.7	260.00	129.1	129.1	89.67	699.34	489.54	349.67
131	-73.5	0	6.36	37	70	43	1.4	0.7	262.33	129.1	129.1	89.67	704.00	492.80	352.00
132	-74.5	0	6.36	37	70	43	1.4	0.7	264.67	129.1	129.1	89.67	708.67	496.07	354.34
133	-75.5	0	6.36	37	70	43	1.4	0.7	267.00	129.1	129.1	89.67	713.34	499.34	356.67
134	-76.5	0	6.36	37	70	43	1.4	0.7	269.33	129.1	129.1	89.67	718.00	502.60	359.00
135	-77.5	0	6.36	37	70	43	1.4	0.7	271.67	129.1	129.1	89.67	722.67	505.87	361.34
136	-78.5	0	6.36	37	70	43	1.4	0.7	274.00	129.1	129.1	89.67	727.34	509.14	363.67
137	-79.5	0	6.36	37	70	43	1.4	0.7	276.33	129.1	129.1	89.67	732.00	512.40	366.00
138	-80.5	0	6.36	37	70	43	1.4	0.7	278.67	129.1	129.1	89.67	736.67	515.67	368.34
139	-81.5	0	6.36	37	70	43	1.4	0.7	281.00	129.1	129.1	89.67	741.34	518.94	370.67
140	-82.5	0	6.36	37	70	43	1.4	0.7	283.33	129.1	129.1	89.67	746.00	522.20	373.00
141	-83.5	0	6.36	37	70	43	1.4	0.7	285.67	129.1	129.1	89.67	750.67	525.47	375.34
142	-84.5	0	6.36	37	70	43	1.4	0.7	288.00	129.1	129.1	89.67	755.34	528.74	377.67
143	-85.5	0	6.36	37	70	43	1.4	0.7	290.33	129.1	129.1	89.67	760.00	532.00	380.00
144	-86.5	0	6.36	37	70	43	1.4	0.7	292.67	129.1	129.1	89.67	764.67	535.27	382.34
145	-87.5	0	6.36	37	70	43	1.4	0.7	295.00	129.1	129.1	89.67	769.34	538.54	384.67
146	-88.5	0	6.36	37	70	43	1.4	0.7	297.33	129.1	129.1	89.67	774.00	541.80	387.00
147	-89.5	0	6.36	37	70	43	1.4	0.7	299.67	129.1	129.1	89.67	778.67	545.07	389.34
148	-90.5	0	6.36	37	70	43	1.4	0.7	302.00	129.1	129.1	89.67	783.34	548.34	391.67
149	-91.5	0	6.36	37	70	43	1.4	0.7	304.33	129.1	129.1	89.67	788.00	551.60	394.00
150	-92.5	0	6.36	37	70	43	1.4	0.7	306.67	129.1	129.1	89.67	792.67	554.87	396.34
151	-93.5	0	6.36	37	70	43	1.4	0.7	309.00	129.1	129.1	89.67	797.34	558.14	398.67
152	-94.5	0	6.36	37	70	43	1.4	0.7	311.33	129.1	129.1	89.67	802.00	561.40	401.00
153	-95.5	0	6.36	37	70	43	1.4	0.7	313.67	129.1	129.1	89.67	806.67	564.67	403.34
154	-96.5	0	6.36	37	70	43	1.4	0.7	316.00	129.1	129.1	89.67	811.34	567.94	405.67
155	-97.5	0	6.36	37	70	43	1.4	0.7	318.33	129.1	129.1	89.67	816.00	571.20	408.00
156	-98.5	0	6.36	37	70	43	1.4	0.7	320.67	129.1	129.1	89.67	820.67	574.47	410.34
157	-99.5	0	6.36	37	70	43	1.4	0.7	323.00	129.1	129.1	89.67	825.34	577.74	412.67
158	-100.5	0	6.36	37	70	43	1.4	0.7	325.33	129.1	129.1	89.67	830.00	581.00	415.00
159	-101.5	0	6.36	37	70	43	1.4	0.7	327.67	129.1	129.1	89.67	834.67	584.27	417.34
160	-102.5	0	6.36	37	70	43	1.4	0.7	330.00	129.1	129.1	89.67	839.34	587.54	419.67
161	-103.5	0	6.36	37	70	43	1.4	0.7	332.33	129.1	129.1	89.67	844.00	590.80	422.00
162	-104.5	0	6.36	37	70	43	1.4	0.7	334.67	129.1	129.1	89.67	848.67	594.07	424.34
163	-105.5	0	6.36	37	70	43	1.4	0.7	337.00	129.1	129.1	89.67	853.34	597.34	426.67
164	-106.5	0	6.36	37	70	43	1.4	0.7	339.33	129.1	129.1	89.67	858.00	600.60	429.00
165	-107.5	0	6.36	37	70	43	1.4	0.7	341.67	129.1	129.1	89.67	862.67	603.87	431.34
166	-108.5	0	6.36	37	70	43	1.4	0.7	344.00	129.1	129.1	89.67	867.34	607.14	433.67
167	-109.5	0	6.36	37	70	43	1.4	0.7	346.33	129.1	129.1	89.67	872.00	610.40	436.00
168	-110.5	0	6.36	37	70	43	1.4	0.7	348.67	129.1	129.1	89.67	876.67	613.67	438.34
169	-111.5	0	6.36	37	70	43	1.4	0.7	351.00	129.1	129.1	89.67	881.34	616.94	440.67
170	-112.5	0	6.36	37	70	43	1.4	0.7	353.33	129.1	129.1	89.67	886.00	620.20	443.00

171	-113.5	0	6.36	37	70	43	1.4	0.7	355.67	129.1	129.1	89.67	890.67	623.47	445.34
172	-114.5	0	6.36	37	70	43	1.4	0.7	358.00	129.1	129.1	89.67	895.34	626.74	447.67
173	-115.5	0	6.36	37	70	43	1.4	0.7	360.33	129.1	129.1	89.67	900.00	630.00	450.00
174	-116.5	0	6.36	37	70	43	1.4	0.7	362.67	129.1	129.1	89.67	904.67	633.27	452.34
175	-117.5	0	6.36	37	70	43	1.4	0.7	365.00	129.1	129.1	89.67	909.34	636.54	454.67
176	-118.5	0	6.36	37	70	43	1.4	0.7	367.33	129.1	129.1	89.67	914.00	639.80	457.00
177	-119.5	0	6.36	37	70	43	1.4	0.7	369.67	129.1	129.1	89.67	918.67	643.07	459.34
178	-120.5	0	6.36	37	70	43	1.4	0.7	372.00	129.1	129.1	89.67	923.34	646.34	461.67
179	-121.5	0	6.36	37	70	43	1.4	0.7	374.33	129.1	129.1	89.67	928.00	649.60	464.00
180	-122.5	0	6.36	37	70	43	1.4	0.7	376.67	129.1	129.1	89.67	932.67	652.87	466.34

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	12
280	12
280	(80)


ABUT 3R
HP 10x57
80
60
40
20
0
-20
-40
-60
-80
Elevation, feet MSL
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
280 kips

SR-163/Friars Rd - Bent 2 Left

CIDH Calculation Based on AASHTO LRFD

Touma & Reese (1974) for qs

Reese & O'Neill (1988) for qp in Tst qpr =4.17qp/Dp 20.9 tsf

Location	Bent 2L		PILE		
Ref Boring	A-12-053/A-B-2		D, diameter	9	ft
Pile Cap El	45.00	ft	At, base area	63.6	sq ft
GW El	25.5	ft	S, surface area	28.3	sq ft/ft
GS El	45	ft			
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120	
Tot Unit Weight 2	120	pcf	Eff Unit W 2	57.6	
Tot Unit Weight 3	125	pcf	Eff Unit W 3	62.6	
Top of Soil 1 El	45	ft			
Top of Soil 2 El	25.5	ft			
Top of Soil 3 El	-4	ft			

Soil Profile, Boring GS El 45 ft

Depth ft	Ele ft	γt pcf	γ't pcf	Design Profile, N	ϕ °
0	45	120	120	12	30
10	35	120	120	12	30
10	35	120	120	70	36
19.5	25.5	120	57.6	70	36
19.5	25.5	125	62.6	100	40
27	18	125	62.6	100	40
27	18	125	62.6	100	45
37	8	125	62.6	100	45
37	8	125	62.6	100	45
98	-53	125	62.6	100	45

Depth below Pile Cap ft	Elev ft	γ' pcf	σ' ksf	ϕ °	Side Resistance K	qs tsf	Qs ton	Tip Resistance k	qp tsf	Qp ton	Resistance (kips) Nominal Resistance	LRFD Factored (ϕ = 0.7)	WSD Factored FS = 2.0
0	45	120	0.00	29	0.7	0.0000	0.00	1.00	16.00	1017.88	2035.75	1425.03	1017.88
1	44	120	0.12	30	0.7	0.0242	0.69	1.00	16.00	1017.88	2037.12	1425.99	1018.56
2	43	120	0.24	30	0.7	0.0485	2.06	5.40	2.96	188.50	381.10	266.77	190.55
3	42	120	0.36	30	0.7	0.0727	4.11	5.40	2.96	188.50	385.22	269.65	192.61
4	41	120	0.48	30	0.7	0.0970	6.86	5.40	2.96	188.50	390.70	273.49	195.35
5	40	120	0.60	30	0.7	0.1212	10.28	5.40	2.96	188.50	397.56	278.29	198.78
6	39	120	0.72	30	0.7	0.1455	14.40	5.40	2.96	188.50	405.79	284.05	202.89
7	38	120	0.84	30	0.7	0.1697	19.20	5.40	2.96	188.50	415.39	290.77	207.69
8	37	120	0.96	30	0.7	0.1940	24.68	5.40	2.96	188.50	426.36	298.45	213.18
9	36	120	1.08	30	0.7	0.2182	30.85	5.40	2.96	188.50	438.70	307.09	219.35
10	35	120	1.20	30	0.7	0.2425	37.71	5.40	2.96	188.50	452.41	316.69	226.20
11	34	120	1.32	36	0.7	0.3357	47.20	5.40	2.96	188.50	471.39	329.97	235.70
12	33	120	1.44	36	0.7	0.3662	57.55	5.40	2.96	188.50	492.10	344.47	246.05
13	32	120	1.56	36	0.7	0.3967	68.77	5.40	2.96	188.50	514.53	360.17	257.26
14	31	120	1.68	36	0.7	0.4272	80.85	5.40	2.96	188.50	538.69	377.08	269.34
15	30	120	1.80	36	0.7	0.4577	93.79	5.40	2.96	188.50	564.57	395.20	282.29
16	29	120	1.92	36	0.7	0.4882	107.59	5.40	2.96	188.50	592.18	414.53	296.09
17	28	120	2.04	36	0.7	0.5188	122.26	5.40	2.96	188.50	621.51	435.06	310.76
18	27	120	2.16	36	0.7	0.5493	137.79	5.40	2.96	188.50	652.58	456.80	326.29
19	26	120	2.28	36	0.7	0.5798	154.18	5.40	2.96	188.50	685.36	479.75	342.68
20	25	57.6	2.34	40	0.7	0.6865	173.60	5.40	7.41	471.24	1289.67	902.77	644.83
21	24	57.6	2.40	40	0.7	0.7034	193.48	5.40	7.41	471.24	1329.45	930.61	664.72
22	23	57.6	2.45	40	0.7	0.7204	213.85	5.40	7.41	471.24	1370.18	959.13	685.09
23	22	57.6	2.51	40	0.7	0.7373	234.70	5.40	7.41	471.24	1411.87	988.31	705.94
24	21	57.6	2.57	40	0.7	0.7542	256.02	5.40	7.41	471.24	1454.52	1018.17	727.26
25	20	57.6	2.63	40	0.7	0.7711	277.82	5.40	7.41	471.24	1498.13	1048.69	749.06
26	19	57.6	2.68	40	0.6	0.6754	296.92	5.40	7.41	471.24	1536.32	1075.43	768.16
27	18	57.6	2.74	40	0.6	0.6899	316.43	5.40	7.41	471.24	1575.34	1102.74	787.67
28	17	57.6	2.80	45	0.6	0.8395	340.17	5.40	7.41	471.24	1622.81	1135.97	811.41
29	16	57.6	2.86	45	0.6	0.8568	364.39	5.40	7.41	471.24	1671.26	1169.88	835.63
30	15	57.6	2.91	45	0.6	0.8741	389.11	5.40	7.41	471.24	1720.69	1204.48	860.34
31	14	57.6	2.97	45	0.6	0.8914	414.31	5.40	7.41	471.24	1771.09	1239.77	885.55
32	13	57.6	3.03	45	0.6	0.9086	440.00	5.40	7.41	471.24	1822.48	1275.73	911.24
33	12	57.6	3.09	45	0.6	0.9259	466.18	5.40	7.41	471.24	1874.84	1312.39	937.42
34	11	57.6	3.14	45	0.6	0.9432	492.85	5.40	7.41	471.24	1928.17	1349.72	964.09
35	10	57.6	3.20	45	0.6	0.9605	520.00	5.40	7.41	471.24	1982.49	1387.74	991.24
36	9	57.6	3.26	45	0.6	0.9778	547.65	5.40	7.41	471.24	2037.78	1426.44	1018.89
37	8	57.6	3.32	45	0.6	0.9950	575.78	5.40	7.41	471.24	2094.05	1465.83	1047.02
38	7	57.6	3.37	45	0.6	1.0123	604.41	5.40	7.41	471.24	2151.29	1505.90	1075.65
39	6	57.6	3.43	45	0.6	1.0296	633.52	5.40	7.41	471.24	2209.51	1546.66	1104.76
40	5	57.6	3.49	45	0.6	1.0469	663.12	5.40	7.41	471.24	2268.71	1588.10	1134.36
41	4	57.6	3.55	45	0.5	0.8868	686.19	5.40	7.41	471.24	2318.86	1623.20	1159.43
42	3	57.6	3.60	45	0.5	0.9012	713.67	5.40	7.41	471.24	2369.82	1658.88	1184.91
43	2	57.6	3.66	45	0.5	0.9156	739.56	5.40	7.41	471.24	2421.60	1695.12	1210.80
44	1	57.6	3.72	45	0.5	0.9300	765.86	5.40	7.41	471.24	2474.19	1731.93	1237.09
45	0	57.6	3.78	45	0.5	0.9444	792.56	5.40	7.41	471.24	2527.59	1769.32	1263.80

46	-1	57.6	3.84	45	0.5	0.9588	819.67	5.40	7.41	471.24	2581.81	1807.27	1290.91
47	-2	57.6	3.89	45	0.5	0.9732	847.18	5.40	7.41	471.24	2636.85	1845.79	1318.42
48	-3	57.6	3.95	45	0.5	0.9876	875.11	5.40	7.41	471.24	2692.69	1884.89	1346.35
49	-4	62.6	4.01	45	0.5	1.0032	903.47	5.40	7.41	471.24	2749.43	1924.60	1374.71
50	**-5**	**62.6**	**4.08**	**45**	**0.5**	**1.0189**	**932.28**	**5.40**	**20.90**	**1329.60**	**4523.77**	**3166.64**	**2261.88**
51	-6	62.6	4.14	45	0.5	1.0345	961.53	5.40	20.90	1329.60	4582.27	3207.59	2291.13
52	-7	62.6	4.20	45	0.5	1.0502	991.23	5.40	20.90	1329.60	4641.66	3249.16	2320.83
53	-8	62.6	4.26	45	0.5	1.0658	1021.36	5.40	20.90	1329.60	4701.93	3291.35	2350.96
54	-9	62.6	4.33	45	0.5	1.0815	1051.94	5.40	20.90	1329.60	4763.09	3334.16	2381.54
55	-10	62.6	4.39	45	0.5	1.0971	1082.96	5.40	20.90	1329.60	4825.13	3377.59	2412.56
56	-11	62.6	4.45	45	0.5	1.1128	1114.43	5.40	20.90	1329.60	4888.06	3421.64	2444.03
57	-12	62.6	4.51	45	0.5	1.1284	1146.33	5.40	20.90	1329.60	4951.87	3466.31	2475.93
58	-13	62.6	4.58	45	0.5	1.1441	1178.68	5.40	20.90	1329.60	5016.57	3511.60	2508.28
59	-14	62.6	4.64	45	0.5	1.1597	1211.47	5.40	20.90	1329.60	5082.15	3557.50	2541.07
60	-15	62.6	4.70	45	0.5	1.1754	1244.71	5.40	20.90	1329.60	5148.62	3604.03	2574.31
61	-16	62.6	4.76	45	0.5	1.1910	1278.38	5.40	20.90	1329.60	5215.97	3651.18	2607.98
62	-17	62.6	4.83	45	0.5	1.2067	1312.50	5.40	20.90	1329.60	5284.20	3698.94	2642.10
63	-18	62.6	4.89	45	0.5	1.2223	1347.06	5.40	20.90	1329.60	5353.33	3747.33	2676.66
64	-19	62.6	4.95	45	0.5	1.2380	1382.07	5.40	20.90	1329.60	5423.33	3796.33	2711.67
65	-20	62.6	5.01	45	0.5	1.2536	1417.51	5.40	20.90	1329.60	5494.23	3845.96	2747.11
66	-21	62.6	5.08	45	0.5	1.2693	1453.40	5.40	20.90	1329.60	5566.00	3896.20	2783.00
67	-22	62.6	5.14	45	0.5	1.2849	1489.73	5.40	20.90	1329.60	5638.67	3947.07	2819.33
68	-23	62.6	5.20	45	0.5	1.3006	1526.51	5.40	20.90	1329.60	5712.21	3998.55	2856.11
69	-24	62.6	5.26	45	0.5	1.3162	1563.72	5.40	20.90	1329.60	5786.65	4050.65	2893.32
70	-25	62.6	5.33	45	0.5	1.3319	1601.38	5.40	20.90	1329.60	5861.96	4103.37	2930.98
71	-26	62.6	5.39	45	0.5	1.3475	1639.49	5.40	20.90	1329.60	5938.16	4156.72	2969.08
72	-27	62.6	5.45	45	0.5	1.3632	1678.03	5.40	20.90	1329.60	6015.25	4210.68	3007.63
73	-28	62.6	5.52	45	0.5	1.3788	1717.01	5.40	20.90	1329.60	6093.22	4265.26	3046.61
74	-29	62.6	5.58	45	0.5	1.3945	1756.44	5.40	20.90	1329.60	6172.08	4320.46	3086.04
75	-30	62.6	5.64	45	0.5	1.4101	1796.31	5.40	20.90	1329.60	6251.82	4376.28	3125.91
76	-31	62.6	5.70	45	0.5	1.4258	1836.62	5.40	20.90	1329.60	6332.45	4432.72	3166.23
77	-32	62.6	5.77	45	0.5	1.4414	1877.38	5.40	20.90	1329.60	6413.96	4489.77	3206.98
78	-33	62.6	5.83	45	0.5	1.4571	1918.58	5.40	20.90	1329.60	6496.36	4547.45	3248.18
79	-34	62.6	5.89	45	0.5	1.4727	1960.22	5.40	20.90	1329.60	6579.64	4605.75	3289.82
80	-35	62.6	5.95	45	0.5	1.4884	2002.30	5.40	20.90	1329.60	6663.81	4664.67	3331.90
81	-36	62.6	6.02	45	0.5	1.5040	2044.83	5.40	20.90	1329.60	6748.86	4724.20	3374.43
82	-37	62.6	6.08	45	0.5	1.5197	2087.80	5.40	20.90	1329.60	6834.80	4784.36	3417.40
83	-38	62.6	6.14	45	0.5	1.5353	2131.21	5.40	20.90	1329.60	6921.62	4845.13	3460.81
84	-39	62.6	6.20	45	0.5	1.5510	2175.06	5.40	20.90	1329.60	7009.33	4906.53	3504.66
85	-40	62.6	6.27	45	0.5	1.5666	2219.36	5.40	20.90	1329.60	7097.92	4968.54	3548.96
86	-41	62.6	6.33	45	0.5	1.5823	2264.10	5.40	20.90	1329.60	7187.40	5031.18	3593.70
87	-42	62.6	6.39	45	0.5	1.5979	2309.28	5.40	20.90	1329.60	7277.78	5094.43	3638.88
88	-43	62.6	6.45	45	0.5	1.6136	2354.90	5.40	20.90	1329.60	7369.00	5158.30	3684.50
89	-44	62.6	6.52	45	0.5	1.6292	2400.97	5.40	20.90	1329.60	7461.14	5222.80	3730.57
90	-45	62.6	6.58	45	0.5	1.6449	2447.48	5.40	20.90	1329.60	7554.15	5287.91	3777.08
91	-46	62.6	6.64	45	0.5	1.6605	2494.43	5.40	20.90	1329.60	7648.06	5353.64	3824.03
92	-47	62.6	6.70	45	0.5	1.6762	2541.82	5.40	20.90	1329.60	7742.84	5419.99	3871.42
93	-48	62.6	6.77	45	0.5	1.6918	2589.66	5.40	20.90	1329.60	7838.51	5486.96	3919.26
94	-49	62.6	6.83	45	0.5	1.7075	2637.93	5.40	20.90	1329.60	7935.07	5554.55	3967.54
95	-50	62.6	6.89	45	0.5	1.7231	2686.66	5.40	20.90	1329.60	8032.51	5622.76	4016.26
96	-51	62.6	6.96	45	0.5	1.7388	2735.82	5.40	20.90	1329.60	8130.84	5691.59	4065.42
97	-52	62.6	7.02	45	0.5	1.7544	2785.42	5.40	20.90	1329.60	8230.05	5761.04	4115.03
98	-53	62.6	7.08	45	0.5	1.7701	2835.47	5.40	20.90	1329.60	8330.15	5831.10	4165.07
99	-54	62.6	7.14	45	0.5	1.7857	2885.96	5.40	20.90	1329.60	8431.13	5901.79	4215.56
100	-55	62.6	7.21	45	0.5	1.8014	2936.90	5.40	20.90	1329.60	8533.00	5973.10	4266.50
101	**-56**	**62.6**	**7.27**	**45**	**0.5**	**1.8170**	**2988.27**	**5.40**	**20.90**	**1329.60**	**8635.75**	**6045.02**	**4317.87**
102	-57	62.6	7.33	45	0.5	1.8327	3040.09	5.40	20.90	1329.60	8739.38	6117.57	4369.69
103	-58	62.6	7.39	45	0.5	1.8483	3092.35	5.40	20.90	1329.60	8843.91	6190.73	4421.95
104	-59	62.6	7.46	45	0.5	1.8640	3145.06	5.40	20.90	1329.60	8949.31	6264.52	4474.66
105	-60	62.6	7.52	45	0.5	1.8796	3198.20	5.40	20.90	1329.60	9055.61	6338.92	4527.80
106	-61	62.6	7.58	45	0.5	1.8953	3251.79	5.40	20.90	1329.60	9162.78	6413.95	4581.39
107	-62	62.6	7.64	45	0.5	1.9109	3305.82	5.40	20.90	1329.60	9270.84	6489.59	4635.42
108	-63	62.6	7.71	45	0.5	1.9266	3360.29	5.40	20.90	1329.60	9379.79	6565.85	4689.90
109	-64	62.6	7.77	45	0.5	1.9422	3415.21	5.40	20.90	1329.60	9489.62	6642.74	4744.81
110	-65	62.6	7.83	45	0.5	1.9579	3470.57	5.40	20.90	1329.60	9600.34	6720.24	4800.17
111	-66	62.6	7.89	45	0.5	1.9735	3526.37	5.40	20.90	1329.60	9711.94	6798.36	4855.97
112	-67	62.6	7.96	45	0.5	1.9892	3582.61	5.40	20.90	1329.60	9824.43	6877.10	4912.21

113	-68	62.6	8.02	45	0.5	2.0048	3639.30	5.40	20.90	1329.60	9937.80	6956.46	4968.90
114	-69	62.6	8.08	45	0.5	2.0205	3696.43	5.40	20.90	1329.60	10052.05	7036.44	5026.03
115	-70	62.6	8.14	45	0.5	2.0361	3754.00	5.40	20.90	1329.60	10167.20	7117.04	5083.60
116	-71	62.6	8.21	45	0.5	2.0518	3812.01	5.40	20.90	1329.60	10283.22	7198.26	5141.61
117	-72	62.6	8.27	45	0.5	2.0674	3870.47	5.40	20.90	1329.60	10400.13	7280.09	5200.07
118	-73	62.6	8.33	45	0.5	2.0831	3929.36	5.40	20.90	1329.60	10517.93	7362.55	5258.97
119	-74	62.6	8.39	45	0.5	2.0987	3988.71	5.40	20.90	1329.60	10636.61	7445.63	5318.31
120	-75	62.6	8.46	45	0.5	2.1144	4048.49	5.40	20.90	1329.60	10756.18	7529.33	5378.09
121	-76	62.6	8.52	45	0.5	2.1300	4108.71	5.40	20.90	1329.60	10876.63	7613.64	5438.32
122	-77	62.6	8.58	45	0.5	2.1457	4169.36	5.40	20.90	1329.60	10997.97	7698.58	5498.98
123	-78	62.6	8.65	45	0.5	2.1613	4230.46	5.40	20.90	1329.60	11120.19	7784.13	5560.09
124	-79	62.6	8.71	45	0.5	2.1770	4292.05	5.40	20.90	1329.60	11243.29	7870.31	5621.65
125	-80	62.6	8.77	45	0.5	2.1926	4354.04	5.40	20.90	1329.60	11367.29	7957.10	5683.64
126	-81	62.6	8.83	45	0.5	2.2083	4416.48	5.40	20.90	1329.60	11492.16	8044.51	5746.08
127	-82	62.6	8.90	45	0.5	2.2239	4479.36	5.40	20.90	1329.60	11617.92	8132.55	5808.96
128	-83	62.6	8.96	45	0.5	2.2396	4542.68	5.40	20.90	1329.60	11744.57	8221.20	5872.29
129	-84	62.6	9.02	45	0.5	2.2552	4606.45	5.40	20.90	1329.60	11872.10	8310.47	5936.05
130	-85	62.6	9.08	45	0.5	2.2709	4670.66	5.40	20.90	1329.60	12000.52	8400.36	6000.26
131	-86	62.6	9.15	45	0.5	2.2865	4735.31	5.40	20.90	1329.60	12129.82	8490.87	6064.91
132	-87	62.6	9.21	45	0.5	2.3022	4800.40	5.40	20.90	1329.60	12260.01	8582.00	6130.00
133	-88	62.6	9.27	45	0.5	2.3178	4865.94	5.40	20.90	1329.60	12391.08	8673.75	6195.54
134	-89	62.6	9.33	45	0.5	2.3335	4931.92	5.40	20.90	1329.60	12523.03	8766.12	6261.52
135	-90	62.6	9.40	45	0.5	2.3491	4998.34	5.40	20.90	1329.60	12655.87	8859.11	6327.94
136	-91	62.6	9.46	45	0.5	2.3648	5065.20	5.40	20.90	1329.60	12789.60	8952.72	6394.80
137	-92	62.6	9.52	45	0.5	2.3804	5132.51	5.40	20.90	1329.60	12924.21	9046.95	6462.11
138	-93	62.6	9.58	45	0.5	2.3961	5200.25	5.40	20.90	1329.60	13059.71	9141.80	6529.85
139	-94	62.6	9.65	45	0.5	2.4117	5268.44	5.40	20.90	1329.60	13196.09	9237.26	6598.04
140	-95	62.6	9.71	45	0.5	2.4274	5337.08	5.40	20.90	1329.60	13333.36	9333.35	6666.68

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0 (42)
7270 (42)
7270 (90)

Depth below Pile Cap	Elev	Side Resistance before Adjustment Qs		Adjusted, kips For Liq. ?? ??? kips	For Liq & Downdrag 2/3 of ???
ft	ft	ton	kips		
0	45	0	0		
1	44	1	1		
2	43	2	4		
3	42	4	8		
4	41	7	14		
5	40	10	21		
6	39	14	29		
7	38	19	38		
8	37	25	49		
9	36	31	62		
10	35	38	75		
11	34	47	94		
12	33	58	115		
13	32	69	138		
14	31	81	162		
15	30	94	188		
16	29	108	215		
17	28	122	245		
18	27	138	276		
19	26	154	308		
20	25	174	347		
21	24	193	387		
22	23	214	428		
23	22	235	469		

Tip Resistance before Adjustment Qp		Adjusted kips 100% Reduction
ton	kips	
1018	2036	**2036**
1018	2036	**2036**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
188	377	**377**
471	942	**942**
471	942	**942**
471	942	**942**
471	942	**942**

Resistance (kips)		
Nominal Resistance	LRFD Factored (ϕ = 0.7)	WSD Factored FS = 2.0
2035.75	1425.03	1017.88
2037.12	1425.99	1018.56
381.10	266.77	190.55
385.22	269.65	192.61
390.70	273.49	195.35
397.56	278.29	198.78
405.79	284.05	202.89
415.39	290.77	207.69
426.36	298.45	213.18
438.70	307.09	219.35
452.41	316.69	226.20
471.39	329.97	235.70
492.10	344.47	246.05
514.53	360.17	257.26
538.69	377.08	269.34
564.57	395.20	282.29
592.18	414.53	296.09
621.51	435.06	310.76
652.58	456.80	326.29
685.36	479.75	342.68
1289.67	902.77	644.83
1329.45	930.61	664.72
1370.18	959.13	685.09
1411.87	988.31	705.94

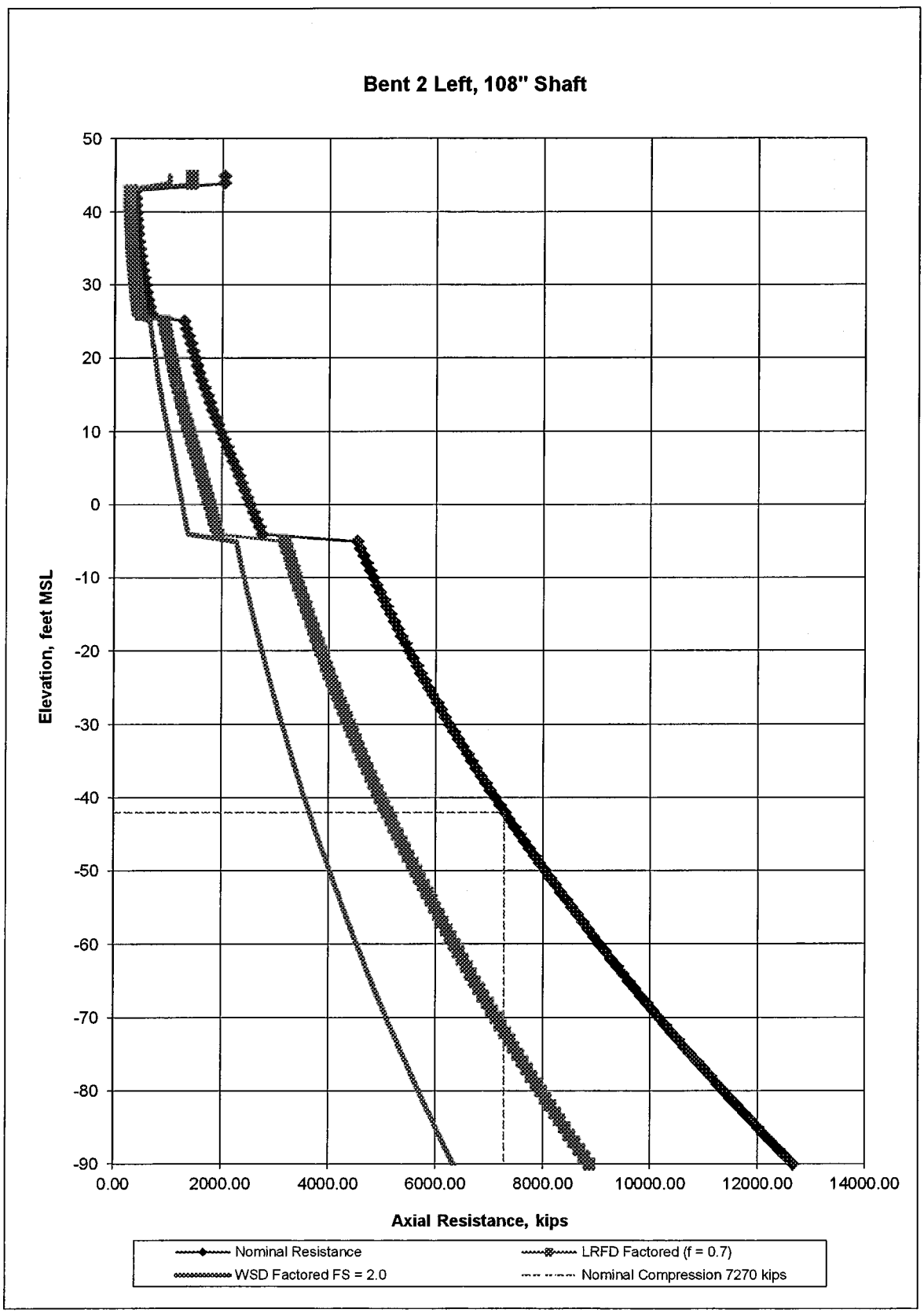
24	21	256	512			471	942	**942**	1454.52	1018.17	727.26
25	20	278	556			471	942	**942**	1498.13	1048.69	749.06
26	19	297	594			471	942	**942**	1536.32	1075.43	768.16
27	18	316	633			471	942	**942**	1575.34	1102.74	787.67
28	17	340	680			471	942	**942**	1622.81	1135.97	811.41
29	16	364	729			471	942	**942**	1671.26	1169.88	835.63
30	15	389	778			471	942	**942**	1720.69	1204.48	860.34
31	14	414	829			471	942	**942**	1771.09	1239.77	885.55
32	13	440	880			471	942	**942**	1822.48	1275.73	911.24
33	12	466	932			471	942	**942**	1874.84	1312.39	937.42
34	11	493	986			471	942	**942**	1928.17	1349.72	964.09
35	10	520	1040			471	942	**942**	1982.49	1387.74	991.24
36	9	548	1095			471	942	**942**	2037.78	1426.44	1018.89
37	8	576	1152			471	942	**942**	2094.05	1465.83	1047.02
38	7	604	1209			471	942	**942**	2151.29	1505.90	1075.65
39	6	634	1267			471	942	**942**	2209.51	1546.66	1104.76
40	5	663	1326			471	942	**942**	2268.71	1588.10	1134.36
41	4	688	1376			471	942	**942**	2318.86	1623.20	1159.43
42	3	714	1427			471	942	**942**	2369.82	1658.88	1184.91
43	2	740	1479			471	942	**942**	2421.60	1695.12	1210.80
44	1	766	1532			471	942	**942**	2474.19	1731.93	1237.09
45	0	793	1585			471	942	**942**	2527.59	1769.32	1263.80
46	-1	820	1639			471	942	**942**	2581.81	1807.27	1290.91
47	-2	847	1694			471	942	**942**	2636.85	1845.79	1318.42
48	-3	875	1750			471	942	**942**	2692.69	1884.89	1346.35
49	-4	903	1807			471	942	**942**	2749.43	1924.60	1374.71
50	-5	932	1865			1330	2659	**2659**	4523.77	3166.64	2261.88
51	-6	962	1923			1330	2659	**2659**	4582.27	3207.59	2291.13
52	-7	991	1982			1330	2659	**2659**	4641.66	3249.16	2320.83
53	-8	1021	2043			1330	2659	**2659**	4701.93	3291.35	2350.96
54	-9	1052	2104			1330	2659	**2659**	4763.09	3334.16	2381.54
55	-10	1083	2166			1330	2659	**2659**	4825.13	3377.59	2412.56
56	-11	1114	2229			1330	2659	**2659**	4888.06	3421.64	2444.03
57	-12	1146	2293			1330	2659	**2659**	4951.87	3466.31	2475.93
58	-13	1179	2357			1330	2659	**2659**	5016.57	3511.60	2508.28
59	-14	1211	2423			1330	2659	**2659**	5082.15	3557.50	2541.07
60	-15	1245	2489			1330	2659	**2659**	5148.62	3604.03	2574.31
61	-16	1278	2557			1330	2659	**2659**	5215.97	3651.18	2607.98
62	-17	1313	2625			1330	2659	**2659**	5284.20	3698.94	2642.10
63	-18	1347	2694			1330	2659	**2659**	5353.33	3747.33	2676.66
64	-19	1382	2764			1330	2659	**2659**	5423.33	3796.33	2711.67
65	-20	1418	2835			1330	2659	**2659**	5494.23	3845.96	2747.11
66	-21	1453	2907			1330	2659	**2659**	5566.00	3896.20	2783.00
67	-22	1490	2979			1330	2659	**2659**	5638.67	3947.07	2819.33
68	-23	1527	3053			1330	2659	**2659**	5712.21	3998.55	2856.11
69	-24	1564	3127			1330	2659	**2659**	5786.65	4050.65	2893.32
70	-25	1601	3203			1330	2659	**2659**	5861.96	4103.37	2930.98
71	-26	1639	3279			1330	2659	**2659**	5938.16	4156.72	2969.08
72	-27	1678	3356			1330	2659	**2659**	6015.25	4210.68	3007.63
73	-28	1717	3434			1330	2659	**2659**	6093.22	4265.26	3046.61
74	-29	1756	3513			1330	2659	**2659**	6172.08	4320.46	3086.04
75	-30	1796	3593			1330	2659	**2659**	6251.82	4376.28	3125.91
76	-31	1837	3673			1330	2659	**2659**	6332.45	4432.72	3166.23
77	-32	1877	3755			1330	2659	**2659**	6413.96	4489.77	3206.98
78	-33	1919	3837			1330	2659	**2659**	6496.36	4547.45	3248.18
79	-34	1960	3920			1330	2659	**2659**	6579.64	4605.75	3289.82
80	-35	2002	4005			1330	2659	**2659**	6663.81	4664.67	3331.90
81	-36	2045	4090			1330	2659	**2659**	6748.86	4724.20	3374.43

82	-37	2088	4176			1330	2659	**2659**	6834.80	4784.36	3417.40
83	-38	2131	4262			1330	2659	**2659**	6921.62	4845.13	3460.81
84	-39	2175	4350			1330	2659	**2659**	7009.33	4906.53	3504.66
85	-40	2219	4439			1330	2659	**2659**	7097.92	4968.54	3548.96
86	-41	2264	4528			1330	2659	**2659**	7187.40	5031.18	3593.70
87	-42	2309	4619			1330	2659	**2659**	7277.76	5094.43	3638.88
88	-43	2355	4710			1330	2659	**2659**	7369.00	5158.30	3684.50
89	-44	2401	4802			1330	2659	**2659**	7461.14	5222.80	3730.57
90	-45	2447	4895			1330	2659	**2659**	7554.15	5287.91	3777.08
91	-46	2494	4989			1330	2659	**2659**	7648.06	5353.64	3824.03
92	-47	2542	5084			1330	2659	**2659**	7742.84	5419.99	3871.42
93	-48	2590	5179			1330	2659	**2659**	7838.51	5486.96	3919.26
94	-49	2638	5276			1330	2659	**2659**	7935.07	5554.55	3967.54
95	-50	2687	5373			1330	2659	**2659**	8032.51	5622.76	4016.26
96	-51	2736	5472			1330	2659	**2659**	8130.84	5691.59	4065.42
97	-52	2785	5571			1330	2659	**2659**	8230.05	5761.04	4115.03
98	-53	2835	5671			1330	2659	**2659**	8330.15	5831.10	4165.07
99	-54	2886	5772			1330	2659	**2659**	8431.13	5901.79	4215.56
100	-55	2937	5874			1330	2659	**2659**	8533.00	5973.10	4266.50
101	-56	2988	5977			1330	2659	**2659**	8635.75	6045.02	4317.87
102	-57	3040	6080			1330	2659	**2659**	8739.38	6117.57	4369.69
103	-58	3092	6185			1330	2659	**2659**	8843.91	6190.73	4421.95
104	-59	3145	6290			1330	2659	**2659**	8949.31	6264.52	4474.66
105	-60	3198	6396			1330	2659	**2659**	9055.61	6338.92	4527.80
106	-61	3252	6504			1330	2659	**2659**	9162.78	6413.95	4581.39
107	-62	3306	6612			1330	2659	**2659**	9270.84	6489.59	4635.42
108	-63	3360	6721			1330	2659	**2659**	9379.79	6565.85	4689.90
109	-64	3415	6830			1330	2659	**2659**	9489.62	6642.74	4744.81
110	-65	3471	6941			1330	2659	**2659**	9600.34	6720.24	4800.17
111	-66	3526	7053			1330	2659	**2659**	9711.94	6798.36	4855.97
112	-67	3583	7165			1330	2659	**2659**	9824.43	6877.10	4912.21
113	-68	3639	7279			1330	2659	**2659**	9937.80	6956.46	4968.90
114	-69	3696	7393			1330	2659	**2659**	10052.05	7036.44	5026.03
115	-70	3754	7508			1330	2659	**2659**	10167.20	7117.04	5083.60
116	-71	3812	7624			1330	2659	**2659**	10283.22	7198.26	5141.61
117	-72	3870	7741			1330	2659	**2659**	10400.13	7280.09	5200.07
118	-73	3929	7859			1330	2659	**2659**	10517.93	7362.55	5258.97
119	-74	3989	7977			1330	2659	**2659**	10636.61	7445.63	5318.31
120	-75	4048	8097			1330	2659	**2659**	10756.18	7529.33	5378.09
121	-76	4109	8217			1330	2659	**2659**	10876.63	7613.64	5438.32
122	-77	4169	8339			1330	2659	**2659**	10997.97	7698.58	5498.98
123	-78	4230	8461			1330	2659	**2659**	11120.19	7784.13	5560.09
124	-79	4292	8584			1330	2659	**2659**	11243.29	7870.31	5621.65
125	-80	4354	8708			1330	2659	**2659**	11367.29	7957.10	5683.64
126	-81	4416	8833			1330	2659	**2659**	11492.16	8044.51	5746.08
127	-82	4479	8959			1330	2659	**2659**	11617.92	8132.55	5808.96
128	-83	4543	9085			1330	2659	**2659**	11744.57	8221.20	5872.29
129	-84	4606	9213			1330	2659	**2659**	11872.10	8310.47	5936.05
130	-85	4671	9341			1330	2659	**2659**	12000.52	8400.36	6000.26
131	-86	4735	9471			1330	2659	**2659**	12129.82	8490.87	6064.91
132	-87	4800	9601			1330	2659	**2659**	12260.01	8582.00	6130.00
133	-88	4866	9732			1330	2659	**2659**	12391.08	8673.75	6195.54
134	-89	4932	9864			1330	2659	**2659**	12523.03	8766.12	6261.52
135	-90	4998	9997			1330	2659	**2659**	12655.87	8859.11	6327.94
136	-91	5065	10130			1330	2659	**2659**	12789.60	8952.72	6394.80
137	-92	5133	10265			1330	2659	**2659**	12924.21	9046.95	6462.11
138	-93	5200	10401			1330	2659	**2659**	13059.71	9141.80	6529.85
139	-94	5268	10537			1330	2659	**2659**	13196.09	9237.26	6598.04

140	-95	5337	10674			1430	2659	2659	13333.36	9333.35	6666.68

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	(42)
7270	(42)
7270	(90)


Bent 2 Left, 108" Shaft
Elevation, feet MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
Nominal Compression 7270 kips

SR-163/Friars Rd - Bent 2 Right

CIDH Calculation Based on AASHTO LRFD

Touma & Reese (1974) for qs

Reese & O'Neill (1988) for qp in Tst qpr =4.17qp/Dp 20.9 tsf

Location	Bent 2R		PILE		
Ref Boring	A-12-053/B2/B6		D, diameter	9	ft
Pile Cap El	41.00	ft	At, base area	63.6	sq ft
GW El	25.5	ft	S, surface area	28.3	sq ft/ft
GS El	41	ft			
Tot Unit Weight 1	120	pcf	Eff Unit W 1	120	
Tot Unit Weight 2	120	pcf	Eff Unit W 2	57.6	
Tot Unit Weight 3	125	pcf	Eff Unit W 3	62.6	
Top of Soil 1 El	41	ft			
Top of Soil 2 El	25.5	ft			
Top of Soil 3 El	-4	ft			

Soil Profile, Boring GS El 41 ft

Depth ft	Ele ft	γt pcf	γ't pcf	Design Profile, N	ϕ °
0	41	120	120	40	33
15.5	25.5	120	57.6	40	33
15.5	25.5	120	57.6	100	36
45	-4	120	57.6	100	36
45	-4	125	62.6	100	40
55	-14	125	62.6	100	40
55	-14	125	62.6	100	45
68	-27	125	62.6	100	45
68	-27	125	62.6	100	45
98	-57	125	62.6	100	45

Depth below Pile Cap ft	Elev ft	γ' pcf	σ' ksf	ϕ °	Side Resistance K	Side Resistance qs tsf	Side Resistance Qs ton	Tip Resistance k	Tip Resistance qp tsf	Tip Resistance Qp ton	Resistance (kips) Nominal Resistance	Resistance (kips) LRFD Factored (ϕ = 0.7)	Resistance (kips) WSD Factored FS = 2.0
0	41	120	0.00	29	0.7	0.0000	0.00	1.00	16.00	1017.88	2035.75	1425.03	1017.88
1	40	120	0.12	33	0.7	0.0273	0.77	1.00	16.00	1017.88	2037.29	1426.11	1018.65
2	39	120	0.24	33	0.7	0.0546	2.31	5.40	2.96	188.50	381.62	267.13	190.81
3	38	120	0.36	33	0.7	0.0818	4.63	5.40	2.96	188.50	386.25	270.37	193.12
4	37	120	0.48	33	0.7	0.1091	7.71	5.40	2.96	188.50	392.41	274.69	196.21
5	36	120	0.60	33	0.7	0.1364	11.57	5.40	2.96	188.50	400.13	280.09	200.06
6	35	120	0.72	33	0.7	0.1637	16.19	5.40	2.96	188.50	409.38	286.57	204.69
7	34	120	0.84	33	0.7	0.1909	21.59	5.40	2.96	188.50	420.18	294.12	210.09
8	33	120	0.96	33	0.7	0.2182	27.76	5.40	2.96	188.50	432.52	302.76	216.26
9	32	120	1.08	33	0.7	0.2455	34.70	5.40	2.96	188.50	446.40	312.48	223.20
10	31	120	1.20	33	0.7	0.2728	42.42	5.40	2.96	188.50	461.82	323.28	230.91
11	30	120	1.32	33	0.7	0.3000	50.90	5.40	2.96	188.50	478.79	335.15	239.39
12	29	120	1.44	33	0.7	0.3273	60.15	5.40	2.96	188.50	497.30	348.11	248.65
13	28	120	1.56	33	0.7	0.3546	70.18	5.40	2.96	188.50	517.35	362.14	258.67
14	27	120	1.68	33	0.7	0.3819	80.97	5.40	2.96	188.50	538.94	377.26	269.47
15	26	120	1.80	33	0.7	0.4091	92.54	5.40	2.96	188.50	562.08	393.45	281.04
16	25	57.6	1.86	36	0.7	0.4724	105.90	5.40	2.96	188.50	588.79	412.15	294.39
17	24	57.6	1.92	36	0.7	0.4870	119.67	5.40	2.96	188.50	616.33	431.43	308.16
18	23	57.6	1.97	36	0.7	0.5017	133.85	5.40	2.96	188.50	644.70	451.29	322.35
19	22	57.6	2.03	36	0.7	0.5163	148.45	5.40	2.96	188.50	673.89	471.72	336.95
20	21	57.6	2.09	36	0.7	0.5310	163.48	5.40	2.96	188.50	703.92	492.74	351.96
21	20	57.6	2.15	36	0.7	0.5456	178.89	5.40	2.96	188.50	734.77	514.34	367.39
22	19	57.6	2.20	36	0.7	0.5603	194.73	5.40	2.96	188.50	766.45	536.52	383.23
23	18	57.6	2.26	36	0.7	0.5749	210.99	5.40	2.96	188.50	798.96	559.27	399.48
24	17	57.6	2.32	36	0.7	0.5895	227.65	5.40	2.96	188.50	832.30	582.61	416.15
25	16	57.6	2.38	36	0.7	0.6042	244.74	5.40	2.96	188.50	866.47	606.53	433.23
26	15	57.6	2.43	36	0.6	0.5304	259.74	5.40	2.96	188.50	896.46	627.52	448.23
27	14	57.6	2.49	36	0.6	0.5430	275.09	5.40	2.96	188.50	927.17	649.02	463.58
28	13	57.6	2.55	36	0.6	0.5555	290.80	5.40	2.96	188.50	958.58	671.01	479.29
29	12	57.6	2.61	36	0.6	0.5681	306.86	5.40	2.96	188.50	990.71	693.50	495.35
30	11	57.6	2.66	36	0.6	0.5807	323.28	5.40	2.96	188.50	1023.54	716.48	511.77
31	10	57.6	2.72	36	0.6	0.5932	340.05	5.40	2.96	188.50	1057.09	739.96	528.54
32	9	57.6	2.78	36	0.6	0.6058	357.18	5.40	2.96	188.50	1091.34	763.94	545.67
33	8	57.6	2.84	36	0.6	0.6183	374.66	5.40	2.96	188.50	1126.31	788.42	563.15
34	7	57.6	2.89	36	0.6	0.6309	392.50	5.40	2.96	188.50	1161.98	813.39	580.99
35	6	57.6	2.95	36	0.6	0.6434	410.69	5.40	2.96	188.50	1198.37	838.86	599.18
36	5	57.6	3.01	36	0.6	0.6560	429.24	5.40	2.96	188.50	1235.46	864.82	617.73
37	4	57.6	3.07	36	0.6	0.6685	448.14	5.40	2.96	188.50	1273.27	891.29	636.63
38	3	57.6	3.12	36	0.6	0.6811	467.40	5.40	2.96	188.50	1311.78	918.25	655.89
39	2	57.6	3.18	36	0.6	0.6936	487.01	5.40	2.96	188.50	1351.01	945.70	675.50
40	1	57.6	3.24	36	0.6	0.7062	506.98	5.40	2.96	188.50	1390.94	973.66	695.47
41	0	57.6	3.30	36	0.5	0.5990	523.91	5.40	2.96	188.50	1424.81	997.37	712.41
42	-1	57.6	3.36	36	0.5	0.6094	541.14	5.40	2.96	188.50	1459.27	1021.49	729.64
43	-2	57.6	3.41	36	0.5	0.6199	558.67	5.40	2.96	188.50	1494.33	1046.03	747.16
44	-3	57.6	3.47	36	0.5	0.6303	576.49	5.40	2.96	188.50	1529.97	1070.98	764.99
45	-4	62.6	3.53	36	0.5	0.6417	594.64	5.40	2.96	188.50	1566.26	1096.38	783.13

46	-5	62.6	3.60	40	0.5	0.7543	513.96	5.40	20.90	1329.60	3891.12	2723.79	1945.56
47	-6	62.6	3.66	40	0.5	0.7674	637.66	5.40	20.90	1329.60	3934.52	2754.16	1967.26
48	-7	62.6	3.72	40	0.5	0.7805	659.73	5.40	20.90	1329.60	3978.66	2785.06	1989.33
49	-8	62.6	3.78	40	0.5	0.7937	682.17	5.40	20.90	1329.60	4023.54	2816.48	2011.77
50	-9	62.6	3.85	40	0.5	0.8068	704.96	5.40	20.90	1329.60	4069.16	2848.41	2034.58
51	-10	62.6	3.91	40	0.5	0.8199	728.16	5.40	20.90	1329.60	4115.53	2880.87	2057.78
52	-11	62.6	3.97	40	0.5	0.8331	751.72	5.40	20.90	1329.60	4162.64	2913.84	2081.32
53	-12	62.6	4.03	40	0.5	0.8462	775.64	5.40	20.90	1329.60	4210.49	2947.34	2105.24
54	-13	62.6	4.10	40	0.5	0.8593	799.94	5.40	20.90	1329.60	4259.08	2981.36	2129.54
55	-14	62.6	4.16	40	0.5	0.8725	824.61	5.40	20.90	1329.60	4308.42	3015.89	2154.21
56	-15	62.6	4.22	45	0.5	1.0554	854.45	5.40	20.90	1329.60	4368.10	3057.67	2184.05
57	-16	62.6	4.28	45	0.5	1.0710	884.73	5.40	20.90	1329.60	4428.66	3100.06	2214.33
58	-17	62.6	4.35	45	0.5	1.0867	915.46	5.40	20.90	1329.60	4490.11	3143.08	2245.06
59	-18	62.6	4.41	45	0.5	1.1023	946.63	5.40	20.90	1329.60	4552.45	3186.72	2276.23
60	-19	62.6	4.47	45	0.5	1.1180	978.24	5.40	20.90	1329.60	4615.67	3230.97	2307.84
61	-20	62.6	4.53	45	0.5	1.1336	1010.29	5.40	20.90	1329.60	4679.78	3275.85	2339.89
62	-21	62.6	4.60	45	0.5	1.1493	1042.78	5.40	20.90	1329.60	4744.77	3321.34	2372.39
63	-22	62.6	4.66	45	0.5	1.1649	1075.72	5.40	20.90	1329.60	4810.65	3367.45	2405.32
64	-23	62.6	4.72	45	0.5	1.1806	1109.10	5.40	20.90	1329.60	4877.41	3414.19	2438.70
65	-24	62.6	4.79	45	0.5	1.1962	1142.93	5.40	20.90	1329.60	4945.05	3461.54	2472.53
66	-25	62.6	4.85	45	0.5	1.2119	1177.19	5.40	20.90	1329.60	5013.59	3509.51	2506.79
67	-26	62.6	4.91	45	0.5	1.2275	1211.90	5.40	20.90	1329.60	5083.00	3558.10	2541.50
68	-27	62.6	4.97	45	0.5	1.2432	1247.05	5.40	20.90	1329.60	5153.30	3607.31	2576.65
69	-28	62.6	5.04	45	0.5	1.2588	1282.64	5.40	20.90	1329.60	5224.49	3657.14	2612.24
70	-29	62.6	5.10	45	0.5	1.2745	1318.68	5.40	20.90	1329.60	5296.56	3707.59	2648.28
71	-30	62.6	5.16	45	0.5	1.2901	1355.16	5.40	20.90	1329.60	5369.52	3758.66	2684.76
72	**-31**	**62.6**	**5.22**	**45**	**0.5**	**1.3058**	**1392.08**	**5.40**	**20.90**	**1329.60**	**5443.36**	**3810.35**	**2721.68**
73	-32	62.6	5.29	45	0.5	1.3214	1429.44	5.40	20.90	1329.60	5518.08	3862.66	2759.04
74	-33	62.6	5.35	45	0.5	1.3371	1467.25	5.40	20.90	1329.60	5593.70	3915.59	2796.85
75	-34	62.6	5.41	45	0.5	1.3527	1505.50	5.40	20.90	1329.60	5670.19	3969.13	2835.10
76	-35	62.6	5.47	45	0.5	1.3684	1544.19	5.40	20.90	1329.60	5747.57	4023.30	2873.79
77	-36	62.6	5.54	45	0.5	1.3840	1583.32	5.40	20.90	1329.60	5825.84	4078.09	2912.92
78	-37	62.6	5.60	45	0.5	1.3997	1622.89	5.40	20.90	1329.60	5904.99	4133.49	2952.50
79	-38	62.6	5.66	45	0.5	1.4153	1662.91	5.40	20.90	1329.60	5985.03	4189.52	2992.51
80	-39	62.6	5.72	45	0.5	1.4310	1703.37	5.40	20.90	1329.60	6065.95	4246.16	3032.97
81	-40	62.6	5.79	45	0.5	1.4466	1744.28	5.40	20.90	1329.60	6147.75	4303.43	3073.88
82	-41	62.6	5.85	45	0.5	1.4623	1785.62	5.40	20.90	1329.60	6230.45	4361.31	3115.22
83	-42	62.6	5.91	45	0.5	1.4779	1827.41	5.40	20.90	1329.60	6314.02	4419.82	3157.01
84	-43	62.6	5.97	45	0.5	1.4936	1869.64	5.40	20.90	1329.60	6398.48	4478.94	3199.24
85	-44	62.6	6.04	45	0.5	1.5092	1912.31	5.40	20.90	1329.60	6483.83	4538.68	3241.91
86	-45	62.6	6.10	45	0.5	1.5249	1955.43	5.40	20.90	1329.60	6570.06	4599.04	3285.03
87	-46	62.6	6.16	45	0.5	1.5405	1998.99	5.40	20.90	1329.60	6657.18	4660.02	3328.59
88	-47	62.6	6.22	45	0.5	1.5562	2042.99	5.40	20.90	1329.60	6745.18	4721.62	3372.59
89	-48	62.6	6.29	45	0.5	1.5718	2087.43	5.40	20.90	1329.60	6834.06	4783.84	3417.03
90	-49	62.6	6.35	45	0.5	1.5875	2132.32	5.40	20.90	1329.60	6923.83	4846.68	3461.92
91	-50	62.6	6.41	45	0.5	1.6031	2177.64	5.40	20.90	1329.60	7014.49	4910.14	3507.24
92	-51	62.6	6.48	45	0.5	1.6188	2223.41	5.40	20.90	1329.60	7106.03	4974.22	3553.02
93	-52	62.6	6.54	45	0.5	1.6344	2269.63	5.40	20.90	1329.60	7198.46	5038.92	3599.23
94	-53	62.6	6.60	45	0.5	1.6501	2316.28	5.40	20.90	1329.60	7291.77	5104.24	3645.88
95	-54	62.6	6.66	45	0.5	1.6657	2363.38	5.40	20.90	1329.60	7385.98	5170.17	3692.98
96	-55	62.6	6.73	45	0.5	1.6814	2410.92	5.40	20.90	1329.60	7481.04	5236.73	3740.52
97	-56	62.6	6.79	45	0.5	1.6970	2458.90	5.40	20.90	1329.60	7577.01	5303.91	3788.51
98	-57	62.6	6.85	45	0.5	1.7127	2507.33	5.40	20.90	1329.60	7673.86	5371.70	3836.93
99	-58	62.6	6.91	45	0.5	1.7283	2556.20	5.40	20.90	1329.60	7771.60	5440.12	3885.80
100	-59	62.6	6.98	45	0.5	1.7440	2605.51	5.40	20.90	1329.60	7870.22	5509.15	3935.11
101	-60	62.6	7.04	45	0.5	1.7596	2655.26	5.40	20.90	1329.60	7969.72	5578.81	3984.86
102	-61	62.6	7.10	45	0.5	1.7753	2705.46	5.40	20.90	1329.60	8070.11	5649.08	4035.06
103	-62	62.6	7.16	45	0.5	1.7909	2756.09	5.40	20.90	1329.60	8171.39	5719.97	4085.70
104	-63	62.6	7.23	45	0.5	1.8066	2807.16	5.40	20.90	1329.60	8273.55	5791.49	4136.78
105	-64	62.6	7.29	45	0.5	1.8222	2858.70	5.40	20.90	1329.60	8376.60	5863.62	4188.30
106	-65	62.6	7.35	45	0.5	1.8379	2910.66	5.40	20.90	1329.60	8480.53	5936.37	4240.26
107	-66	62.6	7.41	45	0.5	1.8535	2963.07	5.40	20.90	1329.60	8585.34	6009.74	4292.67
108	-67	62.6	7.48	45	0.5	1.8692	3015.92	5.40	20.90	1329.60	8691.04	6083.73	4345.52
109	-68	62.6	7.54	45	0.5	1.8848	3069.21	5.40	20.90	1329.60	8797.63	6158.34	4398.82
110	-69	62.6	7.60	45	0.5	1.9005	3122.95	5.40	20.90	1329.60	8905.10	6233.57	4452.55
111	-70	62.6	7.66	45	0.5	1.9161	3177.13	5.40	20.90	1329.60	9013.46	6309.42	4506.73
112	-71	62.6	7.73	45	0.5	1.9318	3231.75	5.40	20.90	1329.60	9122.70	6385.89	4561.35

113	-72	62.6	7.79	45	0.5	1.9474	3286.81	5.40	20.90	1329.60	9232.82	6462.98	4616.41
114	-73	62.6	7.85	45	0.5	1.9631	3342.32	5.40	20.90	1329.60	9343.83	6540.68	4671.92
115	-74	62.6	7.91	45	0.5	1.9787	3398.26	5.40	20.90	1329.60	9455.73	6619.01	4727.86
116	-75	62.6	7.98	45	0.5	1.9944	3454.65	5.40	20.90	1329.60	9568.51	6697.96	4784.26
117	-76	62.6	8.04	45	0.5	2.0100	3511.49	5.40	20.90	1329.60	9682.18	6777.52	4841.09
118	-77	62.6	8.10	45	0.5	2.0257	3568.76	5.40	20.90	1329.60	9796.73	6857.71	4898.36
119	-78	62.6	8.17	45	0.5	2.0413	3626.48	5.40	20.90	1329.60	9912.16	6938.51	4956.08
120	-79	62.6	8.23	45	0.5	2.0570	3684.64	5.40	20.90	1329.60	10028.48	7019.94	5014.24
121	-80	62.6	8.29	45	0.5	2.0726	3743.24	5.40	20.90	1329.60	10145.69	7101.98	5072.84
122	-81	62.6	8.35	45	0.5	2.0883	3802.29	5.40	20.90	1329.60	10263.78	7184.65	5131.89
123	-82	62.6	8.42	45	0.5	2.1039	3861.78	5.40	20.90	1329.60	10382.75	7267.93	5191.38
124	-83	62.6	8.48	45	0.5	2.1196	3921.71	5.40	20.90	1329.60	10502.62	7351.83	5251.31
125	-84	62.6	8.54	45	0.5	2.1352	3982.08	5.40	20.90	1329.60	10623.36	7436.35	5311.68
126	-85	62.6	8.60	45	0.5	2.1509	4042.90	5.40	20.90	1329.60	10744.99	7521.49	5372.50
127	-86	62.6	8.67	45	0.5	2.1665	4104.15	5.40	20.90	1329.60	10867.51	7607.25	5433.75
128	-87	62.6	8.73	45	0.5	2.1822	4165.85	5.40	20.90	1329.60	10990.91	7693.64	5495.45
129	-88	62.6	8.79	45	0.5	2.1978	4228.00	5.40	20.90	1329.60	11115.19	7780.63	5557.60
130	-89	62.6	8.85	45	0.5	2.2135	4290.58	5.40	20.90	1329.60	11240.36	7868.25	5620.18
131	-90	62.6	8.92	45	0.5	2.2291	4353.61	5.40	20.90	1329.60	11366.42	7956.49	5683.21
132	-91	62.6	8.98	45	0.5	2.2448	4417.08	5.40	20.90	1329.60	11493.36	8045.35	5746.68
133	-92	62.6	9.04	45	0.5	2.2604	4480.99	5.40	20.90	1329.60	11621.18	8134.83	5810.59
134	-93	62.6	9.10	45	0.5	2.2761	4545.35	5.40	20.90	1329.60	11749.89	8224.93	5874.95
135	-94	62.6	9.17	45	0.5	2.2917	4610.14	5.40	20.90	1329.60	11879.49	8315.64	5939.75
136	-95	62.6	9.23	45	0.5	2.3074	4675.38	5.40	20.90	1329.60	12009.97	8406.98	6004.99
137	-96	62.6	9.29	45	0.5	2.3230	4741.07	5.40	20.90	1329.60	12141.34	8498.94	6070.67
138	-97	62.6	9.35	45	0.5	2.3387	4807.19	5.40	20.90	1329.60	12273.59	8591.51	6136.79
139	-98	62.6	9.42	45	0.5	2.3543	4873.76	5.40	20.90	1329.60	12406.72	8684.71	6203.36
140	-99	62.6	9.48	45	0.5	2.3700	4940.77	5.40	20.90	1329.60	12540.74	8778.52	6270.37

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0 (10)
4110 (10)
4110 (70)

Depth below Pile Cap	Elev	Side Resistance before Adjustment Qs		Adjusted kips For Liq 77 kips	Adjusted kips For Liq & Downdrag 2/3 of 77
ft	ft	ton	kips		
0	41	0	0		
1	40	1	2		
2	39	2	5		
3	38	5	9		
4	37	8	15		
5	36	12	23		
6	35	16	32		
7	34	22	43		
8	33	28	56		
9	32	35	69		
10	31	43	85		
11	30	51	102		
12	29	60	120		
13	28	70	140		
14	27	81	162		
15	26	93	185		
16	25	106	212		
17	24	120	239		
18	23	134	268		
19	22	149	297		
20	21	163	327		
21	20	179	358		
22	19	195	389		
23	18	211	422		

Tip Resistance before Adjustment Qp		Adjusted kips 100% Reduction
ton	kips	
1018	2036	2036
1018	2036	2036
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
188	377	377
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188	377	377
188	377	377
188	377	377
188	377	377

Resistance (kips)		
Nominal Resistance	LRFD Factored (ϕ = 0.7)	WSD Factored FS = 2.0
2035.75	1425.03	1017.88
2037.29	1426.11	1018.65
381.62	267.13	190.81
386.25	270.37	193.12
392.41	274.69	196.21
400.13	280.09	200.06
409.38	286.57	204.69
420.18	294.12	210.09
432.52	302.76	216.26
446.40	312.48	223.20
461.82	323.28	230.91
478.79	335.15	239.39
497.30	348.11	248.65
517.35	362.14	258.67
538.94	377.26	269.47
562.08	393.45	281.04
588.79	412.15	294.39
616.33	431.43	308.16
644.70	451.29	322.35
673.89	471.72	336.95
703.92	492.74	351.96
734.77	514.34	367.39
766.45	536.52	383.23
798.96	559.27	399.48

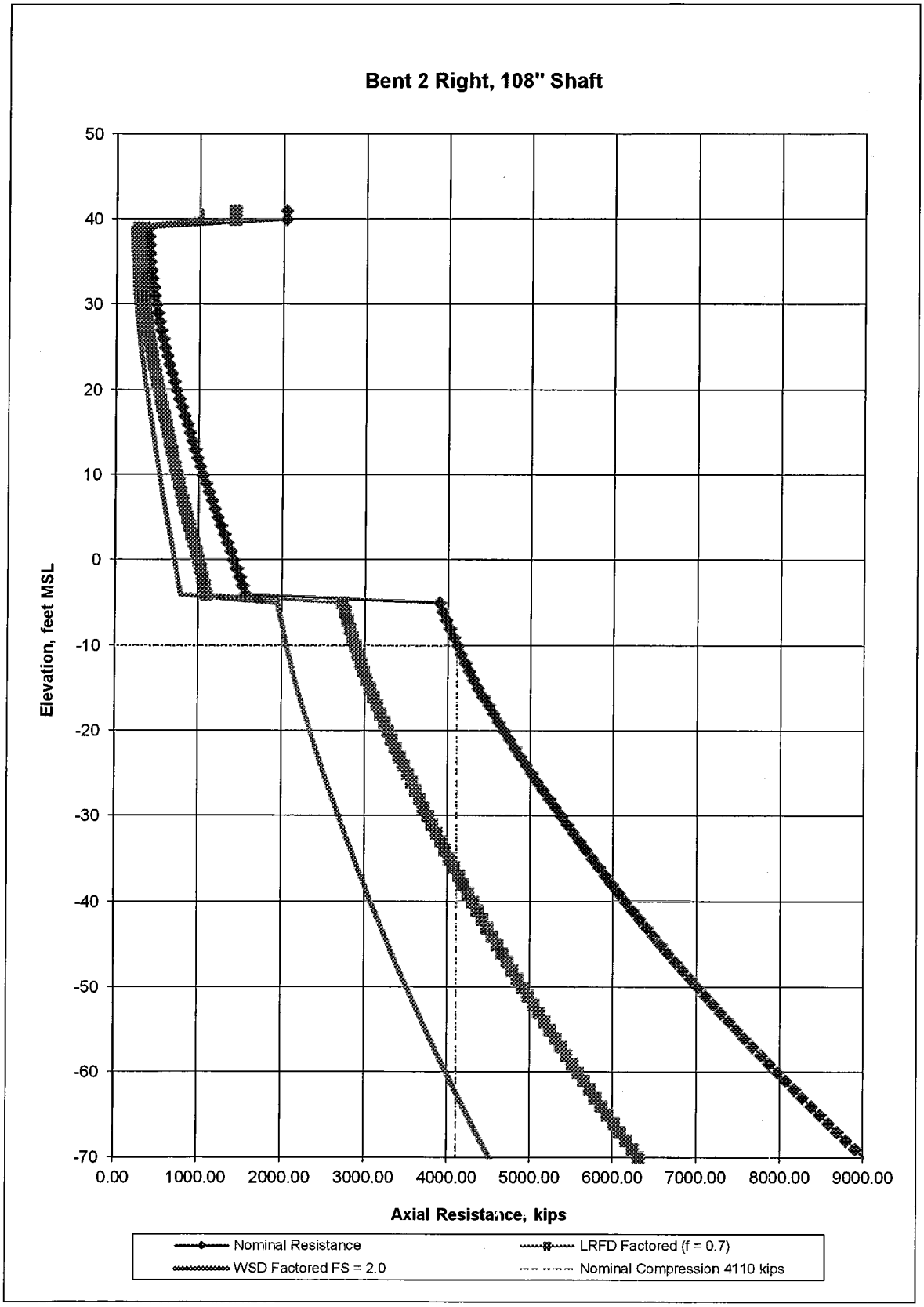
24	17	228	455			188	377	**377**	832.30	582.61	416.15
25	16	245	489			188	377	**377**	866.47	606.53	433.23
26	15	260	519			188	377	**377**	896.46	627.52	448.23
27	14	275	550			188	377	**377**	927.17	649.02	463.58
28	13	291	582			188	377	**377**	958.58	671.01	479.29
29	12	307	614			188	377	**377**	990.71	693.50	495.35
30	11	323	647			188	377	**377**	1023.54	716.48	511.77
31	10	340	680			188	377	**377**	1057.09	739.96	528.54
32	9	357	714			188	377	**377**	1091.34	763.94	545.67
33	8	375	749			188	377	**377**	1126.31	788.42	563.15
34	7	392	785			188	377	**377**	1161.98	813.39	580.99
35	6	411	821			188	377	**377**	1198.37	838.86	599.18
36	5	429	858			188	377	**377**	1235.46	864.82	617.73
37	4	448	896			188	377	**377**	1273.27	891.29	636.63
38	3	467	935			188	377	**377**	1311.78	918.25	655.89
39	2	487	974			188	377	**377**	1351.01	945.70	675.50
40	1	507	1014			188	377	**377**	1390.94	973.66	695.47
41	0	524	1048			188	377	**377**	1424.81	997.37	712.41
42	-1	541	1082			188	377	**377**	1459.27	1021.49	729.64
43	-2	559	1117			188	377	**377**	1494.33	1046.03	747.16
44	-3	576	1153			188	377	**377**	1529.97	1070.98	764.99
45	-4	595	1189			188	377	**377**	1566.26	1096.38	783.13
46	-5	616	1232			1330	2659	**2659**	3891.12	2723.79	1945.56
47	-6	638	1275			1330	2659	**2659**	3934.52	2754.16	1967.26
48	-7	660	1319			1330	2659	**2659**	3978.66	2785.06	1989.33
49	-8	682	1364			1330	2659	**2659**	4023.54	2816.48	2011.77
50	-9	705	1410			1330	2659	**2659**	4069.16	2848.41	2034.58
51	-10	728	1456			1330	2659	**2659**	4115.53	2880.87	2057.76
52	-11	752	1503			1330	2659	**2659**	4162.64	2913.84	2081.32
53	-12	776	1551			1330	2659	**2659**	4210.49	2947.34	2105.24
54	-13	800	1600			1330	2659	**2659**	4259.08	2981.36	2129.54
55	-14	825	1649			1330	2659	**2659**	4308.42	3015.89	2154.21
56	-15	854	1709			1330	2659	**2659**	4368.10	3057.67	2184.05
57	-16	885	1769			1330	2659	**2659**	4428.66	3100.06	2214.33
58	-17	915	1831			1330	2659	**2659**	4490.11	3143.08	2245.06
59	-18	947	1893			1330	2659	**2659**	4552.45	3186.72	2276.23
60	-19	978	1956			1330	2659	**2659**	4615.67	3230.97	2307.84
61	-20	1010	2021			1330	2659	**2659**	4679.78	3275.85	2339.89
62	-21	1043	2086			1330	2659	**2659**	4744.77	3321.34	2372.39
63	-22	1076	2151			1330	2659	**2659**	4810.65	3367.45	2405.32
64	-23	1109	2218			1330	2659	**2659**	4877.41	3414.19	2438.70
65	-24	1143	2286			1330	2659	**2659**	4945.05	3461.54	2472.53
66	-25	1177	2354			1330	2659	**2659**	5013.59	3509.51	2506.79
67	-26	1212	2424			1330	2659	**2659**	5083.00	3558.10	2541.50
68	-27	1247	2494			1330	2659	**2659**	5153.30	3607.31	2576.65
69	-28	1283	2565			1330	2659	**2659**	5224.49	3657.14	2612.24
70	-29	1319	2637			1330	2659	**2659**	5296.56	3707.59	2648.28
71	-30	1355	2710			1330	2659	**2659**	5369.52	3758.66	2684.76
72	-31	1392	2784			1330	2659	**2659**	5443.36	3810.35	2721.68
73	-32	1429	2859			1330	2659	**2659**	5518.08	3862.66	2759.04
74	-33	1467	2934			1330	2659	**2659**	5593.70	3915.59	2796.85
75	-34	1505	3011			1330	2659	**2659**	5670.19	3969.13	2835.10
76	-35	1544	3088			1330	2659	**2659**	5747.57	4023.30	2873.79
77	-36	1583	3167			1330	2659	**2659**	5825.84	4078.09	2912.92
78	-37	1623	3246			1330	2659	**2659**	5904.99	4133.49	2952.50
79	-38	1663	3326			1330	2659	**2659**	5985.03	4189.52	2992.51
80	-39	1703	3407			1330	2659	**2659**	6065.95	4246.16	3032.97
81	-40	1744	3489			1330	2659	**2659**	6147.75	4303.43	3073.88

82	-41	1786	3571			1330	2659	**2659**	6230.45	4361.31	3115.22
83	-42	1827	3655			1330	2659	**2659**	6314.02	4419.82	3157.01
84	-43	1870	3739			1330	2659	**2659**	6398.48	4478.94	3199.24
85	-44	1912	3825			1330	2659	**2659**	6483.83	4538.68	3241.91
86	-45	1956	3911			1330	2659	**2659**	6570.06	4599.04	3285.03
87	-46	1999	3998			1330	2659	**2659**	6657.18	4660.02	3328.59
88	-47	2043	4086			1330	2659	**2659**	6745.18	4721.62	3372.59
89	-48	2087	4175			1330	2659	**2659**	6834.06	4783.84	3417.03
90	-49	2132	4265			1330	2659	**2659**	6923.83	4846.68	3461.92
91	-50	2178	4355			1330	2659	**2659**	7014.49	4910.14	3507.24
92	-51	2223	4447			1330	2659	**2659**	7106.03	4974.22	3553.02
93	-52	2270	4539			1330	2659	**2659**	7198.46	5038.92	3599.23
94	-53	2316	4633			1330	2659	**2659**	7291.77	5104.24	3645.88
95	-54	2363	4727			1330	2659	**2659**	7385.96	5170.17	3692.98
96	-55	2411	4822			1330	2659	**2659**	7481.04	5236.73	3740.52
97	-56	2459	4918			1330	2659	**2659**	7577.01	5303.91	3788.51
98	-57	2507	5015			1330	2659	**2659**	7673.86	5371.70	3836.93
99	-58	2556	5112			1330	2659	**2659**	7771.60	5440.12	3885.80
100	-59	2606	5211			1330	2659	**2659**	7870.22	5509.15	3935.11
101	-60	2655	5311			1330	2659	**2659**	7969.72	5578.81	3984.86
102	-61	2705	5411			1330	2659	**2659**	8070.11	5649.08	4035.06
103	-62	2756	5512			1330	2659	**2659**	8171.39	5719.97	4085.70
104	-63	2807	5614			1330	2659	**2659**	8273.55	5791.49	4136.78
105	-64	2859	5717			1330	2659	**2659**	8376.60	5863.62	4188.30
106	-65	2911	5821			1330	2659	**2659**	8480.53	5936.37	4240.26
107	-66	2963	5926			1330	2659	**2659**	8585.34	6009.74	4292.67
108	-67	3016	6032			1330	2659	**2659**	8691.04	6083.73	4345.52
109	-68	3069	6138			1330	2659	**2659**	8797.63	6158.34	4398.82
110	-69	3123	6246			1330	2659	**2659**	8905.10	6233.57	4452.55
111	-70	3177	6354			1330	2659	**2659**	9013.46	6309.42	4506.73
112	-71	3232	6463			1330	2659	**2659**	9122.70	6385.89	4561.35
113	-72	3287	6574			1330	2659	**2659**	9232.82	6462.98	4616.41
114	-73	3342	6685			1330	2659	**2659**	9343.83	6540.68	4671.92
115	-74	3398	6797			1330	2659	**2659**	9455.73	6619.01	4727.86
116	-75	3455	6909			1330	2659	**2659**	9568.51	6697.96	4784.26
117	-76	3511	7023			1330	2659	**2659**	9682.18	6777.52	4841.09
118	-77	3569	7138			1330	2659	**2659**	9796.73	6857.71	4898.36
119	-78	3626	7253			1330	2659	**2659**	9912.16	6938.51	4956.08
120	-79	3685	7369			1330	2659	**2659**	10028.48	7019.94	5014.24
121	-80	3743	7486			1330	2659	**2659**	10145.69	7101.98	5072.84
122	-81	3802	7605			1330	2659	**2659**	10263.78	7184.65	5131.89
123	-82	3862	7724			1330	2659	**2659**	10382.75	7267.93	5191.38
124	-83	3922	7843			1330	2659	**2659**	10502.62	7351.83	5251.31
125	-84	3982	7964			1330	2659	**2659**	10623.36	7436.35	5311.68
126	-85	4043	8086			1330	2659	**2659**	10744.99	7521.49	5372.50
127	-86	4104	8208			1330	2659	**2659**	10867.51	7607.25	5433.75
128	-87	4166	8332			1330	2659	**2659**	10990.91	7693.64	5495.45
129	-88	4228	8456			1330	2659	**2659**	11115.19	7780.63	5557.60
130	-89	4291	8581			1330	2659	**2659**	11240.36	7868.25	5620.18
131	-90	4354	8707			1330	2659	**2659**	11366.42	7956.49	5683.21
132	-91	4417	8834			1330	2659	**2659**	11493.36	8045.35	5746.68
133	-92	4481	8962			1330	2659	**2659**	11621.18	8134.83	5810.59
134	-93	4546	9091			1330	2659	**2659**	11749.89	8224.93	5874.95
135	-94	4610	9220			1330	2659	**2659**	11879.49	8315.64	5939.75
136	-95	4675	9351			1330	2659	**2659**	12009.97	8406.98	6004.99
137	-96	4741	9482			1330	2659	**2659**	12141.34	8498.94	6070.67
138	-97	4807	9614			1330	2659	**2659**	12273.59	8591.51	6136.79
139	-98	4874	9748			1330	2659	**2659**	12406.72	8684.71	6203.36

140	-99	4041	9882			1320	2659	2659	12540.74	8778.52	6270.37

Note: Design tip elevations may be adjusted to ignore certain portions of embedment at the top and bottom of the piles to account for the effects of seasonal moisture changes, disturbance during construction, cyclic lateral loading, low lateral stresses from freshly placed concrete, and development of tensile cracks in soils and/or rock.

0	(10)
4110	(10)
4110	(70)


Bent 2 Right, 108" Shaft
Elevation, feet MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
9000.00
Axial Resistance, kips
Nominal Resistance
LRFD Factored (f = 0.7)
WSD Factored FS = 2.0
Nominal Compression 4110 kips

Friars Rd OC
Preliminary Recommended Soil Parameters for LPILE Analysis

Abut 1R, ref Borings A-12-054/B3

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	8.0	48.0	40.0	120.0	0.0694	33	90
2	SAND	8.0	19.0	40.0	29.0	62.6	0.0362	36	100
3	SAND	19.0	67.0	29.0	-19.0	62.6	0.0362	40	100
4	SAND	67.0	92.0	-19.0	-44.0	62.6	0.0362	45	125
5	SAND	92.0	--	-44.0		62.6	0.0362	45	125

Abut 1L, ref Borings A-12-054/B3

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	20.0	61.5	41.5	120.0	0.0694	33	90
2	SAND	20.0	32.5	41.5	29.0	120.0	0.0694	36	100
3	SAND	32.5	79.0	29.0	-17.5	62.6	0.0362	40	100
4	SAND	79.0	104.0	-17.5	-42.5	62.6	0.0362	45	125
5	SAND	104.0	--	-42.5		62.6	0.0362	45	125

Bent 2R, ref Borings A-12-053/B2/B6

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	15.5	41.0	25.5	120.0	0.0694	33	95
2	SAND	15.5	45.0	25.5	-4.0	62.6	0.0362	36	100
3	SAND	45.0	55.0	-4.0	-14.0	62.6	0.0362	40	110
4	SAND	55.0	68.0	-14.0	-27.0	62.6	0.0362	45	125
5	SAND	68.0	98.0	-27.0	-57.0	62.6	0.0362	45	125
6	SAND	98.0		-57.0		62.6	0.0362	45	125

Bent 2L, ref Borings A-12-053/A-B-2

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	10.0	45.0	35.0	120.0	0.0694	33	95
2	SAND	10.0	19.5	35.0	25.5	62.6	0.0362	36	100
3	SAND	19.5	27.0	25.5	18.0	62.6	0.0362	40	110
4	SAND	27.0	37.0	18.0	8.0	62.6	0.0362	45	125
5	SAND	37.0	98.0	8.0	-53.0	62.6	0.0362	45	125
6	SAND	98.0		-53.0		62.6	0.0362	45	125

Abut 3R, ref Borings A-B-44/B-1

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	12.0	57.5	45.5	120.0	0.0694	29	80
2	SAND	12.0	29.0	45.5	28.5	120.0	0.0694	30	80
3	SAND	29.0	48.0	28.5	9.5	120.0	0.0694	32	80
4	SAND	48.0	39.5	9.5	18.0	120.0	0.0694	32	80
5	SAND	39.5	47.5	18.0	10.0	57.6	0.0333	32	60
6	SAND	47.5		10.0		62.6	0.0362	45	125

Abut 3L, ref Borings A-B-44/A-B-3

Soil Layer	Soil Model (LPILE)	Depth (ft)		Elevation (ft)		Unit Weight, γ		Friction Angle, Φ (°)	k (pci)
		Top	Bottom	Top	Bottom	(pcf)	(pci)		
1	SAND	0.0	19.0	65.0	46.0	120.0	0.0694	29	80
2	SAND	19.0	36.0	46.0	29.0	120.0	0.0694	30	80
3	SAND	36.0	47.0	29.0	18.0	120.0	0.0694	32	80
4	SAND	47.0	55.0	18.0	10.0	57.6	0.0333	32	60
5	SAND	55.0	59.0	10.0	6.0	62.6	0.0362	45	125
6	SAND	59.0		6.0		62.6	0.0362	45	125

GEOCON
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GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

FOUNDATION REPORT

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT WEST GROUND ANCHOR WALL (BRIDGE NO. 57E0126) 11-SD-163-PM 4.4 CONTRACT NO. 11-085781 SAN DIEGO, CALIFORNIA

PREPARED FOR

DOKKEN ENGINEERING
SAN DIEGO, CALIFORNIA

NOVEMBER 30, 2012
REVISED AUGUST 15, 2014
PROJECT NO. G1447-52-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G1447-52-01
November 30, 2012
Revised August 15, 2014

Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Attention: Mr. Gerard Lumabas

Subject: FOUNDATION REPORT
FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL
(BRIDGE NO. 57E0126)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

In accordance with your request, we herein submit our Foundation Report (FR) for the proposed West Ground Anchor Wall (Bridge No. 57E0126) for the Friars Road Overcrossing at State Route 163 Interchange project in the City of San Diego, California. The accompanying report presents the findings and conclusions from our study.

Please contact the undersigned at your convenience if you have any questions regarding this FR, or if we may be of further service.

Very truly yours,

GEOCON CONSULTANTS, INC.

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(e-mail) Addressee

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FOUNDATION REPORT

1. INTRODUCTION

This Foundation Report (FR) was prepared for the proposed West Ground Anchor Wall (Bridge No. 57E-0126) as part of the Friars Road Overcrossing (OC) at State Route (SR) 163 Interchange project in the City of San Diego, California. The approximate site location is depicted on the Vicinity Map, Figure 1. This FR is based on subsurface exploration and laboratory tests performed by Southern California Soil and Testing (SCS&T), Inc. The purpose of the investigation was to evaluate general subsurface geologic and geotechnical conditions along the proposed West Ground Anchor Wall alignment and to provide geotechnical recommendations for use in preparing project plans and specifications.

The recommendations presented herein are based on our review of the subsurface and laboratory data obtained by SCS&T, engineering analyses, and our experience with similar soil and geologic conditions. The logs of test boring (LOTB) sheets in Caltrans format, as-built plans and LOTB sheets, laboratory test results, and analyses and calculations are presented as Appendices A, B, C, and D, respectively.

2. SCOPE OF SERVICES

We performed the following scope of services:

- Reviewed published geologic maps, aerial photographs, as-built plans, project plans, in-house documents, and other literature pertaining to the site to aid in evaluating geologic conditions and hazards that may be present.
- Reviewed as-built plans for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed as-built plans for Friars Road OC Earthquake Retrofit Project No. 272 prepared by the California Department of Transportation, dated December 9, 1997.
- Reviewed as-built LOTB sheet for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed the *Geotechnical Design Report for SR 163/Friars Road Interchange Modification Project* prepared by SCS&T.
- Reviewed the *Structure Foundation Investigation for Friars Road at SR 163 Interchange Project (Bridge No. 57-0595)* prepared by SCS&T.
- Reviewed the *Preliminary Foundation Report for Friars Road at SR 163 Interchange, West Tieback Wall Number 1 (Bridge No. 57E-0126)* prepared by SCS&T.

- Reviewed the project plans prepared by T. Y. Lin International for the Friars Road OC Widening project, including the plans for the West Ground Anchor Wall.
- Reviewed subsurface data and laboratory test results collected by SCS&T.
- Performed engineering analyses to evaluate liquefaction potential, seismic design criteria, and foundation design criteria.
- Prepared this FR in general accordance with Caltrans' *Foundation Report Preparation for Bridge Foundations*, December 2009.

SCS&T prepared a *Preliminary Foundation Report (PFR)* for the project (West Ground Anchor Wall project) dated May 2010. This FR supersedes the PFR for the project.

3. PROJECT DESCRIPTION

3.1 Background and Site Description

The project site is located approximately ½ mile north of Interstate 8 on the SR 163 corridor in the City of San Diego, California. The approximate site coordinates are 32.771560° (latitude) and -117.161362° (longitude).

The proposed improvements are part of the Friars Road and SR 163 Interchange Improvements project. The Vicinity Map, Figure 1, shows the approximate location of the site with respect to surrounding improvements. Based on the current plans and project information, the SR 163 southbound (SB) direction below the existing Friars Road OC on the west side will be widened and will require a ground anchor retaining wall and Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls on either end.

3.2 Existing Structures

The SR 163 corridor is oriented in a north-south direction and Friars Road crosses over SR 163 in an east-west direction. At the existing OC structure, SR 163 is comprised of a divided highway with four northbound (NB) lanes and four southbound (SB) lanes. Based on the as-built plans, the existing Friars Road OC (Bridge No. 57-0595) is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments and intersects SR 163 at an approximate skew angle of 35°20'24". The bridge was constructed in 1970 and seismically retrofitted in 1996. The existing OC structure extends 390 feet from approximately Station (Sta.) 17+52 to approximately Sta. 21+42 along the original Friars Road centerline ('F' Line). The OC is approximately 114 feet wide and accommodates three 12-foot lanes, a 5-foot-wide outside shoulder in each direction, a 4-foot-wide sidewalk along the eastbound (EB) direction with metal railing, and a slightly raised concrete median with varying widths. The existing Abutments 1 and 3 are supported on a combination of vertical and battered driven steel H-piles (HP 10x57) with average pile tip elevations

of 19.8 feet and 14.4 feet above mean sea level (MSL), respectively. The existing bent is supported on driven steel H-piles (HP 10x57) with an average pile tip elevation of 15.1 feet above MSL. However, the subsequent seismic retrofit consisted of increasing the size of the pile caps at Bent 2 and installing higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations were modified as part of the seismic retrofit.

All elevations used in this report are based on the current project plans that refer to the current datum of NAD83 and NAVD88. We understand that the as-built plans of this project were based on the original datum of NGVD29. According to conversations with Dokken Engineering, a vertical transformation of +2.10 feet should be applied to convert the original datum (NGVD29) of these as-built plans to the current datum (NAD83 and NAVD88).

3.3 Proposed Structure

Information regarding the proposed structure are based on the *Project Plans for Final PS&E on West Ground Anchor Wall* prepared by T. Y. Lin International, dated September 6, 2013. We understand the project consists of widening the SR 163 SB direction on the west side in order to accommodate the SR 163 on- and off-ramps modifications for the Friars Road at SR 163 Interchange project. The widening of SR 163 SB direction (west side) will require a ground anchor retaining wall with Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls on either end in order to support the existing abutment (Abutment 1) embankment. The proposed West Ground Anchor Wall structure will extend approximately 230.75 feet from approximately Station (Sta.) 10+90 to approximately Sta. 13+20.75 along the wall alignment. The Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls connect from both the north and south ends of the proposed ground anchor wall. The proposed Type 1 north and south retaining walls will be approximately 54.75 feet and 98 feet in length, respectively, with a maximum height of approximately 16 feet. Bottom of footing elevations range from approximately 34.95 feet to 48.14 feet MSL. The proposed ground anchor retaining wall will be constructed using top-down method with multiple lifts at approximately 5 feet each. The existing Abutment 1 structure will be located approximately 9 to 10 feet from the face of the proposed ground anchor wall.

3.4 Pertinent Project Information

We reviewed the following documents related to the project:

1. California Department of Transportation, *As-built plans, Friars Road Overcrossing,* dated December 2, 1968.

2. California Department of Transportation, *As-built Log of Test Borings (LOTBs), Friars Road Overcrossing,* dated December 2, 1968.

3. Geocon Incorporated, *Preliminary Recommendation Letter, SR 163/ Friars Road Interchange Project, San Diego, California,* dated September 27, 2012 (Geocon Project No. G1447-52-01).

4. Geocon Incorporated, *Foundation Report, Friars Road / State Route 163 Interchange Project, West Abutment Wall (Bridge No. 57E-0126), 11-SD-163-PM 3.8/5.5, EA 11225-085781, San Diego, California,* dated November 30, 2012. (Geocon Project No. G1447-52-01).

5. Geocon Incorporated, *Foundation Report-Memorandum No. 1, Friars Road / State Route 163 Interchange Project, West Abutment Wall (Bridge No. 57E-0126), 11-SD-163-PM 3.8/5.5, EA 11225-085781, San Diego, California,* dated October 25, 2013. (Geocon Project No. G1447-52-01).

6. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8,* dated Jul 23, 2012.

7. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8, Log of Test Borings (LOTBs) Sheets 1, 2, 3, 4, and 14 of 19* ,dated July 23, 2012.

8. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Friars Road at SR 163, Log of Test Borings (LOTBs) Sheet 1 of 1,* dated 2012.

9. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, East Tieback Wall Number 2, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California,* dated May 12, 2010.

10. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, West Tieback Wall Number 1, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California*, dated May 12, 2010.

11. Southern California Soil & Testing, Inc. (SCS&T No. 0311116), *Structure Foundation Investigation, Friars Road at SR163 Interchange, Bridge No. 57-595, 11-SD-163-RO69-84, EA No. 11-085780, San Diego, California*, dated July 9, 2009.

12. Southern California Soil and Testing, Inc., *Structure Foundation Investigation, Friars Road at SR 163 Interchange (Bridge No. 57-0595),* dated July 9, 2009.

13. T. Y. Lin International, *Project Plans for 65% Unchecked Details on Friars Road Overcrossing (Widen),* dated September 21, 2012.

14. T. Y. Lin International, *Project Plans for 65% Unchecked Details on West Abutment Wall (Bridge No. 57E-0126),* dated September 21, 2012.

15. T. Y. Lin International, *Project Plans for Final PS&E, West Ground Anchor Wall (Bridge No. 57E0126),* dated September 6, 2013.

4. EXCEPTIONS TO POLICY

Unless otherwise stated in the report, this report was prepared in general conformance with Caltrans' current policy.

5. FIELD INVESTIGATION AND TESTING PROGRAM

The field investigation for this FR was performed by SCS&T on October 3 (Boring A-12-053) and 5 (Boring A-12-054), 2012. These exploratory borings were drilled by SCS&T near the proposed West Ground Anchor Wall alignment as depicted on the Site Plan, Figure 2. Table 5 is a summary of the field investigation information including approximate boring locations, surface elevations, and boring depths.

TABLE 5
SUMMARY OF BORINGS

Boring No.	Approximate Boring Location				Boring Depth (feet)
	Location in Structure	Station No. / Alignment	Offset (feet)	Elevation (feet)	
A-03-002	Bent 2	244+60 'FR' Line	0R	47.5	35.0
A-03-003	Abut 3	447+20 'FR' Line	185R	59.0	60.0
A-12-044	Abut 3	245+12 'SR 163' Line	176R	76.0	70.0
A-12-053	Bent 2	243+00 'SR 163' Line	4L	43.0	100.0
A-12-054	Abut 1	244+00 'SR 163' Line	200L	57.0	125.0

Two exploratory borings (A-12-053 and A-12-054) were performed by SCS&T to approximate depths of up to 125 feet using a mobile drill rig equipped with 8-inch-diameter, hollow-stem augers.

In-situ testing and sampling during drilling were performed in general conformance with current Caltrans' *Soil and Rock Logging, Classification and Presentation Manual* (2010 Edition). Soil samples were collected from near the ground surface and at approximately 2½- to 5-foot intervals to the total depths explored. Relatively undisturbed samples were obtained by driving a 3-inch outside-diameter (OD), 2.5-inch inside-diameter (ID) split-spoon sampler (Modified California sampler) into the "undisturbed" soil mass with blows from a 140-pound hammer (auto) falling 30 inches. The sampler was equipped with 6-inch-long by 2½-inch-diameter brass sample tubes to facilitate sample removal and laboratory testing. SPTs were performed by driving a 2-inch OD and a 1.4-inch ID split-spoon SPT sampler 18 inches in general accordance with ASTM D1586. The number of blows required to drive the samplers (blow counts) the last 12 inches of the 18-inch sample drive (or portion thereof) are reported on the LOTB sheets prepared by SCS&T (in Caltrans format), which are included in Appendix A.

6. LABORATORY TESTING PROGRAM

SCS&T performed laboratory tests on samples from three borings (A-03-002, A-03-003, and A-12-044) associated with the Friars Road at SR 163 Interchange project in general conformance with California Test Methods (CTM) and generally accepted test methods of the American Society for Testing and Materials (ASTM). Due to the lack of soil sample recovery in Borings A-12-053 and A-12-054, laboratory testing could not be performed on samples from these borings. Pertinent laboratory test results from these nearby borings are presented and were used for design purposes within this FR. SCS&T performed the following laboratory tests:

- In-place dry density and moisture content: ASTM D2937 (CTM 226)
- Grain Size Distribution/Percent Passing No. 200 Sieve: ASTM D422
- pH and Resistivity: CTM 643
- Sulfate Content: CTM 417
- Chloride Content: CTM 422
- Consolidation: ASTM D2435
- Direct Shear: ASTM D3080

In-place dry density and moisture content laboratory test results are shown on the LOTBs presented in Appendix A. All other laboratory test results are presented in Appendix C of this report.

7. SITE GEOLOGY AND SUBSURFACE CONDITIONS

7.1 Topography and Geology

Private and commercial properties occupy the area surrounding the Friars Road/SR 163 Interchange. The general topography of the project location is relatively flat with a gentle slope descending from the northwest to the southeast. Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that an existing cut slope comprised of formational material commonly identified as Stadium Conglomerate is located northwest of the existing OC. The slope ranges between about 30 feet and 100 feet in height at inclinations of between about 1:1 (horizontal:vertical) and 1½:1 (horizontal:vertical). At the location of Friars Road/ SR 163 Interchange, embankments for Friars Road and the interchange ramps are raised above the surrounding area where runoff flows into the existing drainage systems. The existing drainage systems include swales, drainage inlets, and storm drains that collect offsite and surface runoff. Most of the existing drainage systems at the project site eventually discharge into the San Diego River, which is located near the southern portion of the project. The San Diego River flows from east to west.

A *Regional Geologic Map* is presented as Figure 3. The site is located in the Coastal Plains physiographic province of San Diego County and is underlain by the Tertiary Friars Formation

(Tf), Tertiary Stadium Conglomerate (Tst), Quaternary very old paralic deposits (Qvop), alluvium (Qal), and artificial fill (Qaf) as mapped by Kennedy and Tan (2008). The approximate distribution of these materials at the proposed West Ground Anchor Wall, as presented as Figure 4 (Geologic Cross-Section A-A′), is based on SCS&T's surface investigation, LOTBs, and our review of the local geologic and topographic maps.

Existing fill associated with the approach embankments are located on the east and west portions of the site. The thickness of the fill is estimated to be up to approximately 30 feet. Very old paralic deposits cap the mesas/hillsides in the northwestern portion of the project. These deposits consist of well-cemented, poorly sorted, cobble in siltstone and sandstone matrices. We expect that cobbles up to 12 inches in diameter exist within the very old paralic deposits. Quaternary alluvium associated with the San Diego River plain (Mission Valley) and the tributary drainage canyons that connect with the river plain underlie most of the site. The thickness of the alluvium is anticipated to exceed 80 feet toward the southern portion of the site and decreases near the hillsides. The alluvium consists of interbedded layers of sand, gravel, cobble, and clay. We expect that cobbles up to 12 inches in diameter also exist within the Quaternary alluvium. The Stadium Conglomerate is the primary bedrock unit underlying the very old paralic deposits in the north and alluvial deposits in the southern portion of the project. The conglomerate is exposed in cut slopes on the site. The Stadium Conglomerate is comprised of sandy cobble with cross-bedded lenses of medium to coarse sandstone. Boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate. Locally, the Stadium Conglomerate is moderately to well-cemented. The Friars Formation underlies the Stadium Conglomerate within the San Diego River Plain. The Friars Formation is comprised of non-marine and lagoonal sandstone interbedded with layers of siltstone and claystone. The Friars Formation contains zones of varying degrees of cementation. The Stadium Conglomerate and Friars Formation were not observed to outcrop on the site.

7.2 Types of Soil and Rock

Based on the results of the previous investigation performed by SCS&T, the study area is generally underlain by fill and alluvium overlying Stadium Conglomerate and Friars Formation. The LOTBs from SCS&T are in general agreement of the types of soil material encountered at the study area. The fill material generally consists of dense silty sands and clayey sand with varying amounts of gravels and cobbles. Below the fill in Boring A-12-053, alluvium generally consists of dense silty sand with varying amounts of gravels and cobbles. Below the alluvium in Boring A-12-053 and fill in Boring A-12-054, sedimentary rock generally consisting of Stadium Conglomerate overlying Friars Formation. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate. Friars Formation generally consists of moderately hard massive sandstone and claystone.

Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that well-cemented zones should be expected within the formational materials. Construction considerations for the following materials are further described in Section 14 of this report.

7.2.1 Previously Placed Fill and Alluvium

Onsite fill soils were likely placed over existing alluvium during the original construction of the approach embankments for the interchange. The previously placed fill was encountered in both borings (Borings A-12-053 and A-12-054) from the ground surface (approximate Elevations +43 to +57 feet MSL) to approximately 6 to 14 feet below ground surface (approximate Elevations +37 to +43 feet MSL). Alluvium was encountered in Boring A-12-053 from below the previously placed fill (approximate Elevation +37 feet MSL) to approximately 47 feet below ground surface (approximate Elevation -4 feet MSL). Borings A-12-053 and A-12-054 were drilled near the proposed West Ground Anchor Wall alignment. The fill and alluvium consists primarily of brown to dark brown, dense, silty sand and clayey sand with varying amounts of gravels and cobbles. We expect that cobbles up to 12 inches in diameter exist within the fill and alluvium material.

Previously placed fill is located within the proposed West Ground Anchor Wall areas. The alluvium and underlying formational material is considered suitable for direct support of the proposed West Ground Anchor Wall structure. The existing fill is not suitable for direct support of the retaining structure foundations. Therefore, possible removals of existing fill may be considered necessary to provide suitable foundation support.

7.2.2 Stadium Conglomerate (Tst) and Friars Formation (Tf)

Stadium Conglomerate and Friars Formation consist of sedimentary rock and was encountered in borings conducted by SCS&T as underlying the fill/alluvial deposits. Stadium Conglomerate was encountered in borings (A-12-053 and A-12-054) from beneath the previously placed fill/alluvial deposits from approximately 14 to 47 feet below ground surface (approximate Elevations +43 to -4 feet MSL) to approximately 58 to 74 feet below ground surface (approximate Elevations -15 to -17 feet MSL). Although boulders were not indicated on the LOTBs, boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate and should be anticipated. Friars formation was encountered in both borings underlying the Stadium Conglomerate from approximately 58 to 74 feet below ground surface (approximate Elevations -15 to -17 feet MSL) to maximum explored depths ranging from approximately 100 to 125 feet below ground surface (approximate Elevations -57 to -68 feet MSL).

The Stadium Conglomerate encountered in the borings consists primarily of massive cobble conglomerate and fine-grained massive sandstone. The Friars Formation encountered consists primarily of fine-grained massive sandstone and massive claystone.

7.3 Pertinent Soil Conditions or Geologic Hazards

The following sections discuss other potential geologic hazards evaluated for the project including landslides, embankment failures, ground subsidence, expansive soils, and collapsible soils.

7.3.1 Landslides

Based on previous analyses performed by SCS&T (*Geotechnical Design Report*, July 2009) and the review of the Landslide Hazard Identification Map No. 33 (1995), the project site is located in Landslide Hazard Areas 1, 2, and Subarea 3-1. Area 1 is classified as Least Susceptible to slope instability. Landslides and other features related to slope instability are non-existent to very rare within this area due primarily to lack of steep slopes. Land within Area 1 will probably remain relatively stable unless the topography is radically modified. Area 2 is classified as Marginally Susceptible to slope instability. Area 2 includes gentle to moderate slopes, where slope angles are generally less than 15 degrees. This area includes low-lying bottoms of broad valleys and basins and large elevated surfaces of Pleistocene terrace deposits. Landslides and other slope failures are rare within this area, although slope hazards are possible on some steeper slopes within the area or along its borders. Subarea 3-1 is classified as Generally Susceptible to slope instability and may contain slopes that are at or near their stability limits due to a combination of weak materials and steep slopes. Although most slopes within Area 3-1 do not currently contain landslide deposits, they can be expected to fail, locally, when adversely modified.

No indications of gross, deep-seated, slope failures were noted during SCS&T's geotechnical investigations. The materials comprising the Stadium Conglomerate typically have relatively high shear strengths and are not known to have a potential for deep-seated, gross, slope failure. Thus, the potential for gross, deep-seated, slope failures to affect the proposed OC widening is considered low. However, shallow surficial failures where soil, gravel, and cobble erode from the faces of steep, sparsely vegetated slopes are quite common. The Landslide Hazards Map is presented as Figure 5.

7.3.2 Embankment Failures

No embankment failures were observed during the investigations performed by SCS&T.

7.3.3 Ground Subsidence

Ground subsidence occurs where underlying loose geologic units undergo a densification process. Subsidence can result from the extraction of mineral resources and/or groundwater, as well as the rapid settlement induced by seismic activity. The potential for ground subsidence is considered low at the site.

7.3.4 Expansive Soils

Expansive soils possess a high swelling or shrinking potential due to change in moisture content. The common materials associated with high expansion potential are clays. The majority of the onsite soil is medium- to coarse-grained with varying amounts of fines, gravels, and cobbles and are identified as relatively no to low plasticity. Proposed foundations will be supported below a depth where significant moisture variation is expected. Thus, the potential for expansive soils to affect the proposed foundations is considered low.

7.3.5 Collapsible Soils

Collapsible soils are unsaturated soils that undergo a large volume change upon saturation, even without increase in external loads. Soils that generally display collapsible potential are porous and have a low dry density. Generally no porous or honeycomb structure was reported previously. Surficial soils described as loose will be removed and recompacted as outlined in the recommendations of this report. Thus, the potential for collapsible soils onsite is considered low.

7.4 Depth to Bedrock

The depth to rock-like materials (Stadium Conglomerate and Friars Formation) varies from approximately 14 to 47 feet as illustrated on the LOTB sheets as shown in Appendix A.

7.5 Groundwater

Groundwater was observed in each of the borings (Borings A-12-053 and A-12-054) at approximate elevations ranging from 25.5 to 29 feet MSL (approximately 17.5 to 28 feet below ground surface) during SCS&T's investigation. The As-Built LOTB encountered groundwater at approximate elevations of 34 and 39 feet MSL. We expect the groundwater to be near the water levels mentioned in the borings at the approximate proposed location of the West Ground Anchor Wall. The presence of groundwater should be considered and incorporated into the design and construction of proposed foundations.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors. Depth to groundwater can also vary significantly due to localized pumping, irrigation practices, and seasonal fluctuations. Therefore, it is possible that groundwater may be higher or lower than the levels observed during our investigation.

8. SCOUR EVALUATION

The site is not located in the vicinity of flowing channels or any large bodies of water, so scour is not expected to affect the proposed improvements.

9. CORROSION EVALUATION

Corrosion parameter testing was performed by SCS&T on seven samples obtained from Borings A-03-002, A-03-003, and A-12-044, which were selected at random to represent surficial onsite soil for the proposed Friars Road/SR 163 Interchange project.

According to Caltrans' *Corrosion Guidelines* (Version 1.0, September 2003), a site is considered corrosive to foundation elements if chloride concentration is greater than 0.05 percent (%), or sulfate concentration greater than 0.2%, or the potential of hydrogen (pH) is 5.5 or less. Resistivity, pH, chlorides content, and soluble-sulfate content tests were performed on one sample selected at random to generally evaluate the corrosion potential to subsurface structures. These tests were performed in accordance with CTM. 643, CTM 417, and CTM 422. The results are summarized in Table 9, which indicates that the site need not be considered a corrosive environment in accordance with Caltrans criteria. The results are presented in Appendix C and should be considered for design of underground structures.

TABLE 9
SOIL CORROSION TEST SUMMARY

Boring No. / Sample No.	Sample Depth (feet)	Resistivity (ohm centimeters)	pH	Chloride Content (%)	Sulfate Content (%)
A-03-002/1-3.5	1 to 3.5	1,870	8.7	0.001	0.007
A-03-002/12.5	12.5	-	9	-	0.001
A-03-002/26-28	26 to 28	935	8.4	0.015	0.017
A-03-003/1-3.5	1 to 3.5	2,204	8.1	0.007	0.008
A-03-003/32-34	32 to 34	1,336	7.1	0.006	0.025
A-03-003/45	45	-	7.1	0.023	0.016
A-12-044/1-5	1 to 5	1,750	9.2	0.002	0.003

Note: (-) Represents negligible exposure.

Proposed improvements in contact with the ground should be designed and constructed in accordance with Caltrans' *Standard Specifications* and good construction practices. Geocon does not practice in the field of corrosion engineering. If corrosion sensitive improvements are planned, we recommend that further evaluations by a corrosion engineer be performed to incorporate the necessary precautions to avoid premature corrosion on corrosion sensitive structures in direct contact with the soils.

10. SEISMIC RECOMMENDATIONS

10.1 Faulting

Much of Southern California, including the San Diego County area, is characterized by a series of Quaternary fault zones that typically consist of several individual en echelon faults generally striking in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as active while others are classified as potentially active according to the criteria of the California Geologic Survey. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). Potentially active faults have demonstrated movement during the Pleistocene Epoch (11,000 to 1.6 million years before the present), but no movement during Holocene time.

The fault most likely to have a significant impact on the site is the Newport-Inglewood-Rose Canyon fault (San Diego Section) located approximately 3.5 km southwest of the site.

10.2 Seismic Ground Motion and Design Response Spectrum

Design seismic recommendations including seismic ground motion of the site and the design response spectrum for the bridge widening were developed in accordance with Caltrans' *2009 Seismic Design Procedure.* This procedure is based on current Caltrans' *Seismic Design Criteria (Appendix B), Deterministic PGA Map, ARS Online Report, Geotechnical Services Design Manual,* and USGS probabilistic seismic hazard analysis and tools. Site-specific information used in the procedure included the latitude of 32.771560° and the longitude of -117.161362°.

Based on Caltrans' web-based ARS Online application (V1.0.4) and associated reports, the site is located approximately 3.5 kilometers (km) northeast of Newport-Inglewood-Rose Canyon fault zone, San Diego section (Caltrans Fault ID 224). A portion of the 2007 *Deterministic PGA Map* showing the site and nearby regional faults is presented as Figure 6, Regional Fault Map. Key information for the fault is summarized in Table 10.

TABLE 10
FAULT INFORMATION

Fault Name	Newport-Inglewood-Rose Canyon (San Diego Section)
Fault ID#	224
MMax	7.5
Fault Type	RLSS
Fault Dip	90°
Dip Direction	Vertical
Top of Rupture	0 km
Bottom of Rupture	13 km
R_{RUP}	3.5 km
$Z_{1.0}$	191 m & 241 m*
$Z_{2.5}$	2.0 km

*$Z_{1.0}$ of 191 m for Vs30 of 420 m/sec, 241 m for Vs30 of 380 m/sec.

The site is not located within a deep sedimentary basin in accordance with Caltrans' *2009 Seismic Design Procedure*. Based on the currently available project plans and LOTB sheet prepared by T. Y. Lin International and SCS&T, respectively, the site is underlain by fill soils and/or alluvial soils over sedimentary formational materials (Stadium Conglomerate and Friars Formation). A shear wave velocity in the upper 30 meters (V_{s30}) of approximately 420 meters per second (m/sec) is considered appropriate for the soil profile at Abutment 1 near the planned West Ground Anchor Wall.

Both the deterministic and probabilistic response spectrums of the site were estimated using Caltrans' Deterministic Response Spectrum Spreadsheet, Probabilistic Response Spectrum Spreadsheet (after USGS), 2008 USGS National Seismic Hazard Map, and the ARS Online web tools. The design response spectrum is the upper envelope of the spectral values of deterministic response spectrum and the probabilistic response spectrum, as well as the upper envelop of the results for V_{s30} of 420 m/sec in this case. The peak horizontal ground acceleration at the site is estimated as 0.48g. The recommended design response spectrum is shown on the Recommended Design Response Spectrum, Figure 7. The seismic analyses and calculations are presented in Appendix D.

10.3 Liquefaction

Liquefaction is a phenomenon in which loose, saturated, and relatively cohesionless soil deposits located beneath the groundwater table lose strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground accelerations, characteristics of the subsurface soil, in-situ stress conditions, and depth to groundwater.

Based on the City of San Diego Seismic Safety Map (2008) as shown on Figure 8, the proposed OC widening and associated wingwalls is located in Geologic Hazard Category 32. Hazard Category 32

represents areas with a low potential for liquefaction underlain by fluctuating groundwater with minor drainages. Based on the LOTBs prepared by SCS&T, the soil material at the site generally consisted of dense clayey sands and silty sands with varying amounts of gravels and cobbles overlying moderately hard sedimentary bedrock (Stadium Conglomerate and Friars Formation). Groundwater in borings (A-12-053 and A-12-054) was encountered in dense clayey sand and moderately hard sedimentary rock (Stadium Conglomerate).

We evaluated the potential for liquefaction at the site using methodology of Youd, *et al.* (2001), in general accordance with California Geologic Survey (CGS) *Special Publication 117A* (CGS, 2008). In accordance with Caltrans guidelines, we used the Maximum Credible Earthquake (MCE) Moment Magnitude of 7.5 and Peak Bedrock Acceleration (PBA) of 0.48g in our analysis. Based on the results of our analysis, the potential for liquefaction and associated impacts at the site is considered low.

10.4 Seismic-induced Settlement

As a result of strong ground motions, seismic-induced settlement may be expected in areas underlain by liquefiable soils, unconsolidated alluvial deposits, and/or loose granular soils. The potential for seismic-induced settlement at the site is considered very low due to the presence of primarily medium dense to very dense fill/alluvium over sedimentary bedrock (Stadium Conglomerate and Friars Formation) and the lack of liquefiable soil.

10.5 Tsunami

Tsunamis are large sea waves caused by submarine earthquakes, landslides, or volcanic eruptions. The potential of tsunamis to occur at the site is considered to be very low due to the relatively large distance from the coastline to the site.

10.6 Slope Stability

Planned earthwork will include fill slopes along portions of the approach embankments. Assuming that fill materials meet Caltrans' specifications for structure backfill, 2H:1V (horizontal to vertical) fill slopes should have an adequate factor of safety against deep-seated and shallow failures under static and seismic loading.

11. AS-BUILT FOUNDATION DATA

The existing Friars Road OC is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments. The abutments and bents are supported by driven steel H-piles (HP 10x57).

The existing OC extends approximately 390 linear feet with a typical width of approximately 114 feet. The relevant as-built data available to Geocon are listed below:

1. As-built Plan, *Earthquake Retrofit Project No. 272, Friars Road Overcrossing, Bridge No. 57-0595,* dated July 29, 1996.

2. As-Built Plan, *General Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 1 of 15,* dated December 2, 1968.

3. As-Built Plan, *Foundation Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 3 of 15,* dated December 2, 1968.

4. As-Built Plan, *Log of Test Borings, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 15 of 15,* dated December 2, 1968.

Based on the available original as-built data, the abutments and bent for the existing OC structure are supported by 65-ton capacity driven steel HP 10x57 piles with average tip elevations of 19.8 feet (Abutment 1), 15.1 feet (Bent 2), and 14.4 feet (Abutment 3) MSL. Approximate pile lengths at Abutment 1 range from approximately 16.5 to 28 feet. Approximate pile lengths at Bent 2 range from approximately 21 to 23.5 feet. Approximate pile lengths at Abutment 3 range from approximately, and 40.5 to 47 feet.

The existing OC structure was seismically retrofitted in 1996 that consisted of increasing the size of all existing pile caps at Bent 2 support location supported on higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations required seismic retrofit modifications.

All elevations for the existing structures used in this report are based on the datum of the referenced as-built plans.

Groundwater was encountered during the original explorations at approximate elevations of 34 and 39 feet MSL. The referenced as-built plans including the LOTB sheets are included in Appendix B.

12. FOUNDATION RECOMMENDATIONS

12.1 Ground Anchor Wall

12.1.1 Description

The SR 163 widening along the SB lanes on the west side beneath the existing Friars Road OC will require a ground anchor retaining wall and Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls. Specifically, the ground anchor retaining wall will be approximately 230.75 feet long with a proposed maximum height of approximately 20 feet. Bottom of wall elevations will range from approximately 34.28 feet to 45.22 feet MSL from south to north, respectively. The ground

anchor wall is proposed to have three vertical rows of ground anchors with maximum horizontal spacing of approximately 4½ to 14 feet at a proposed inclination of 10 degrees. The proposed ground anchor wall will be approximately 9 to 10 feet away from the existing Friars Road OC west abutment (Abutment 1) in order to accommodate the additional lanes for SR 163 SB direction. Geotechnical recommendations regarding the proposed Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls are presented in Section 12.2 of this report.

Borings A-12-053 and A-12-054 were drilled near the ground anchor retaining wall alignment using a truck-mounted drill rig. The subsurface conditions generally consisted of previously placed embankment fill ranging from approximately 6 to 14 feet in thickness overlying alluvium and/or sedimentary rock (Stadium Conglomerate and Friars Formation). The fill material generally consisted of dense silty sands and clayey sand with varying amounts of gravels and cobbles. Below the fill in Boring A-12-053, alluvium generally consisting of dense silty sand with varying amounts of gravels and cobbles. Groundwater was encountered in both borings at approximate Elevations of 25.5 feet (Boring A-12-053) and 29 feet (Boring A-12-054) MSL. Below the alluvium in Boring A-12-053 and fill in Boring A-12-054, sedimentary rock generally consisting of Stadium Conglomerate overlying Friars Formation. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate. Friars Formation generally consists of moderately hard massive sandstone and claystone.

12.1.2 Design Parameters

The designer of the ground anchor retaining wall should verify locations of existing piles associated with the west Abutment (Abutment 1) in order to ensure the proposed ground anchor locations are not in conflict with the existing structure.

Ground anchor retaining walls consist of installing ground anchors into slopes or excavations in a top-down construction sequence. Lagging or shotcrete facing should keep pace with excavation and anchor construction. Generally, the excavation should not be advanced deeper than 5 feet below the bottom of lagging or facing at any time. These unsupported gaps of up to 5 feet should only be allowed to stand for short periods of time (two days or less) in order to reduce the potential for soil sloughing and caving. Test sections may be completed during construction to observe if deeper cuts will stand. Based on the proposed ground anchor wall plans prepared by T. Y. Lin International, we understand that the wall will be constructed in three lifts with heights, top to bottom, of 5, 5, and 5 feet, respectively. We performed a stability analysis for the temporary excavation conditions during construction of each lift phase. The results of the stability analysis indicate global stability for each lift phase (Factor of Safety > 1.0); however, the granular soils could be prone to minor raveling and caving.

The proposed ground anchor retaining wall should have a minimum embedment depth of 3 feet into competent soil of the base of the wall as per Load and Resistance Factor Design (LRFD) *Bridge Design Specifications (BDS) C11.9.5.2.*

The proposed ground anchor retaining wall should be designed using the following soil properties, equivalent fluid pressures, allowable friction coefficient, and earthquake surcharge:

- Total Unit Weight of Soil (γ_{tot}) = 120 pounds per cubic foot
- Internal Angle of Friction (Φ) = 32.5 degrees
- Cohesion = 150 pounds per square foot
- Active Equivalent Fluid Pressure = 36 pounds per cubic foot
- Passive Equivalent Fluid Pressure = 300 pounds per cubic foot
- At-rest Equivalent Fluid Pressure = 55 pounds per cubic foot
- Allowable Friction Coefficient = 0.40
- Earthquake Surcharge = 0.24* γ_{tot}*H (where H is the design height of the ground anchor wall)

For the ground anchor retaining wall, we recommend using the apparent earth pressure distribution provided on *LRFD BDS Figure 3.11.5.7.1-1(b) Apparent Earth Pressure Distributions for Anchored Walls Constructed from the Top Down in Cohesionless Soils for Walls with Multiple Levels of Ground Anchors.*

Anchor pullout capacity is influenced by soil conditions, method of anchor hole advancement, hole diameter, bonded length, grout type, and grouting pressure. The contractor must determine the ultimate anchor bond stress based on the selected construction method.

The minimum horizontal spacing of anchors should be the larger of three times the diameter of the bonded zone or 5 feet as per LRFD *BDS Section 11.9.4.2*. If smaller spacings are required to develop the required load, consideration may be given to differing anchor inclinations between alternating anchors. Based on the wall geometry and location of the existing Abutment 1 piles, we recommend a minimum ground anchor unbonded length of 20 feet. The contractor must determine the minimum bonded length of the anchor based on the selected construction method as stated on the project plans.

Corrosion protection of the ground anchors is recommended since it will be a permanent structure. Corrosion protection shall be applied in accordance with the provisions of LRFD *Bridge Construction Specifications*, Section 6 *Ground Anchors*.

Settlement for the ground anchor retaining wall can cause reduction in anchor loads, and therefore should be considered in design. A settlement profile behind anchored walls for cohesionless soil is

presented in LRFD *BDS Figure C11.9.3.1-1*. The majority of the settlement is expected to be completed during construction.

The ground anchor retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces.

12.1.3 Ground Anchor Testing Program

Normally, ground anchors are contractor-designed and installed, and there are numerous construction methods available. Anchor capacity is a function of construction method, depth of anchor, batter, diameter of the bonded section, and the length of the bonded section. Experience has shown that the use of pressure grouting during formation of the bonded portion of the anchor will increase the rock-grout bond stress. A pressure grouting tube should be installed during the construction of the anchor. Post grouting should be performed if adequate capacity cannot be obtained by other construction methods. Non-shrink grout with a minimum 28-day compressive strength of 4,000 psi should be used.

Two types of load tests should be performed on the ground anchors. Load testing should be performed in accordance with the guidelines of the Federal Highway Administration (FHWA 1999) or approved equivalent procedures. Performance tests are performed on a limited number of anchors to confirm the contractor's design, installation methods, and capacity. Proof tests are typically performed on the remaining anchors to verify adequate capacity.

Following a successful load test, we recommend that anchors be locked off at 80% of the anchor's allowable working load. Anchor test acceptance criteria should be established in the project plans and specifications. Acceptance criteria should include minimum and maximum elongation (displacement) and maximum allowable creep movement. Anchor stressing/testing should be conducted only after sufficient curing and strength has developed within the anchor grout. Anchors that fail to meet project specified test criteria should be locked off at an appropriate load and additional anchors should be constructed. Appropriate corrosion protection should be provided for the anchors.

12.2 Type 1 (Case 2) Retaining Wall

The proposed cantilever type retaining walls will connect at both the north and south ends of the ground anchor wall and extend around the Abutment 1 embankment. The cantilever type retaining walls will consist of a Caltrans Standard Type 1 Case 2 (Caltrans Standard Plan RSP B3-1B) supported on a spread footing. The proposed cantilever type retaining walls along the north and south ends of the ground anchor retaining wall will be approximately 54.75 feet and 98 feet in length, respectively, with a maximum height of approximately 16 feet. Bottom of footing elevations range from approximately 34.95 feet to 48.14 feet MSL.

Borings A-12-053 and A-12-054 were drilled near the Type 1 retaining walls alignment using a truck-mounted drill rig. The subsurface conditions generally consisted of previously placed embankment fill ranging from approximately 6 to 14 feet in thickness overlying alluvium and/or sedimentary rock (Stadium Conglomerate and Friars Formation). The fill material generally consisted of dense silty sands and clayey sand with varying amounts of gravels and cobbles. Below the fill in Boring A-12-053, alluvium generally consisting of dense silty sand with varying amounts of gravels and cobbles. Groundwater was not encountered in both borings at approximate Elevations of 25.5 feet (Boring A-12-053) and 29 feet (Boring A-12-054) MSL. Below the alluvium in Boring A-12-053 and fill in Boring A-12-054, sedimentary rock generally consisting of Stadium Conglomerate overlying Friars Formation. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate. Friars Formation generally consists of moderately hard massive sandstone and claystone. The Type 1 retaining walls bottom of footings will be located within existing fill, alluvium, or formational material.

12.2.1 Foundation Subgrade

The alluvium and formational material is considered suitable for direct support of the proposed Type 1 retaining walls. The existing fill is not suitable for direct support of the Type 1 retaining wall foundations. Therefore, possible removals of existing fill may be necessary to provide suitable foundation support. If existing fill is encountered, we recommend that the Type 1 retaining wall footings be supported on a minimum of 2 feet of structural fill. This will require remedial grading in the form of removal and re-compaction of at least 2 feet below footings. The fill below the footings and the outer portion of the embankment fill should consist of structural fill compacted to a minimum of 95 percent of the maximum density.

12.2.2 Design Parameters

The proposed Caltrans Standard Type 1 (Case 2) cantilever type retaining wall may be supported on a conventional spread footing (as detailed on Caltrans Standard Plan RSP B3-1B) founded on undisturbed alluvium, underlying formational material, or structural fill as recommended herein.

Retaining walls capable of rotating 0.001 radians can be designed using active earth pressures. Walls supporting level backfill should be designed for an active equivalent fluid pressure of 36 pcf in accordance with Caltrans' *Bridge Design Specifications* 3.20.1. Walls supporting 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent of 2 feet of fill soil (unit weight of 120 pcf) should be added. Soil placed for retaining wall backfill should meet the requirements outlined in Section 12.3 of this report.

Resistance to lateral loads will be provided by friction along the base of the wall foundation and/or by passive earth pressure against the front face of the footing. The allowable passive pressure should be

taken as 300 pcf assuming a horizontal surface extends at least 5 feet or three times the depth of the footing, whichever is deeper; beyond the face of the footing for walls. An allowable coefficient of friction of 0.40 is recommended for footings on properly compacted fill, relatively undisturbed alluvium, or formational materials. This friction coefficient may be combined with the allowable passive earth pressure when determining resistance to lateral loads. The upper 12 inches of soil in front of the wall should not be relied on for passive resistance unless the ground surface is covered with asphalt or concrete.

An allowable bearing capacity of 3,000 pounds per square foot (psf) can be used provided that wall heights do not exceed 20 feet and the footings bear entirely in compacted fill, relatively undisturbed alluvium, or formational materials. The total settlement of wall footings in structural fill imposing the maximum toe pressure of 2,700 psf is not expected to exceed one inch. Differential settlement is expected to be 50 percent of the total settlement. The majority of the settlement is expected to be completed during construction.

All wing walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces. The drainage system should consist of weepholes or backdrains. The above recommendations assume a properly compacted granular backfill material with no hydrostatic forces. If conditions different than those described are anticipated, or if specific drainage details are desired, Geocon should be contacted for additional recommendations.

12.3 Wall Backfill

All grading should be performed in conformance with *Sections 6-3, 19-3, 19-5*, and *19-6* of the Caltrans Standard Specifications or equivalent. Backfill placed behind retaining walls should have a very low- to low-expansion potential. The extent and placement of the low-expansive soils should conform to Caltrans Standard Specifications 19-5.03. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted.

All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216. All compaction on the project should be based on this test method. Backfill should be compacted in horizontal lifts not exceeding 8 inches (loose thickness) and brought to final design elevations. Each lift should be moisture-conditioned and compacted. Backfill should be benched into existing embankment fill as the fill is placed. Benches should extend at least 3 feet laterally into the existing embankment fill.

12.3.1 Additional Considerations

Consideration should be given to the use of surface treatments to minimize surficial erosion until adequate erosion-resistant vegetation can become established. All roadway drainage should be

directed to appropriate collection and discharge facilities to prevent run-off from flowing over the tops of slopes.

13. GENERAL NOTES TO DESIGNER

This report is prepared based on the currently available project information including the proposed structures and foundations described herein. Geocon must be contacted for review and possible revised recommendations if the proposed structures and foundations are changed.

14. CONSTRUCTION CONSIDERATIONS

Areas to be developed should be cleared and stripped of obstructions, trees, bushes, grass, roots, and the upper few inches of soil containing organic debris. Soils/organics removed by stripping can be transported offsite or stockpiled for use in landscaping. Existing drainage and utility lines or other existing subsurface structures that are not to be utilized, if any, should be removed, destroyed or abandoned in compliance with applicable regulations.

Relevant specifications and important design criteria that were used in the geotechnical design of the foundations include:

- *Sections 6-3, 19-3, 19-5,* and *19-6* of Caltrans' *Standard Specifications*. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted. All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216.

- Remedial grading should be performed to provide a relatively uniform soil mat beneath the footing and no oversized rock (with a maximum dimension of 12 inches or greater) within 5 feet of the footing.

- Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 36 pcf in accordance with Caltrans' *Bridge Design Specifications* 3.20.1. Walls supporting 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf.

- All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces.

Excavation and trench depths greater than 5 feet will need to be sloped and shored in accordance with Cal-OSHA guidelines for the safety and stability of adjacent existing improvements. Existing fill and alluvium, if encountered, can be considered as OSHA Type B soil for excavation purposes (Type C where seepage is freely flowing). For temporary construction purposes, a slope ratio of 1H:1V may be used for cuts in existing fill or alluvium not exceeding 20 feet to a depth five feet above the water table. Formational materials can likely be considered a Type A soil with a slope ratio of ¾ H:1V. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements.

Excavations steeper than those recommended or closer than 15 feet from an existing improvement should be shored in accordance with applicable OSHA codes and regulations.

Temporary excavations should be in compliance with applicable governing agency regulations. The Contractor should also execute a monitoring program for structures in proximity to deep excavations so that appropriate modifications to the excavation/shoring system can be implemented to minimize the surface deflection or structure damage in a timely manner, if warranted.

Excavation of the onsite materials can be accomplished using conventional heavy-duty excavation equipment. Excavation difficulty should be expected within the very dense and hard formational materials. Heavy ripping will generate oversize materials not suitable for backfill.

The existing bridge footings and structures should be protected and monitored during proposed bridge widening and site improvements.

Foundation excavations should be observed by a representative of Geocon prior to the placement of reinforcing steel and concrete. If unanticipated soil conditions are encountered, foundation modifications may be required.

Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that subsurface well-cemented zones should be expected within the formational materials. These areas will require rock-breaking equipment. In addition, buried hard rock requiring special handling should be anticipated. Contract documents should specify that the contractor mobilize equipment capable of excavating, breaking, and drilling hard rock.

15. DISCLAIMER AND CONTACT INFORMATION

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by Dokken Engineering and T. Y. Lin International. If any changes are made during final project design, Geocon should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Mr. Joe Vettel, 858-558-6900, at the San Diego Office of Geocon.

16. CLOSURE

16.1 Foundation and Grading Plan Review

Geocon should review the grading plans and foundation plans prior to final design submittal to evaluate whether additional analysis and/or recommendations are required.

16.2 Limitations and Uniformity of Conditions

The recommendations of this report pertain only to the site investigated and are based upon the assumption that soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon.

This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years. Our professional services were performed in accordance with generally acceptable geotechnical engineering principles and practices in the site area at this time. No warranty is provided, express or implied.

17. REFERENCES

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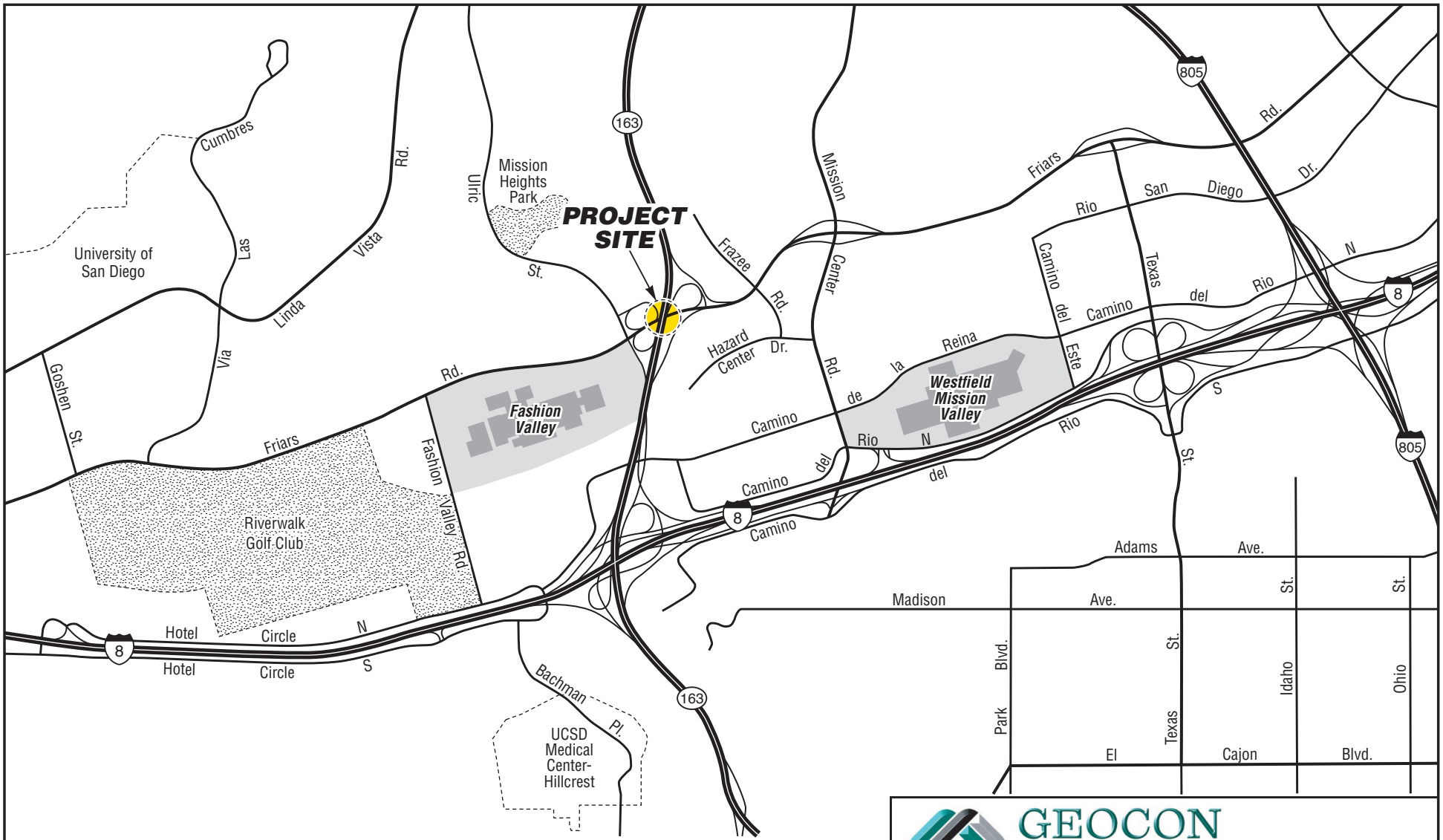

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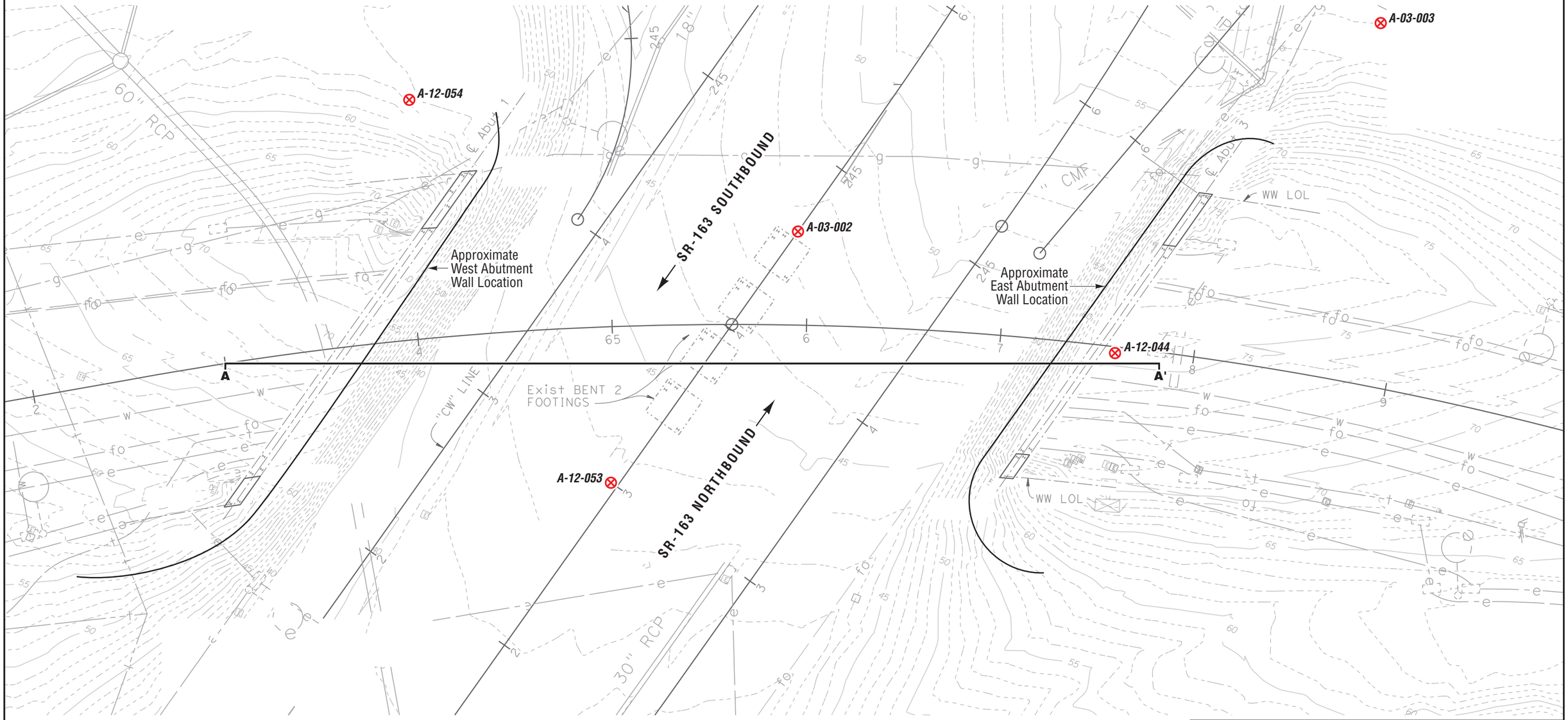
West Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

VICINITY MAP

G1447-52-01	August 2014	Figure 1



LEGEND:

A-12-053 ⊗ Approximate Boring Location

A — A' Approximate Cross-Section Location

0 50

Scale in Feet

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

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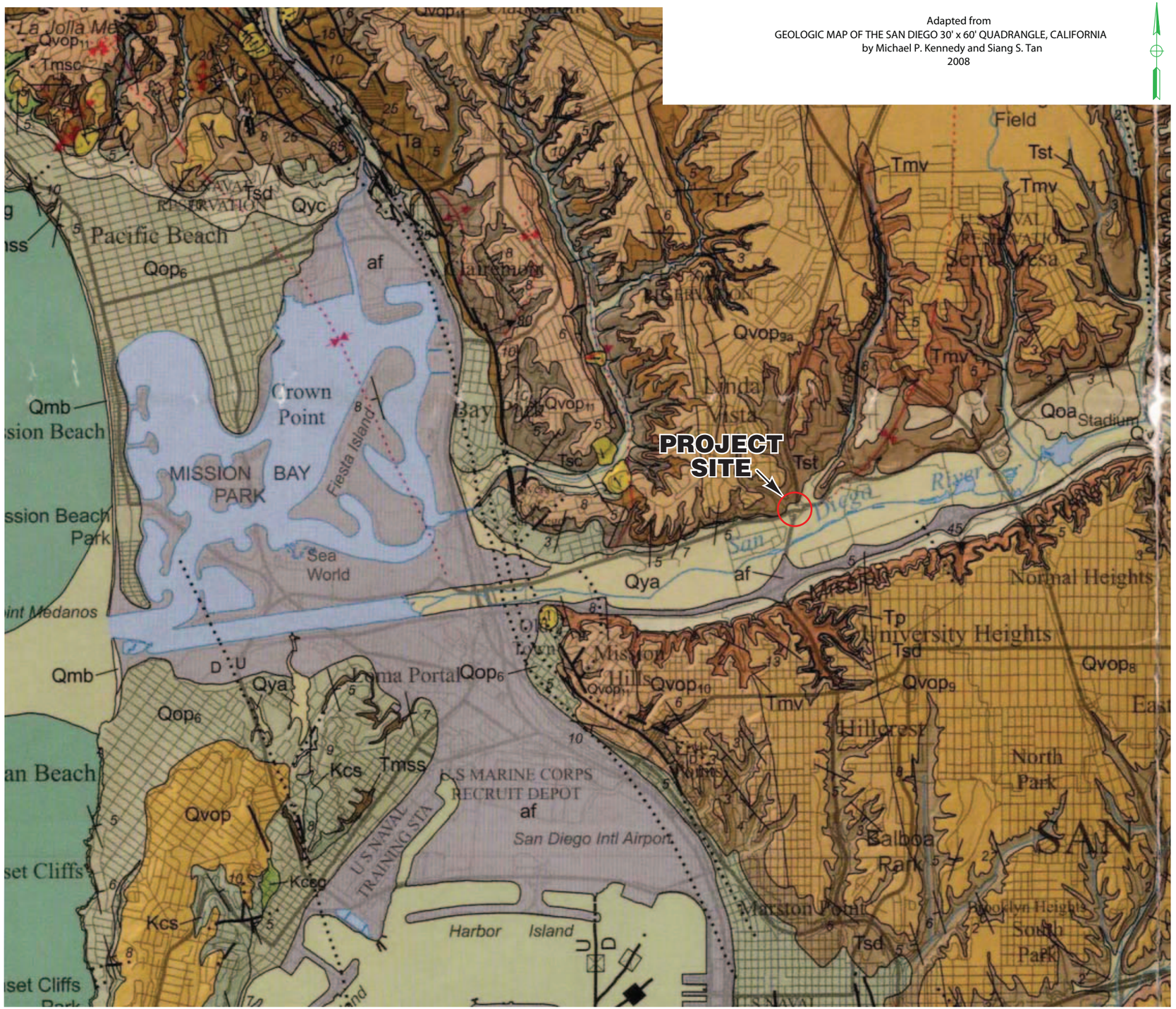
West Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

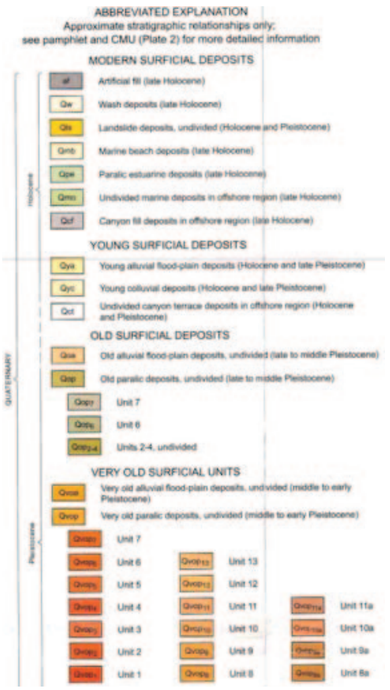
SITE PLAN

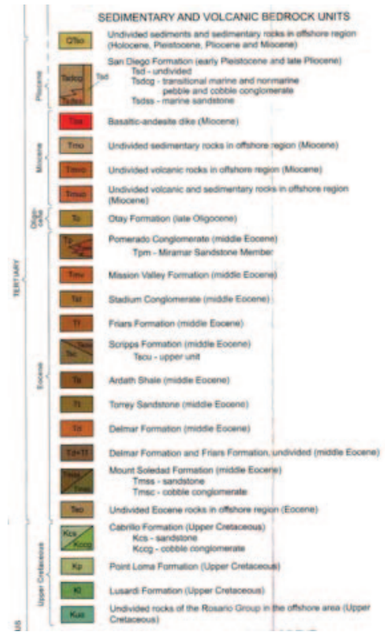
G1447-52-01	August 2014	Figure 2

Adapted from
GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA
by Michael P. Kennedy and Siang S. Tan
2008



NO SCALE





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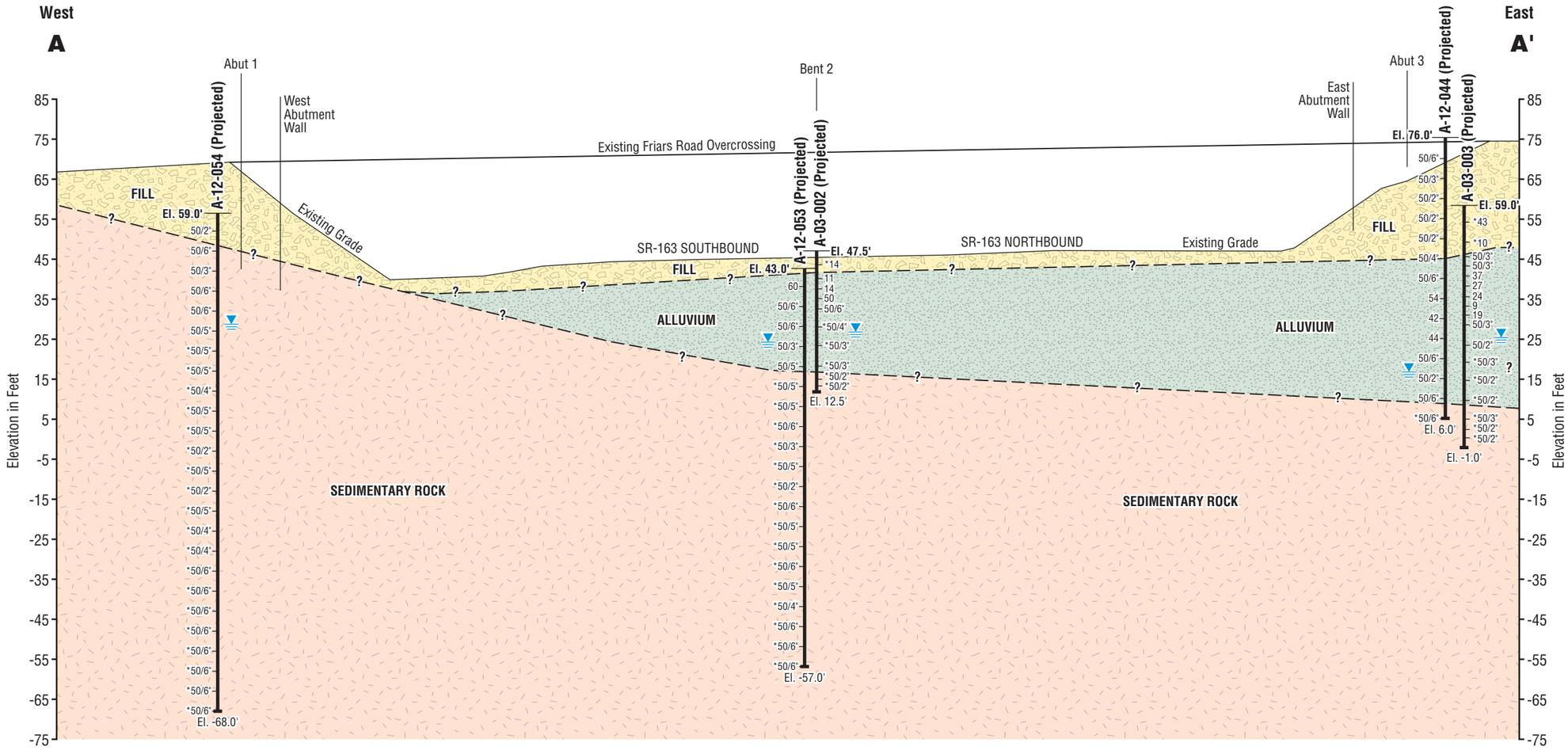
West Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL GEOLOGIC MAP

G1447-52-01	August 2014	Figure 3



LEGEND:

A-03-002 (Projected) — Approximate Exploratory Boring Location

50/4" — Field Blow Count (California Modified Sampler/*SPT Sampler)

Groundwater Observed in Boring

? — — — — Approximate Geologic Contact (Queried Where Uncertain)

EXISTING FILL

ALLUVIUM

SEDIMENTARY ROCK
(Stadium Conglomerate & Friars Formation - Interbedded Sandstone & Claystone)

Vertical Scale in Feet: 30, 0

Horizontal Scale in Feet: 0, 40

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

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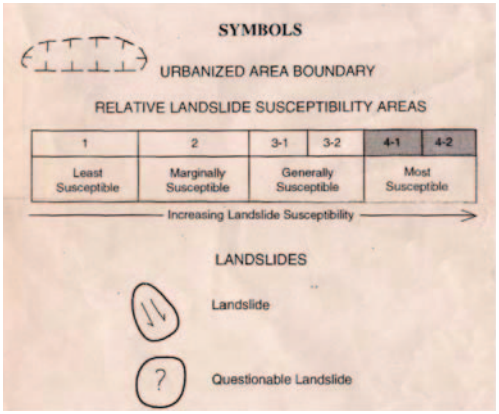
West Ground Anchor Wall

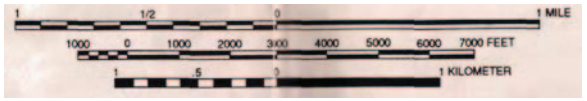
Friars Road/SR-163 Interchange Project
San Diego, California

GEOLOGIC CROSS-SECTION A – A'

G1447-52-01	August 2014	Figure 4



LANDSLIDE HAZARDS IN THE NORTHERN PART OF
THE SAN DIEGO METRPOLITAN AREA,
SAN DIEGO COUNTY, CALIFORNIA
By Siang S. Tan
1995
LA JOLLA QUADRANGLE



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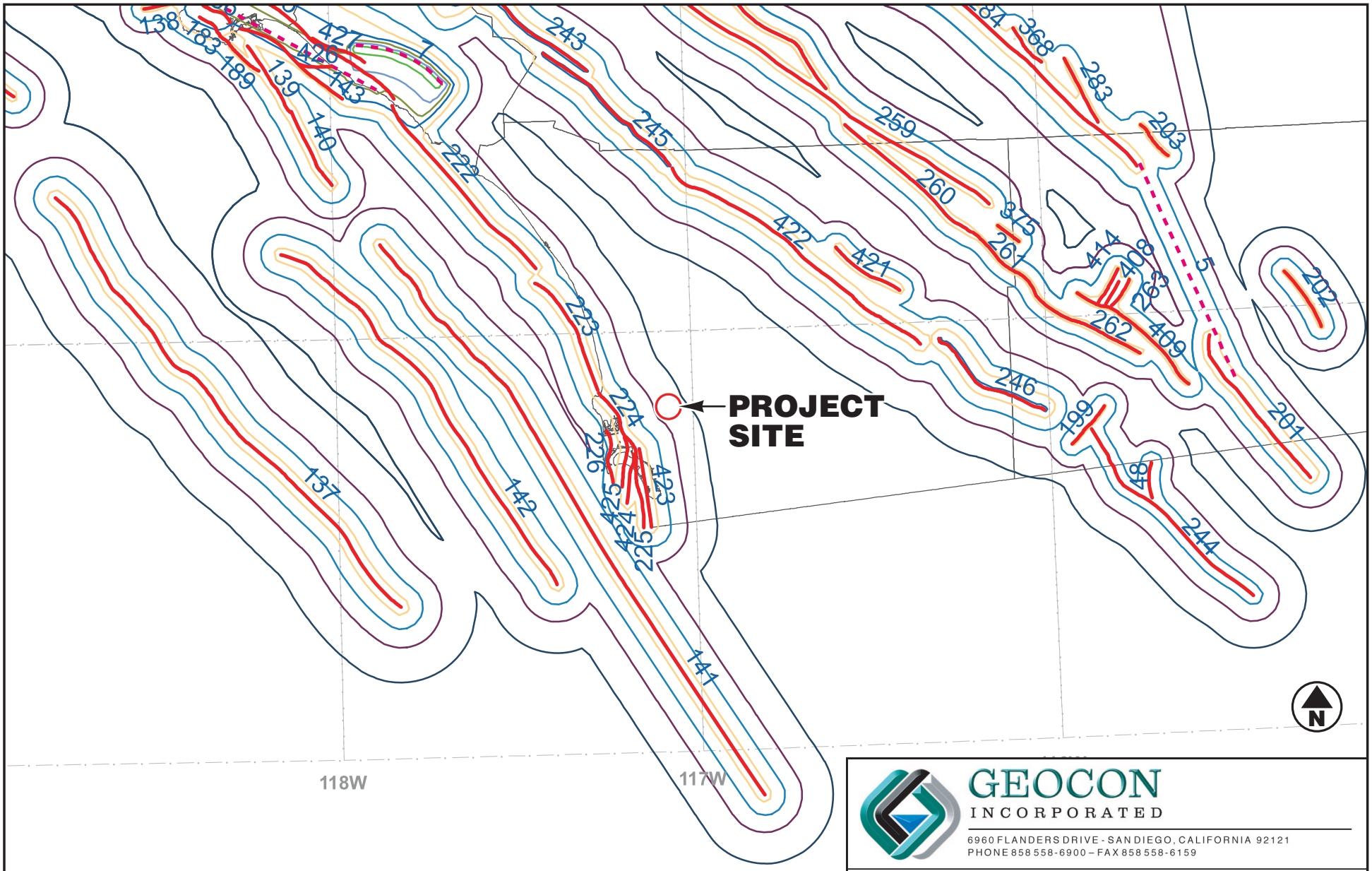
San Diego, California

LANDSLIDE HAZARD MAP

G1447-52-01	August 2014	Figure 5



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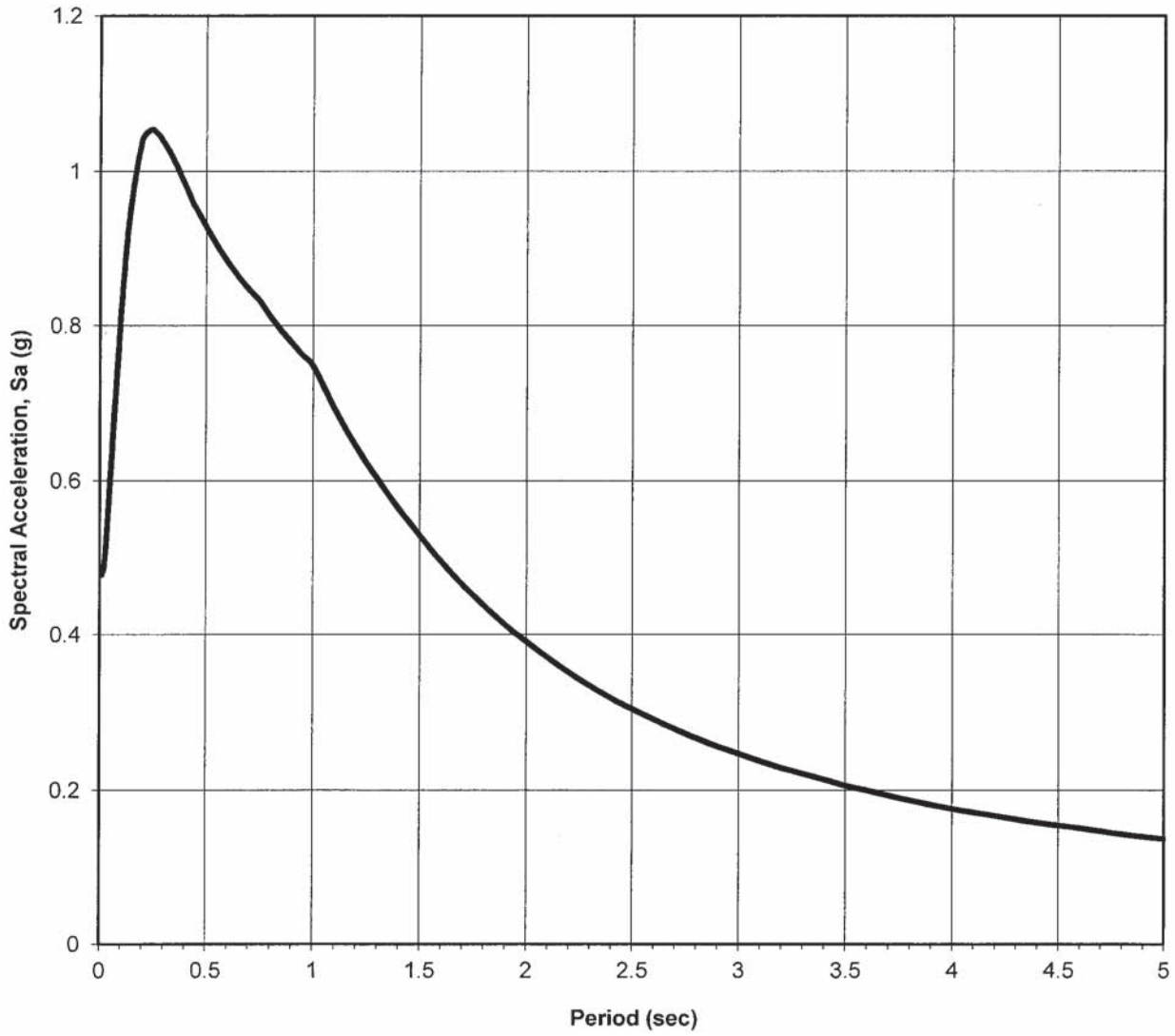
West Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL FAULT MAP

G1447-52-01	August 2014	Figure 6



RECOMMENDED DESIGN RESPONSE SPECTRUM

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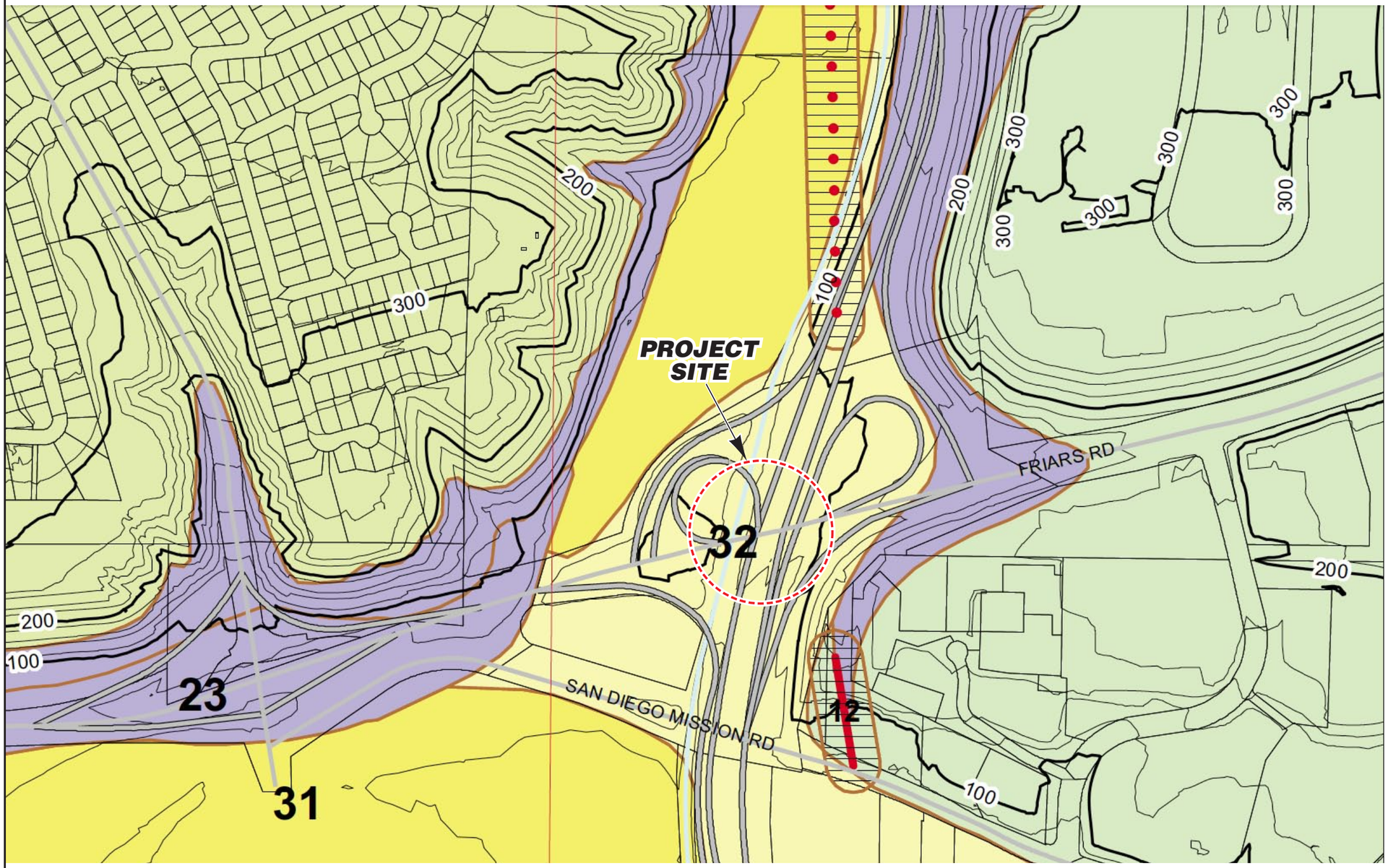
West Ground Anchor Wall		
Friars Road/SR-163 Interchange Project San Diego, California		
G1447-52-01	August 2014	Figure 7



Geologic Hazard Categories

FAULT ZONES

- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES

- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS

- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION

- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS

- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN

- 51 Level mesas -- underlain by terrace deposits and bedrock nomimal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

N

0 1000

Scale in Feet

Ref: City of San Diego, *Seismic Safety Study Geologic Hazards and Faults*, 4/3/08

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West Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

City of San Diego Seismic Safety Map

G1447-52-01	August 2014	Figure 8

APPENDIX A

APPENDIX A

LOG OF TEST BORINGS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL
(BRIDGE NO. 57E0126)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

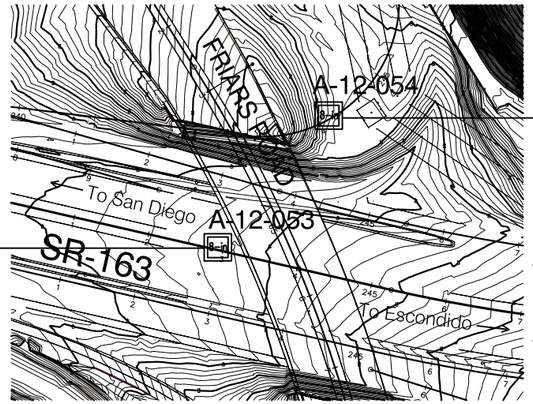
PLANS APPROVAL DATE

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

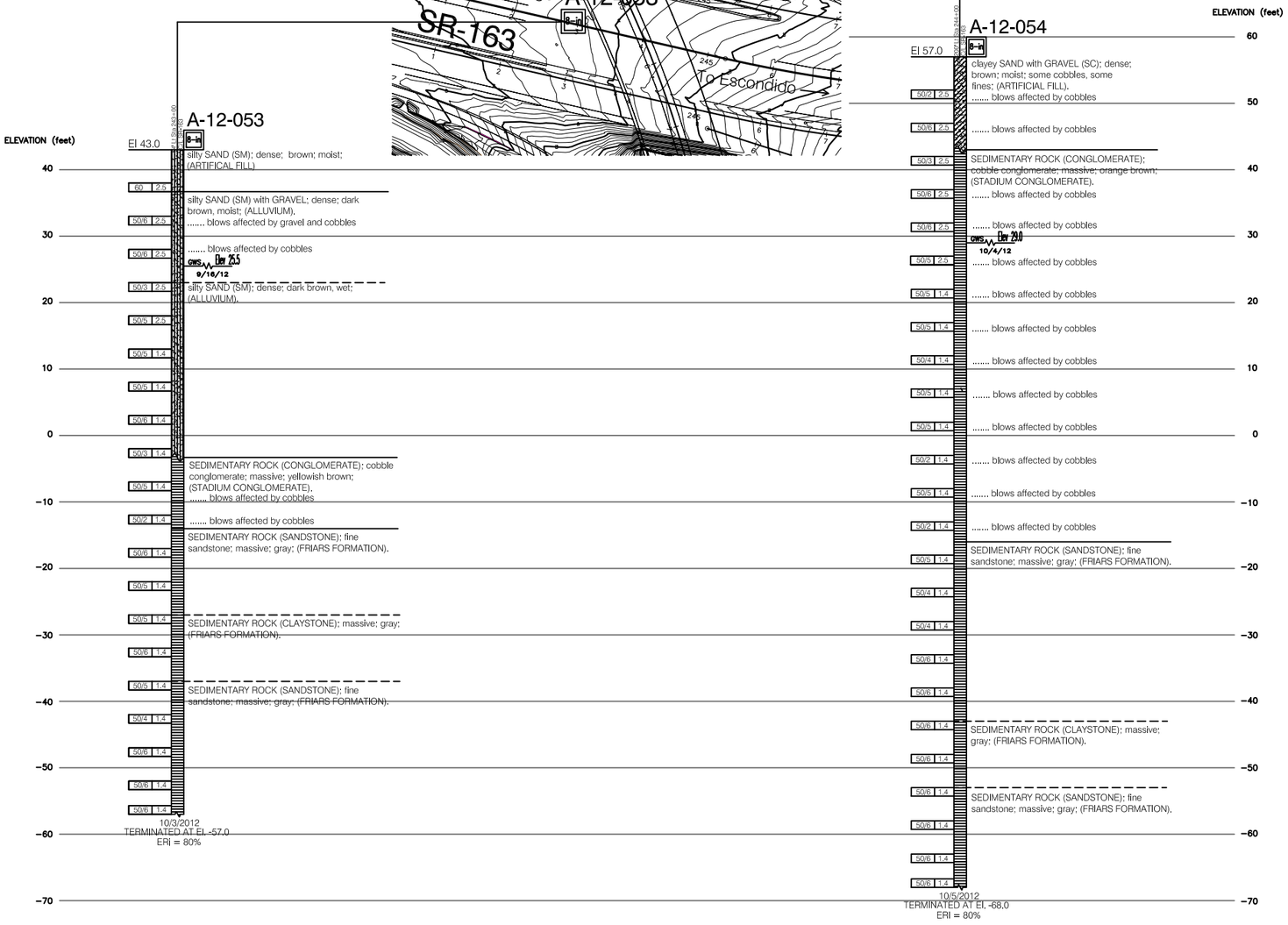
CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120

PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.

X DESIGN OVERSIGHT	DRAWN BY	Eddie Liang, PE Andrew K. Neuhaus, PG	Andrew K. Neuhaus, PG FIELD INVESTIGATION BY:		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57E0126
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 10/03/12 – 10/05/12				POST MILES 4.4

WEST GROUND ANCHOR WALL

LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: PROJECT NUMBER & PHASE: CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES: X

SHEET 17 OF 17

FILE => $REQUEST

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

APPENDIX B

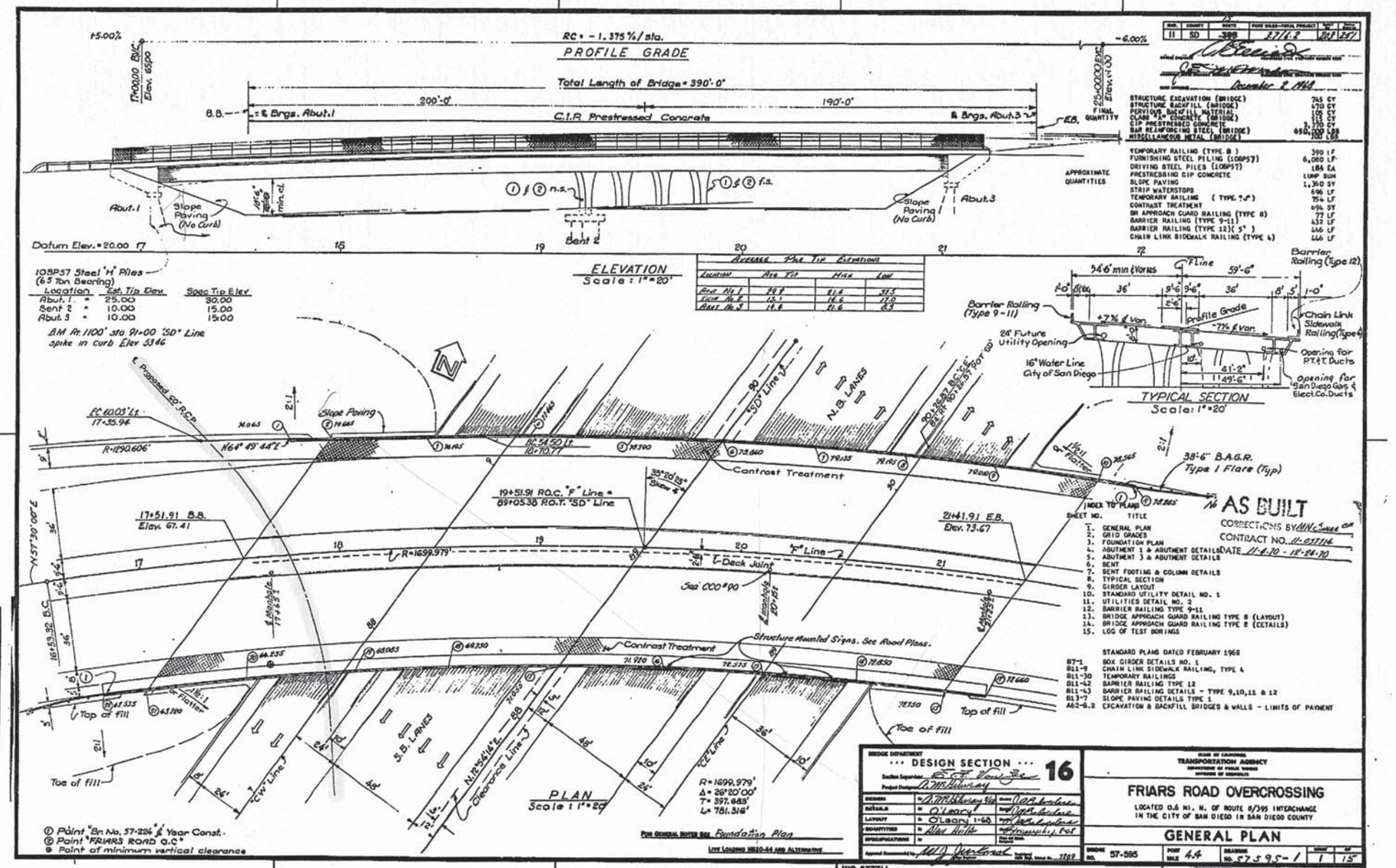
APPENDIX B

AS-BUILT PLANS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL
(BRIDGE NO. 57E0126)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



Location	Est. Tip Elev.	Spec Tip Elev
Abut. 1	25.00	30.00
Bent 2	10.00	15.00
Abut. 3	10.00	15.00

BM Rt. 1100' sta 91+00 "SD" Line spike in curb Elev 53.46

Average Pile Tip Elevations			
Location	Ave Tip	Min	Low
Abut No 1	29.8	21.4	33.5
Bent No 2	15.1	14.6	17.0
Abut No 3	14.6	21.6	8.5

STRUCTURE EXCAVATION (BRIDGE)	745 CY
STRUCTURE BACKFILL (BRIDGE)	470 CY
PERVIOUS BACKFILL MATERIAL	105 CY
CLASS "A" CONCRETE (BRIDGE)	111 CY
CIP PRESTRESSED CONCRETE	3,770 CY
BAR REINFORCING STEEL (BRIDGE)	650,000 LBS
MISCELLANEOUS METAL (BRIDGE)	700 LBS
TEMPORARY RAILING (TYPE 8)	390 LF
FURNISHING STEEL PILING (10BP57)	6,080 LF
DRIVING STEEL PILES (10BP57)	184 EA
PRESTRESSING CIP CONCRETE	LUMP SUM
SLOPE PAVING	1,360 SY
STRIP WATERSTOPS	696 LF
TEMPORARY RAILING (TYPE 7-A)	754 LF
CONTRAST TREATMENT	694 SY
BR APPROACH GUARD RAILING (TYPE 8)	77 LF
BARRIER RAILING (TYPE 9-11)	432 LF
BARRIER RAILING (TYPE 12)(5")	446 LF
CHAIN LINK SIDEWALK RAILING (TYPE 4)	446 LF

SHEET NO.	TITLE
1.	GENERAL PLAN
2.	GRID GRADES
3.	FOUNDATION PLAN
4.	ABUTMENT 1 & ABUTMENT DETAILS
5.	ABUTMENT 3 & ABUTMENT DETAILS
6.	BENT
7.	BENT FOOTING & COLUMN DETAILS
8.	TYPICAL SECTION
9.	GIRDER LAYOUT
10.	STANDARD UTILITY DETAIL NO. 1
11.	UTILITIES DETAIL NO. 2
12.	BARRIER RAILING TYPE 9-11
13.	BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)
14.	BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)
15.	LOG OF TEST BORINGS

STANDARD PLANS DATED FEBRUARY 1968

B7-1	BOX GIRDER DETAILS NO. 1
B11-9	CHAIN LINK SIDEWALK RAILING, TYPE 4
B11-30	TEMPORARY RAILINGS
B11-42	BARRIER RAILING TYPE 12
B11-43	BARRIER RAILING DETAILS - TYPE 9,10,11 & 12
B13-7	SLOPE PAVING DETAILS TYPE 1
A62-6.2	EXCAVATION & BACKFILL BRIDGES & WALLS - LIMITS OF PAYMENT

① Paint "Br. No. 57-224" & Year Const.
② Paint "FRIARS ROAD O.C."
③ Point of minimum vertical clearance

FOR GENERAL NOTES SEE Foundation Plan

LIVE LOADING HS20-44 AND ALTERNATIVE

BRIDGE DEPARTMENT
··· DESIGN SECTION ··· 16

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOCATED 0.6 MI. N. OF ROUTE 8/395 INTERCHANGE IN THE CITY OF SAN DIEGO IN SAN DIEGO COUNTY

GENERAL PLAN

BRIDGE NO. 57-595 | POST MILE 4.4 | DRAWING NO. 57595-1 | SHEET 1 OF 15

WO 037711
CU 11206

Disregard prints bearing earlier revision dates

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A1000797

203

DIST.	COUNTY	ROUTE	POST MILE/KILO-POSTA PREFIX	SHEET NO.	TOTAL SHEETS
11	SD	395	31/12	204	397

E. F. Harrison
Licensed to Practice Civil Engineering in the State of California
DATE APPROVED December 8, 1970

'F' Line

72.15 72.53 72.88 73.23 73.55 73.87 74.18 74.48 74.78 75.06 75.33 75.59 75.83 76.07 76.28 76.49 76.68 76.86 77.02 77.17 77.30 77.43 77.53 77.63 77.71 77.78 77.82 77.87 77.92 77.92 77.92 77.89 77.86 77.81 77.76 77.69 77.60 77.50 77.39 77.27 77.13 76.97 76.81 76.63

65.97 66.44 66.89 67.33 67.75 68.16 68.56 68.94 69.31 69.67 70.01 70.34 70.65 70.95 71.84 71.51 71.77 72.02 72.25 72.47 72.67 72.86 73.04 73.20 73.35 73.49 73.61 73.72 73.81 73.89 73.96 74.01 74.05 74.08 74.09 74.09 74.07 74.04 74.02 73.98 73.92 73.87 73.79 73.69 73.59 73.45 73.31

17 18 19 20 21 22

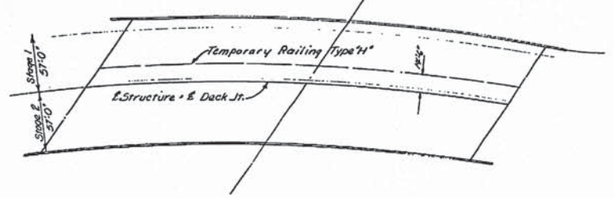
8.8'↑ 50 Lin.↑ 68'↑

Edge of Deck

60.37 60.78 61.09 61.45 61.82 62.19 62.56 62.92 63.30 63.67 64.04 64.41 64.78 65.18 65.50 65.85 66.17 66.49 66.79 67.08 67.35 67.61 67.85 68.09 68.30 68.51 68.70 68.88 69.04 69.19 69.32 69.45 69.55 69.65 69.74 69.80 69.85 69.89 69.91 69.93 69.92 69.91 69.88 69.83 69.78 69.71 69.62

Edge of Deck

Note:
Elevations are figured radially from profile line at 10' stations along 'F' Line.
These elevations do not include camber.



STAGE CONSTRUCTION

AS BUILT
CORRECTIONS BY M.W. Jones CM
CONTRACT NO. 037114
DATE 11-4-70 12-28-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

204

ENGINEERING DEPARTMENT
DESIGN SECTION 16
Project Engineer Orrie Hilburn
DESIGNED W. Orrie Hilburn 6/69
CHECKED Richard A.
DETAILS W. Chiaretti 3/70
CHECKED Dana Sanders
QUANTITIES W. J. Mike Bell
CHECKED Jerry Hill 7/68

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

GRID GRADES

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57-595-13	2	15

WO
CU

Changed plan bearing and/or revision dates → 11/4/70 12/28/70

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DATE 4/6/71 SIGNATURE [illegible] TITLE Asst.

FILMPDF - www.fastfilm.com
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50' 0 200 400 600
SCALE 1" = 50' 0
SCALE 1" = 50'

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	27/6.2	205	351

December 2, 1968

CURVE DATA

R = 1699.979'
Δ = 26°20'00"
T = 397.683'
L = 781.316'
⊙ N 219,787.481 / E 1,720,790.395

R = 2049.320'
Δ = 35°10'09"
T = 649.48'
L = 1,257.91'

R = 2121.319'
Δ = 34°57'42"
T = 668.069'
L = 1,294.421'
⊙ N 221,472.167 / E 1,718,182.847

R = 149.996'
Δ = 135°13'02"
T = 364.06'
L = 353.99'

R = 200.000'
Δ = 41°30'09"
T = 75.778'
L = 144.871'

AS BUILT
CORRECTIONS BY ______
CONTRACT NO. 037714
DATE 11-4-70

BENCH MARKS

B.M. #61 Elev. 36.84'
Conc. ℄ Mon. Sta. 78+00.00 POT. "P"
N 220,221.206 E 719,888.557

B.M. # 8-8 Elev. 46.97'
Conc. ℄ Mon. Sta. 90+50.77 B.C. "P"
N 221,440.188 E 720,167.826

NOTES

⌀ Denotes spot elev.
For Abutment dimensions not shown see Abutment sheet
✲ Denotes electrolier.
+ = Plumb piles ; ǂ = Battered piles.
▭ Denotes Bottom of Footing Elevation.

205

GENERAL NOTES

DESIGN: A A S.H.O. DATED 1965 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.

LIVE LOADING: HS20-44 AND ALTERNATIVE

REINFORCED CONCRETE: f_s = 20,000 P.S.I., N = 10
f_c = 1,200 P.S.I.

CONTOURS CHECKED & VERIFIED IN FIELD
Date: 11/1/68
By: R.P. Davis

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

	DRAWN	CHECKED
DATE	2-28-68	2-28-68
BY	A. FUKUMORI	O.W. McHinty

BRIDGE DEPARTMENT
DESIGN SECTION 16

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

FOUNDATION PLAN

BRIDGE NO. 57-595 | POST MILE 4.4 | SCALE 1" = 20' | SHEET 3 OF 15

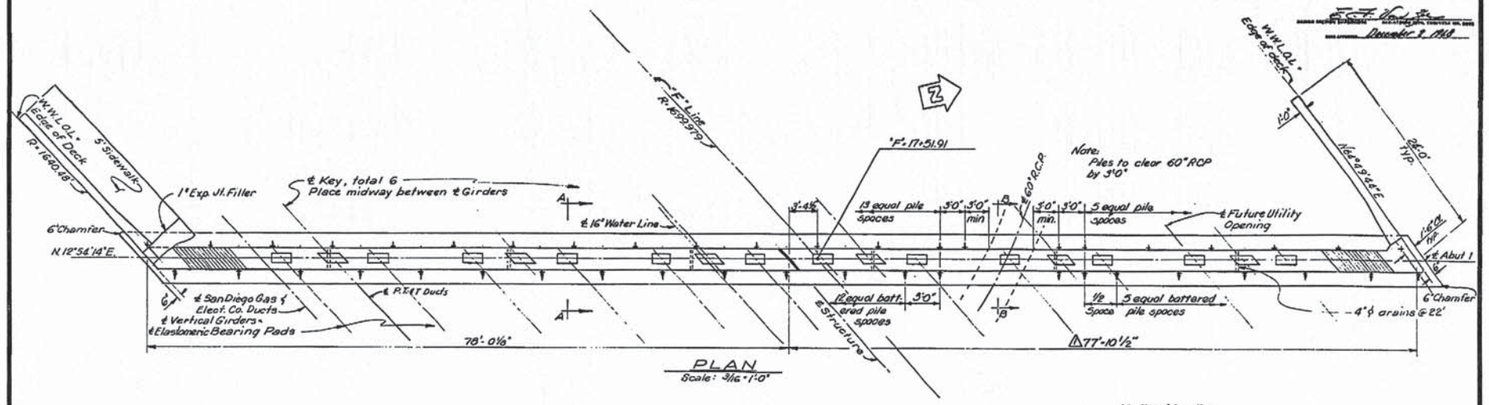
WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE ______ TITLE ______

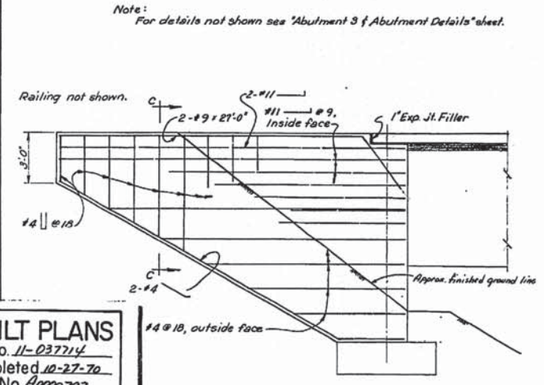
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST.	COUNTY	ROUTE	POST MILES—LOCAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37K.2	204	297

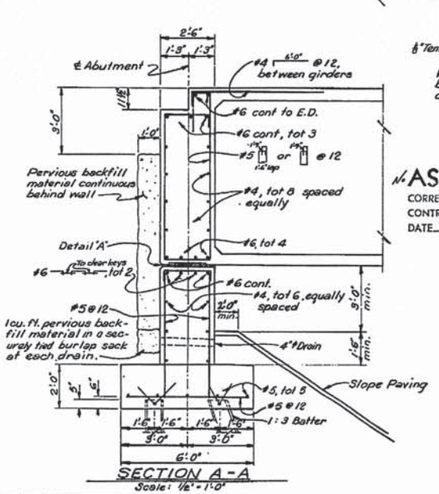
DESIGNED UNDER THE SUPERVISION OF ROBERT L. CONNELLY, REGISTERED CIVIL ENGINEER
DATE APPROVED December 2 1968



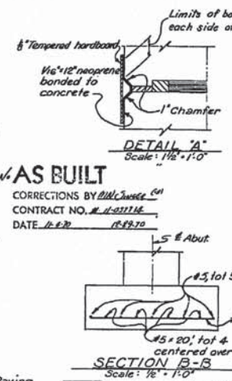
Note: For details not shown see "Abutment 3 & Abutment Details" sheet.



WINGWALL ELEVATION
Scale: 3/8" = 1'-0"

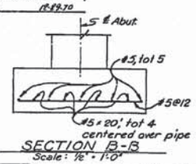


SECTION A-A
Scale: 1/2" = 1'-0"



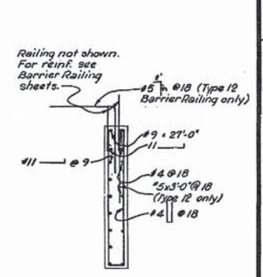
DETAIL "A"
Scale: 1 1/2" = 1'-0"

AS BUILT
CORRECTIONS BY Bill Swede Co
CONTRACT NO. 11-037714
DATE 11-6-70 12-18-70



SECTION B-B
Scale: 1/2" = 1'-0"

Railing not shown. For reinf. see Barrier Railing sheets.



SECTION C-C
Scale: 1/2" = 1'-0"

MARK	DATE	DESCRIPTION	BY	CHK
1	Wilco	Dimension Changed	DMG	EWE

REVISIONS

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

206

DESIGN SECTION 16

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 1 & ABUTMENT DETAILS

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		37595-14	4	13

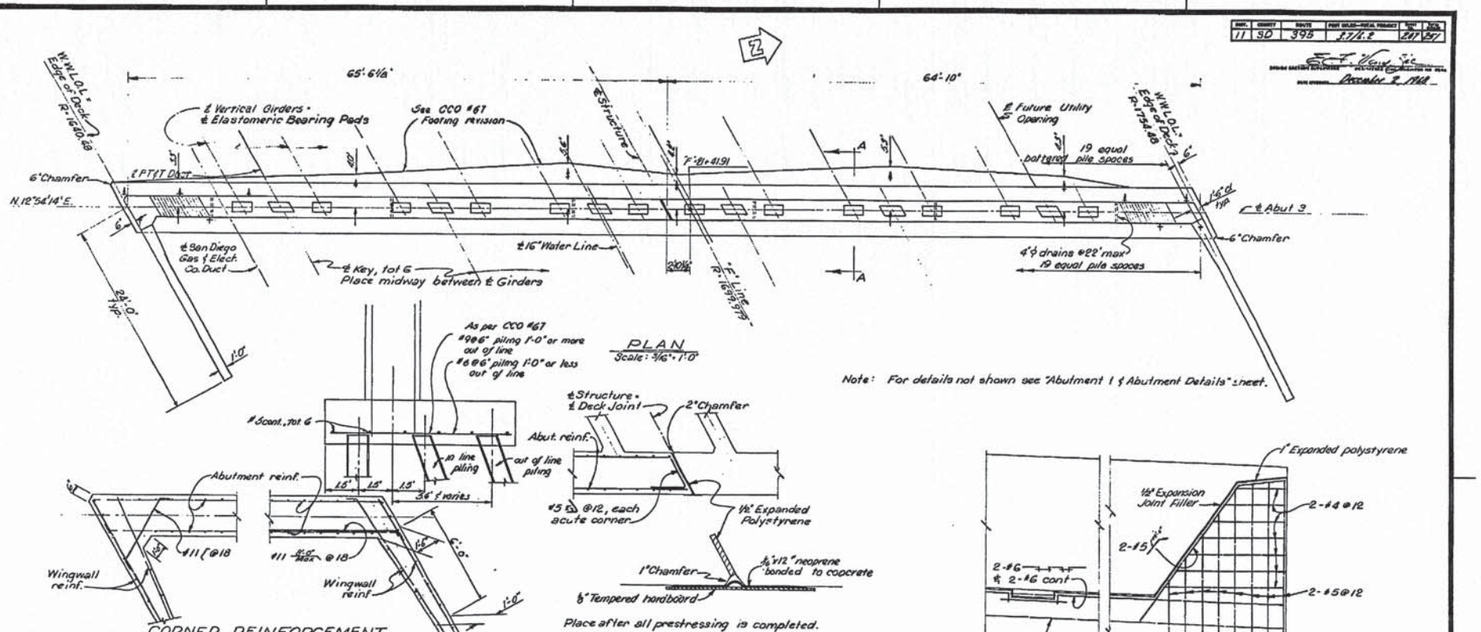
WO CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/01 SIGNATURE [illegible] TITLE [illegible]

DIST.	COUNTY	ROUTE	POST MILES—FISCAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	37/4.2	207	257

E. T. Wolf — Structure Engineer — December 2, 1968



Note: For details not shown see "Abutment 1 & Abutment Details" sheet.

AS BUILT PLANS
Contract No. 11-037214
Date Completed 10-27-70
Document No. A000787

AS BUILT
CORRECTIONS BY Wilsmeyer CM
CONTRACT NO. 11-037214
DATE 11-4-70 11-19-70

DESIGN SECTION 16

Project Engineer	Wm. Hellwig
CHANGES	W. M. Hellwig 9/68
DETAILS	J. Schneider 3/68
QUANTITIES	W. Allen Bullis Drawing 11/68

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 3 & ABUTMENT DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-695		37595-15	5	15

Merged prior bearing seat revision data

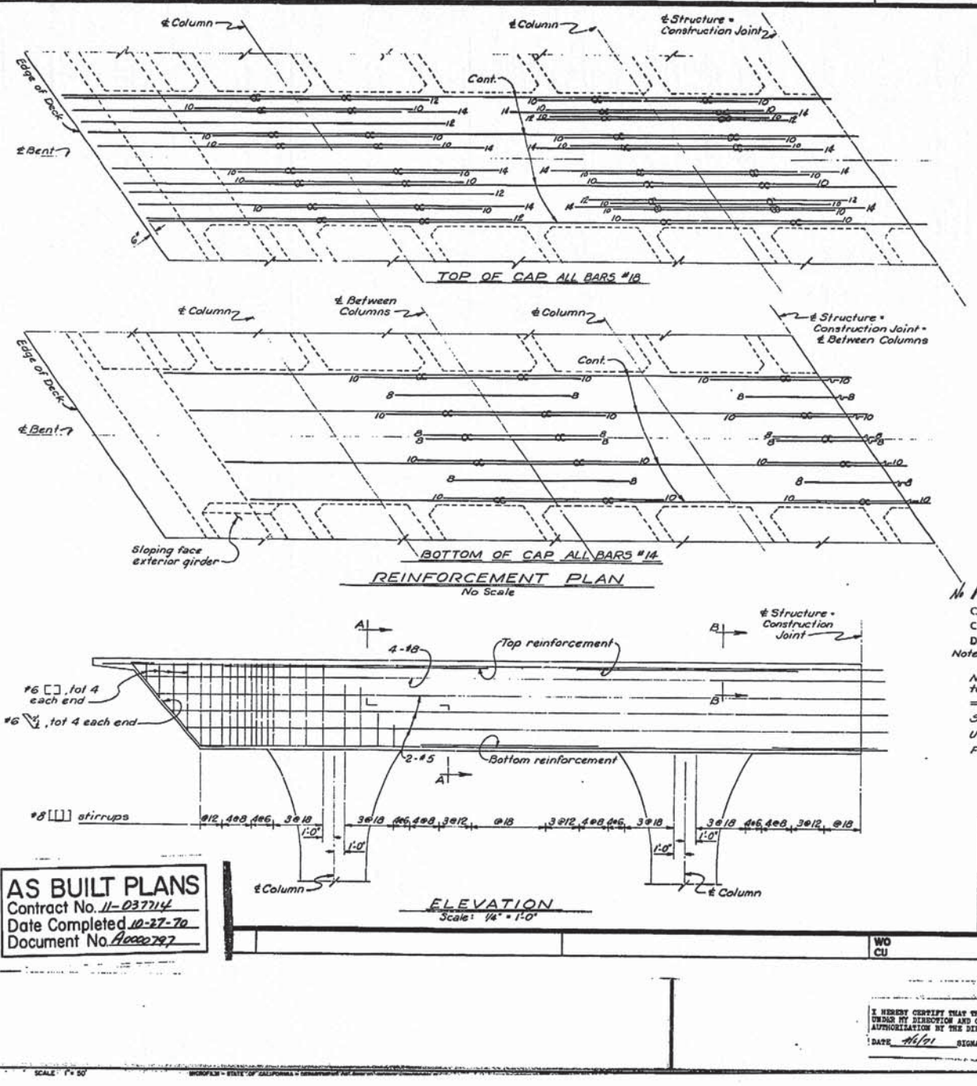
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

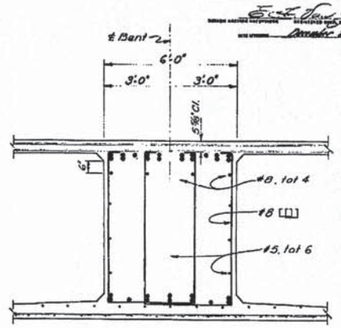
DATE 11/6/01 SIGNATURE [illegible] TITLE Admin

207

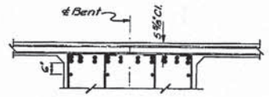
WO CU

SCALE 1" = 50' — SCALE 1" = 50'





SECTION A-A
Scale: 1/2" = 1'-0"



SECTION B-B
Scale: 1/2" = 1'-0"

AS BUILT
CONTRACTOR'S DBA All West Surface
CONTRACT NO. 11-037714
DATE 11-5-70 12-29-70

Note:

Numbers at end of bars indicate distance in feet from ℄ Column for top reinforcement, and from ℄ between Columns for bottom reinforcement.
~~CC~~ indicates bundled bars.
Stage 1 bridge shown; stage 2 bridge similar.
Utility openings not shown. For location see 'Typical Section' sheet.
For Footings and Columns see 'Footing and Column Details' sheet.

DIST.	COUNTY	ROUTE	POST MILE-TOTAL PROJECT	SHT. NO.	TOTAL SHTS.
11	SD	395	31.2/32.7	280	297

BRIDGE DEPARTMENT
DESIGN SECTION 16

Project Engineer	C.M.E. Kilkenny	
DESIGNED	by C.M.E. Kilkenny 6-67	
DETAILED	by Chris Johnson 4-68	
QUANTITIES	by Alan Lamb	
CHECKED	by [illegible] 7-69	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT

DRAWING NO.	37-595	POST MILE	BRIDGE NO.	SHEET	OF
			57585-S	6	15

RECORDED BY: [illegible]
SUBSTANTIAL APPROX. QUANTITY:

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

208

WO
CU

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DATE 4/6/01 SIGNATURE [illegible] TITLE Asst

SCALE: 1" = 50'

DIST.	COUNTY	ROUTE	POST MILE—KILOMETER PREFIX	TOTAL NO.	SHEET NO.
11	SD	395	2.7/4.2	159	160

December 2, 1970

1" polystyrene covered with 1/8" tempered hardboard

4'-0" / 2'-0" / 1'-0"

℄ Bent

#9 x 6'-6", tot 12

COLUMN KEY DETAIL
Scale: 3/8" = 1'-0"

12'-0"
6'-0" 6'-0"
℄ Column
High Point
Level
Soffit Line
10'-0"
B
R = 18'-2"
B.C.
A
2" Chamfer
4'-0"
32'-0" typ.

ELEVATION
Scale: 1/4" = 1'-0"

℄ Column
1'-6" x 3 1/16" key (typ)
3'-6"
#4 @ 6
#4 @ 12
#11 dowels, tot 24
3'-0"
5"

#9, tot 30
#11, tot 32
℄ Bent
15'-0"
7'-6"
7'-6"
7'-6"
15'-0"

FOOTING PLAN
Scale: 1/4" = 1'-0"

℄ Column
1'-0" min. lap
℄ Bent
#4
#11, tot 24

SECTION B-B
Scale: 1/2" = 1'-0"

℄ Column
2" Chamfer (typ.)
#4
℄ Bent
#11, tot 24
2'-0"
2'-0"
4'-0" typ.
3'-0" 3'-0"
6'-0"

SECTION A-A
Scale: 1/2" = 1'-0"

No AS BUILT
CORRECTIONS BY Hill Swan
CONTRACT NO. 11-037114
DATE 11-6-70 12-10-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

DESIGN DEPARTMENT
DESIGN SECTION 16

Project Engineer	Clyde Hilsaay	
DESIGN	In A. Hillsaay 8/68	
	Bridge Engr. W. Saunders	
DETAILED	Chief, Section Hills, Hunter 8/68	
	Bridge Engr. W. Saunders	
QUANTITIES	In C. Allen Hicks	
	Bridge Engr. C. Hilsaay 8/68	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT FOOTING & COLUMN DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	NO. OF SHEETS
57-595		37595-16	7	15

RECORD DATE 8/68 — Changed plan bearing number and date

OPERATING ENGINEER

201

WO
CU

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DATE 11/6/71 SIGNATURE A. J. Lacson TITLE Asst. Engr.

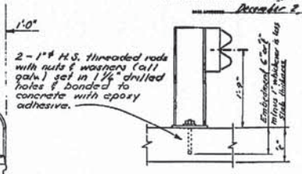
SCALE 1" = 50'

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50'

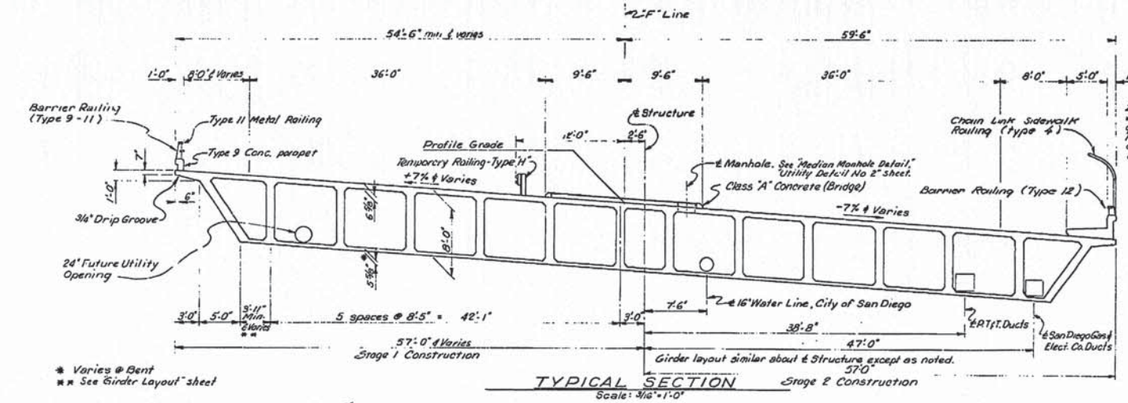
DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	TOTAL SHEETS	SHEET NO.
11	SD	395	37.1/41.2	218	217

Standard Plan No. S3-7 (Formerly Standard No. B3-7)
Dated December 2, 1960

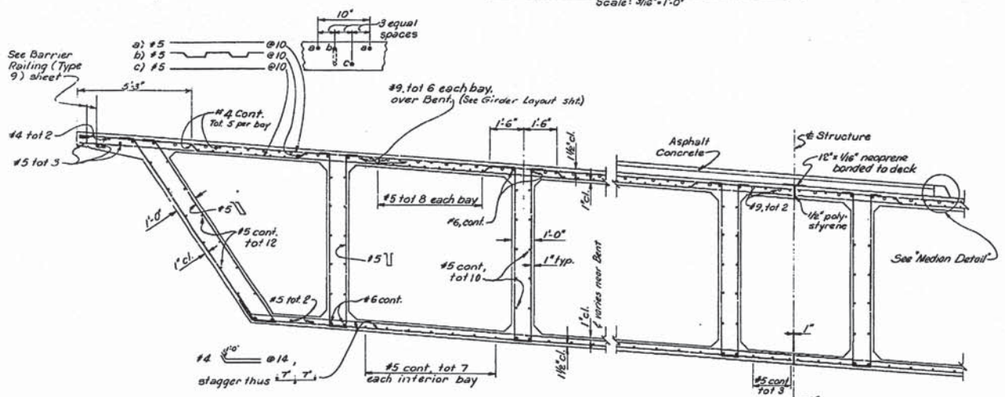


TEMPORARY RAILING - TYPE H
ATTACHMENT DETAIL
NO SCALE
SPECIAL DETAIL

Note
This detail supersedes the type H attachment detail as shown on sheet no. 1311-30 of Standard Plans dated Feb 1968.



TYPICAL SECTION
Scale: 3/16" = 1'-0"



PART SECTION
Scale: 1/2" = 1'-0"

MEDIAN DETAIL
No Scale

PRESTRESSING NOTES

"JACK 18,300 KIPS TOTAL PER 1/2 STRUCTURE (C.L. TO CENTER OF JT.) AT JACKING END.

$A_s = \frac{P_{JACK}}{0.75\ f'_s}$

CONCRETE f'c = 5,100 P.S.I. @ 28 DAYS; f'ci = 3,500 P.S.I. @ TIME OF STRESSING

PRESTRESSING STEEL: THE PRESTRESSING STEEL SHALL BE LOCATED IN THE GIRDER STEMS WITH AN EQUAL FORCE IN EACH STEM. AT THE CONTRACTOR'S OPTION THE PRESTRESSING FORCE MAY VARY TO ± 5% FROM THE THEORETICAL EQUAL FORCE PER GIRDER PROVIDED THE TOTAL P JACK IS OBTAINED AND THE FORCE IS DISTRIBUTED SYMMETRICALLY ABOUT THE ℄ OF THE TYPICAL SECTION. UNITS ARE TO BE TENSIONED A FEW AT A TIME IN EACH STEM IN ORDER TO MINIMIZE THE STRESS DIFFERENTIALS.

CLEARANCE: (1) HORIZONTAL CLEARANCE BETWEEN UNITS = 2 1/2" MIN.
(2) UNITS MAY BE BUNDLED VERTICALLY IN GROUPS OF 3 MAX.
(3) VERTICAL CLEARANCE BETWEEN BUNDLED UNITS = 3" MIN.

GENERAL: (1) P JACK SPECIFIED AT THE JACKING ENDS INCLUDES FRICTION LOSSES AND PROVISION FOR 25,000 P.S.I. LOSS IN STRESS. f's = ULTIMATE TENSILE STRENGTH OF PRESTRESSING STEEL.

(2) TENDONS TO BE JACKED TO 0.75 f's AND ANCHORED WITH AN AVERAGE ANCHORAGE SET OF 1/8" MAXIMUM.

(3) DESIGN IS BASED ON U = 0.25 AND K = 0.0002. CONTRACTOR TO SUBMIT ELONGATION AND JACKING CALCULATIONS BASED ON Uα + KL = 0.109 AND INITIAL STRESS AT @ = 0.896 TIMES JACKING STRESS.

(4) METALLIC ENCLOSURES TO BE GALVANIZED RIGID DUCT.

(5) ENCLOSURES TO BE VENTED THROUGH SLAB WITHIN 3' OF THE HIGH POINTS OF THE CABLE PATH.

(6) DURING STRESSING OPERATIONS, THE ELONGATION SHALL BE CONTINUOUSLY COMPARED WITH GAGE PRESSURE TO CHECK AGAINST TENDON BLOCKAGE AND EXCESSIVE FRICTION.

(7) BAR REINFORCEMENT INTERFERING WITH THE PRESTRESSING TENDON ALIGNMENT SHALL BE ADJUSTED AS DIRECTED BY THE ENGINEER.

AS BUILT
CORRECTIONS BY Mike Swaze CH
CONTRACT NO. 11-037714
DATE 11-6-70 12-28-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0090797

210

DESIGN SECTION 16
Project Engineer Orrie Hilvesey
DESIGN Orrie Hilvesey 4/68
DETAILS Mike Swaze 4/68
QUANTITIES Alex Sutter 4/68
Checked Joseph L. Flint 4/68

TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING
TYPICAL SECTION

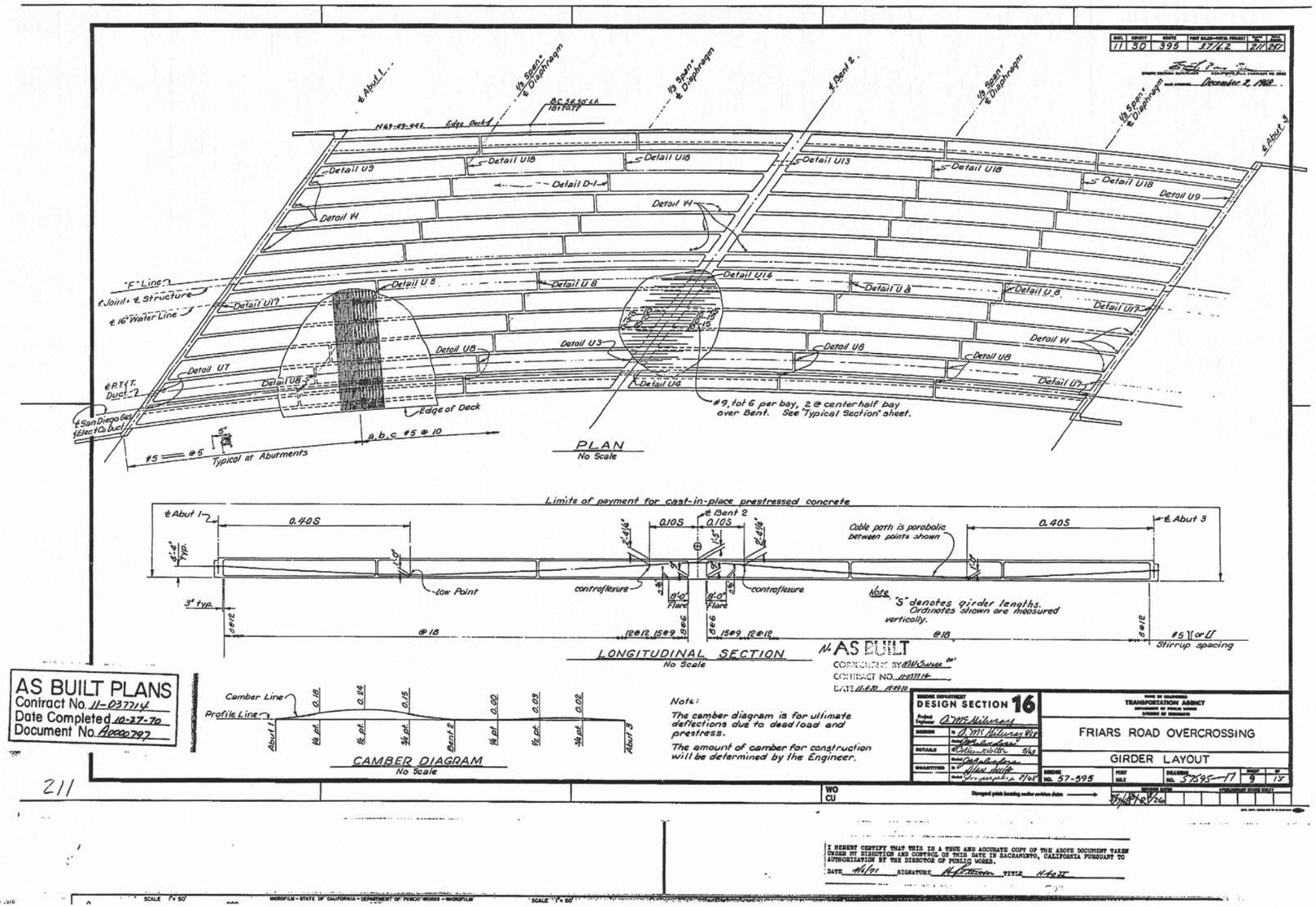
DISTRICT	ROUTE	DRAWING NO.	SHEET	OF
11	395	57595-4	8	15

DESIGNED UNDER THE SUPERVISION OF Orrie Hilvesey
DATE 4/68
REGISTERED CIVIL ENGINEER

WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [illegible] TITLE Assoc

FILMED - [illegible]
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

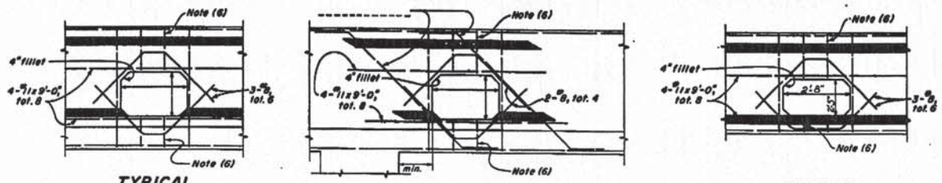


I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

DIST	COUNTY	ROUTE	POST MILE	TOTAL PROJECT	SHEET	DATE
11	SD	395	17.7/R.7		1/14	12/65

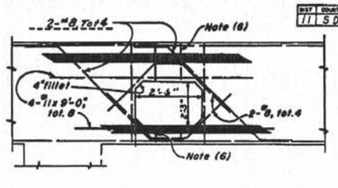
December 7, 1965



TYPICAL
DETAIL U1

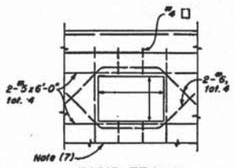
NEAR COLUMN
DETAIL U2

TYPICAL
DETAIL U3

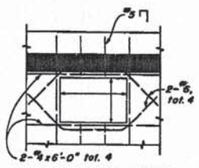


NEAR COLUMN
DETAIL U4

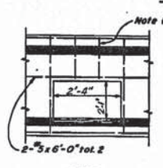
BENT CAP



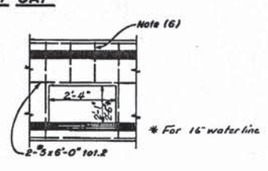
RIGID FRAME
DETAIL U5



CANTILEVER TYPE
DETAIL U6



END
DETAIL U7

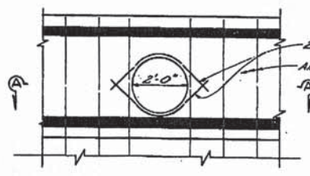


INTERMEDIATE
DETAIL U8

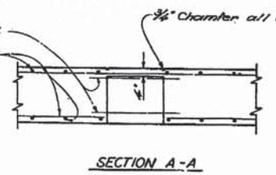
ABUTMENT BACKWALL

DIAPHRAGMS

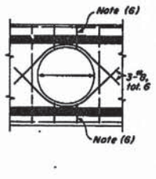
AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797



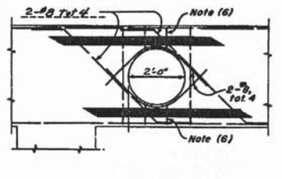
DETAIL U-9



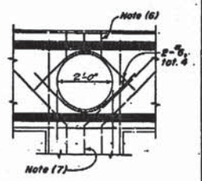
SECTION A-A



TYPICAL
DETAIL U12

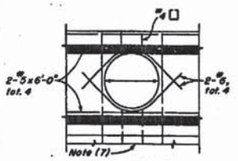


NEAR COLUMN
DETAIL U13

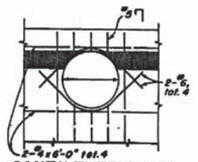


AT COLUMN
DETAIL U14

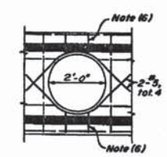
BENT CAP



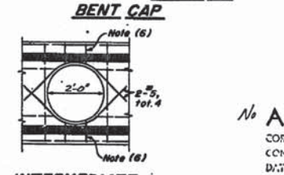
RIGID FRAME
DETAIL U15



CANTILEVER TYPE
DETAIL U16



END
DETAIL U17



INTERMEDIATE
DETAIL U18

ABUTMENT BACKWALL

DIAPHRAGMS

NOTES

(1) For exact location and direction of openings see other sheets.
(2) Location and size of utility openings may be modified as directed by the Engineer, provided minimum dimensions are maintained.
(3) Girders not shown, see other sheets.
(4) Seal around utilities at abutments to be of sufficient strength to withstand earth pressure.
(5) All reinforcement detailed to be placed in addition to reinforcement shown on other sheets.
(6) Stirrups are same size as adjacent stirrups shown on other sheets.
(7) Join reinforcement to clear opening as detailed on other sheets.

No AS BUILT
CORRECTIONS BY Williams Bros
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

MARK	DATE	REVISION	BY	CHK
1	12-6-66	Detail U-9 Added	MS	WC
		REVISED PILES		
		REV. JWS		

4/65

STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

XS 16-49

FRIARS ROAD OVERCROSSING

STANDARD UTILITY DETAIL NO.1 — BOX GIRDER

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	OF
57-595		57595-18	10	15

W.O.

Dropped prints belong under maroon date

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

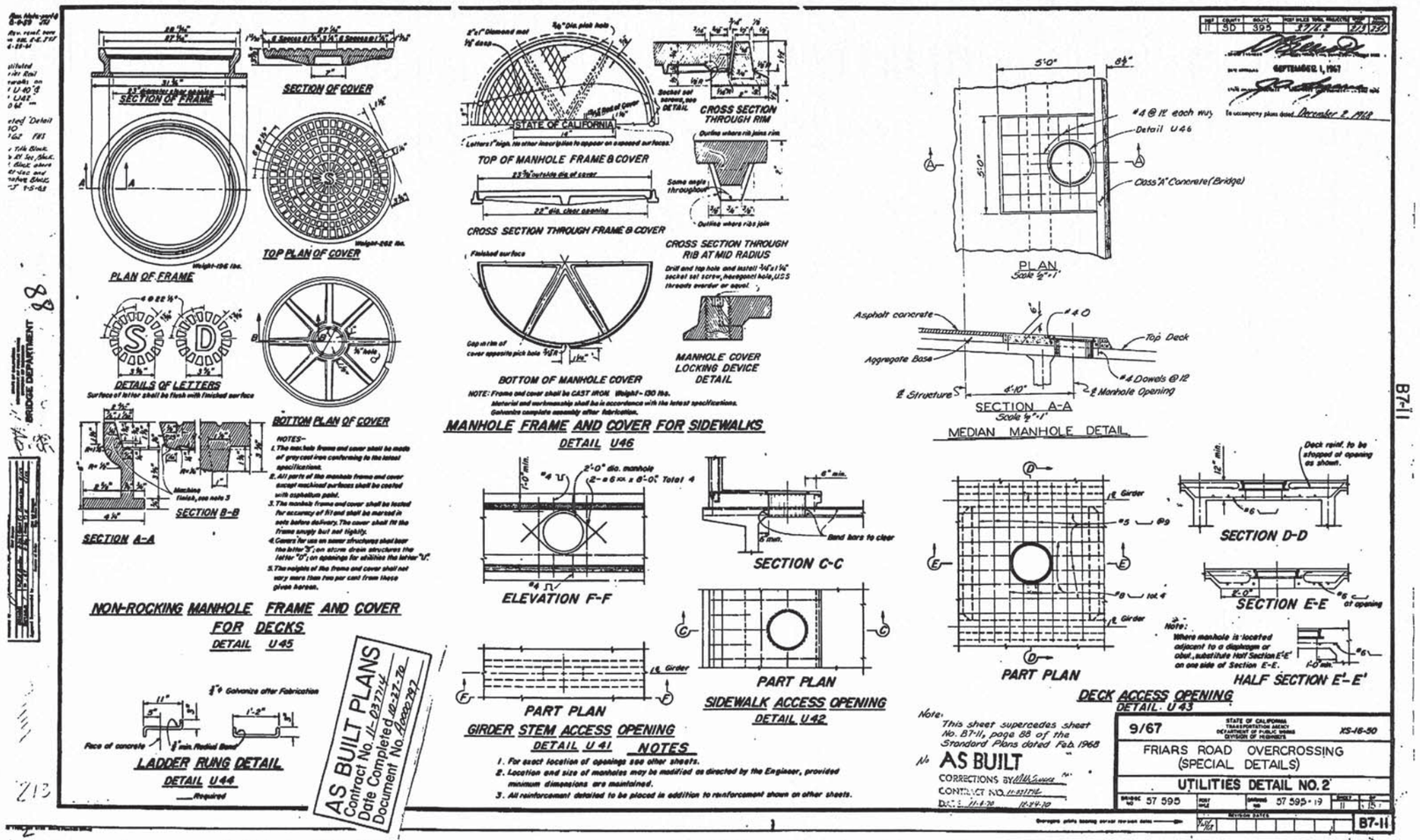
DATE 4/6/01 SIGNATURE [signature] TITLE Assoc

STANDARD DRAWING
Approved for Publication
Chief Engineer
Dec. 1965
Sheet 2 of 2 Sheets
Bridge Department

Alan J. Bell Associates
4/6/01 dp
Caution Retain Details
Detail No. "DETAIL U5, U6 and U8" SHEETS 2,3

212

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM



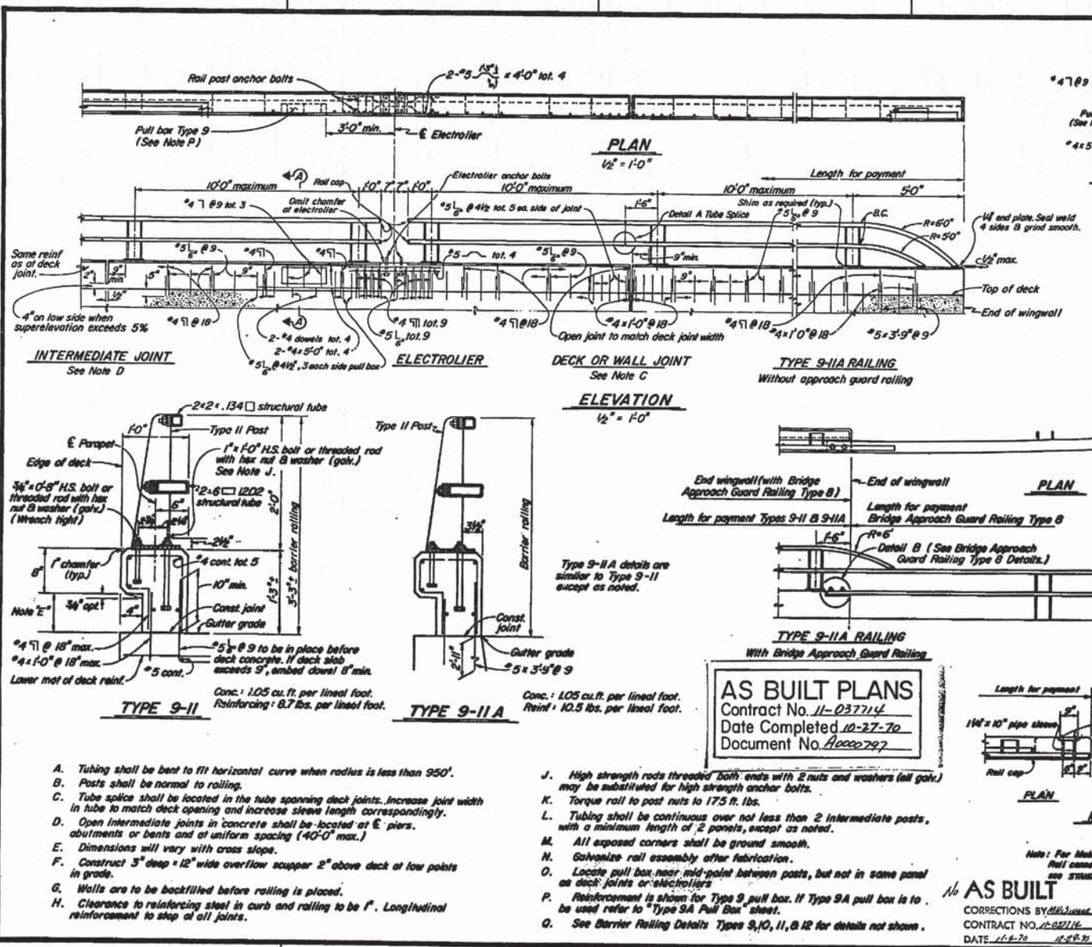
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/71 SIGNATURE [signature] TITLE [illegible]

B7-11

DIST	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	3.7/4.2	214	250

December 2, 1968



AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

A. Tubing shall be bent to fit horizontal curve when radius is less than 950'.
B. Posts shall be normal to railing.
C. Tube splice shall be located in the tube spanning deck joints. Increase joint width in tube to match deck opening and increase sleeve length correspondingly.
D. Open intermediate joints in concrete shall be located at ℄ piers, abutments or bents and at uniform spacing (40'-0" max.)
E. Dimensions will vary with cross slope.
F. Construct 3" deep x 12" wide overflow scupper 2" above deck at low points in grade.
G. Walls are to be backfilled before railing is placed.
H. Clearance to reinforcing steel in curb and railing to be 1". Longitudinal reinforcement to step at all joints.
J. High strength rods threaded both ends with 2 nuts and washers (all galv.) may be substituted for high strength anchor bolts.
K. Torque rail to post nuts to 175 ft. lbs.
L. Tubing shall be continuous over not less than 2 intermediate posts, with a minimum length of 2 panels, except as noted.
M. All exposed corners shall be ground smooth.
N. Galvanize rail assembly after fabrication.
O. Locate pull box near mid-point between posts, but not in same panel as deck joints or electroliers
P. Reinforcement is shown for Type 9 pull box. If Type 9A pull box is to be used refer to "Type 9A Pull Box" sheet.
Q. See Barrier Railing Details Types 9, 10, 11, & 12 for details not shown.

No AS BUILT
CORRECTIONS BY Miscellaneous
CONTRACT NO. 11-037114
DATE 11-6-70 11-29-71

STANDARD DRAWING
DEC. 1968
RS-1
Revised 1-1-69
Revised 1-1-70
Revised 1-1-71

214

7/68
STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS
XS-9-95

FRIARS ROAD OVERCROSSING

BARRIER RAILING TYPE 9-11

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-20	12	15

WO
CU

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DATE 11/1/71 SIGNATURE [illegible] TITLE [illegible]

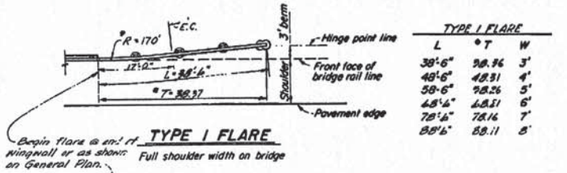
SCALE 1" = 50'
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37.4.2	2/6	2/7

December 2, 1969

TYPE 1 FLARE

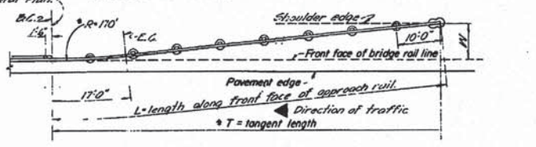
Full shoulder width on bridge



TYPE 1 FLARE		
L	T	W
38'-6"	38.36	3'
48'-6"	48.31	4'
58'-6"	58.26	5'
68'-6"	68.21	6'
78'-6"	78.16	7'
88'-6"	88.11	8'

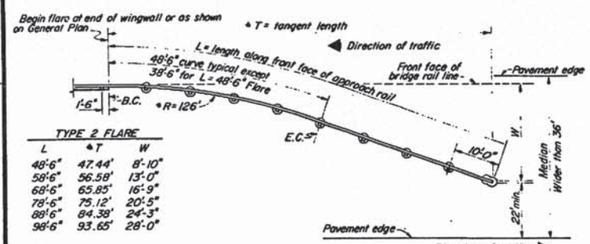
TYPE 1 FLARE

Reduced shoulder width on bridge (right or left)



TYPE 2 FLARE

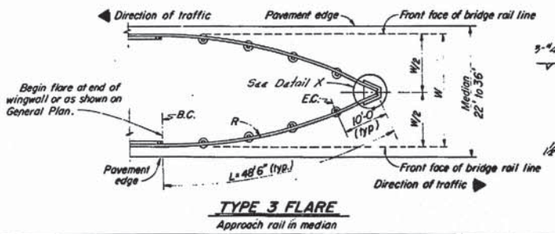
Approach rail in median

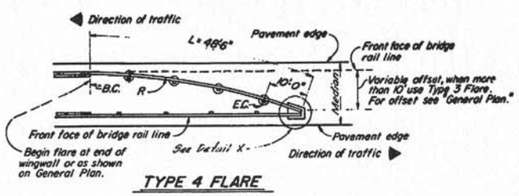


TYPE 2 FLARE		
L	T	W
48'-6"	47.44'	8'-10"
58'-6"	56.58'	13'-0"
68'-6"	65.85'	16'-9"
78'-6"	75.12'	20'-5"
89'-6"	84.38'	24'-3"
98'-6"	93.65'	28'-0"

TYPE 3 FLARE

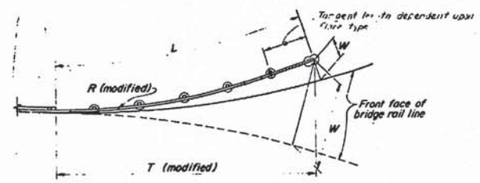
Approach rail in median





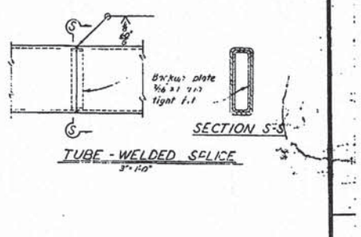
TYPE 4 FLARE

Approach rail in median



FLARE LAYOUT ON CURVED ROADWAY

Note: W is radial to front face of bridge rail line
Railing shown for roadway curve to left

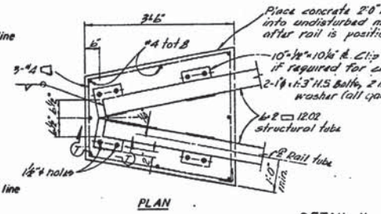


TUBE - WELDED SPLICE

3" I.D.

Notes:

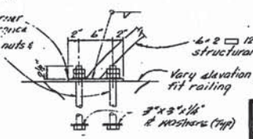
A. Tubing shall be shop bent or fabricated to fit horizontal curves of less than 950' radius.
B. Posts shall be vertical and spaced at 10'-0" c.c. max.
C. Top of rail elevations to be determined by the Engineer unless shown on the plans.
D. Torque rail to post nuts to 175 ft. lbs.
E. No more than one tube splice per panel is permitted.
F. All exposed edges shall be ground smooth.
G. Galvanize rail assembly after fabrication.
H. For details not shown see "Barrier Railing" sheet.
J. Front face of bridge rail line is parallel or concentric to pavement edge.
K. Dimensions marked ℄ are valid for tangent roadway alignment only. Modify for curved roadway.
L. R for Type 3 & 4 Flare must be calculated for each offset.



PLAN

DETAIL X

No Scale



SECTION T-T

AS BUILT
CONSTRUCTION BY Mid County Const.
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-87

FRIARS ROAD OVERCROSSING

BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-21	13	15

WORKING DATES

STANDARD DRAWING

215

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DATE 4/6/71 SIGNATURE [signature] TITLE Asst.

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50' SCALE 1"=20'

DIST	COUNTY	ROUTE	POST MILE/KILOMETER	SHEET NO.	TOTAL SHEETS
11	SD	395	7.7/12.4	216	267

December 2, 1968

DETAIL B
1½"=1'-0"

SECTION N-N

SECTION B-B
1½"=1'-0"

Top of rail grade to be adjusted to provide smooth railing profile

12'-6" post spacing (typ)

8"x6" tube

End of wingwall or as shown on General Plan

Top tube and cap with chain link fence (Type 6)

Approach rail curb to be used when there is no approach sidewalk or approach curb.

PLAN

Pay limit

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

10'-0" post (typ)

Tube splice detail

Pay limit Bridge Approach, Pay limit Type 11 (12), Guard Railing Type 8 (typ)

½" R seal weld & sides & grind smooth

R=3'-0"

Detail B

Match elevation

ELEVATION

CONNECT TO TYPE 11 (12)

See "End Anchorage Details"

L 4"x3"x½" structural tube

BRIDGE APPROACH GUARD RAILING TYPE 8
½"=1'-0"

L 4"x3"x½"x1'-1" long with 1⅛" ø holes

Tube

Cap end of tube

2-1"ø x 1'-0" Hex Bolts with hex nut and washer (galv.)

1⅛" x 1⅜" slotted holes in tube. Place on thin layer of grout

⅜" spiral @ 3" pitch with 3 turns @ top

⅜" tot. 8

2'-0"

2'-6"

2'-9"

2'-6"

2-1"ø H.S. Bolts, 2 hex nuts & washer (all galv.)

L 4"x3"x½" structural tube

1'-0"

1'-0"

Place concrete after rail is positioned

(8"x8"x½" R. washer (Typ)

ELEVATION

TYPE 1 & 2 FLARE
END ANCHORAGE DETAILS
1½"=1'-0"

9'-6"ø

8" R

8" Rail tube

⅝" mm. thickness

1⅛"ø hole

6"x4½"x1'-6" ℄'s

PLAN

SHIM DETAILS
1½"=1'-0"

1⅛" x 1⅜" slotted holes

⅝" R

Rolled bar 2"x6"x0'-8"

ELEVATION

SECTION H-H

RAIL POST DETAILS
1½"=1'-0"

SECTION D-D

1⅛"ø holes

End of wingwall or as shown on General Plan

Pay limit Type 10

Approach rail curb to be used when there is no approach sidewalk or approach curb

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

PLAN

Match elevation

ELEVATION

CONNECT TO TYPE 10

5'-0" Type 11 (12)
2'-0" Type 10

For tube to post connection details see "Barrier Railing Details" sheet

Match height of bridge curb

Approach rail curb

1'-4"x1'-4"x¾" bolt tot 3 with washer & hex nut (all galv.)

Anchor bolt template

⅜" spiral @ 3" pitch with 3 turns @ top

SECTION A-A
½"=1'-0"

End of wingwall or as shown on General Plan

PLAN

Pay limit Bridge Approach, Guard Railing Type 8

Pay limit Type 9

Detail B

ELEVATION

CONNECT TO TYPE 9

1'-0" R

48 Tot. 12

⅝" spiral @ 5" pitch with 3 turns @ top

1'-4"

1"x 9½" H.S. bolt with nut & 2 washers

Top of Railing Tube

ELEVATION

1⅛"ø holes

1⅛"x4" slotted hole in tube - bottom side only

VIEW L-L

PLATE - PLAN VIEW

TUBE SPLICE DETAILS
1½"=1'-0"

8"x 8½"x ⅝" thick with 1⅛"ø hole

⅝"ø rod

ANCHOR BOLT TEMPLATE
1½"=1'-0"

SECTION C-C
Scale: 3"=1'-0"

1/4 AS BUILT
CORRECTIONS BY Bill Sweet
CONTRACT NO. 11-037114
DATE 11-6-70 12-29-70

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-83	
FRIARS ROAD OVERCROSSING			
BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)			
DESIGNED 57-395	DRAWN	CHECKED 57595-22	16 / 15

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT DRAWN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

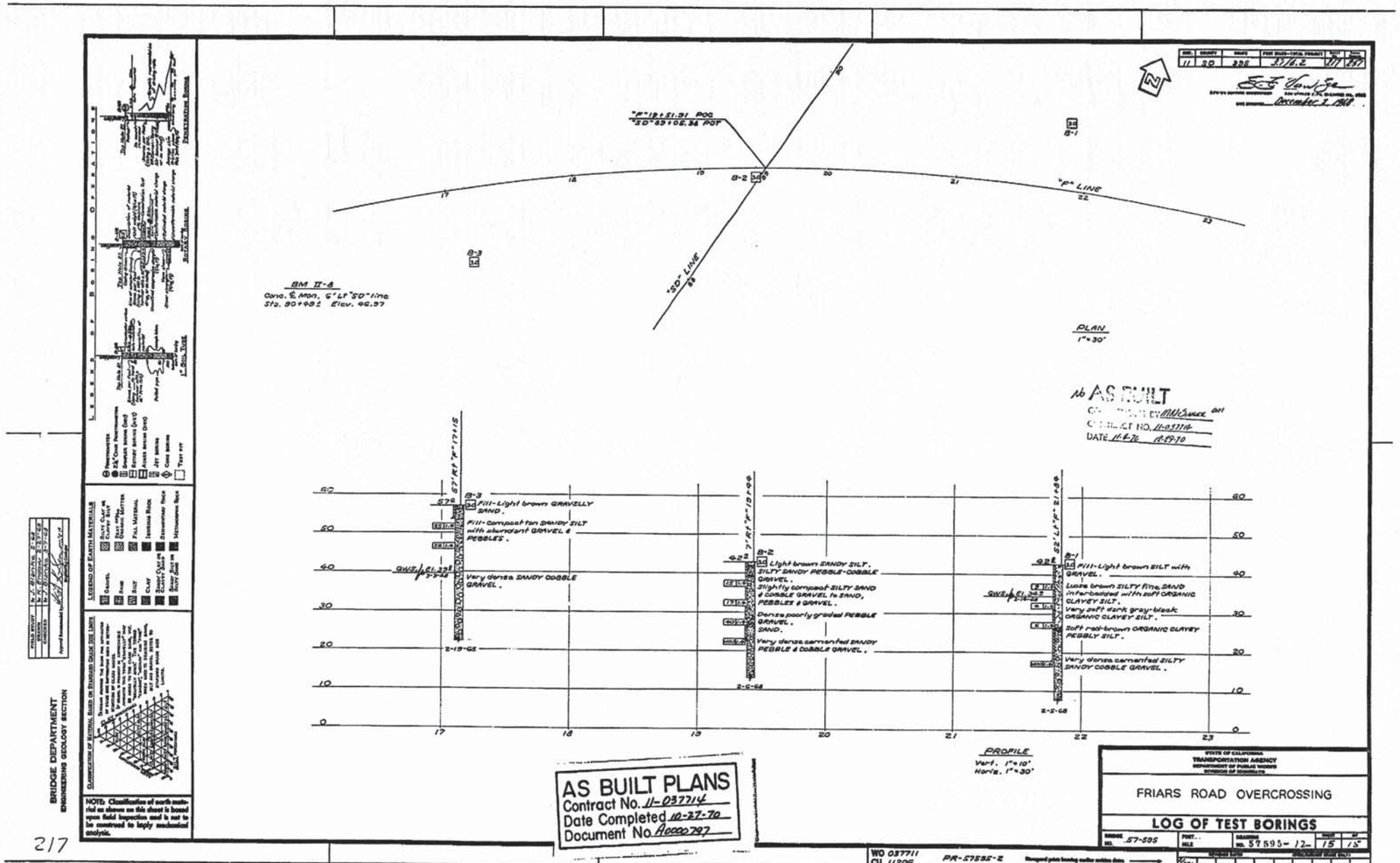
DATE 4/6/01 SIGNATURE M. E. Cooper TITLE Li-Aide

216

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50'

0 100 200 400 600



AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

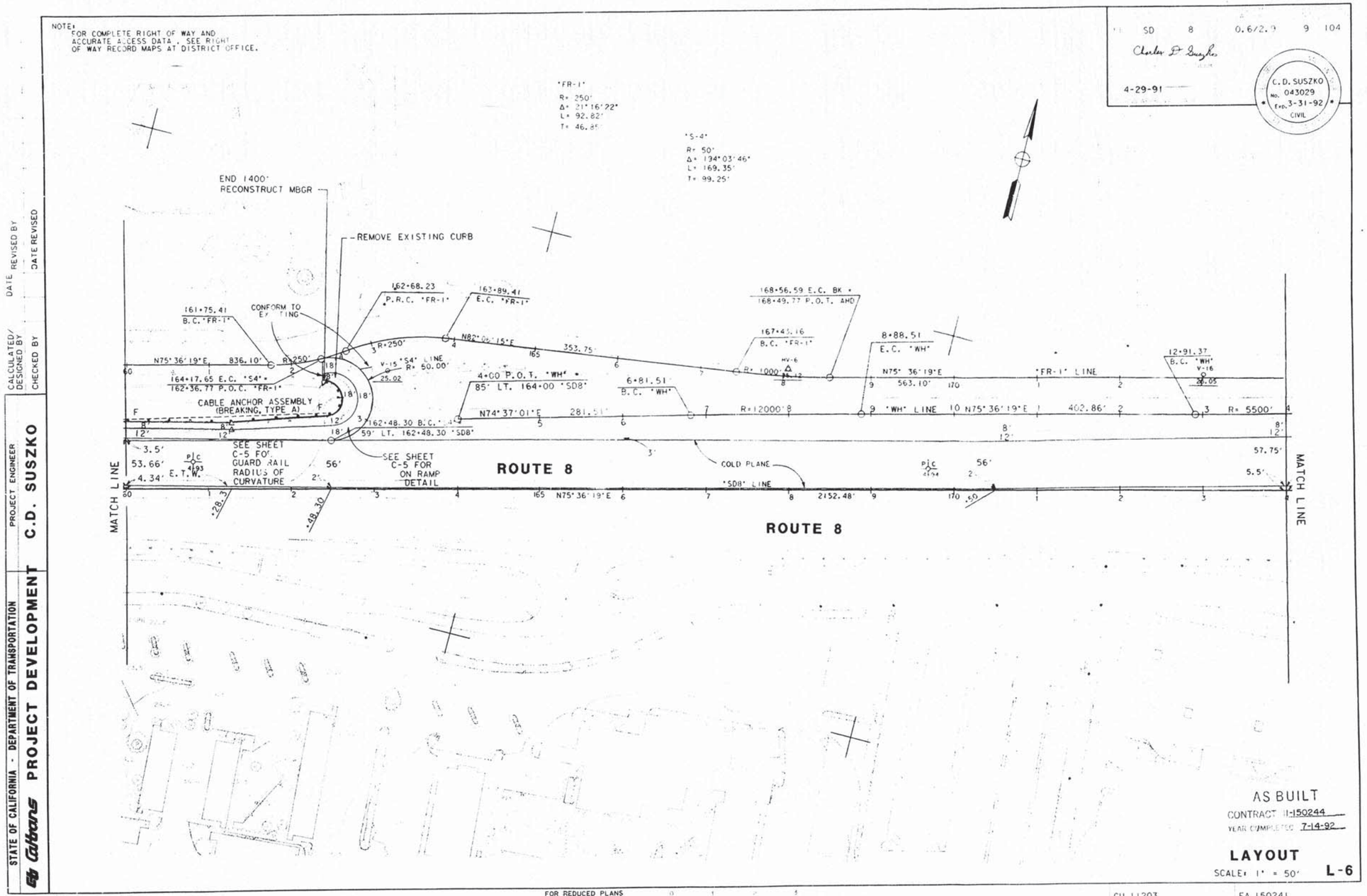
BRIDGE NO. 57-595 | DRAWING NO. 57595-12 | SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

217

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE HAgII



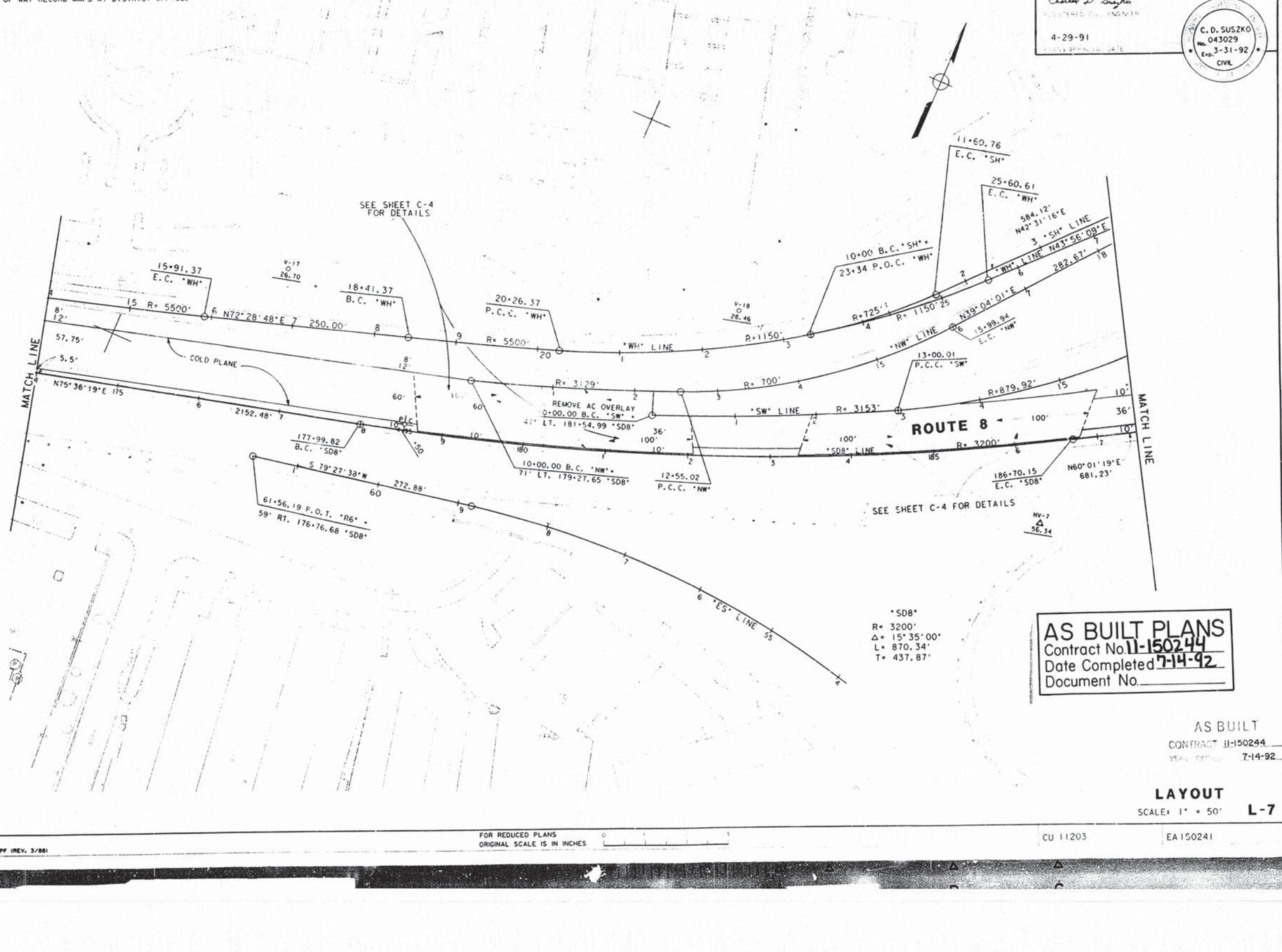
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11	SD	8	0.6/2.9	10	104

Charles D Suszko
REGISTERED CIVIL ENGINEER
4-29-91
DATE

C. D. SUSZKO
043029
No.
Exp. 3-31-92
CIVIL



AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
7-14-92

LAYOUT
SCALE: 1" = 50' **L-7**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans **PROJECT DEVELOPMENT**
PROJECT ENGINEER **C.D. SUSZKO**
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11 SD 8 0.6/2.9 11 104

Charles D Suszko

4-29-91

C. D. SUSZKO
No. 043029
Exp. 3-31-92
CIVIL

18+82.61 P.O.T. "NW"
12' RT. 27+80.29 P.O.T. "WH"

17+44.89
B.C. "SW"

28+33.87
B.C. "WH"

584.12'

"SW" LINE

R= 500'

N17°46'19"E

"SW" LINE

31+28.87
P.C.C. "WH"

R= 700'

19+89.19
E.C. "SW"

"WH" LINE

R= 1000'

34+10.01
E.C. "WH"

N42°31'16"E

N43°36'09"E

"NW"

N84°11'24"E 200.00'

35+68.25 P.O.T. "WH"
68+43.09 B.C. "R-1R"

36+10.01
B.C. "WH"

37+80.80
E.C. "WH"

R= 1000'

N74°24'16"E 9 "WH" LINE 40 395.63'

"WN" LINE 6 R= 500'

R= 879.92'

R= 600'

"WS" LINE

62+31.15
E.C. "WS"

N77°01'06"E

ROUTE 163

MATCH LINE

REMOVE AC OVERLAY

N60°01'19"E

"SD8" LINE 681.23'

COLD PLANE

193+51.38
B.C. "SD8"

ROUTE 8

R= 2500'

66+57.34 P.O.T. "WS"
47' LT. 198+20.01 P.O.C. "SD8"

199+68.09
E.C. "SD8"

N74°09'21"E

199+68.33 P.O.T. "SD8" BK.
1+99.50 P.O.T. "SD8" AHD.

MATCH LINE

SEE SHEET C-4 FOR DETAILS

"SD8"
R= 2500'
Δ= 14°08'02"
L= 616.71'
T= 309.93'

SEE SHEET C-4 FOR DETAILS

AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
YEAR COMPLETED 7-14-92

LAYOUT
SCALE: 1" = 50' L-8

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO

CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	132	162

Ramin Rasheda
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI, No. 37070, Exp. 6-30-98, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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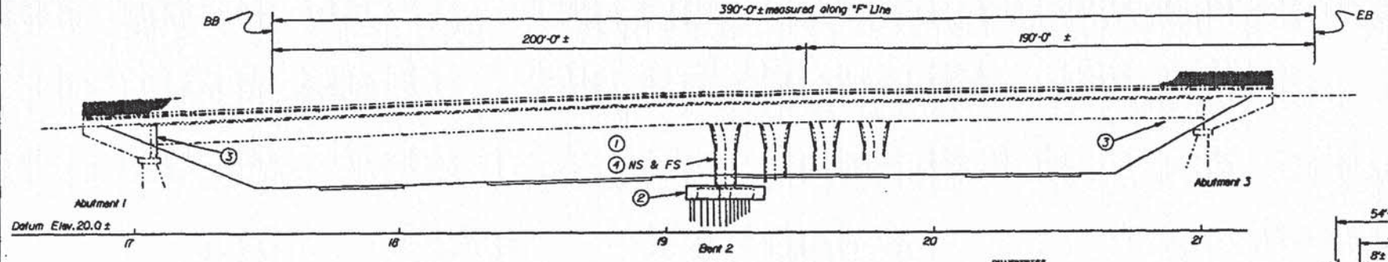


ELEVATION
1"=20'

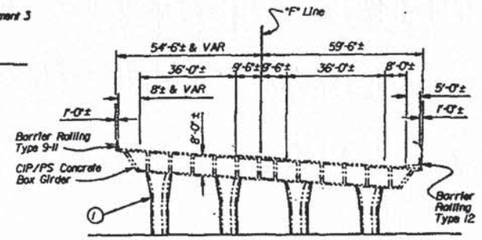
PILE DATA - STEEL HP PILES

Location/Type	Design Loading (Service)	Nominal Resistance		Design & Specified Tip Elevation
		Compression	Tension	
Bent 2/HP10x57	70 Tons	250 kips	130 kips	10.0 (1),(2)

Design Tip Elevation is controlled by the following demands: (1) Compression, (2) Tension.

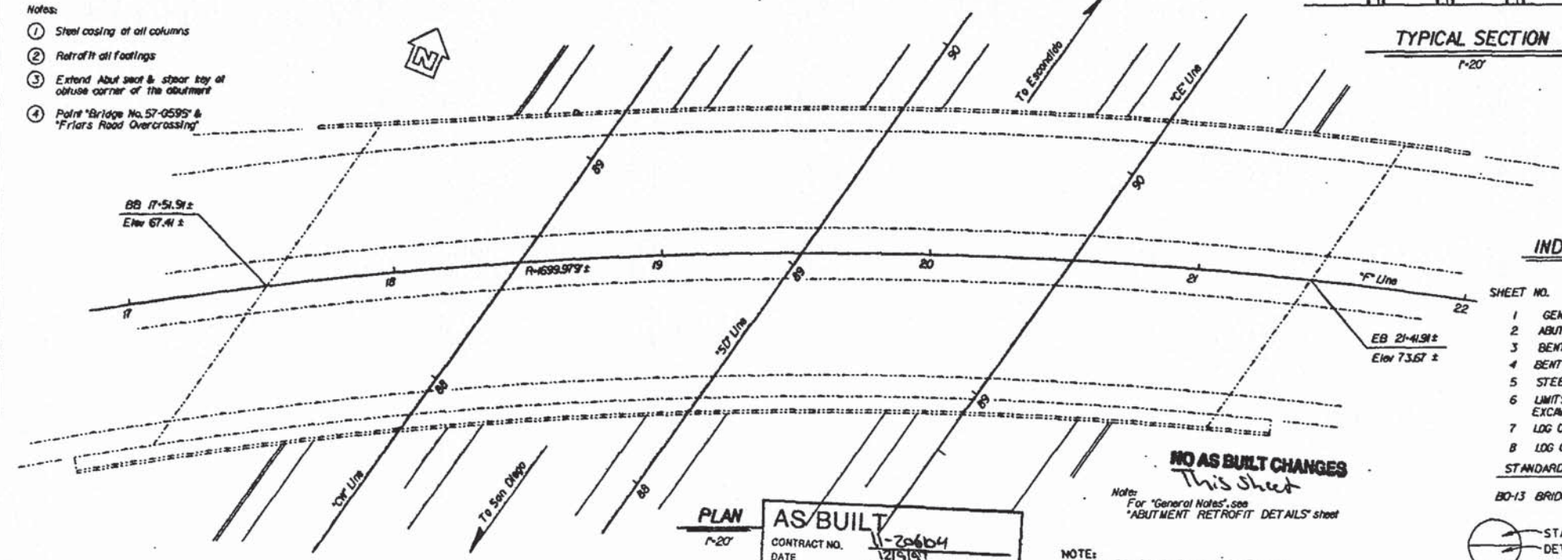
QUANTITIES

	LUMP SUM	
BRIDGE REMOVAL (PORTION), LOCATION C	LUMP SUM	
STRUCTURE EXCAVATION (BRIDGE)	572	CY
STRUCTURE BACKFILL (BRIDGE)	196	CY
FURNISH STEEL PILING (HP 10 X 57)	900	LF
DRIVE STEEL PILE (HP 10 X 57)	32	EA
STRUCTURAL CONCRETE, BRIDGE FOOTING	400	CY
STRUCTURAL CONCRETE, BRIDGE	15	CY
DRILL AND BOND DOWEL	1,460	LF
BAR REINFORCING STEEL, (BRIDGE)	94,900	LB
ASPHALT MEMBRANE WATERPROOFING	110	SQFT
COLUMN CASING	45,900	LB



TYPICAL SECTION
1"=20'

Notes:
1. Steel casing at all columns
2. Retrofit all footings
3. Extend Abut seat & shear key at obtuse corner of the abutment
4. Point "Bridge No. 57-0595" & "Friars Road Overcrossing"



INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN
2	ABUTMENT RETROFIT DETAILS
3	BENT RETROFIT DETAILS
4	BENT FOOTING RETROFIT DETAILS
5	STEEL COLUMN CASINGS
6	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS
7	LOG OF TEST BORINGS 1 OF 2
8	LOG OF TEST BORINGS 2 OF 2

STANDARD PLANS DATED JULY 1992

BD-13 BRIDGE DETAILS

STANDARD PLAN SHEET NO.
DETAIL NO.

PLAN
1"=20'

AS BUILT
CONTRACT NO. 11-206104
DATE 12/9/97
CORRECTIONS BY [signature] Smith-Emery Co. Contractors

NO AS BUILT CHANGES This Sheet

Note: For "General Notes", see "ABUTMENT RETROFIT DETAILS" sheet

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

DESIGN ENGINEER

DESIGN	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	LOAD FACTOR DESIGN			
DETAILS	BY Jim Murphy/E. Tapalla	CHECKED Elias Kurani	LAYOUT	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.Y. Le	SPECIFICATIONS	BY Jill Sewell	PLANS AND SPECS COMPARED Jill Sewell	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	POST MILE
57-0595	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

GENERAL PLAN

REVISION DATES (PRELIMINARY STAGE ONLY)								SHEET	OF
5-3-96	5-7-96	5-21-96	5-28-96	6-3-96	6-4-96	6-5-96	6-6-96	1	8

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DATE PLOTTED => 30-JAN-1996
TIME PLOTTED => 14:36

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	133	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER
RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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GENERAL NOTES
LOAD FACTOR DESIGN

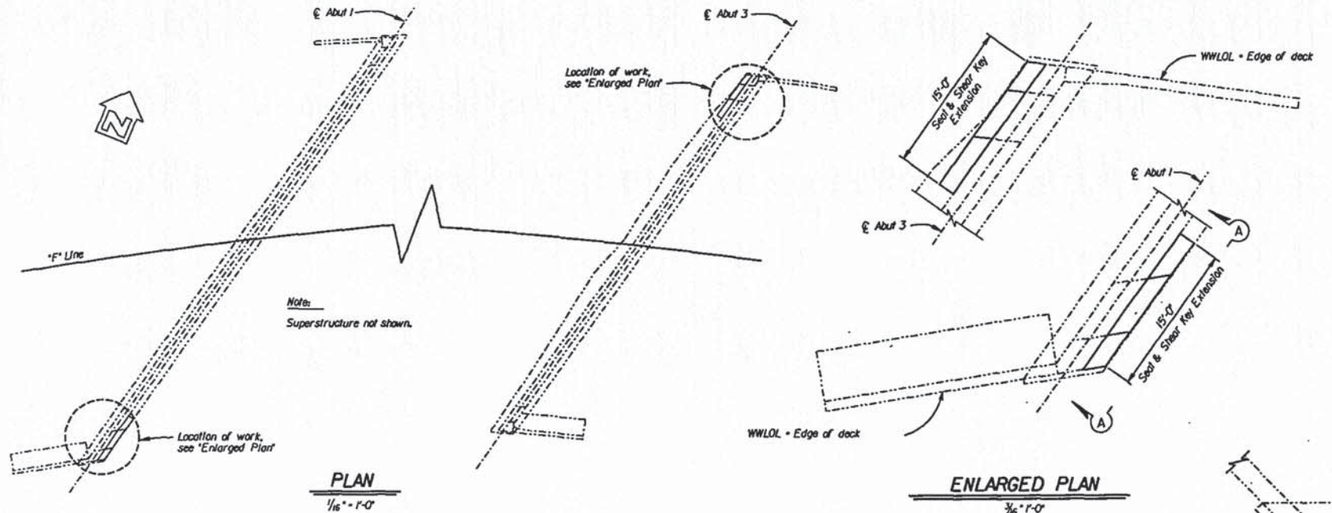
DESIGN: BRIDGE DESIGN SPECIFICATIONS (1983 AASHTO with Interims and Revisions by CALTRANS)

SEISMIC LOADING: Peak Rock Acceleration = 0.6 g
Depth of Alluvium 80-150 ft.

REINFORCED CONCRETE: (EXIST) f_y = 40,000 psi
f'_c = 5,000 psi (assumed)

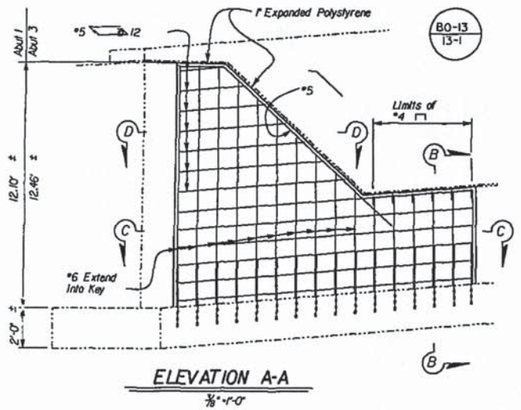
(NEW CONST) f_s = 60,000 psi
f'_c = 4,000 psi

STRUCTURAL STEEL: f_y = 36,000 psi



PLAN
1/16" = 1'-0"

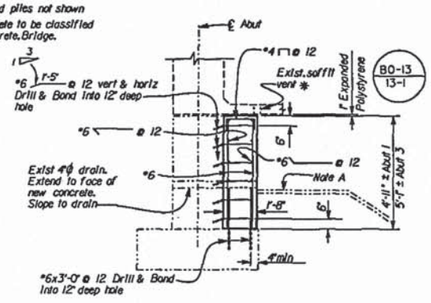
ENLARGED PLAN
3/16" = 1'-0"



ELEVATION A-A
3/8" = 1'-0"

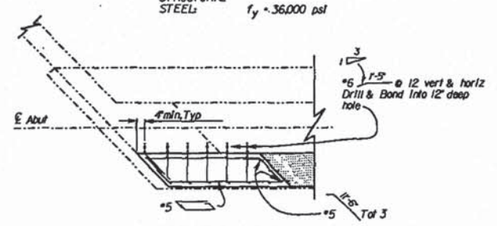
Notes:
*Elevation A-A (Abutment 1) shown, Abutment 3 similar
Barrier railing and piles not shown
All additional concrete to be classified as Structural Concrete, Bridge.

* For Vent Detail see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet.

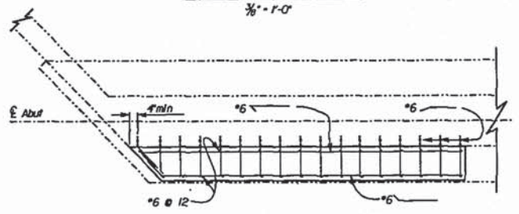


SECTION B-B
3/8" = 1'-0"

Note A:
Remove and replace slope paving. For details, see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet



SECTION D-D
3/8" = 1'-0"



SECTION C-C
3/8" = 1'-0"

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
ABUTMENT RETROFIT DETAILS

	BY	CHECKED
DESIGN	J. Casillari	H. Banakdar/E. Kuroni
DETAILS	K. Endow/D. Kubochi	H. Banakdar/E. Kuroni
QUANTITIES	J. Victor	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 2

DS 0130 2039 (CADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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28-JAN-1998 13:

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163.805	4.4/7.0, 20.5/20.7	134	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER RAMIN RASHEDI No. 37070 Exp. 6-30-08 CIVIL STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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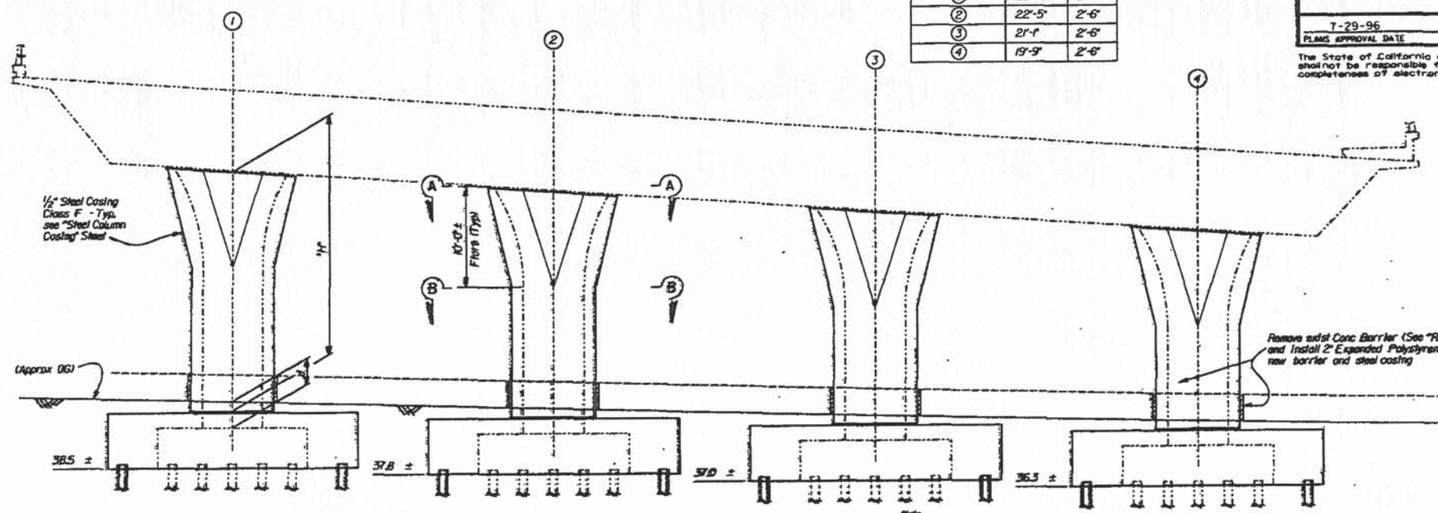
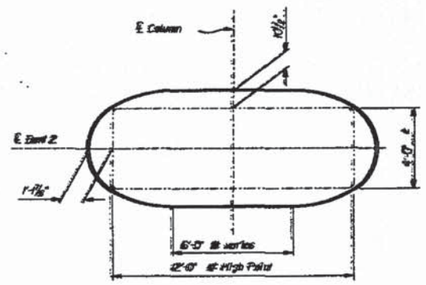
TABLE

COLUMN NO.	H±	d±
1	23'-10"	2'-8"
2	22'-5"	2'-6"
3	21'-1"	2'-6"
4	19'-9"	2'-6"

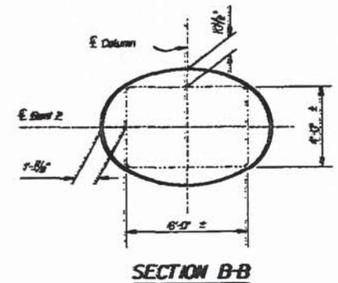


BENT ELEVATION
3/16" = 1'-0"

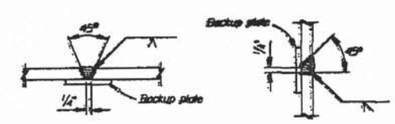
Note:
- For Concrete Barrier replacement, see "ROAD PLANS".
- Casing varies linearly between beginning and end of column flare



SECTION A-A
3/8" = 1'-0"



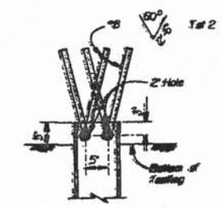
SECTION B-B
3/8" = 1'-0"



SINGLE VEE-GROOVE
SINGLE BEVEL-GROOVE

PILE WELDING DETAIL-BUTT JOINTS

Notes:
1. Single Vee-Groove permitted for all positions.
2. Single Bevel-Groove permitted for horizontal joints only.



STEEL PILE ANCHOR

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT RETROFIT DETAILS

DESIGN	BY J. Cavalieri	CHECKED H. Bonakdar/E. Kurani	
DETAILS	BY K. Endow/C. H. Mamerli	CHECKED H. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.T. Le	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 3 OF 8

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DATE PLOTTED => 28-Jul-1996
TIME PLOTTED => 14:40

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.1/0.0 20.5/20.7	135	162

Ramin Rasheed
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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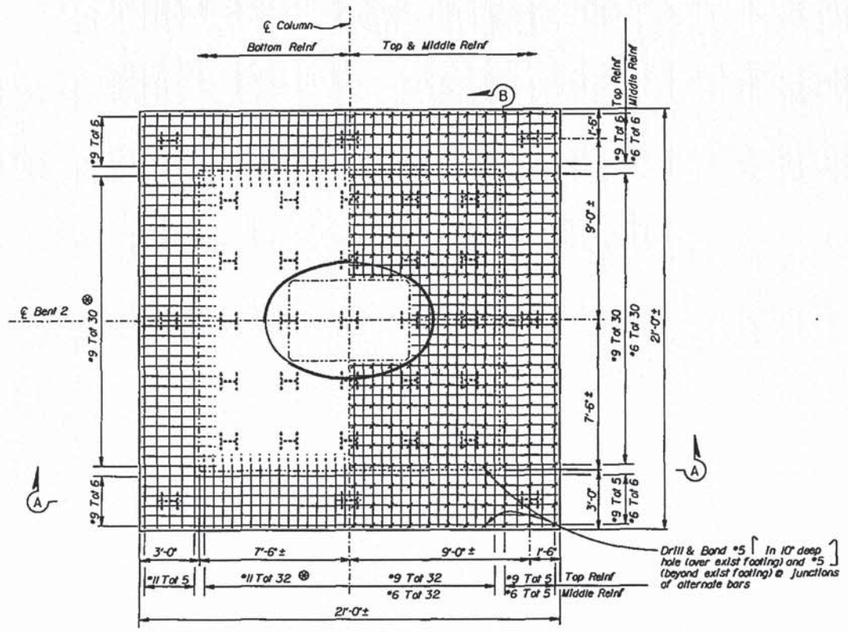
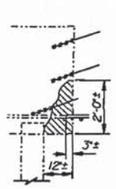
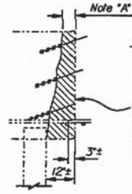


TYPICAL FOOTING PLAN
3/8" = 1'-0"

⊗ Butt weld to exist



ALTERNATIVE 1



ALTERNATIVE 2

DETAIL "A"
No Scale

Note "A"
Dimension may be increased up to 12" at Contractors option.

Remove portion of exist ftg to allow for extension of exist reinf by butt weld - do not remove beyond edge of exist piles

Notes:

All additional concrete around ftgs. is to be classified as Structural Concrete, Bridge Footing.

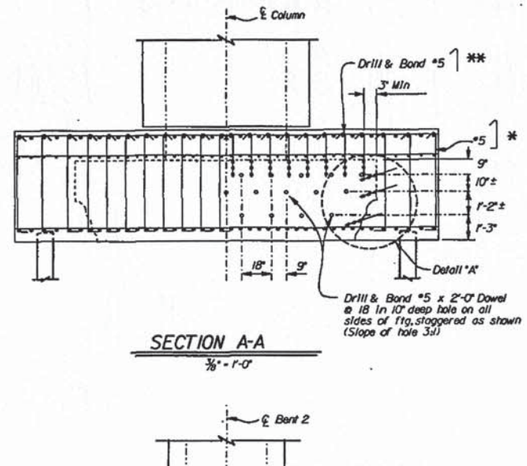
Footing reinforcement and dimensions symmetrical about ℄ Column and ℄ Bent.

Mechanical butt splices may be used in lieu of butt welds noted.

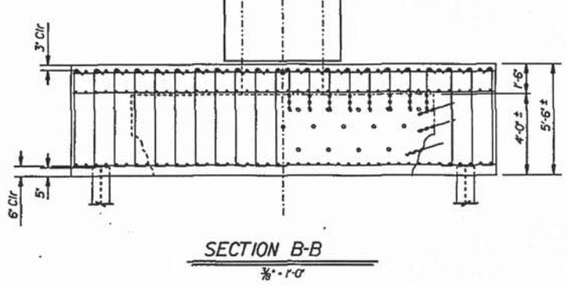
Roughen interface between existing and new footing concrete to an amplitude of 1/4"

For pile details, see "Bent Retrofit Details" Sheet.

* Hook outer bars
** If Alternative 2 of Detail "A" is used first row of drill & bond ties are to be replaced with full height ties similar those in ftg extension



SECTION A-A
3/8" = 1'-0"



SECTION B-B
3/8" = 1'-0"

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

NO AS BUILT CHANGES

DESIGN	BY J. Camilleri	CHECKED	H. Banakdar/E. Kurani
DETAILS	BY E. Endow/E. Tapalla	CHECKED	H. Banakdar/E. Kurani
QUANTITIES	BY J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	57-0595
POST MILE	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT FOOTING RETROFIT DETAILS

DS 050 2139 ICADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 4 OF 8

USERNAME => tsoxp
4_Dnt_ftg_26143743

DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 14:40

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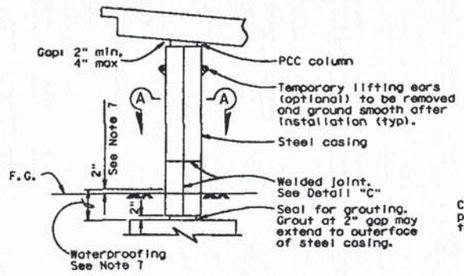
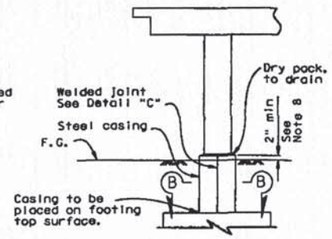
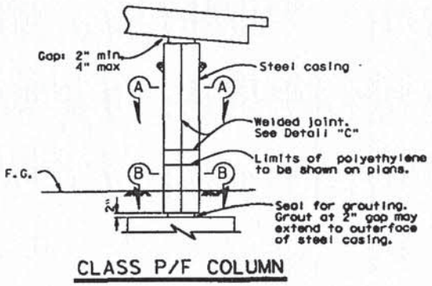
RELEASED 8-12-93



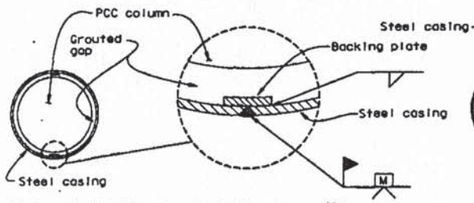
CLASS F COLUMN



CLASS P COLUMN

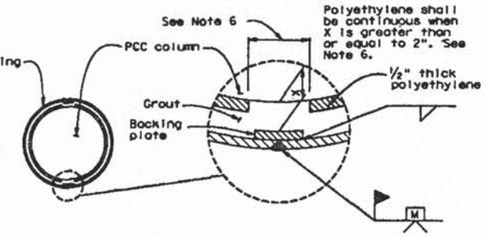


CLASS P/F COLUMN



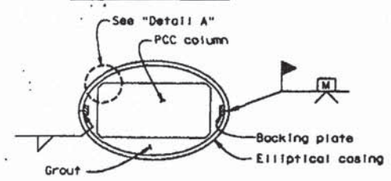
Minimum inside diameter of steel casing = 1½" greater than nominal column diameter for Class F and 2½" for Class P/F.

SECTION A-A
ROUND COLUMN



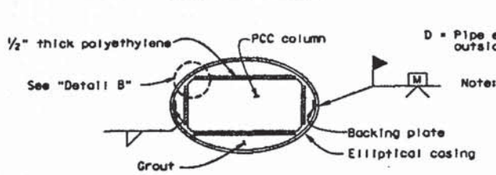
Minimum inside diameter of steel casing = 2½" greater than nominal column diameter for Class P and Class P/F.

SECTION B-B
ROUND COLUMN



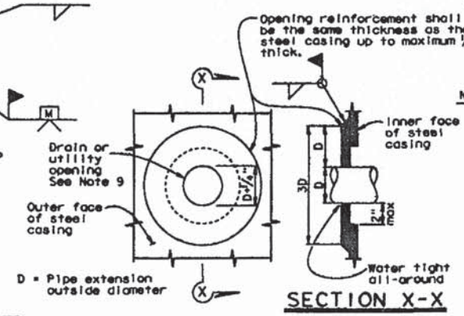
SECTION A-A
RECTANGULAR COLUMN

DETAIL A



SECTION B-B
RECTANGULAR COLUMN

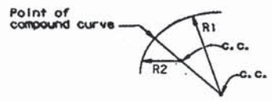
DETAIL B



SECTION X-X

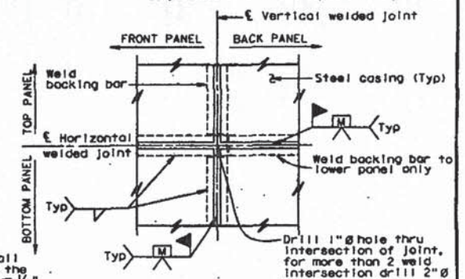
Note: Opening reinforcement required for drain or utility openings larger than 4".

CASING OPENING
No scale



Radii R1 & R2 to be determined by the Contractor subject to the approval of the Engineer.

ELLIPTICAL CASING DETAIL
CLASS P, F AND P/F COLUMN



(TWO WELDED INTERSECTION JOINT)
DETAIL C
No Scale

Notes:

1) For varying thickness steel casing inside surface to remain flush. Minimum clearance from PCC column to casing shall be maintained.
2) Appropriate injection nozzles to be provided on casing, but removed and ground flush following completion of grouting operation.
3) All voids between steel casing and polyethylene (Class P and Class P/F), and steel casing and PCC column (Class F) to be filled with grout.
4) Location and number of vertical and horizontal welds to be determined by the Contractor, and subject to the approval of the Engineer. The location of casing welds are for illustration. No skip welds allowed.
5) Circular steel casing to be ¼" thick minimum for casings with a 4'-4" diameter or less; all other steel casings to be ⅜" thick unless noted differently on contract plans. Backing plates to be the same thickness as casing up to maximum ½" thick.
6) Contractor shall remove 12" polyethylene strip behind backing plate if backing plate is closer than 1½" from polyethylene.
7) Waterproof limits for steel casings. Typical for Types "P", "F" and "P/F".
8) Minimum length of Types "P" and "F" casing shall be 1.50 times the largest dimension of prismatic section of column, or 2" above finished grade whichever is greater. Lengths other than the specified minimum shall be shown on Detail sheets.
9) For pipe extensions, opening shall be no more than ¼" greater than the pipe extension diameter. For other openings, the opening diameter to be determined by the Engineer.

NO AS BUILT CHANGES

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/1.0 20.5/20.7	136	162

Ronna Rabeder
REGISTERED ENGINEER - CIVIL
No. 37870 Exp. 6-30-98 CIVIL STATE OF CALIFORNIA
7-29-96
PLANS APPROVAL DATE

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DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 16:45

EARTHQUAKE RETROFIT PROJECT NO. 272
FRIARS ROAD OVERCROSSING
STEEL COLUMN CASINGS

STANDARD DRAWING			
FILE NO. XS 12-77	DESIGN BY BRIAN MAHONEY	CHECKED R. J. ZELINSKI	APPROVED RECOMMENDED BY
DRAWING DATE 8/93	DETAILS BY K. CHRISTOPHER	CHECKED PAT HIPLEY	
	SUBMITTED BY R. J. ZELINSKI		

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO. 57-0595
POST MILE 4.4

OVERLEAF PRINTS BEARING EARLIER REVISION DATES ——— BY

REVISION DATES (PRELIMINARY STAGE ONLY)
2-96

SHEET 5 OF 8

USERNAME => TSDKD
S_steel_002143954

DS 050 DATA ICADD 10/89

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	137	162

Ramin Rasheen
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER — RAMIN RASHEEN — No. 37070 — Exp. 6-30-00 — CIVIL — STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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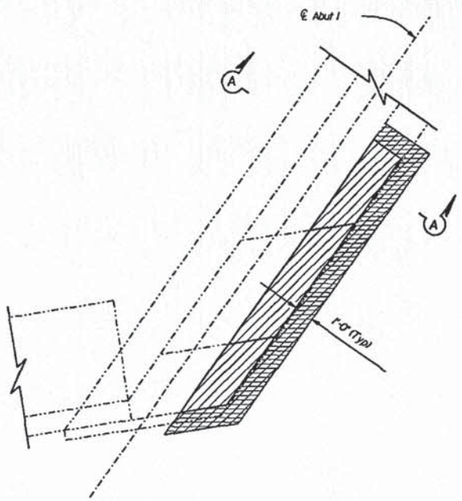
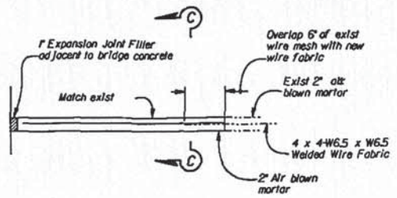


PLAN
SEAT & SHEAR KEY EXTENSION
3/8"=1'-0"

Note:
Abut 1 shown,
Abut 3 similar



SLOPE PAVEMENT REPLACEMENT DETAIL
1/2"=1'-0"

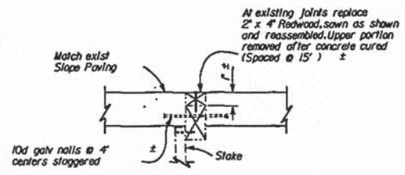
Note:
Limits for removal and replacement of slope paving shall be the same as horizontal limits shown for excavation and backfill for seat and shear key extension

LEGEND

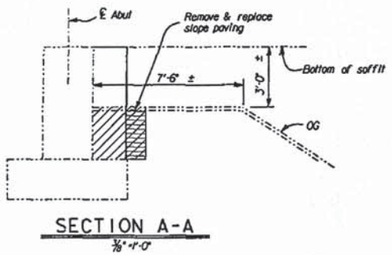
- Indicates Existing Structure
- Indicates New Construction
- Indicates Structure Excavation
- Indicates Structure Backfill

ABBREVIATIONS

OG	Original Ground
FS	Planned Finished Surface
GP	Planned Graded Plane

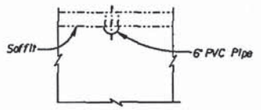


SECTION C-C
No Scale

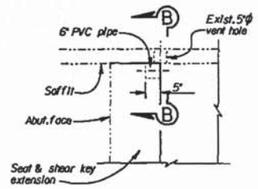


SECTION A-A
3/8"=1'-0"

Where seat & shear key extension interferes with existing vent holes, vent shall be maintained open with the installation of a 6"ϕ PVC pipe or similar device.

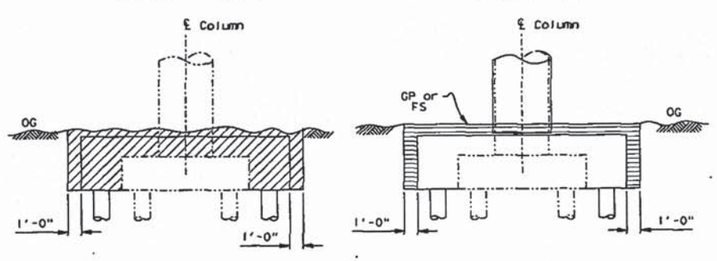


SECTION B-B
No Scale



VENT DETAIL
No Scale

EXCAVATION ——— BACKFILL



COLUMN CASING & FOOTING RETROFIT
NO SCALE

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS

DESIGN	J. Camilleri	CHECKED	H. Bonakdar/E. Kurani
DETAILS	Dale Kubochi	CHECKED	H. Bonakdar/E. Kurani
QUANTITIES	J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 6

DS 050 2331 (CADD 8/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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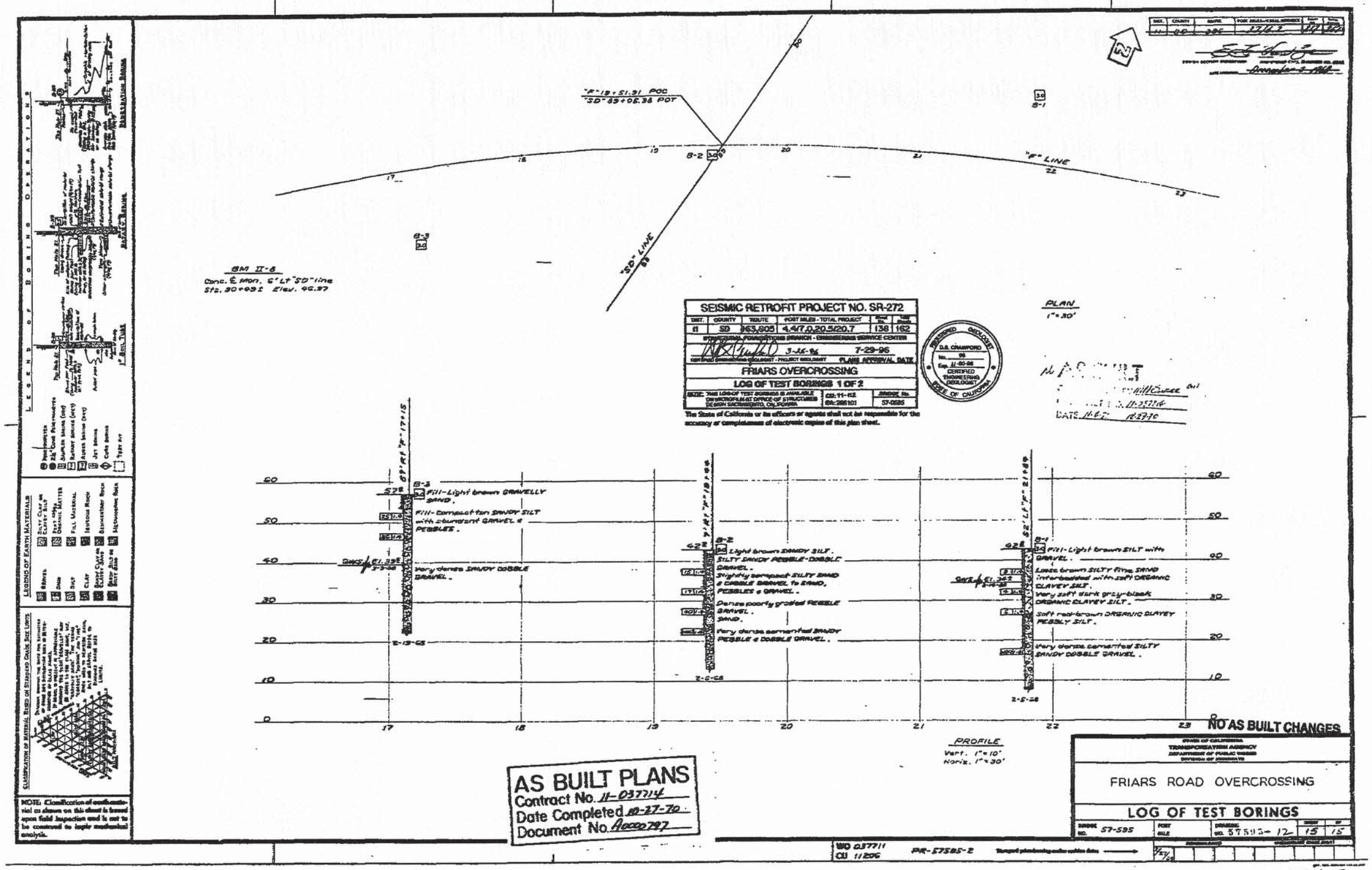

SEISMIC RETROFIT PROJECT NO. SR-272

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
11	SD	163,805	4.4/7.0,20.5/20.7	138	162

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

3-26-96 7-29-96

CERTIFIED ENGINEERING GEOLOGIST - PROJECT GEOLOGIST PLANS APPROVAL DATE

FRIARS OVERCROSSING

LOG OF TEST BORINGS 1 OF 2

NOTE: THIS LOG OF TEST BORINGS IS AVAILABLE ON MICROFILM AT OFFICE OF STRUCTURES DESIGN SACRAMENTO, CALIFORNIA

CU: 11-112 EA: 286101 BRIDGE No. 57-0585

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REGISTERED GEOLOGIST D.S. CRAWFORD No. 98 Exp. 11-30-96 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

AS BUILT

DATE 11-6-7 10-27-70

NO AS BUILT CHANGES

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

BRIDGE NO. 57-595 POST MILE DRAWING NO. 57595-12 SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

SHEET 7 OF 8

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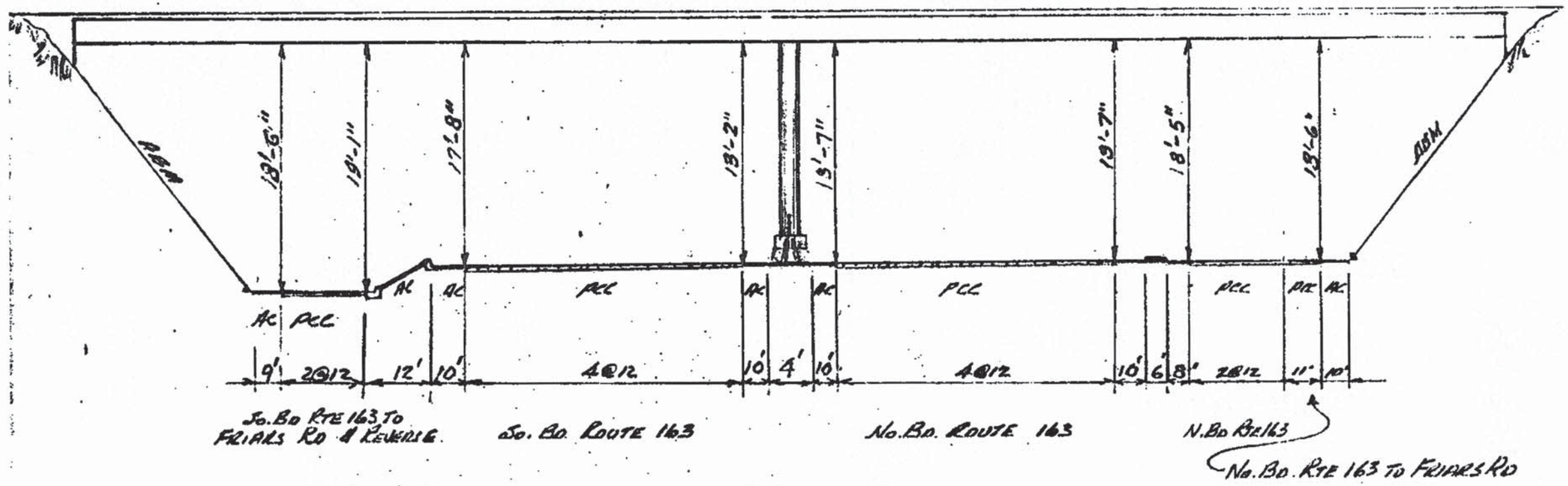
CLEARANCE DIAGRAM



LOOKING AHEAD (NORTH) ON ROUTE 163

FRIARS ROAD OVERCROSSING
11-SD-163-4.37-SD
Bu. No. 57-595

M. I. FOREL
* J. BORIK

Rev. AUG. 1978
Rev. 6/12/85

APPENDIX C

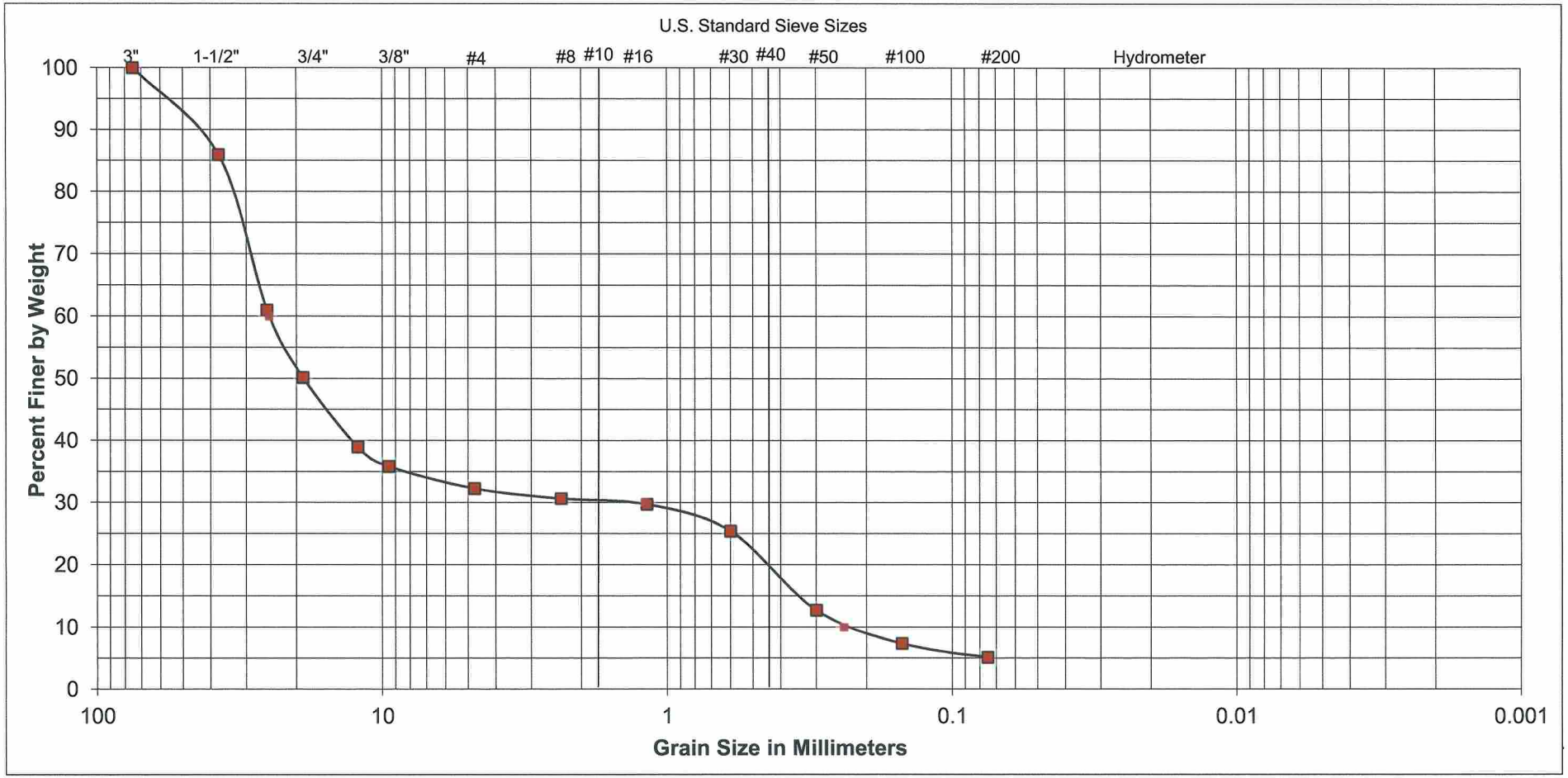
APPENDIX C

LABORATORY TEST RESULTS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL
(BRIDGE NO. 57E0126)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	1 foot to 3½ feet

UNIFIED SOIL CLASSIFICATION:	GP-GM
DESCRIPTION:	POORLY-GRADED GRAVEL with SILT and SAND

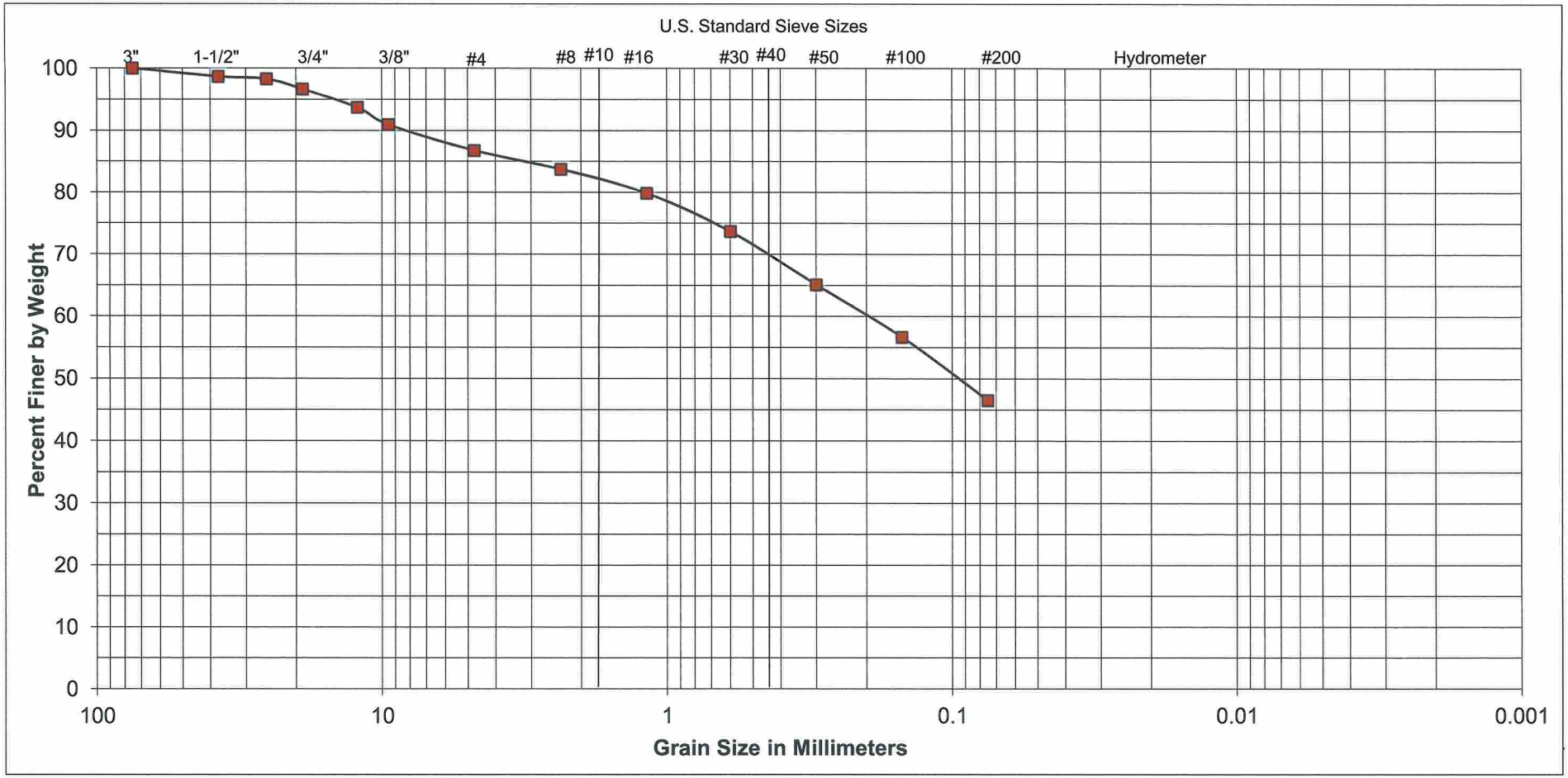
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-3

Figure C1



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	6 feet to 8 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

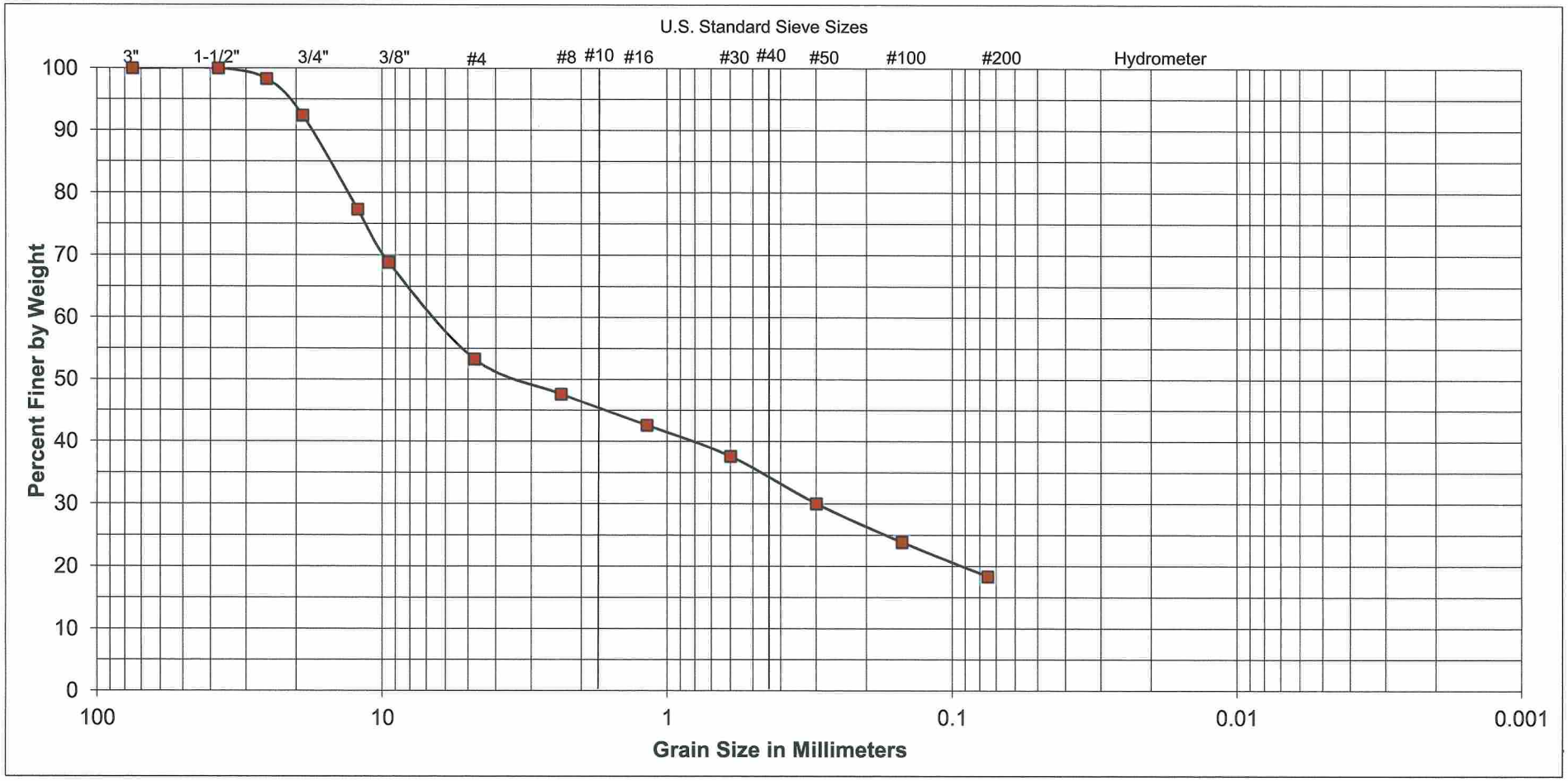
ATTERBERG LIMITS	
LIQUID LIMIT:	56
PLASTIC LIMIT:	24
PLASTICITY INDEX:	32

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-4

Figure C2



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	17 feet to 20 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

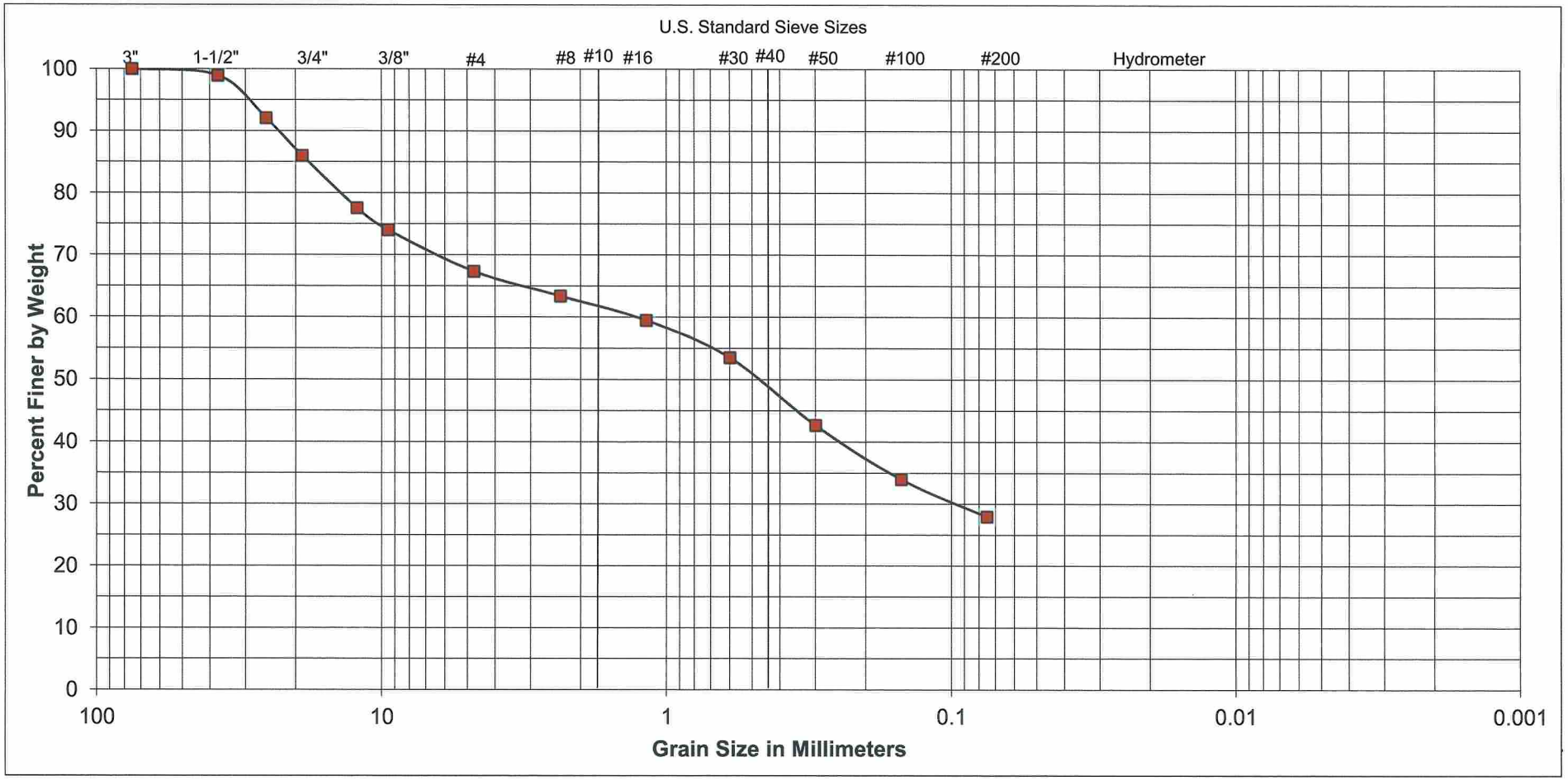
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-5

Figure C3



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	26 feet to 28 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

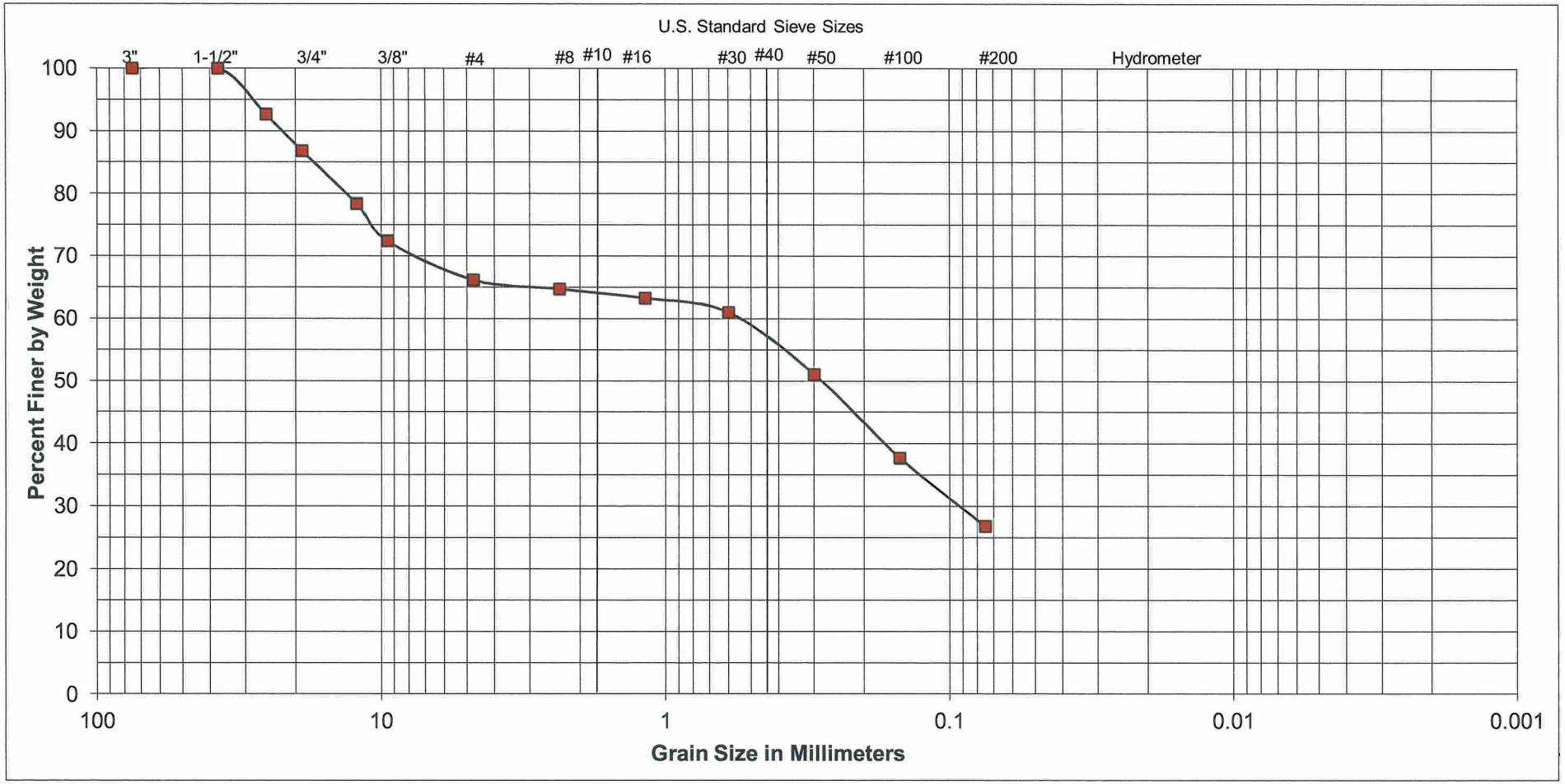
ATTERBERG LIMITS	
LIQUID LIMIT:	33
PLASTIC LIMIT:	21
PLASTICITY INDEX:	12

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE	V-6

Figure C4



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	21½ feet to 23 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

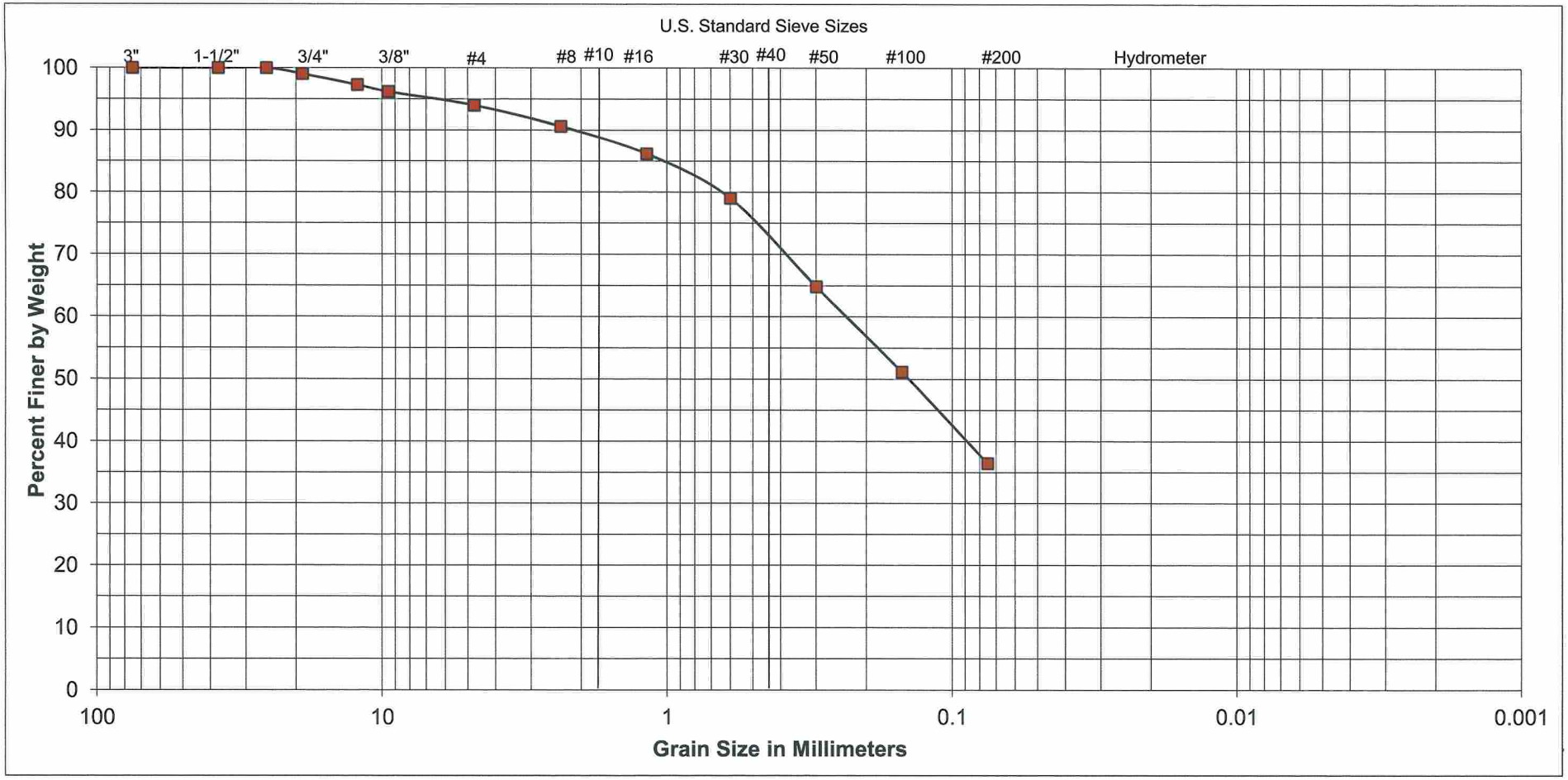
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-7

Figure C5



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	32½ f.t to 34½ ft.

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

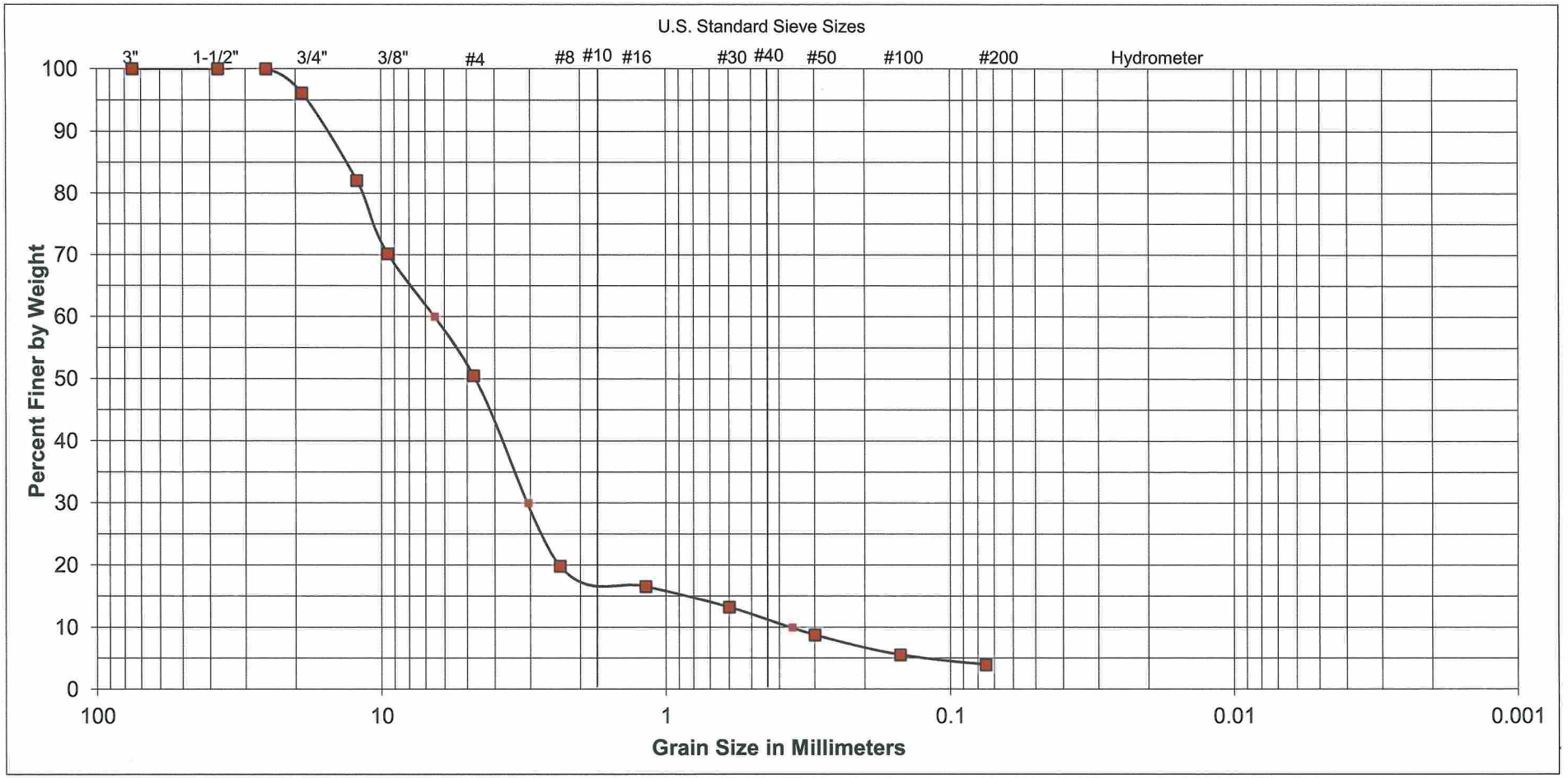
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-8

Figure C6



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	35½ feet

UNIFIED SOIL CLASSIFICATION:	SP
DESCRIPTION:	POORLY-GRADED SAND with GRAVEL

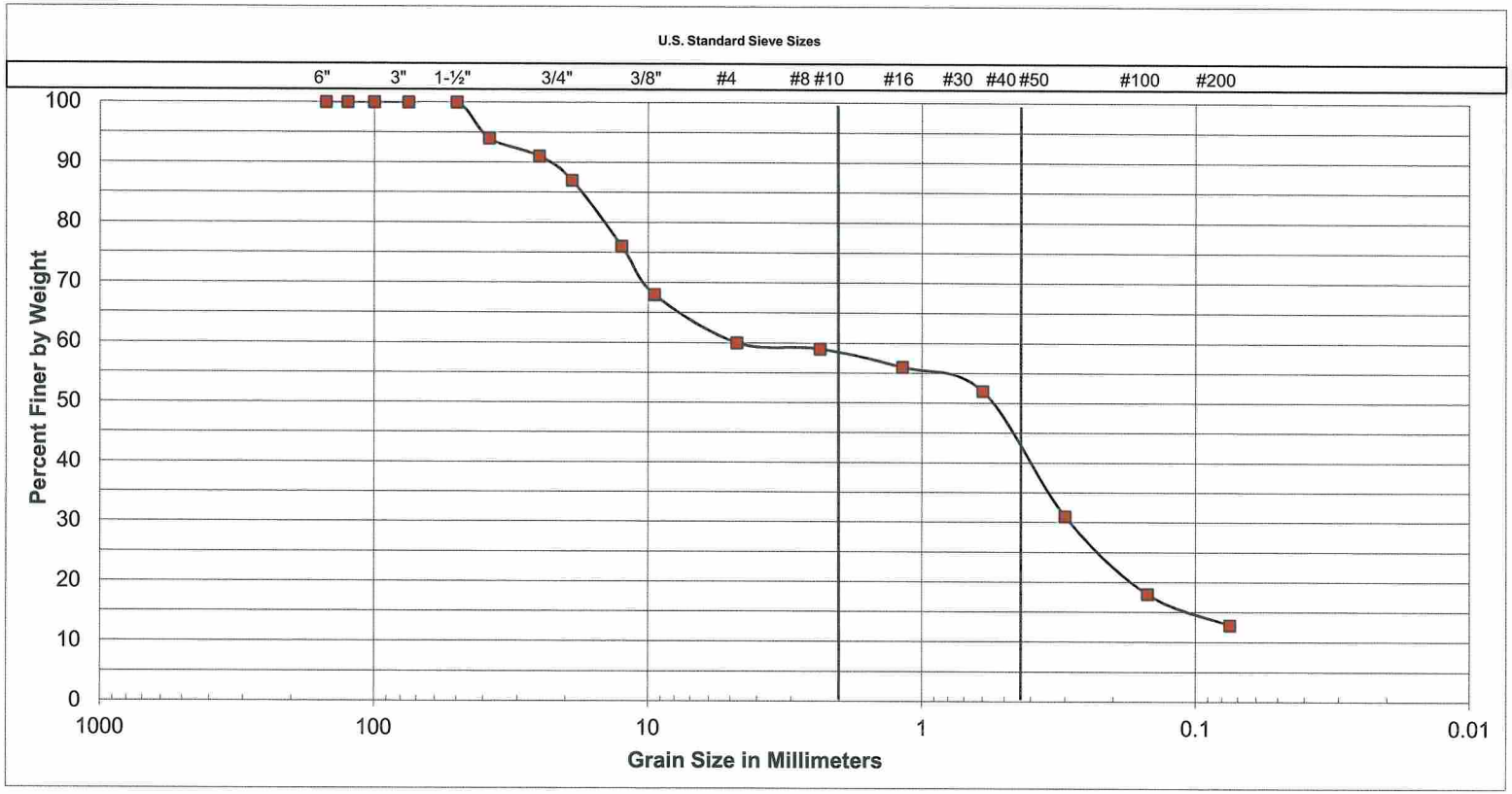
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-9

Figure C7



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 1 foot to 5 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

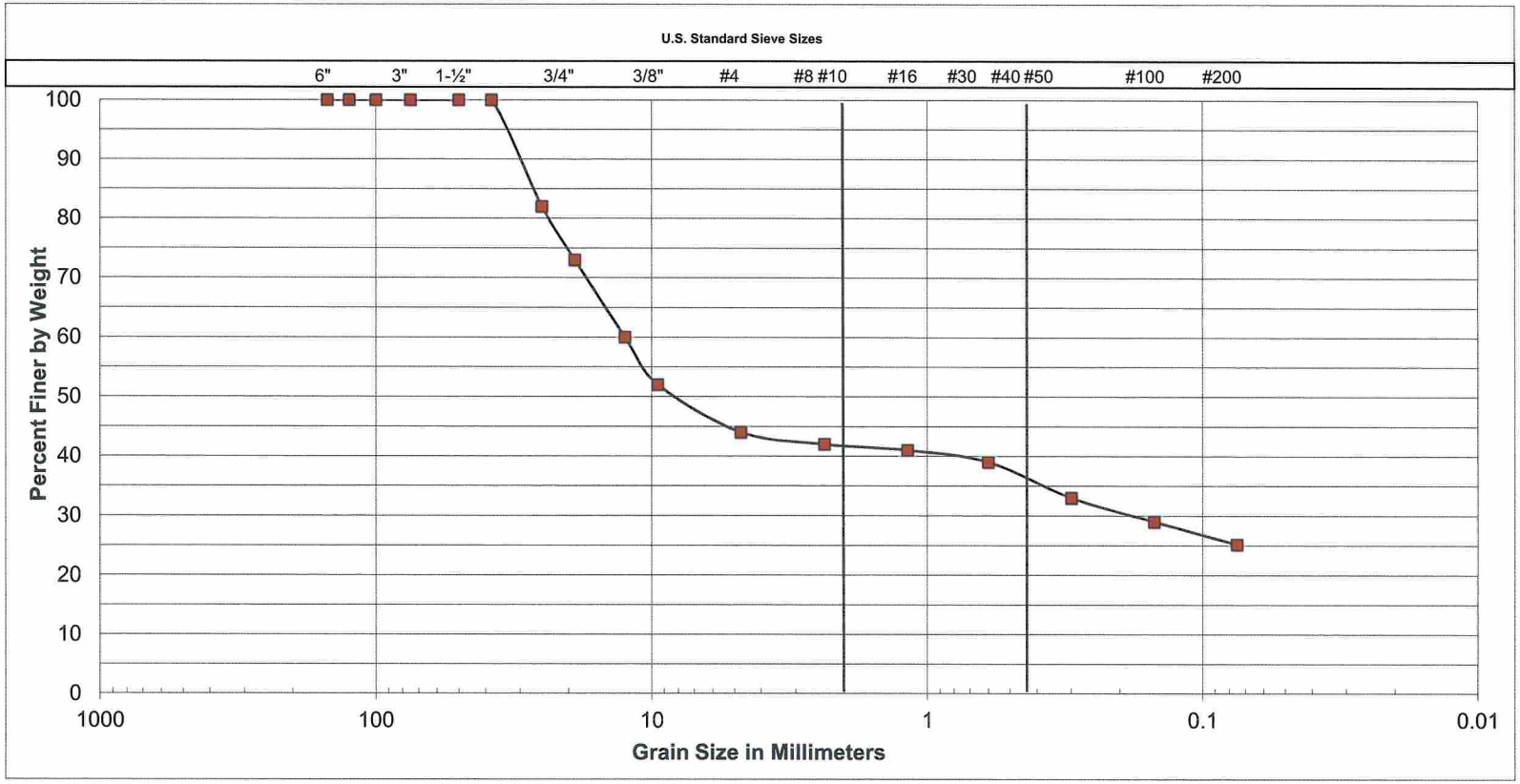
ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-60

Figure C8



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 30 feet 35 feet

UNIFIED SOIL CLASSIFICATION:	GC
DESCRIPTION	CLAYEY GRAVEL with SAND

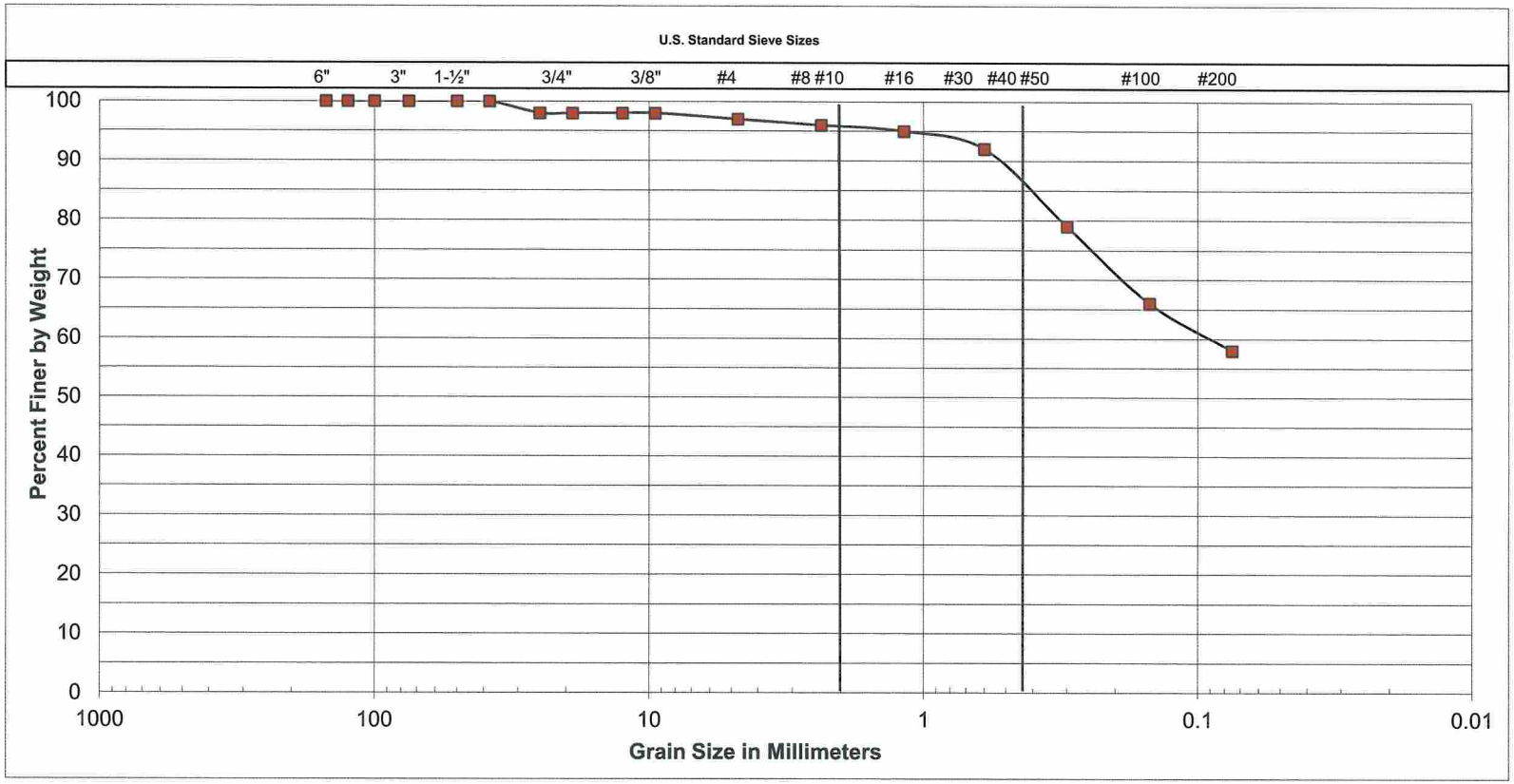
ATTERBERG LIMITS	
LIQUID LIMIT	49
PLASTIC LIMIT	20
PLASTICITY INDEX	29

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-61

Figure C9



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 45 feet to 50 feet

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY LEAN CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	45
PLASTIC LIMIT	19
PLASTICITY INDEX	26

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-62

Figure C10

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-03-001 at 10 feet	3100	6.7	0.001	0.002
A-03-001 at 30 feet	-	7.5	0.005	0.012
A-03-002 at 1 ft. to 3½ ft.	1870	8.7	0.007	0.001
A-03-002 at 12½ feet	-	9	0.001	-
A-03-002 at 26 ft. to 28 ft.	935	8.4	0.017	0.015
A-03-003 at 1 ft. to 3½ ft.	2204	8.1	0.008	0.007
A-03-003 at 32 ft. to 34 ft.	1336	7.7	0.025	0.006
A-03-003 at 45 feet	-	7.1	0.016	0.023
A-03-009 at 1 ft. to 3½ ft.	1536	8.8	0.007	0.003
A-03-012 at 1 ft. to 3½ ft.	1403	8.4	0.011	0.004
A-03-015 at 1 ft. to 3½ ft.	868	7.4	0.037	0.018
A-03-017 at 1 ft. to 3½ ft.	1136	8.9	0.049	0.003

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NUMBEF	1111191-1	FIGURE:	V-68

Figure C11

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-12-034 at 25 feet	1800	8.2	0.013	0.007
R-12-038 at 4 ft. to 9 ft.	2300	8.2	0.011	0.004
R-12-038 at 80 ft.	1500	8.8	0.017	0.005
R-12-041 at 10 ft.	1120	7.8	0.018	0.006
A-12-044 at 1 ft. to 5 ft.	1750	9.2	0.003	0.002

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

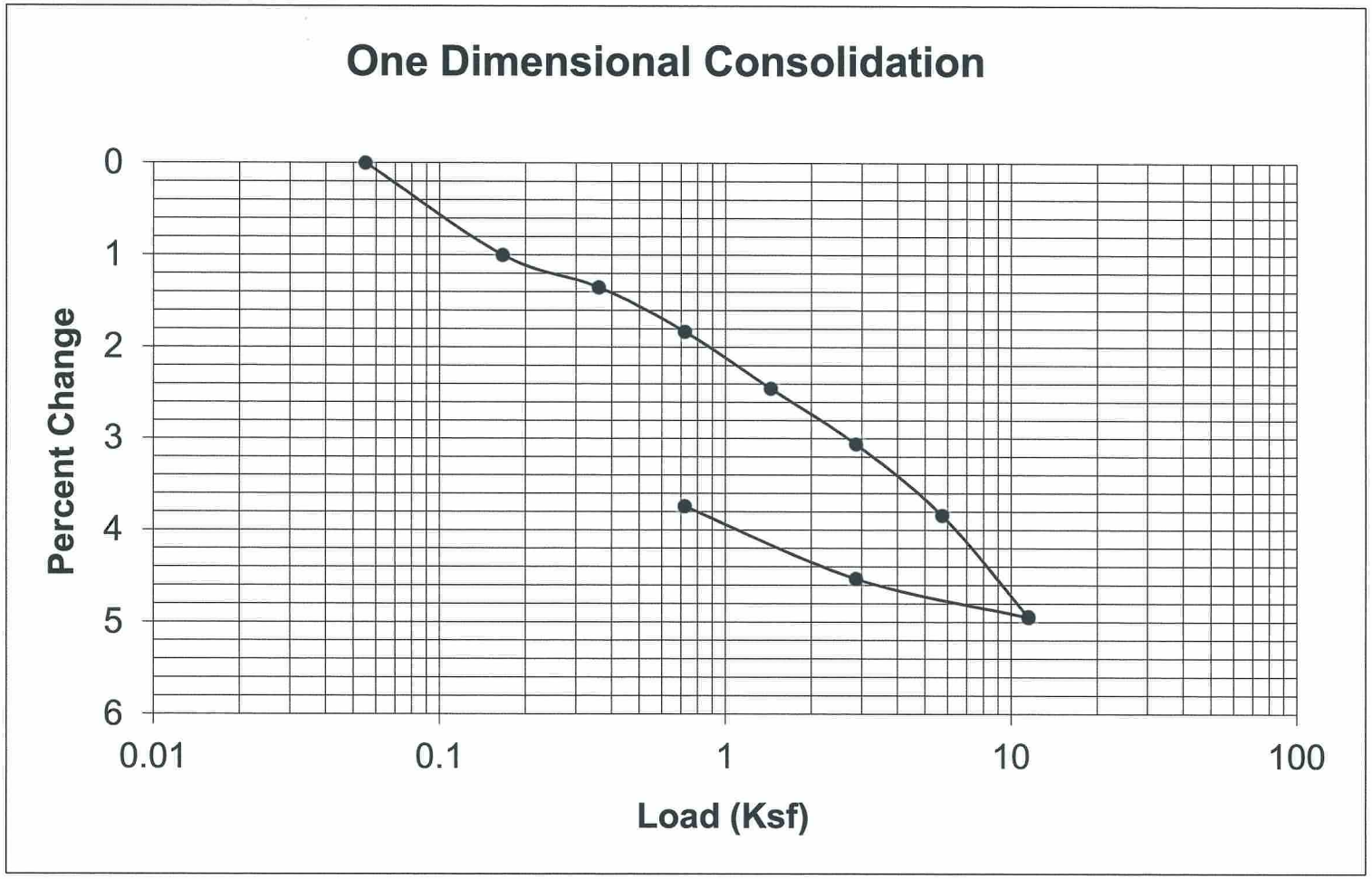
Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NO.:	1111191-1	FIGURE:	V-69

Figure C12

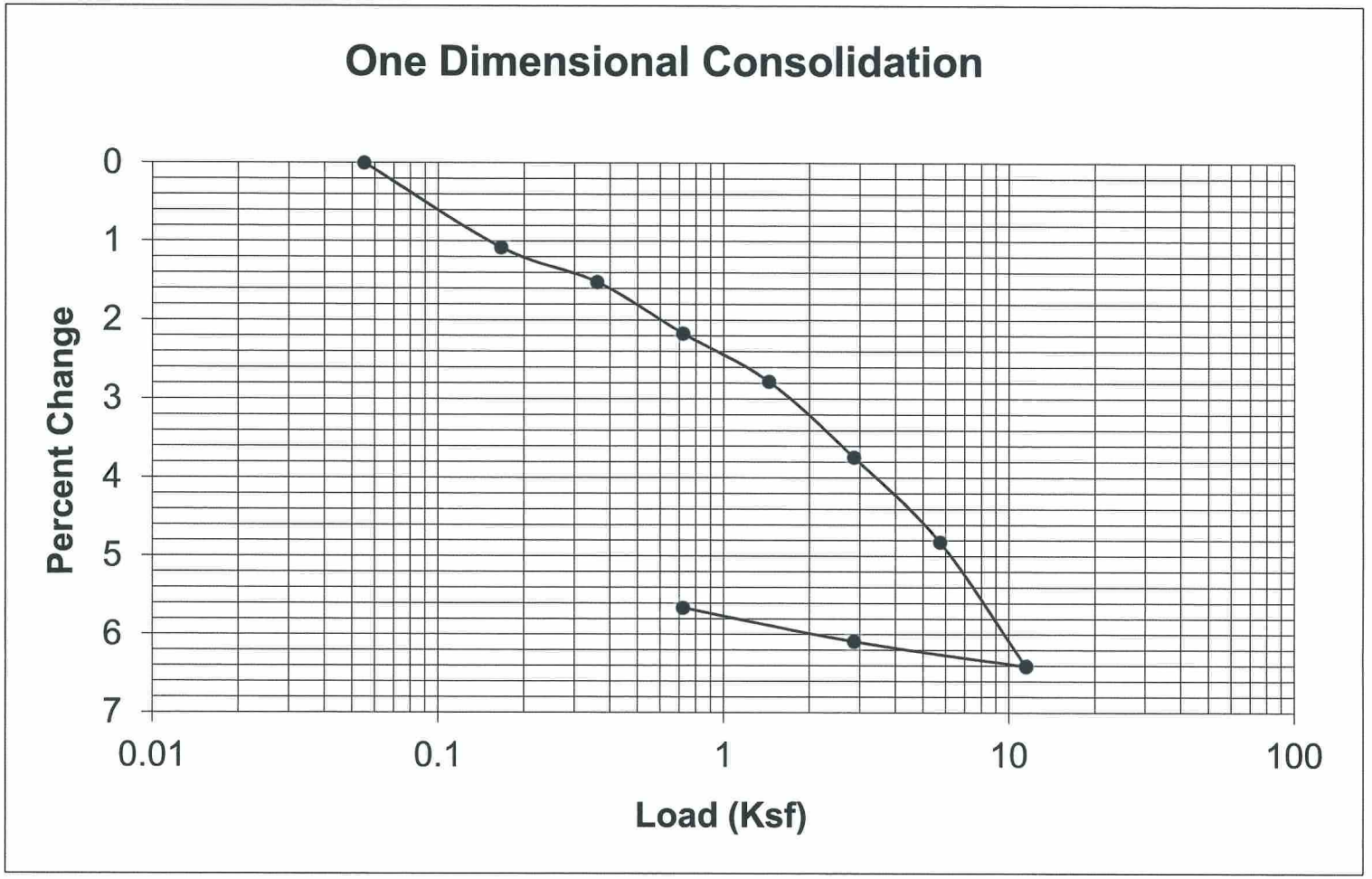
A-03-003 at 20 feet



SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163			
	BY:	AKN	DATE:	6/28/2012
	JOB NUMBER:	1111191-1	FIGURE:	V-70

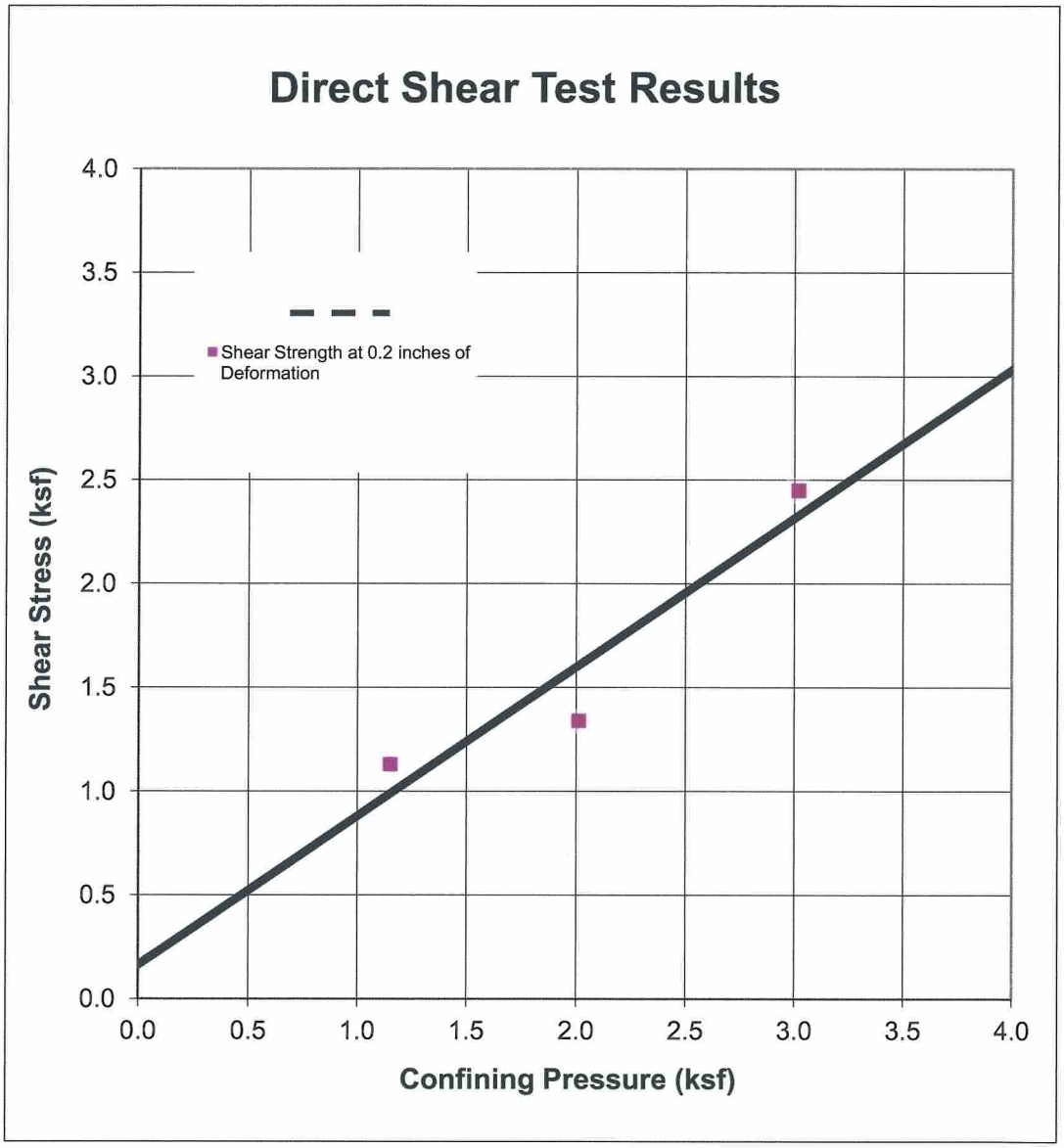
Figure C13

A-03-003 at 25 feet



SCST SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163			
	BY:	AKN	DATE:	6/28/2012
	JOB NUMBER:	1111191-1	FIGURE:	V-71

Figure C14



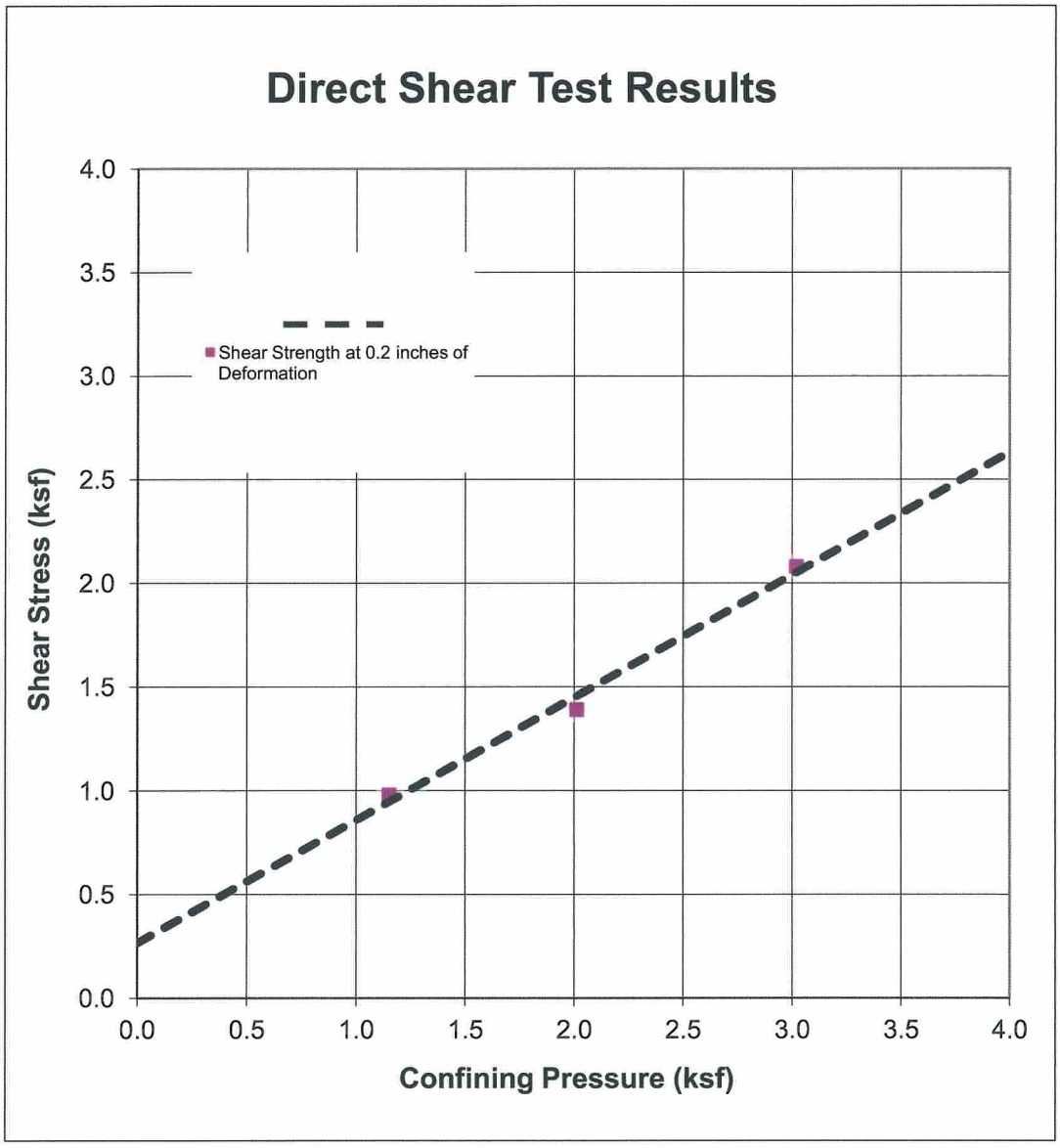
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 7.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		36	162

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-73

Figure C15



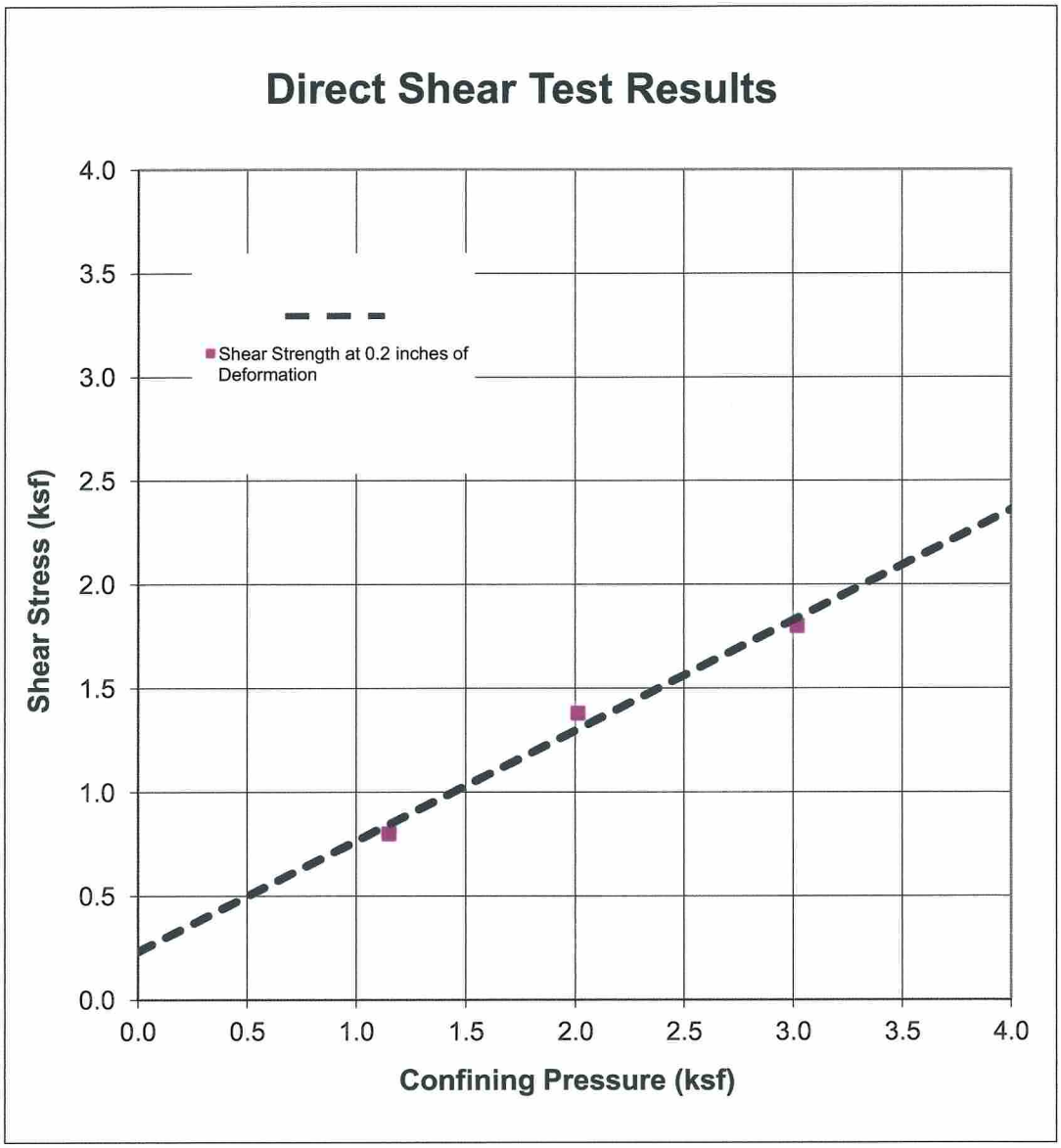
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 10 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	265

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-74

Figure C16



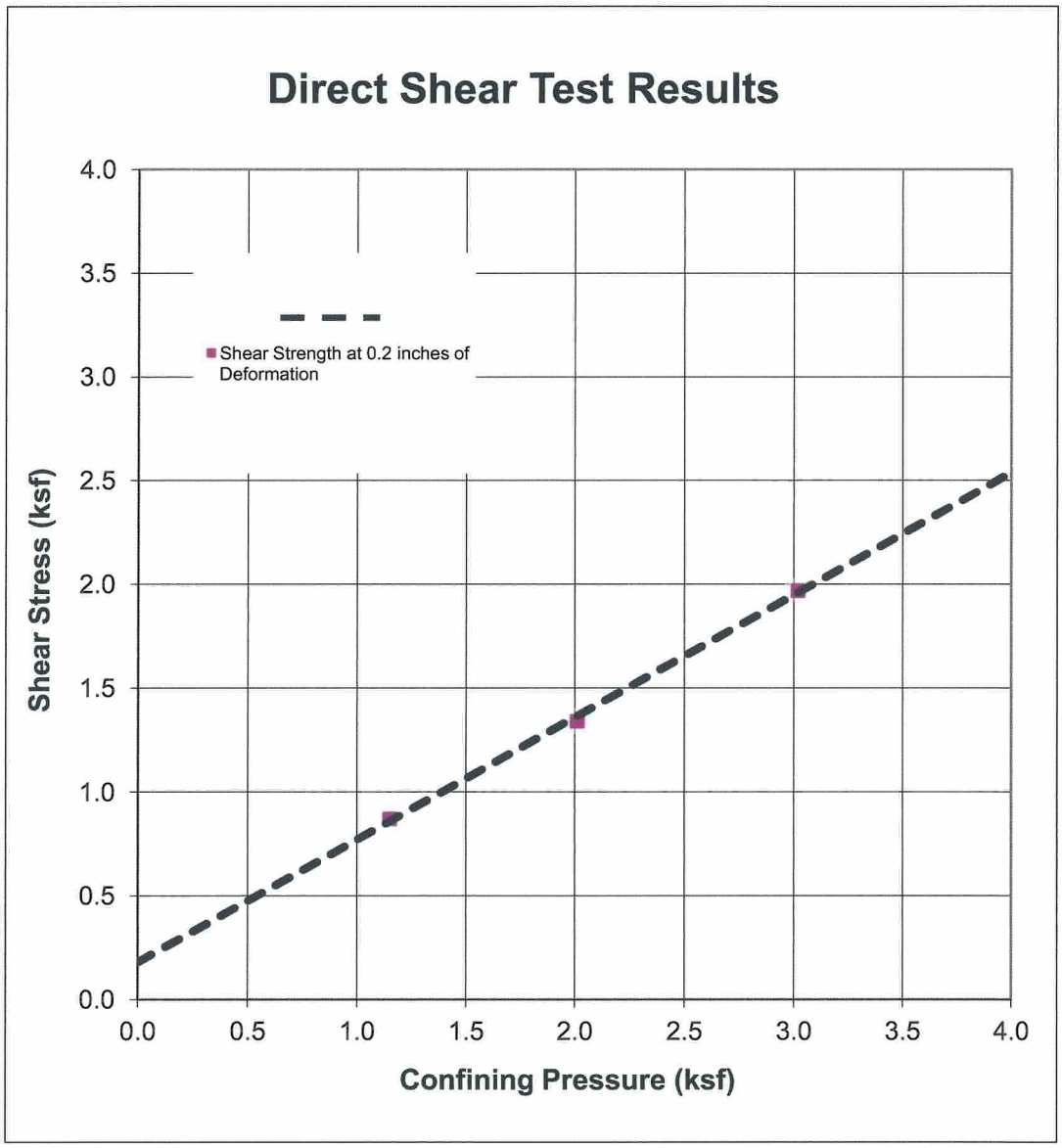
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 20 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		28	231

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-75

Figure C17



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 22 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	178

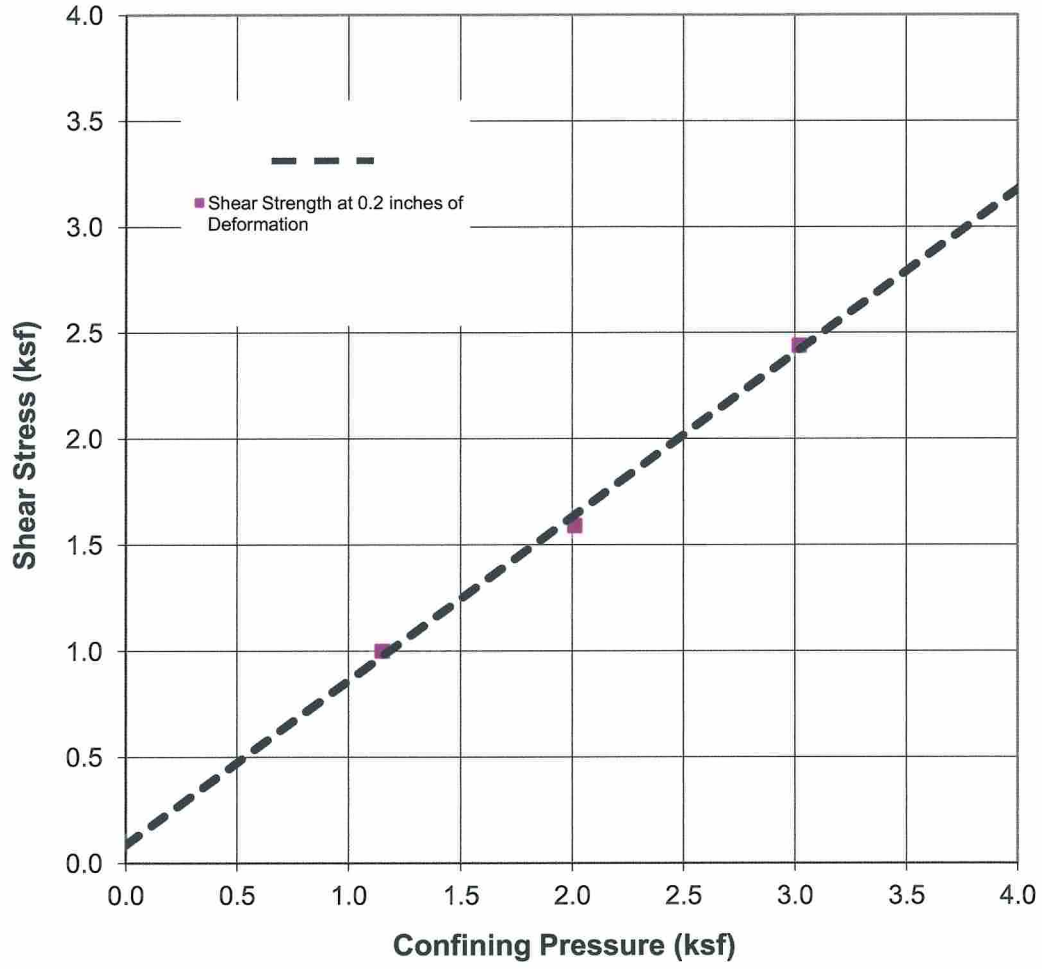
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-76

Figure C18

Direct Shear Test Results



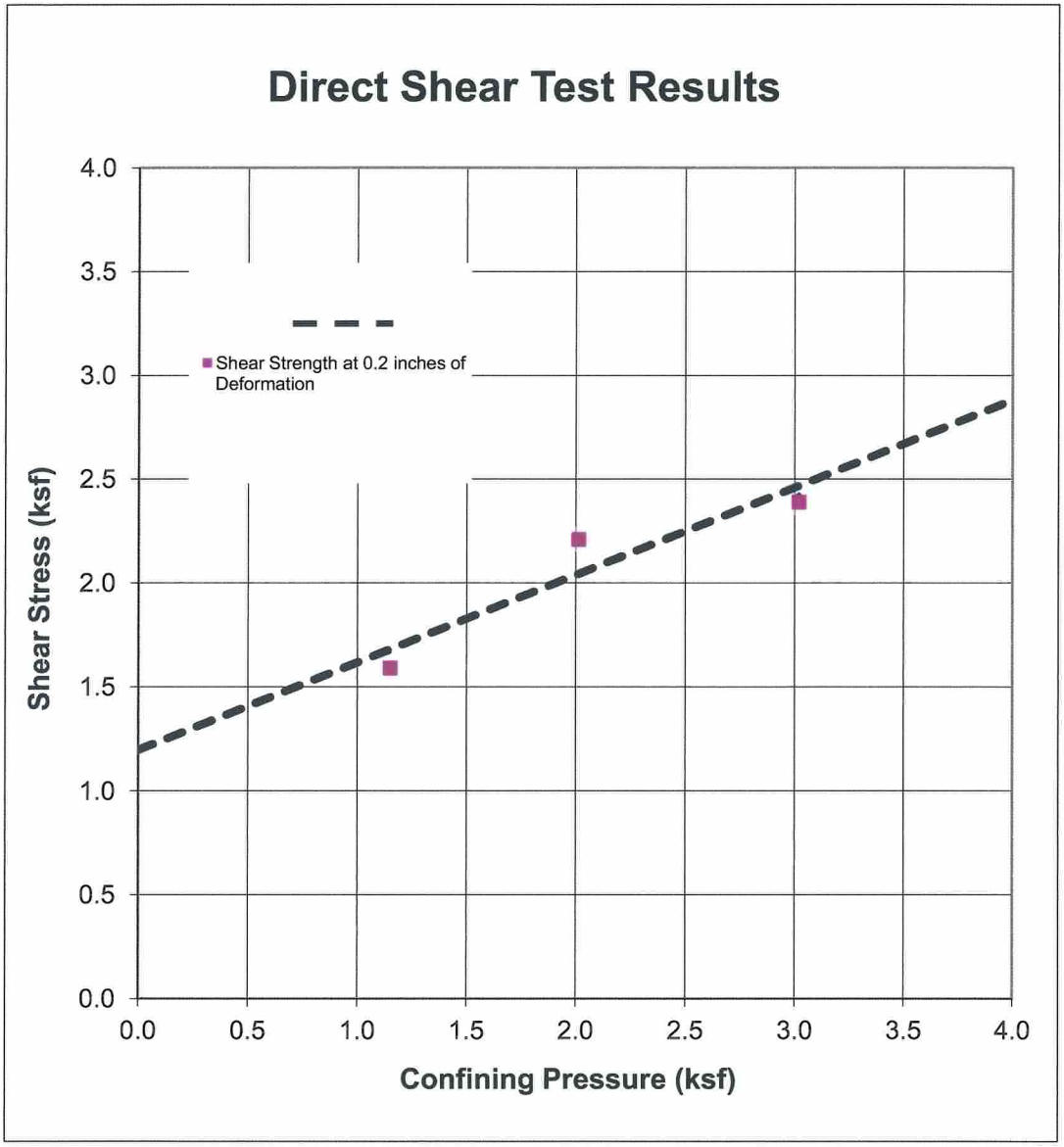
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 25 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		38	85

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-77

Figure C19



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 27.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		23	1196

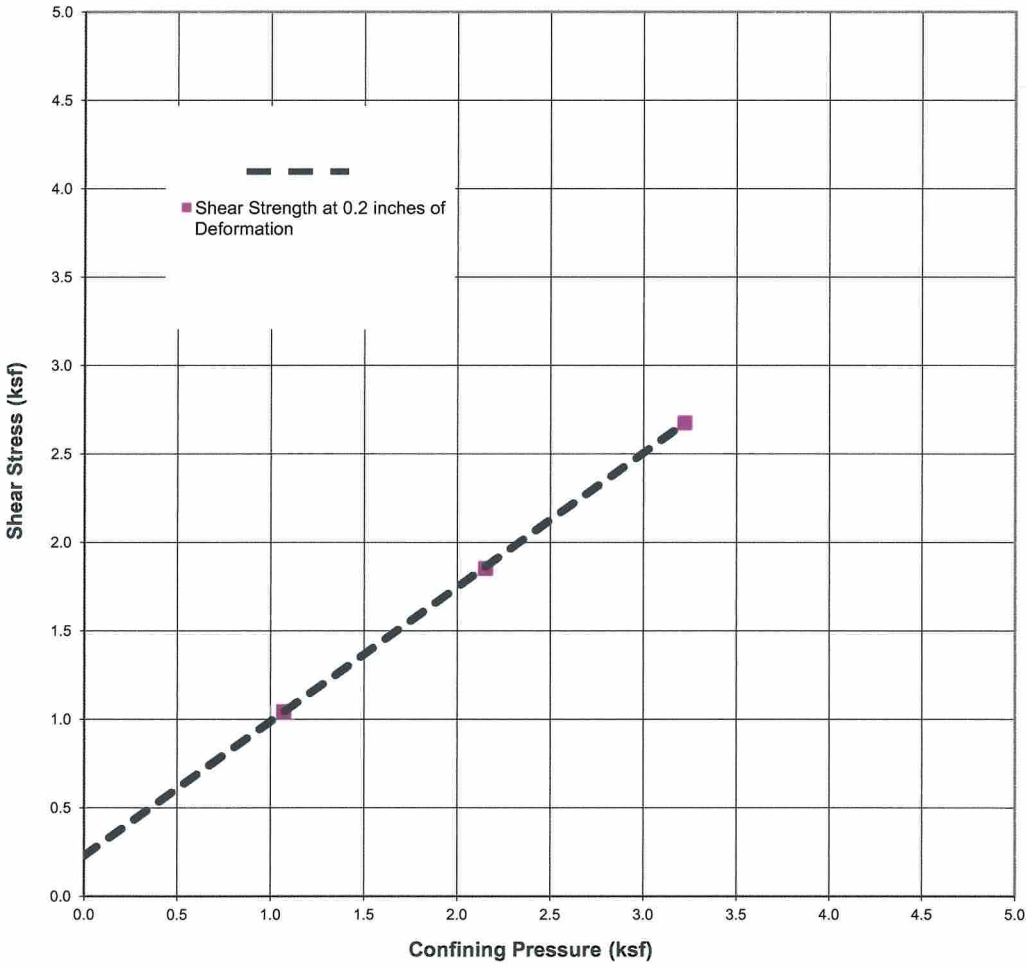
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-78

Figure C20

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 10 ft to 15 ft	silty SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		37	228

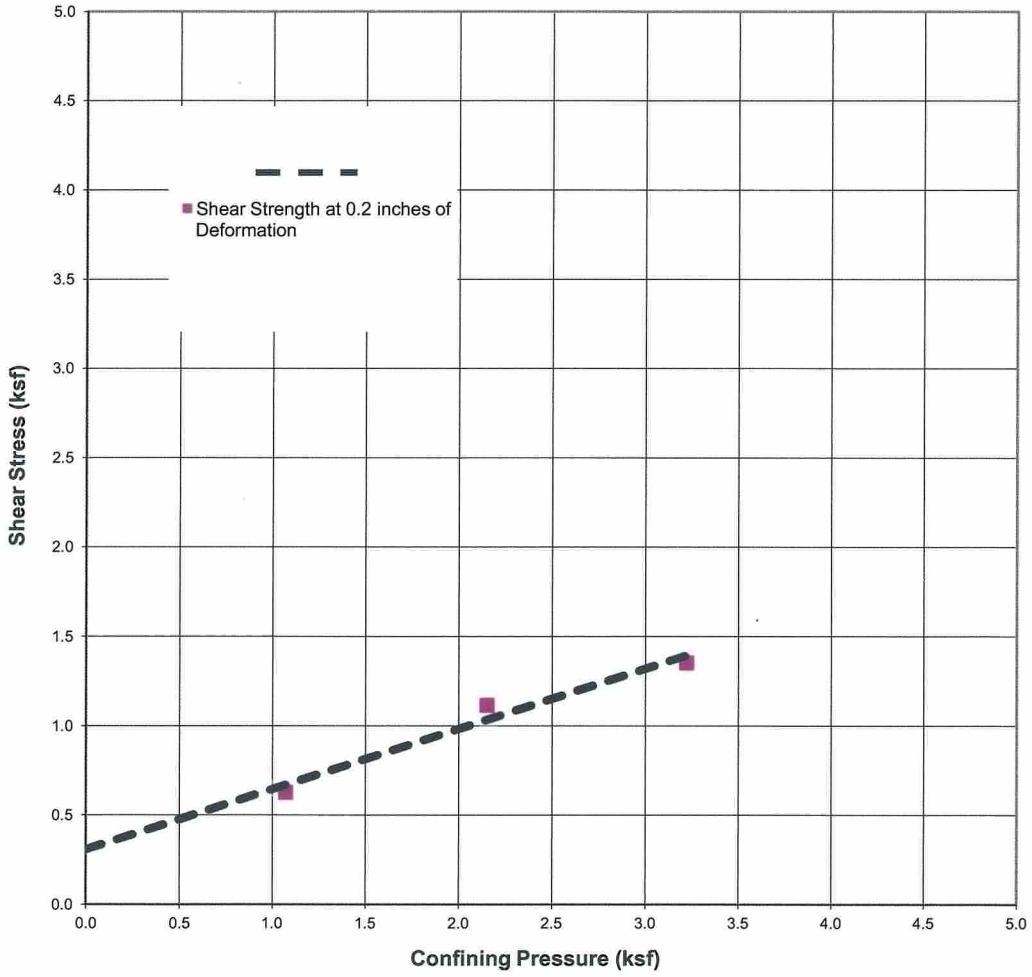
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-82

Figure C21

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 40 feet	clayey SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		19	307

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-83

Figure C22

APPENDIX D

APPENDIX D

ANALYSES AND CALCULATIONS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL
(BRIDGE NO. 57E0126)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

PROJECT NAME SR-163/Friars Rd OC (WIDEN) SEISMIC

PROJECT NO G1447-52-01
BY YW DATE 2/6/12
SHEET 1 OF 57

REVISIONS
BY ____ DATE ____
BY ____ DATE ____

BY ____ DATE ____
CHECKED BY ____

SEISMIC STUDY UPDATE

ITEM	DESCRIPTION	PAGE
1	FAULT & SITE DATA INPUT	2
2	ARS ONLINE (V_{S30} 420 & 380 m/s)	3 & 4
3	SHAKE RESULTS – V_{S30} = 420 m/s	5 ~ 12
4	SHAKE RESULTS – V_{S30} = 380 m/s	13 ~ 20
5	DETERMINISTIC RESULTS V_{S30} 420 & 380 m/s	21 ~ 24
6	PROBABILISTIC RESULTS V_{S30} 420 & 380 m/s	25 ~ 28
7	USGS DEAGGREATION RESULTS V_{S30} = 420 m/s	29 ~ 38
8	USGS DEAGGREGATION RESULTS V_{S30} = 380 m/s	39 ~ 48
9	DESIGN RESPONSE SPECTRUM CURVE	49
10	DESIGN RESPONSE SPECTRUM DATA	50 & 51
11	SPT N & V_{S30} ESTIMATE	52 ~ 57

GEOCON INCORPORATED

Fault & Site Data Input Sheet

The input sheet is to help the user organize the site data for developing the design response spectrum. Beta-Testers: If you fill out the fault and site information for each location, please provide this document and the *checker* to facilitate the QC/QA procedures listed in the 2009 Deterministic Fault Information & Seismic Procedures QC/QA checklist.

Project Information

Dist – EA: 11-085780 County: SD Route: 163 PM: 4.4

Bridge/Facility Name: Friars Rd OC (wide) Bridge/Facility No.: 57-0595

Latitude: 32.771560 Longitude: -117.161362

Fault Information (#1)

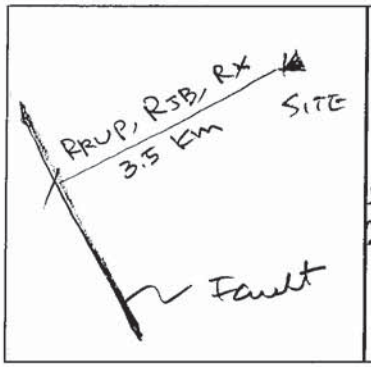
Fault Name: ~~fault CSO section~~ Newport Inglewood-Rose Canyon Fault ID#: 224

MMax: 7.5 Fault Type: RLSS

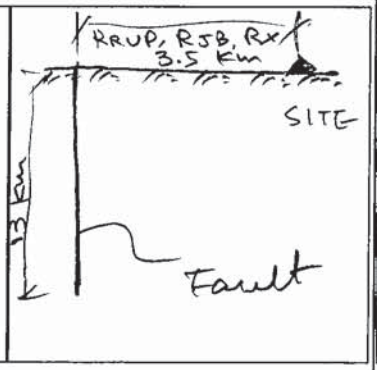
Fault Dip: 90° Dip Direction: V

Top of Rupture: 0 Bottom of Rupture: 13 km

Plan View



Elevation View



Calculated or Measure Distances

R_{RUP}: 3.5 km

R_{JB}: 3.5 km

R_X: 3.5 km

Determination of V_{S30}

V_{S30} (m/s): 420 (About 1), 380 (Best/About 3)

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): 191/241 (V_{S30} = 420/380 m/s)

$Z_{2.5}$ (km/s): 2 km

Notes:

Fault Information (#2)

Fault Name: _____ Fault ID#: _____

MMax: _____ Fault Type: _____

Fault Dip: _____ Dip Direction: _____

Top of Rupture: _____ Bottom of Rupture: _____

Plan View **Elevation View**

Calculated or Measure Distances

R_{RUP}: _____

R_{JB}: _____

R_X: _____

Determination of V_{S30}

V_{S30} (m/s): _____

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): _____

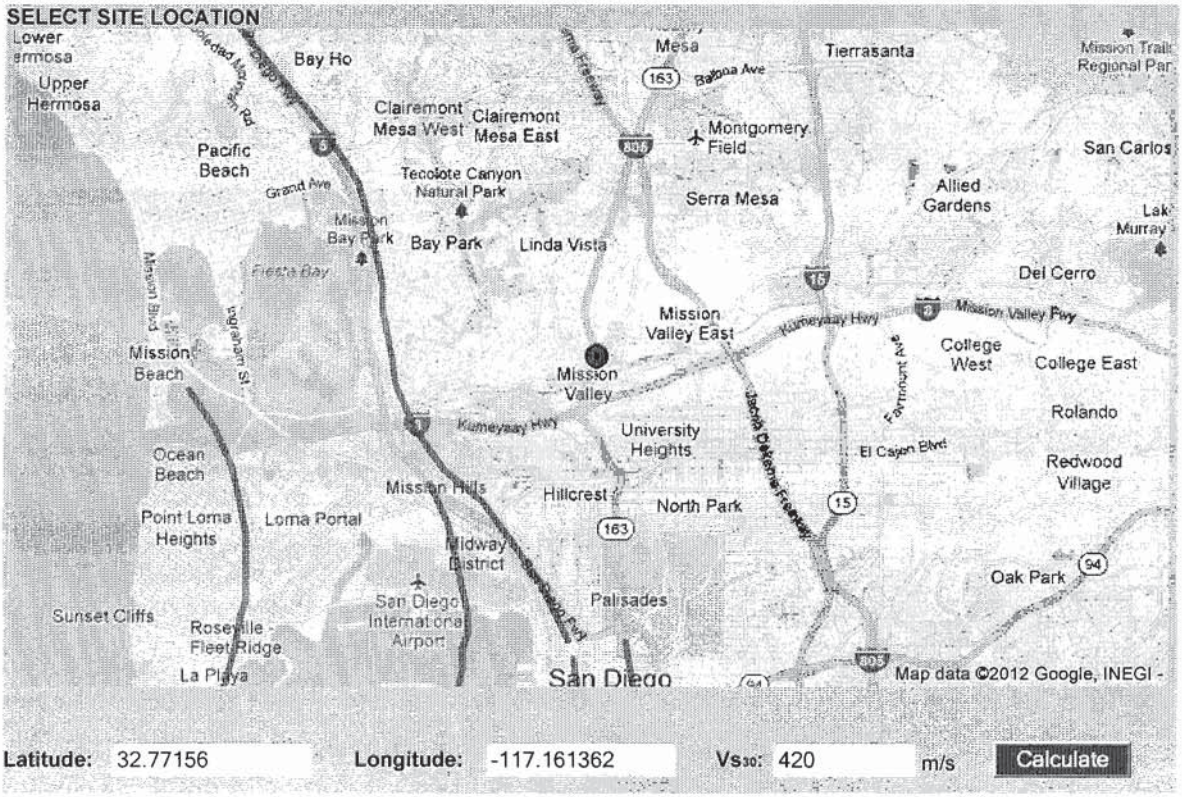
$Z_{2.5}$ (km/s): _____

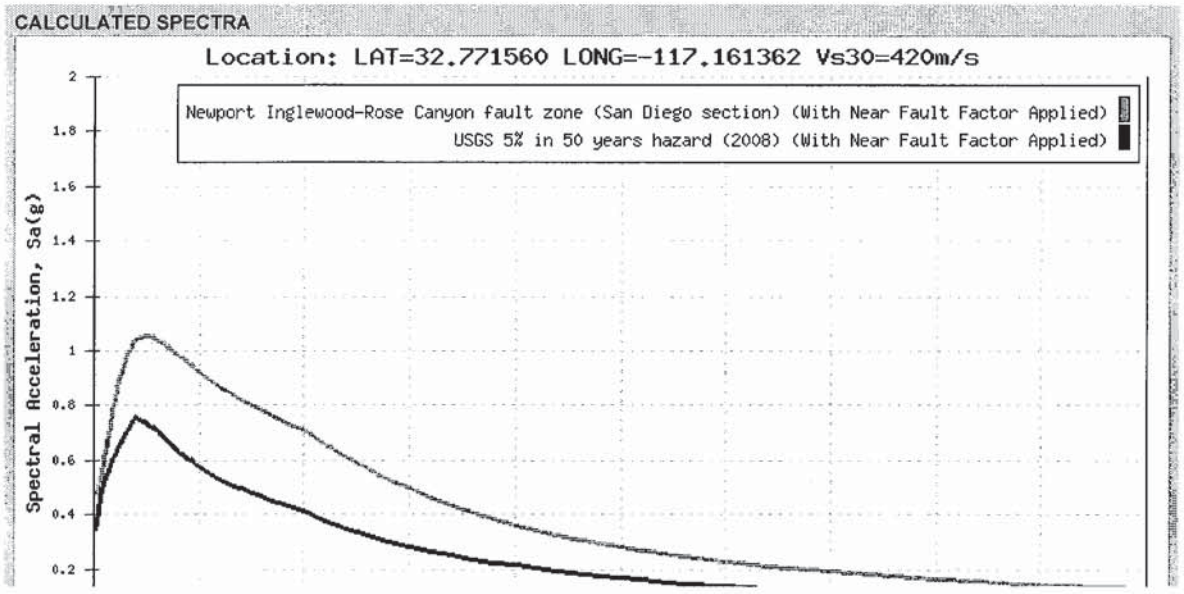
Notes:

CA.GOV CALIFORNIA DEPARTMENT OF TRANSPORTATION

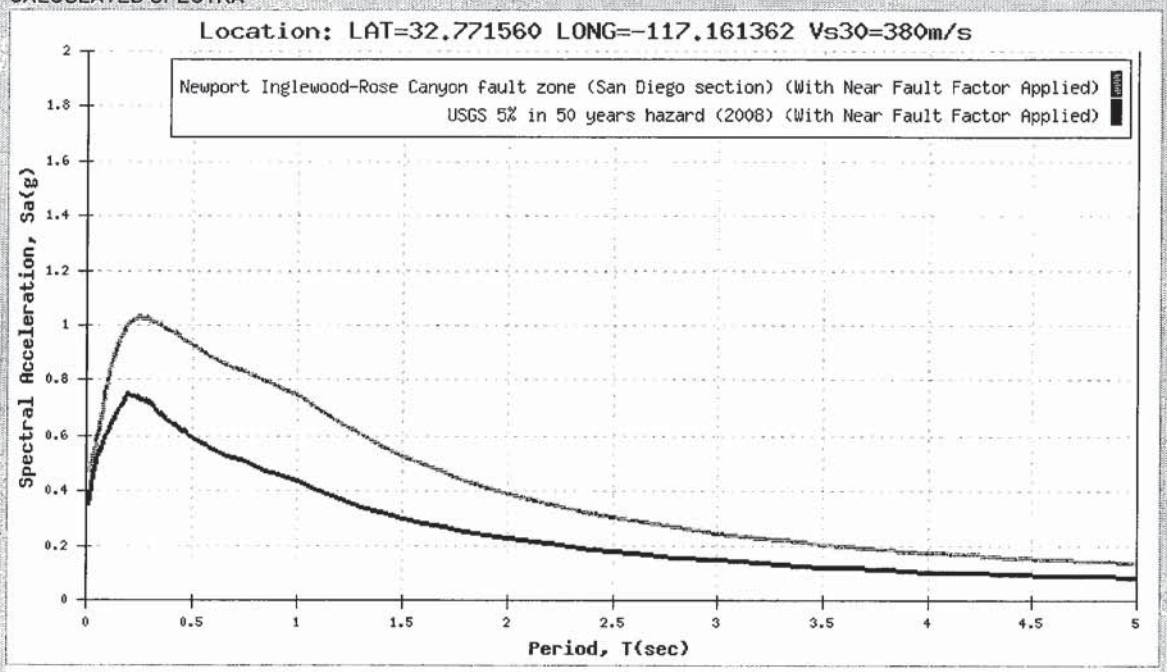
Caltrans ARS Online (v1.0.4)

This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in *Appendix B of Caltrans Seismic Design Criteria*. More...





CALCULATED SPECTRA



View Tabular Data | Show Envelope Only | Hide Near Fault Adjustment | Axis Scale | Printer Friendly View | Show Basin Factor

Apply Near Fault Adjustment To:

NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

☑ Deterministic Spectrum Using

3.50 Km Newport Inglewood-Rose Canyon fault zone (San Diego section)

☑ Probabilistic Spectrum Using

3.50 Km (Recommend Performing Deaggregation To Verify)

◉ Show Spectrum with Adjustment Only
○ Show Spectrum with and without near fault Adjustment

OK

SITE DATA

Shear Wave Velocity, Vs_{30}:	420 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	191 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.478	1.000	1.000	0.478
0.02	0.487	1.000	1.000	0.487
0.022	0.493	1.000	1.000	0.493
0.025	0.502	1.000	1.000	0.502
0.029	0.514	1.000	1.000	0.514
0.03	0.518	1.000	1.000	0.518
0.032	0.526	1.000	1.000	0.526
0.035	0.538	1.000	1.000	0.538
0.036	0.543	1.000	1.000	0.543
0.04	0.560	1.000	1.000	0.560
0.042	0.569	1.000	1.000	0.569
0.044	0.577	1.000	1.000	0.577
0.045	0.582	1.000	1.000	0.582
0.046	0.586	1.000	1.000	0.586
0.048	0.595	1.000	1.000	0.595

0.05	0.604	1.000	1.000	0.604
0.055	0.627	1.000	1.000	0.627
0.06	0.650	1.000	1.000	0.650
0.065	0.672	1.000	1.000	0.672
0.067	0.681	1.000	1.000	0.681
0.07	0.694	1.000	1.000	0.694
0.075	0.716	1.000	1.000	0.716
0.08	0.738	1.000	1.000	0.738
0.085	0.760	1.000	1.000	0.760
0.09	0.781	1.000	1.000	0.781
0.095	0.802	1.000	1.000	0.802
0.1	0.822	1.000	1.000	0.822
0.11	0.858	1.000	1.000	0.858
0.12	0.891	1.000	1.000	0.891
0.13	0.920	1.000	1.000	0.920
0.133	0.927	1.000	1.000	0.927
0.14	0.944	1.000	1.000	0.944
0.15	0.965	1.000	1.000	0.965
0.16	0.985	1.000	1.000	0.985
0.17	1.002	1.000	1.000	1.002
0.18	1.018	1.000	1.000	1.018
0.19	1.031	1.000	1.000	1.031
0.2	1.043	1.000	1.000	1.043
0.22	1.050	1.000	1.000	1.050
0.24	1.054	1.000	1.000	1.054
0.25	1.054	1.000	1.000	1.054
0.26	1.051	1.000	1.000	1.051
0.28	1.046	1.000	1.000	1.046
0.29	1.041	1.000	1.000	1.041
0.3	1.037	1.000	1.000	1.037
0.32	1.028	1.000	1.000	1.028
0.34	1.018	1.000	1.000	1.018
0.35	1.012	1.000	1.000	1.012
0.36	1.007	1.000	1.000	1.007
0.38	0.994	1.000	1.000	0.994
0.4	0.982	1.000	1.000	0.982
0.42	0.970	1.000	1.000	0.970
0.44	0.957	1.000	1.000	0.957
0.45	0.952	1.000	1.000	0.952
0.46	0.946	1.000	1.000	0.946
0.48	0.934	1.000	1.000	0.934
0.5	0.922	1.000	1.000	0.922
0.55	0.875	1.000	1.020	0.892
0.6	0.833	1.000	1.040	0.866
0.65	0.795	1.000	1.060	0.843
0.667	0.783	1.000	1.067	0.836

	0.761	1.000	1.080	0.822
0.75	0.731	1.000	1.100	0.804
0.8	0.698	1.000	1.120	0.782
0.85	0.668	1.000	1.140	0.762
0.9	0.641	1.000	1.160	0.744
0.95	0.616	1.000	1.180	0.727
1	0.592	1.000	1.200	0.711
1.1	0.547	1.000	1.200	0.656
1.2	0.507	1.000	1.200	0.609
1.3	0.472	1.000	1.200	0.567
1.4	0.441	1.000	1.200	0.529
1.5	0.413	1.000	1.200	0.495
1.6	0.385	1.000	1.200	0.462
1.7	0.361	1.000	1.200	0.433
1.8	0.339	1.000	1.200	0.407
1.9	0.319	1.000	1.200	0.383
2	0.302	1.000	1.200	0.362
2.2	0.270	1.000	1.200	0.324
2.4	0.244	1.000	1.200	0.293
2.5	0.233	1.000	1.200	0.280
2.6	0.223	1.000	1.200	0.268
2.8	0.205	1.000	1.200	0.246
3	0.189	1.000	1.200	0.227
3.2	0.175	1.000	1.200	0.210
3.4	0.163	1.000	1.200	0.196
3.5	0.158	1.000	1.200	0.189
3.6	0.153	1.000	1.200	0.183
3.8	0.143	1.000	1.200	0.172
4	0.135	1.000	1.200	0.162
4.2	0.128	1.000	1.200	0.153
4.4	0.121	1.000	1.200	0.145
4.6	0.115	1.000	1.200	0.138
4.8	0.110	1.000	1.200	0.132
5	0.105	1.000	1.200	0.126

To use above data in Excel, copy/paste:

```
0.01    0.478    1.000    1.000    0.478
0.02    0.487    1.000    1.000    0.487
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.344	1.000	1.000	0.344

0.02	0.410	1.000	1.000	0.410
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.451	1.000	1.000	0.451
0.03	0.454	1.000	1.000	0.454
0.032	0.462	1.000	1.000	0.462
0.035	0.473	1.000	1.000	0.473
0.036	0.476	1.000	1.000	0.476
0.04	0.489	1.000	1.000	0.489
0.042	0.495	1.000	1.000	0.495
0.044	0.501	1.000	1.000	0.501
0.045	0.504	1.000	1.000	0.504
0.046	0.507	1.000	1.000	0.507
0.048	0.512	1.000	1.000	0.512
0.05	0.518	1.000	1.000	0.518
0.055	0.530	1.000	1.000	0.530
0.06	0.542	1.000	1.000	0.542
0.065	0.553	1.000	1.000	0.553
0.067	0.558	1.000	1.000	0.558
0.07	0.564	1.000	1.000	0.564
0.075	0.574	1.000	1.000	0.574
0.08	0.583	1.000	1.000	0.583
0.085	0.592	1.000	1.000	0.592
0.09	0.601	1.000	1.000	0.601
0.095	0.609	1.000	1.000	0.609
0.1	0.618	1.000	1.000	0.618
0.11	0.635	1.000	1.000	0.635
0.12	0.651	1.000	1.000	0.651
0.13	0.667	1.000	1.000	0.667
0.133	0.671	1.000	1.000	0.671
0.14	0.682	1.000	1.000	0.682
0.15	0.696	1.000	1.000	0.696
0.16	0.709	1.000	1.000	0.709
0.17	0.722	1.000	1.000	0.722
0.18	0.734	1.000	1.000	0.734
0.19	0.746	1.000	1.000	0.746
0.2	0.757	1.000	1.000	0.757
0.22	0.746	1.000	1.000	0.746
0.24	0.735	1.000	1.000	0.735
0.25	0.731	1.000	1.000	0.731
0.26	0.726	1.000	1.000	0.726
0.28	0.718	1.000	1.000	0.718
0.29	0.714	1.000	1.000	0.714
0.3	0.710	1.000	1.000	0.710
0.32	0.692	1.000	1.000	0.692
0.34	0.675	1.000	1.000	0.675

	0.667	1.000	1.000	0.667
0.36	0.659	1.000	1.000	0.659
0.38	0.645	1.000	1.000	0.645
0.4	0.632	1.000	1.000	0.632
0.42	0.619	1.000	1.000	0.619
0.44	0.608	1.000	1.000	0.608
0.45	0.602	1.000	1.000	0.602
0.46	0.597	1.000	1.000	0.597
0.48	0.587	1.000	1.000	0.587
0.5	0.577	1.000	1.000	0.577
0.55	0.541	1.000	1.020	0.551
0.6	0.510	1.000	1.040	0.530
0.65	0.482	1.000	1.060	0.511
0.667	0.474	1.000	1.067	0.506
0.7	0.459	1.000	1.080	0.495
0.75	0.438	1.000	1.100	0.481
0.8	0.415	1.000	1.120	0.465
0.85	0.394	1.000	1.140	0.450
0.9	0.376	1.000	1.160	0.436
0.95	0.360	1.000	1.180	0.424
1	0.345	1.000	1.200	0.414
1.1	0.315	1.000	1.200	0.378
1.2	0.289	1.000	1.200	0.347
1.3	0.268	1.000	1.200	0.322
1.4	0.250	1.000	1.200	0.300
1.5	0.234	1.000	1.200	0.281
1.6	0.220	1.000	1.200	0.264
1.7	0.207	1.000	1.200	0.249
1.8	0.196	1.000	1.200	0.236
1.9	0.187	1.000	1.200	0.224
2	0.178	1.000	1.200	0.213
2.2	0.160	1.000	1.200	0.192
2.4	0.145	1.000	1.200	0.174
2.5	0.138	1.000	1.200	0.166
2.6	0.132	1.000	1.200	0.159
2.8	0.122	1.000	1.200	0.146
3	0.113	1.000	1.200	0.135
3.2	0.104	1.000	1.200	0.125
3.4	0.097	1.000	1.200	0.117
3.5	0.094	1.000	1.200	0.113
3.6	0.091	1.000	1.200	0.109
3.8	0.085	1.000	1.200	0.102
4	0.080	1.000	1.200	0.096
4.2	0.077	1.000	1.200	0.092
4.4	0.073	1.000	1.200	0.088
4.6	0.070	1.000	1.200	0.084

	0.068	1.000	1.200	0.081	
5	0.065	1.000	1.200	0.078	

To use above data in Excel, copy/paste:

```
0.01    0.344    1.000    1.000    0.344
0.02    0.410    1.000    1.000    0.410
```

Envelope Data

Period	SA
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.560
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.650
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.760
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.920
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018

0.19	1.031
0.2	1.043
0.22	1.050
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982
0.42	0.970
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.280
2.6	0.268

2.8	0.246
3	0.227
3.2	0.210
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126
To use above data in Excel, copy/paste:	0.01 0.478 0.02 0.487

SITE DATA

Shear Wave Velocity, Vs_{30}:	380 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	241 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.474	1.000	1.000	0.474
0.02	0.483	1.000	1.000	0.483
0.022	0.489	1.000	1.000	0.489
0.025	0.497	1.000	1.000	0.497
0.029	0.508	1.000	1.000	0.508
0.03	0.511	1.000	1.000	0.511
0.032	0.519	1.000	1.000	0.519
0.035	0.530	1.000	1.000	0.530
0.036	0.534	1.000	1.000	0.534
0.04	0.550	1.000	1.000	0.550
0.042	0.558	1.000	1.000	0.558
0.044	0.565	1.000	1.000	0.565
0.045	0.570	1.000	1.000	0.570
0.046	0.574	1.000	1.000	0.574
0.048	0.582	1.000	1.000	0.582

0.05	0.590	1.000	1.000	0.590
0.055	0.610	1.000	1.000	0.610
0.06	0.631	1.000	1.000	0.631
0.065	0.651	1.000	1.000	0.651
0.067	0.659	1.000	1.000	0.659
0.07	0.671	1.000	1.000	0.671
0.075	0.691	1.000	1.000	0.691
0.08	0.711	1.000	1.000	0.711
0.085	0.732	1.000	1.000	0.732
0.09	0.752	1.000	1.000	0.752
0.095	0.771	1.000	1.000	0.771
0.1	0.790	1.000	1.000	0.790
0.11	0.825	1.000	1.000	0.825
0.12	0.856	1.000	1.000	0.856
0.13	0.884	1.000	1.000	0.884
0.133	0.891	1.000	1.000	0.891
0.14	0.907	1.000	1.000	0.907
0.15	0.928	1.000	1.000	0.928
0.16	0.948	1.000	1.000	0.948
0.17	0.966	1.000	1.000	0.966
0.18	0.982	1.000	1.000	0.982
0.19	0.996	1.000	1.000	0.996
0.2	1.008	1.000	1.000	1.008
0.22	1.019	1.000	1.000	1.019
0.24	1.026	1.000	1.000	1.026
0.25	1.028	1.000	1.000	1.028
0.26	1.027	1.000	1.000	1.027
0.28	1.025	1.000	1.000	1.025
0.29	1.022	1.000	1.000	1.022
0.3	1.019	1.000	1.000	1.019
0.32	1.013	1.000	1.000	1.013
0.34	1.006	1.000	1.000	1.006
0.35	1.001	1.000	1.000	1.001
0.36	0.997	1.000	1.000	0.997
0.38	0.987	1.000	1.000	0.987
0.4	0.977	1.000	1.000	0.977
0.42	0.967	1.000	1.000	0.967
0.44	0.957	1.000	1.000	0.957
0.45	0.953	1.000	1.000	0.953
0.46	0.948	1.000	1.000	0.948
0.48	0.938	1.000	1.000	0.938
0.5	0.928	1.000	1.000	0.928
0.55	0.886	1.000	1.020	0.904
0.6	0.849	1.000	1.040	0.883
0.65	0.815	1.000	1.060	0.864
0.667	0.804	1.000	1.067	0.858

	0.784	1.000	1.080	0.847
0.75	0.756	1.000	1.100	0.832
0.8	0.725	1.000	1.120	0.812
0.85	0.697	1.000	1.140	0.794
0.9	0.670	1.000	1.160	0.778
0.95	0.646	1.000	1.180	0.762
1	0.623	1.000	1.200	0.748
1.1	0.578	1.000	1.200	0.693
1.2	0.538	1.000	1.200	0.645
1.3	0.502	1.000	1.200	0.603
1.4	0.470	1.000	1.200	0.564
1.5	0.441	1.000	1.200	0.529
1.6	0.413	1.000	1.200	0.495
1.7	0.388	1.000	1.200	0.465
1.8	0.365	1.000	1.200	0.438
1.9	0.344	1.000	1.200	0.413
2	0.326	1.000	1.200	0.391
2.2	0.293	1.000	1.200	0.351
2.4	0.265	1.000	1.200	0.318
2.5	0.253	1.000	1.200	0.304
2.6	0.242	1.000	1.200	0.291
2.8	0.223	1.000	1.200	0.267
3	0.206	1.000	1.200	0.247
3.2	0.191	1.000	1.200	0.229
3.4	0.178	1.000	1.200	0.214
3.5	0.172	1.000	1.200	0.206
3.6	0.166	1.000	1.200	0.200
3.8	0.156	1.000	1.200	0.187
4	0.147	1.000	1.200	0.176
4.2	0.139	1.000	1.200	0.167
4.4	0.132	1.000	1.200	0.158
4.6	0.125	1.000	1.200	0.151
4.8	0.120	1.000	1.200	0.143
5	0.114	1.000	1.200	0.137

To use above data in Excel, copy/paste:

```
0.01    0.474    1.000    1.000    0.474
0.02    0.483    1.000    1.000    0.483
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.346	1.000	1.000	0.346

0.02	0.411	1.000	1.000	0.411
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.450	1.000	1.000	0.450
0.03	0.454	1.000	1.000	0.454
0.032	0.461	1.000	1.000	0.461
0.035	0.471	1.000	1.000	0.471
0.036	0.475	1.000	1.000	0.475
0.04	0.487	1.000	1.000	0.487
0.042	0.493	1.000	1.000	0.493
0.044	0.499	1.000	1.000	0.499
0.045	0.501	1.000	1.000	0.501
0.046	0.504	1.000	1.000	0.504
0.048	0.509	1.000	1.000	0.509
0.05	0.515	1.000	1.000	0.515
0.055	0.527	1.000	1.000	0.527
0.06	0.538	1.000	1.000	0.538
0.065	0.549	1.000	1.000	0.549
0.067	0.553	1.000	1.000	0.553
0.07	0.559	1.000	1.000	0.559
0.075	0.569	1.000	1.000	0.569
0.08	0.578	1.000	1.000	0.578
0.085	0.587	1.000	1.000	0.587
0.09	0.595	1.000	1.000	0.595
0.095	0.603	1.000	1.000	0.603
0.1	0.610	1.000	1.000	0.610
0.11	0.628	1.000	1.000	0.628
0.12	0.645	1.000	1.000	0.645
0.13	0.660	1.000	1.000	0.660
0.133	0.665	1.000	1.000	0.665
0.14	0.675	1.000	1.000	0.675
0.15	0.689	1.000	1.000	0.689
0.16	0.703	1.000	1.000	0.703
0.17	0.715	1.000	1.000	0.715
0.18	0.728	1.000	1.000	0.728
0.19	0.740	1.000	1.000	0.740
0.2	0.751	1.000	1.000	0.751
0.22	0.743	1.000	1.000	0.743
0.24	0.735	1.000	1.000	0.735
0.25	0.732	1.000	1.000	0.732
0.26	0.729	1.000	1.000	0.729
0.28	0.722	1.000	1.000	0.722
0.29	0.719	1.000	1.000	0.719
0.3	0.717	1.000	1.000	0.717
0.32	0.700	1.000	1.000	0.700
0.34	0.685	1.000	1.000	0.685

	0.678	1.000	1.000	0.678
0.36	0.671	1.000	1.000	0.671
0.38	0.658	1.000	1.000	0.658
0.4	0.646	1.000	1.000	0.646
0.42	0.634	1.000	1.000	0.634
0.44	0.624	1.000	1.000	0.624
0.45	0.619	1.000	1.000	0.619
0.46	0.614	1.000	1.000	0.614
0.48	0.604	1.000	1.000	0.604
0.5	0.596	1.000	1.000	0.596
0.55	0.561	1.000	1.020	0.572
0.6	0.531	1.000	1.040	0.552
0.65	0.505	1.000	1.060	0.535
0.667	0.497	1.000	1.067	0.530
0.7	0.482	1.000	1.080	0.520
0.75	0.461	1.000	1.100	0.507
0.8	0.438	1.000	1.120	0.491
0.85	0.417	1.000	1.140	0.476
0.9	0.399	1.000	1.160	0.462
0.95	0.382	1.000	1.180	0.451
1	0.367	1.000	1.200	0.440
1.1	0.335	1.000	1.200	0.402
1.2	0.309	1.000	1.200	0.371
1.3	0.287	1.000	1.200	0.344
1.4	0.268	1.000	1.200	0.321
1.5	0.251	1.000	1.200	0.301
1.6	0.236	1.000	1.200	0.283
1.7	0.223	1.000	1.200	0.268
1.8	0.212	1.000	1.200	0.254
1.9	0.201	1.000	1.200	0.241
2	0.192	1.000	1.200	0.230
2.2	0.173	1.000	1.200	0.207
2.4	0.157	1.000	1.200	0.188
2.5	0.150	1.000	1.200	0.180
2.6	0.143	1.000	1.200	0.172
2.8	0.132	1.000	1.200	0.159
3	0.122	1.000	1.200	0.147
3.2	0.113	1.000	1.200	0.136
3.4	0.106	1.000	1.200	0.127
3.5	0.102	1.000	1.200	0.122
3.6	0.099	1.000	1.200	0.118
3.8	0.093	1.000	1.200	0.111
4	0.087	1.000	1.200	0.105
4.2	0.083	1.000	1.200	0.100
4.4	0.080	1.000	1.200	0.096
4.6	0.076	1.000	1.200	0.092

	0.073	1.000	1.200	0.088	
5	0.071	1.000	1.200	0.085	

To use above data in Excel, copy/paste:

```
0.01    0.346    1.000    1.000    0.346
0.02    0.411    1.000    1.000    0.411
```

Envelope Data

Period	SA
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.530
0.036	0.534
0.04	0.550
0.042	0.558
0.044	0.565
0.045	0.570
0.046	0.574
0.048	0.582
0.05	0.590
0.055	0.610
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.790
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982

0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977
0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291

2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.200
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137
To use above data in Excel, copy/paste:	0.01 0.474 0.02 0.483

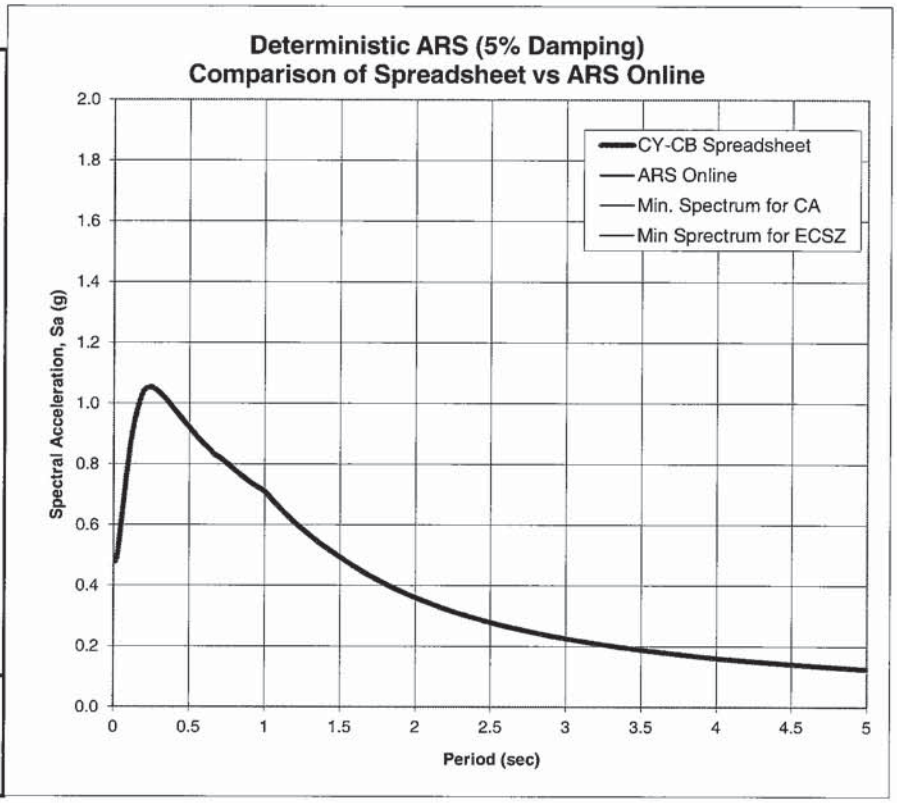
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	420	(270 to 1500 m/s)
$Z_{1.0}$ (m)	191	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 1%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47789
0.020	0.48686
0.022	0.49308
0.025	0.50248
0.029	0.51423
0.030	0.51759
0.032	0.52590
0.035	0.53849
0.036	0.54284
0.040	0.55973
0.042	0.56862
0.044	0.57722
0.045	0.58182
0.046	0.58628
0.048	0.59508
0.050	0.60406
0.055	0.62681
0.060	0.64992
0.065	0.67218
0.067	0.68124
0.070	0.69413
0.075	0.71578
0.080	0.73787
0.085	0.75998
0.090	0.78110
0.095	0.80197
0.100	0.82221
0.110	0.85852
0.120	0.89139
0.130	0.91999
0.133	0.92734
0.140	0.94388
0.150	0.96504
0.160	0.98526
0.170	1.00230

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.478	1	1	0.478	0%
0.02	0.487	1	1	0.487	0%
0.022	0.493	1	1	0.493	0%
0.025	0.502	1	1	0.502	0%
0.029	0.514	1	1	0.514	0%
0.03	0.518	1	1	0.518	0%
0.032	0.526	1	1	0.526	0%
0.035	0.538	1	1	0.538	0%
0.036	0.543	1	1	0.543	0%
0.04	0.56	1	1	0.56	0%
0.042	0.569	1	1	0.569	0%
0.044	0.577	1	1	0.577	0%
0.045	0.582	1	1	0.582	0%
0.046	0.586	1	1	0.586	0%
0.048	0.595	1	1	0.595	0%
0.05	0.604	1	1	0.604	0%
0.055	0.627	1	1	0.627	0%
0.06	0.65	1	1	0.65	0%
0.065	0.672	1	1	0.672	0%
0.067	0.681	1	1	0.681	0%
0.07	0.694	1	1	0.694	0%
0.075	0.716	1	1	0.716	0%
0.08	0.738	1	1	0.738	0%
0.085	0.76	1	1	0.76	0%
0.09	0.781	1	1	0.781	0%
0.095	0.802	1	1	0.802	0%
0.1	0.822	1	1	0.822	0%
0.11	0.858	1	1	0.858	0%
0.12	0.891	1	1	0.891	0%
0.13	0.92	1	1	0.92	0%
0.133	0.927	1	1	0.927	0%
0.14	0.944	1	1	0.944	0%
0.15	0.965	1	1	0.965	0%
0.16	0.985	1	1	0.985	0%
0.17	1.002	1	1	1.002	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

0.180	1.01786

0.18	1.018	1	1	1.018	0%

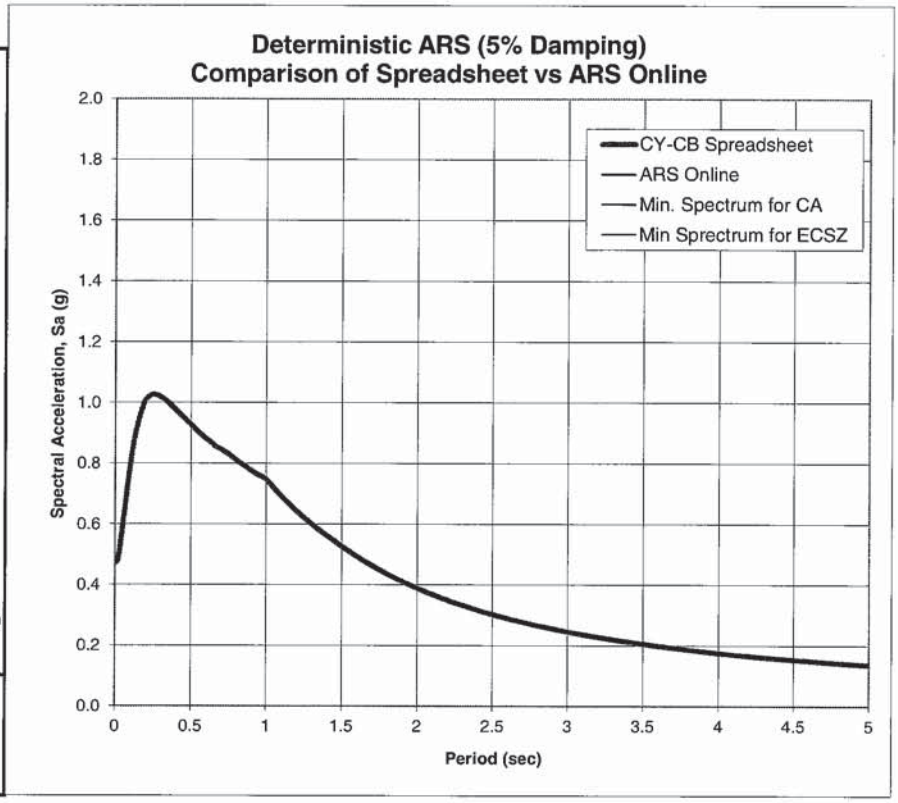
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	380	(270 to 1500 m/s)
$Z_{1.0}$ (m)	241	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 0%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47415
0.020	0.48287
0.022	0.48875
0.025	0.49754
0.029	0.50835
0.030	0.51146
0.032	0.51908
0.035	0.53054
0.036	0.53448
0.040	0.54968
0.042	0.55771
0.044	0.56547
0.045	0.56963
0.046	0.57367
0.048	0.58160
0.050	0.58968
0.055	0.61012
0.060	0.63092
0.065	0.65105
0.067	0.65928
0.070	0.67103
0.075	0.69080
0.080	0.71131
0.085	0.73186
0.090	0.75164
0.095	0.77123
0.100	0.79029
0.110	0.82488
0.120	0.85639
0.130	0.88404
0.133	0.89123
0.140	0.90735
0.150	0.92813
0.160	0.94846
0.170	0.96587

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.474	1	1	0.474	0%
0.02	0.483	1	1	0.483	0%
0.022	0.489	1	1	0.489	0%
0.025	0.497	1	1	0.497	0%
0.029	0.508	1	1	0.508	0%
0.03	0.511	1	1	0.511	0%
0.032	0.519	1	1	0.519	0%
0.035	0.53	1	1	0.53	0%
0.036	0.534	1	1	0.534	0%
0.04	0.55	1	1	0.55	0%
0.042	0.558	1	1	0.558	0%
0.044	0.565	1	1	0.565	0%
0.045	0.57	1	1	0.57	0%
0.046	0.574	1	1	0.574	0%
0.048	0.582	1	1	0.582	0%
0.05	0.59	1	1	0.59	0%
0.055	0.61	1	1	0.61	0%
0.06	0.631	1	1	0.631	0%
0.065	0.651	1	1	0.651	0%
0.067	0.659	1	1	0.659	0%
0.07	0.671	1	1	0.671	0%
0.075	0.691	1	1	0.691	0%
0.08	0.711	1	1	0.711	0%
0.085	0.732	1	1	0.732	0%
0.09	0.752	1	1	0.752	0%
0.095	0.771	1	1	0.771	0%
0.1	0.79	1	1	0.79	0%
0.11	0.825	1	1	0.825	0%
0.12	0.856	1	1	0.856	0%
0.13	0.884	1	1	0.884	0%
0.133	0.891	1	1	0.891	0%
0.14	0.907	1	1	0.907	0%
0.15	0.928	1	1	0.928	0%
0.16	0.948	1	1	0.948	0%
0.17	0.966	1	1	0.966	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

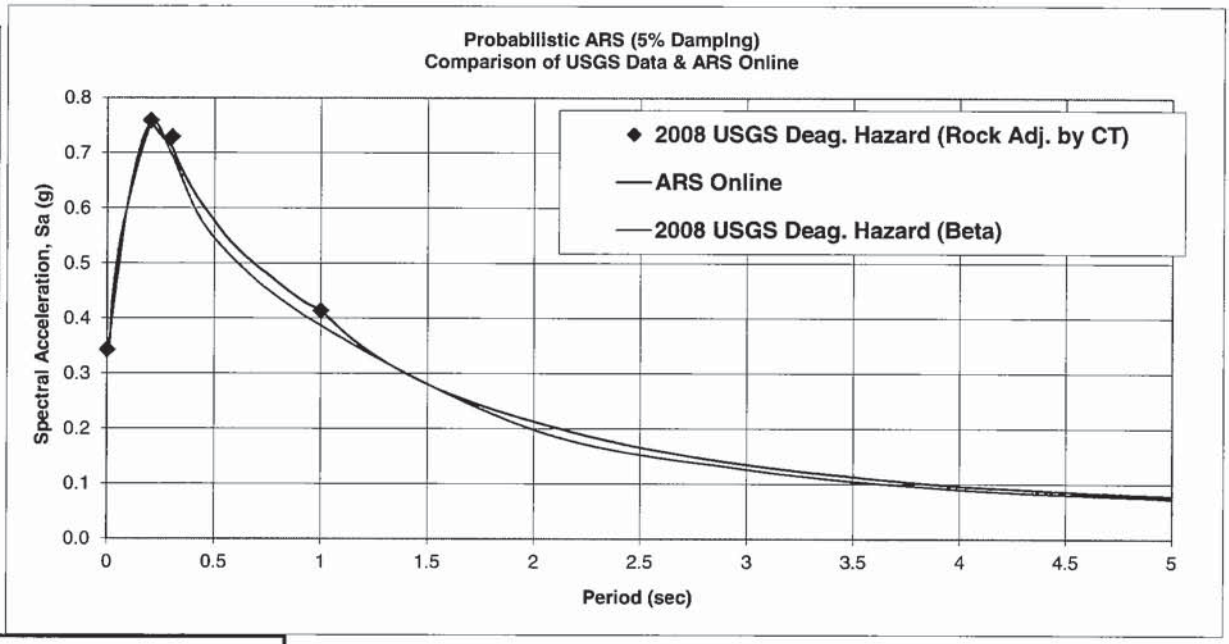
0.180	0.98191

0.18	0.982	1	1	0.982	0%

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	420
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	191
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.344	1	1	0.344
0.02	0.41	1	1	0.41
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.451	1	1	0.451
0.03	0.454	1	1	0.454
0.032	0.462	1	1	0.462
0.035	0.473	1	1	0.473
0.036	0.476	1	1	0.476
0.04	0.489	1	1	0.489
0.042	0.495	1	1	0.495
0.044	0.501	1	1	0.501
0.045	0.504	1	1	0.504
0.046	0.507	1	1	0.507
0.048	0.512	1	1	0.512
0.05	0.518	1	1	0.518
0.055	0.53	1	1	0.53
0.06	0.542	1	1	0.542
0.065	0.553	1	1	0.553
0.067	0.558	1	1	0.558
0.07	0.564	1	1	0.564
0.075	0.574	1	1	0.574
0.08	0.583	1	1	0.583
0.085	0.592	1	1	0.592
0.09	0.601	1	1	0.601
0.095	0.609	1	1	0.609
0.1	0.618	1	1	0.618
0.11	0.635	1	1	0.635
0.12	0.651	1	1	0.651
0.13	0.667	1	1	0.667
0.133	0.671	1	1	0.671
0.14	0.682	1	1	0.682
0.15	0.696	1	1	0.696
0.16	0.709	1	1	0.709

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.116	1.000	0.343	0.344	-0.2%
0.2	0.722	1.000	1.052	1.000	0.760	0.757	0.4%
0.3	0.597	1.000	1.222	1.000	0.730	0.71	2.7%
1	0.226	1.200	1.528	1.000	0.414	0.414	0.0%

Max % Difference = 2.7%

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3306	1.000	1.000	0.331	0.344	3.9%
0.1	0.6232	1.000	1.000	0.623	0.618	0.8%
0.2	0.7568	1.000	1.000	0.757	0.757	0.0%
0.3	0.696	1.000	1.000	0.696	0.71	2.0%
0.5	0.5454	1.000	1.000	0.545	0.577	5.8%
1	0.3227	1.200	1.000	0.387	0.414	6.9%
2	0.1652	1.200	1.000	0.198	0.213	7.4%
3	0.1054	1.200	1.000	0.126	0.135	6.7%
4	0.07516	1.200	1.000	0.090	0.096	6.4%
5	0.06116	1.200	1.000	0.073	0.078	6.3%

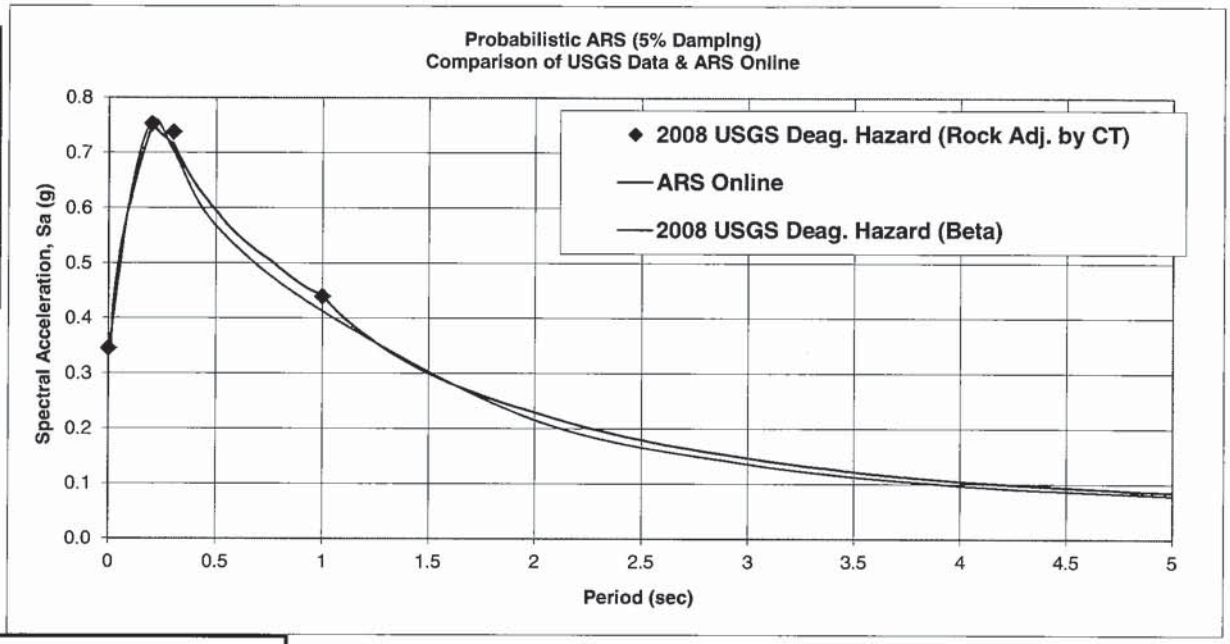
Max % Difference = 7.4%

0.17	0.722	1	1	0.722
0.18	0.734	1	1	0.734
0.19	0.746	1	1	0.746
0.2	0.757	1	1	0.757
0.22	0.746	1	1	0.746
0.24	0.735	1	1	0.735
0.25	0.731	1	1	0.731

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	380
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	241
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.346	1	1	0.346
0.02	0.411	1	1	0.411
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.45	1	1	0.45
0.03	0.454	1	1	0.454
0.032	0.461	1	1	0.461
0.035	0.471	1	1	0.471
0.036	0.475	1	1	0.475
0.04	0.487	1	1	0.487
0.042	0.493	1	1	0.493
0.044	0.499	1	1	0.499
0.045	0.501	1	1	0.501
0.046	0.504	1	1	0.504
0.048	0.509	1	1	0.509
0.05	0.515	1	1	0.515
0.055	0.527	1	1	0.527
0.06	0.538	1	1	0.538
0.065	0.549	1	1	0.549
0.067	0.553	1	1	0.553
0.07	0.559	1	1	0.559
0.075	0.569	1	1	0.569
0.08	0.578	1	1	0.578
0.085	0.587	1	1	0.587
0.09	0.595	1	1	0.595
0.095	0.603	1	1	0.603
0.1	0.61	1	1	0.61
0.11	0.628	1	1	0.628
0.12	0.645	1	1	0.645
0.13	0.66	1	1	0.66
0.133	0.665	1	1	0.665
0.14	0.675	1	1	0.675
0.15	0.689	1	1	0.689
0.16	0.703	1	1	0.703

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.124	1.000	0.346	0.346	-0.1%
0.2	0.722	1.000	1.043	1.000	0.754	0.751	0.4%
0.3	0.597	1.000	1.237	1.000	0.739	0.717	2.9%
1	0.226	1.200	1.625	1.000	0.440	0.44	0.1%

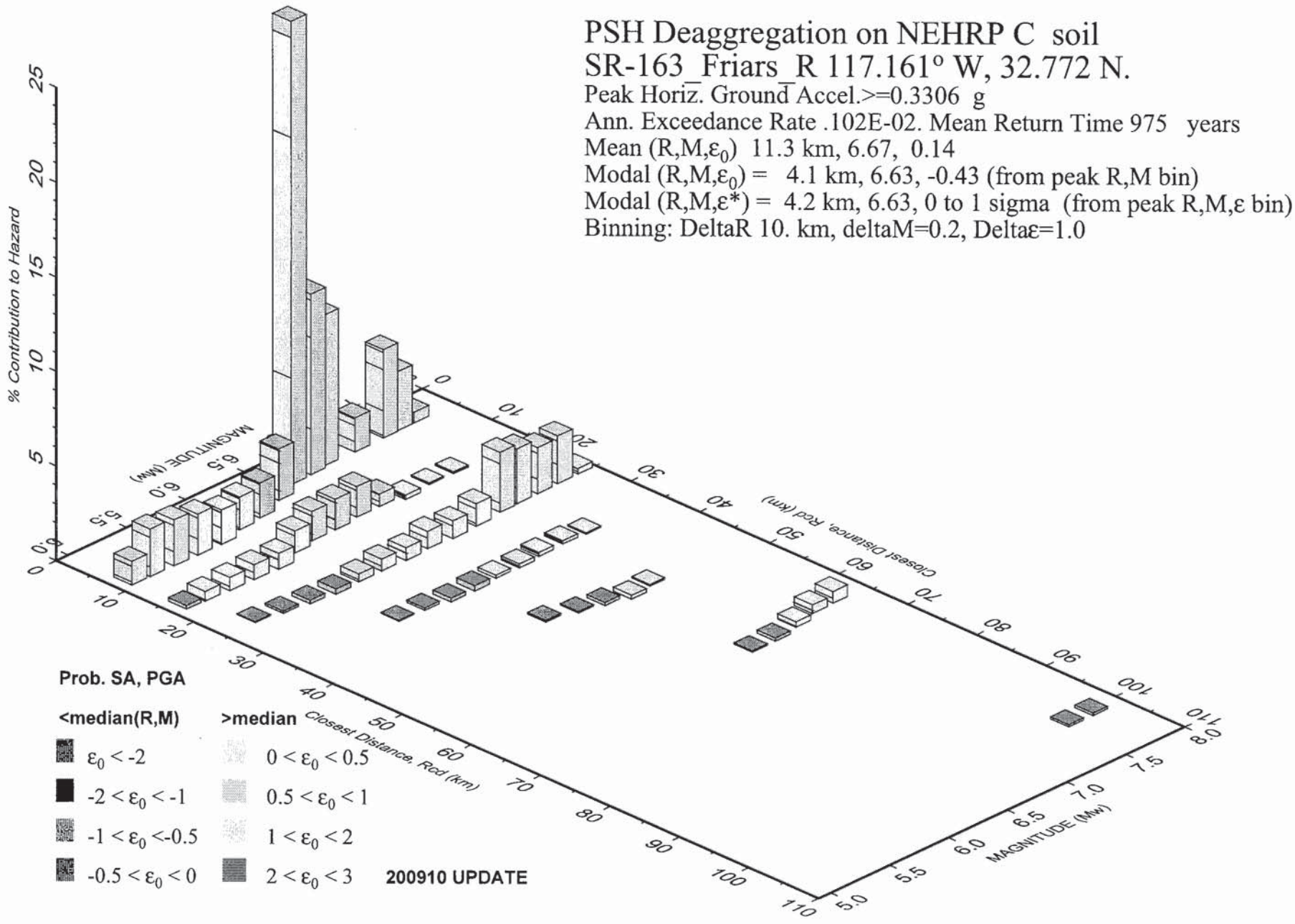
Max % Difference = **2.9%**

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3376	1.000	1.000	0.338	0.346	2.5%
0.1	0.6205	1.000	1.000	0.621	0.61	1.7%
0.2	0.759	1.000	1.000	0.759	0.751	1.1%
0.3	0.705	1.000	1.000	0.705	0.717	1.7%
0.5	0.5681	1.000	1.000	0.568	0.596	4.9%
1	0.3446	1.200	1.000	0.414	0.44	6.4%
2	0.18	1.200	1.000	0.216	0.23	6.5%
3	0.11364	1.200	1.000	0.136	0.147	7.8%
4	0.08119	1.200	1.000	0.097	0.105	7.8%
5	0.06605	1.200	1.000	0.079	0.085	7.2%

Max % Difference = **7.8%**

0.17	0.715	1	1	0.715
0.18	0.728	1	1	0.728
0.19	0.74	1	1	0.74
0.2	0.751	1	1	0.751
0.22	0.743	1	1	0.743
0.24	0.735	1	1	0.735
0.25	0.732	1	1	0.732



GMT 2012 Jul 5 23:31:17 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6232 g

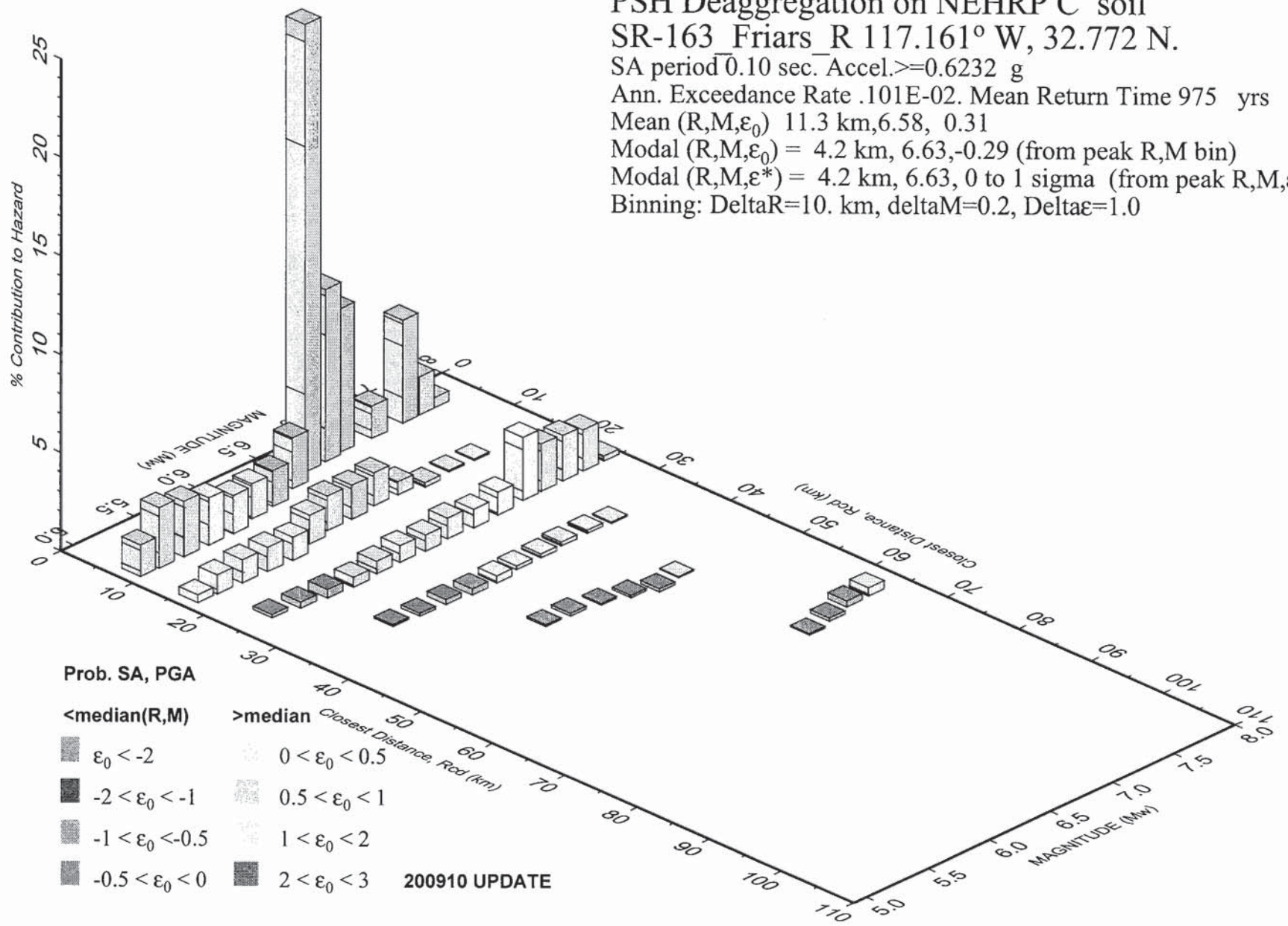
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 11.3 km,6.58, 0.31

Modal (R,M,ε_0) = 4.2 km, 6.63,-0.29 (from peak R,M bin)

Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

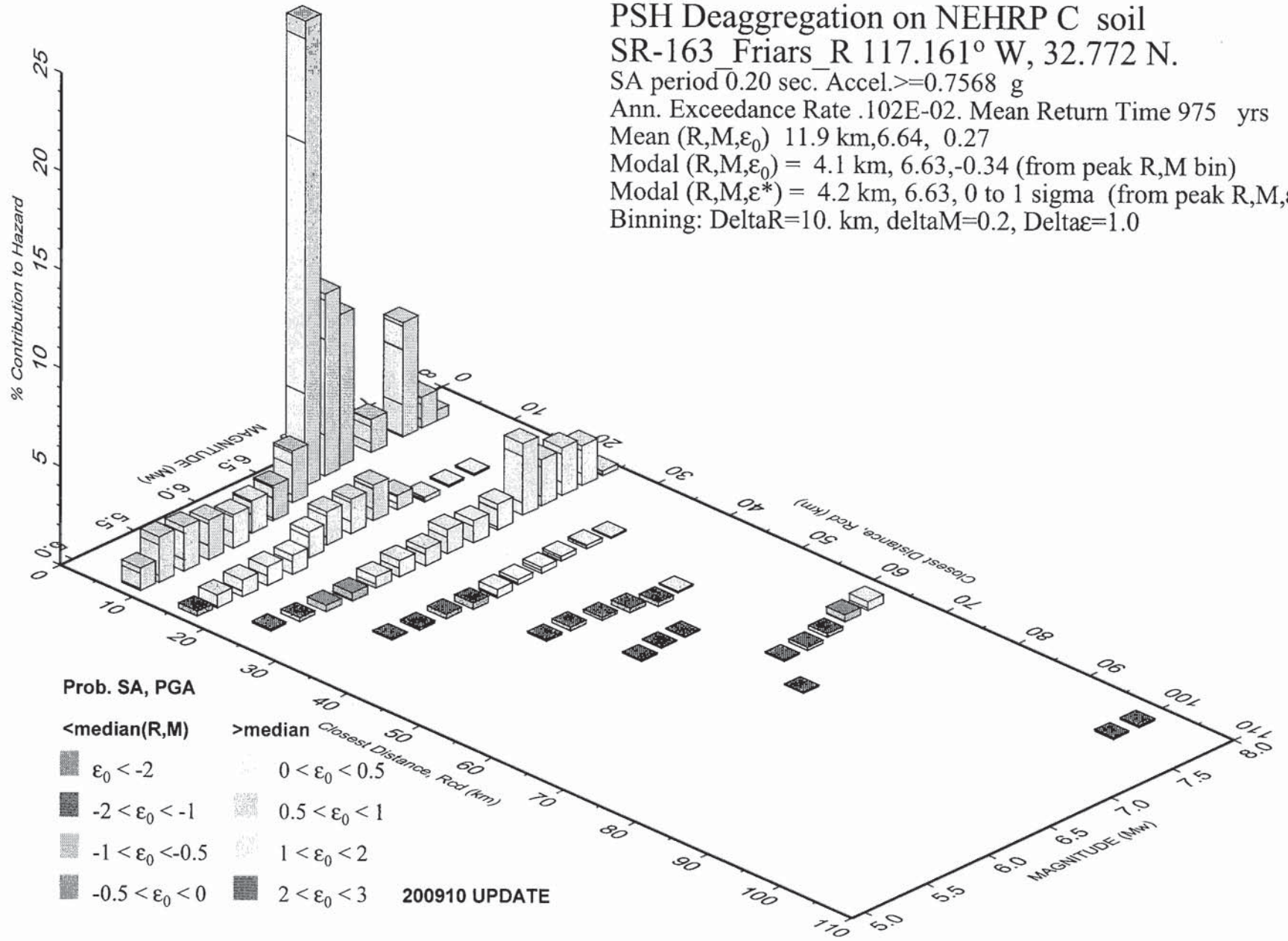
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:34:04 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

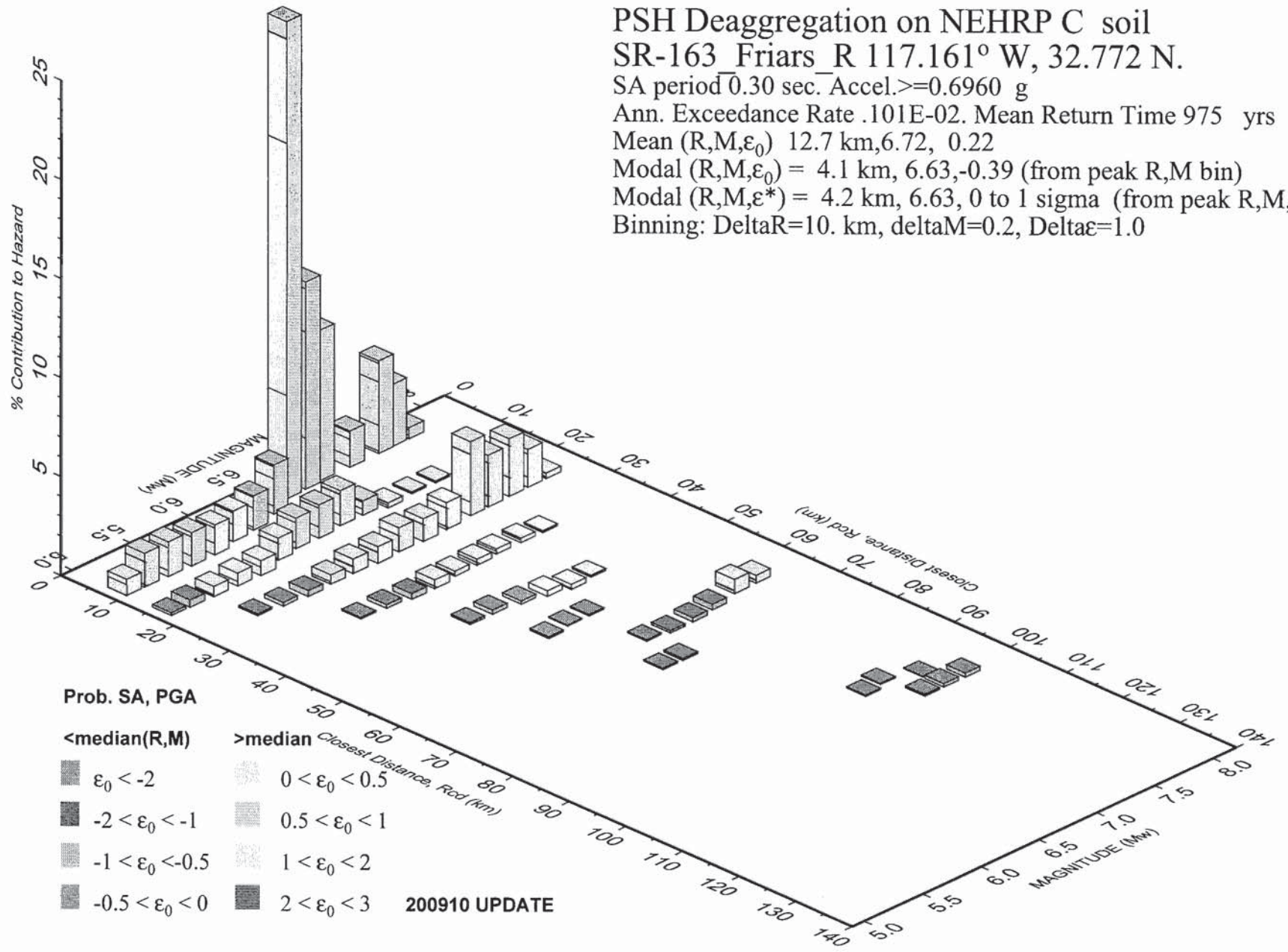
SA period 0.20 sec. Accel.>=0.7568 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.9 km,6.64, 0.27
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:36:42 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

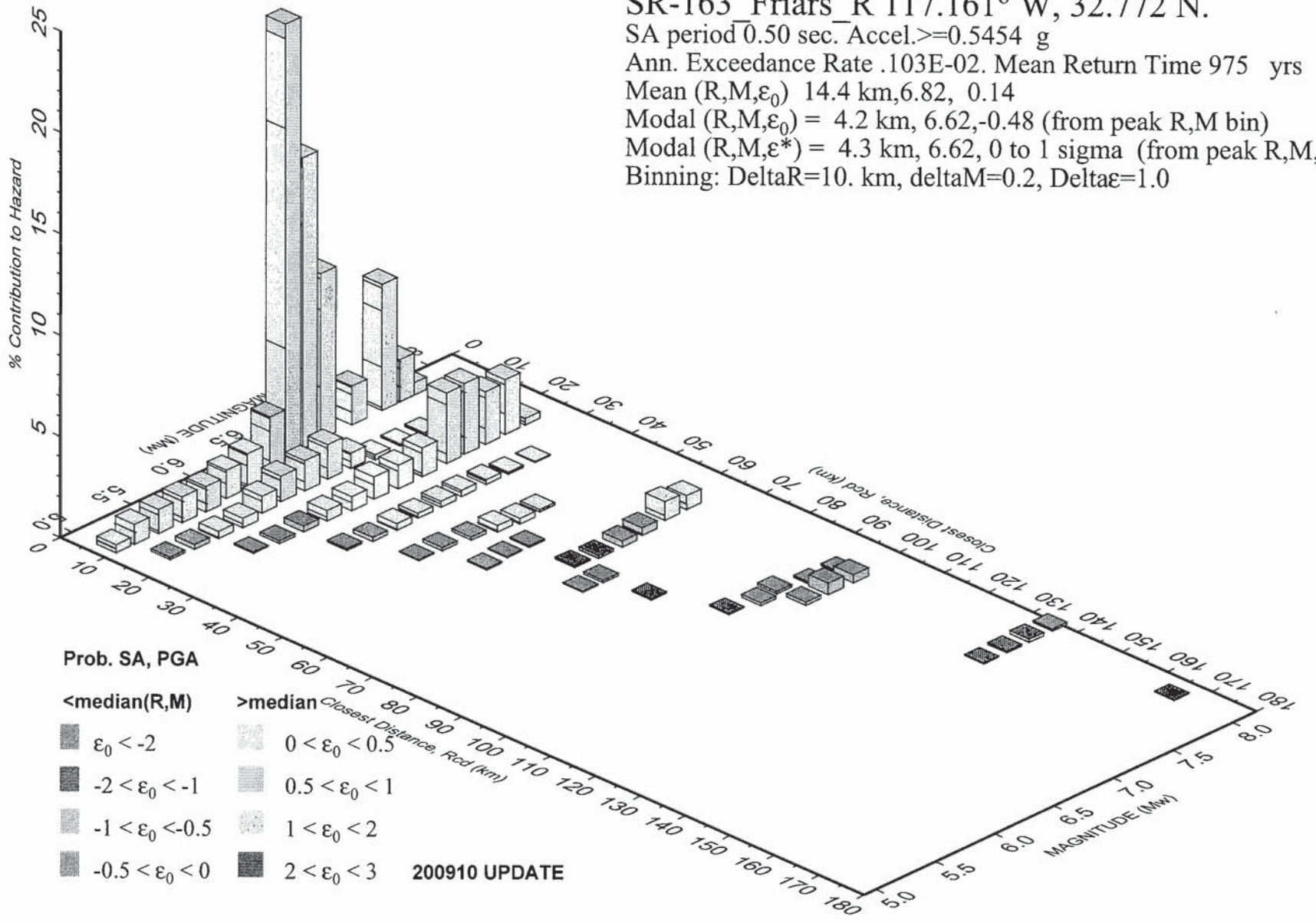
SA period 0.30 sec. Accel.>=0.6960 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.7 km,6.72, 0.22
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.39 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:39:24 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

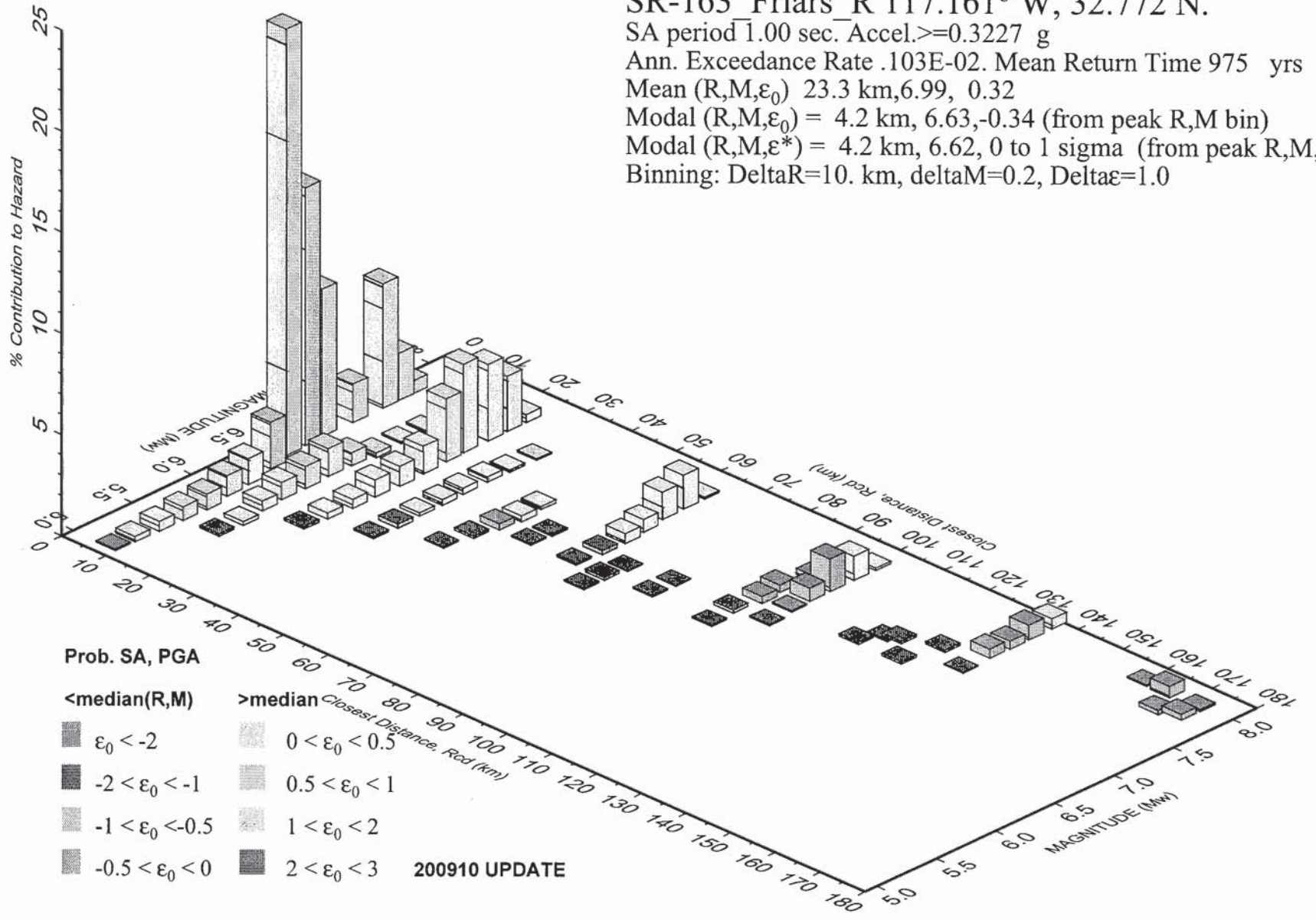
SA period 0.50 sec. Accel.>=0.5454 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.4 km,6.82, 0.14
Modal (R,M,ε_0) = 4.2 km, 6.62,-0.48 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:41:05 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

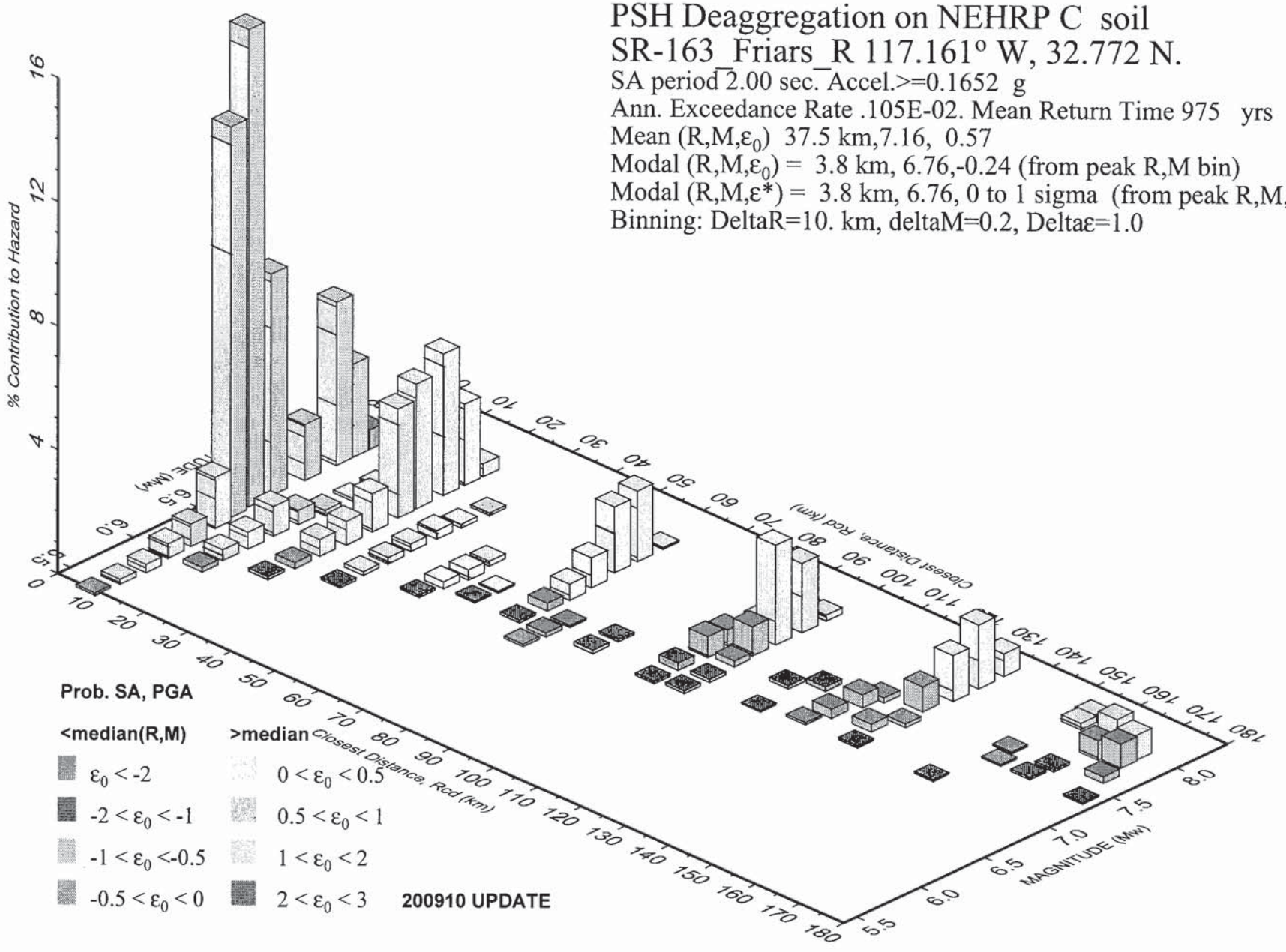
SA period 1.00 sec. Accel.>=0.3227 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.3 km,6.99, 0.32
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:46:44 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

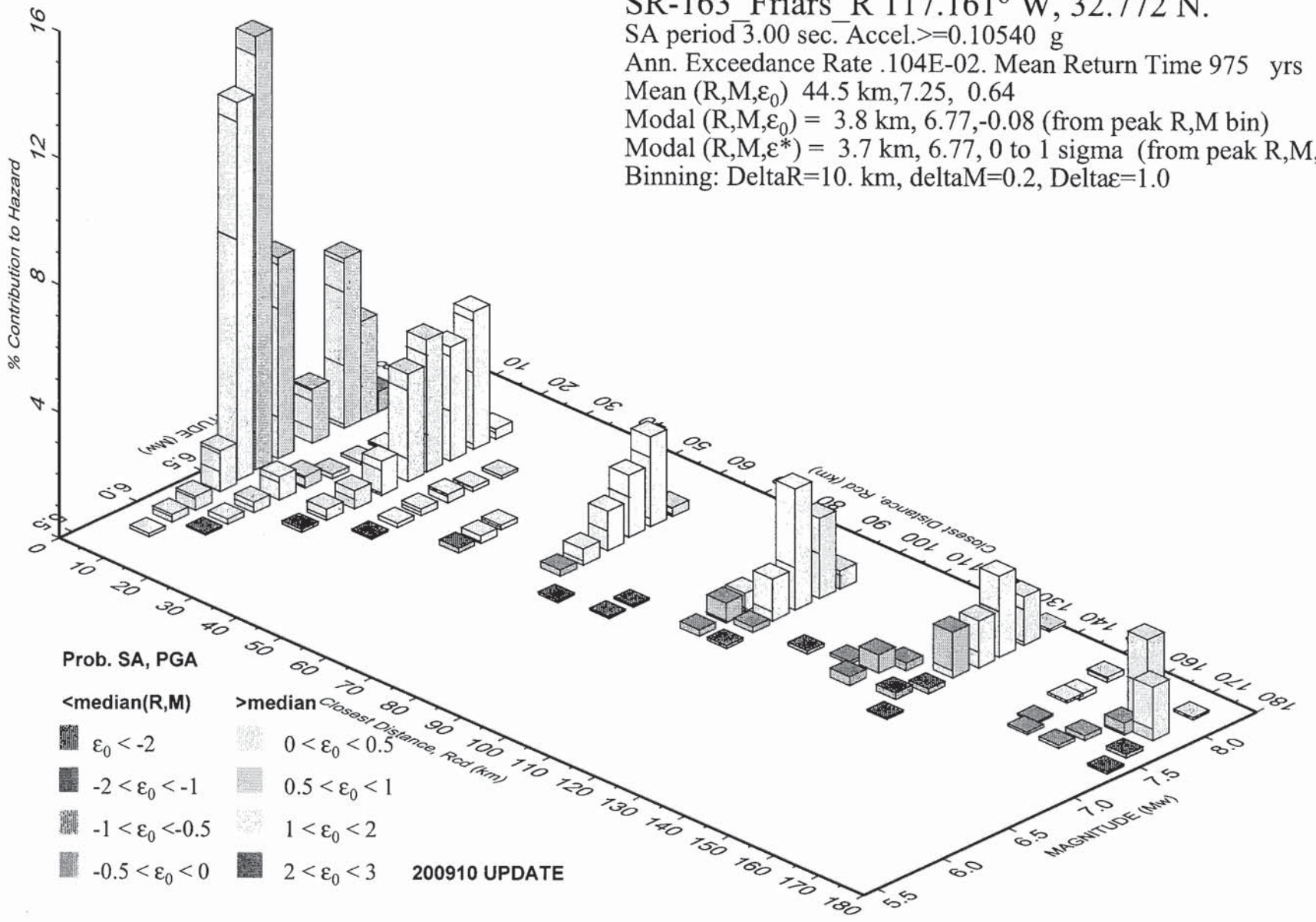
SA period 2.00 sec. Accel.>=0.1652 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.5 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.24 (from peak R,M bin)
Modal (R,M,ε*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:48:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 3.00 sec. Accel.>=0.10540 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.5 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.07516 g

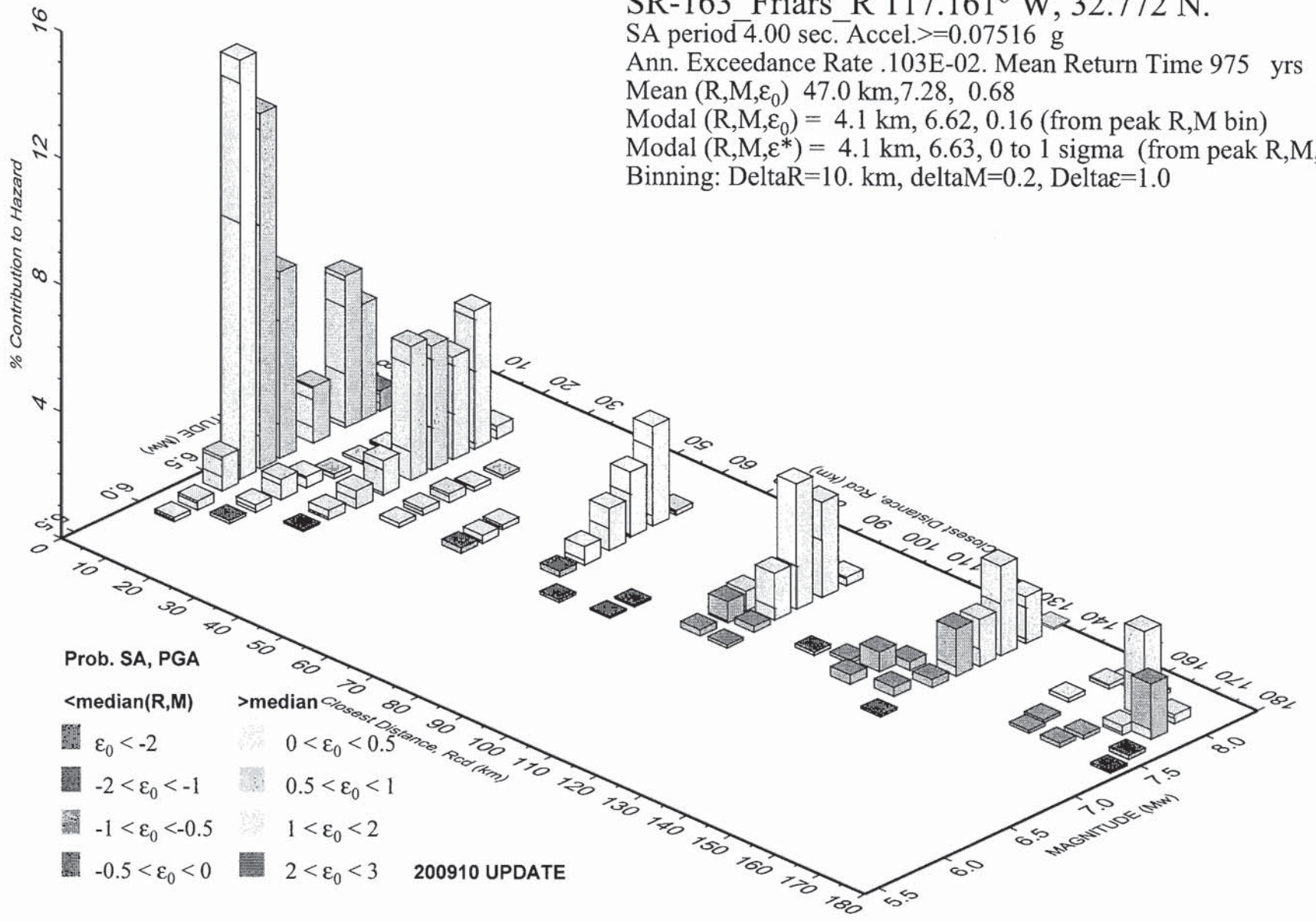
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 47.0 km,7.28, 0.68

Modal (R,M,ε_0) = 4.1 km, 6.62, 0.16 (from peak R,M bin)

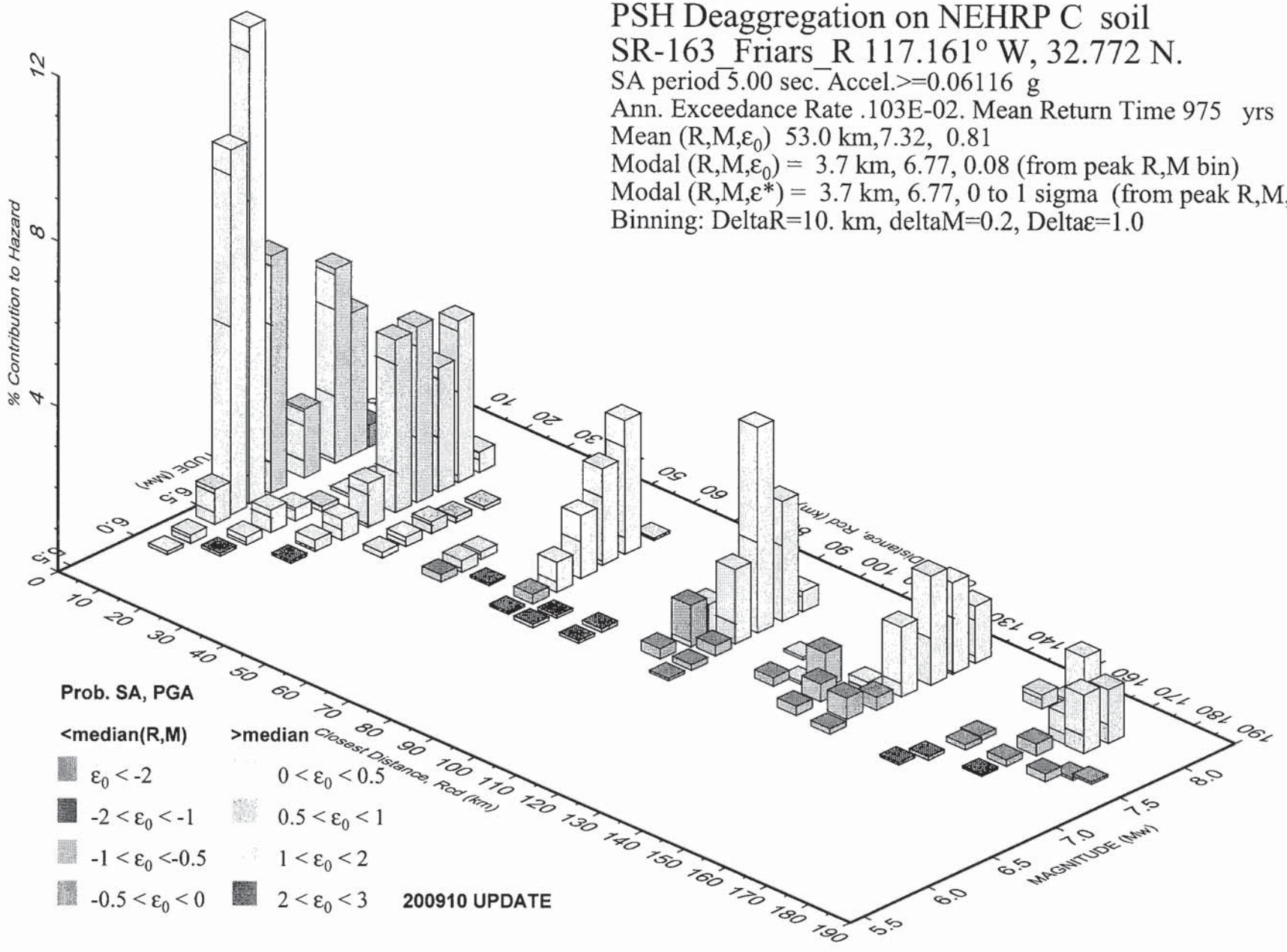
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

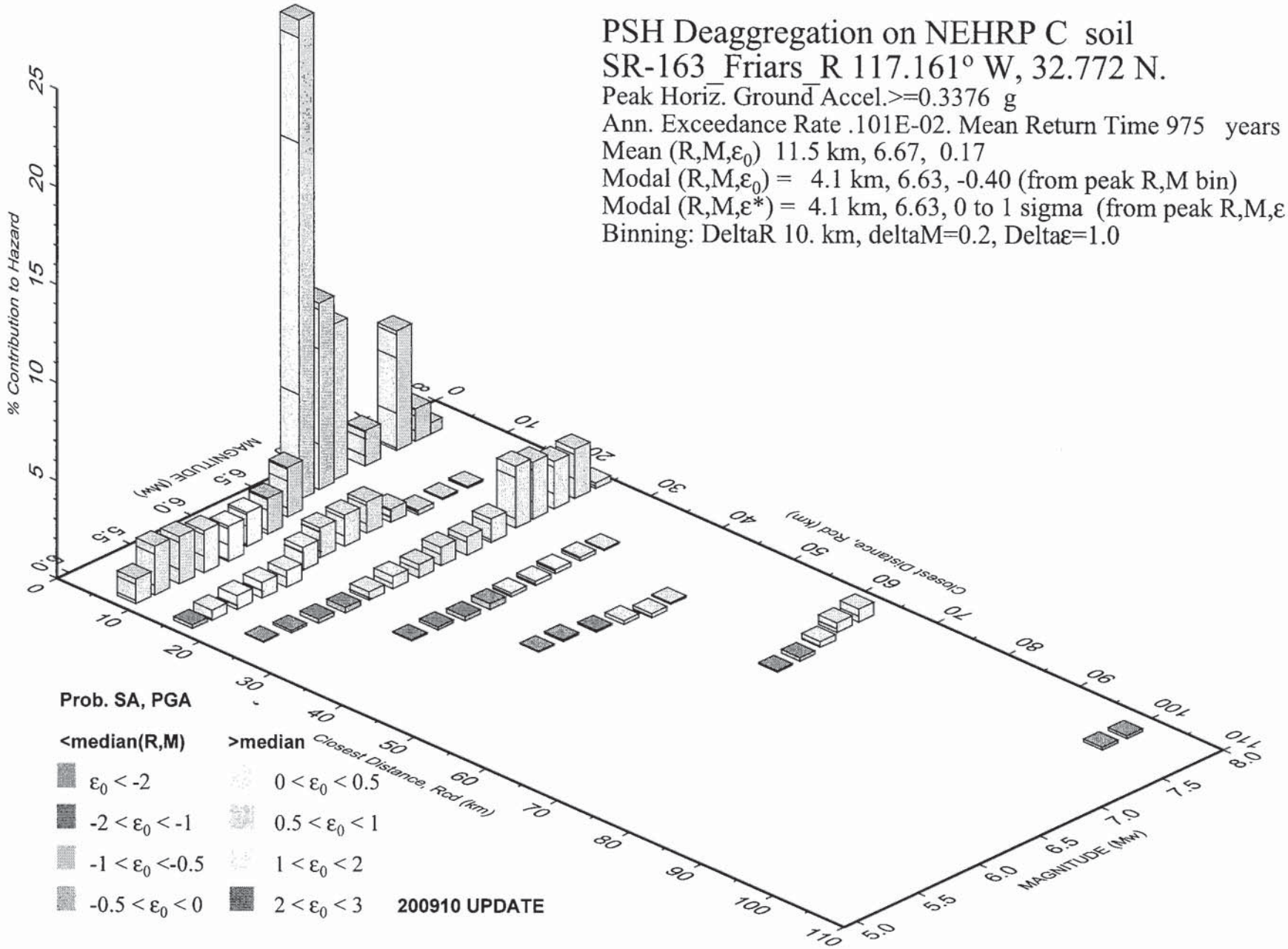


PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 5.00 sec. Accel.>=0.06116 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 53.0 km,7.32, 0.81
Modal (R,M,ε_0) = 3.7 km, 6.77, 0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



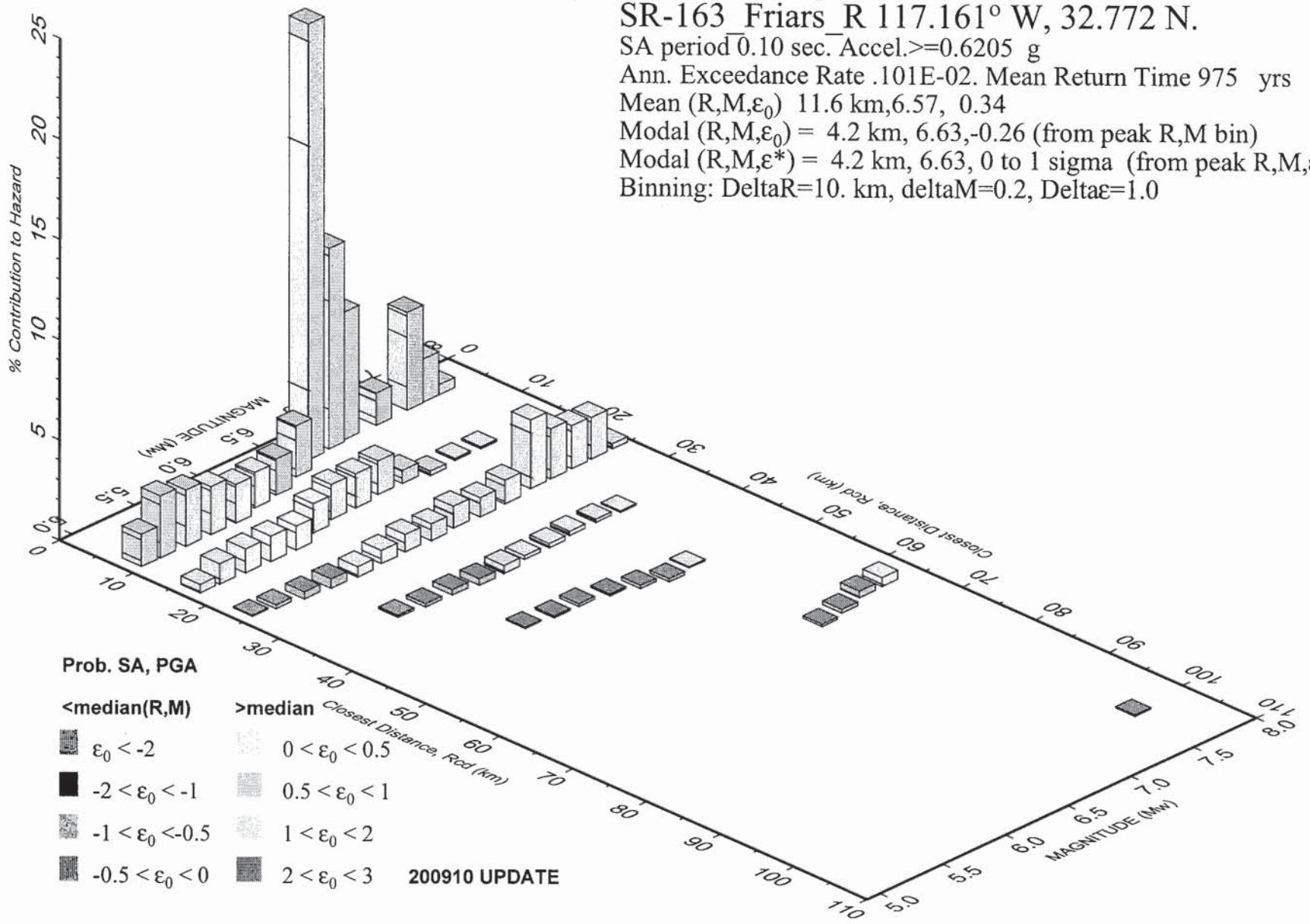
GMT 2012 Jul 5 23:54:48 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted



GMT 2012 Jul 5 23:57:26 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

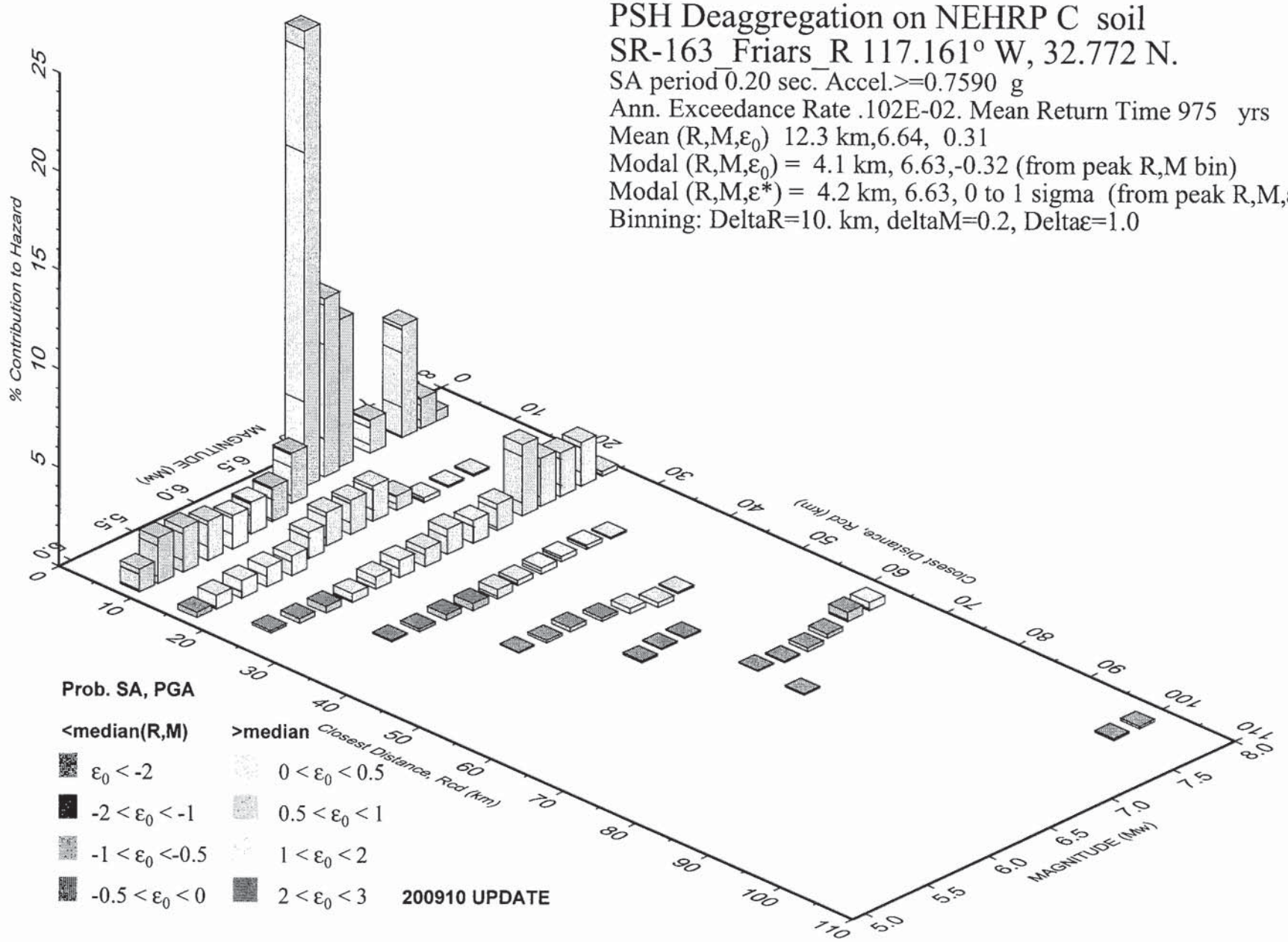
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6205 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.6 km,6.57, 0.34
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.26 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

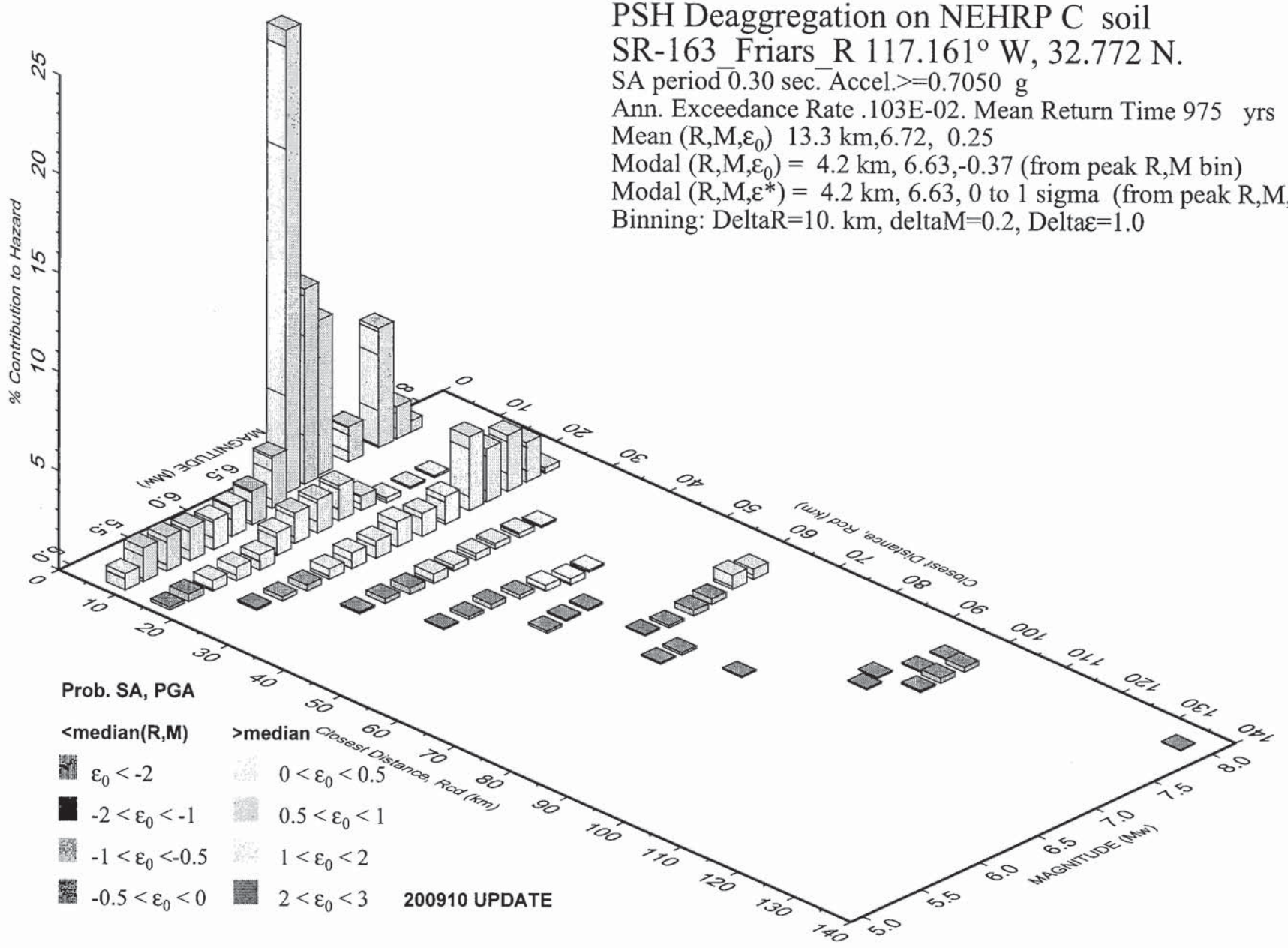
SA period 0.20 sec. Accel.>=0.7590 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.3 km,6.64, 0.31
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.32 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:00:19 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

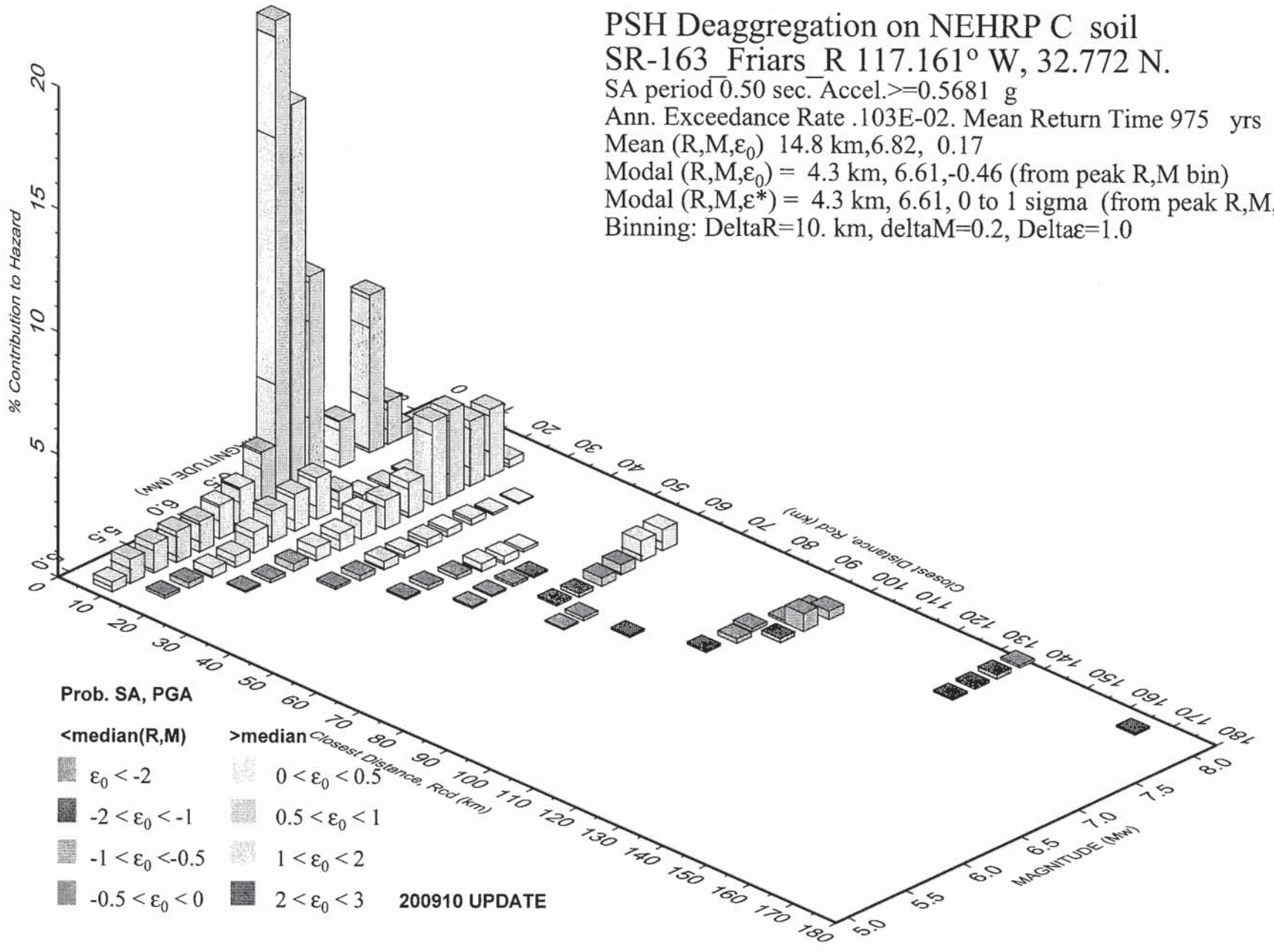
SA period 0.30 sec. Accel.>=0.7050 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 13.3 km,6.72, 0.25
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.37 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:01:39 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.50 sec. Accel.>=0.5681 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.8 km,6.82, 0.17
Modal (R,M,ε_0) = 4.3 km, 6.61,-0.46 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.61, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

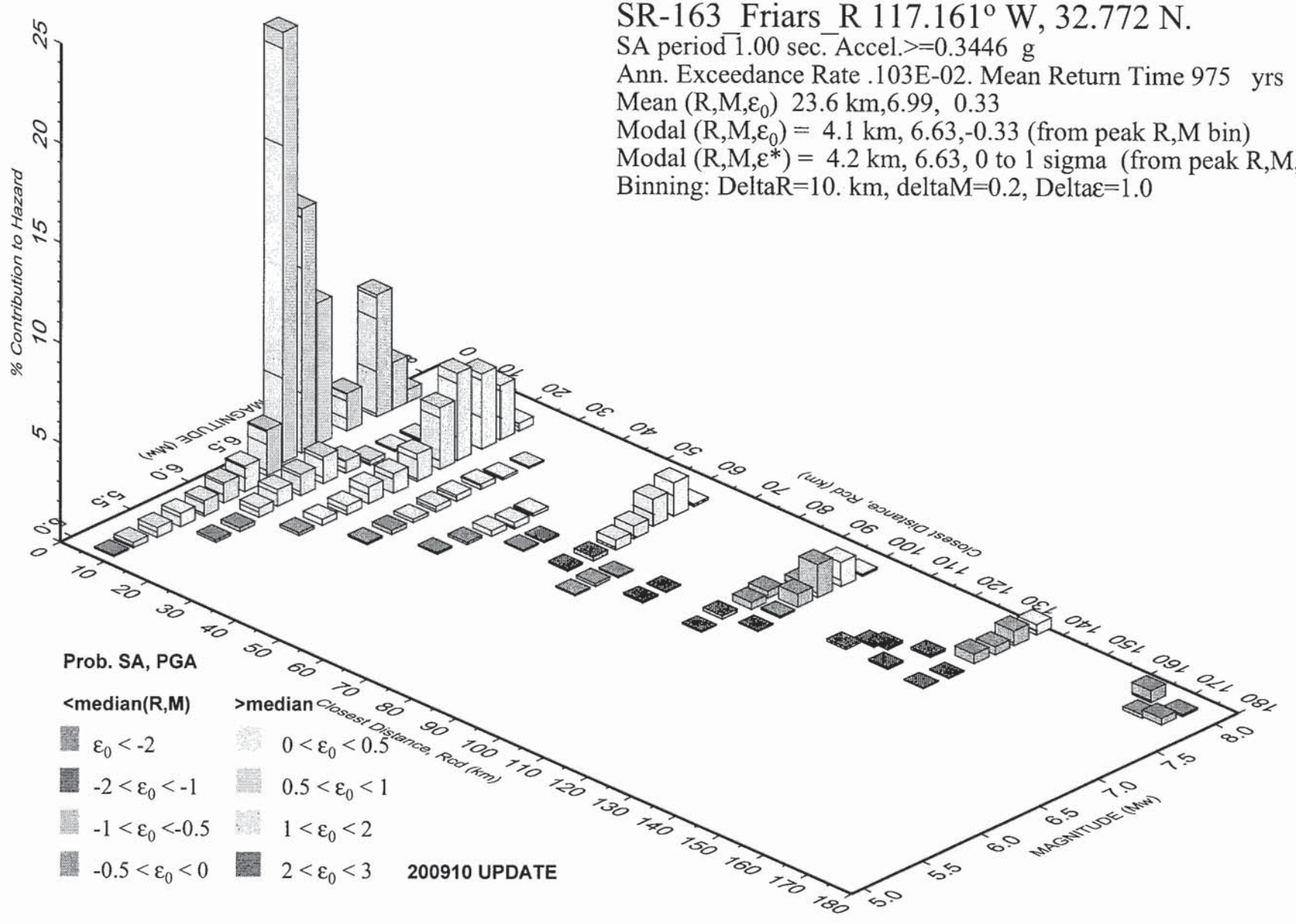


GMT 2012 Jul 6 00:04:36 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

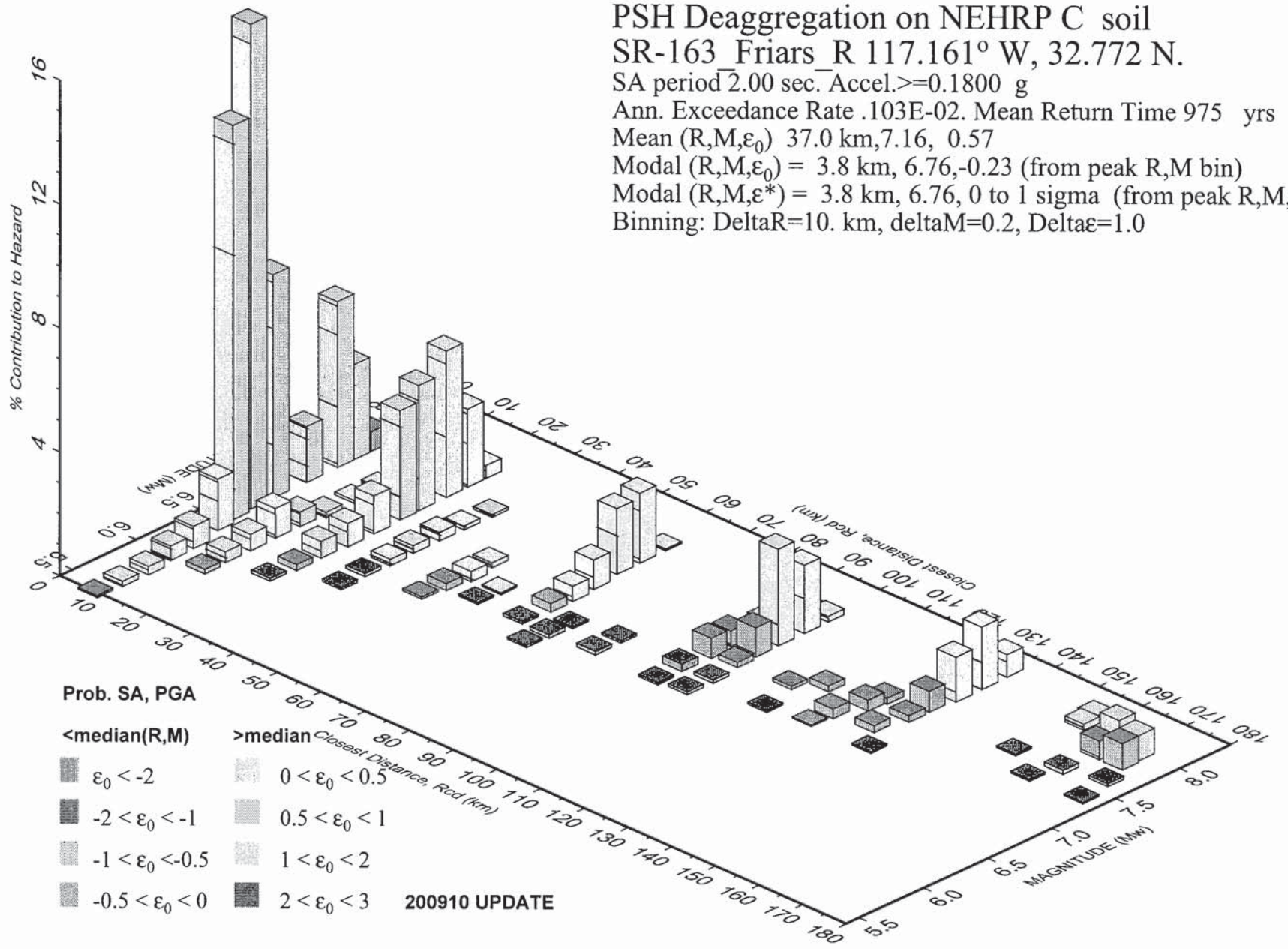
SA period 1.00 sec. Accel.>=0.3446 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.6 km,6.99, 0.33
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.33 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:05:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

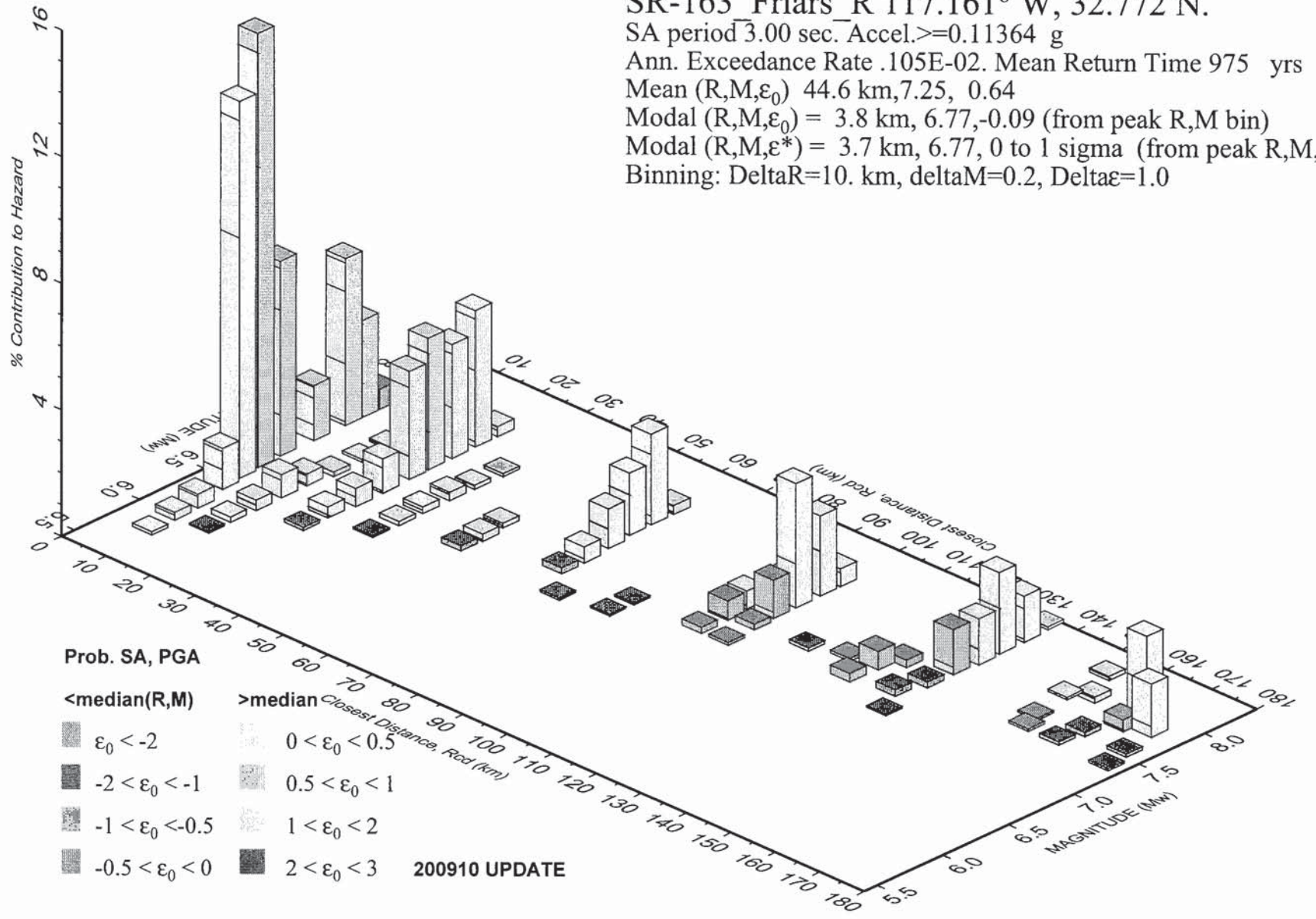
SA period 2.00 sec. Accel.>=0.1800 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.0 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.23 (from peak R,M bin)
Modal (R,M,ε^*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:07:37 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

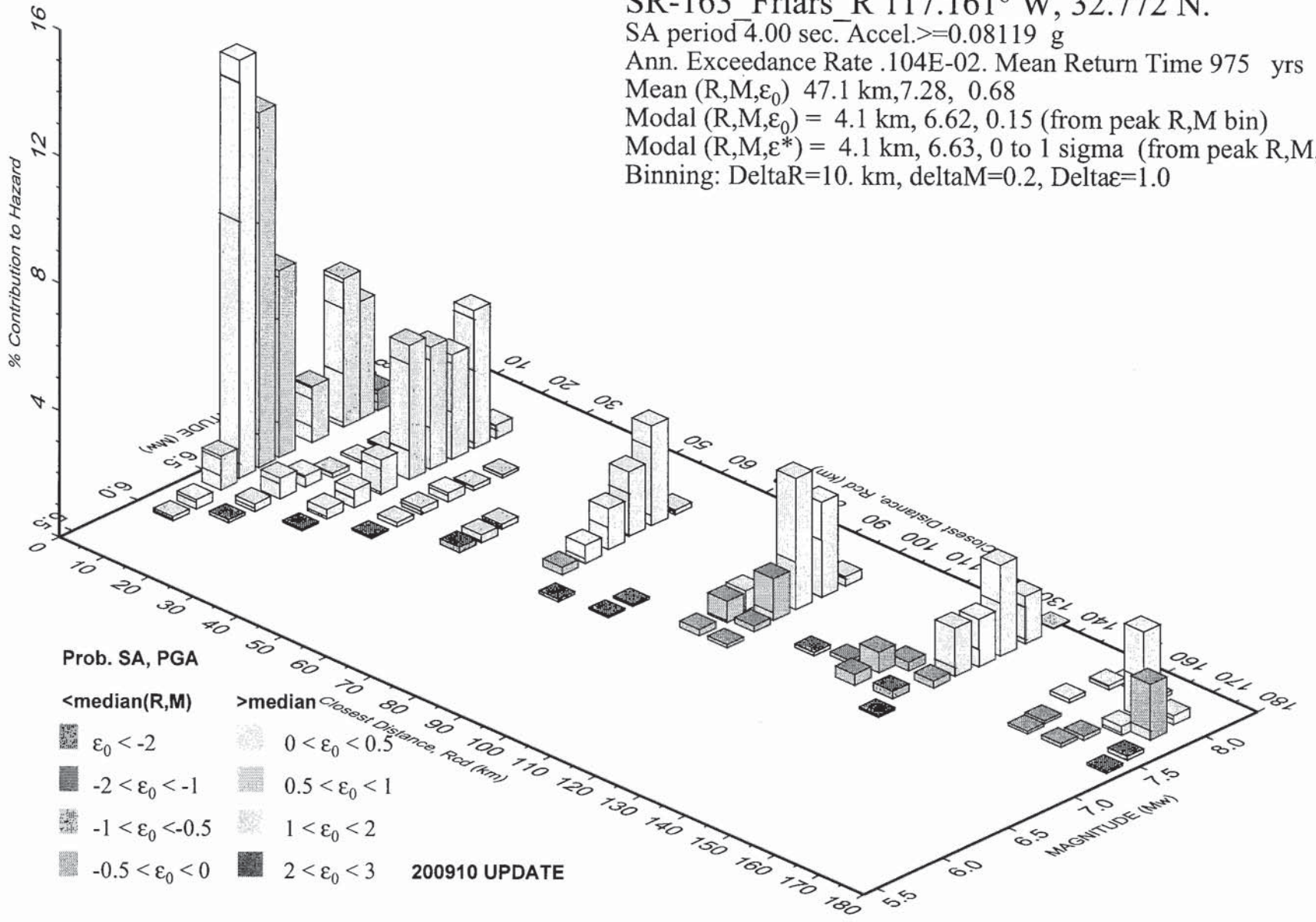
SA period 3.00 sec. Accel.>=0.11364 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.6 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.09 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

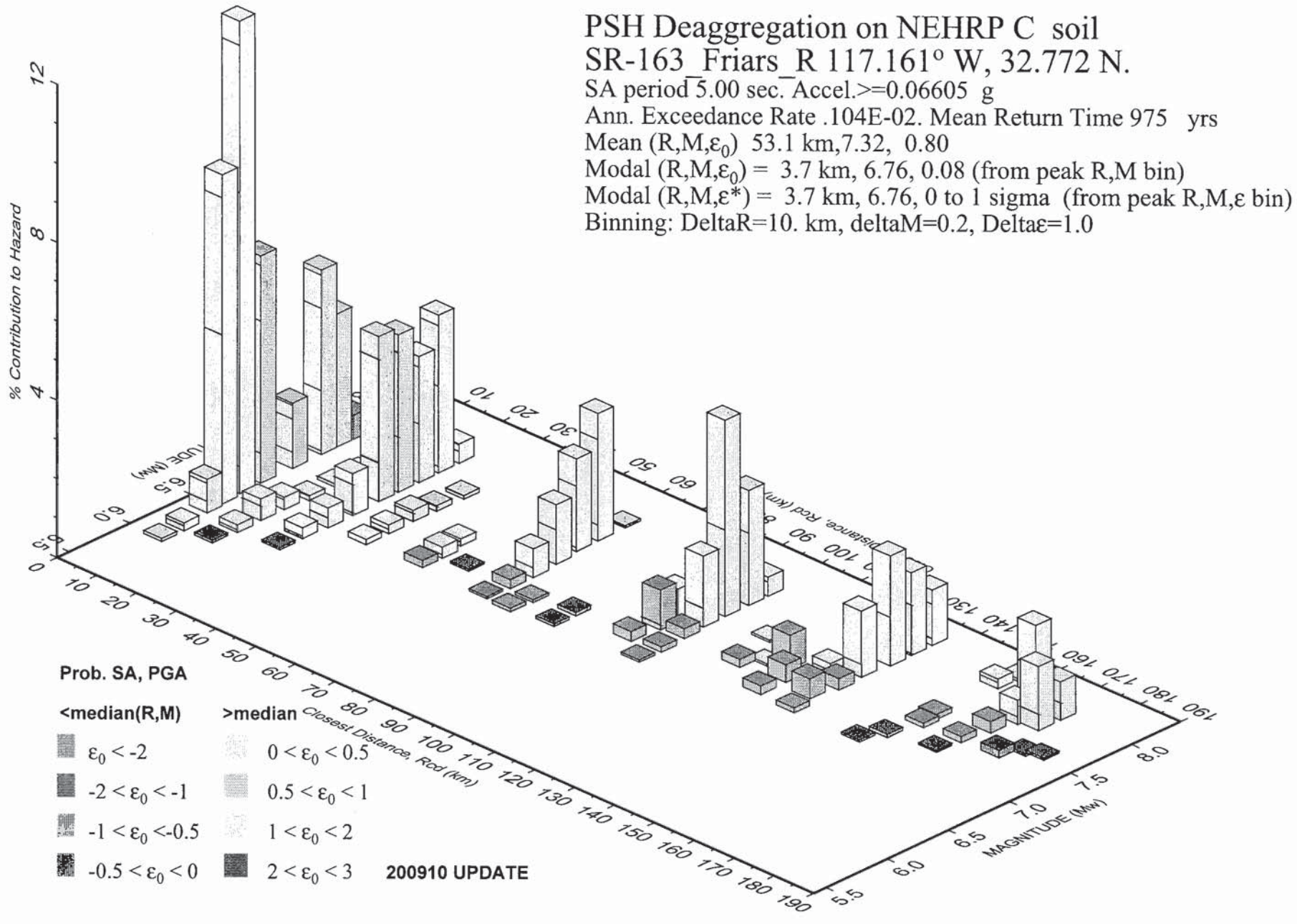


GMT 2012 Jul 6 00:08:54 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

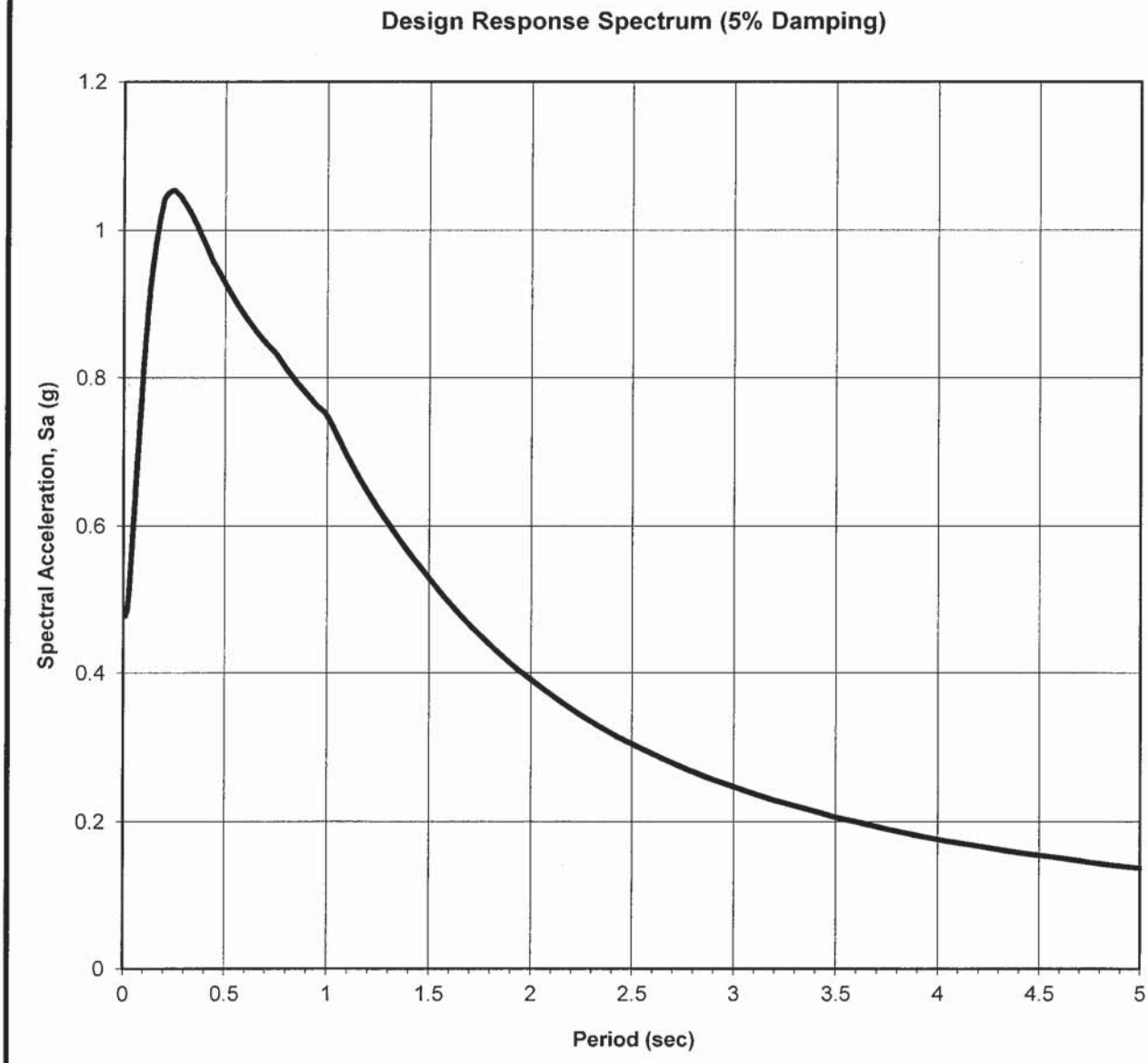
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.08119 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 47.1 km,7.28, 0.68
Modal (R,M,ε_0) = 4.1 km, 6.62, 0.15 (from peak R,M bin)
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0





GMT 2012 Jul 6 00:11:50 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted


Design Response Spectrum (5% Damping)
Spectral Acceleration, Sa (g)
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Period (sec)

Vs30 = 380 m/s	
T (sec)	Design Envelop S (a)
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.53
0.036	0.534
0.04	0.55
0.042	0.558
0.044	0.565
0.045	0.57
0.046	0.574
0.048	0.582
0.05	0.59
0.055	0.61
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.79
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982
0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977

Vs30 = 420 m/s	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

Envelope Data	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

0.42	0.97
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.28
2.6	0.268
2.8	0.246
3	0.227
3.2	0.21
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126

0.42	0.97
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

Abut 1

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B3 (1968)			A-B-5 (2003)																										Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	25		25	100		100																									63	0.08	333.4	0.015		
5	10	5	26		26	100		100																									63	0.08	334.18	0.01496		
10	15	5	100		100	100		100																									100	0.05	382.09	0.01309		
15	20	5	100		100	100		100																									100	0.05	382.09	0.01309		
20	25	5	100		100	100		100																									100	0.05	382.09	0.01309		
25	30	5	100		100	100		100																									100	0.05	382.09	0.01309		
30	35	5	100		100	100		100																									100	0.05	382.09	0.01309		
35	40	5	100		100	100		100																									100	0.05	382.09	0.01309		
40	45	5	100		100	100		100																									100	0.05	382.09	0.01309		
45	50	5	100		100	100		100																									100	0.05	382.09	0.01309		
50	55	5	100		100	100		100																									100	0.05	382.09	0.01309		
55	60	5	100		100	100		100																									100	0.05	382.09	0.01309		
60	65	5	100		100	100		100																									100	0.05	382.09	0.01309		
65	70	5	100		100	100		100																									100	0.05	382.09	0.01309		
70	75	5	100		100	100		100																									100	0.05	382.09	0.01309		
75	80	5	100		100	100		100																									100	0.05	382.09	0.01309		
80	85	5	100		100	100		100																									100	0.05	382.09	0.01309		
85	90	5	100		100	100		100																									100	0.05	382.09	0.01309		
90	95	5	100		100	100		100																									100	0.05	382.09	0.01309		
95	100	5	100		100	100		100																									100	0.05	382.09	0.01309		
	sum	100																															Weighted Avg N	94.40	V_{s30}	377		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 421 m/s

Say 420 m/s

Bent 2

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B6 (1963)			B2 (1968)			A-B-2 (2003)																								Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	24		24	15		15	14		14																						18	0.28	231.1	0.02163		
5	10	5	15		15	17		17		11	8																						13	0.38	212.54	0.02352		

VI

10	15	5	12		12	40		40		14	10																					21	0.24	241.65	0.02069		
15	20	5	100		100	100		100		50	35																					78	0.06	355.97	0.01405		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
35	40	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
40	45	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
45	50	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
50	55	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	100																														Weighted Avg N	56.58	V_{s30}	346		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 384 m/s

Say 380 m/s

Abut 3

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B1 (1963)			B1 (1968)			A-B-44 (2012)																								Cohesionless Soils					
																																	SPT			CP		
From	To	DI	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	5		5	5		5		100	100																					37	0.14	285.6	0.01751		
5	10	5	7		7	4		4		100	100																					37	0.14	286.38	0.01746		
10	15	5	50		50	6		6		100	100																					52	0.10	316.09	0.01582		
15	20	5	100		100	20		20		100	100																					73	0.07	349.22	0.01432		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		

35	40	5	100		100	100		100		54	38																					79	0.06	357.19	0.014		
40	45	5	100		100	100		100		42	29																					76	0.07	353.49	0.01414		
45	50	5	100		100	100		100		44	31																					77	0.06	354.11	0.01412		
50	55	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	**100**																														**Weighted Avg N**	**78.17**	V_{s30}	**360**		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 402 m/s

Say **380** m/s

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	344.4	0.0145	407.7	0.012264724
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	345.3	0.0145	408.7	0.012233589
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	396	V_{s30}	466
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	226.1	0.0221	272.4	0.018352752
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	205.4	0.0243	248.4	0.020124774

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	238.0	0.021	286.1	0.017475108
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	371.3	0.0135	438.1	0.011412336
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	358	V_{s30}	423
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS D		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
T		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	288.4	0.0173	343.9	0.014539214
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	289.2	0.0173	344.9	0.014497301
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	323.9	0.0154	384.4	0.013005841
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	363.2	0.0138	429.0	0.011655002
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	372.7	0.0134	439.8	0.011369297
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	368.3	0.0136	434.8	0.011500478
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	369.1	0.0135	435.6	0.011478178
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	376	V_{s30}	444
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

GEOCON

Hammer Energy Correction Factors

Reference: Youd, et al, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Environmental Engineering, October, 2001, Vol. 127, No. 10

Project Name: Friars Road/SR 163 Date: 11/6/2012

Project Number: G1447-52-01

Hole Diameter, Inches: 8 Hole Diameter Correction, C_B: 1.15

Average Unit Weight, γ (pcf): 120

Adjustment Factor for 350 LB Hammer Above Groundwater 1.00 <-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples

Adjustment Factor for 350 LB Hammer Below Groundwater 1.00 <-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples

Approximate Depth to Groundwater 20

*Auto, Cathead, or Downhole Hammer

					Adjust for each GWT Level		Energy Correction, C_E (1.0 Safe-T-Driver/Cathead, 1.3 Automatic)				
Sample	Depth, Feet	Field Blow Count (per Foot)	Type of Sampler (MC or SPT)	Hammer Type* (A/C/D)	Equiv. SPT Blow Count, N	σ'_v, psf	Overburden Pressure Correction, C_N	Energy Ratio Correction, C_E	Rod Length Correction, C_R	Sampling Correction, C_S	N1|60 Blowcounts (Pror to Fines)
A-03-002: 5	5.0	14	SPt	a	14.0	600.0	1.70	1.3	0.75	1.10	29.35
A-03-002: 7	7.0	11	MC	a	7.3	840.0	1.54	1.3	0.80	1.00	13.53
A-03-002: 10.5	10.5	14	MC	a	9.3	1260.0	1.26	1.3	0.85	1.00	14.94
A-03-002: 13	13.0	50	MC	a	33.3	1560.0	1.13	1.3	0.85	1.00	47.96
A-03-002: 15	15.0	100	MC	a	66.7	1800.0	1.05	1.3	0.85	1.00	89.30
A-03-002: 20	20.0	100	SPT	a	100.0	2400.0	0.91	1.3	0.95	1.10	100.00
A-03-002: 25	25.0	100	SPT	a	100.0	2688.0	0.86	1.3	0.95	1.10	100.00
A-03-002: 30	30.0	100	SPT	a	100.0	2976.0	0.82	1.3	1.00	1.10	100.00
A-03-002: 33	33.0	100	SPT	a	100.0	3148.8	0.80	1.3	1.00	1.10	100.00
A-03-002: 34.5	34.5	100	SPT	a	100.0	3235.2	0.79	1.3	1.00	1.10	100.00

Liquefaction Analysis Using SPT

Project Name: Friars Road/SR 163
Project Number: G1447-52-01
Boring: A-03-002

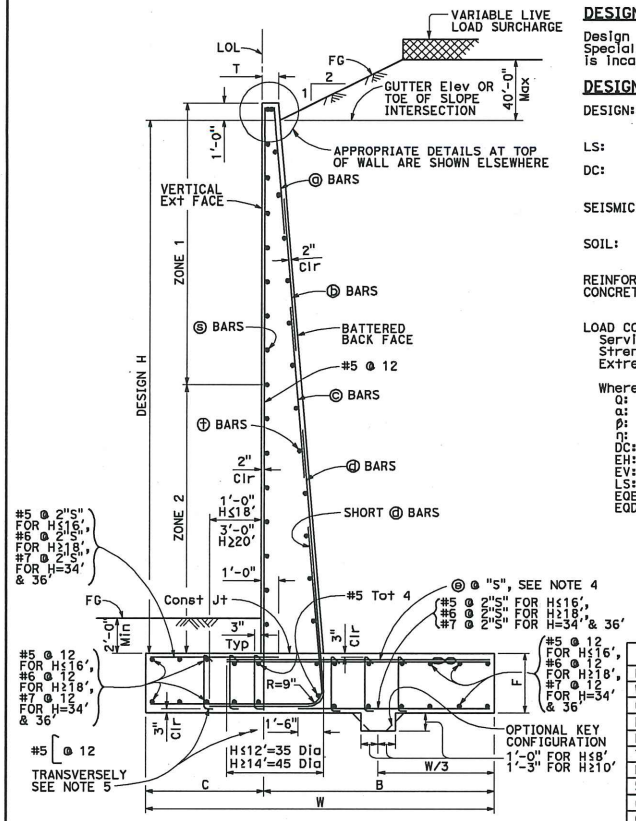
a_{max}/g 0.48
Magnitude 7.50
Groundwater Depth, Ft 20.0
Reference Pressure, p_a 2000
Unit Weight of Water 62.4
Soil Unit Weight, pcf 120

Include Kσ (Y/N) N
Use NCEER $CRR_{7.5}$ (1) or Rauch $CRR_{7.5}$ (2) 2
Minimum Factor of Safety for Liquefaction 1

MWF Idriss(1997) = $(M)^{2.56}/10^{2.24}$ From Graph

Depth, ft	N_1[60]	Fines Content, FC (%)	N_1[60], Adj. for Fines	σ, psf	σ', psf	r_d	$K_σ$	NCEER $CRR_{7.5}$	RAUCH $CRR_{7.5}$	CSR M=7.5	Liquefaction Potential	Factor of Safety	Volumetric Strain, %	Settlement, in.
1	29	15	32.9	120.0	120.0	1.00	1.00	0.800	0.800	0.312	Above GWT	2.564		
2	29	15	32.9	240.0	240.0	1.00	1.00	0.800	0.800	0.311	Above GWT	2.570		
3	29	15	32.9	360.0	360.0	0.99	1.00	0.800	0.800	0.311	Above GWT	2.576		
4	29	15	32.9	480.0	480.0	0.99	1.00	0.800	0.800	0.310	Above GWT	2.582		
5	29	15	32.9	600.0	600.0	0.99	1.00	0.800	0.800	0.309	Above GWT	2.588		
6	14	35	21.8	720.0	720.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.776		
7	14	35	21.8	840.0	840.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.777		
8	15	35	23.0	960.0	960.0	0.98	1.00	0.255	0.257	0.307	Above GWT	0.837		
9	15	35	23.0	1080.0	1080.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.839		
10	15	35	23.0	1200.0	1200.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.841		
11	15	35	23.0	1320.0	1320.0	0.98	1.00	0.255	0.257	0.305	Above GWT	0.843		
12	50	35	65.0	1440.0	1440.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.629		
13	50	35	65.0	1560.0	1560.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.635		
14	89	35	111.8	1680.0	1680.0	0.97	1.00	0.800	0.800	0.303	Above GWT	2.641		
15	89	35	111.8	1800.0	1800.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.646		
16	89	35	111.8	1920.0	1920.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.652		
17	89	35	111.8	2040.0	2040.0	0.96	1.00	0.800	0.800	0.301	Above GWT	2.659		
18	89	35	111.8	2160.0	2160.0	0.96	1.00	0.800	0.800	0.300	Above GWT	2.665		
19	89	35	111.8	2280.0	2280.0	0.96	1.00	0.800	0.800	0.299	Above GWT	2.672		
20	89	35	111.8	2400.0	2400.0	0.96	1.00	0.800	0.800	0.299	NL	2.679		
21	100	35	125.0	2520.0	2457.6	0.95	1.00	0.800	0.800	0.305	NL	2.620		
22	100	35	125.0	2640.0	2515.2	0.95	1.00	0.800	0.800	0.312	NL	2.567		
23	100	35	125.0	2760.0	2572.8	0.95	1.00	0.800	0.800	0.318	NL	2.519		
24	100	35	125.0	2880.0	2630.4	0.95	1.00	0.800	0.800	0.323	NL	2.477		
25	100	35	125.0	3000.0	2688.0	0.94	1.00	0.800	0.800	0.328	NL	2.439		
26	100	35	125.0	3120.0	2745.6	0.94	1.00	0.800	0.800	0.333	NL	2.404		
27	100	35	125.0	3240.0	2803.2	0.93	1.00	0.800	0.800	0.337	NL	2.374	0.75	0.09
28	100	35	125.0	3360.0	2860.8	0.93	1.00	0.800	0.800	0.341	NL	2.347	0.75	0.09
29	100	35	125.0	3480.0	2918.4	0.93	1.00	0.800	0.800	0.344	NL	2.323	0.75	0.09
30	100	35	125.0	3600.0	2976.0	0.92	1.00	0.800	0.800	0.348	NL	2.302	0.75	0.09
31	100	0	100.0	3720.0	3033.6	0.92	1.00	0.800	0.800	0.350	NL	2.284	0.75	0.09
32	100	0	100.0	3840.0	3091.2	0.91	1.00	0.800	0.800	0.353	NL	2.268	0.75	0.09
33	100	0	100.0	3960.0	3148.8	0.90	1.00	0.800	0.800	0.355	NL	2.255		
34	100	0	100.0	4080.0	3206.4	0.90	1.00	0.800	0.800	0.356	NL	2.245		
35	100	0	100.0	4200.0	3264.0	0.89	1.00	0.800	0.800	0.358	NL	2.237		

Total Settlement, S_{LIQ} (in.) = 0.54
Total Liquifiable Layers = 6



TYPICAL SECTION

NOTES:

1. For details not shown and drainage notes see RSP B3-5
2. For wall stem joint details see B0-3 3-3 and B0-3 3-4
3. At ⓓ and short ⓓ bars:
   H ≤ 6', no splices are allowed within 1'-8" above the top of footing.
   H > 6', no splices are allowed within H/4 above the top of footing.
4. Bundle ⓔ bars for H ≥ 26'.
5. Hook stirrups around & space with alternating transverse reinforcement at 2 x "S".

DESIGN CONDITIONS:

Design H may be exceeded by 6" before going to the next size. Special footing design is required where foundation material is incapable of supporting bearing stress listed in the table.

DESIGN NOTES:

DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition with California Amendments

LS: Varied surcharge on level ground surface

DC: Stem Architectural Treatment of thickness up to 6" of concrete (75 psf) considered

SEISMIC: $k_h = 0.2$, $k_v = 0.0$

SOIL: $\phi = 34°$, $\gamma = 120$ pcf

REINFORCED CONCRETE: $f'c = 3{,}600$ psi, $fy = 60{,}000$ psi

LOAD COMBINATIONS AND LIMIT STATES:

Service I	$Q = 1.00DC+1.00EV+1.00EH+1.00LS$
Strength I	$Q = \alpha DC+\beta EV+\eta EH+1.75LS$
Extreme I	$Q = 1.00DC+1.00EV+1.00EH+1.00EQD+1.00EQE$

Where:

Q:	Force Effects
α:	1.25 or 0.90, Whichever Controls Design
β:	1.35 or 1.00, Whichever Controls Design
η:	1.50 or 0.90, Whichever Controls Design
DC:	Dead Load of Structure Components
EH:	Horizontal Earth Fill Pressure
EV:	Vertical Earth Pressure from Earth Fill Weight
LS:	Live Load Surcharge
EQE:	Seismic Earth Pressure
EQD:	Soil and Structural and Nonstructural Components Inertia

SYMBOLS:

TO ACCOMPANY PLANS DATED _____

Ser - service limit state I
Str - strength limit state I
Ext - extreme event limit state I
B' - effective footing width (ft)
q_0 - net bearing stress (ksf), OG assumed to be FG at toe
q_0 - gross uniform bearing stress (ksf)
h1 = Top of footing to top of short ⓓ bar
h2 = Top of footing to top of ⓓ bar
h3 = Top of footing to top of ⓒ bar
h4 = Top of footing to top of ⓑ bar
Zone 1 = Top half of stem height
Zone 2 = Bottom half of stem height
⊂⊃ - Bundle of two bars

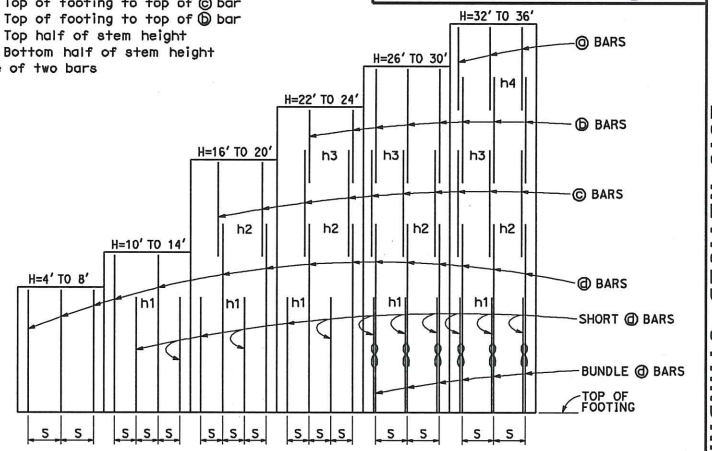
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

Gary Wong
REGISTERED CIVIL ENGINEER

April 20, 2012
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Gary Wang — No. C58298 — Exp. 6-30-12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.



ELEVATION

TABLE OF REINFORCING STEEL, DIMENSIONS AND DATA

DESIGN H	4'	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'	34'	36'
W	6'-0"	7'-6"	9'-6"	11'-0"	12'-6"	15'-6"	17'-3"	19'-6"	21'-9"	23'-6"	26'-0"	28'-1"	30'-3"	31'-6"	33'-0"	34'-8"	35'-11"
C	2'-0"	2'-6"	3'-3"	3'-6"	4'-3"	5'-0"	5'-3"	5'-9"	6'-9"	7'-3"	8'-3"	8'-9"	9'-0"	9'-6"	10'-0"	10'-10"	11'-3"
B	4'-0"	5'-0"	6'-3"	7'-6"	8'-3"	10'-6"	12'-0"	13'-9"	15'-0"	16'-3"	17'-9"	19'-4"	21'-3"	22'-0"	23'-0"	23'-10"	24'-8"
F	1'-6"	1'-6"	2'-0"	2'-3"	2'-6"	2'-8"	2'-10"	3'-0"	3'-4"	3'-6"	3'-6"	3'-7"	3'-7"	3'-9"	3'-9"	4'-0"	4'-4"
T	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	1'-2"	1'-5"	1'-10"	2'-3"	2'-9"
BATTER	½: 12	½: 12	½: 12	½: 12	½: 12	⅝: 12	⅝: 12	¾: 12	⅞: 12	1 : 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12
SPACING "S"	16"	12"	10"	7"	7"	7"	7"	7"	7"	6"	6"	10"	8"	7"	7"	7"	7"
ⓐ BARS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	#5	#5	#5
ⓑ BARS	-	-	-	-	-	-	-	-	-	#5	#5	#5	#5	#5	#7	#7	#7
ⓒ BARS	-	-	-	-	-	-	#6	#6	#6	#7	#8	#8	#8	#8	#9	#9	#9
ⓓ BARS	#5	#5	#6	#6	#7	#8	#9	#10	#10	#10	#11	#11	#11	#11	#11	#11	#11
ⓔ BARS	#5	#5	#6	#6	#7	#8	#9	#10	#10	#10	#11	#11	#11	#11	#11	#11	#11
h1	-	-	-	5'-3"	6'-4"	7'-6"	8'-9"	9'-9"	11'-0"	11'-3"	11'-6"	10'-3"	11'-9"	12'-3"	12'-6"	13'-3"	13'-8"
h2	-	-	-	-	-	-	12'-8"	15'-6"	17'-0"	16'-6"	17'-3"	18'-0"	17'-6"	17'-4"	14'-10"	15'-9"	16'-4"
h3	-	-	-	-	-	-	-	-	-	18'-9"	21'-3"	21'-3"	22'-4"	22'-8"	18'-0"	18'-6"	19'-6"
h4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26'-3"	27'-4"	28'-6"
No. of Toe Stirrups	0	0	0	0	0	0	0	0	0	0	0	5	5	6	7	8	9
No. of Heel Stirrups	0	0	0	0	0	0	0	0	4	6	7	8	10	10	11	11	11
ZONE 1 ⓢ BARS	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#6 @ 10	#6 @ 10
ZONE 2 ⓢ BARS	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#7 @ 12	#7 @ 12	#7 @ 12	#7 @ 12	#7 @ 10	#7 @ 10
ZONE 1 ⓣ BARS	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 12	#4 @ 12	#4 @ 12	#5 @ 12	#5 @ 12	#5 @ 12
ZONE 2 ⓣ BARS	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#6 @ 12
Ser: B', q_0	4.0, 0.9	5.5, 1.0	9.3, 1.0	10.9, 1.3	12.3, 1.5	14.8, 1.9	16.6, 2.1	18.7, 2.4	20.6, 2.7	22.3, 3.0	24.2, 3.3	26.1, 3.5	28.2, 3.9	29.6, 4.0	31.1, 4.2	32.7, 4.4	34.1, 4.6
Str: B', q_0	2.2, 2.2	3.5, 2.2	5.1, 2.3	6.3, 2.6	7.6, 2.7	12.9, 3.1	14.3, 3.6	16.5, 3.9	19.4, 4.5	20.7, 4.8	22.5, 5.2	24.3, 5.6	26.2, 6.0	27.5, 6.3	28.8, 6.6	30.3, 6.9	31.8, 7.2
Ext: B', q_0	2.3, 3.4	2.7, 4.4	3.6, 5.0	3.8, 6.5	4.5, 7.0	7.0, 6.1	7.6, 6.9	9.3, 7.0	11.0, 7.1	11.8, 7.6	14.1, 7.4	15.6, 7.7	17.1, 8.0	17.2, 8.7	18.1, 9.0	19.0, 9.4	19.4, 10.0

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL TYPE 1 (CASE 2)

NO SCALE

RSP B3-1B DATED APRIL 20, 2012 SUPPLEMENTS THE STANDARD PLANS BOOK DATED 2010.

REVISED STANDARD PLAN RSP B3-1B

3-30-12

2010 REVISED STANDARD PLAN RSP B3-1B

Project Name:	Friars Road
Project No.	G1447-52-01
Date:	7-Nov-12
Support Location:	West Abutment Wall

Determination of Elastic Settlement

Vertical Stress of Loaded Area (Allowable Bearing Capacity (ksf)):	**qo =**	8.1	qpn = 8.1 ksf qpn > 2.1 ksf , therefore, GOOD!
Poisson's Ratio (taken at 1/3 to 2/3 B):	**v =**	0.35	
Young's Modulus, ksf (taken at 1/3 to 2/3 B):	**Es =**	2500	
Footing Length (feet)	**L =**	44	
Footing Width (feet)	**B =**	22	
Footing Contact Area (ft^2) =	**A =**	968	
L/B =	**L/B =**	2	
Combined Shape/Rigidity Factor (from Table 4.4.7.2.2B)	**Bz =**	1.06	

Elastic Settlement:	**0.08345**	**(feet)**
	1.001394	**(inches)**
	25.43542	**(mm)**

Project No. G1447-52-01
May 22, 2015

Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Attention: Mr. Chris Thomas

Subject: FOUNDATION REPORT – MEMORANDUM NO. 2
FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
WEST GROUND ANCHOR WALL (BRIDGE NO. 57E0126)
11-SD-163-PM 4.4; CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

References:
1. *Foundation Report, Friars Road/State Route 163 Interchange Project, West Ground Anchor Wall (Bridge No. 57E0126), 11-SD-163-PM 4.4, Contract No. 11-085781, San Diego, California,* prepared by Geocon Incorporated, dated November 30, 2012, revised August 15, 2014 (Project No. G1447-52-01).

2. *Project Plans, West Ground Anchor Wall, Bridge No. 57E0126, Post Miles 4.4, Sheets 1 through 17 of 17 Sheets,* prepared by T.Y. Lin International, undated (Final PS&E).

Dear Mr. Thomas:

In accordance with your request, we have prepared this memorandum addressing the design updates of the subject wall.

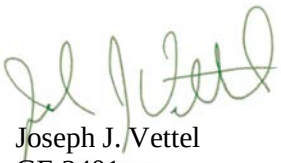
We understand that the beginning segment of the subject wall, approximately 13'-10" in length and approximately 13½ to 17 feet in height, will be a soldier pile wall. Specifically, this segment of wall will be supported by three solider piles installed in 30-inch-diameter drilled holes extending approximately 16½ to 26 feet below the bottom of the wall. We consider the update appropriate from a geotechnical engineering standpoint. The contractor should have adequate drilling equipment available onsite for excavating in Stadium Conglomerate and Friars Formation.

We also understand that an existing 60-inch-diameter RCP will be protected in place during construction. A layout verification by the project structure engineer (T.Y. Lin International) indicates unlikely conflict between the existing 60-inch-diameter RCP and the proximate, planned Tie 15 ground anchor. However, as a construction consideration, the contractor should verify the locations of the existing 60-inch-diameter RCP and/or other underground utilities in field prior to starting construction. In addition, the contractor should execute a monitoring program so appropriate modifications to the planned ground anchors can be implemented in a timely manner to avoid conflict with the existing 60-inch-diameter RCP and/or other underground utilities.

If there are any questions regarding this memorandum, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED



Yong Wang
GE 2775

Joseph J. Vettel
GE 2401

YW:JJV:dmc

(e-mail) Addressee

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

FOUNDATION REPORT

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT EAST GROUND ANCHOR WALL (BRIDGE NO. 57E0127) 11-SD-163-PM 4.4 CONTRACT NO. 11-085781 SAN DIEGO, CALIFORNIA

PREPARED FOR

DOKKEN ENGINEERING
SAN DIEGO, CALIFORNIA

NOVEMBER 30, 2012
REVISED AUGUST 15, 2014
PROJECT NO. G1447-52-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G1447-52-01
November 30, 2012
Revised August 15, 2014

Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Attention: Mr. Gerard Lumabas

Subject: FOUNDATION REPORT
FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
EAST GROUND ANCHOR WALL
(BRIDGE NO. 57E0127)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

In accordance with your request, we herein submit our Foundation Report (FR) for the proposed East Ground Anchor Wall (Bridge No. 57E0127) for the Friars Road Overcrossing at State Route 163 Interchange project in the City of San Diego, California. The accompanying report presents the findings and conclusions from our study.

Please contact the undersigned at your convenience if you have any questions regarding this FR, or if we may be of further service.

Very truly yours,

GEOCON CONSULTANTS, INC.

Joseph J. Vettel
GE 2401

Yong Wang
GE 2775

YW:JJV:dmc

(e-mail) Addressee

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FOUNDATION REPORT

1. INTRODUCTION

This Foundation Report (FR) was prepared for the proposed East Ground Anchor Wall (Bridge No. 57E-0127) as part of the Friars Road Overcrossing (OC) at State Route (SR) 163 Interchange project in the City of San Diego, California. The approximate site location is depicted on the Vicinity Map, Figure 1. This FR is based on subsurface exploration and laboratory tests performed by Southern California Soil and Testing (SCS&T), Inc. The purpose of the investigation was to evaluate general subsurface geologic and geotechnical conditions along the proposed East Ground Anchor Wall alignment and to provide geotechnical recommendations for use in preparing project plans and specifications.

The recommendations presented herein are based on our review of the subsurface and laboratory data obtained by SCS&T, engineering analyses, and our experience with similar soil and geologic conditions. The logs of test boring (LOTB) sheets in Caltrans format, as-built plans and LOTB sheets, laboratory test results, and analyses and calculations are presented as Appendices A, B, C, and D, respectively.

2. SCOPE OF SERVICES

We performed the following scope of services:

- Reviewed published geologic maps, aerial photographs, as-built plans, project plans, in-house documents, and other literature pertaining to the site to aid in evaluating geologic conditions and hazards that may be present.
- Reviewed as-built plans for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed as-built plans for Friars Road OC Earthquake Retrofit Project No. 272 prepared by the California Department of Transportation, dated December 9, 1997.
- Reviewed as-built LOTB sheet for Friars Road OC prepared by California Department of Transportation, dated December 2, 1968.
- Reviewed the *Geotechnical Design Report for SR 163/Friars Road Interchange Modification Project* prepared by SCS&T.
- Reviewed the *Structure Foundation Investigation for Friars Road at SR 163 Interchange Project (Bridge No. 57-0595)* prepared by SCS&T.
- Reviewed the *Preliminary Foundation Report for Friars Road at SR 163 Interchange, East Tieback Wall Number 2 (Bridge No. 57E-0127)* prepared by SCS&T.

- Reviewed the project plans prepared by T. Y. Lin International for the Friars Road OC Widening project, including the plans for the East Ground Anchor Wall.

- Reviewed subsurface data and laboratory test results collected by SCS&T.

- Performed engineering analyses to evaluate liquefaction potential, seismic design criteria, and foundation design criteria.

- Prepared this FR in general accordance with Caltrans' *Foundation Report Preparation for Bridge Foundations,* December 2009.

SCS&T prepared a *Preliminary Foundation Report (PFR)* for the project (East Ground Anchor Wall project) dated May 2010. This FR supersedes the PFR for the project.

3. PROJECT DESCRIPTION

3.1 Background and Site Description

The project site is located approximately ½ mile north of Interstate 8 on the SR 163 corridor in the City of San Diego, California. The approximate site coordinates are 32.771560° (latitude) and -117.161362° (longitude).

The proposed improvements are part of the Friars Road and SR 163 Interchange Improvements project. The Vicinity Map, Figure 1, shows the approximate location of the site with respect to surrounding improvements. Based on the current plans and project information, the SR 163 northbound (NB) direction below the existing Friars Road OC on the east side will be widened and will require a ground anchor retaining wall and Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls on either end.

3.2 Existing Structures

The SR 163 corridor is oriented in a north-south direction and Friars Road crosses over SR 163 in an east-west direction. At the existing OC structure, SR 163 is comprised of a divided highway with four northbound (NB) lanes and four southbound (SB) lanes. Based on the as-built plans, the existing Friars Road OC (Bridge No. 57-0595) is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments and intersects SR 163 at an approximate skew angle of 35°20'24". The bridge was constructed in 1970 and seismically retrofitted in 1996. The existing OC structure extends 390 feet from approximately Station (Sta.) 17+52 to approximately Sta. 21+42 along the original Friars Road centerline ('F' Line). The OC is approximately 114 feet wide and accommodates three 12-foot lanes, a 5-foot-wide outside shoulder in each direction, a 4-foot-wide sidewalk along the eastbound (EB) direction with metal railing, and a slightly raised concrete median with varying widths. The existing abutments (Abutment 1 and 3) are supported on a combination of vertical and battered driven steel H-piles (HP 10x57) with average pile tip elevations

of 19.8 feet and 14.4 feet above mean sea level (MSL), respectively. The existing bent is supported on driven steel H-piles (HP 10x57) with an average pile tip elevation of 15.1 feet above MSL. However, the subsequent seismic retrofit consisted of increasing the size of the pile caps at Bent 2 and installing higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations were modified as part of the seismic retrofit.

All elevations used in this report are based on the current project plans that refer to the current datum of NAD83 and NAVD88. We understand that the as-built plans of this project were based on the original datum of NGVD29. According to conversations with Dokken Engineering, a vertical transformation of +2.10 feet should be applied to convert the original datum (NGVD29) of these as-built plans to the current datum (NAD83 and NAVD88).

3.3 Proposed Structure

Information regarding the proposed structure are based on the *Project Plans for Final PS&E on East Ground Anchor Wall* prepared by T. Y. Lin International, dated September 6, 2013. We understand the project consists of widening the SR 163 NB direction on the east side in order to accommodate the on- and off-ramps modifications for the Friars Road at SR 163 Interchange project. The widening of SR 163 NB direction (east side) will require a ground anchor retaining wall and Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls on either end in order to support the existing abutment (Abutment 3) embankment. The proposed East Ground Anchor Wall structure will extend approximately 190 feet from approximately Station (Sta.) 10+80 to approximately Sta. 12+70 along the wall alignment. The Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls connect from both the north and south ends of the proposed ground anchor retaining wall. The proposed Type 1 retaining walls will be approximately 57.75 feet and 91.67 feet in length on the north and south sides, respectively, with a maximum height of approximately 16 feet. Bottom of footing elevations range from approximately 40.73 feet to 58.23 feet MSL. The proposed ground anchor retaining wall will be constructed using top-down method with multiple lifts at approximately 5 feet each. The existing Abutment 3 structure will be located approximately 13½ to 16¼ feet from the face of the proposed ground anchor wall.

3.4 Pertinent Project Information

We reviewed the following documents related to the project:

1. California Department of Transportation, *As-built plans, Friars Road Overcrossing,* dated December 2, 1968.

2. California Department of Transportation, *As-built Log of Test Borings (LOTBs), Friars Road Overcrossing,* dated December 2, 1968.

3. Geocon Incorporated, *Preliminary Recommendation Letter, SR 163/ Friars Road Interchange Project, San Diego, California,* dated September 27, 2012 (Geocon Project No. G1447-52-01).

4. Geocon Incorporated, *Foundation Report, Friars Road / State Route 163 Interchange Project, East Abutment Wall (Bridge No. 57E-0127), 11-SD-163-PM 3.8/5.5, EA 11225-085781, San Diego, California,* dated November 30, 2012. (Geocon Project No. G1447-52-01).

5. Geocon Incorporated, *Foundation Report-Memorandum No. 1, Friars Road / State Route 163 Interchange Project, East Abutment Wall (Bridge No. 57E-0127), 11-SD-163-PM 3.8/5.5, EA 11225-085781, San Diego, California,* dated October 25, 2013. (Geocon Project No. G1447-52-01).

6. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8, dated July 23, 2012.

7. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Geotechnical Design Report, SR 163/Friars Road Interchange Modification PM 3.8-5.8, Log of Test Borings (LOTBs) Sheets 1, 2, 3, 4, and 14 of 19,* dated July 23, 2012.

8. Southern California Soil and Testing, Inc. (SCS&T No. 1111191P), *Friars Road at SR 163, Log of Test Borings (LOTBs) Sheet 1 of 1*, dated 2012.

9. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, East Tieback Wall Number 2, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California*, dated May 12, 2010.

10. Southern California Soil & Testing, Inc. (SCS&T No. 0911163), *Preliminary Foundation Report, Friars Road at SR163 Interchange, West Tieback Wall Number 1, 11-SD-163-6.2/9.3 (3.8/5.8), EA No. 11-085780, San Diego, California*, dated May 12, 2010.

11. Southern California Soil & Testing, Inc. (SCS&T No. 0311116), *Structure Foundation Investigation, Friars Road at SR163 Interchange, Bridge No. 57-595, 11-SD-163-RO69-84, EA No. 11-085780, San Diego, California,* dated July 9, 2009.

12. Southern California Soil and Testing, Inc., Structure Foundation Investigation, Friars Road at SR 163 Interchange (Bridge No. 57-0595), dated July 9, 2009.

13. T. Y. Lin International, *Project Plans for 65% Unchecked Details on Friars Road Overcrossing (Widen),* dated September 21, 2012.

14. T. Y. Lin International, *Project Plans for 65% Unchecked Details on East Abutment Wall (Bridge No. 57E-0127),* dated September 21, 2012.

15. T. Y. Lin International, *Project Plans for Final PS&E, East Ground Anchor Wall (Bridge No. 57E0127),* dated September 6, 2013.

4. EXCEPTIONS TO POLICY

Unless otherwise stated in the report, this report was prepared in general conformance with Caltrans' current policy.

5. FIELD INVESTIGATION AND TESTING PROGRAM

The field investigation for this FR was performed by SCS&T on October 8, 2003 (Boring A-03-003) and May 18, 2012 (Boring A-12-044). These exploratory borings were drilled by SCS&T near the proposed East Ground Anchor Wall alignment as depicted on the Site Plan, Figure 2. Table 5 is a summary of the field investigation information including approximate boring locations, surface elevations, and boring depths.

TABLE 5
SUMMARY OF BORINGS

Boring No.	Approximate Boring Location				Boring Depth (feet)
	Location in Structure	Station No. / Alignment	Offset (feet)	Elevation (feet)	
A-03-003	East Ground Anchor Wall	447+20 'FR' Line	185R	59.0	60.0
A-12-044	East Ground Anchor Wall	245+12 'SR 163' Line	176R	76.0	70.0

Two exploratory borings (A-03-003 and A-12-044) were performed by SCS&T to approximate depths of up to 70 feet using a mobile drill rig equipped with 8-inch-diameter, hollow-stem augers.

In-situ testing and sampling during drilling were performed in general conformance with current Caltrans' *Soil and Rock Logging, Classification and Presentation Manual* (2010 Edition). Soil samples were collected from near the ground surface and at approximately 2½- to 5-foot intervals to the total depths explored. Relatively undisturbed samples were obtained by driving a 3-inch outside-diameter (OD), 2.5-inch inside-diameter (ID) split-spoon sampler (Modified California sampler) into the "undisturbed" soil mass with blows from a 140-pound hammer (auto) falling 30 inches. The

sampler was equipped with 6-inch-long by 2½-inch-diameter brass sample tubes to facilitate sample removal and laboratory testing. SPTs were performed by driving a 2-inch OD and a 1.4-inch ID split-spoon SPT sampler 18 inches in general accordance with ASTM D1586. The number of blows required to drive the samplers (blow counts) the last 12 inches of the 18-inch sample drive (or portion thereof) are reported on the LOTB sheets prepared by SCS&T (in Caltrans format), which are included in Appendix A.

6. LABORATORY TESTING PROGRAM

SCS&T performed laboratory tests on samples obtained from the two borings (A-03-003 and A-12-044) associated with the Friars Road at SR 163 Interchange project in general conformance with California Test Methods (CTM) and generally accepted test methods of the American Society for Testing and Materials (ASTM). Pertinent laboratory test results from these nearby borings are presented and were used for design purposes within this FR. SCS&T performed the following laboratory tests:

- In-place dry density and moisture content: ASTM D2937 (CTM 226)
- Grain Size Distribution/Percent Passing No. 200 Sieve: ASTM D422
- pH and Resistivity: CTM 643
- Sulfate Content: CTM 417
- Chloride Content: CTM 422
- Consolidation: ASTM D2435
- Direct Shear: ASTM D3080

In-place dry density and moisture content laboratory test results are shown on the LOTBs presented in Appendix A. All other laboratory test results are presented in Appendix C of this report.

7. SITE GEOLOGY AND SUBSURFACE CONDITIONS

7.1 Topography and Geology

Private and commercial properties occupy the area surrounding the Friars Road/SR 163 Interchange. The general topography of the project location is relatively flat with a gentle slope descending from the northwest to the southeast. Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that an existing cut slope comprised of formational material commonly identified as Stadium Conglomerate is located northwest of the existing OC. The slope ranges between about 30 feet and 100 feet in height at inclinations of between about 1:1 (horizontal:vertical) and 1½:1 (horizontal:vertical). At the location of Friars Road/ SR 163 Interchange, embankments for Friars Road and the interchange ramps are raised above the surrounding area where runoff flows into the existing drainage systems. The existing

drainage systems include swales, drainage inlets, and storm drains that collect offsite and surface runoff. Most of the existing drainage systems at the project site eventually discharge into the San Diego River, which is located near the southern portion of the project. The San Diego River flows from east to west.

A *Regional Geologic Map* is presented as Figure 3. The site is located in the Coastal Plains physiographic province of San Diego County and is underlain by the Tertiary Friars Formation (Tf), Tertiary Stadium Conglomerate (Tst), Quaternary very old paralic deposits (Qvop), alluvium (Qal), and artificial fill (Qaf) as mapped by Kennedy and Tan (2008). The approximate distribution of these materials at the proposed East Ground Anchor Wall, as presented as Figure 4 (Geologic Cross-Section A-A′), is based on SCS&T's surface investigation, LOTBs, and our review of the local geologic and topographic maps.

Existing fill associated with the approach embankments are located on the east and west portions of the site. The thickness of the fill is estimated to be up to approximately 30 feet. Very old paralic deposits cap the mesas/hillsides in the northwestern portion of the project. These deposits consist of well-cemented, poorly sorted, cobble in siltstone and sandstone matrices. We expect that cobbles up to 12 inches in diameter exist within the very old paralic deposits. Quaternary alluvium associated with the San Diego River plain (Mission Valley) and the tributary drainage canyons that connect with the river plain underlie most of the site. The thickness of the alluvium is anticipated to exceed 80 feet toward the southern portion of the site and decreases near the hillsides. The alluvium consists of interbedded layers of sand, gravel, cobble, and clay. We expect that cobbles up to 12 inches in diameter also exist within the Quaternary alluvium. The Stadium Conglomerate is the primary bedrock unit underlying the very old paralic deposits in the north and alluvial deposits in the southern portion of the project. The conglomerate is exposed in cut slopes on the site. The Stadium Conglomerate is comprised of sandy cobble with cross-bedded lenses of medium to coarse sandstone. Boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate. Locally, the Stadium Conglomerate is moderately to well-cemented. The Friars Formation underlies the Stadium Conglomerate within the San Diego River Plain. The Friars Formation is comprised of non-marine and lagoonal sandstone interbedded with layers of siltstone and claystone. The Friars Formation contains zones of varying degrees of cementation. The Stadium Conglomerate and Friars Formation were not observed to outcrop on the site.

7.2 Types of Soil and Rock

Based on the results of the previous investigation performed by SCS&T, the study area is generally underlain by fill and alluvium overlying Stadium Conglomerate. The LOTBs from SCS&T are in general agreement of the types of soil material encountered at the study area. The fill material generally consists of medium dense to dense silty gravel and clayey sand with varying amounts of

gravels and cobbles. Below the fill, alluvium generally consists of medium dense to dense clayey sand, poorly-graded sand, and clayey gravel and stiff sandy lean clay with varying amounts of gravels and cobbles. Below the alluvium, sedimentary rock generally consisting of Stadium Conglomerate. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate.

Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that well-cemented zones should be expected within the formational materials. Construction considerations for the following materials are further described in Section 14 of this report.

7.2.1 Previously Placed Fill and Alluvium

Onsite fill soils were likely placed over existing alluvium during the original construction of the approach embankments for the interchange. The previously placed fill was encountered in both borings (Borings A-03-003 and A-12-044) from the ground surface (approximate Elevations +59 to +76 feet MSL) to approximately 10 to 31 feet below ground surface (approximate Elevations +49 to +45 feet MSL). Alluvium was encountered in borings (Borings A-03-003 and A-12-044) from below the previously placed fill (approximate Elevations +49 to +45 feet MSL) to approximately 41 to 68 feet below ground surface (approximate Elevation +18 to +8 feet MSL). Borings A-12-053 and A-12-054 were drilled near the proposed East Ground Anchor Wall alignment. The fill and alluvium consists primarily of light tan to brown, medium dense to dense, silty gravel, clayey sand, and poorly-graded sand and stiff sandy lean clay with varying amounts of gravels and cobbles. We expect that cobbles up to 12 inches in diameter exist within the fill and alluvium material.

Previously placed fill is located within the proposed East Ground Anchor Wall areas. The alluvium is considered suitable for direct support of the proposed East Ground Anchor Wall structure. The existing fill is not suitable for direct support of the retaining structure foundations. Therefore, possible removals of existing fill may be considered necessary to provide suitable foundation support.

7.2.2 Stadium Conglomerate (Tst)

Stadium Conglomerate consists of sedimentary rock and was encountered in borings conducted by SCS&T as underlying the fill/alluvial deposits. Stadium Conglomerate was encountered in borings (A-03-003 and A-12-044) from beneath the previously placed fill/alluvial deposits from approximately 41 to 68 feet below ground surface (approximate Elevations +18 to +8 feet MSL) to approximately 60 to 70 feet below ground surface (approximate Elevations -1 to +6 feet MSL). Although boulders were not indicated on the LOTBs, boulders up to approximately 24 inches in diameter typically occur within the Stadium Conglomerate and should be anticipated.

The Stadium Conglomerate encountered in the borings consists primarily of massive cobble conglomerate and fine-grained massive sandstone.

7.3 Pertinent Soil Conditions or Geologic Hazards

The following sections discuss other potential geologic hazards evaluated for the project including landslides, embankment failures, ground subsidence, expansive soils, and collapsible soils.

7.3.1 Landslides

Based on previous analyses performed by SCS&T (*Geotechnical Design Report*, July 2009) and the review of the Landslide Hazard Identification Map No. 33 (1995), the project site is located in Landslide Hazard Areas 1, 2, and Subarea 3-1. Area 1 is classified as Least Susceptible to slope instability. Landslides and other features related to slope instability are non-existent to very rare within this area due primarily to lack of steep slopes. Land within Area 1 will probably remain relatively stable unless the topography is radically modified. Area 2 is classified as Marginally Susceptible to slope instability. Area 2 includes gentle to moderate slopes, where slope angles are generally less than 15 degrees. This area includes low-lying bottoms of broad valleys and basins and large elevated surfaces of Pleistocene terrace deposits. Landslides and other slope failures are rare within this area, although slope hazards are possible on some steeper slopes within the area or along its borders. Subarea 3-1 is classified as Generally Susceptible to slope instability and may contain slopes that are at or near their stability limits due to a combination of weak materials and steep slopes. Although most slopes within Area 3-1 do not currently contain landslide deposits, they can be expected to fail, locally, when adversely modified.

No indications of gross, deep-seated, slope failures were noted during SCS&T's geotechnical investigations. The materials comprising the Stadium Conglomerate typically have relatively high shear strengths and are not known to have a potential for deep-seated, gross, slope failure. Thus, the potential for gross, deep-seated, slope failures to affect the proposed OC widening is considered low. However, shallow surficial failures where soil, gravel, and cobble erode from the faces of steep, sparsely vegetated slopes are quite common. The Landslide Hazards Map is presented as Figure 5.

7.3.2 Embankment Failures

No embankment failures were observed during the investigations performed by SCS&T.

7.3.3 Ground Subsidence

Ground subsidence occurs where underlying loose geologic units undergo a densification process. Subsidence can result from the extraction of mineral resources and/or groundwater, as well as the

rapid settlement induced by seismic activity. The potential for ground subsidence is considered low at the site.

7.3.4 Expansive Soils

Expansive soils possess a high swelling or shrinking potential due to change in moisture content. The common materials associated with high expansion potential are clays. The majority of the onsite soil is medium- to coarse-grained with varying amounts of fines, gravels, and cobbles and are identified as relatively no to low plasticity. Proposed foundations will be supported below a depth where significant moisture variation is expected. Thus, the potential for expansive soils to affect the proposed foundations is considered low.

7.3.5 Collapsible Soils

Collapsible soils are unsaturated soils that undergo a large volume change upon saturation, even without increase in external loads. Soils that generally display collapsible potential are porous and have a low dry density. Generally no porous or honeycomb structure was reported previously. Surficial soils described as loose will be removed and recompacted as outlined in the recommendations of this report. Thus, the potential for collapsible soils onsite is considered low.

7.4 Depth to Bedrock

The depth to rock-like materials (Stadium Conglomerate) varies from approximately 41 to 68 feet as illustrated on the LOTB sheets as shown in Appendix A.

7.5 Groundwater

Groundwater was observed in each of the borings (Borings A-03-003 and A-12-044) at approximate elevations ranging from 25.6 to 18 feet MSL (approximately 33 to 58 feet below ground surface) during SCS&T's investigation. The As-Built LOTB encountered groundwater at approximate elevations of 34 and 39 feet MSL. We expect the groundwater to be near the water levels mentioned in the borings at the approximate proposed location of the East Ground Anchor Wall. The presence of groundwater should be considered and incorporated into the design and construction of proposed foundations.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors. Depth to groundwater can also vary significantly due to localized pumping, irrigation practices, and seasonal fluctuations. Therefore, it is possible that groundwater may be higher or lower than the levels observed during our investigation.

8. SCOUR EVALUATION

The site is not located in the vicinity of flowing channels or any large bodies of water, so scour is not expected to affect the proposed improvements.

9. CORROSION EVALUATION

Corrosion parameter testing was performed by SCS&T on four samples obtained from Borings A-03-003 and A-12-044, which were selected at random to represent surficial onsite soil for the proposed Friars Road/SR 163 Interchange project.

According to Caltrans' *Corrosion Guidelines* (Version 1.0, September 2003), a site is considered corrosive to foundation elements if chloride concentration is greater than 0.05 percent (%), or sulfate concentration greater than 0.2%, or the potential of hydrogen (pH) is 5.5 or less. Resistivity, pH, chlorides content, and soluble-sulfate content tests were performed on one sample selected at random to generally evaluate the corrosion potential to subsurface structures. These tests were performed in accordance with CTM. 643, CTM 417, and CTM 422. The results are summarized in Table 9, which indicates that the site need not be considered a corrosive environment in accordance with Caltrans criteria. The results are presented in Appendix B and should be considered for design of underground structures.

TABLE 9
SOIL CORROSION TEST SUMMARY

Boring No. / Sample No.	Sample Depth (feet)	Resistivity (ohm centimeters)	pH	Chloride Content (%)	Sulfate Content (%)
A-03-003/1-3.5	1 to 3.5	2,204	8.1	0.007	0.008
A-03-003/32-34	32 to 34	1,336	7.1	0.006	0.025
A-03-003/45	45	-	7.1	0.023	0.016
A-12-044/1-5	1 to 5	1,750	9.2	0.002	0.003

Note: (-) Represents negligible exposure.

Proposed improvements in contact with the ground should be designed and constructed in accordance with Caltrans' *Standard Specifications* and good construction practices. Geocon does not practice in the field of corrosion engineering. If corrosion sensitive improvements are planned, we recommend that further evaluations by a corrosion engineer be performed to incorporate the necessary precautions to avoid premature corrosion on corrosion sensitive structures in direct contact with the soils.

10. SEISMIC RECOMMENDATIONS

10.1 Faulting

Much of Southern California, including the San Diego County area, is characterized by a series of Quaternary fault zones that typically consist of several individual en echelon faults generally striking in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as active while others are classified as potentially active according to the criteria of the California Geologic Survey. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). Potentially active faults have demonstrated movement during the Pleistocene Epoch (11,000 to 1.6 million years before the present), but no movement during Holocene time.

The fault most likely to have a significant impact on the site is the Newport-Inglewood-Rose Canyon fault (San Diego Section) located approximately 3.5 km southwest of the site.

10.2 Seismic Ground Motion and Design Response Spectrum

Design seismic recommendations including seismic ground motion of the site and the design response spectrum for the bridge widening were developed in accordance with Caltrans' *2009 Seismic Design Procedure*. This procedure is based on current Caltrans' *Seismic Design Criteria (Appendix B), Deterministic PGA Map, ARS Online Report, Geotechnical Services Design Manual,* and USGS probabilistic seismic hazard analysis and tools. Site-specific information used in the procedure included the latitude of 32.771560° and the longitude of -117.161362°.

Based on Caltrans' web-based ARS Online application (V1.0.4) and associated reports, the site is located approximately 3.5 kilometers (km) northeast of Newport-Inglewood-Rose Canyon fault zone, San Diego section (Caltrans Fault ID 224). A portion of the 2007 *Deterministic PGA Map* showing the site and nearby regional faults is presented as Figure 6, Regional Fault Map. Key information for the fault is summarized in Table 10.

TABLE 10
FAULT INFORMATION

Fault Name	Newport-Inglewood-Rose Canyon (San Diego Section)
Fault ID#	224
MMax	7.5
Fault Type	RLSS
Fault Dip	90°
Dip Direction	Vertical
Top of Rupture	0 km
Bottom of Rupture	13 km
R_{RUP}	3.5 km
$Z_{1.0}$	191 m & 241 m*
$Z_{2.5}$	2.0 km

*$Z_{1.0}$ of 191 m for Vs30 of 420 m/sec, 241 m for Vs30 of 380 m/sec.

The site is not located within a deep sedimentary basin in accordance with Caltrans' *2009 Seismic Design Procedure*. Based on the currently available project plans and LOTB sheet prepared by T. Y. Lin International and SCS&T, respectively, the site is underlain by fill soils and/or alluvial soils over sedimentary formational materials (Stadium Conglomerate and Friars Formation). A shear wave velocity in the upper 30 meters (V_{s30}) of approximately 380 meters per second (m/sec) is considered appropriate for the soil profile at Abutment 3 location adjacent to the East Ground Anchor Wall.

Both the deterministic and probabilistic response spectrums of the site were estimated using Caltrans' Deterministic Response Spectrum Spreadsheet, Probabilistic Response Spectrum Spreadsheet (after USGS), 2008 USGS National Seismic Hazard Map, and the ARS Online web tools. The design response spectrum is the upper envelope of the spectral values of deterministic response spectrum and the probabilistic response spectrum, as well as the upper envelop of the results for V_{s30} of 380 m/sec and 420 m/sec in this case. The peak horizontal ground acceleration at the site is estimated as 0.48g. The recommended design response spectrum is shown on the Recommended Design Response Spectrum, Figure 7. The seismic analyses and calculations are presented in Appendix D.

10.3 Liquefaction

Liquefaction is a phenomenon in which loose, saturated, and relatively cohesionless soil deposits located beneath the groundwater table lose strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground accelerations, characteristics of the subsurface soil, in-situ stress conditions, and depth to groundwater.

Based on the City of San Diego Seismic Safety Map (2008) as shown on Figure 8, the proposed OC widening and associated wingwalls is located in Geologic Hazard Category 32. Hazard Category 32 represents areas with a low potential for liquefaction underlain by fluctuating groundwater with minor drainages. Based on the LOTBs prepared by SCS&T, the soil material at the site generally consisted of medium dense to dense silty gravel, poorly-graded sand, clayey sand, and clayey gravel and stiff sandy lean clay with varying amounts of gravels and cobbles overlying moderately hard sedimentary bedrock (Stadium Conglomerate). Groundwater in borings (A-03-003 and A-12-044) was encountered in dense clayey sand and stiff sandy lean clay.

We evaluated the potential for liquefaction at the site using methodology of Youd, *et al.* (2001), in general accordance with California Geologic Survey (CGS) *Special Publication 117A* (CGS, 2008). In accordance with Caltrans guidelines, we used the Maximum Credible Earthquake (MCE) Moment Magnitude of 7.5 and Peak Bedrock Acceleration (PBA) of 0.48g in our analysis. Based on the results of our analysis, the potential for liquefaction and associated impacts at the site is considered low.

10.4 Seismic-induced Settlement

As a result of strong ground motions, seismic-induced settlement may be expected in areas underlain by liquefiable soils, unconsolidated alluvial deposits, and/or loose granular soils. The potential for seismic-induced settlement at the site is considered very low due to the presence of primarily medium dense to very dense fill/alluvium over sedimentary bedrock (Stadium Conglomerate and Friars Formation) and the lack of liquefiable soil.

10.5 Tsunami

Tsunamis are large sea waves caused by submarine earthquakes, landslides, or volcanic eruptions. The potential of tsunamis to occur at the site is considered to be very low due to the relatively large distance from the coastline to the site.

10.6 Slope Stability

Planned earthwork will include fill slopes along portions of the approach embankments. Assuming that fill materials meet Caltrans' specifications for structure backfill, 2H:1V (horizontal to vertical) fill slopes should have an adequate factor of safety against deep-seated and shallow failures under static and seismic loading.

11. AS-BUILT FOUNDATION DATA

The existing Friars Road OC is a two span, cast-in-place concrete box girder structure supported on four column bents and seat type abutments. The abutments and bents are supported by driven steel H-piles (HP 10x57).

The existing OC extends approximately 390 linear feet with a typical width of approximately 114 feet. The relevant as-built data available to Geocon are listed below:

1. *As-built Plan, Earthquake Retrofit Project No. 272, Friars Road Overcrossing, Bridge No. 57-0595,* dated July 29, 1996.

2. *As-Built Plan, General Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 1 of 15,* dated December 2, 1968.

3. *As-Built Plan, Foundation Plan, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 3 of 15,* dated December 2, 1968.

4. *As-Built Plan, Log of Test Borings, Friars Road Overcrossing, Bridge No. 57-0595, Sheet 15 of 15,* dated December 2, 1968.

Based on the available original as-built data, the abutments and bent for the existing OC structure are supported by 65-ton capacity driven steel HP 10x57 piles with average tip elevations of 19.8 feet (Abutment 1), 15.1 feet (Bent 2), and 14.4 feet (Abutment 3) MSL. Approximate pile lengths at Abutment 1 range from approximately 16.5 to 28 feet. Approximate pile lengths at Bent 2 range from approximately 21 to 23.5 feet. Approximate pile lengths at Abutment 3 range from approximately, and 40.5 to 47 feet.

The existing OC structure was seismically retrofitted in 1996 that consisted of increasing the size of all existing pile caps at Bent 2 support location supported on higher capacity 75-ton driven steel HP 10x57 piles with a specified tip elevation of 10 feet MSL. No other support locations required seismic retrofit modifications.

All elevations for the existing structures used in this report are based on the datum of the referenced as-built plans.

Groundwater was encountered during the original explorations at approximate elevations of 34 and 39 feet MSL. The referenced as-built plans including LOTB sheets are included in Appendix B.

12. FOUNDATION RECOMMENDATIONS

12.1 Ground Anchor Wall

12.1.1 Description

The SR 163 widening along the NB lanes on the east side beneath the existing Friars Road OC will require a ground anchor retaining wall and Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls on either end. Specifically, the proposed ground anchor retaining wall will be approximately 190 feet long with a proposed maximum height of approximately 17 feet. Bottom of wall elevations will range from approximately 42.45 feet to 48.80 feet MSL from south to north, respectively. The ground anchor retaining wall is proposed to have three vertical rows of ground anchors with maximum horizontal spacing of approximately 10¼ to 14 feet at a proposed inclination of 10 degrees. The face of the proposed ground anchor retaining wall will be approximately 13½ to 16¼ feet away from the existing Friars Road OC east abutment (Abutment 3) in order to accommodate the additional lanes for SR 163 NB direction. Geotechnical recommendations regarding the proposed Caltrans Standard Plan Type 1 (Case 2) cantilever type retaining walls are presented in Section 12.2 of this report.

Borings A-03-003 and A-12-044 were drilled near the proposed ground anchor retaining wall alignment using a truck-mounted drill rig. The subsurface conditions generally consisted of previously placed embankment fill ranging from approximately 10 to 31 feet in thickness overlying alluvium and/or sedimentary rock (Stadium Conglomerate). The fill material generally consisted of medium dense to dense silty gravels and clayey sand with varying amounts of gravels and cobbles. Below the fill, alluvium generally consisting of medium dense to dense clayey sand, poorly-graded sand, and clayey gravel and stiff sandy lean clay with varying amounts of gravels and cobbles. Groundwater was encountered in both borings at approximate Elevations of 25.6 feet (Boring A-03-003) and 18 feet (Boring A-12-044) MSL. Below the alluvium, sedimentary rock generally consisting of Stadium Conglomerate. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate.

12.1.2 Design Parameters

The designer of the ground anchor retaining wall should verify locations of existing piles associated with the east Abutment (Abutment 3) in order to ensure the proposed ground anchor locations are not in conflict with the existing structure.

Ground anchor retaining walls consist of installing ground anchors into slopes or excavations in a top-down construction sequence. Lagging or shotcrete facing should keep pace with excavation and anchor construction. Generally, the excavation should not be advanced deeper than 5 feet below the bottom of lagging or facing at any time. These unsupported gaps of up to 5 feet should only be

allowed to stand for short periods of time (two days or less) in order to reduce the potential for soil sloughing and caving. Test sections may be completed during construction to observe if deeper cuts will stand. Based on the proposed ground anchor wall plans prepared by T.Y. Lin International, we understand that the wall will be constructed in three lifts with heights, top to bottom, of 5, 5, and 5 feet, respectively. We performed a stability analysis for the temporary excavation conditions during construction of each lift phase. The results of the stability analysis indicate global stability for each lift phase (Factor of Safety > 1.0); however, the granular soils could be prone to minor raveling and caving.

The proposed ground anchor retaining wall should have a minimum embedment depth of 3 feet into competent soil of the base of the wall as per Load and Resistance Factor Design (LRFD) *Bridge Design Specifications (BDS) C11.9.5.2.*

The proposed ground anchor retaining wall should be designed using the following soil properties, equivalent fluid pressures, allowable friction coefficient, and earthquake surcharge:

- Total Unit Weight of Soil (γ_{tot}) = 120 pounds per cubic foot
- Internal Angle of Friction (Φ) = 32.5 degrees
- Cohesion = 200 pounds per square foot
- Active Equivalent Fluid Pressure = 36 pounds per cubic foot
- Passive Equivalent Fluid Pressure = 300 pounds per cubic foot
- At-rest Equivalent Fluid Pressure = 55 pounds per cubic foot
- Allowable Friction Coefficient = 0.40
- Earthquake Surcharge = 0.24* γ_{tot}*H (where H is the design height of the ground anchor wall)

For the ground anchor retaining wall, we recommend using the apparent earth pressure distribution provided on *LRFD BDS Figure 3.11.5.7.1-1(b) Apparent Earth Pressure Distributions for Anchored Walls Constructed from the Top Down in Cohesionless Soils for Walls with Multiple Levels of Ground Anchors.*

Anchor pullout capacity is influenced by soil conditions, method of anchor hole advancement, hole diameter, bonded length, grout type, and grouting pressure. The contractor must determine the ultimate anchor bond stress based on the selected construction method.

The minimum horizontal spacing of anchors should be the larger of three times the diameter of the bonded zone or 5 feet as per LRFD *BDS Section 11.9.4.2*. If smaller spacings are required to develop the required load, consideration may be given to differing anchor inclinations between alternating anchors. Based on the wall geometry and location of the existing Abutment 3 piles, we recommend a

minimum ground anchor unbonded length of 25 feet. The contractor must determine the minimum bonded length of the anchor based on the selected construction method as stated on the project plans.

Corrosion protection of the ground anchors is recommended since it will be a permanent structure. Corrosion protection shall be applied in accordance with the provisions of LRFD *Bridge Construction Specifications*, Section 6 *Ground Anchors*.

Settlement for the ground anchor wall can cause reduction in anchor loads, and therefore should be considered in design. A settlement profile behind anchored walls for cohesionless soil is presented in LRFD *BDS Figure C11.9.3.1-1*. The majority of the settlement is expected to be completed during construction.

The ground anchor retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces.

12.1.3 Ground Anchor Testing Program

Normally, ground anchors are contractor-designed and installed, and there are numerous construction methods available. Anchor capacity is a function of construction method, depth of anchor, batter, diameter of the bonded section, and the length of the bonded section. Experience has shown that the use of pressure grouting during formation of the bonded portion of the anchor will increase the soil-grout bond stress. A pressure grouting tube should be installed during the construction of the anchor. Post grouting should be performed if adequate capacity cannot be obtained by other construction methods. Non-shrink grout with a minimum 28-day compressive strength of 4,000 psi should be used.

Two types of load tests should be performed on the ground anchors. Load testing should be performed in accordance with the guidelines of the Federal Highway Administration (FHWA 1999) or approved equivalent procedures. Performance tests are performed on a limited number of anchors to confirm the contractor's design, installation methods, and capacity. Proof tests are typically performed on the remaining anchors to verify adequate capacity.

Following a successful load test, we recommend that anchors be locked off at 80% of the anchor's allowable working load. Anchor test acceptance criteria should be established in the project plans and specifications. Acceptance criteria should include minimum and maximum elongation (displacement) and maximum allowable creep movement. Anchor stressing/testing should be conducted only after sufficient curing and strength has developed within the anchor grout. Anchors that fail to meet project specified test criteria should be locked off at an appropriate load and additional anchors should be constructed. Appropriate corrosion protection should be provided for the anchors.

12.2 Type 1 (Case 2) Retaining Walls

The proposed cantilever type retaining walls will connect at both the north and south ends of the ground anchor retaining wall and extend around the Abutment 3 embankment. The cantilever type retaining walls of the East Ground Anchor Wall will consist of a Caltrans Standard Type 1 Case 2 retaining wall (Caltrans Standard Plan RSP B3-1B) supported on a spread footing. The proposed Type 1 retaining wall along the north and south ends of the ground anchor retaining wall will be approximately 57.75 feet and 91.67 feet in length, respectively, with a maximum height of approximately 16 feet. Bottom of footing elevations range from approximately 40.73 feet to 58.23 feet MSL.

Borings A-03-003 and A-12-044 were drilled near the Type 1 retaining wall alignment using a truck-mounted drill rig. The subsurface conditions generally consisted of previously placed embankment fill ranging from approximately 10 to 31 feet in thickness overlying alluvium and sedimentary rock (Stadium Conglomerate). The fill material generally consisted of medium dense to dense silty gravels and clayey sand with varying amounts of gravels and cobbles. Below the fill, alluvium generally consisting of medium dense to dense clayey sand, poorly-graded sand, and clayey gravel and stiff sandy lean clay with varying amounts of gravels and cobbles. Groundwater was encountered in both borings at approximate Elevations of 25.6 feet (Boring A-03-003) and 18 feet (Boring A-12-044) MSL. Below the alluvium, sedimentary rock generally consisting of Stadium Conglomerate. Stadium Conglomerate generally consists of moderately hard massive cobble conglomerate. The Type 1 retaining walls bottom of footings will be located within existing fill or alluvium.

12.2.1 Foundation Subgrade

The alluvium is considered suitable for direct support of the proposed Type 1 retaining walls. The existing fill is not suitable for direct support of the Type 1 retaining wall foundations. Therefore, possible removals of existing fill may be necessary to provide suitable foundation support. If existing fill is encountered, we recommend that the wing wall footings be supported on a minimum of 2 feet of structural fill. This will require remedial grading in the form of removal and re-compaction of at least 2 feet below footings. The fill below the footings and the outer portion of the embankment fill should consist of structural fill compacted to a minimum of 95 percent of the maximum density.

12.2.2 Design Parameters

The proposed Caltrans Standard Type 1 (Case 2) cantilever type retaining walls may be supported on a conventional spread footing (as detailed on Caltrans Standard Plan RSP B3-1B) founded on undisturbed alluvium or structural fill as recommended herein.

Retaining walls capable of rotating 0.001 radians can be designed using active earth pressures. Walls supporting level backfill should be designed for an active equivalent fluid pressure of 36 pcf in accordance with Caltrans' *Bridge Design Specifications* 3.20.1. Walls supporting 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent of 2 feet of fill soil (unit weight of 120 pcf) should be added. Soil placed for retaining wall backfill should meet the requirements outlined in Section 12.3 of this report.

Resistance to lateral loads will be provided by friction along the base of the wall foundation and/or by passive earth pressure against the front face of the footing. The allowable passive pressure should be taken as 300 pcf assuming that a horizontal surface extends at least 5 feet or three times the depth of the footing, whichever is deeper; beyond the face of the footing for walls. An allowable coefficient of friction of 0.40 is recommended for footings on properly compacted fill or relatively undisturbed alluvium. This friction coefficient may be combined with the allowable passive earth pressure when determining resistance to lateral loads. The upper 12 inches of soil in front of the wall should not be relied on for passive resistance unless the ground surface is covered with asphalt or concrete.

An allowable bearing capacity of 3,000 pounds per square foot (psf) can be used provided that wall heights do not exceed 20 feet and the footings bear entirely in compacted fill or relatively undisturbed alluvium. The total settlement of wall footings in structural fill imposing the maximum toe pressure of 2,100 psf is not expected to exceed one inch. Differential settlement is expected to be 50 percent of the total settlement. The majority of the settlement is expected to be completed during construction.

All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces. The drainage system should consist of weepholes or backdrains. The above recommendations assume a properly compacted granular backfill material with no hydrostatic forces. If conditions different than those described are anticipated, or if specific drainage details are desired, Geocon should be contacted for additional recommendations.

12.3 Wall Backfill

All grading should be performed in conformance with *Sections 6-3, 19-3, 19-5*, and *19-6* of the Caltrans Standard Specifications or equivalent. Backfill placed behind retaining walls should have a very low- to low-expansion potential. The extent and placement of the low-expansive soils should conform to Caltrans Standard Specifications 19-5.03. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted.

All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216. All compaction on the project should be based on this test method. Backfill should be compacted in horizontal lifts not exceeding 8 inches (loose thickness) and brought to final design elevations. Each lift should be moisture-conditioned and compacted. Backfill should be benched into existing embankment fill as the fill is placed. Benches should extend at least 3 feet laterally into the existing embankment fill.

12.3.1 Additional Considerations

Consideration should be given to the use of surface treatments to minimize surficial erosion until adequate erosion-resistant vegetation can become established. All roadway drainage should be directed to appropriate collection and discharge facilities to prevent run-off from flowing over the tops of slopes.

13. GENERAL NOTES TO DESIGNER

This report is prepared based on the currently available project information including the proposed structures and foundations described herein. Geocon must be contacted for review and possible revised recommendations if the proposed structures and foundations are changed.

14. CONSTRUCTION CONSIDERATIONS

Areas to be developed should be cleared and stripped of obstructions, trees, bushes, grass, roots, and the upper few inches of soil containing organic debris. Soils/organics removed by stripping can be transported offsite or stockpiled for use in landscaping. Existing drainage and utility lines or other existing subsurface structures that are not to be utilized, if any, should be removed, destroyed or abandoned in compliance with applicable regulations.

Relevant specifications and important design criteria that were used in the geotechnical design of the foundations include:

- *Sections 6-3, 19-3, 19-5,* and *19-6* of Caltrans' *Standard Specifications*. Backfill should have an Expansion Index (EI) no greater than 50 and a Sand Equivalent of 20 or greater. Ponding or jetting of backfill should not be permitted. All structural backfill should be compacted to 95 percent of the maximum density as determined by CTM 216.

- Remedial grading should be performed to provide a relatively uniform soil mat beneath the footing and no oversized rock (with a maximum dimension of 12 inches or greater) within 5 feet of the footing.

- Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 36 pcf in accordance with Caltrans' *Bridge Design Specifications* 3.20.1. Walls supporting 2H:1V backfill should be designed for an equivalent fluid pressure of 50 pcf.

- All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces.

Excavation and trench depths greater than 5 feet will need to be sloped and shored in accordance with Cal-OSHA guidelines for the safety and stability of adjacent existing improvements. Existing fill and alluvium, if encountered, can be considered as OSHA Type B soil for excavation purposes (Type C where seepage is freely flowing). For temporary construction purposes, a slope ratio of 1H:1V may be used for cuts in existing fill or alluvium not exceeding 20 feet to a depth five feet above the water table. Formational materials can likely be considered a Type A soil with a slope ratio of ¾H:1V. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing improvement should be shored in accordance with applicable OSHA codes and regulations.

Temporary excavations should be in compliance with applicable governing agency regulations. The Contractor should also execute a monitoring program for structures in proximity to deep excavations so that appropriate modifications to the excavation/shoring system can be implemented to minimize the surface deflection or structure damage in a timely manner, if warranted.

Excavation of the onsite materials can be accomplished using conventional heavy-duty excavation equipment. Excavation difficulty should be expected within the very dense and hard formational materials. Heavy ripping will generate oversize materials not suitable for backfill.

The existing bridge footings and structures should be protected and monitored during proposed bridge widening and site improvements.

Foundation excavations should be observed by a representative of Geocon prior to the placement of reinforcing steel and concrete. If unanticipated soil conditions are encountered, foundation modifications may be required.

Based on previous analyses performed by SCS&T (*Geotechnical Design Report,* July 2009), it was stated that subsurface well-cemented zones should be expected within the formational materials. These areas will require rock-breaking equipment. In addition, buried hard rock requiring special handling should be anticipated. Contract documents should specify that the contractor mobilize equipment capable of excavating, breaking, and drilling hard rock.

15. DISCLAIMER AND CONTACT INFORMATION

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by Dokken Engineering and T. Y. Lin International. If any changes are made during final project design, Geocon should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Mr. Joe Vettel, 858-558-6900, at the San Diego Office of Geocon.

16. CLOSURE

16.1 Foundation and Grading Plan Review

Geocon should review the grading plans and foundation plans prior to final design submittal to evaluate whether additional analysis and/or recommendations are required.

16.2 Limitations and Uniformity of Conditions

The recommendations of this report pertain only to the site investigated and are based upon the assumption that soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon.

This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years. Our professional services were performed in accordance with generally acceptable geotechnical engineering principles and practices in the site area at this time. No warranty is provided, express or implied.

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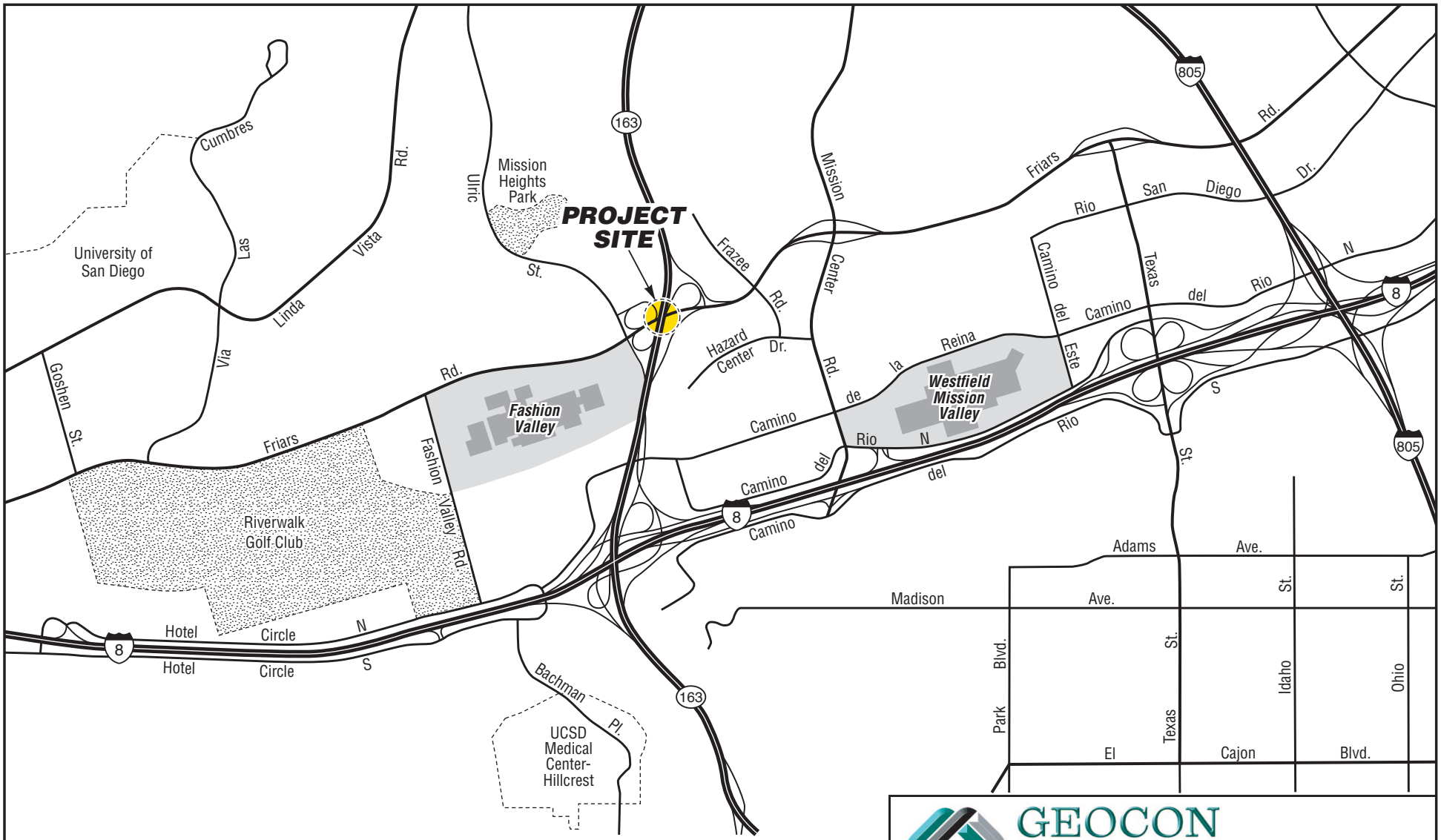

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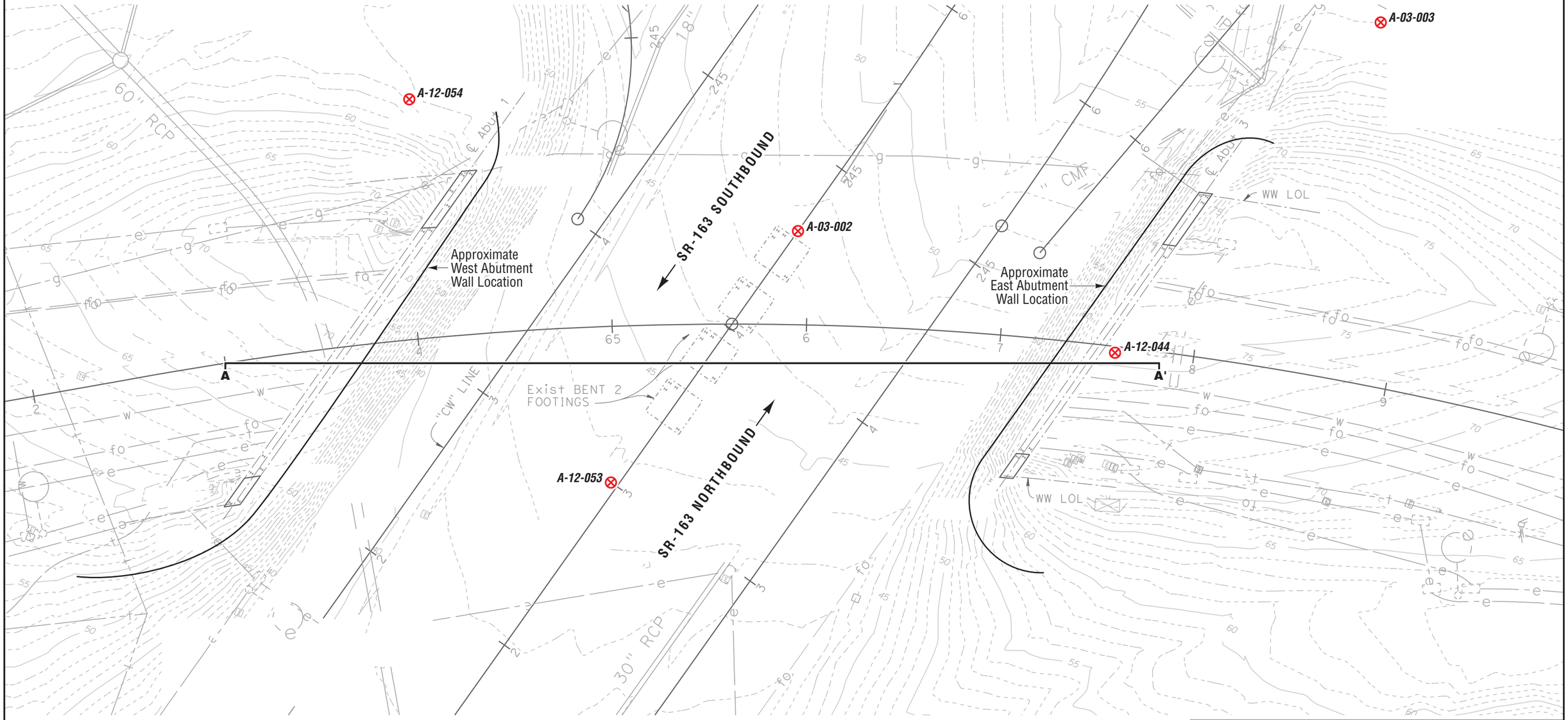
East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

VICINITY MAP

G1447-52-01	August 2014	Figure 1



LEGEND:

A-12-053 ⊗ Approximate Boring Location

A — A' Approximate Cross-Section Location

0 50

Scale in Feet

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

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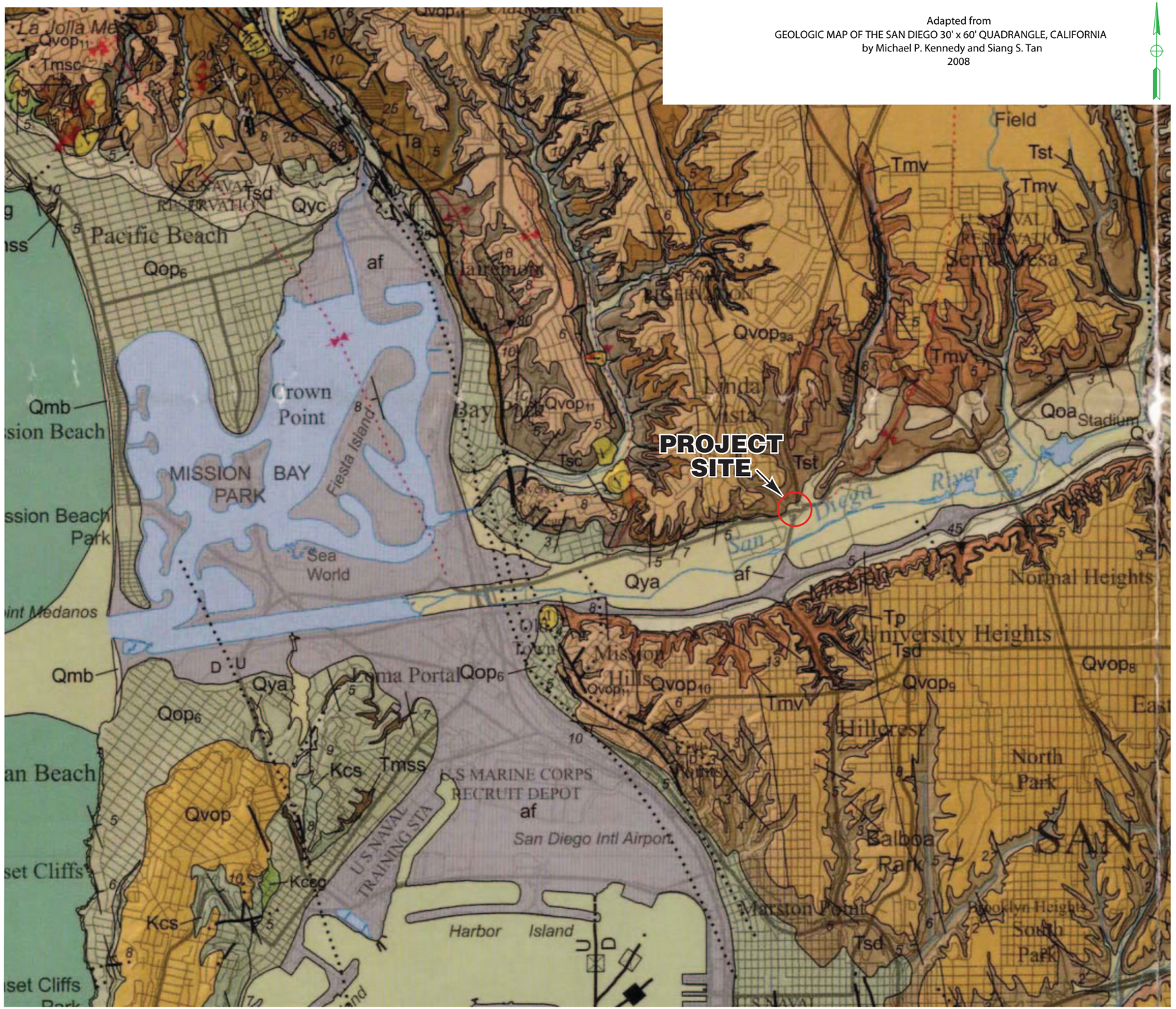
East Ground Anchor Wall

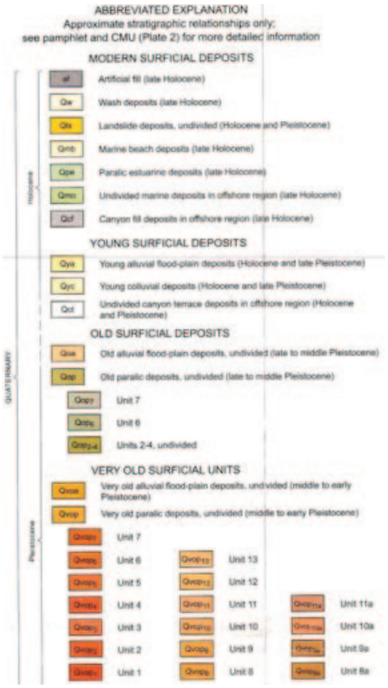
Friars Road/SR-163 Interchange Project
San Diego, California

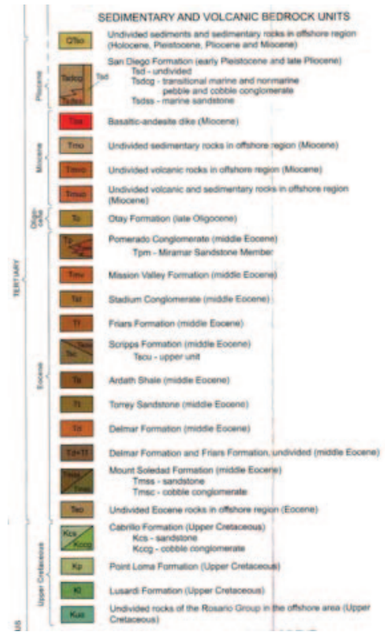
SITE PLAN

G1447-52-01	August 2014	Figure 2

Adapted from
GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA
by Michael P. Kennedy and Siang S. Tan
2008







NO SCALE

Ref: Southern California Soil & Testing, Inc., 6/28/12

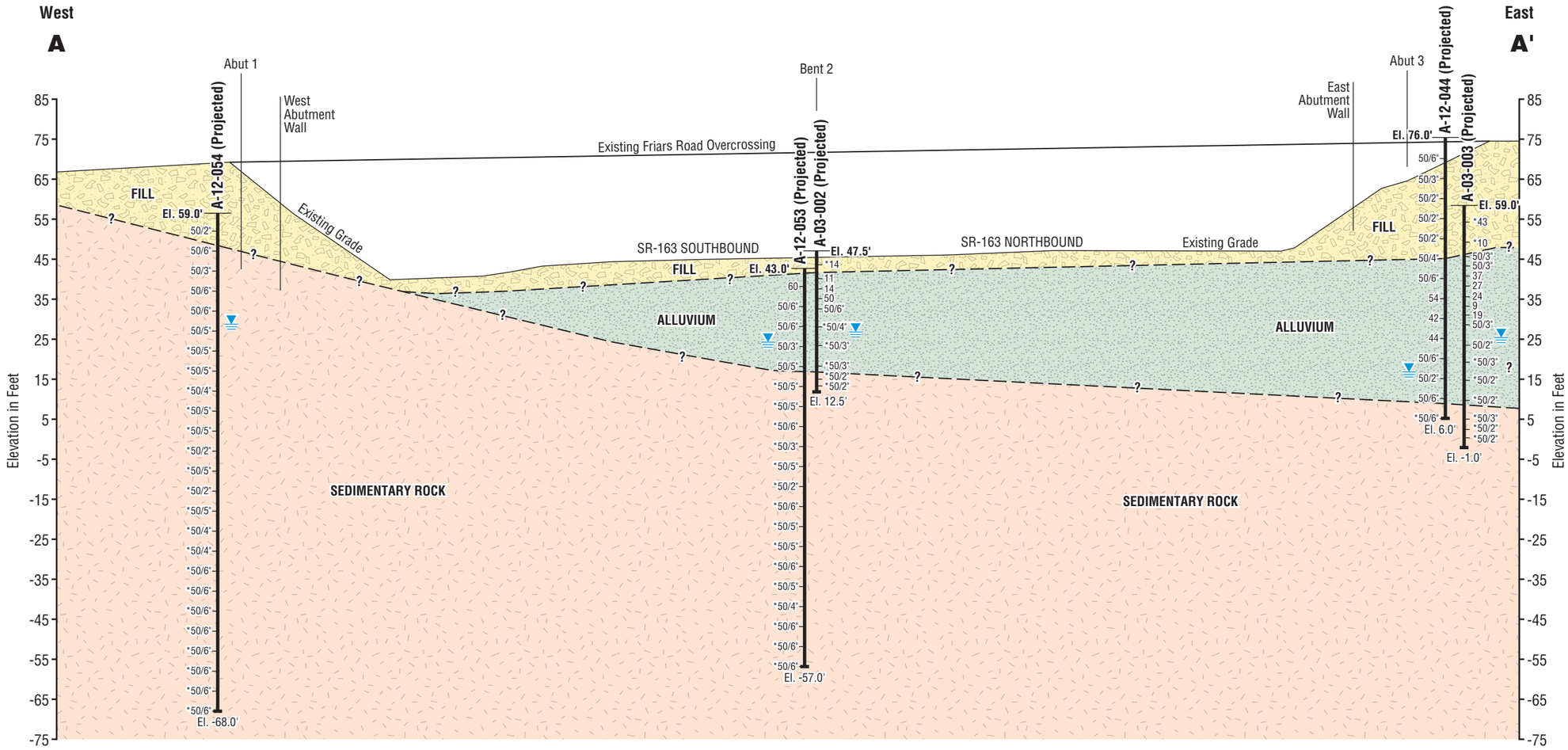
GEOCON INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL GEOLOGIC MAP

G1447-52-01	August 2014	Figure 3



LEGEND:

A-03-002 (Projected) — Approximate Exploratory Boring Location

50/4" — Field Blow Count (California Modified Sampler/*SPT Sampler)

Groundwater Observed in Boring

? — — — Approximate Geologic Contact (Queried Where Uncertain)

EXISTING FILL

ALLUVIUM

SEDIMENTARY ROCK
(Stadium Conglomerate & Friars Formation - Interbedded Sandstone & Claystone)

Vertical Scale in Feet: 30, 0

Horizontal Scale in Feet: 0, 40

Ref: *Project Plans for Friars Road OC (Widen)*, prepared by T.Y. Lin International, dated September 9, 2012

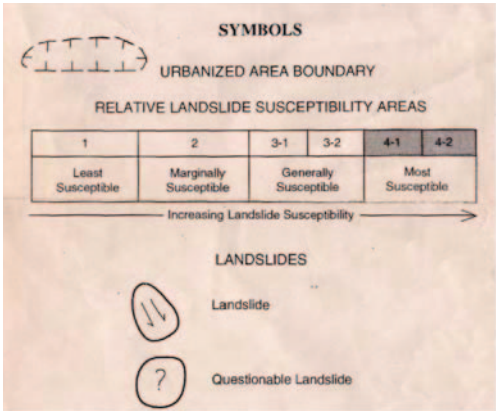
GEOCON INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

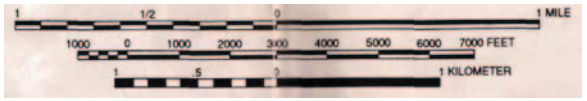
Friars Road/SR-163 Interchange Project
San Diego, California

GEOLOGIC CROSS-SECTION A – A'

G1447-52-01	August 2014	Figure 4



LANDSLIDE HAZARDS IN THE NORTHERN PART OF
THE SAN DIEGO METRPOLITAN AREA,
SAN DIEGO COUNTY, CALIFORNIA
By Siang S. Tan
1995
LA JOLLA QUADRANGLE



Ref: Southern California Soil & Testing, Inc., 6/29/12

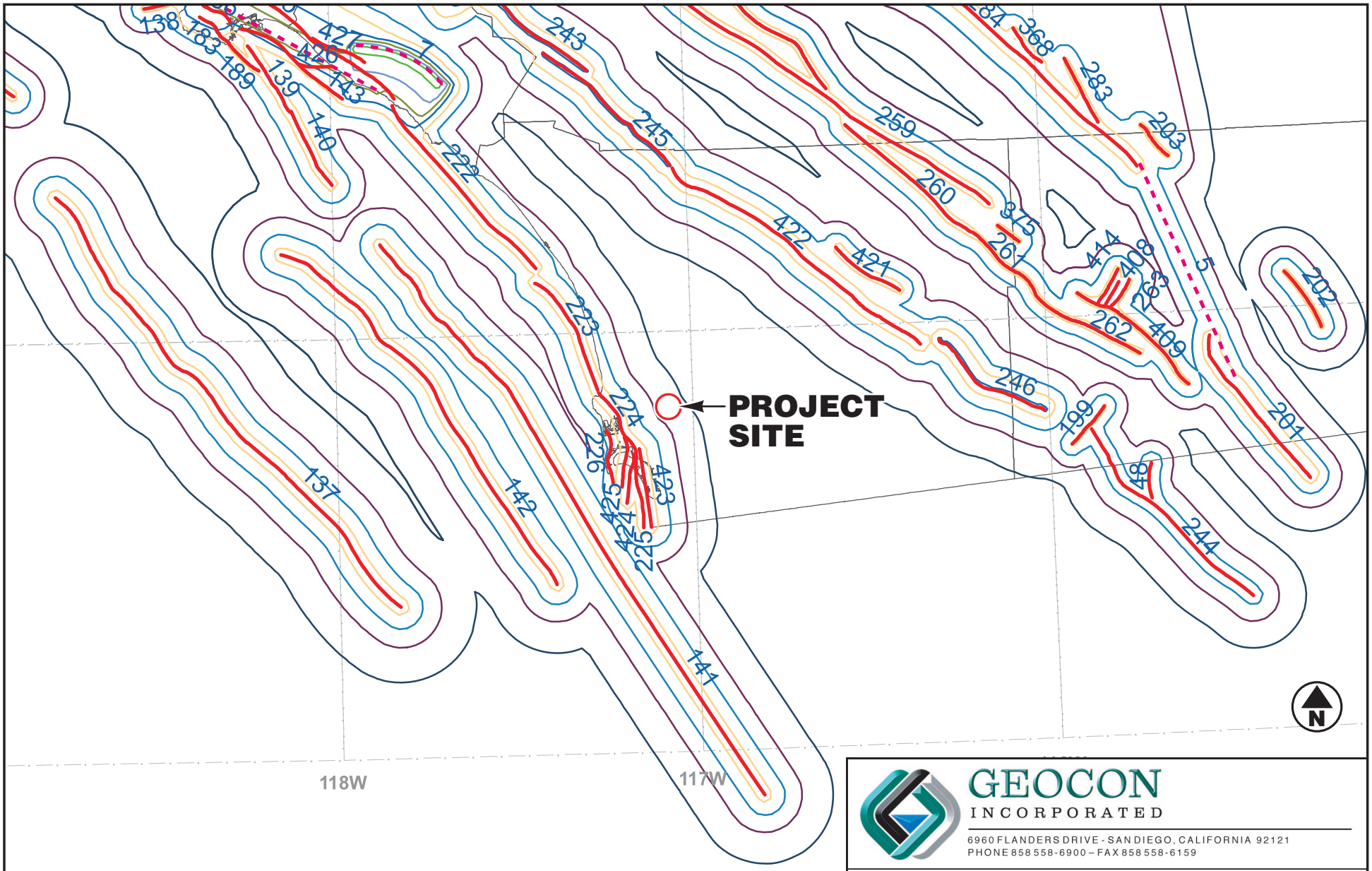
GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

LANDSLIDE HAZARD MAP

G1447-52-01	August 2014	Figure 5



Ref: 2007 Caltrans Deterministic PGA Map, September 2007

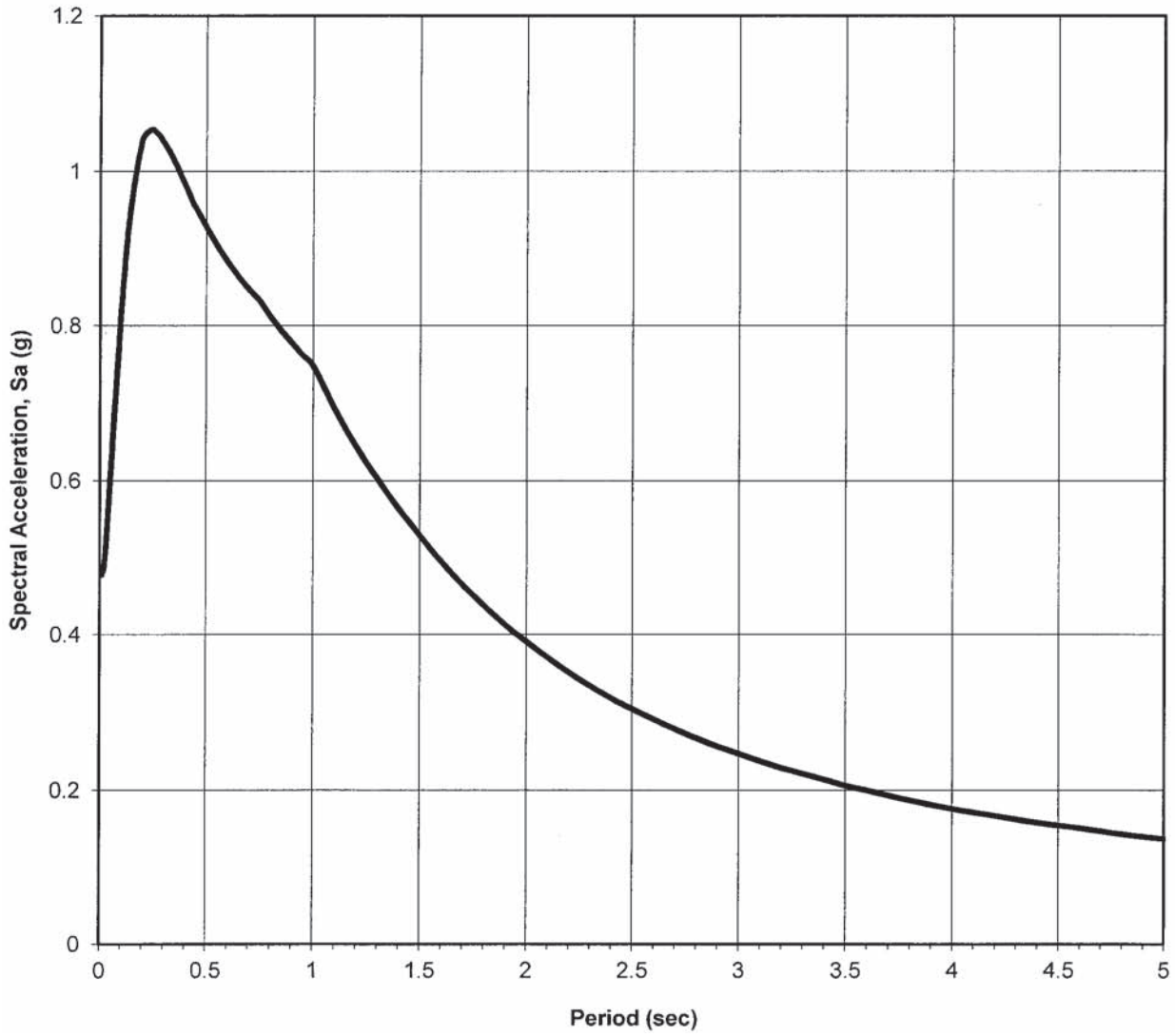
GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

REGIONAL FAULT MAP

G1447-52-01	August 2014	Figure 6



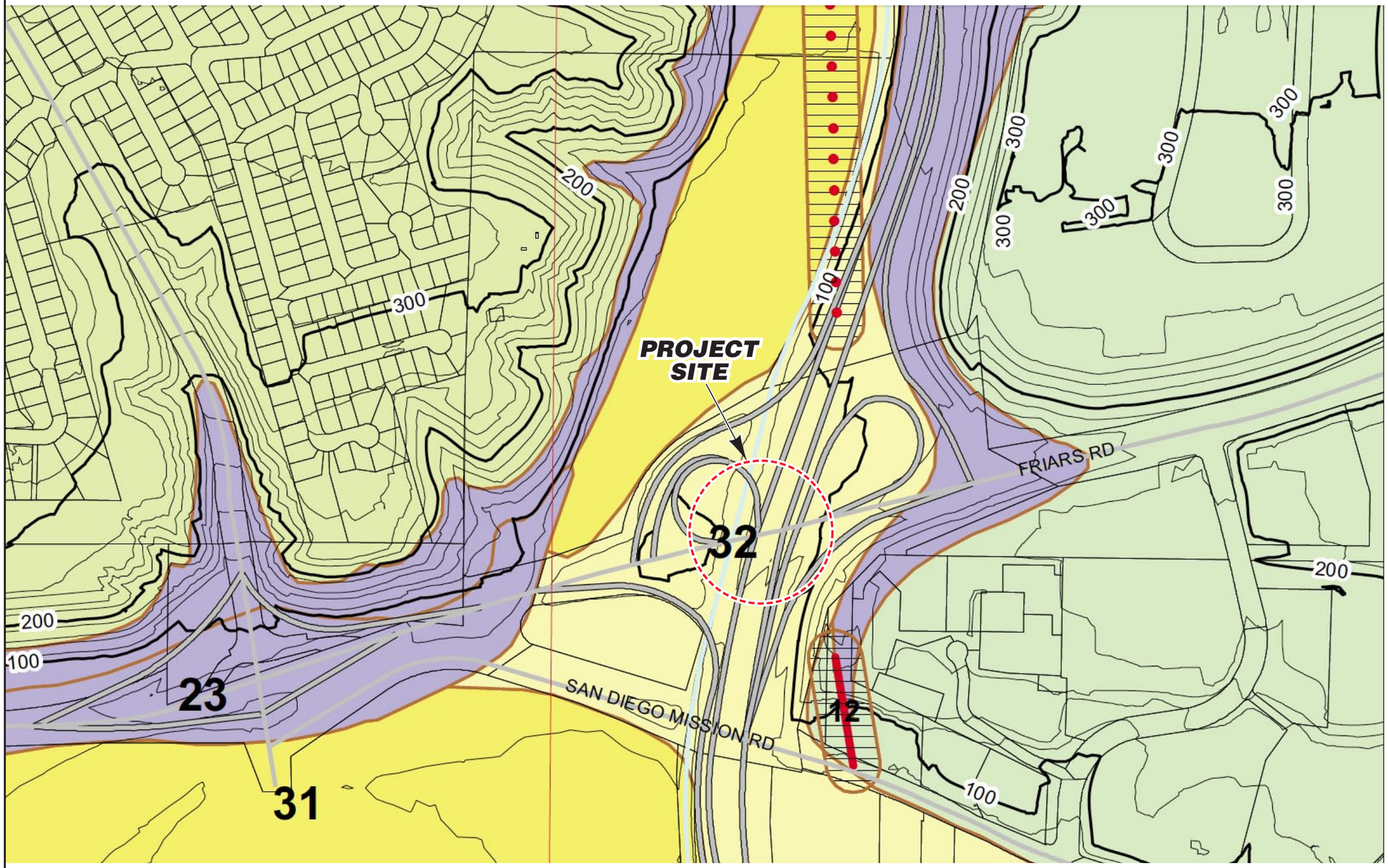
RECOMMENDED DESIGN RESPONSE SPECTRUM

GEOCON
INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

G1447-52-01	August 2014	Figure 7



Geologic Hazard Categories

FAULT ZONES

- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES

- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS

- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION

- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS

- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN

- 51 Level mesas -- underlain by terrace deposits and bedrock nomimal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

N

0 1000

Scale in Feet

Ref: City of San Diego, *Seismic Safety Study Geologic Hazards and Faults*, 4/3/08

GEOCON INCORPORATED
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121
PHONE 858 558-6900 – FAX 858 558-6159

East Ground Anchor Wall

Friars Road/SR-163 Interchange Project
San Diego, California

City of San Diego Seismic Safety Map

G1447-52-01	August 2014	Figure 8

APPENDIX A

APPENDIX A

LOG OF TEST BORINGS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
EAST GROUND ANCHOR WALL
(BRIDGE NO. 57E0127)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

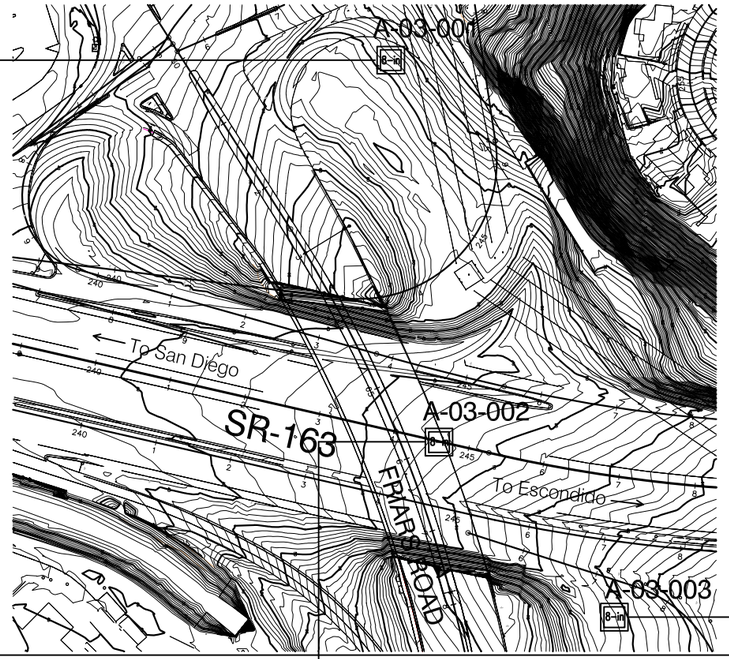
REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

PLANS APPROVAL DATE

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

CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

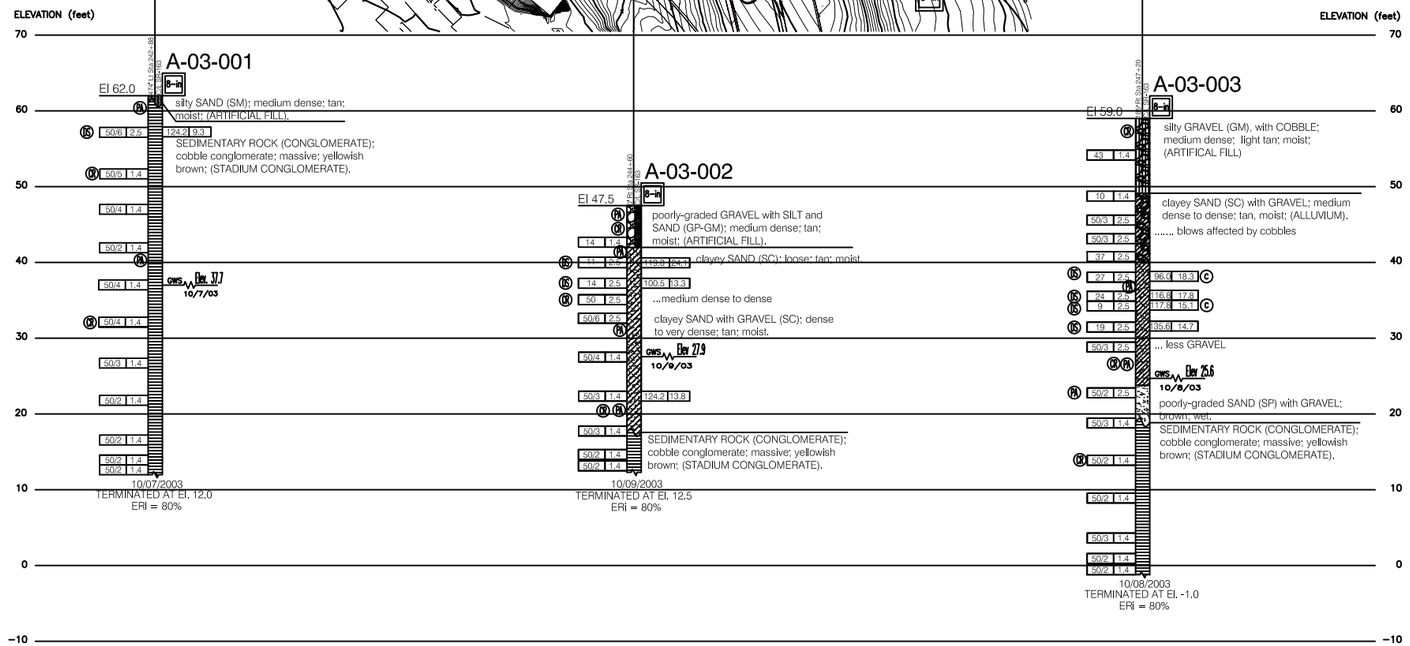
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120



PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

X DESIGN OVERSIGHT	DRAWN BY	Andrew K. Neuhaus, PG	Garrett B. Fountain, GE FIELD INVESTIGATION BY:		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57E0127
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 10/07/03 – 10/09/03				POST MILES 4.4

EAST GROUND ANCHOR WALL
LOG OF TEST BORINGS (1 of 2)

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
X				12	13

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	163	4.1/4.9		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER THOMAS B. CANADY No. 50057 Exp. 6/30/17 STATE OF CALIFORNIA

PLANS APPROVAL DATE

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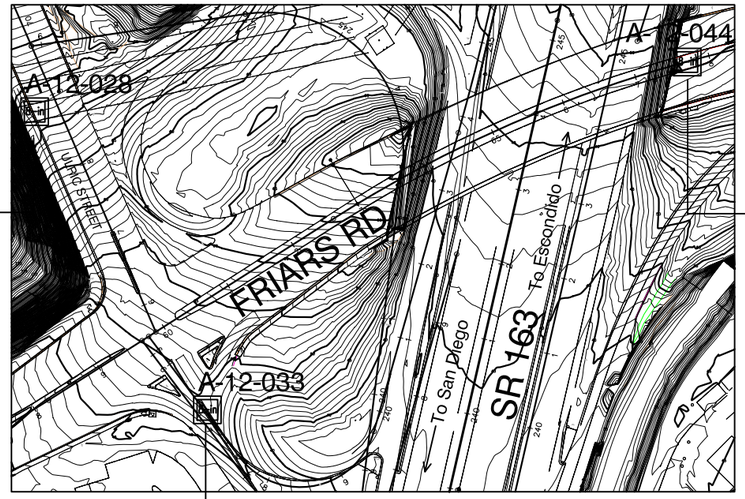
CITY OF SAN DIEGO—PUBLIC WORKS DEPARTMENT
525 B Street, Suite 750
San Diego, CA 92101

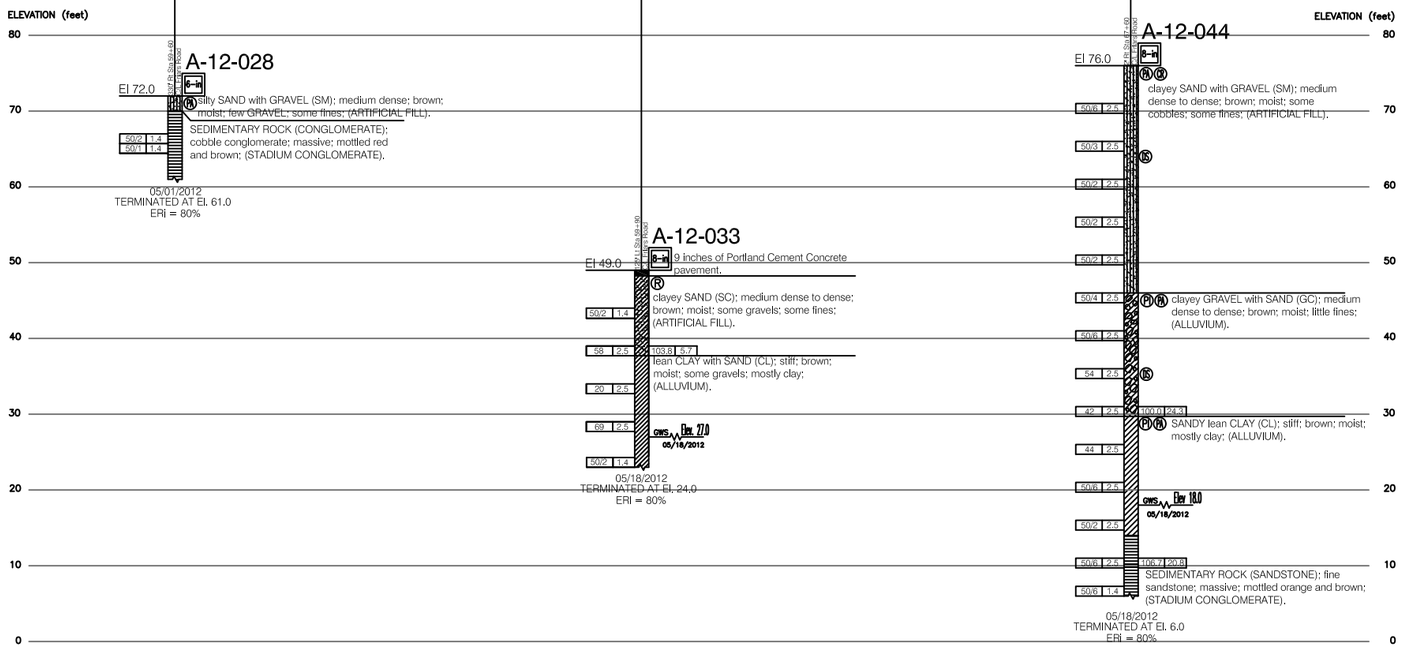
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120



PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

X DESIGN OVERSIGHT	DRAWN BY	Andrew K. Neuhaus, PG	Ray N. Butz, PG FIELD INVESTIGATION BY:		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Roya Golchoobian PROJECT ENGINEER	BRIDGE NO. 57E0127
X SIGN OFF DATE	CHECKED BY	Garrett B. Fountain, GE	DATE: 05/01/12 – 05/18/12				POST MILES 4.4

EAST GROUND ANCHOR WALL
LOG OF TEST BORINGS (2 of 2)

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: CONTRACT NO.: 11-085781

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
X				13	13

FILE => $REQUEST

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

APPENDIX B

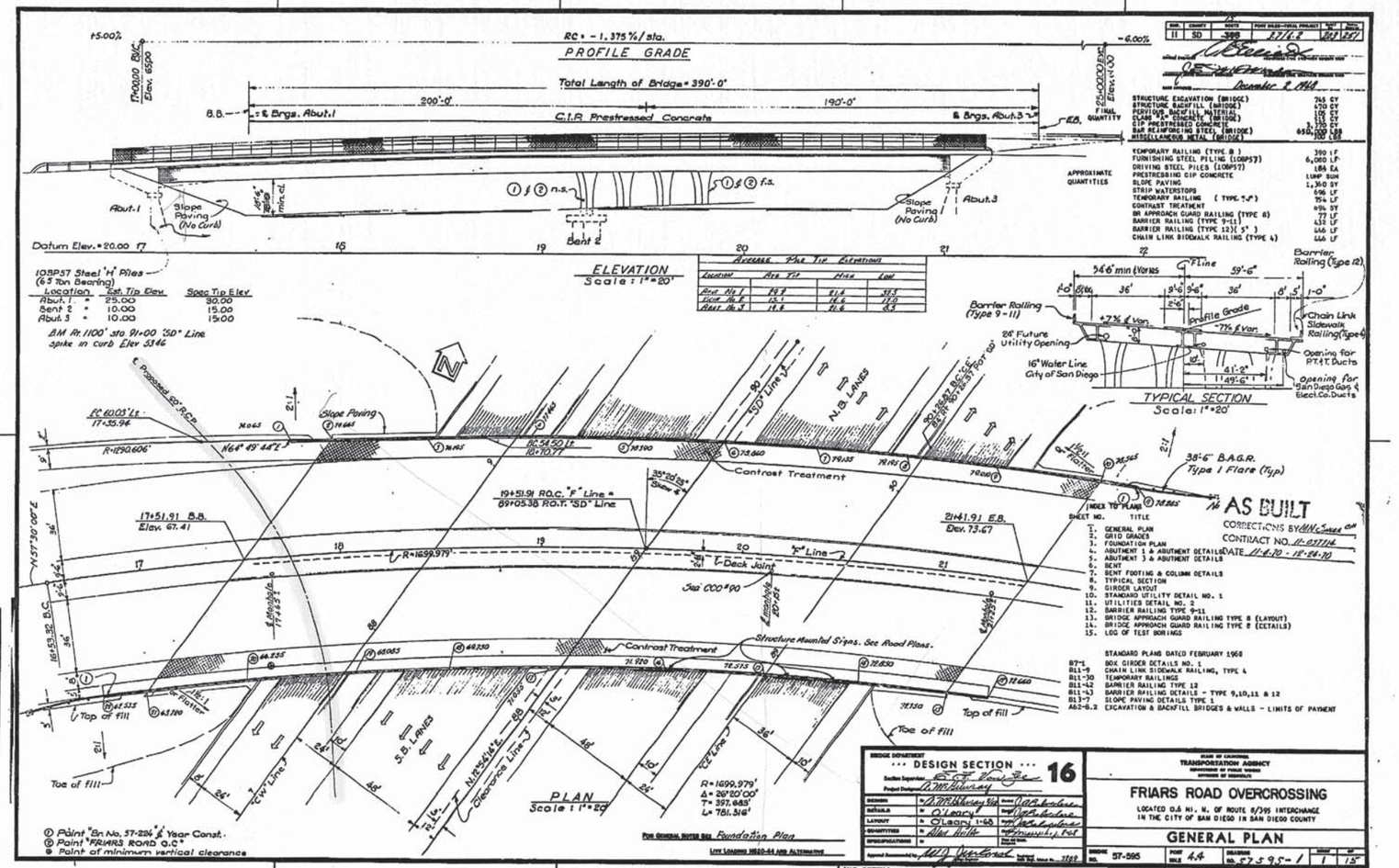
APPENDIX B

AS-BUILT PLANS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
EAST GROUND ANCHOR WALL
(BRIDGE NO. 57E0127)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



Location	Est. Tip Elev.	Spec Tip Elev
Abut. 1	25.00	30.00
Bent 2	10.00	15.00
Abut. 3	10.00	15.00

BM Rt. 1100' sta 91+00 "SD" Line spike in curb Elev 53.46

Average Pile Tip Elevations			
Location	Ave Tip	Mean	Low
Abut No 1	29.8	21.4	33.5
Bent No 2	15.1	14.6	17.0
Abut No 3	14.6	21.6	8.5

STRUCTURE EXCAVATION (BRIDGE)	745 CY
STRUCTURE BACKFILL (BRIDGE)	470 CY
PERVIOUS BACKFILL MATERIAL	105 CY
CLASS "A" CONCRETE (BRIDGE)	111 CY
CIP PRESTRESSED CONCRETE	3,770 CY
BAR REINFORCING STEEL (BRIDGE)	650,000 LBS
MISCELLANEOUS METAL (BRIDGE)	700 LBS

APPROXIMATE QUANTITIES

TEMPORARY RAILING (TYPE 8)	390 LF
FURNISHING STEEL PILING (10BP57)	6,080 LF
DRIVING STEEL PILES (10BP57)	184 EA
PRESTRESSING CIP CONCRETE	LUMP SUM
SLOPE PAVING	1,360 SY
STRIP WATERSTOPS	696 LF
TEMPORARY RAILING (TYPE 7-A)	754 LF
CONTRAST TREATMENT	694 SY
BR APPROACH GUARD RAILING (TYPE 8)	77 LF
BARRIER RAILING (TYPE 9-11)	432 LF
BARRIER RAILING (TYPE 12)(5")	446 LF
CHAIN LINK SIDEWALK RAILING (TYPE 4)	446 LF

SHEET NO.	TITLE
1.	GENERAL PLAN
2.	GRID GRADES
3.	FOUNDATION PLAN
4.	ABUTMENT 1 & ABUTMENT DETAILS
5.	ABUTMENT 3 & ABUTMENT DETAILS
6.	BENT
7.	BENT FOOTING & COLUMN DETAILS
8.	TYPICAL SECTION
9.	GIRDER LAYOUT
10.	STANDARD UTILITY DETAIL NO. 1
11.	UTILITIES DETAIL NO. 2
12.	BARRIER RAILING TYPE 9-11
13.	BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)
14.	BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)
15.	LOG OF TEST BORINGS

STANDARD PLANS DATED FEBRUARY 1968

B7-1	BOX GIRDER DETAILS NO. 1
B11-9	CHAIN LINK SIDEWALK RAILING, TYPE 4
B11-30	TEMPORARY RAILINGS
B11-42	BARRIER RAILING TYPE 12
B11-43	BARRIER RAILING DETAILS - TYPE 9,10,11 & 12
B13-7	SLOPE PAVING DETAILS TYPE 1
A62-6.2	EXCAVATION & BACKFILL BRIDGES & WALLS - LIMITS OF PAYMENT

① Paint "Br. No. 57-224" & Year Const.
② Paint "FRIARS ROAD O.C."
③ Point of minimum vertical clearance

FOR GENERAL NOTES SEE Foundation Plan

LIVE LOADING HS20-44 AND ALTERNATIVE

BRIDGE DEPARTMENT
··· DESIGN SECTION ··· 16

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOCATED 0.6 MI. N. OF ROUTE 8/395 INTERCHANGE IN THE CITY OF SAN DIEGO IN SAN DIEGO COUNTY

GENERAL PLAN

BRIDGE NO. 57-595 | POST MILE 4.4 | DRAWING NO. 57595-1 | SHEET 1 OF 15

WO 037711
CU 11206

Disregard prints bearing earlier revision dates

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A1000797

203

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST.	COUNTY	ROUTE	POST MILE/KILO-POSTA PREFIX	SHEET NO.	TOTAL SHEETS
11	SD	395	31/12	204	397

E. F. Harrison
Licensed to Practice Civil Engineering in the State of California
DATE APPROVED December 8, 1970

'F' Line

72.15 72.53 72.88 73.23 73.55 73.87 74.18 74.48 74.78 75.06 75.33 75.59 75.83 76.07 76.28 76.49 76.68 76.86 77.02 77.17 77.30 77.43 77.53 77.63 77.71 77.78 77.82 77.87 77.92 77.92 77.92 77.89 77.86 77.81 77.76 77.69 77.60 77.50 77.39 77.27 77.13 76.97 76.81 76.63

65.97 66.44 66.89 67.33 67.75 68.16 68.56 68.94 69.31 69.67 70.01 70.34 70.65 70.95 71.84 71.51 71.77 72.02 72.25 72.47 72.67 72.86 73.04 73.20 73.35 73.49 73.61 73.72 73.81 73.89 73.96 74.01 74.05 74.08 74.09 74.09 74.07 74.04 74.02 73.98 73.92 73.87 73.79 73.69 73.59 73.45 73.31

17 18 19 20 21 22

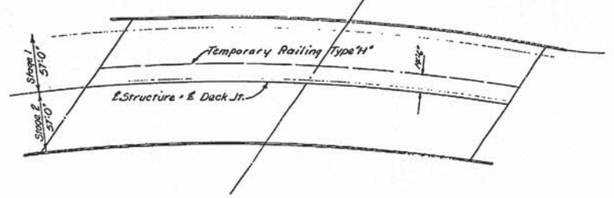
8.8'↑ 50 Lin.↑ 68'↑

Edge of Deck

60.37 60.78 61.09 61.45 61.82 62.19 62.56 62.92 63.30 63.67 64.04 64.41 64.78 65.18 65.50 65.85 66.17 66.49 66.79 67.08 67.35 67.61 67.85 68.09 68.30 68.51 68.70 68.88 69.04 69.19 69.32 69.45 69.55 69.65 69.74 69.80 69.85 69.89 69.91 69.93 69.92 69.91 69.88 69.83 69.78 69.71 69.62

Edge of Deck

Note:
Elevations are figured radially from profile line at 10' stations along 'F' Line.
These elevations do not include camber.



STAGE CONSTRUCTION

AS BUILT
CORRECTIONS BY M.W. Jones CM
CONTRACT NO. 037114
DATE 11-4-70 12-28-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

204

ENGINEERING DEPARTMENT
DESIGN SECTION 16
Project Engineer Orrie Hilburn
DESIGNED W. Orrie Hilburn 6/69
CHECKED Richard A.
DETAILS W. Chiaretti 3/70
CHECKED Dana Sanders
QUANTITIES W. J. Mike Bell
CHECKED Jerry Hill 7/68

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

GRID GRADES

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57-595-13	2	15

WO
CU

Changed plan bearing and/or revision dates → 11/4/70 12/28/70

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [illegible] TITLE Asst.

FILMPDF - www.fastfilm.com
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50' 0 200 400 600
SCALE 1" = 50' 0
SCALE 1" = 50'

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	27/6.2	205	351

December 2, 1968

BENCH MARKS

B.M. #61 — Elev. 36.84'
Conc. ℄ Mon. Sta. 78+00.00 P.O.T. "P"
N 220,221.206 E 719,888.557

B.M. # B-8 — Elev. 46.97'
Conc. ℄ Mon. Sta. 90+50.77 B.C. "P"
N 221,440.168 E 720,167.826

NOTES

⊕ Denotes spot elev.
For Abutment dimensions not shown see Abutment sheet
✲ Denotes electrolier.
+ = Plumb piles ; ‡ = Battered piles.
▭ Denotes Bottom of Footing Elevation.

205

GENERAL NOTES

DESIGN: A.A.S.H.O. DATED 1965 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.

LIVE LOADING: HS20-44 AND ALTERNATIVE

REINFORCED CONCRETE: f_s = 20,000 P.S.I., N = 10
f_c = 1,200 P.S.I.

AS BUILT
CORRECTIONS BY ...
CONTRACT NO. 037714
DATE 11-4-70

CONTOURS CHECKED & VERIFIED IN FIELD
Date: 4/17/68
By: R.P. Davis

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

	DRAWN	CHECKED
DATE	2-28-68	2-28-68
BY	R. FUKUMORI	O.W. McHenry

DESIGN SECTION 16

FRIARS ROAD OVERCROSSING

FOUNDATION PLAN

BRIDGE NO. 57-595 | POST MILE 4.4 | SCALE 1" = 20' | SHEET 3 OF 15

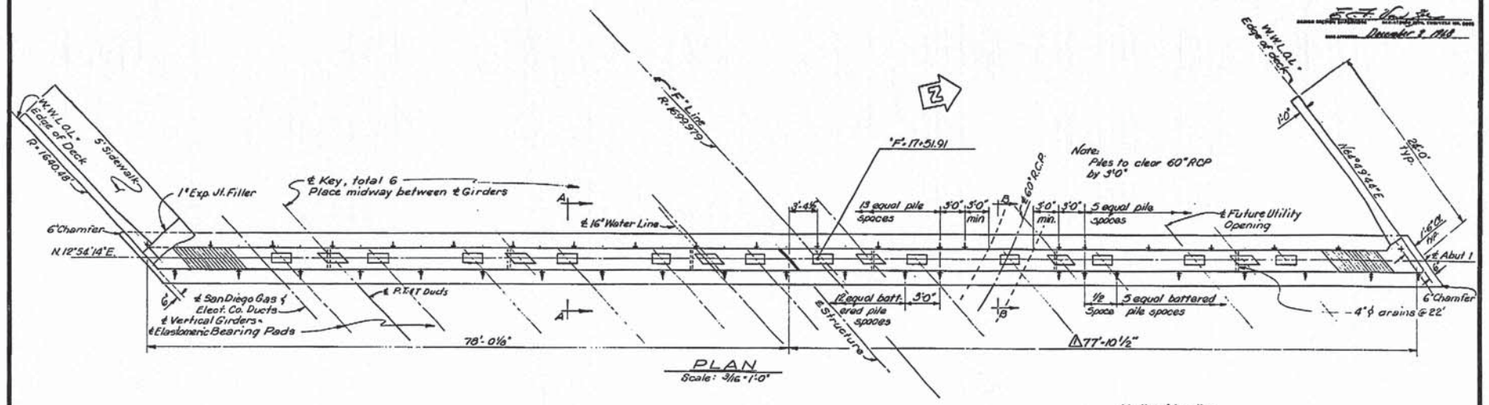
WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE ... TITLE ...

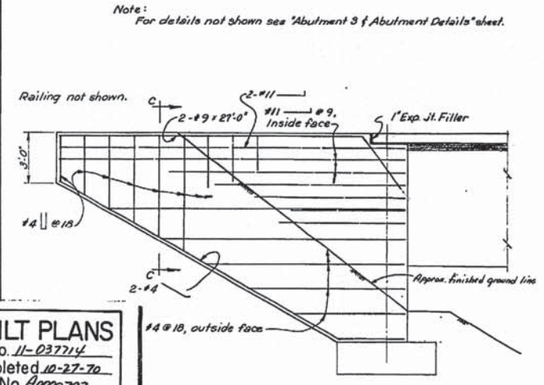
SCALE 1" = 50' 0 100 200 300 400 500 600 — MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST.	COUNTY	ROUTE	POST MILES—LOCAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37K.2	204	297

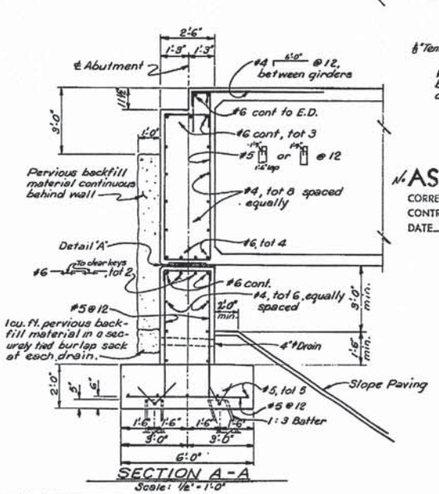
DESIGNED UNDER THE SUPERVISION OF ROBERT L. CONNELLY, REGISTERED CIVIL ENGINEER
DATE APPROVED December 2 1968



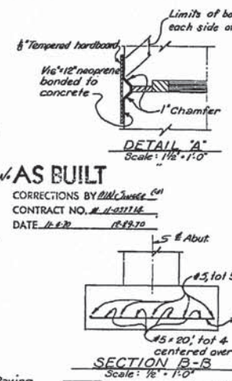
Note: For details not shown see "Abutment 3 & Abutment Details" sheet.



WINGWALL ELEVATION
Scale: 3/8" = 1'-0"

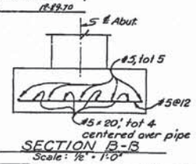


SECTION A-A
Scale: 1/2" = 1'-0"



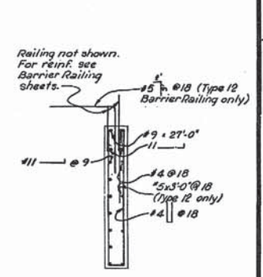
DETAIL "A"
Scale: 1 1/2" = 1'-0"

AS BUILT
CORRECTIONS BY Bill Swede Co
CONTRACT NO. 11-037714
DATE 11-6-70 12-18-70



SECTION B-B
Scale: 1/2" = 1'-0"

Railing not shown. For reinf. see Barrier Railing sheets.



SECTION C-C
Scale: 1/2" = 1'-0"

MARK	DATE	DESCRIPTION	BY	CHK
1	Wilco	Dimension Changed	DMG	EWE

REVISIONS

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

206

DESIGN SECTION 16

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 1 & ABUTMENT DETAILS

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		37595-14	4	13

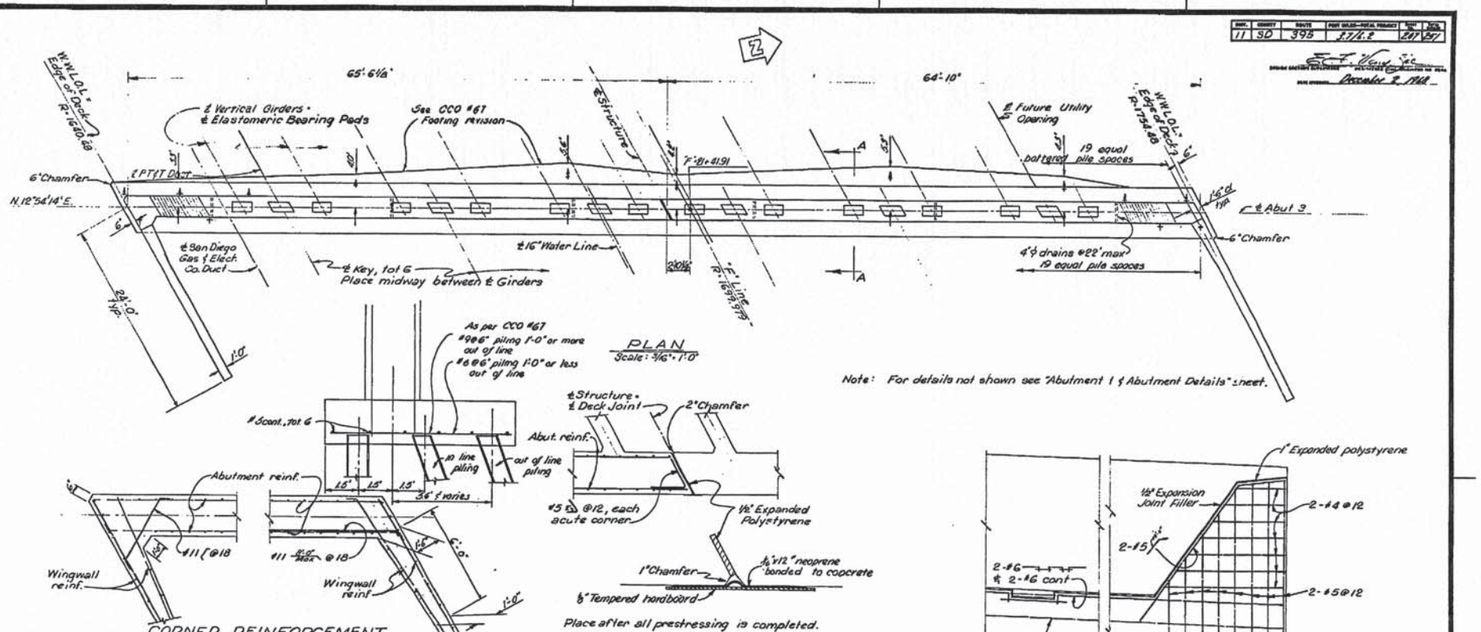
WO CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/01 SIGNATURE [illegible] TITLE [illegible]

DIST.	COUNTY	ROUTE	POST MILES—FISCAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	37/4.2	207	257

E. T. Wolf — Structure Engineer — December 2, 1968



Note: For details not shown see "Abutment 1 & Abutment Details" sheet.

AS BUILT PLANS
Contract No. 11-037214
Date Completed 10-27-70
Document No. A000787

AS BUILT
CORRECTIONS BY Wilsmeyer CM
CONTRACT NO. 11-037214
DATE 11-4-70 11-19-70

DESIGN SECTION 16

Project Engineer	Wm. Hellwig
CHANGES	W. M. Hellwig 9/68
DETAILS	J. Schneider 3/68
QUANTITIES	W. Allen Bullis Drawing 11/68

STATE OF CALIFORNIA — TRANSPORTATION AGENCY — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

ABUTMENT 3 & ABUTMENT DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-695		37595-15	5	15

Merged prior bearing seat revision data

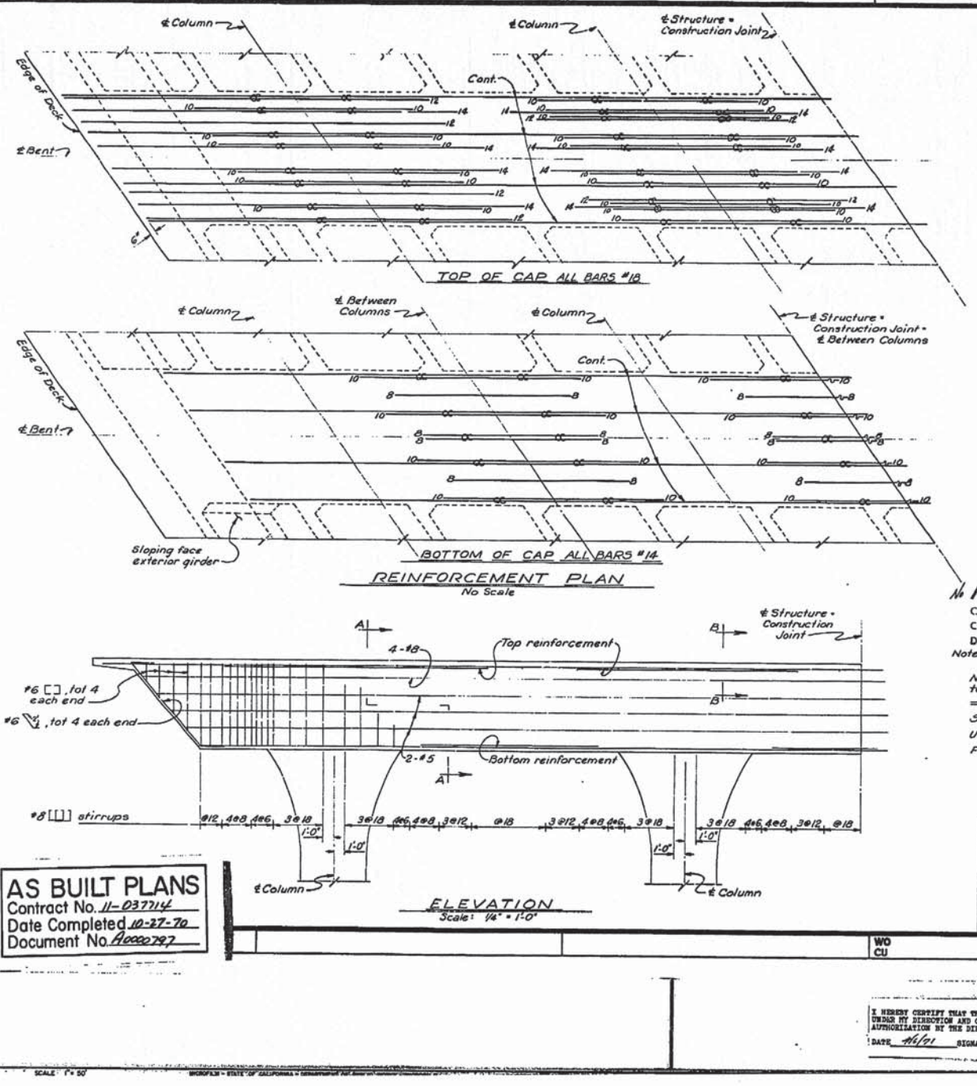
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

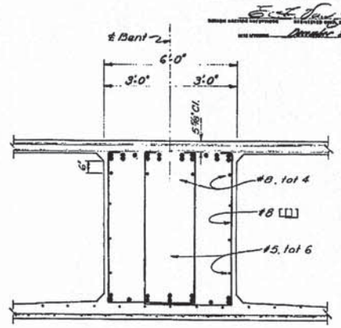
DATE 11/6/01 SIGNATURE [illegible] TITLE Admin

207

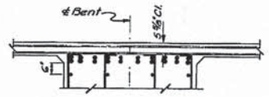
WO CU

SCALE 1" = 50' — SCALE 1" = 50'





SECTION A-A
Scale: 1/2" = 1'-0"



SECTION B-B
Scale: 1/2" = 1'-0"

AS BUILT
CONTRACTOR'S DBA All West Surface
CONTRACT NO. 11-037714
DATE 11-5-70 12-29-70

Note:

Numbers at end of bars indicate distance in feet from ℄ Column for top reinforcement, and from ℄ between Columns for bottom reinforcement.
~~CC~~ indicates bundled bars.
Stage 1 bridge shown; stage 2 bridge similar.
Utility openings not shown. For location see 'Typical Section' sheet.
For Footings and Columns see 'Footing and Column Details' sheet.

DIST.	COUNTY	ROUTE	POST MILE-TOTAL PROJECT	SHT. NO.	TOTAL SHTS.
11	SD	395	31.2/32.7	280	297

BRIDGE DEPARTMENT
DESIGN SECTION 16

Project Engineer	C.M.E. Kilkenny	
DESIGNED	by C.M.E. Kilkenny 6-67	
DETAILED	by Chris Johnson 4-68	
QUANTITIES	by Alan Lamb	
CHECKED	by [illegible] 7-69	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT

DRAWING NO.	37-595	POST MILE	BRIDGE NO.	SHEET	OF
			57585-S	6	15

RECORDED BY: [illegible]
SUBSTANTIAL APPROX. QUANTITY:

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

208

WO
CU

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DATE 4/6/01 SIGNATURE [illegible] TITLE Asst

SCALE: 1" = 50'

DIST.	COUNTY	ROUTE	POST MILE—KILOMETER PREFIX	TOTAL NO.	SHEET NO.
11	SD	395	2.7/4.2	159	160

December 2, 1970

1" polystyrene covered with 1/8" tempered hardboard

4'-0" / 2'-0" / 1'-0"

℄ Bent

#9 x 6'-6", tot 12

COLUMN KEY DETAIL
Scale: 3/8" = 1'-0"

12'-0"
6'-0" 6'-0"
℄ Column
High Point
Level
Soffit Line
10'-0"
B
R = 18'-2"
B.C.
A
2" Chamfer
4'-0"
32'-0" typ.

ELEVATION
Scale: 1/4" = 1'-0"

℄ Column
1'-6" x 3 1/16" key (typ)
3'-6"
#4 @ 6
#4 @ 12
#11 dowels, tot 24
3'-0"
5"

#9, tot 30
#11, tot 32
℄ Bent
15'-0"
7'-6"
7'-6"
7'-6"
15'-0"

FOOTING PLAN
Scale: 1/4" = 1'-0"

℄ Column
1'-0" min. lap
℄ Bent
#4
#11, tot 24

SECTION B-B
Scale: 1/2" = 1'-0"

℄ Column
2" Chamfer (typ.)
#4
℄ Bent
#11, tot 24
2'-0"
2'-0"
4'-0" typ.
3'-0" 3'-0"
6'-0"

SECTION A-A
Scale: 1/2" = 1'-0"

No AS BUILT
CORRECTIONS BY Hill Swan
CONTRACT NO. 11-037114
DATE 11-6-70 12-10-70

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

DESIGN DEPARTMENT
DESIGN SECTION 16

Project Engineer	Clyde Hilsaay	
DESIGN	In A. Hillsaay 8/68	
	Bridge Engr. W. Saunders	
DETAILED	Chief, Section Hills, Hunter 8/68	
	Bridge Engr. W. Saunders	
QUANTITIES	In C. Allen Hicks	
	Bridge Engr. C. Hilsaay 8/68	

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

BENT FOOTING & COLUMN DETAILS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	NO. OF SHEETS
57-595		37595-16	7	15

RECORD DATE 8/68 — Changed plan bearing number and date

OPERATING ENGINEER

201

WO
CU

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DATE 11/6/71 SIGNATURE A. J. Lacson TITLE Asst. Engr.

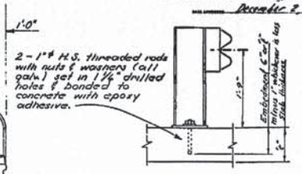
SCALE 1" = 50'

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1" = 50'

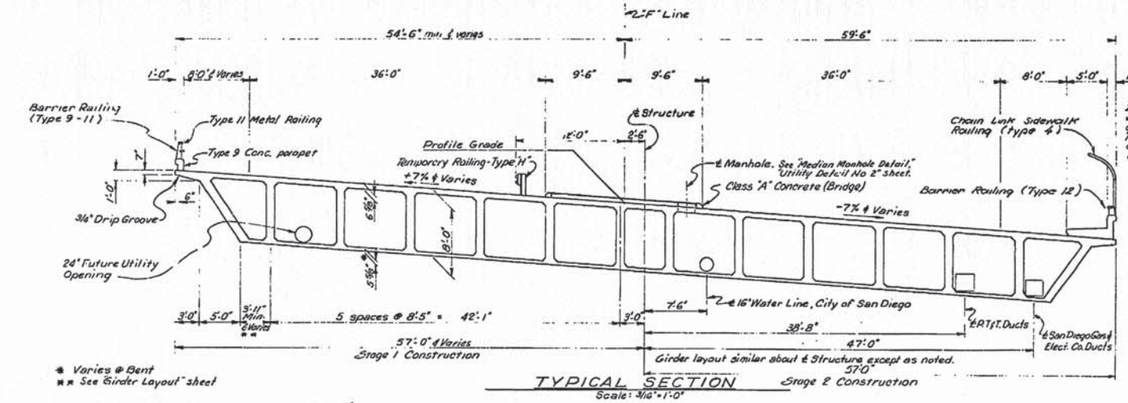
DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	TOTAL SHEETS	SHEET NO.
11	SD	395	37.1/41.2	218	217

Standard Plan No. S3-7 (Formerly Standard No. B3-7)
Dated December 2, 1960

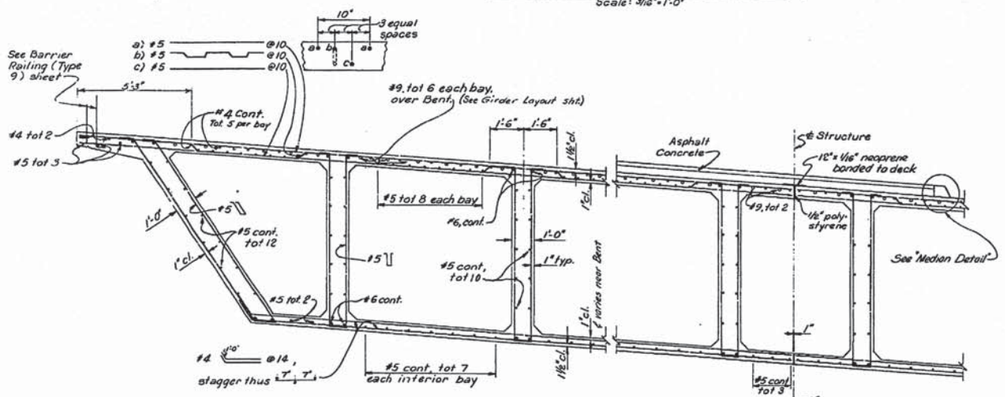


TEMPORARY RAILING - TYPE H
ATTACHMENT DETAIL
NO SCALE
SPECIAL DETAIL

Note
This detail supersedes the type H attachment detail as shown on sheet no. 1311-30 of Standard Plans dated Feb 1968.



TYPICAL SECTION
Scale: 3/16" = 1'-0"



PART SECTION
Scale: 1/2" = 1'-0"

MEDIAN DETAIL
No Scale

PRESTRESSING NOTES

"JACK 18,300 KIPS TOTAL PER 1/2 STRUCTURE (C.L. TO CENTER OF JT.) AT JACKING END.

$A_s = \frac{P_{JACK}}{0.75\ f'_s}$

CONCRETE f'c = 5,100 P.S.I. @ 28 DAYS; f'ci = 3,500 P.S.I. @ TIME OF STRESSING

PRESTRESSING STEEL: THE PRESTRESSING STEEL SHALL BE LOCATED IN THE GIRDER STEMS WITH AN EQUAL FORCE IN EACH STEM. AT THE CONTRACTOR'S OPTION THE PRESTRESSING FORCE MAY VARY TO ± 5% FROM THE THEORETICAL EQUAL FORCE PER GIRDER PROVIDED THE TOTAL P JACK IS OBTAINED AND THE FORCE IS DISTRIBUTED SYMMETRICALLY ABOUT THE ℄ OF THE TYPICAL SECTION. UNITS ARE TO BE TENSIONED A FEW AT A TIME IN EACH STEM IN ORDER TO MINIMIZE THE STRESS DIFFERENTIALS.

CLEARANCE: (1) HORIZONTAL CLEARANCE BETWEEN UNITS = 2 1/2" MIN.
(2) UNITS MAY BE BUNDLED VERTICALLY IN GROUPS OF 3 MAX.
(3) VERTICAL CLEARANCE BETWEEN BUNDLED UNITS = 3" MIN.

GENERAL: (1) P JACK SPECIFIED AT THE JACKING ENDS INCLUDES FRICTION LOSSES AND PROVISION FOR 25,000 P.S.I. LOSS IN STRESS. f's = ULTIMATE TENSILE STRENGTH OF PRESTRESSING STEEL.

(2) TENDONS TO BE JACKED TO 0.75 f's AND ANCHORED WITH AN AVERAGE ANCHORAGE SET OF 1/8" MAXIMUM.

(3) DESIGN IS BASED ON U = 0.25 AND K = 0.0002. CONTRACTOR TO SUBMIT ELONGATION AND JACKING CALCULATIONS BASED ON Uα + KL = 0.109 AND INITIAL STRESS AT @ = 0.896 TIMES JACKING STRESS.

(4) METALLIC ENCLOSURES TO BE GALVANIZED RIGID DUCT.

(5) ENCLOSURES TO BE VENTED THROUGH SLAB WITHIN 3' OF THE HIGH POINTS OF THE CABLE PATH.

(6) DURING STRESSING OPERATIONS, THE ELONGATION SHALL BE CONTINUOUSLY COMPARED WITH GAGE PRESSURE TO CHECK AGAINST TENDON BLOCKAGE AND EXCESSIVE FRICTION.

(7) BAR REINFORCEMENT INTERFERING WITH THE PRESTRESSING TENDON ALIGNMENT SHALL BE ADJUSTED AS DIRECTED BY THE ENGINEER.

AS BUILT
CORRECTIONS BY Mike Swaze CH
CONTRACT NO. 11-037714
DATE 11-6-70 12-28-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0090797

210

DESIGN SECTION 16
Project Engineer Orrie Hilvesey
DESIGN Orrie Hilvesey 4/68
DETAILS Mike Swaze 4/68
QUANTITIES Alex Sutter 4/68
Checked Joseph L. Flint 4/68

TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING
TYPICAL SECTION

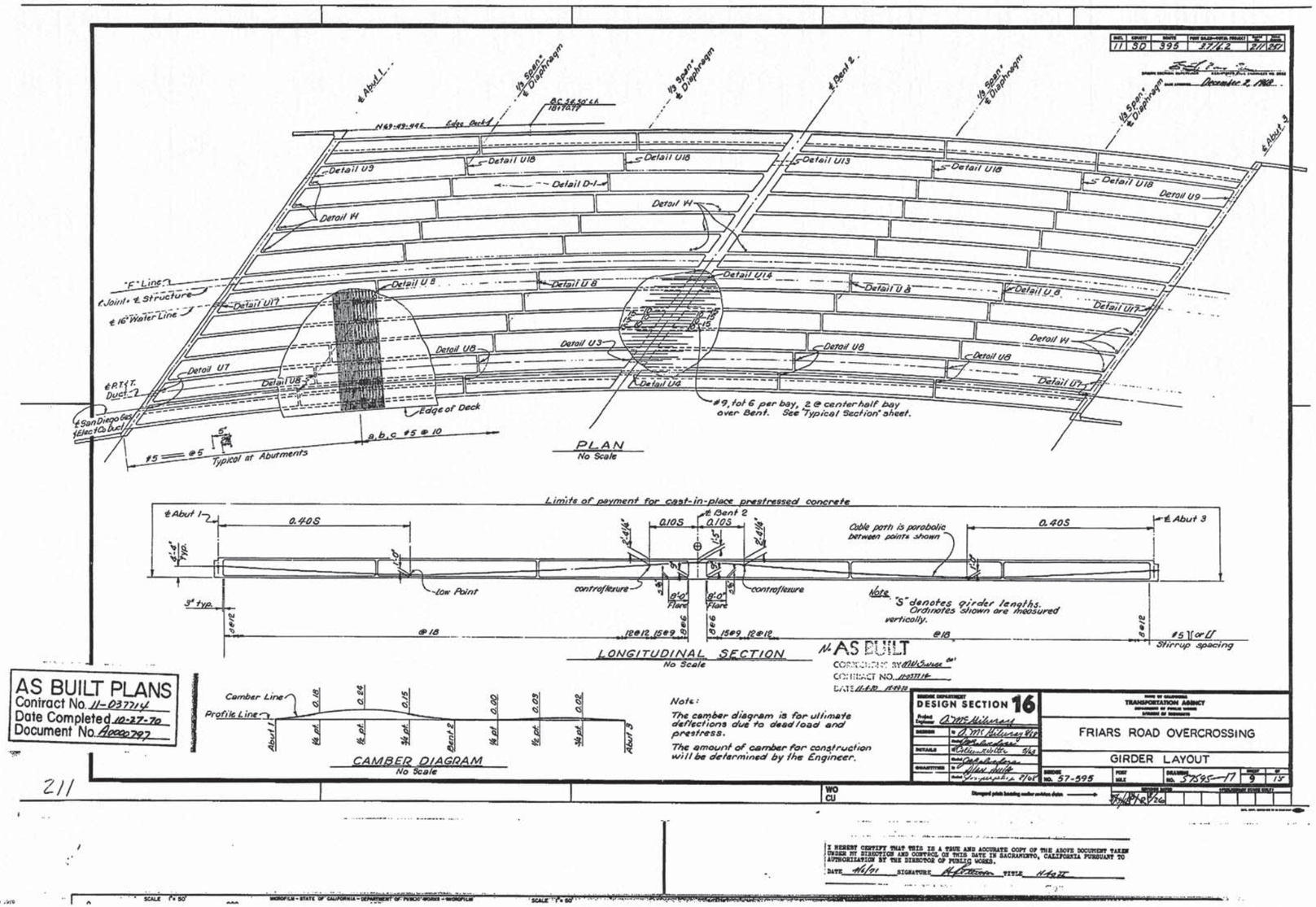
DISTRICT	ROUTE	DRAWING NO.	SHEET	OF
11	395	57595-4	8	15

DESIGNED UNDER THE SUPERVISION OF Orrie Hilvesey
DATE 4/68
REGISTERED CIVIL ENGINEER

WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/6/71 SIGNATURE [illegible] TITLE Assoc

FILMED - [illegible]
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM



AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

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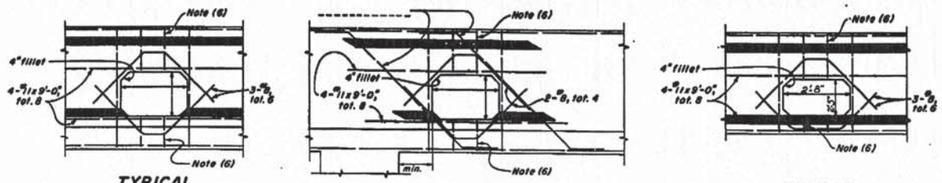
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE [illegible]

DIST	COUNTY	ROUTE	POST MILE	TOTAL PROJECT	SHEET	DATE
11	SD	395	17.7/R.7		1/14	12/65

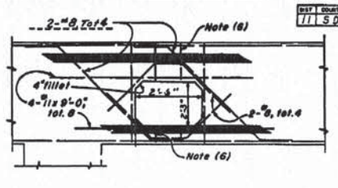
December 7, 1965



TYPICAL
DETAIL U1

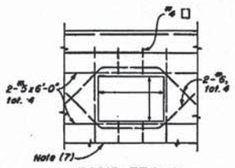
NEAR COLUMN
DETAIL U2

TYPICAL
DETAIL U3

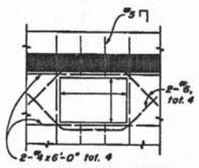


NEAR COLUMN
DETAIL U4

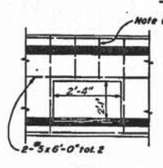
BENT CAP



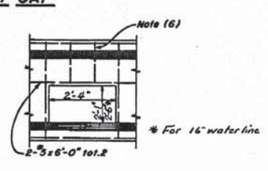
RIGID FRAME
DETAIL U5



CANTILEVER TYPE
DETAIL U6



END
DETAIL U7

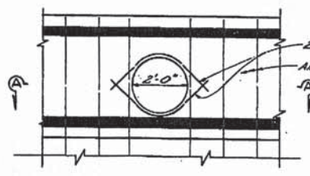


INTERMEDIATE
DETAIL U8

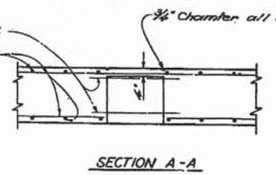
ABUTMENT BACKWALL

DIAPHRAGMS

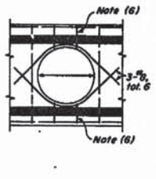
AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797



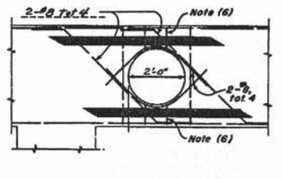
DETAIL U-9



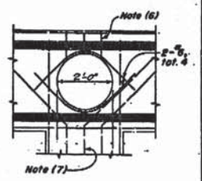
SECTION A-A



TYPICAL
DETAIL U12

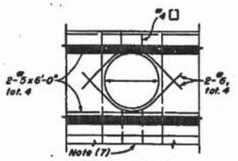


NEAR COLUMN
DETAIL U13

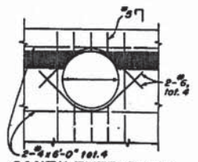


AT COLUMN
DETAIL U14

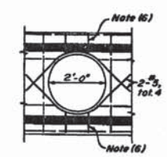
BENT CAP



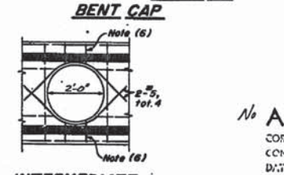
RIGID FRAME
DETAIL U15



CANTILEVER TYPE
DETAIL U16



END
DETAIL U17



INTERMEDIATE
DETAIL U18

ABUTMENT BACKWALL

DIAPHRAGMS

NOTES

(1) For exact location and direction of openings see other sheets.
(2) Location and size of utility openings may be modified as directed by the Engineer, provided minimum dimensions are maintained.
(3) Girders not shown, see other sheets.
(4) Seal around utilities at abutments to be of sufficient strength to withstand earth pressure.
(5) All reinforcement detailed to be placed in addition to reinforcement shown on other sheets.
(6) Stirrups are same size as adjacent stirrups shown on other sheets.
(7) Join reinforcement to clear opening as detailed on other sheets.

No AS BUILT
CORRECTIONS BY Williams Bros
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

MARK	DATE	REVISION	BY	CHK
1	12-6-66	Detail U-9 Added	MS	WC
		REVISED PILES		
		REV. JWS		

4/65

STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

XS 16-49

FRIARS ROAD OVERCROSSING

STANDARD UTILITY DETAIL NO.1 — BOX GIRDER

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET NO.	OF
57-595		57595-18	10	15

W.O.

Dropped prints belong under maroon date

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

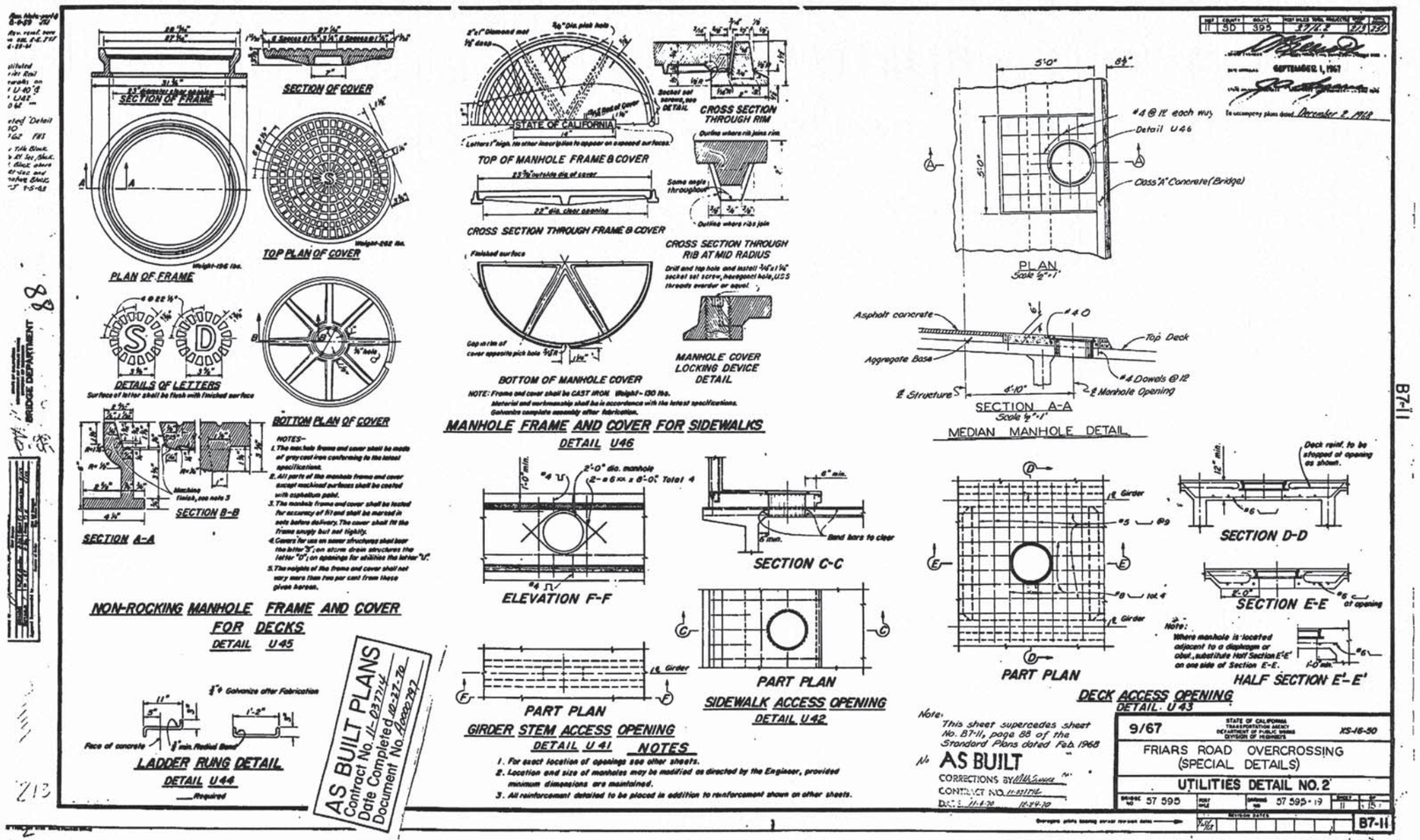
DATE 4/6/01 SIGNATURE [signature] TITLE Assoc

STANDARD DRAWING
Approved for Publication
Chief Engineer
Dec. 1965
Sheet 2 of 2 Sheets
Bridge Department

Alan J. Bell Associates
4/6/01 dp
Caution Retain Details
Detail No. "DETAIL U5, U6 and U8" SHEETS 2,3

212

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM



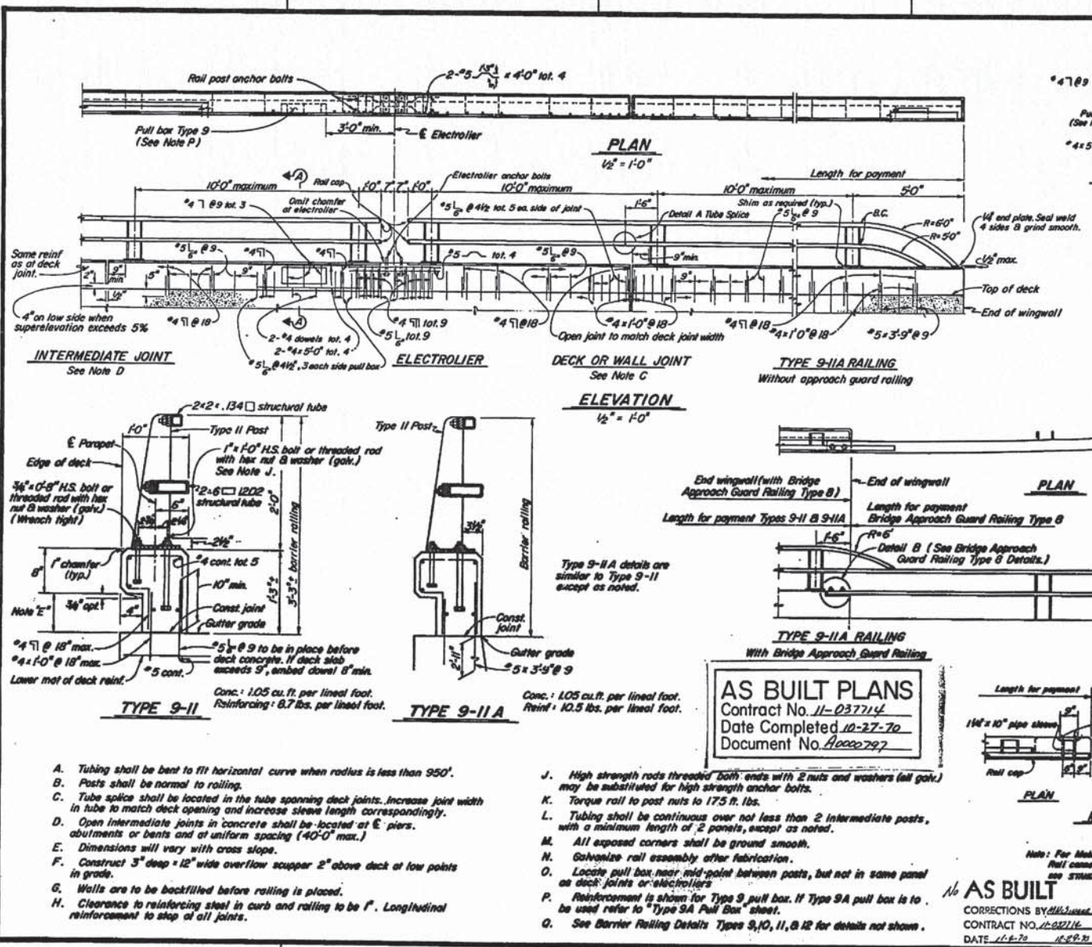
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 11/6/71 SIGNATURE [signature] TITLE [illegible]

B7-11

DIST	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET	TOTAL SHEETS
11	SD	395	3.7/4.2	214	250

December 2, 1968



AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0000797

A. Tubing shall be bent to fit horizontal curve when radius is less than 950'.
B. Posts shall be normal to railing.
C. Tube splice shall be located in the tube spanning deck joints. Increase joint width in tube to match deck opening and increase sleeve length correspondingly.
D. Open intermediate joints in concrete shall be located at ℄ piers, abutments or bents and at uniform spacing (40'-0" max.)
E. Dimensions will vary with cross slope.
F. Construct 3" deep x 12" wide overflow scupper 2" above deck at low points in grade.
G. Walls are to be backfilled before railing is placed.
H. Clearance to reinforcing steel in curb and railing to be 1". Longitudinal reinforcement to step at all joints.
J. High strength rods threaded both ends with 2 nuts and washers (all galv.) may be substituted for high strength anchor bolts.
K. Torque rail to post nuts to 175 ft. lbs.
L. Tubing shall be continuous over not less than 2 intermediate posts, with a minimum length of 2 panels, except as noted.
M. All exposed corners shall be ground smooth.
N. Galvanize rail assembly after fabrication.
O. Locate pull box near mid-point between posts, but not in same panel as deck joints or electroliers
P. Reinforcement is shown for Type 9 pull box. If Type 9A pull box is to be used refer to "Type 9A Pull Box" sheet.
Q. See Barrier Railing Details Types 9, 10, 11, & 12 for details not shown.

No AS BUILT
CORRECTIONS BY Miscellaneous
CONTRACT NO. 11-037114
DATE 11-6-70 11-29-71

STANDARD DRAWING
DEC. 1968
RS-1
Revised 1-1-69
Revised 1-1-70
Revised 1-1-71

214

7/68
STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS
XS-9-95

FRIARS ROAD OVERCROSSING

BARRIER RAILING TYPE 9-11

DESIGN NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-20	12	15

WO
CU

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 11/1/71 SIGNATURE [illegible] TITLE [illegible]

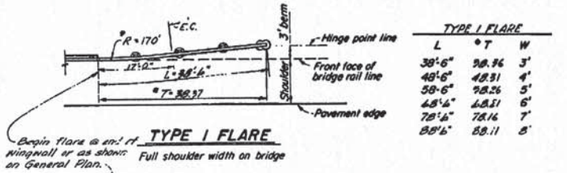
SCALE 1" = 50'
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

DIST	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	395	37.4.2	2/6	2/7

December 2, 1969

TYPE 1 FLARE

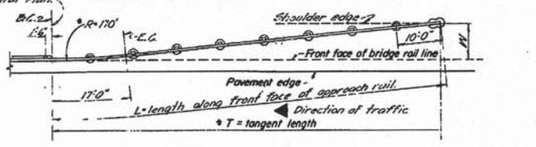
Full shoulder width on bridge



TYPE 1 FLARE		
L	T	W
38'-6"	38.36	3'
48'-6"	48.31	4'
58'-6"	58.26	5'
68'-6"	68.21	6'
78'-6"	78.16	7'
88'-6"	88.11	8'

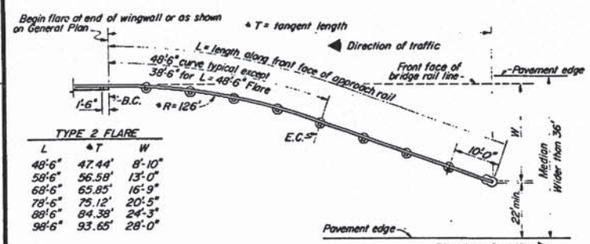
TYPE 1 FLARE

Reduced shoulder width on bridge (right or left)



TYPE 2 FLARE

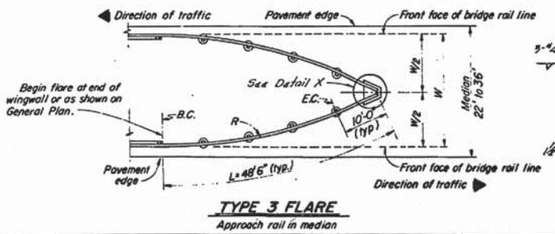
Approach rail in median

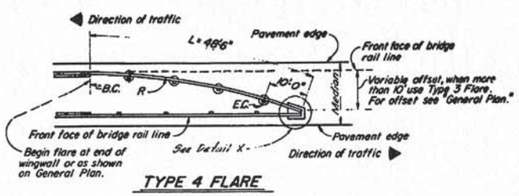


TYPE 2 FLARE		
L	T	W
48'-6"	47.44'	8'-10"
58'-6"	56.58'	13'-0"
68'-6"	65.85'	16'-9"
78'-6"	75.12'	20'-5"
89'-6"	84.38'	24'-3"
98'-6"	93.65'	28'-0"

TYPE 3 FLARE

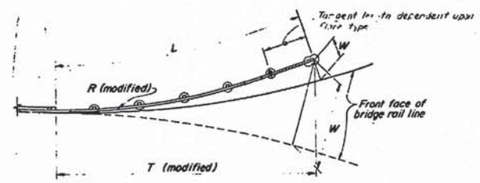
Approach rail in median





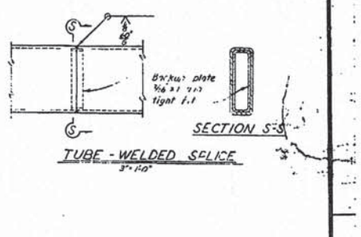
TYPE 4 FLARE

Approach rail in median



FLARE LAYOUT ON CURVED ROADWAY

Note: W is radial to front face of bridge rail line
Railing shown for roadway curve to left

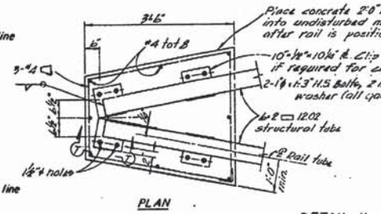


TUBE - WELDED SPLICE

3" I.D.

Notes:

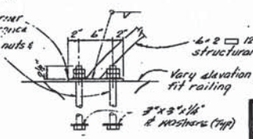
A. Tubing shall be shop bent or fabricated to fit horizontal curves of less than 950' radius.
B. Posts shall be vertical and spaced at 10'-0" c.c. max.
C. Top of rail elevations to be determined by the Engineer unless shown on the plans.
D. Torque rail to post nuts to 175 ft. lbs.
E. No more than one tube splice per panel is permitted.
F. All exposed edges shall be ground smooth.
G. Galvanize rail assembly after fabrication.
H. For details not shown see "Barrier Railing" sheet.
J. Front face of bridge rail line is parallel or concentric to pavement edge.
K. Dimensions marked ℄ are valid for tangent roadway alignment only. Modify for curved roadway.
L. R for Type 3 & 4 Flare must be calculated for each offset.



PLAN

DETAIL X

No Scale



SECTION T-T

AS BUILT
CONSTRUCTION BY Mid County Const.
CONTRACT NO. 11-037714
DATE 11-6-70 12-29-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-87

FRIARS ROAD OVERCROSSING

BRIDGE APPROACH GUARD RAILING TYPE 8 (LAYOUT)

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
57-595		57595-21	13	15

WORKING DATES

STANDARD DRAWING

215

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE Asst.

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50' SCALE 1"=20'

DIST	COUNTY	ROUTE	POST MILE/KILOMETER	SHEET NO.	TOTAL SHEETS
11	SD	395	7.7/12.4	216	267

December 2, 1968

DETAIL B
1½"=1'-0"

SECTION N-N

SECTION B-B
1½"=1'-0"

Top of rail grade to be adjusted to provide smooth railing profile

12'-6" post spacing (typ)

8"x6" tube

End of wingwall or as shown on General Plan

Top tube and cap with chain link fence (Type 6)

Approach rail curb to be used when there is no approach sidewalk or approach curb.

PLAN

Pay limit

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

10'-0" post (typ)

Tube splice detail

Pay limit Bridge Approach, Pay limit Type 11 (12), Guard Railing Type 8 (typ)

½" R seal weld & sides & grind smooth

R=3'-0"

Detail B

Match elevation

ELEVATION

CONNECT TO TYPE 11 (12)

See "End Anchorage Details"

L 4"x3"x½" structural tube

BRIDGE APPROACH GUARD RAILING TYPE 8
½"=1'-0"

L 4"x3"x½"x1'-1" long with 1⅛" ø holes

Tube

Cap end of tube

2-1"ø x 1'-0" Hex Bolts with hex nut and washer (galv.)

1⅛" x 1⅜" slotted holes in tube. Place on thin layer of grout

⅜" spiral @ 3" pitch with 3 turns @ top

⅜" tot. 8

2'-0"

2'-6"

2'-9"

2'-6"

2-1"ø H.S. Bolts, 2 hex nuts & washer (all galv.)

L 4"x3"x½" structural tube

1'-0"

1'-0"

Place concrete after rail is positioned

(8"x8"x½" R. washer (Typ)

ELEVATION

TYPE 1 & 2 FLARE
END ANCHORAGE DETAILS
1½"=1'-0"

9'-6"ø

8" R

8" Rail tube

⅝" mm. thickness

1⅛"ø hole

6"x4½"x1'-6" ℄'s

PLAN

SHIM DETAILS
1½"=1'-0"

1⅛" x 1⅜" slotted holes

⅝" R

Rolled bar 2"x6"x0'-8"

ELEVATION

SECTION H-H

RAIL POST DETAILS
1½"=1'-0"

SECTION D-D

1⅛"ø holes

End of wingwall or as shown on General Plan

Pay limit Type 10

Approach rail curb to be used when there is no approach sidewalk or approach curb

Front face of sidewalk or approach curb 10' transition to mast bridge sidewalk

PLAN

Match elevation

ELEVATION

CONNECT TO TYPE 10

5'-0" Type 11 (12)
2'-0" Type 10

For tube to post connection details see "Barrier Railing Details" sheet

Match height of bridge curb

Approach rail curb

1'-4"x1'-4"x¾" bolt tot 3 with washer & hex nut (all galv.)

Anchor bolt template

⅜" spiral @ 3" pitch with 3 turns @ top

SECTION A-A
½"=1'-0"

End of wingwall or as shown on General Plan

PLAN

Pay limit Bridge Approach, Guard Railing Type 8

Pay limit Type 9

Detail B

ELEVATION

CONNECT TO TYPE 9

1'-0" R

48 Tot. 12

⅝" spiral @ 5" pitch with 3 turns @ top

1'-4"

1"x 9½" H.S. bolt with nut & 2 washers

Top of Railing Tube

ELEVATION

1⅛"ø holes

1⅛"x4" slotted hole in tube - bottom side only

VIEW L-L

PLATE - PLAN VIEW

TUBE SPLICE DETAILS
1½"=1'-0"

8"x 8½"x ⅝" thick with 1⅛"ø hole

⅝"ø rod

ANCHOR BOLT TEMPLATE
1½"=1'-0"

SECTION C-C
Scale: 3"=1'-0"

1/4 AS BUILT
CORRECTIONS BY Bill Sweet
CONTRACT NO. 11-037114
DATE 11-6-70 12-29-70

5/68	STATE OF CALIFORNIA TRANSPORTATION AGENCY DEPARTMENT OF PUBLIC WORKS DIVISION OF HIGHWAYS	XS-9-83	
FRIARS ROAD OVERCROSSING			
BRIDGE APPROACH GUARD RAILING TYPE 8 (DETAILS)			
DESIGNED 57-395	DRAWN	CHECKED 57595-22	16 / 15

AS BUILT PLANS
Contract No. 11-037114
Date Completed 10-27-70
Document No. A0002797

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT DRAWN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

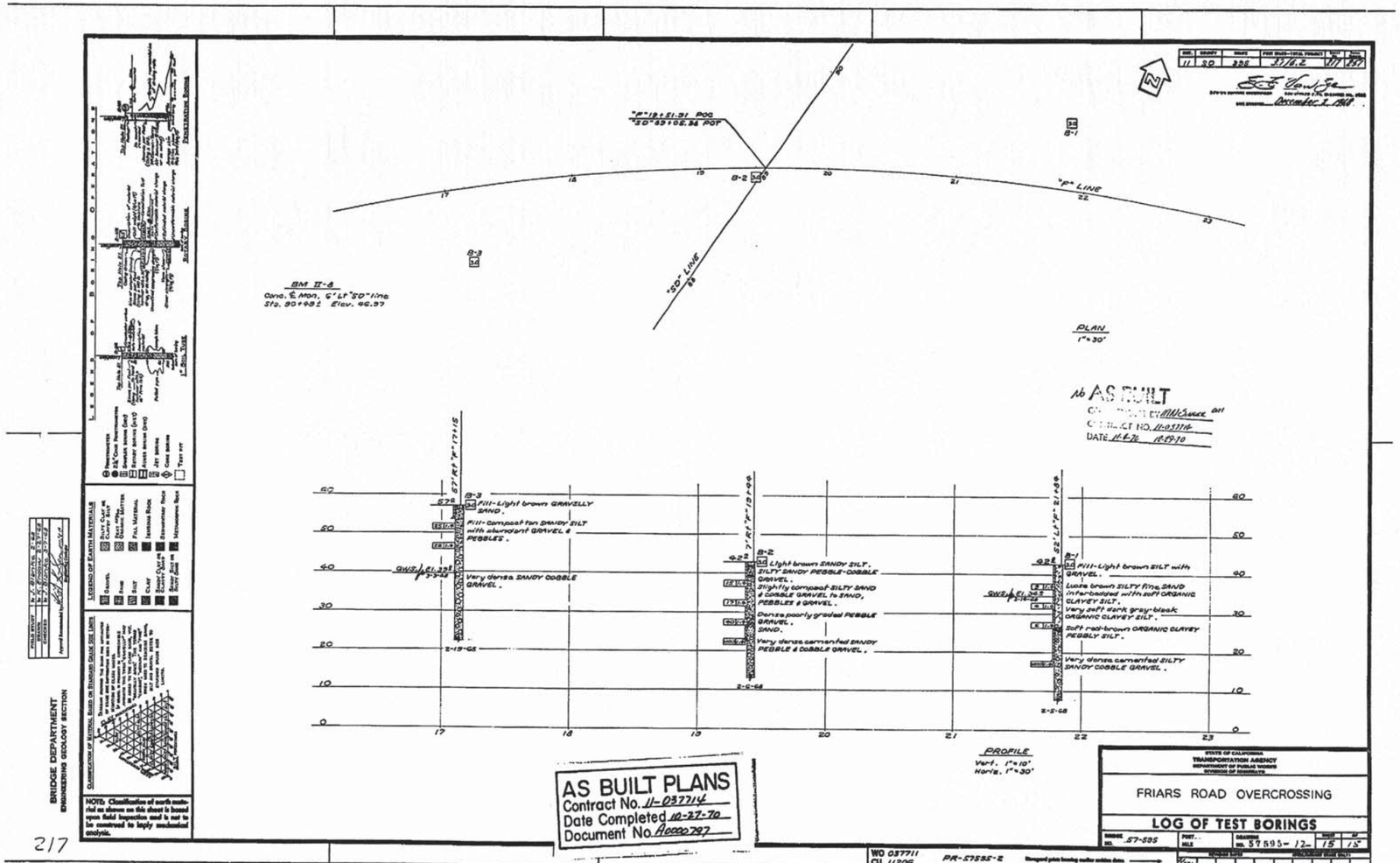
DATE 4/6/01 SIGNATURE M. E. Cooper TITLE Li-Aide

216

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

SCALE 1"=50'

0 100 200 400 600



AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

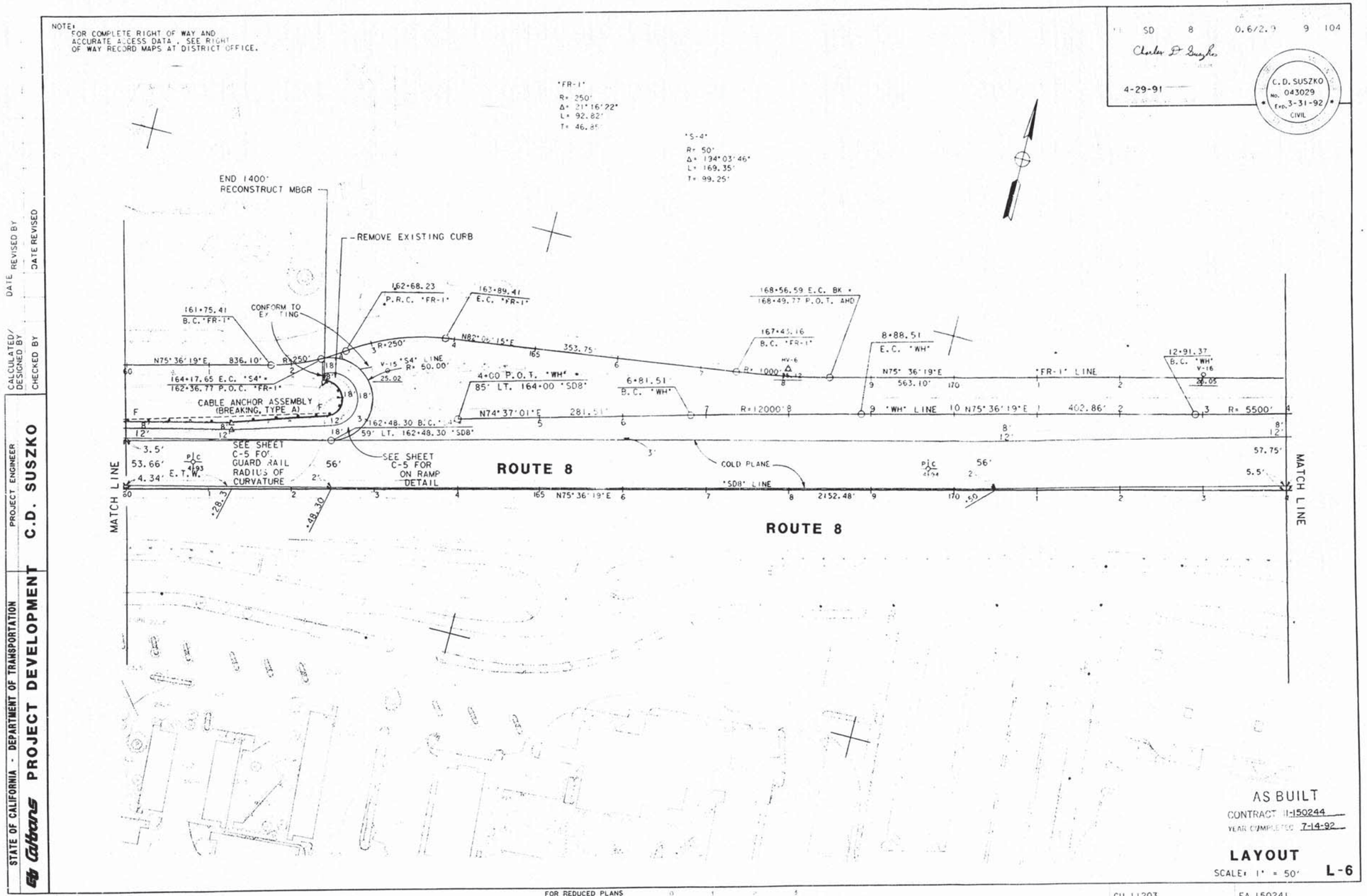
BRIDGE NO. 57-595 | DRAWING NO. 57595-12 | SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

217

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/6/71 SIGNATURE [signature] TITLE HAgII



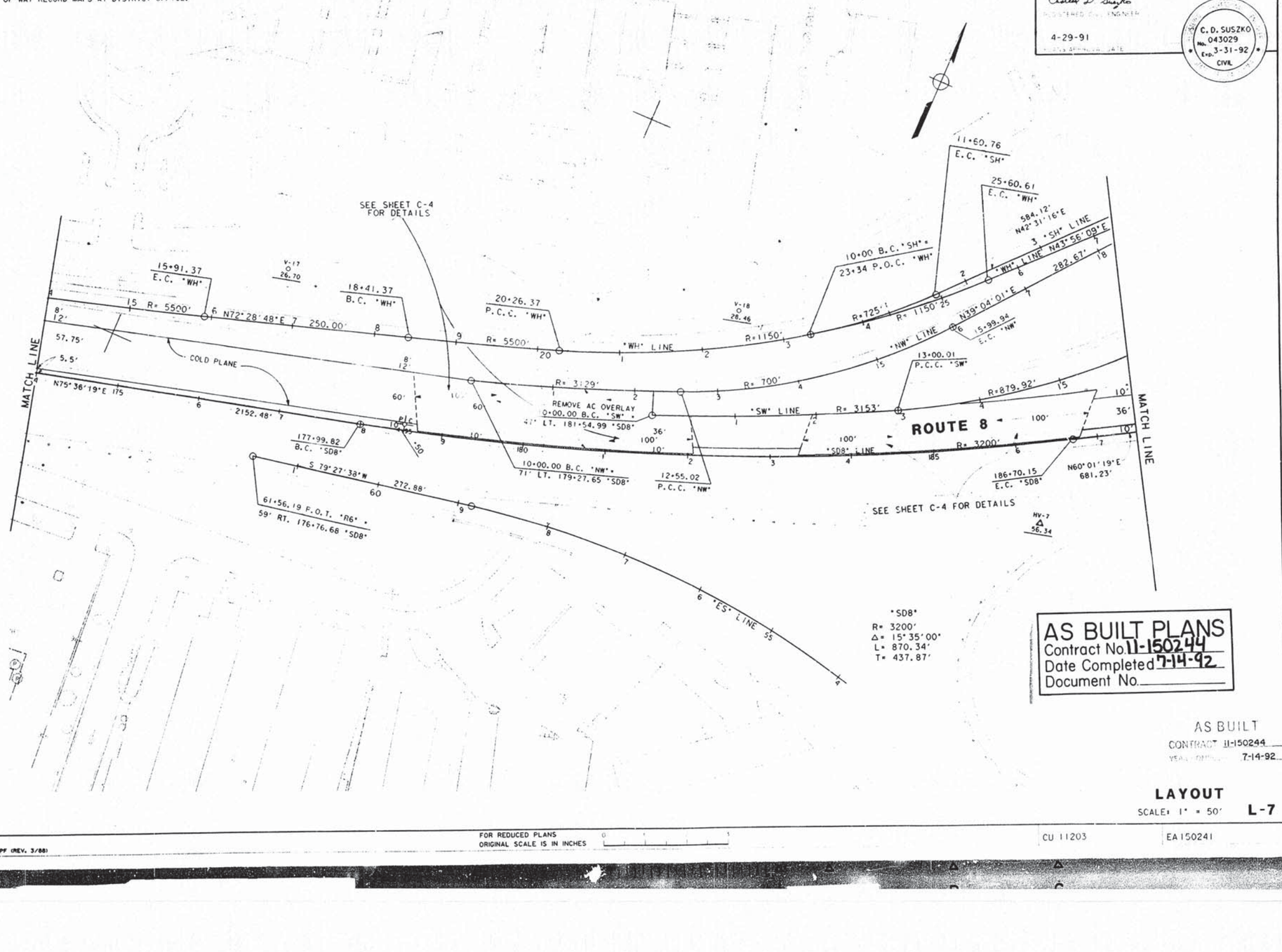
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11	SD	8	0.6/2.9	10	104

Charles D Suszko
REGISTERED CIVIL ENGINEER
4-29-91
DATE

C. D. SUSZKO
043029
No.
Exp. 3-31-92
CIVIL



AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
7-14-92

LAYOUT
SCALE: 1" = 50' **L-7**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans **PROJECT DEVELOPMENT**
PROJECT ENGINEER **C.D. SUSZKO**
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

11 SD 8 0.6/2.9 11 104

Charles D Suszko

4-29-91

C. D. SUSZKO
No. 043029
Exp. 3-31-92
CIVIL

18+82.61 P.O.T. "NW"
12' RT. 27+80.29 P.O.T. "WH"

17+44.89
B.C. "SW"

28+33.87
B.C. "WH"

584.12'

"SW" LINE

R= 500'

N17°46'19"E

"SW" LINE

31+28.87
P.C.C. "WH"

R= 700'

19+89.19
E.C. "SW"

"WH" LINE

R= 1000'

34+10.01
E.C. "WH"

N42°31'16"E

N43°36'09"E

"NW"

N84°11'24"E 200.00'

35+68.25 P.O.T. "WH"
68+43.09 B.C. "R-1R"

36+10.01
B.C. "WH"

37+80.80
E.C. "WH"

R= 1000'

N74°24'16"E 9 "WH" LINE 40 395.63'

"WN" LINE 6 R= 500'

R= 879.92'

R= 600'

"WS" LINE

62+31.15
E.C. "WS"

N77°01'06"E

ROUTE 163

MATCH LINE

REMOVE AC OVERLAY

N60°01'19"E

"SD8" LINE 681.23'

COLD PLANE

193+51.38
B.C. "SD8"

ROUTE 8

R= 2500'

66+57.34 P.O.T. "WS"
47' LT. 198+20.01 P.O.C. "SD8"

199+68.09
E.C. "SD8"

N74°09'21"E

199+68.33 P.O.T. "SD8" BK.
1+99.50 P.O.T. "SD8" AHD.

MATCH LINE

SEE SHEET C-4 FOR DETAILS

"SD8"
R= 2500'
Δ= 14°08'02"
L= 616.71'
T= 309.93'

SEE SHEET C-4 FOR DETAILS

AS BUILT PLANS
Contract No. 11-150244
Date Completed 7-14-92
Document No.

AS BUILT
CONTRACT 11-150244
YEAR COMPLETED 7-14-92

LAYOUT
SCALE: 1" = 50' L-8

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 11203 EA 150241

FORM DC-OE-92-PF (REV. 3/88)

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT DEVELOPMENT
PROJECT ENGINEER C.D. SUSZKO

CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

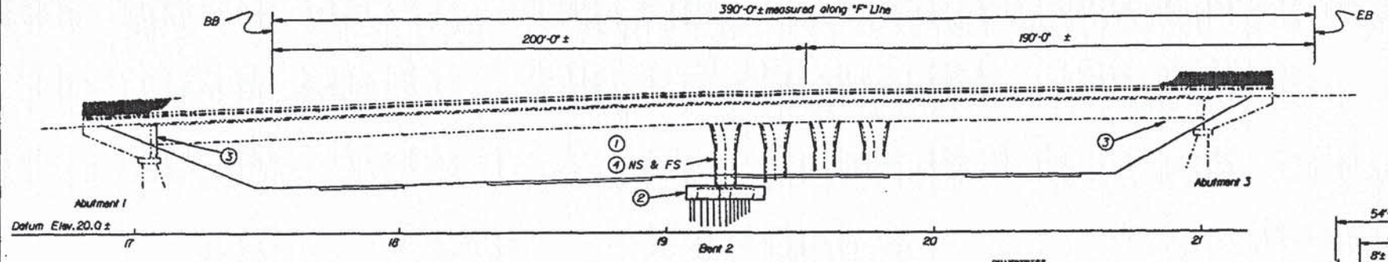
DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	132	162

Ramin Rasheda
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI, No. 37070, Exp. 6-30-98, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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



ELEVATION
1"=20'

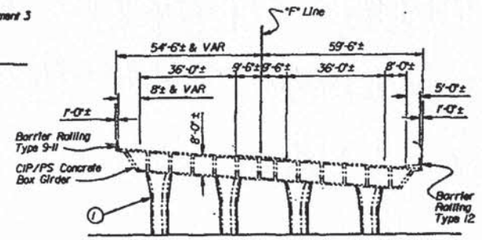
PILE DATA - STEEL HP PILES

Location/Type	Design Loading (Service)	Nominal Resistance		Design & Specified Tip Elevation
		Compression	Tension	
Bent 2/HP10x57	70 Tons	250 kips	130 kips	10.0 (1),(2)

Design Tip Elevation is controlled by the following demands: (1) Compression, (2) Tension.

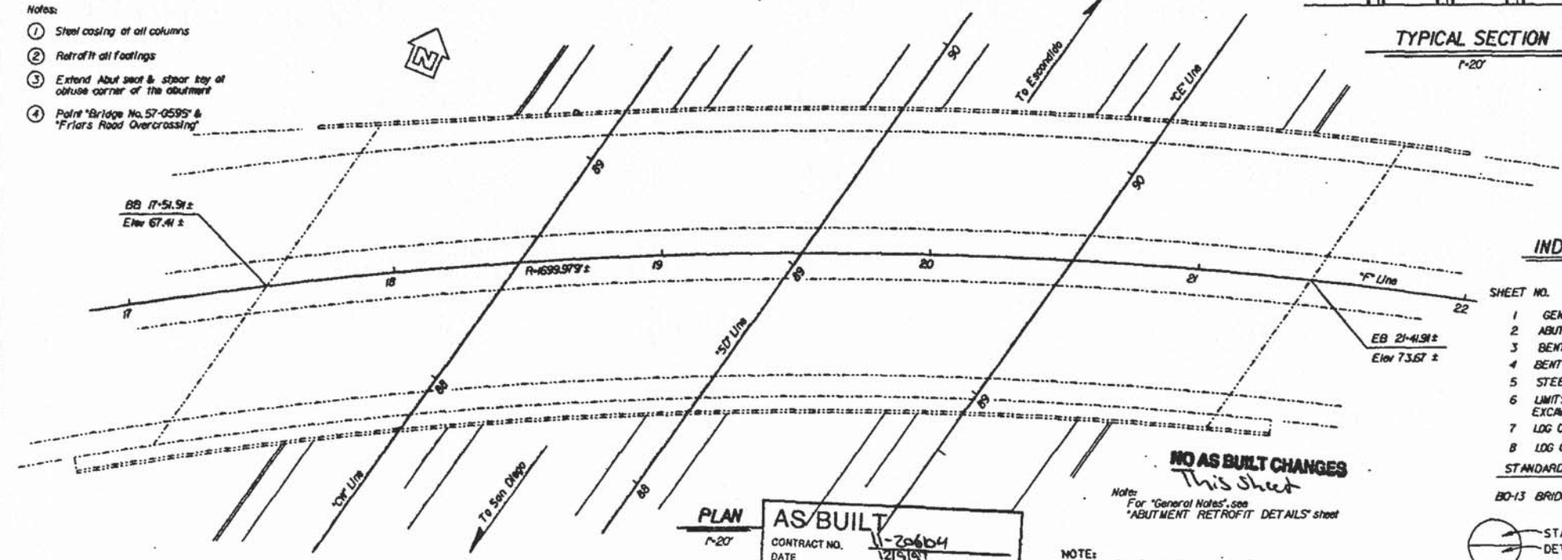
QUANTITIES

	LUMP SUM	
BRIDGE REMOVAL (PORTION), LOCATION C	LUMP SUM	
STRUCTURE EXCAVATION (BRIDGE)	572	CY
STRUCTURE BACKFILL (BRIDGE)	196	CY
FURNISH STEEL PILING (HP 10 X 57)	900	LF
DRIVE STEEL PILE (HP 10 X 57)	32	EA
STRUCTURAL CONCRETE, BRIDGE FOOTING	400	CY
STRUCTURAL CONCRETE, BRIDGE	15	CY
DRILL AND BOND DOWEL	1,460	LF
BAR REINFORCING STEEL, (BRIDGE)	94,900	LB
ASPHALT MEMBRANE WATERPROOFING	110	SQFT
COLUMN CASING	45,900	LB



TYPICAL SECTION
1"=20'

Notes:
1. Steel casing at all columns
2. Retrofit all footings
3. Extend Abut seat & shear key at obtuse corner of the abutment
4. Point "Bridge No. 57-0595" & "Friars Road Overcrossing"



INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN
2	ABUTMENT RETROFIT DETAILS
3	BENT RETROFIT DETAILS
4	BENT FOOTING RETROFIT DETAILS
5	STEEL COLUMN CASINGS
6	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS
7	LOG OF TEST BORINGS 1 OF 2
8	LOG OF TEST BORINGS 2 OF 2

STANDARD PLANS DATED JULY 1992

BD-13 BRIDGE DETAILS

STANDARD PLAN SHEET NO.
DETAIL NO.

PLAN
1"=20'

AS BUILT
CONTRACT NO. 11-206104
DATE 12/9/97
CORRECTIONS BY [signature] Smith-Emery Co. Contractors

NO AS BUILT CHANGES This Sheet

Note: For "General Notes", see "ABUTMENT RETROFIT DETAILS" sheet

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

DESIGN ENGINEER

DESIGN	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	LOAD FACTOR DESIGN			
DETAILS	BY Jim Murphy/E. Tapalla	CHECKED Elias Kurani	LAYOUT	BY Joe Comiteri	CHECKED K. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.Y. Le	SPECIFICATIONS	BY Jill Sewell	PLANS AND SPECS COMPARED Jill Sewell	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	POST MILE
57-0595	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

GENERAL PLAN

REVISION DATES (PRELIMINARY STAGE ONLY)								SHEET	OF
5-3-96	5-7-96	5-21-96	5-28-96	6-3-96	6-4-96	6-5-96	6-6-96	1	8

USERNAME => TSDKD
1_go26143515

DATE PLOTTED => 30-JAN-1996
TIME PLOTTED => 14:36

ClibPDF - www.fastio.com

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	133	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER
RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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

GENERAL NOTES
LOAD FACTOR DESIGN

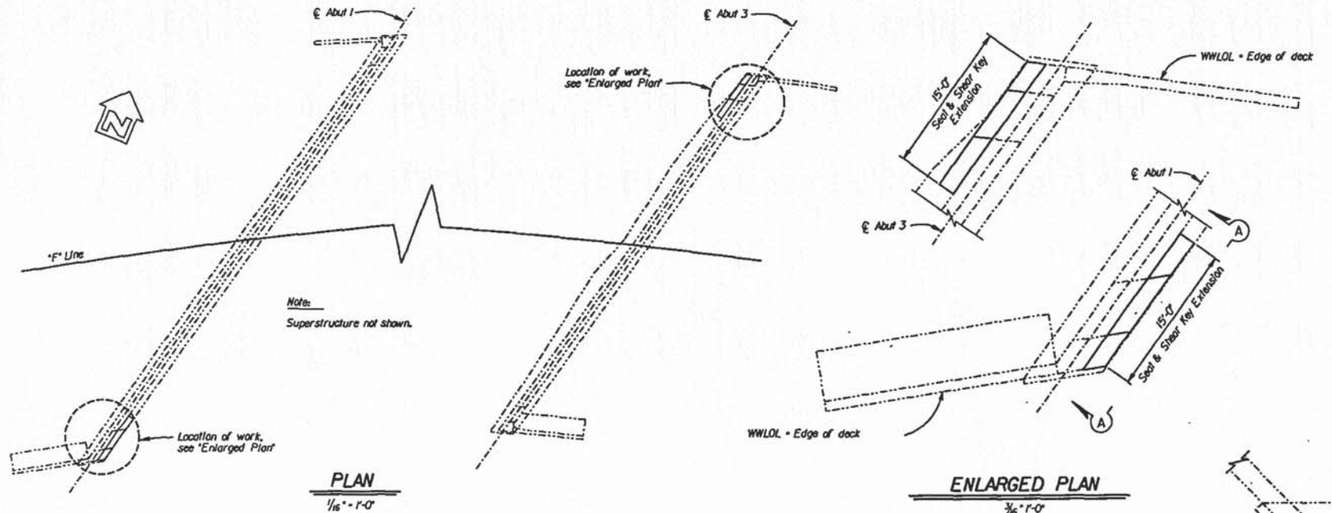
DESIGN: BRIDGE DESIGN SPECIFICATIONS (1983 AASHTO with Interims and Revisions by CALTRANS)

SEISMIC LOADING: Peak Rock Acceleration = 0.6 g
Depth of Alluvium 80-150 ft.

REINFORCED CONCRETE: (EXIST) f_y = 40,000 psi
f'_c = 5,000 psi (assumed)

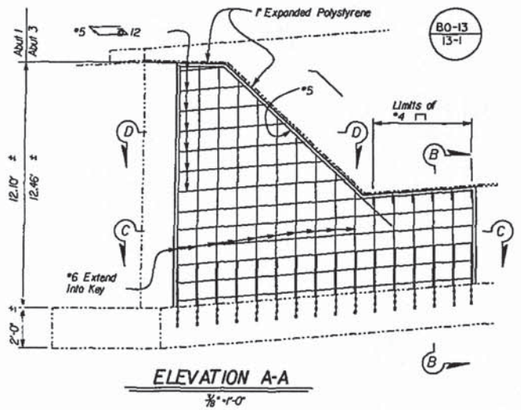
(NEW CONST) f_s = 60,000 psi
f'_c = 4,000 psi

STRUCTURAL STEEL: f_y = 36,000 psi



PLAN
1/16" = 1'-0"

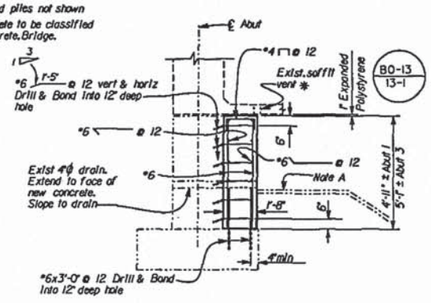
ENLARGED PLAN
3/16" = 1'-0"



ELEVATION A-A
3/8" = 1'-0"

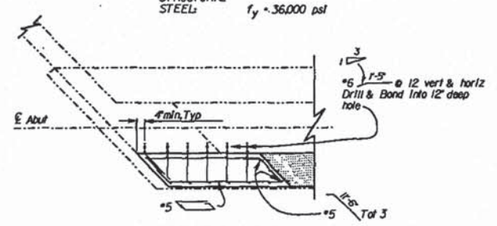
Notes:
*Elevation A-A (Abutment 1) shown, Abutment 3 similar
Barrier railing and piles not shown
All additional concrete to be classified as Structural Concrete, Bridge.

* For Vent Detail see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet.

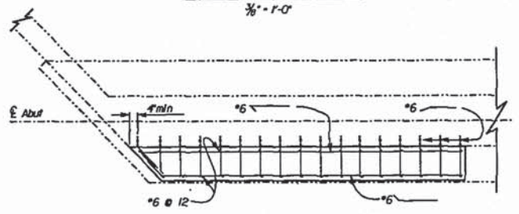


SECTION B-B
3/8" = 1'-0"

Note A:
Remove and replace slope paving. For details, see "LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS" sheet



SECTION D-D
3/8" = 1'-0"



SECTION C-C
3/8" = 1'-0"

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
ABUTMENT RETROFIT DETAILS

	BY	CHECKED
DESIGN	J. Casillari	H. Banakdar/E. Kuroni
DETAILS	K. Endow/D. Kubochi	H. Banakdar/E. Kuroni
QUANTITIES	J. Victor	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 2

DS 0130 2039 (CADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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28-JAN-1998 13:

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163.805	4.4/7.0, 20.5/20.7	134	162

Ramin Rashedi
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER RAMIN RASHEDI No. 37070 Exp. 6-30-08 CIVIL STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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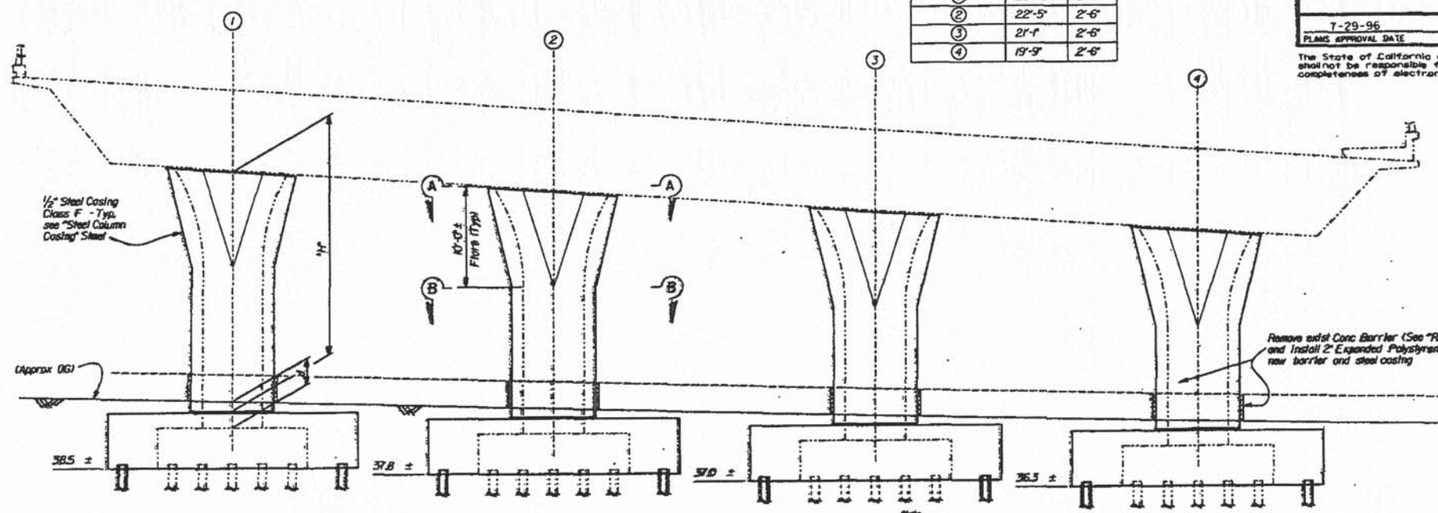
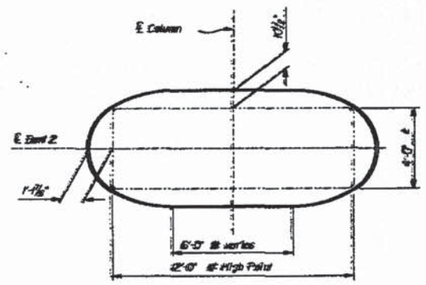
TABLE

COLUMN NO.	H±	d±
1	23'-10"	2'-8"
2	22'-5"	2'-6"
3	21'-1"	2'-6"
4	19'-9"	2'-6"

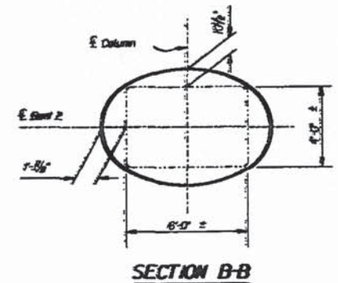


BENT ELEVATION
3/16" = 1'-0"

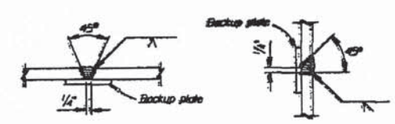
Note:
- For Concrete Barrier replacement, see "ROAD PLANS".
- Casing varies linearly between beginning and end of column flare



SECTION A-A
3/8" = 1'-0"



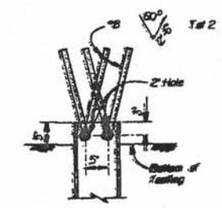
SECTION B-B
3/8" = 1'-0"



SINGLE VEE-GROOVE
SINGLE BEVEL-GROOVE

PILE WELDING DETAIL-BUTT JOINTS

Notes:
1. Single Vee-Groove permitted for all positions.
2. Single Bevel-Groove permitted for horizontal joints only.



STEEL PILE ANCHOR

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT RETROFIT DETAILS

DESIGN	BY J. Cavalieri	CHECKED H. Bonakdar/E. Kurani	
DETAILS	BY K. Endow/C. H. Mamerli	CHECKED H. Bonakdar/E. Kurani	
QUANTITIES	BY J. Victor	CHECKED K.T. Le	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 3 OF 8

USERNAME => tabxp
3_bnt_ret_26143657

DATE PLOTTED => 28-Jul-1996
TIME PLOTTED => 14:40

ClibPDF - www.fastio.com

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.1/0.0 20.5/20.7	135	162

Ramin Rasheed
REGISTERED ENGINEER - CIVIL

RAMIN RASHEDI
No. 37070
Exp. 6-30-00
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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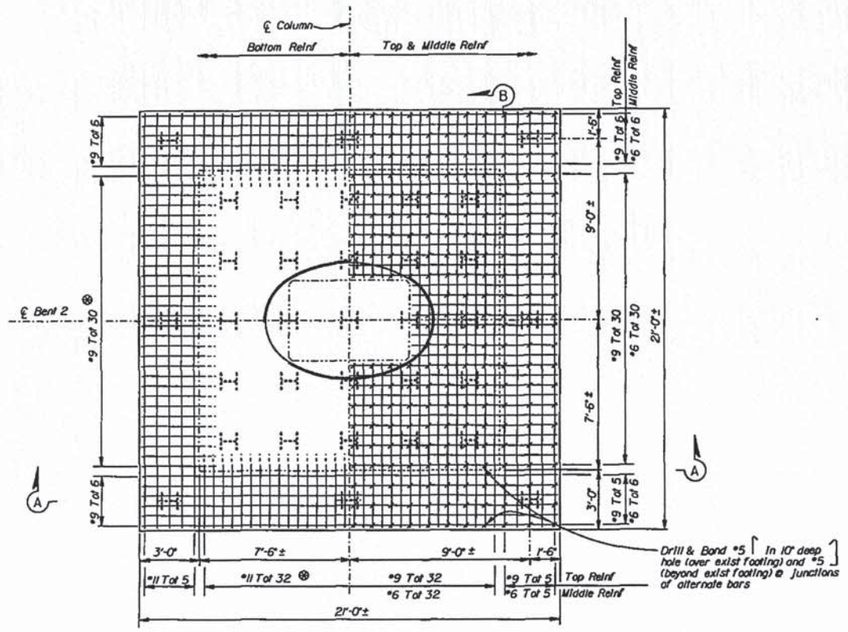
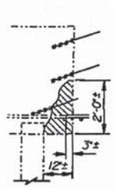
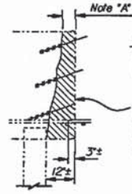


TYPICAL FOOTING PLAN
3/8" = 1'-0"

⊗ Butt weld to exist



ALTERNATIVE 1



ALTERNATIVE 2

DETAIL "A"
No Scale

Note "A"
Dimension may be increased up to 12" at Contractors option.

Remove portion of exist ftg to allow for extension of exist reinf by butt weld - do not remove beyond edge of exist piles

Notes:

All additional concrete around ftgs. is to be classified as Structural Concrete, Bridge Footing.

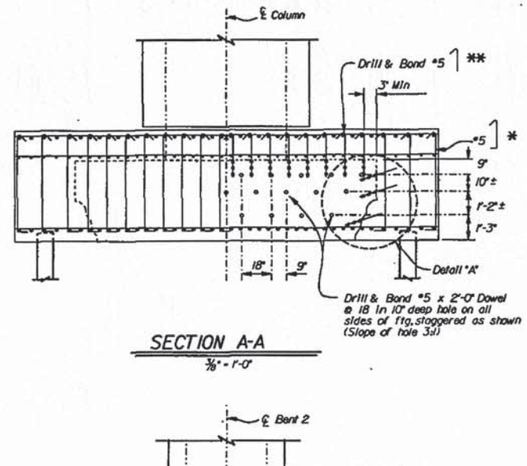
Footing reinforcement and dimensions symmetrical about ℄ Column and ℄ Bent.

Mechanical butt splices may be used in lieu of butt welds noted.

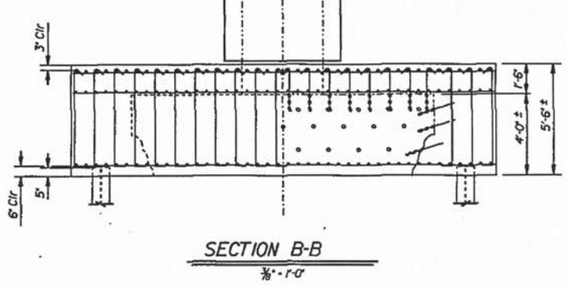
Roughen interface between existing and new footing concrete to an amplitude of 1/4"

For pile details, see "Bent Retrofit Details" Sheet.

* Hook outer bars
** If Alternative 2 of Detail "A" is used first row of drill & bond ties are to be replaced with full height ties similar those in ftg extension



SECTION A-A
3/8" = 1'-0"



SECTION B-B
3/8" = 1'-0"

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

NO AS BUILT CHANGES

DESIGN	BY J. Camilleri	CHECKED	H. Banakdar/E. Kurani
DETAILS	BY E. Endow/E. Tapalla	CHECKED	H. Banakdar/E. Kurani
QUANTITIES	BY J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO.	57-0595
POST MILE	4.4

EARTHQUAKE RETROFIT-PROJECT NO. 272
FRIARS ROAD OVERCROSSING
BENT FOOTING RETROFIT DETAILS

DS 050 2139 ICADD 10/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 4 OF 8

USERNAME => tsoxp
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DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 14:40

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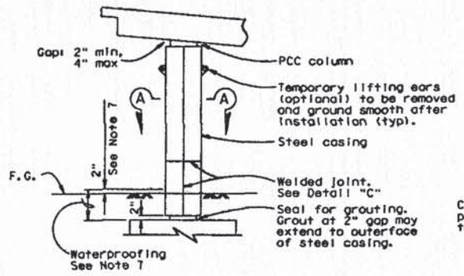
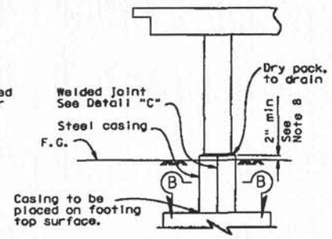
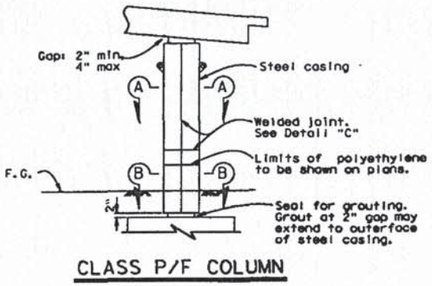
RELEASED 8-12-93



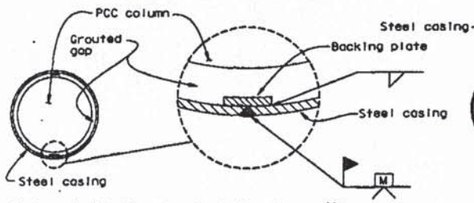
CLASS F COLUMN



CLASS P COLUMN

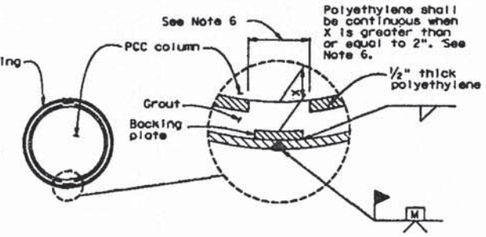


CLASS P/F COLUMN



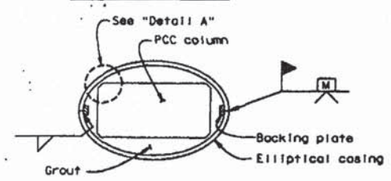
Minimum inside diameter of steel casing = 1½" greater than nominal column diameter for Class F and 2½" for Class P/F.

SECTION A-A
ROUND COLUMN



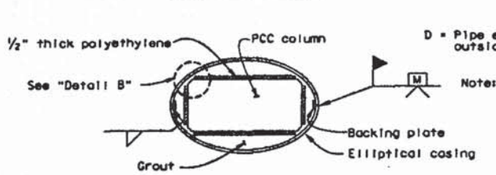
Minimum inside diameter of steel casing = 2½" greater than nominal column diameter for Class P and Class P/F.

SECTION B-B
ROUND COLUMN



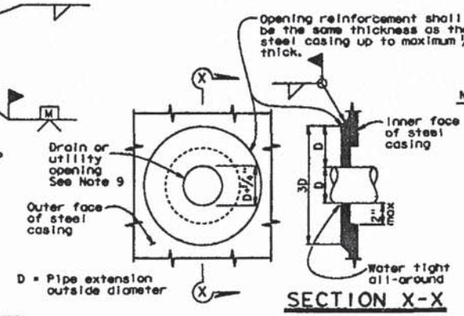
SECTION A-A
RECTANGULAR COLUMN

DETAIL A



SECTION B-B
RECTANGULAR COLUMN

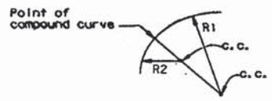
DETAIL B



SECTION X-X

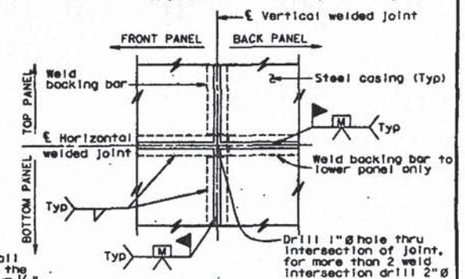
Note: Opening reinforcement required for drain or utility openings larger than 4".

CASING OPENING
No scale



Radii R1 & R2 to be determined by the Contractor subject to the approval of the Engineer.

ELLIPTICAL CASING DETAIL
CLASS P, F AND P/F COLUMN



(TWO WELDED INTERSECTION JOINT)
DETAIL C
No Scale

Notes:

1) For varying thickness steel casing inside surface to remain flush. Minimum clearance from PCC column to casing shall be maintained.
2) Appropriate injection nozzles to be provided on casing, but removed and ground flush following completion of grouting operation.
3) All voids between steel casing and polyethylene (Class P and Class P/F), and steel casing and PCC column (Class F) to be filled with grout.
4) Location and number of vertical and horizontal welds to be determined by the Contractor, and subject to the approval of the Engineer. The location of casing welds are for illustration. No skip welds allowed.
5) Circular steel casing to be ¼" thick minimum for casings with a 4'-4" diameter or less; all other steel casings to be ⅜" thick unless noted differently on contract plans. Backing plates to be the same thickness as casing up to maximum ½" thick.
6) Contractor shall remove 12" polyethylene strip behind backing plate if backing plate is closer than 1½" from polyethylene.
7) Waterproof limits for steel casings. Typical for Types "P", "F" and "P/F".
8) Minimum length of Types "P" and "F" casing shall be 1.50 times the largest dimension of prismatic section of column, or 2" above finished grade whichever is greater. Lengths other than the specified minimum shall be shown on Detail sheets.
9) For pipe extensions, opening shall be no more than ¼" greater than the pipe extension diameter. For other openings, the opening diameter to be determined by the Engineer.

NO AS BUILT CHANGES

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/1.0 20.5/20.7	136	162

Ronna Rabeder
REGISTERED ENGINEER - CIVIL
No. 37870 Exp. 6-30-98 CIVIL STATE OF CALIFORNIA
7-29-96
PLANS APPROVAL DATE

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DATE PLOTTED => 26-JUN-1996
TIME PLOTTED => 16:45

EARTHQUAKE RETROFIT PROJECT NO. 272
FRIARS ROAD OVERCROSSING
STEEL COLUMN CASINGS

STANDARD DRAWING			
FILE NO. XS 12-77	DESIGN BY BRIAN MAHONEY	CHECKED R. J. ZELINSKI	APPROVED RECOMMENDED BY
DRAWING DATE 8/93	DETAILS BY K. CHRISTOPHER	CHECKED PAT HIPLEY	
	SUBMITTED BY R. J. ZELINSKI		

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

CU 11
EA 206101

BRIDGE NO. 57-0595
POST MILE 4.4

OVERLEAF PRINTS BEARING EARLIER REVISION DATES ——— BY

REVISION DATES (PRELIMINARY STAGE ONLY)
2-96

SHEET 5 OF 8

USERNAME => TSDKD
S_steel_002143954

DS 050 DATA ICADD 10/89

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163, 805	4.4/7.0, 20.5/20.7	137	162

Ramin Rasheen
REGISTERED ENGINEER - CIVIL

REGISTERED PROFESSIONAL ENGINEER — RAMIN RASHEEN — No. 37070 — Exp. 6-30-00 — CIVIL — STATE OF CALIFORNIA

7-29-96
PLANS APPROVAL DATE

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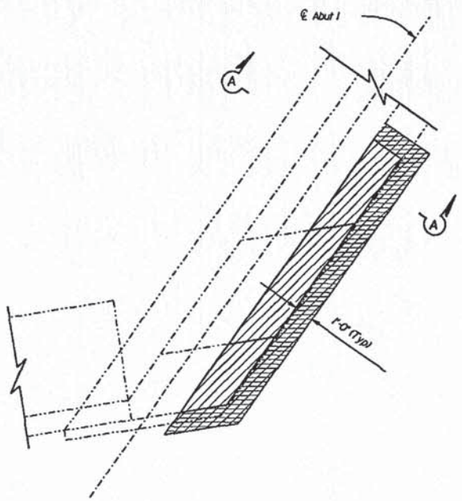
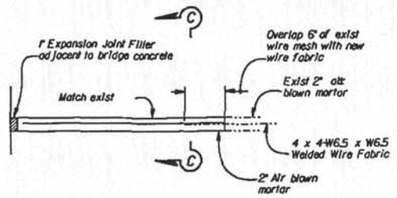


PLAN
SEAT & SHEAR KEY EXTENSION
3/8"=1'-0"

Note:
Abut 1 shown,
Abut 3 similar



SLOPE PAVEMENT REPLACEMENT DETAIL
1/2"=1'-0"

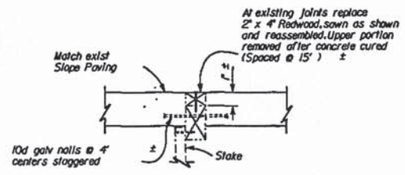
Note:
Limits for removal and replacement of slope paving shall be the same as horizontal limits shown for excavation and backfill for seat and shear key extension

LEGEND

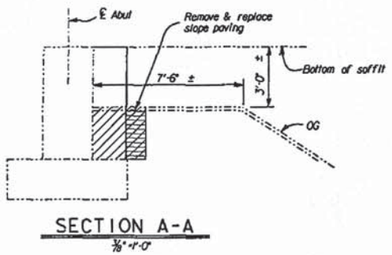
- Indicates Existing Structure
- Indicates New Construction
- Indicates Structure Excavation
- Indicates Structure Backfill

ABBREVIATIONS

OG	Original Ground
FS	Planned Finished Surface
GP	Planned Graded Plane

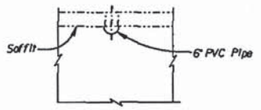


SECTION C-C
No Scale

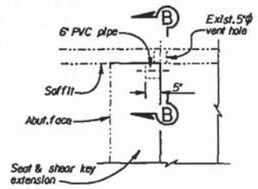


SECTION A-A
3/8"=1'-0"

Where seat & shear key extension interferes with existing vent holes, vent shall be maintained open with the installation of a 6"ϕ PVC pipe or similar device.

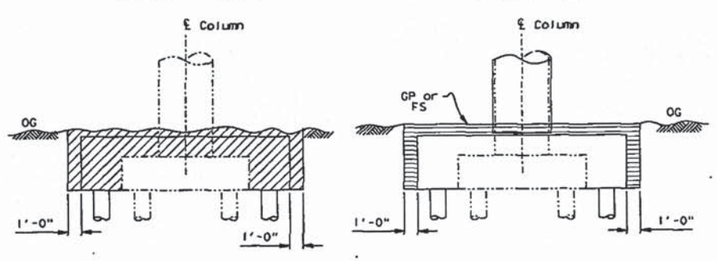


SECTION B-B
No Scale



VENT DETAIL
No Scale

EXCAVATION ——— BACKFILL



COLUMN CASING & FOOTING RETROFIT
NO SCALE

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

NO AS BUILT CHANGES

EARTHQUAKE RETROFIT-PROJECT NO. 272

FRIARS ROAD OVERCROSSING

LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL LIMITS

DESIGN	J. Camilleri	CHECKED	H. Bonakdar/E. Kurani
DETAILS	Dale Kubochi	CHECKED	H. Bonakdar/E. Kurani
QUANTITIES	J. Victor	CHECKED	K.T. Le

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 11

BRIDGE NO. 57-0595
POST MILE 4.4

CU 11
EA 206101

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

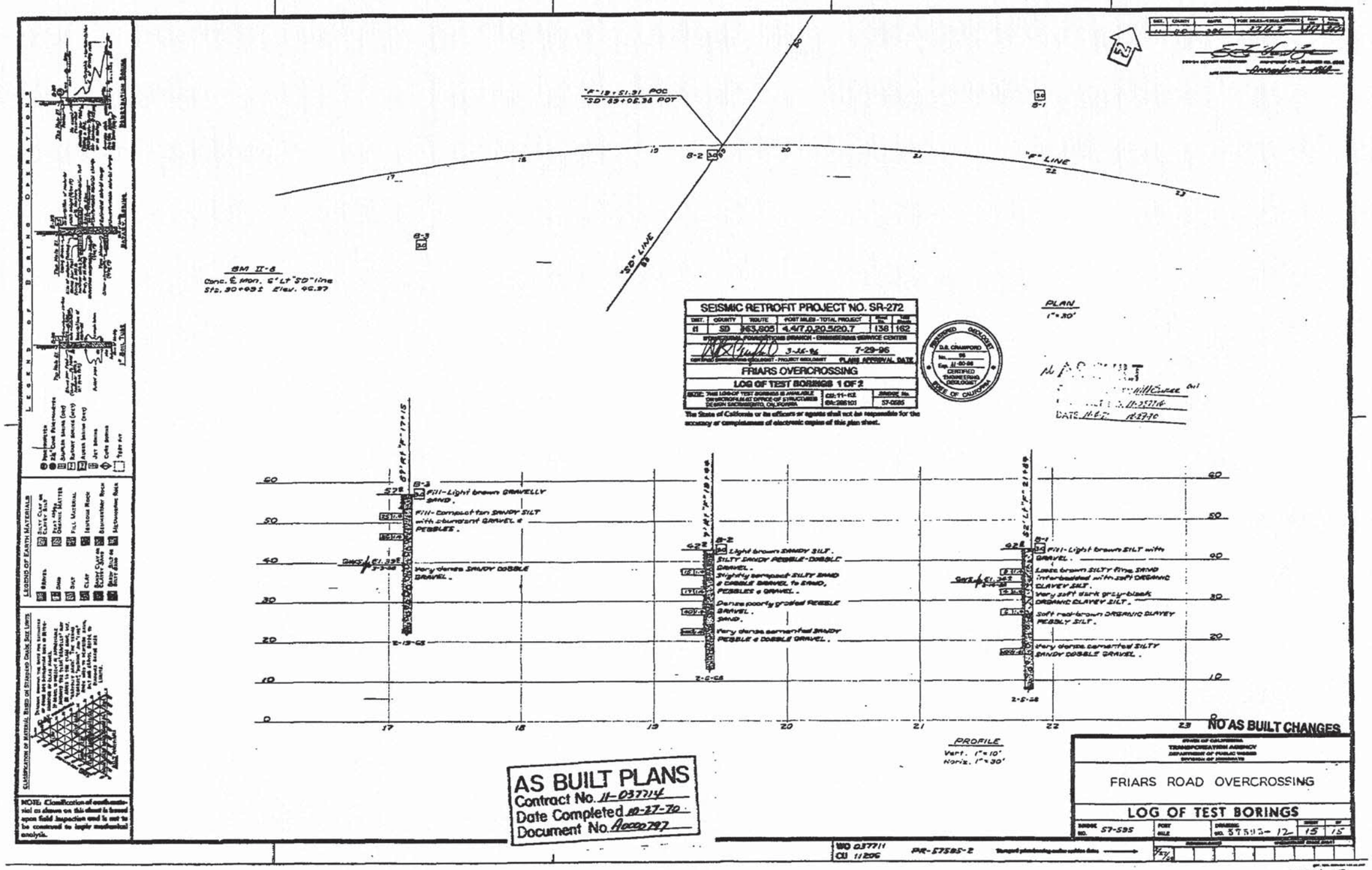
SHEET 6

DS 050 2331 (CADD 8/95)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

USERNAME => tsbxp
d_limits_a26144137

ClibPDF - www.fastio.com



SEISMIC RETROFIT PROJECT NO. SR-272

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
11	SD	163,805	4.4/7.0,20.5/20.7	138	162

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

3-26-96 7-29-96

CERTIFIED ENGINEERING GEOLOGIST - PROJECT GEOLOGIST PLANS APPROVAL DATE

FRIARS OVERCROSSING

LOG OF TEST BORINGS 1 OF 2

NOTE: THIS LOG OF TEST BORINGS IS AVAILABLE ON MICROFILM AT OFFICE OF STRUCTURES DESIGN SACRAMENTO, CALIFORNIA

CU: 11-112 EA: 286101 BRIDGE No. 57-0585

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

REGISTERED GEOLOGIST D.S. CRAWFORD No. 98 Exp. 11-30-96 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

AS BUILT

DATE 11-6-7 10-27-70

AS BUILT PLANS
Contract No. 11-037714
Date Completed 10-27-70
Document No. A0000797

NO AS BUILT CHANGES

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

FRIARS ROAD OVERCROSSING

LOG OF TEST BORINGS

BRIDGE NO. 57-595 POST MILE DRAWING NO. 57595-12 SHEET 15 OF 15

WO 037711
CU 11206
PR-57595-2

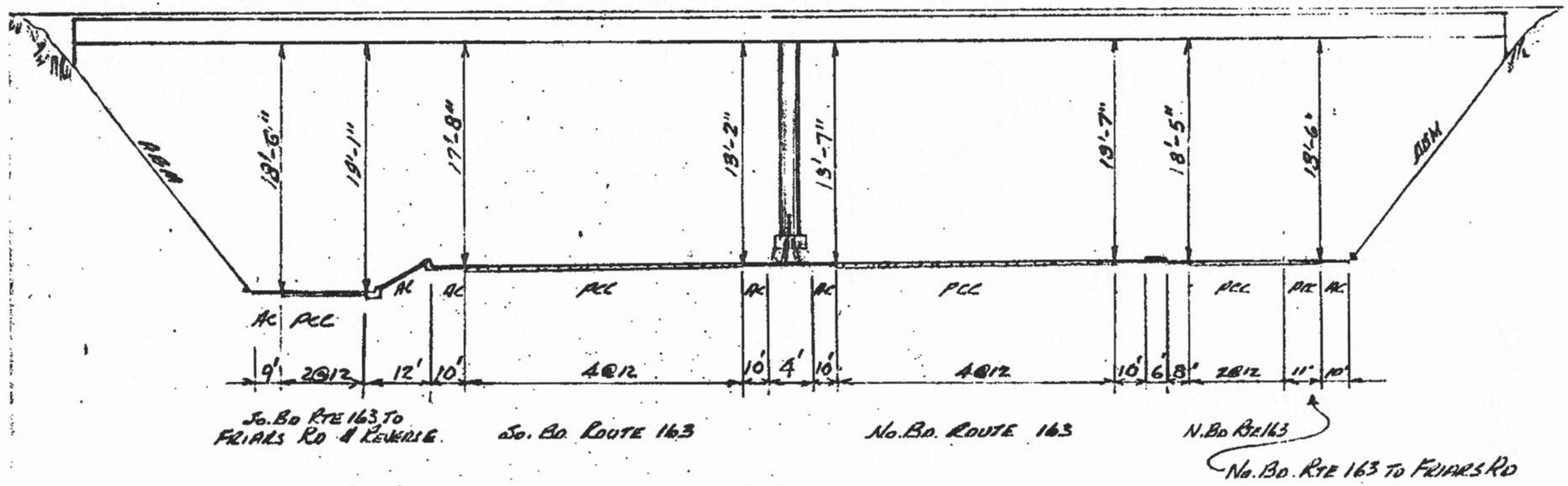
SHEET 7 OF 8

ClibPDF - www.fastio.com

ClibPDF - www.fastio.com

ClibPDF - www.fastio.com

CLEARANCE DIAGRAM



LOOKING AHEAD (NORTH) ON ROUTE 163

FRIARS ROAD OVERCROSSING
11-SD-163-4.37-SD
Bu. No. 57-595

M. I. FOREL
* J. BORIK

Rev. AUG. 1978
Rev. 6/12/85

APPENDIX C

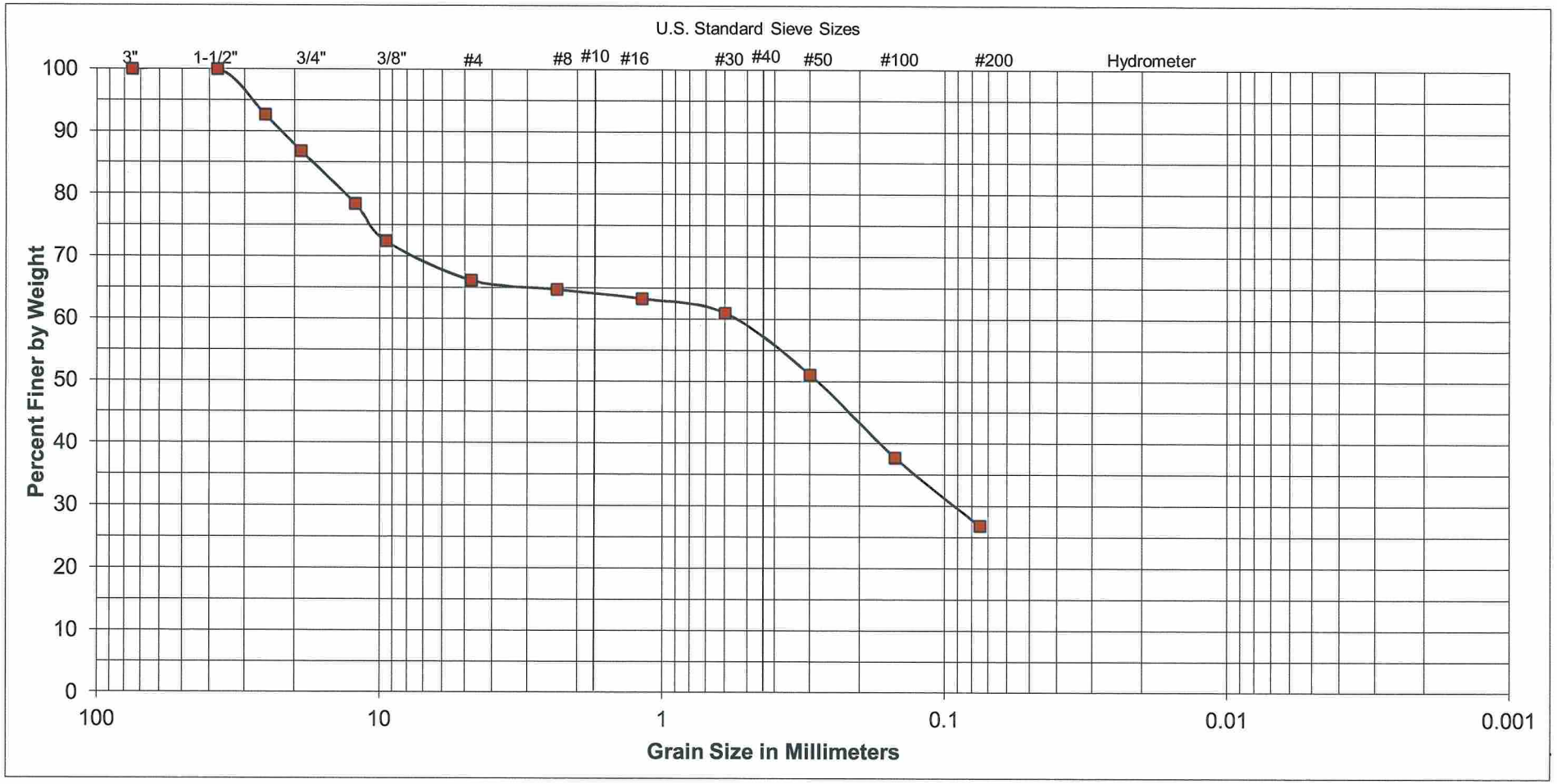
APPENDIX C

LABORATORY TEST RESULTS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
EAST GROUND ANCHOR WALL
(BRIDGE NO. 57E0127)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	21½ feet to 23 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

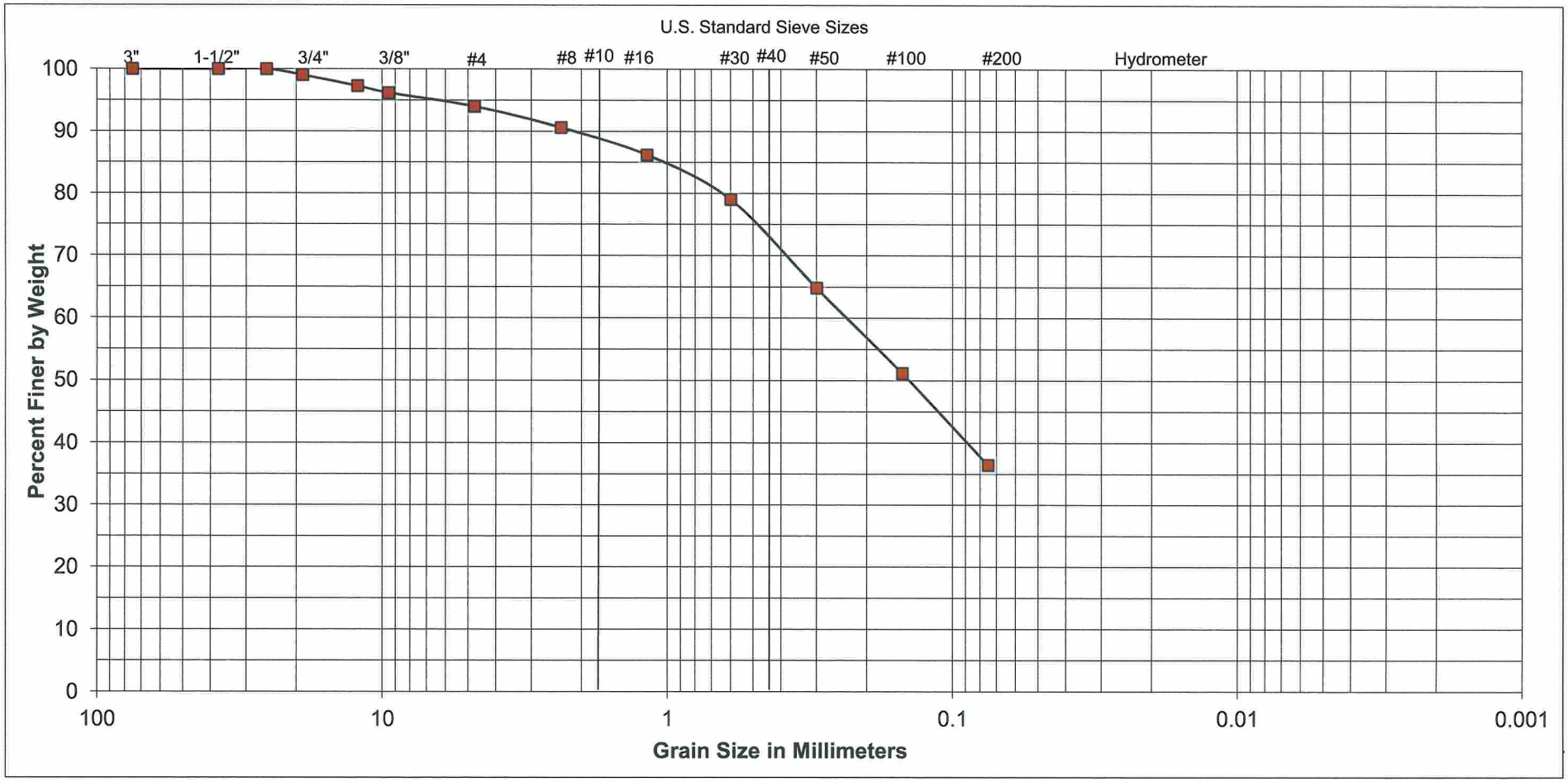
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-7

Figure C1



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	32½ f.t to 34½ ft.

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

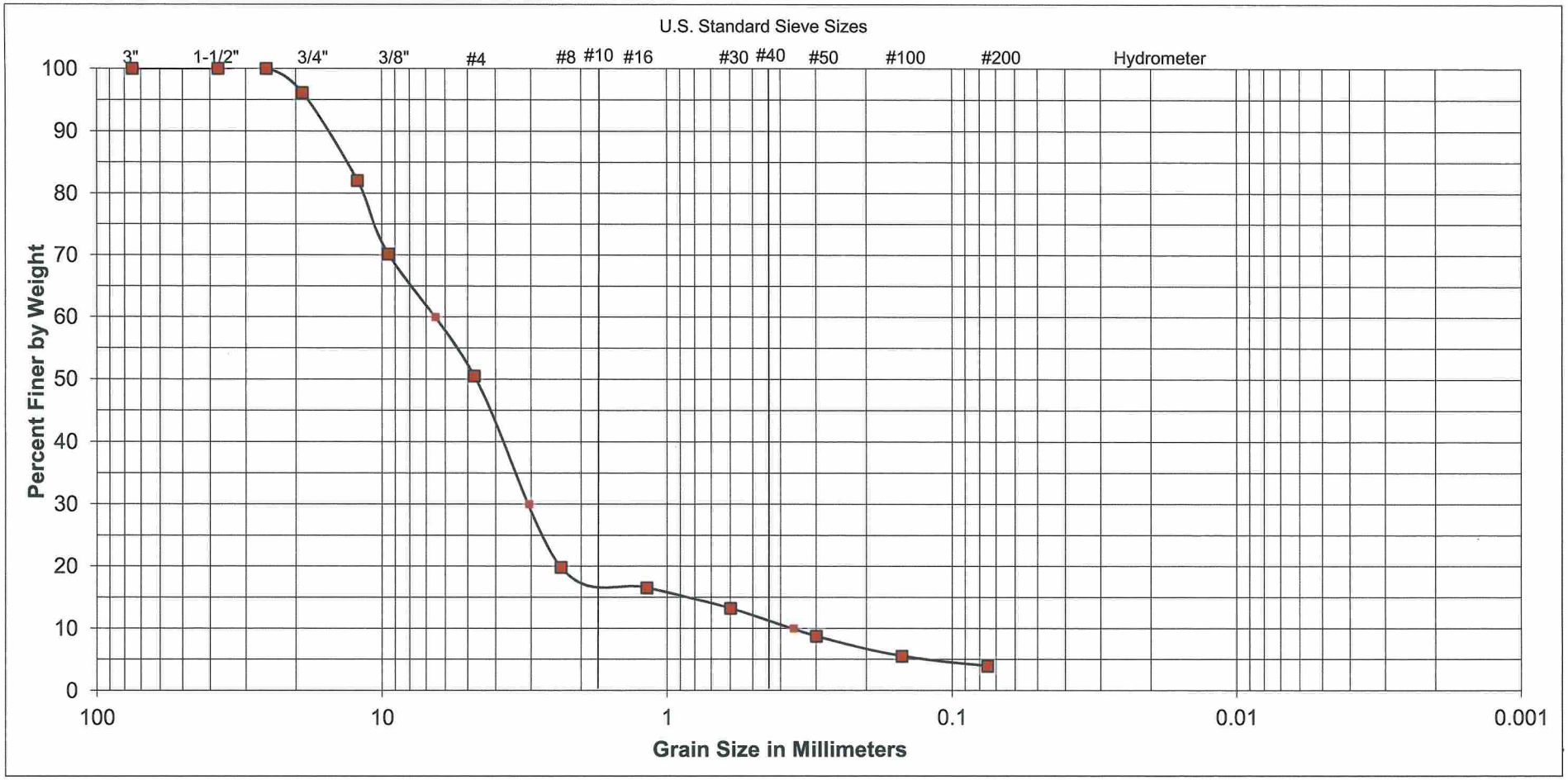
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-8

Figure C2



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	35½ feet

UNIFIED SOIL CLASSIFICATION:	SP
DESCRIPTION:	POORLY-GRADED SAND with GRAVEL

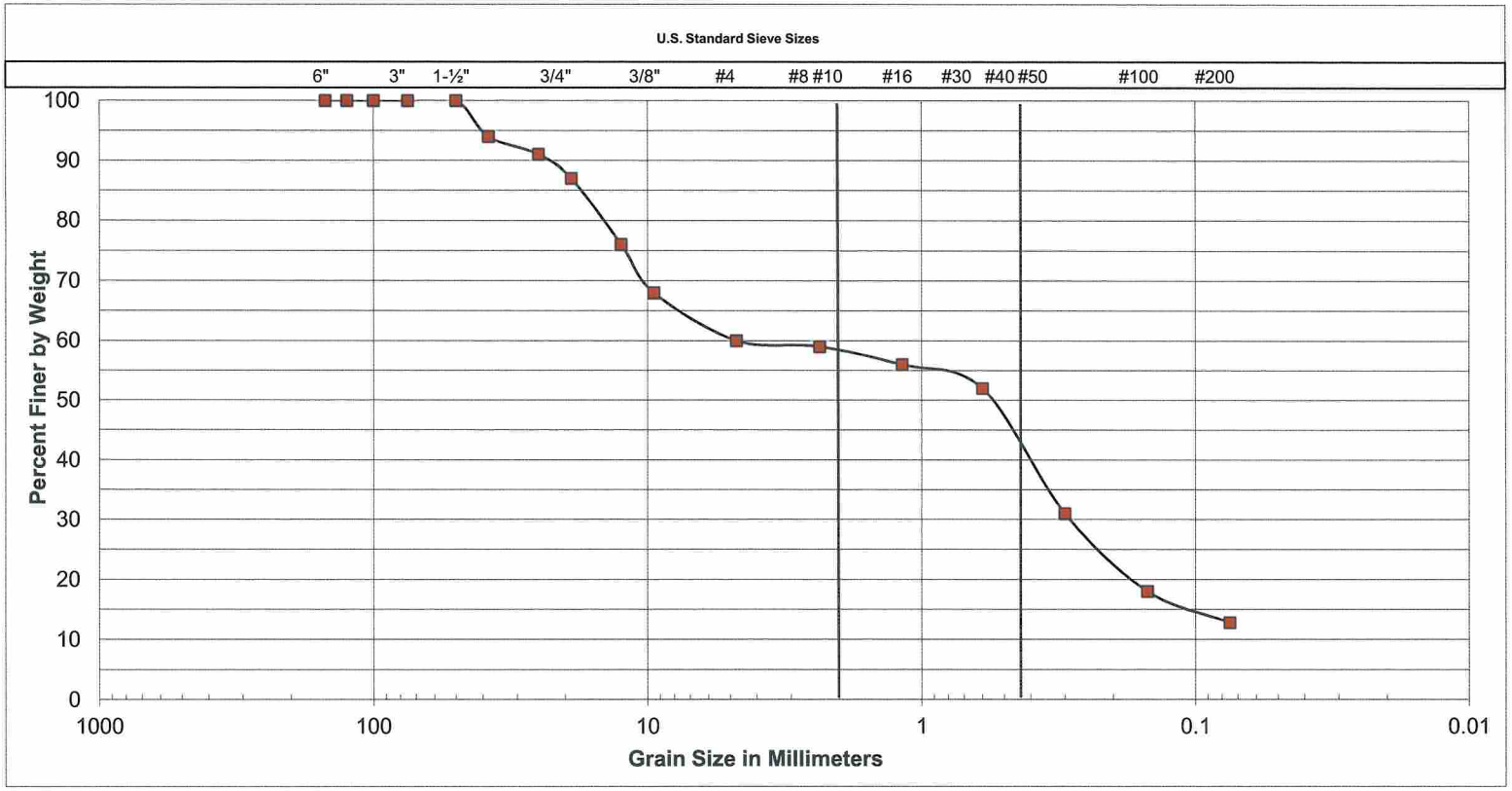
ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-9

Figure C3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 1 foot to 5 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

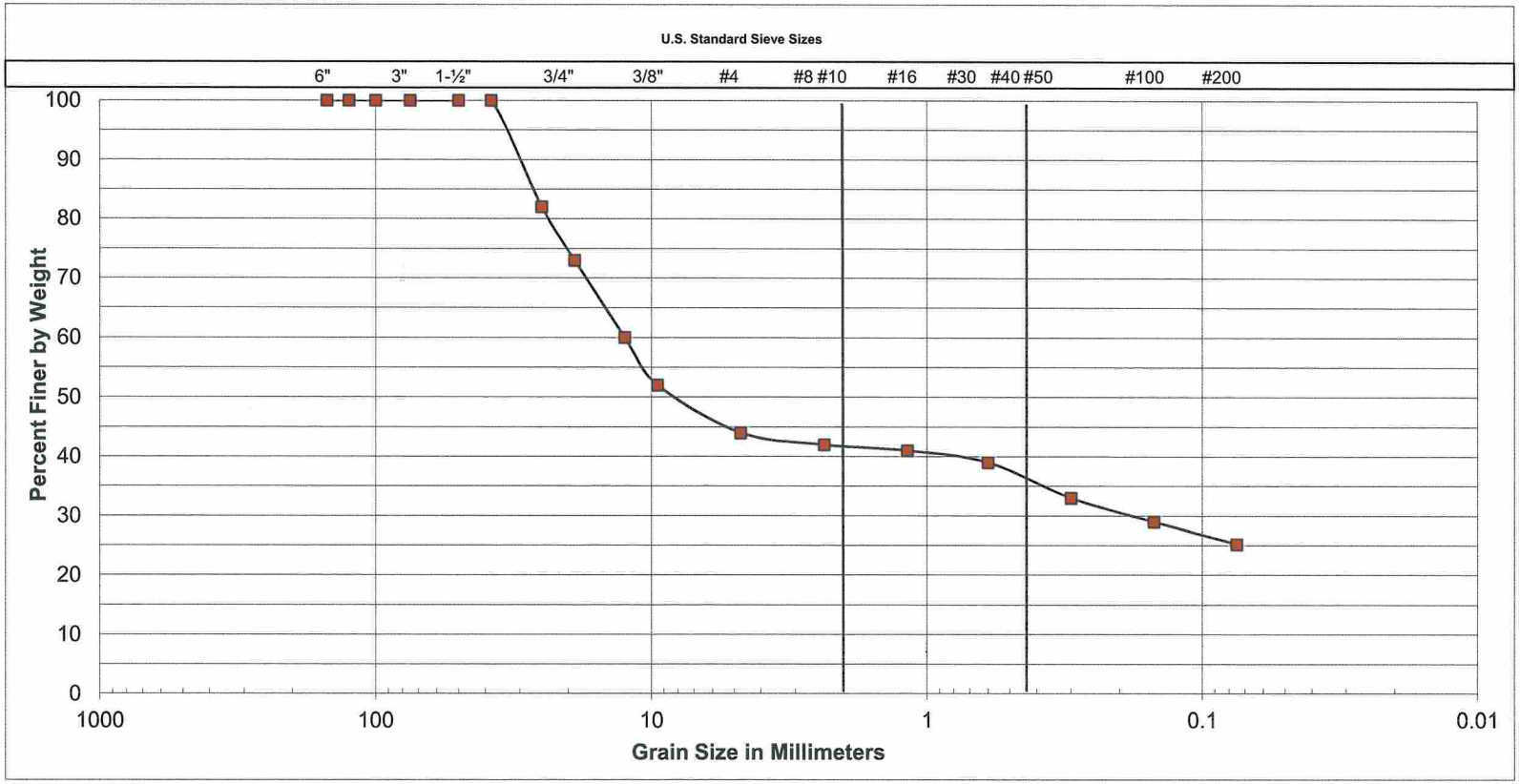
ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-60

Figure C4



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 30 feet 35 feet

UNIFIED SOIL CLASSIFICATION:	GC
DESCRIPTION	CLAYEY GRAVEL with SAND

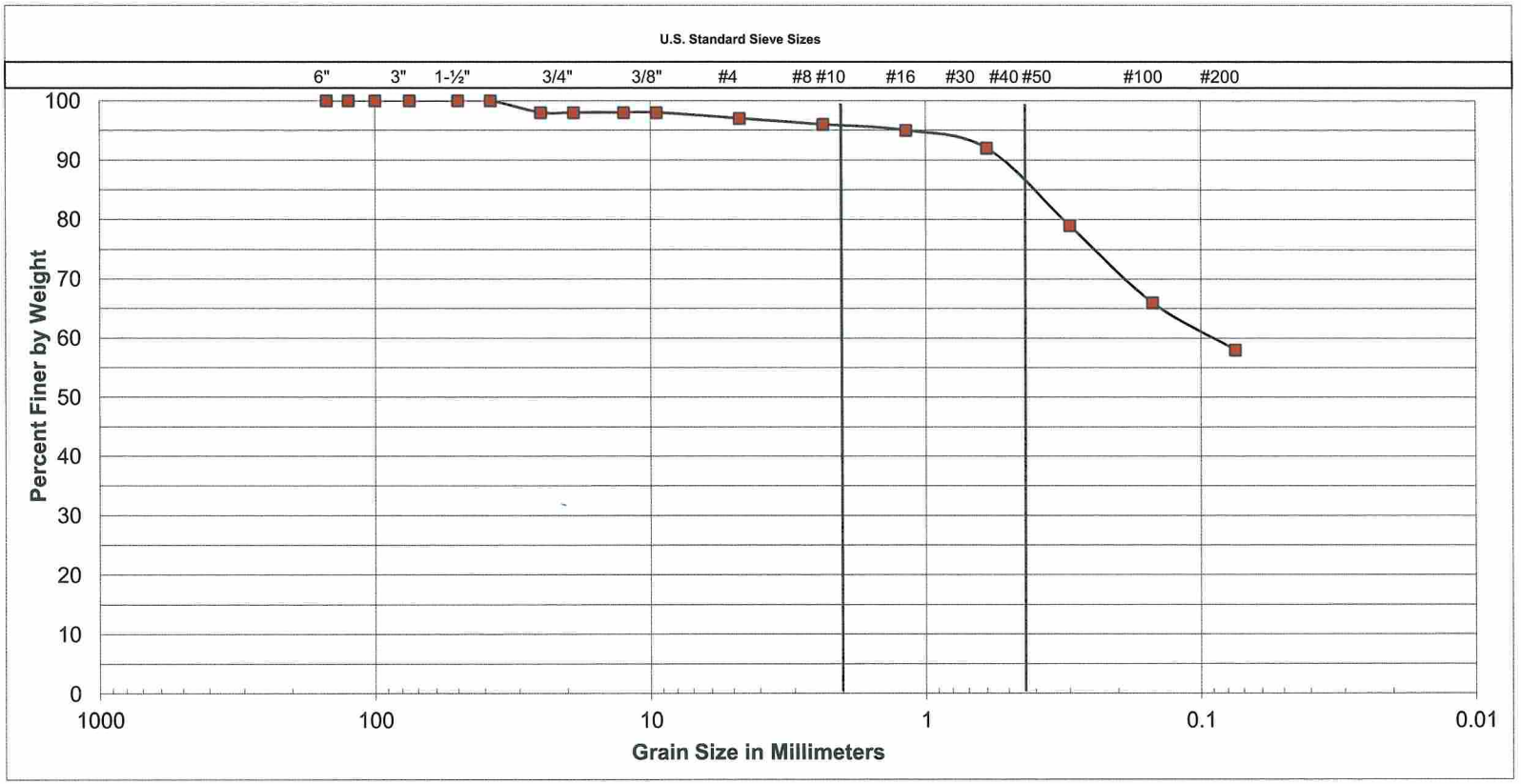
ATTERBERG LIMITS	
LIQUID LIMIT	49
PLASTIC LIMIT	20
PLASTICITY INDEX	29

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-61

Figure C5



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 45 feet to 50 feet

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY LEAN CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	45
PLASTIC LIMIT	19
PLASTICITY INDEX	26

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-62

Figure C6

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-03-001 at 10 feet	3100	6.7	0.001	0.002
A-03-001 at 30 feet	-	7.5	0.005	0.012
A-03-002 at 1 ft. to 3½ ft.	1870	8.7	0.007	0.001
A-03-002 at 12½ feet	-	9	0.001	-
A-03-002 at 26 ft. to 28 ft.	935	8.4	0.017	0.015
A-03-003 at 1 ft. to 3½ ft.	2204	8.1	0.008	0.007
A-03-003 at 32 ft. to 34 ft.	1336	7.7	0.025	0.006
A-03-003 at 45 feet	-	7.1	0.016	0.023
A-03-009 at 1 ft. to 3½ ft.	1536	8.8	0.007	0.003
A-03-012 at 1 ft. to 3½ ft.	1403	8.4	0.011	0.004
A-03-015 at 1 ft. to 3½ ft.	868	7.4	0.037	0.018
A-03-017 at 1 ft. to 3½ ft.	1136	8.9	0.049	0.003

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NUMBEF	1111191-1	FIGURE:	V-68

Figure C7

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-12-034 at 25 feet	1800	8.2	0.013	0.007
R-12-038 at 4 ft. to 9 ft.	2300	8.2	0.011	0.004
R-12-038 at 80 ft.	1500	8.8	0.017	0.005
R-12-041 at 10 ft.	1120	7.8	0.018	0.006
A-12-044 at 1 ft. to 5 ft.	1750	9.2	0.003	0.002

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

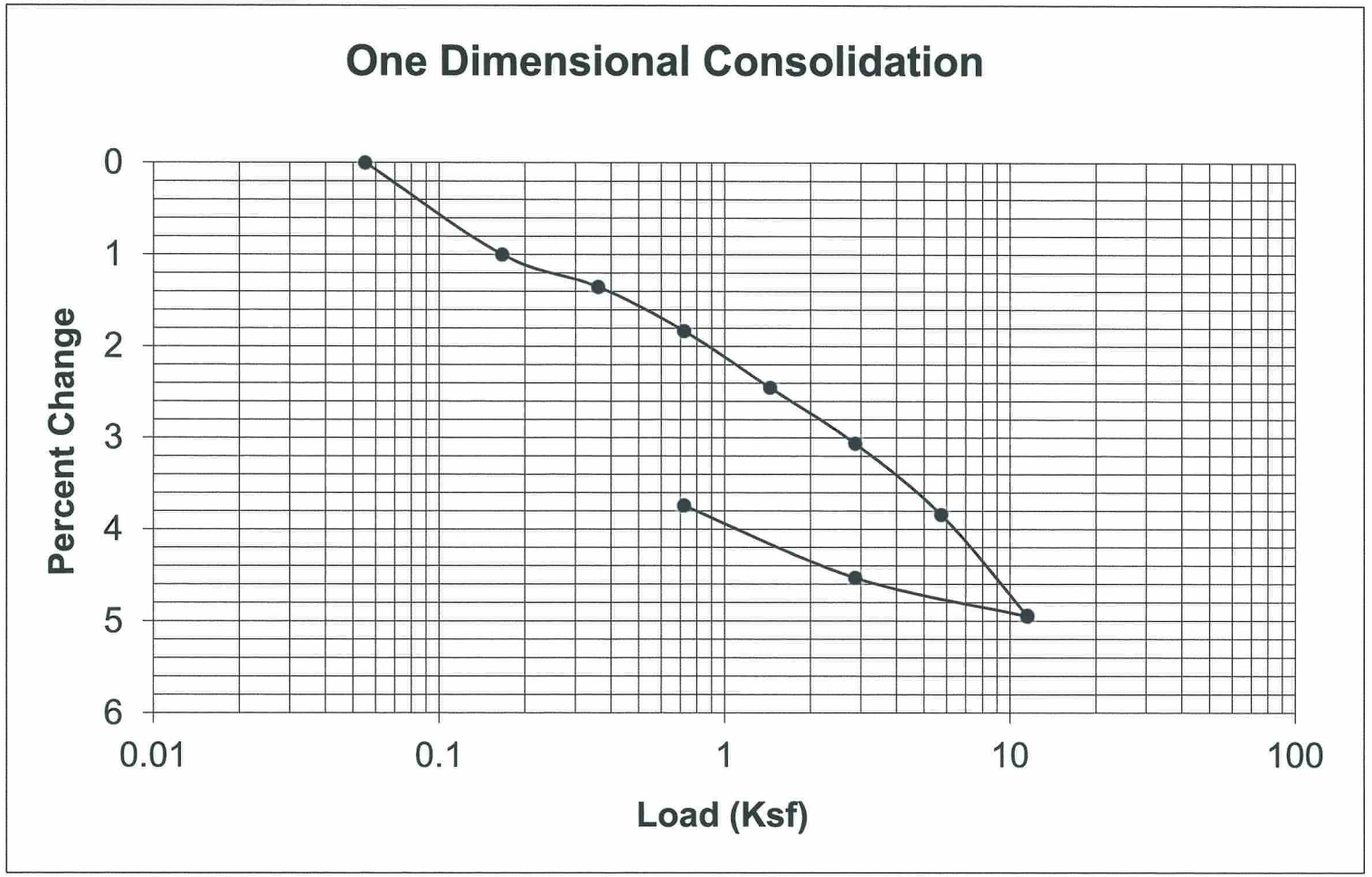
Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	BY:	GF/EL	DATE:	6/28/2012
	JOB NO.:	1111191-1	FIGURE:	V-69

Figure C8

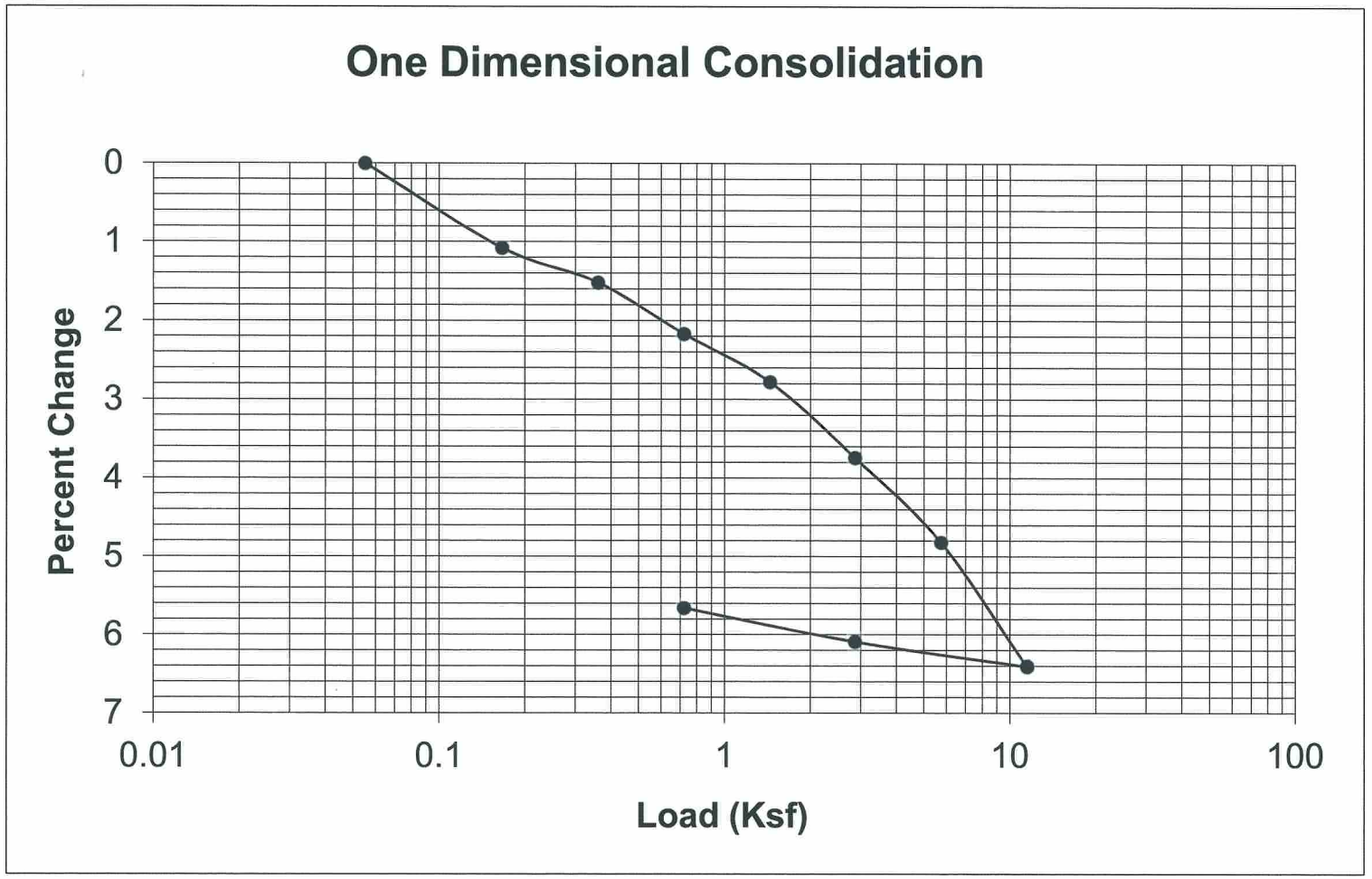
A-03-003 at 20 feet



SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163			
	BY:	AKN	DATE:	6/28/2012
	JOB NUMBER:	1111191-1	FIGURE:	V-70

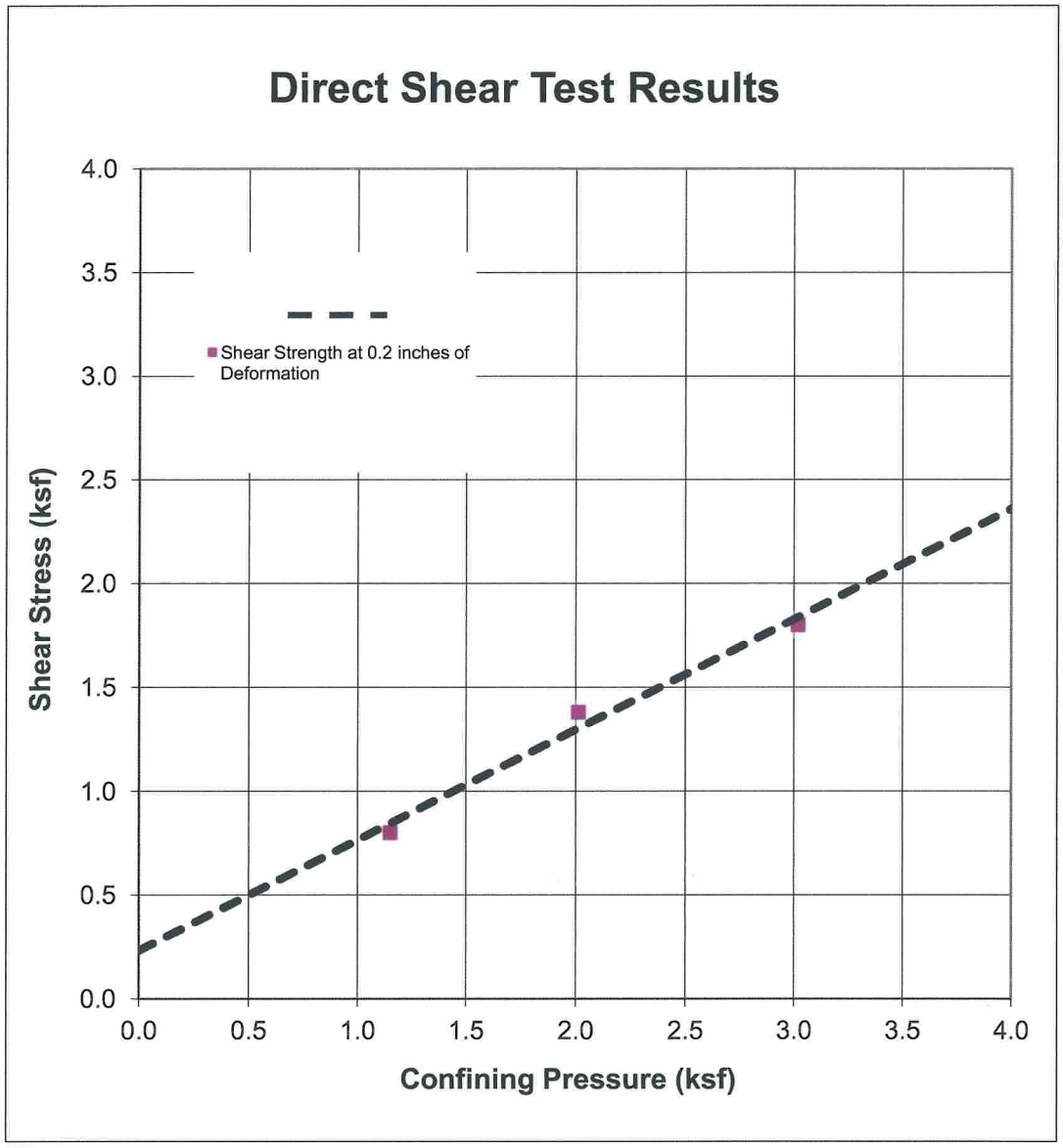
Figure C9

A-03-003 at 25 feet



SCST SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163
	BY: AKN DATE: 6/28/2012
	JOB NUMBER: 1111191-1 FIGURE: V-71

Figure C10



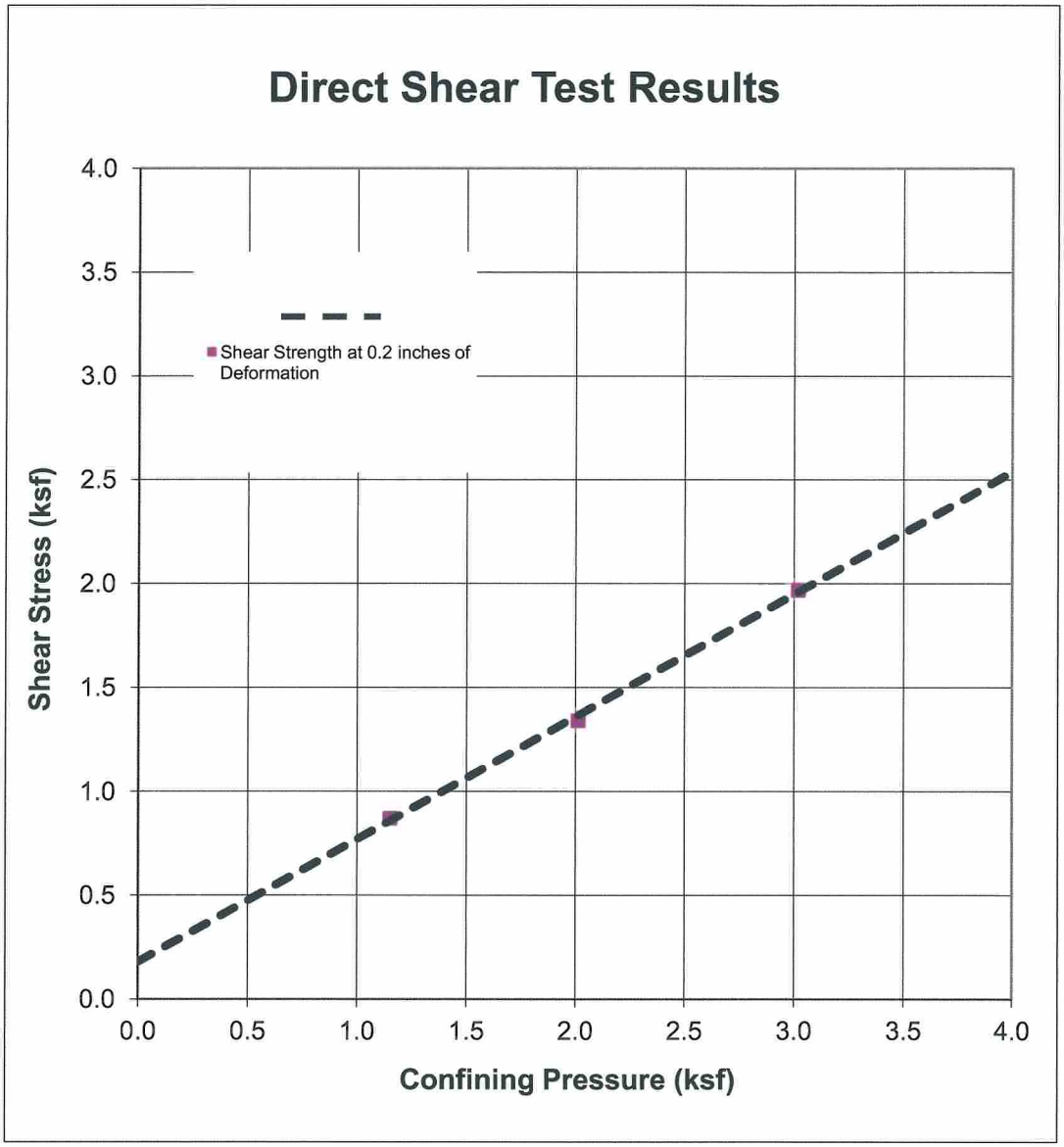
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 20 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		28	231

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-75

Figure C11



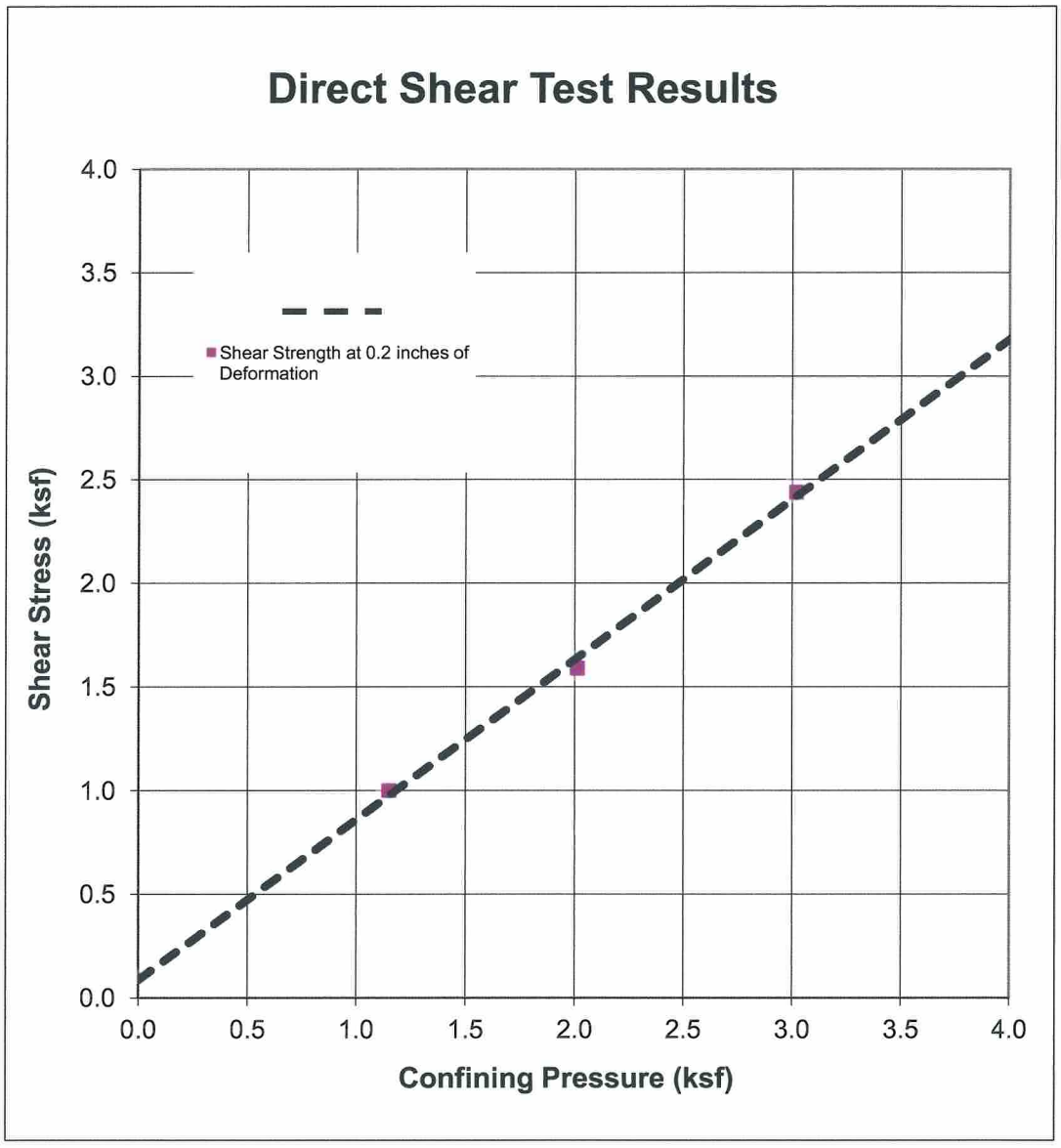
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 22 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	178

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-76

Figure C12



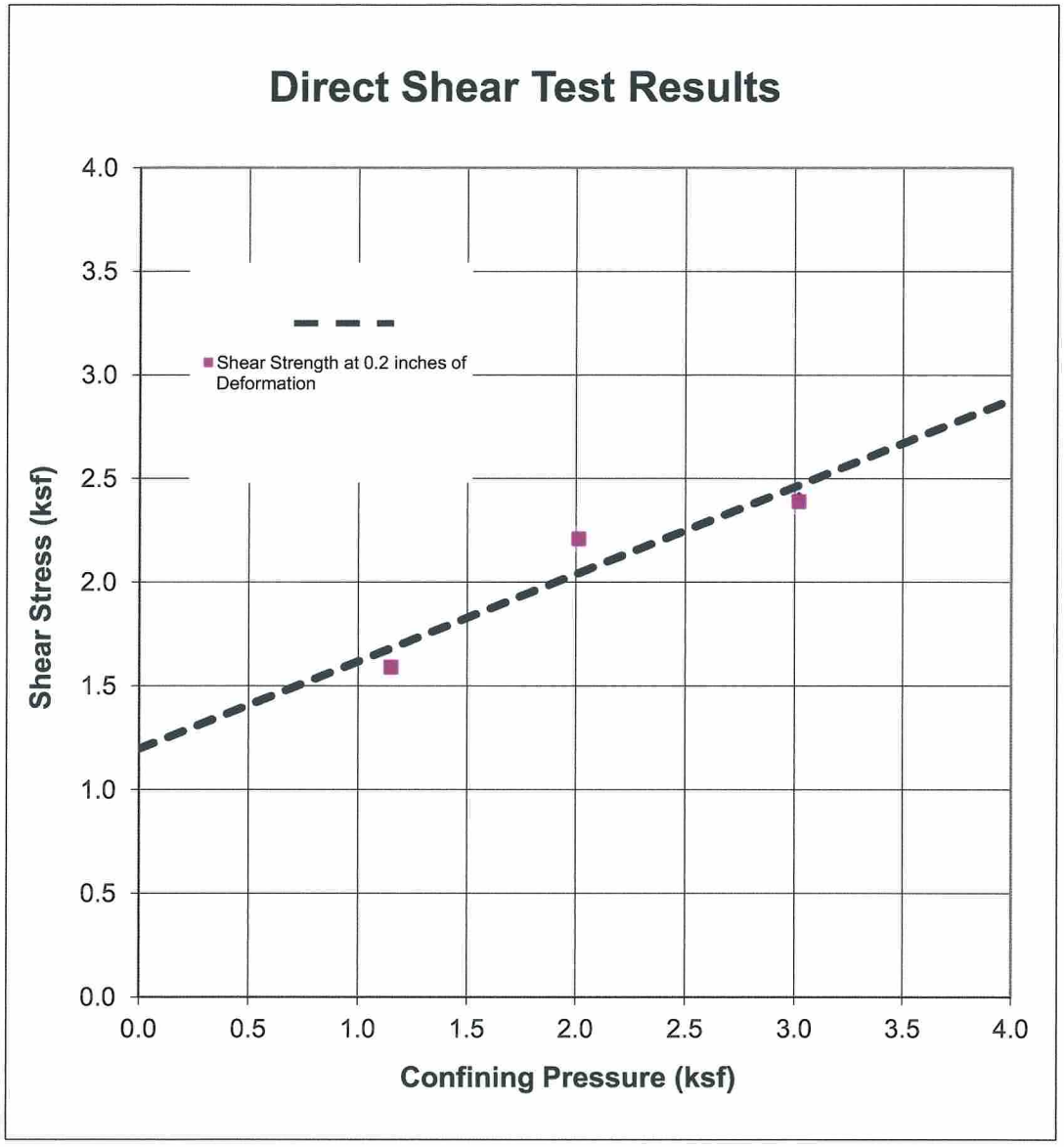
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 25 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		38	85

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-77

Figure C13



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 27.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		23	1196

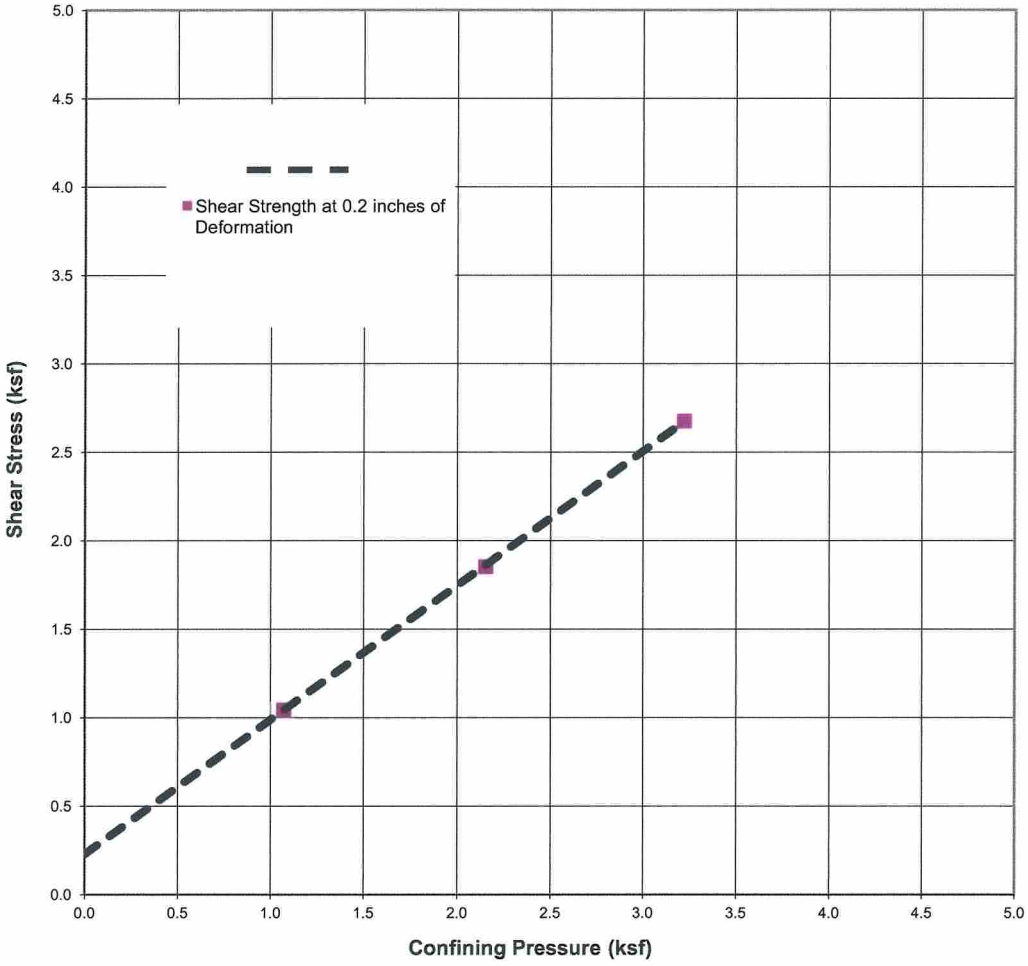
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-78

Figure C14

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 10 ft to 15 ft	silty SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		37	228

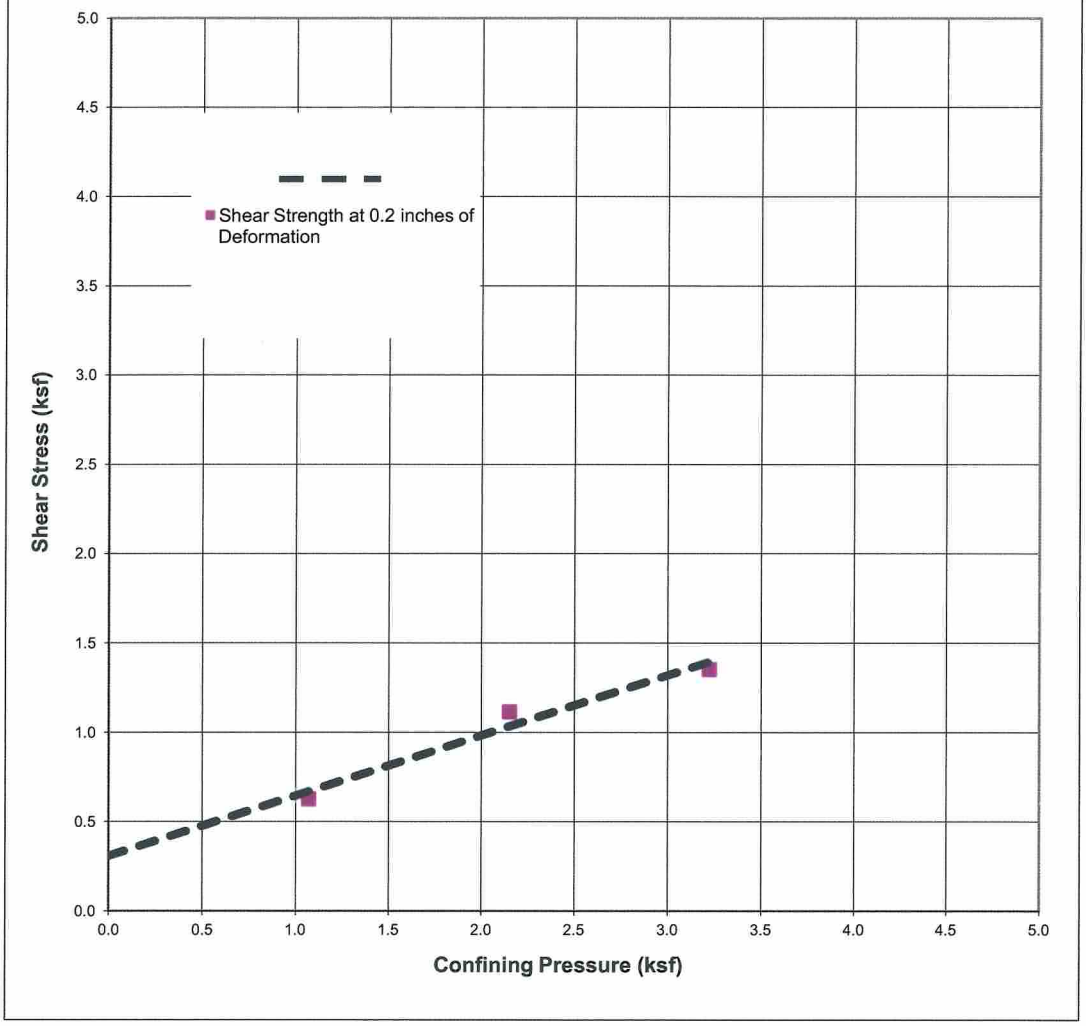
SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-82

Figure C15

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 40 feet	clayey SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		19	307

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-83

Figure C16

APPENDIX D

APPENDIX D

ANALYSES AND CALCULATIONS

FOR

FRIARS ROAD/STATE ROUTE 163 INTERCHANGE PROJECT
EAST GROUND ANCHOR WALL
(BRIDGE NO. 57E0127)
11-SD-163-PM 4.4
CONTRACT NO. 11-085781
SAN DIEGO, CALIFORNIA

PROJECT NO. G1447-52-01

PROJECT NAME SR-163/Friars Rd OC (WIDEN) SEISMIC

PROJECT NO G1447-52-01
BY YW DATE 2/6/12
SHEET 1 OF 57

REVISIONS
BY ____ DATE ____
BY ____ DATE ____

BY ____ DATE ____
CHECKED BY ____

SEISMIC STUDY UPDATE

ITEM	DESCRIPTION	PAGE
1	FAULT & SITE DATA INPUT	2
2	ARS ONLINE (V_{S30} 420 & 380 m/s)	3 & 4
3	SHAKE RESULTS – V_{S30} = 420 m/s	5 ~ 12
4	SHAKE RESULTS – V_{S30} = 380 m/s	13 ~ 20
5	DETERMINISTIC RESULTS V_{S30} 420 & 380 m/s	21 ~ 24
6	PROBABILISTIC RESULTS V_{S30} 420 & 380 m/s	25 ~ 28
7	USGS DEAGGREATION RESULTS V_{S30} = 420 m/s	29 ~ 38
8	USGS DEAGGREGATION RESULTS V_{S30} = 380 m/s	39 ~ 48
9	DESIGN RESPONSE SPECTRUM CURVE	49
10	DESIGN RESPONSE SPECTRUM DATA	50 & 51
11	SPT N & V_{S30} ESTIMATE	52 ~ 57

GEOCON INCORPORATED

Fault & Site Data Input Sheet

The input sheet is to help the user organize the site data for developing the design response spectrum. Beta-Testers: If you fill out the fault and site information for each location, please provide this document and the *checker* to facilitate the QC/QA procedures listed in the 2009 Deterministic Fault Information & Seismic Procedures QC/QA checklist.

Project Information

Dist – EA: 11-085780 County: SD Route: 163 PM: 4.4

Bridge/Facility Name: Friars Rd OC (wide) Bridge/Facility No.: 57-0595

Latitude: 32.771560 Longitude: -117.161362

Fault Information (#1)

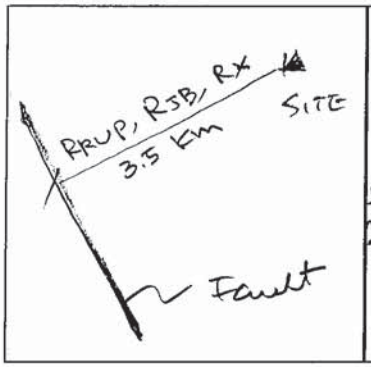
Fault Name: ~~fault CSO section~~ Newport Inglewood-Rose Canyon Fault ID#: 224

MMax: 7.5 Fault Type: RLSS

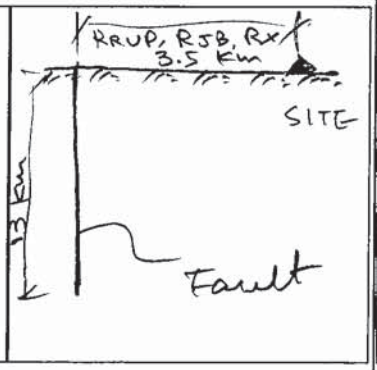
Fault Dip: 90° Dip Direction: V

Top of Rupture: 0 Bottom of Rupture: 13 km

Plan View



Elevation View



Calculated or Measure Distances

R_{RUP}: 3.5 km

R_{JB}: 3.5 km

R_X: 3.5 km

Determination of V_{S30}

V_{S30} (m/s): 420 (About 1), 380 (Best/About 3)

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): 191/241 (V_{S30} = 420/380 m/s)

$Z_{2.5}$ (km/s): 2 km

Notes:

Fault Information (#2)

Fault Name: _____ Fault ID#: _____

MMax: _____ Fault Type: _____

Fault Dip: _____ Dip Direction: _____

Top of Rupture: _____ Bottom of Rupture: _____

Plan View **Elevation View**

Calculated or Measure Distances

R_{RUP}: _____

R_{JB}: _____

R_X: _____

Determination of V_{S30}

V_{S30} (m/s): _____

Determination of Z1.0 and Z2.5

$Z_{1.0}$ (m/s): _____

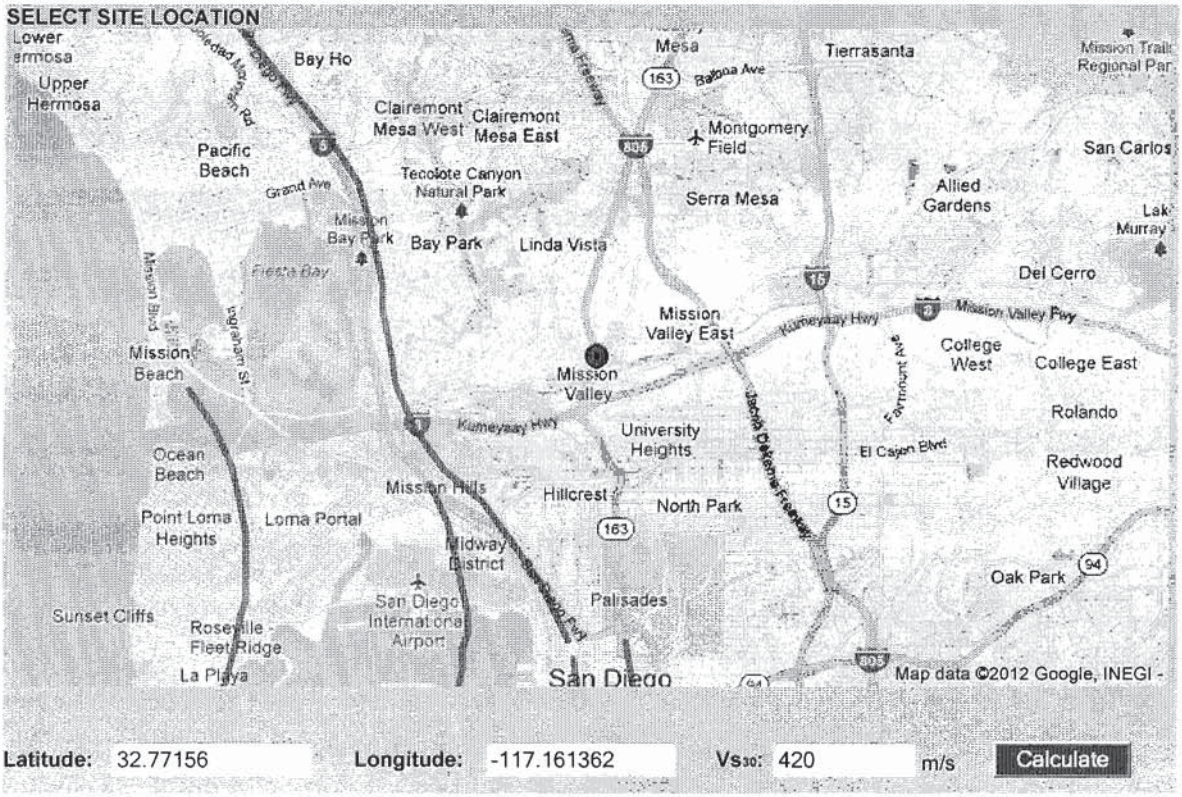
$Z_{2.5}$ (km/s): _____

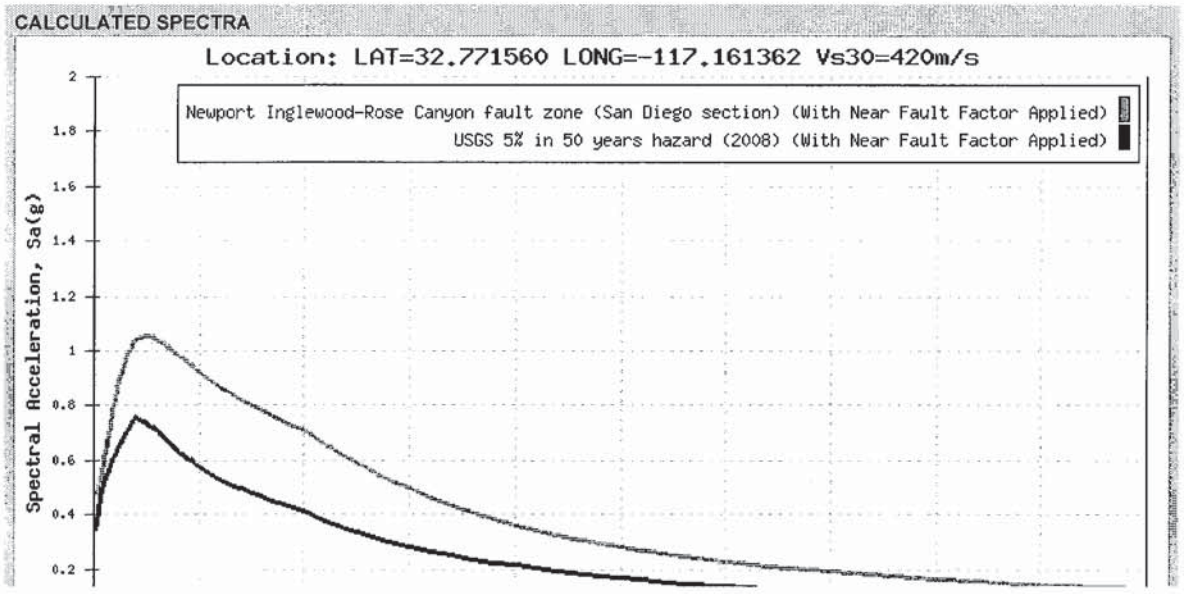
Notes:

CA.GOV CALIFORNIA DEPARTMENT OF TRANSPORTATION

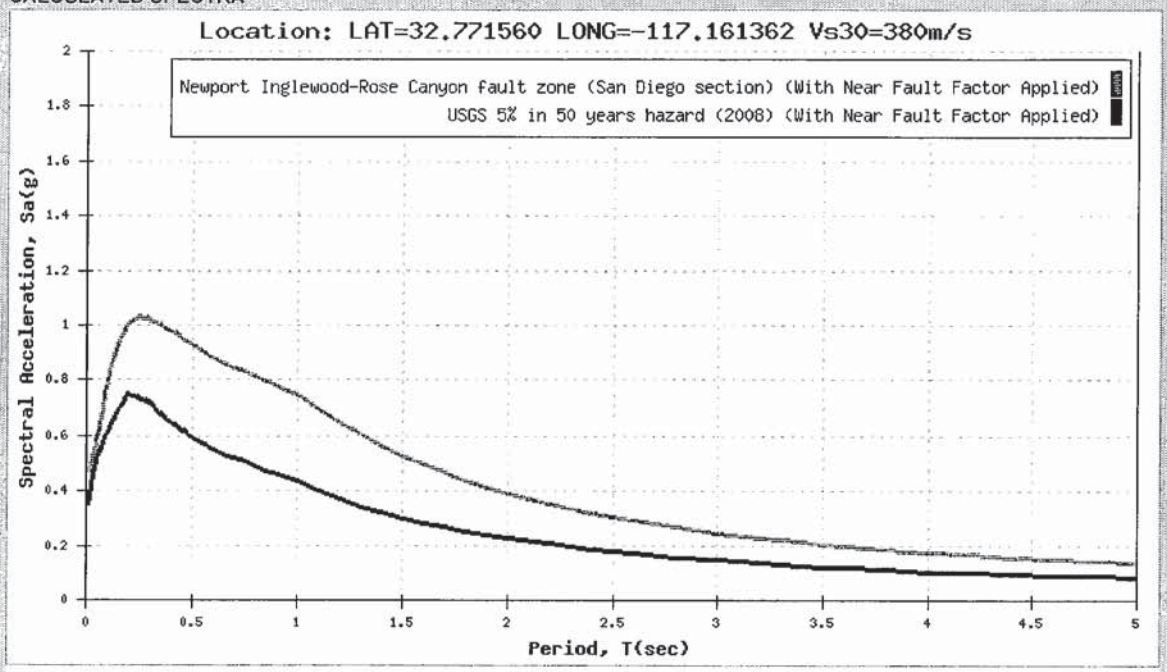
Caltrans ARS Online (v1.0.4)

This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in *Appendix B of Caltrans Seismic Design Criteria*. More...





CALCULATED SPECTRA



View Tabular Data | Show Envelope Only | Hide Near Fault Adjustment | Axis Scale | Printer Friendly View | Show Basin Factor

Apply Near Fault Adjustment To:

NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

☑ Deterministic Spectrum Using

3.50 Km Newport Inglewood-Rose Canyon fault zone (San Diego section)

☑ Probabilistic Spectrum Using

3.50 Km (Recommend Performing Deaggregation To Verify)

◉ Show Spectrum with Adjustment Only
○ Show Spectrum with and without near fault Adjustment

OK

SITE DATA

Shear Wave Velocity, Vs_{30}:	420 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	191 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.478	1.000	1.000	0.478
0.02	0.487	1.000	1.000	0.487
0.022	0.493	1.000	1.000	0.493
0.025	0.502	1.000	1.000	0.502
0.029	0.514	1.000	1.000	0.514
0.03	0.518	1.000	1.000	0.518
0.032	0.526	1.000	1.000	0.526
0.035	0.538	1.000	1.000	0.538
0.036	0.543	1.000	1.000	0.543
0.04	0.560	1.000	1.000	0.560
0.042	0.569	1.000	1.000	0.569
0.044	0.577	1.000	1.000	0.577
0.045	0.582	1.000	1.000	0.582
0.046	0.586	1.000	1.000	0.586
0.048	0.595	1.000	1.000	0.595

0.05	0.604	1.000	1.000	0.604
0.055	0.627	1.000	1.000	0.627
0.06	0.650	1.000	1.000	0.650
0.065	0.672	1.000	1.000	0.672
0.067	0.681	1.000	1.000	0.681
0.07	0.694	1.000	1.000	0.694
0.075	0.716	1.000	1.000	0.716
0.08	0.738	1.000	1.000	0.738
0.085	0.760	1.000	1.000	0.760
0.09	0.781	1.000	1.000	0.781
0.095	0.802	1.000	1.000	0.802
0.1	0.822	1.000	1.000	0.822
0.11	0.858	1.000	1.000	0.858
0.12	0.891	1.000	1.000	0.891
0.13	0.920	1.000	1.000	0.920
0.133	0.927	1.000	1.000	0.927
0.14	0.944	1.000	1.000	0.944
0.15	0.965	1.000	1.000	0.965
0.16	0.985	1.000	1.000	0.985
0.17	1.002	1.000	1.000	1.002
0.18	1.018	1.000	1.000	1.018
0.19	1.031	1.000	1.000	1.031
0.2	1.043	1.000	1.000	1.043
0.22	1.050	1.000	1.000	1.050
0.24	1.054	1.000	1.000	1.054
0.25	1.054	1.000	1.000	1.054
0.26	1.051	1.000	1.000	1.051
0.28	1.046	1.000	1.000	1.046
0.29	1.041	1.000	1.000	1.041
0.3	1.037	1.000	1.000	1.037
0.32	1.028	1.000	1.000	1.028
0.34	1.018	1.000	1.000	1.018
0.35	1.012	1.000	1.000	1.012
0.36	1.007	1.000	1.000	1.007
0.38	0.994	1.000	1.000	0.994
0.4	0.982	1.000	1.000	0.982
0.42	0.970	1.000	1.000	0.970
0.44	0.957	1.000	1.000	0.957
0.45	0.952	1.000	1.000	0.952
0.46	0.946	1.000	1.000	0.946
0.48	0.934	1.000	1.000	0.934
0.5	0.922	1.000	1.000	0.922
0.55	0.875	1.000	1.020	0.892
0.6	0.833	1.000	1.040	0.866
0.65	0.795	1.000	1.060	0.843
0.667	0.783	1.000	1.067	0.836

	0.761	1.000	1.080	0.822
0.75	0.731	1.000	1.100	0.804
0.8	0.698	1.000	1.120	0.782
0.85	0.668	1.000	1.140	0.762
0.9	0.641	1.000	1.160	0.744
0.95	0.616	1.000	1.180	0.727
1	0.592	1.000	1.200	0.711
1.1	0.547	1.000	1.200	0.656
1.2	0.507	1.000	1.200	0.609
1.3	0.472	1.000	1.200	0.567
1.4	0.441	1.000	1.200	0.529
1.5	0.413	1.000	1.200	0.495
1.6	0.385	1.000	1.200	0.462
1.7	0.361	1.000	1.200	0.433
1.8	0.339	1.000	1.200	0.407
1.9	0.319	1.000	1.200	0.383
2	0.302	1.000	1.200	0.362
2.2	0.270	1.000	1.200	0.324
2.4	0.244	1.000	1.200	0.293
2.5	0.233	1.000	1.200	0.280
2.6	0.223	1.000	1.200	0.268
2.8	0.205	1.000	1.200	0.246
3	0.189	1.000	1.200	0.227
3.2	0.175	1.000	1.200	0.210
3.4	0.163	1.000	1.200	0.196
3.5	0.158	1.000	1.200	0.189
3.6	0.153	1.000	1.200	0.183
3.8	0.143	1.000	1.200	0.172
4	0.135	1.000	1.200	0.162
4.2	0.128	1.000	1.200	0.153
4.4	0.121	1.000	1.200	0.145
4.6	0.115	1.000	1.200	0.138
4.8	0.110	1.000	1.200	0.132
5	0.105	1.000	1.200	0.126

To use above data in Excel, copy/paste:

```
0.01    0.478    1.000    1.000    0.478
0.02    0.487    1.000    1.000    0.487
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.344	1.000	1.000	0.344

0.02	0.410	1.000	1.000	0.410
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.451	1.000	1.000	0.451
0.03	0.454	1.000	1.000	0.454
0.032	0.462	1.000	1.000	0.462
0.035	0.473	1.000	1.000	0.473
0.036	0.476	1.000	1.000	0.476
0.04	0.489	1.000	1.000	0.489
0.042	0.495	1.000	1.000	0.495
0.044	0.501	1.000	1.000	0.501
0.045	0.504	1.000	1.000	0.504
0.046	0.507	1.000	1.000	0.507
0.048	0.512	1.000	1.000	0.512
0.05	0.518	1.000	1.000	0.518
0.055	0.530	1.000	1.000	0.530
0.06	0.542	1.000	1.000	0.542
0.065	0.553	1.000	1.000	0.553
0.067	0.558	1.000	1.000	0.558
0.07	0.564	1.000	1.000	0.564
0.075	0.574	1.000	1.000	0.574
0.08	0.583	1.000	1.000	0.583
0.085	0.592	1.000	1.000	0.592
0.09	0.601	1.000	1.000	0.601
0.095	0.609	1.000	1.000	0.609
0.1	0.618	1.000	1.000	0.618
0.11	0.635	1.000	1.000	0.635
0.12	0.651	1.000	1.000	0.651
0.13	0.667	1.000	1.000	0.667
0.133	0.671	1.000	1.000	0.671
0.14	0.682	1.000	1.000	0.682
0.15	0.696	1.000	1.000	0.696
0.16	0.709	1.000	1.000	0.709
0.17	0.722	1.000	1.000	0.722
0.18	0.734	1.000	1.000	0.734
0.19	0.746	1.000	1.000	0.746
0.2	0.757	1.000	1.000	0.757
0.22	0.746	1.000	1.000	0.746
0.24	0.735	1.000	1.000	0.735
0.25	0.731	1.000	1.000	0.731
0.26	0.726	1.000	1.000	0.726
0.28	0.718	1.000	1.000	0.718
0.29	0.714	1.000	1.000	0.714
0.3	0.710	1.000	1.000	0.710
0.32	0.692	1.000	1.000	0.692
0.34	0.675	1.000	1.000	0.675

	0.667	1.000	1.000	0.667
0.36	0.659	1.000	1.000	0.659
0.38	0.645	1.000	1.000	0.645
0.4	0.632	1.000	1.000	0.632
0.42	0.619	1.000	1.000	0.619
0.44	0.608	1.000	1.000	0.608
0.45	0.602	1.000	1.000	0.602
0.46	0.597	1.000	1.000	0.597
0.48	0.587	1.000	1.000	0.587
0.5	0.577	1.000	1.000	0.577
0.55	0.541	1.000	1.020	0.551
0.6	0.510	1.000	1.040	0.530
0.65	0.482	1.000	1.060	0.511
0.667	0.474	1.000	1.067	0.506
0.7	0.459	1.000	1.080	0.495
0.75	0.438	1.000	1.100	0.481
0.8	0.415	1.000	1.120	0.465
0.85	0.394	1.000	1.140	0.450
0.9	0.376	1.000	1.160	0.436
0.95	0.360	1.000	1.180	0.424
1	0.345	1.000	1.200	0.414
1.1	0.315	1.000	1.200	0.378
1.2	0.289	1.000	1.200	0.347
1.3	0.268	1.000	1.200	0.322
1.4	0.250	1.000	1.200	0.300
1.5	0.234	1.000	1.200	0.281
1.6	0.220	1.000	1.200	0.264
1.7	0.207	1.000	1.200	0.249
1.8	0.196	1.000	1.200	0.236
1.9	0.187	1.000	1.200	0.224
2	0.178	1.000	1.200	0.213
2.2	0.160	1.000	1.200	0.192
2.4	0.145	1.000	1.200	0.174
2.5	0.138	1.000	1.200	0.166
2.6	0.132	1.000	1.200	0.159
2.8	0.122	1.000	1.200	0.146
3	0.113	1.000	1.200	0.135
3.2	0.104	1.000	1.200	0.125
3.4	0.097	1.000	1.200	0.117
3.5	0.094	1.000	1.200	0.113
3.6	0.091	1.000	1.200	0.109
3.8	0.085	1.000	1.200	0.102
4	0.080	1.000	1.200	0.096
4.2	0.077	1.000	1.200	0.092
4.4	0.073	1.000	1.200	0.088
4.6	0.070	1.000	1.200	0.084

	0.068	1.000	1.200	0.081	
5	0.065	1.000	1.200	0.078	

To use above data in Excel, copy/paste:

```
0.01    0.344    1.000    1.000    0.344
0.02    0.410    1.000    1.000    0.410
```

Envelope Data

Period	SA
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.560
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.650
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.760
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.920
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018

0.19	1.031
0.2	1.043
0.22	1.050
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982
0.42	0.970
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.280
2.6	0.268

2.8	0.246
3	0.227
3.2	0.210
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126
To use above data in Excel, copy/paste:	0.01 0.478 0.02 0.487

SITE DATA

Shear Wave Velocity, Vs_{30}:	380 m/s
Latitude:	32.771560
Longitude:	-117.161362
Depth to Vs = 1.0 km/s:	241 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)	
Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.50 km
Rjb:	3.50 km
Rx:	3.50 km
Fnorm:	0
Frev:	0

Period	SA (Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA (Final Spectrum)
0.01	0.474	1.000	1.000	0.474
0.02	0.483	1.000	1.000	0.483
0.022	0.489	1.000	1.000	0.489
0.025	0.497	1.000	1.000	0.497
0.029	0.508	1.000	1.000	0.508
0.03	0.511	1.000	1.000	0.511
0.032	0.519	1.000	1.000	0.519
0.035	0.530	1.000	1.000	0.530
0.036	0.534	1.000	1.000	0.534
0.04	0.550	1.000	1.000	0.550
0.042	0.558	1.000	1.000	0.558
0.044	0.565	1.000	1.000	0.565
0.045	0.570	1.000	1.000	0.570
0.046	0.574	1.000	1.000	0.574
0.048	0.582	1.000	1.000	0.582

0.05	0.590	1.000	1.000	0.590
0.055	0.610	1.000	1.000	0.610
0.06	0.631	1.000	1.000	0.631
0.065	0.651	1.000	1.000	0.651
0.067	0.659	1.000	1.000	0.659
0.07	0.671	1.000	1.000	0.671
0.075	0.691	1.000	1.000	0.691
0.08	0.711	1.000	1.000	0.711
0.085	0.732	1.000	1.000	0.732
0.09	0.752	1.000	1.000	0.752
0.095	0.771	1.000	1.000	0.771
0.1	0.790	1.000	1.000	0.790
0.11	0.825	1.000	1.000	0.825
0.12	0.856	1.000	1.000	0.856
0.13	0.884	1.000	1.000	0.884
0.133	0.891	1.000	1.000	0.891
0.14	0.907	1.000	1.000	0.907
0.15	0.928	1.000	1.000	0.928
0.16	0.948	1.000	1.000	0.948
0.17	0.966	1.000	1.000	0.966
0.18	0.982	1.000	1.000	0.982
0.19	0.996	1.000	1.000	0.996
0.2	1.008	1.000	1.000	1.008
0.22	1.019	1.000	1.000	1.019
0.24	1.026	1.000	1.000	1.026
0.25	1.028	1.000	1.000	1.028
0.26	1.027	1.000	1.000	1.027
0.28	1.025	1.000	1.000	1.025
0.29	1.022	1.000	1.000	1.022
0.3	1.019	1.000	1.000	1.019
0.32	1.013	1.000	1.000	1.013
0.34	1.006	1.000	1.000	1.006
0.35	1.001	1.000	1.000	1.001
0.36	0.997	1.000	1.000	0.997
0.38	0.987	1.000	1.000	0.987
0.4	0.977	1.000	1.000	0.977
0.42	0.967	1.000	1.000	0.967
0.44	0.957	1.000	1.000	0.957
0.45	0.953	1.000	1.000	0.953
0.46	0.948	1.000	1.000	0.948
0.48	0.938	1.000	1.000	0.938
0.5	0.928	1.000	1.000	0.928
0.55	0.886	1.000	1.020	0.904
0.6	0.849	1.000	1.040	0.883
0.65	0.815	1.000	1.060	0.864
0.667	0.804	1.000	1.067	0.858

	0.784	1.000	1.080	0.847
0.75	0.756	1.000	1.100	0.832
0.8	0.725	1.000	1.120	0.812
0.85	0.697	1.000	1.140	0.794
0.9	0.670	1.000	1.160	0.778
0.95	0.646	1.000	1.180	0.762
1	0.623	1.000	1.200	0.748
1.1	0.578	1.000	1.200	0.693
1.2	0.538	1.000	1.200	0.645
1.3	0.502	1.000	1.200	0.603
1.4	0.470	1.000	1.200	0.564
1.5	0.441	1.000	1.200	0.529
1.6	0.413	1.000	1.200	0.495
1.7	0.388	1.000	1.200	0.465
1.8	0.365	1.000	1.200	0.438
1.9	0.344	1.000	1.200	0.413
2	0.326	1.000	1.200	0.391
2.2	0.293	1.000	1.200	0.351
2.4	0.265	1.000	1.200	0.318
2.5	0.253	1.000	1.200	0.304
2.6	0.242	1.000	1.200	0.291
2.8	0.223	1.000	1.200	0.267
3	0.206	1.000	1.200	0.247
3.2	0.191	1.000	1.200	0.229
3.4	0.178	1.000	1.200	0.214
3.5	0.172	1.000	1.200	0.206
3.6	0.166	1.000	1.200	0.200
3.8	0.156	1.000	1.200	0.187
4	0.147	1.000	1.200	0.176
4.2	0.139	1.000	1.200	0.167
4.4	0.132	1.000	1.200	0.158
4.6	0.125	1.000	1.200	0.151
4.8	0.120	1.000	1.200	0.143
5	0.114	1.000	1.200	0.137

To use above data in Excel, copy/paste:

```
0.01    0.474    1.000    1.000    0.474
0.02    0.483    1.000    1.000    0.483
```

PROBABILISTIC

Probabilistic Model USGS Seismic Hazard Map(2008) 975 Year Return Period				
Period	**SA (Base Spectrum)**	**Basin Factor**	**Near Fault Factor (Applied)**	**SA (Final Spectrum)**
0.01	0.346	1.000	1.000	0.346

0.02	0.411	1.000	1.000	0.411
0.022	0.420	1.000	1.000	0.420
0.025	0.434	1.000	1.000	0.434
0.029	0.450	1.000	1.000	0.450
0.03	0.454	1.000	1.000	0.454
0.032	0.461	1.000	1.000	0.461
0.035	0.471	1.000	1.000	0.471
0.036	0.475	1.000	1.000	0.475
0.04	0.487	1.000	1.000	0.487
0.042	0.493	1.000	1.000	0.493
0.044	0.499	1.000	1.000	0.499
0.045	0.501	1.000	1.000	0.501
0.046	0.504	1.000	1.000	0.504
0.048	0.509	1.000	1.000	0.509
0.05	0.515	1.000	1.000	0.515
0.055	0.527	1.000	1.000	0.527
0.06	0.538	1.000	1.000	0.538
0.065	0.549	1.000	1.000	0.549
0.067	0.553	1.000	1.000	0.553
0.07	0.559	1.000	1.000	0.559
0.075	0.569	1.000	1.000	0.569
0.08	0.578	1.000	1.000	0.578
0.085	0.587	1.000	1.000	0.587
0.09	0.595	1.000	1.000	0.595
0.095	0.603	1.000	1.000	0.603
0.1	0.610	1.000	1.000	0.610
0.11	0.628	1.000	1.000	0.628
0.12	0.645	1.000	1.000	0.645
0.13	0.660	1.000	1.000	0.660
0.133	0.665	1.000	1.000	0.665
0.14	0.675	1.000	1.000	0.675
0.15	0.689	1.000	1.000	0.689
0.16	0.703	1.000	1.000	0.703
0.17	0.715	1.000	1.000	0.715
0.18	0.728	1.000	1.000	0.728
0.19	0.740	1.000	1.000	0.740
0.2	0.751	1.000	1.000	0.751
0.22	0.743	1.000	1.000	0.743
0.24	0.735	1.000	1.000	0.735
0.25	0.732	1.000	1.000	0.732
0.26	0.729	1.000	1.000	0.729
0.28	0.722	1.000	1.000	0.722
0.29	0.719	1.000	1.000	0.719
0.3	0.717	1.000	1.000	0.717
0.32	0.700	1.000	1.000	0.700
0.34	0.685	1.000	1.000	0.685

	0.678	1.000	1.000	0.678
0.36	0.671	1.000	1.000	0.671
0.38	0.658	1.000	1.000	0.658
0.4	0.646	1.000	1.000	0.646
0.42	0.634	1.000	1.000	0.634
0.44	0.624	1.000	1.000	0.624
0.45	0.619	1.000	1.000	0.619
0.46	0.614	1.000	1.000	0.614
0.48	0.604	1.000	1.000	0.604
0.5	0.596	1.000	1.000	0.596
0.55	0.561	1.000	1.020	0.572
0.6	0.531	1.000	1.040	0.552
0.65	0.505	1.000	1.060	0.535
0.667	0.497	1.000	1.067	0.530
0.7	0.482	1.000	1.080	0.520
0.75	0.461	1.000	1.100	0.507
0.8	0.438	1.000	1.120	0.491
0.85	0.417	1.000	1.140	0.476
0.9	0.399	1.000	1.160	0.462
0.95	0.382	1.000	1.180	0.451
1	0.367	1.000	1.200	0.440
1.1	0.335	1.000	1.200	0.402
1.2	0.309	1.000	1.200	0.371
1.3	0.287	1.000	1.200	0.344
1.4	0.268	1.000	1.200	0.321
1.5	0.251	1.000	1.200	0.301
1.6	0.236	1.000	1.200	0.283
1.7	0.223	1.000	1.200	0.268
1.8	0.212	1.000	1.200	0.254
1.9	0.201	1.000	1.200	0.241
2	0.192	1.000	1.200	0.230
2.2	0.173	1.000	1.200	0.207
2.4	0.157	1.000	1.200	0.188
2.5	0.150	1.000	1.200	0.180
2.6	0.143	1.000	1.200	0.172
2.8	0.132	1.000	1.200	0.159
3	0.122	1.000	1.200	0.147
3.2	0.113	1.000	1.200	0.136
3.4	0.106	1.000	1.200	0.127
3.5	0.102	1.000	1.200	0.122
3.6	0.099	1.000	1.200	0.118
3.8	0.093	1.000	1.200	0.111
4	0.087	1.000	1.200	0.105
4.2	0.083	1.000	1.200	0.100
4.4	0.080	1.000	1.200	0.096
4.6	0.076	1.000	1.200	0.092

	0.073	1.000	1.200	0.088	
5	0.071	1.000	1.200	0.085	

To use above data in Excel, copy/paste:

```
0.01    0.346    1.000    1.000    0.346
0.02    0.411    1.000    1.000    0.411
```

Envelope Data

Period	SA
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.530
0.036	0.534
0.04	0.550
0.042	0.558
0.044	0.565
0.045	0.570
0.046	0.574
0.048	0.582
0.05	0.590
0.055	0.610
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.790
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982

0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977
0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291

2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.200
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137
To use above data in Excel, copy/paste:	0.01 0.474 0.02 0.483

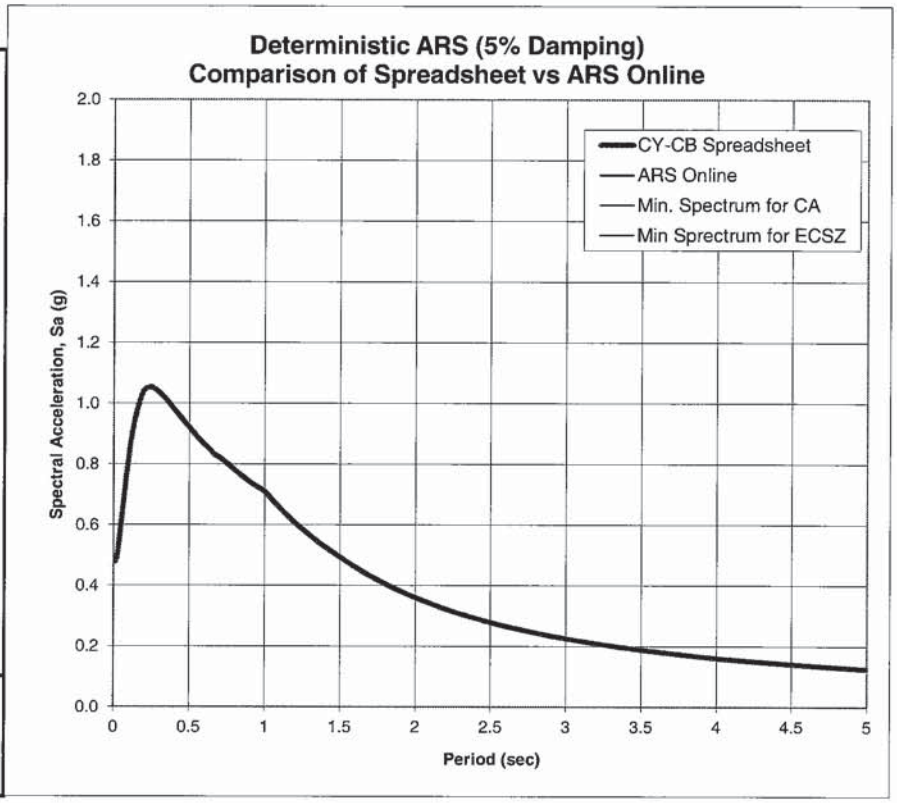
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	420	(270 to 1500 m/s)
$Z_{1.0}$ (m)	191	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 1%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47789
0.020	0.48686
0.022	0.49308
0.025	0.50248
0.029	0.51423
0.030	0.51759
0.032	0.52590
0.035	0.53849
0.036	0.54284
0.040	0.55973
0.042	0.56862
0.044	0.57722
0.045	0.58182
0.046	0.58628
0.048	0.59508
0.050	0.60406
0.055	0.62681
0.060	0.64992
0.065	0.67218
0.067	0.68124
0.070	0.69413
0.075	0.71578
0.080	0.73787
0.085	0.75998
0.090	0.78110
0.095	0.80197
0.100	0.82221
0.110	0.85852
0.120	0.89139
0.130	0.91999
0.133	0.92734
0.140	0.94388
0.150	0.96504
0.160	0.98526
0.170	1.00230

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.478	1	1	0.478	0%
0.02	0.487	1	1	0.487	0%
0.022	0.493	1	1	0.493	0%
0.025	0.502	1	1	0.502	0%
0.029	0.514	1	1	0.514	0%
0.03	0.518	1	1	0.518	0%
0.032	0.526	1	1	0.526	0%
0.035	0.538	1	1	0.538	0%
0.036	0.543	1	1	0.543	0%
0.04	0.56	1	1	0.56	0%
0.042	0.569	1	1	0.569	0%
0.044	0.577	1	1	0.577	0%
0.045	0.582	1	1	0.582	0%
0.046	0.586	1	1	0.586	0%
0.048	0.595	1	1	0.595	0%
0.05	0.604	1	1	0.604	0%
0.055	0.627	1	1	0.627	0%
0.06	0.65	1	1	0.65	0%
0.065	0.672	1	1	0.672	0%
0.067	0.681	1	1	0.681	0%
0.07	0.694	1	1	0.694	0%
0.075	0.716	1	1	0.716	0%
0.08	0.738	1	1	0.738	0%
0.085	0.76	1	1	0.76	0%
0.09	0.781	1	1	0.781	0%
0.095	0.802	1	1	0.802	0%
0.1	0.822	1	1	0.822	0%
0.11	0.858	1	1	0.858	0%
0.12	0.891	1	1	0.891	0%
0.13	0.92	1	1	0.92	0%
0.133	0.927	1	1	0.927	0%
0.14	0.944	1	1	0.944	0%
0.15	0.965	1	1	0.965	0%
0.16	0.985	1	1	0.985	0%
0.17	1.002	1	1	1.002	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

0.180	1.01786

0.18	1.018	1	1	1.018	0%

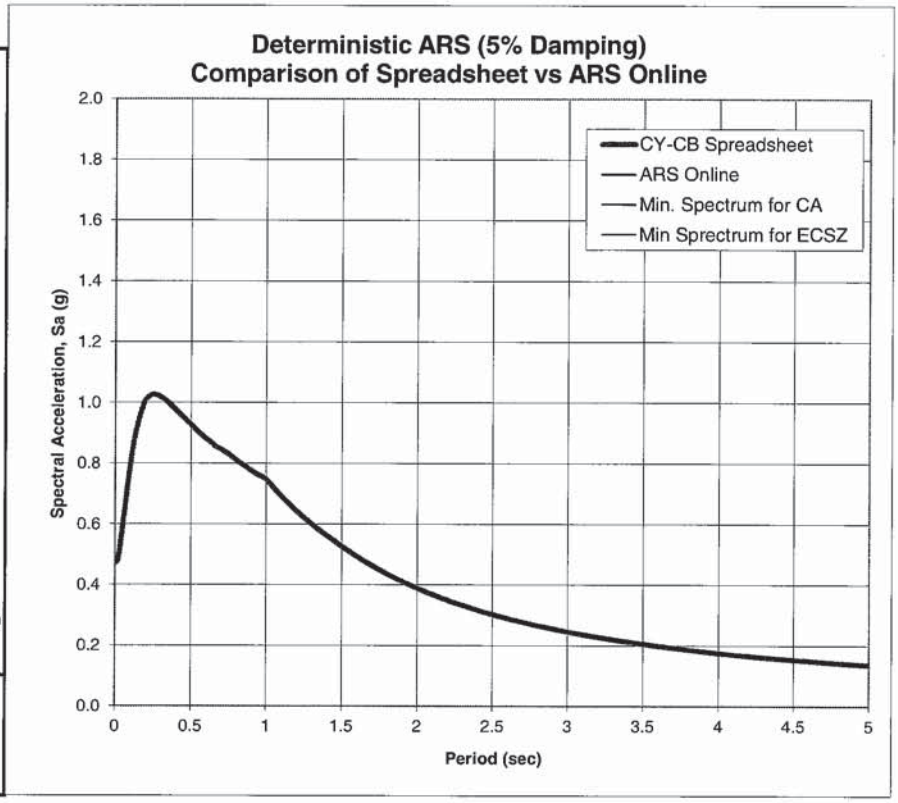
Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault		
Magnitude	7.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	0	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	
Distance		
R_{RUP} (km)	3.5	
R_{JB} (km)	3.5	
R_x (km)	3.5	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	
Site		
V_{S30} (m/sec)	380	(270 to 1500 m/s)
$Z_{1.0}$ (m)	241	(0 - No Basin)
$Z_{2.5}$ (km)	2	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 0%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.47415
0.020	0.48287
0.022	0.48875
0.025	0.49754
0.029	0.50835
0.030	0.51146
0.032	0.51908
0.035	0.53054
0.036	0.53448
0.040	0.54968
0.042	0.55771
0.044	0.56547
0.045	0.56963
0.046	0.57367
0.048	0.58160
0.050	0.58968
0.055	0.61012
0.060	0.63092
0.065	0.65105
0.067	0.65928
0.070	0.67103
0.075	0.69080
0.080	0.71131
0.085	0.73186
0.090	0.75164
0.095	0.77123
0.100	0.79029
0.110	0.82488
0.120	0.85639
0.130	0.88404
0.133	0.89123
0.140	0.90735
0.150	0.92813
0.160	0.94846
0.170	0.96587

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.474	1	1	0.474	0%
0.02	0.483	1	1	0.483	0%
0.022	0.489	1	1	0.489	0%
0.025	0.497	1	1	0.497	0%
0.029	0.508	1	1	0.508	0%
0.03	0.511	1	1	0.511	0%
0.032	0.519	1	1	0.519	0%
0.035	0.53	1	1	0.53	0%
0.036	0.534	1	1	0.534	0%
0.04	0.55	1	1	0.55	0%
0.042	0.558	1	1	0.558	0%
0.044	0.565	1	1	0.565	0%
0.045	0.57	1	1	0.57	0%
0.046	0.574	1	1	0.574	0%
0.048	0.582	1	1	0.582	0%
0.05	0.59	1	1	0.59	0%
0.055	0.61	1	1	0.61	0%
0.06	0.631	1	1	0.631	0%
0.065	0.651	1	1	0.651	0%
0.067	0.659	1	1	0.659	0%
0.07	0.671	1	1	0.671	0%
0.075	0.691	1	1	0.691	0%
0.08	0.711	1	1	0.711	0%
0.085	0.732	1	1	0.732	0%
0.09	0.752	1	1	0.752	0%
0.095	0.771	1	1	0.771	0%
0.1	0.79	1	1	0.79	0%
0.11	0.825	1	1	0.825	0%
0.12	0.856	1	1	0.856	0%
0.13	0.884	1	1	0.884	0%
0.133	0.891	1	1	0.891	0%
0.14	0.907	1	1	0.907	0%
0.15	0.928	1	1	0.928	0%
0.16	0.948	1	1	0.948	0%
0.17	0.966	1	1	0.966	0%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)

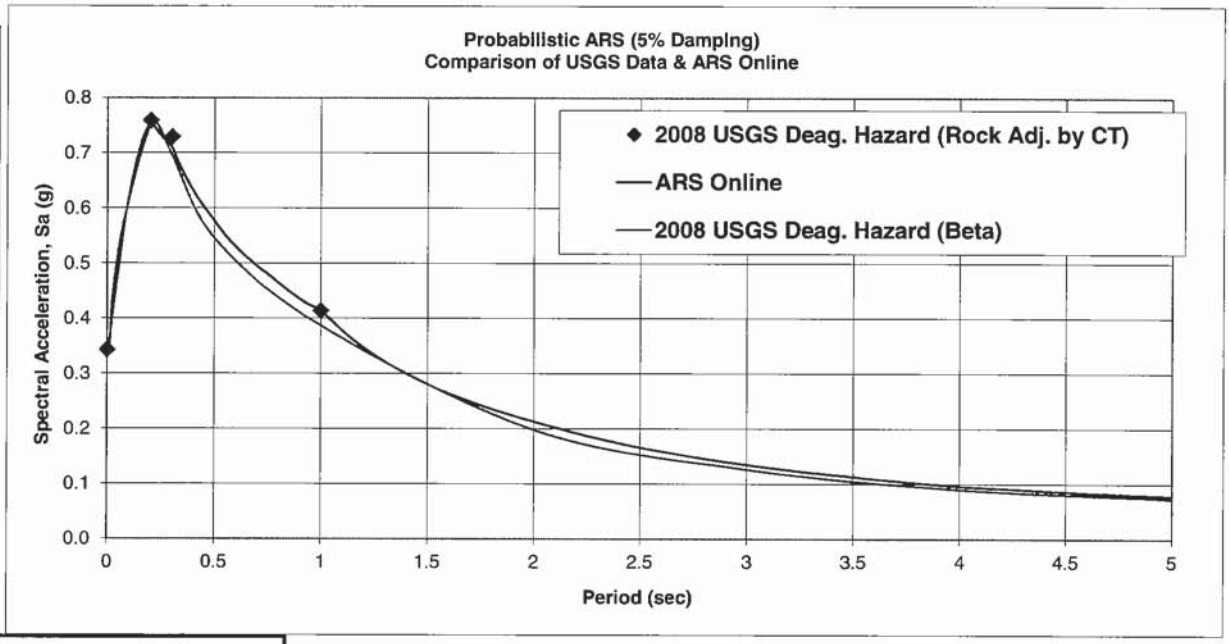
0.180	0.98191

0.18	0.982	1	1	0.982	0%

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	420
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	191
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.344	1	1	0.344
0.02	0.41	1	1	0.41
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.451	1	1	0.451
0.03	0.454	1	1	0.454
0.032	0.462	1	1	0.462
0.035	0.473	1	1	0.473
0.036	0.476	1	1	0.476
0.04	0.489	1	1	0.489
0.042	0.495	1	1	0.495
0.044	0.501	1	1	0.501
0.045	0.504	1	1	0.504
0.046	0.507	1	1	0.507
0.048	0.512	1	1	0.512
0.05	0.518	1	1	0.518
0.055	0.53	1	1	0.53
0.06	0.542	1	1	0.542
0.065	0.553	1	1	0.553
0.067	0.558	1	1	0.558
0.07	0.564	1	1	0.564
0.075	0.574	1	1	0.574
0.08	0.583	1	1	0.583
0.085	0.592	1	1	0.592
0.09	0.601	1	1	0.601
0.095	0.609	1	1	0.609
0.1	0.618	1	1	0.618
0.11	0.635	1	1	0.635
0.12	0.651	1	1	0.651
0.13	0.667	1	1	0.667
0.133	0.671	1	1	0.671
0.14	0.682	1	1	0.682
0.15	0.696	1	1	0.696
0.16	0.709	1	1	0.709

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.116	1.000	0.343	0.344	-0.2%
0.2	0.722	1.000	1.052	1.000	0.760	0.757	0.4%
0.3	0.597	1.000	1.222	1.000	0.730	0.71	2.7%
1	0.226	1.200	1.528	1.000	0.414	0.414	0.0%

Max % Difference = 2.7%

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3306	1.000	1.000	0.331	0.344	3.9%
0.1	0.6232	1.000	1.000	0.623	0.618	0.8%
0.2	0.7568	1.000	1.000	0.757	0.757	0.0%
0.3	0.696	1.000	1.000	0.696	0.71	2.0%
0.5	0.5454	1.000	1.000	0.545	0.577	5.8%
1	0.3227	1.200	1.000	0.387	0.414	6.9%
2	0.1652	1.200	1.000	0.198	0.213	7.4%
3	0.1054	1.200	1.000	0.126	0.135	6.7%
4	0.07516	1.200	1.000	0.090	0.096	6.4%
5	0.06116	1.200	1.000	0.073	0.078	6.3%

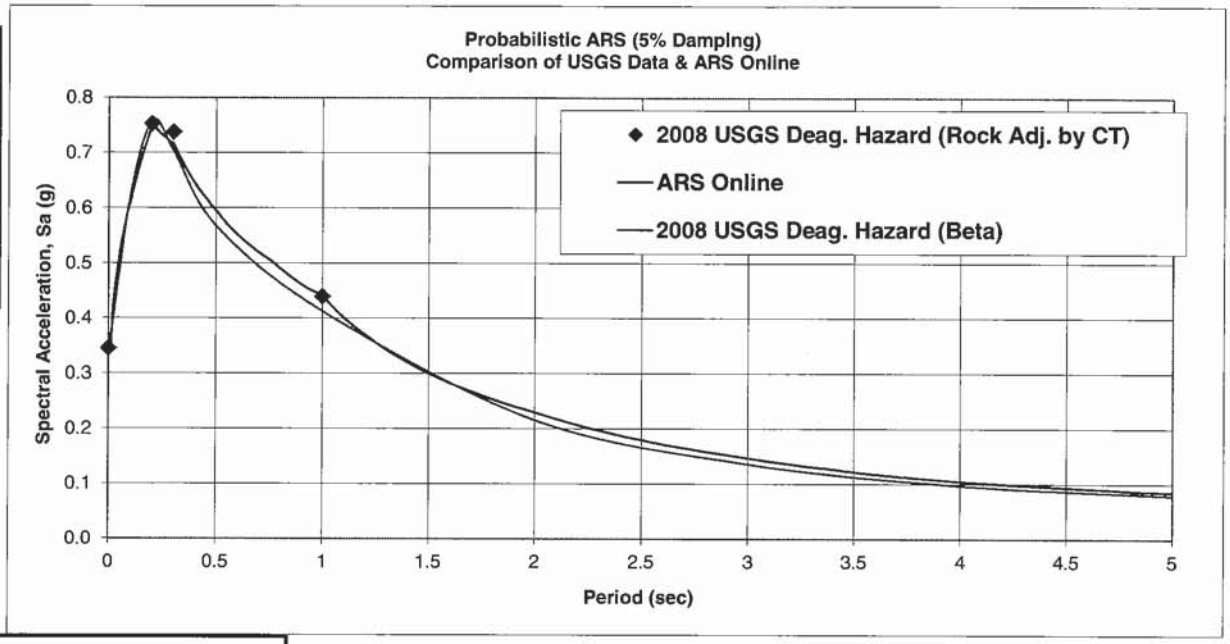
Max % Difference = 7.4%

0.17	0.722	1	1	0.722
0.18	0.734	1	1	0.734
0.19	0.746	1	1	0.746
0.2	0.757	1	1	0.757
0.22	0.746	1	1	0.746
0.24	0.735	1	1	0.735
0.25	0.731	1	1	0.731

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
32.7716	-117.1614
V_{S30} (m/s) =	380
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	4.1
$Z_{1.0}$ (m) =	241
$Z_{2.5}$ (km) =	2



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.346	1	1	0.346
0.02	0.411	1	1	0.411
0.022	0.42	1	1	0.42
0.025	0.434	1	1	0.434
0.029	0.45	1	1	0.45
0.03	0.454	1	1	0.454
0.032	0.461	1	1	0.461
0.035	0.471	1	1	0.471
0.036	0.475	1	1	0.475
0.04	0.487	1	1	0.487
0.042	0.493	1	1	0.493
0.044	0.499	1	1	0.499
0.045	0.501	1	1	0.501
0.046	0.504	1	1	0.504
0.048	0.509	1	1	0.509
0.05	0.515	1	1	0.515
0.055	0.527	1	1	0.527
0.06	0.538	1	1	0.538
0.065	0.549	1	1	0.549
0.067	0.553	1	1	0.553
0.07	0.559	1	1	0.559
0.075	0.569	1	1	0.569
0.08	0.578	1	1	0.578
0.085	0.587	1	1	0.587
0.09	0.595	1	1	0.595
0.095	0.603	1	1	0.603
0.1	0.61	1	1	0.61
0.11	0.628	1	1	0.628
0.12	0.645	1	1	0.645
0.13	0.66	1	1	0.66
0.133	0.665	1	1	0.665
0.14	0.675	1	1	0.675
0.15	0.689	1	1	0.689
0.16	0.703	1	1	0.703

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.308	1.000	1.124	1.000	0.346	0.346	-0.1%
0.2	0.722	1.000	1.043	1.000	0.754	0.751	0.4%
0.3	0.597	1.000	1.237	1.000	0.739	0.717	2.9%
1	0.226	1.200	1.625	1.000	0.440	0.44	0.1%

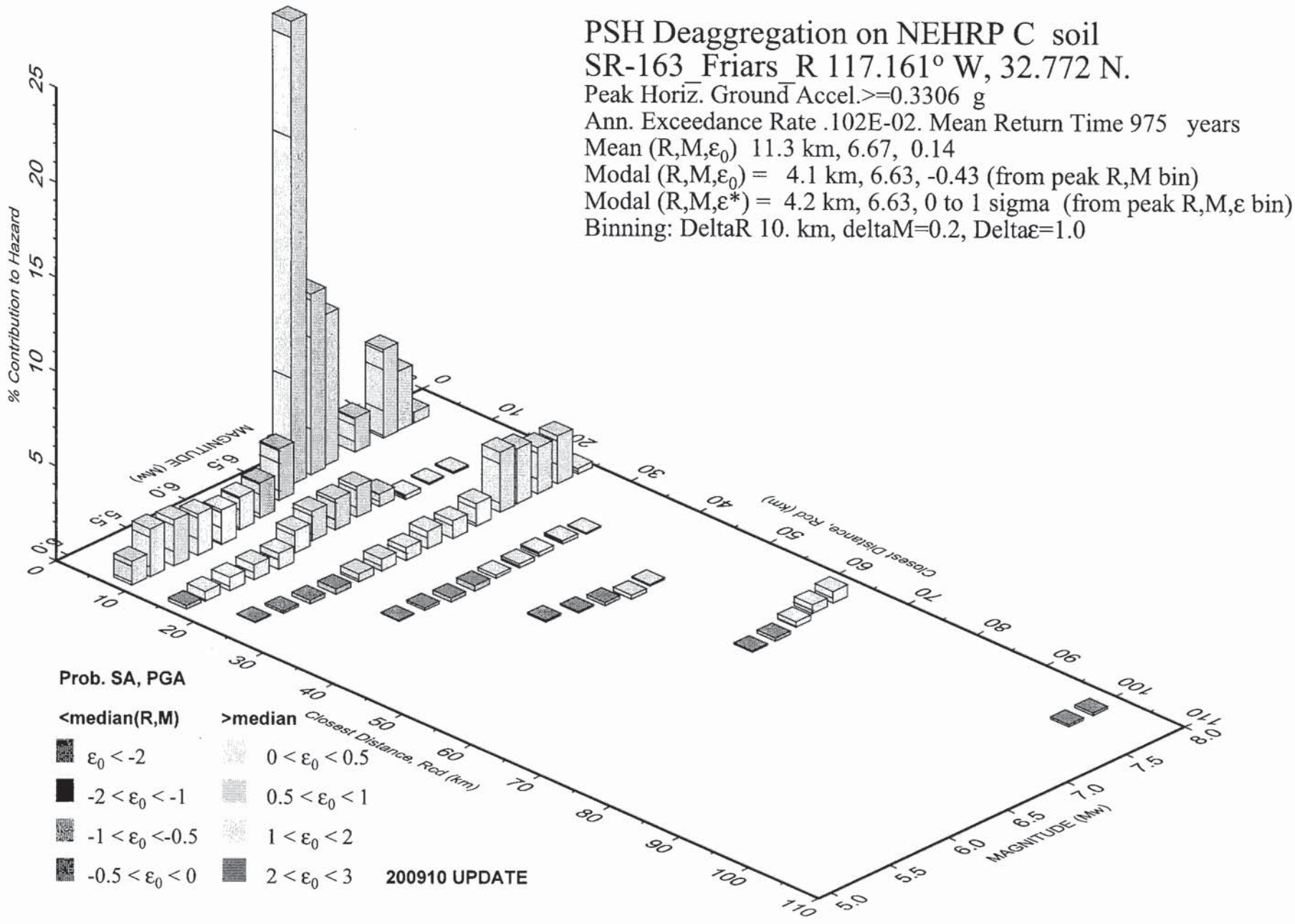
Max % Difference = **2.9%**

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.3376	1.000	1.000	0.338	0.346	2.5%
0.1	0.6205	1.000	1.000	0.621	0.61	1.7%
0.2	0.759	1.000	1.000	0.759	0.751	1.1%
0.3	0.705	1.000	1.000	0.705	0.717	1.7%
0.5	0.5681	1.000	1.000	0.568	0.596	4.9%
1	0.3446	1.200	1.000	0.414	0.44	6.4%
2	0.18	1.200	1.000	0.216	0.23	6.5%
3	0.11364	1.200	1.000	0.136	0.147	7.8%
4	0.08119	1.200	1.000	0.097	0.105	7.8%
5	0.06605	1.200	1.000	0.079	0.085	7.2%

Max % Difference = **7.8%**

0.17	0.715	1	1	0.715
0.18	0.728	1	1	0.728
0.19	0.74	1	1	0.74
0.2	0.751	1	1	0.751
0.22	0.743	1	1	0.743
0.24	0.735	1	1	0.735
0.25	0.732	1	1	0.732



GMT 2012 Jul 5 23:31:17 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6232 g

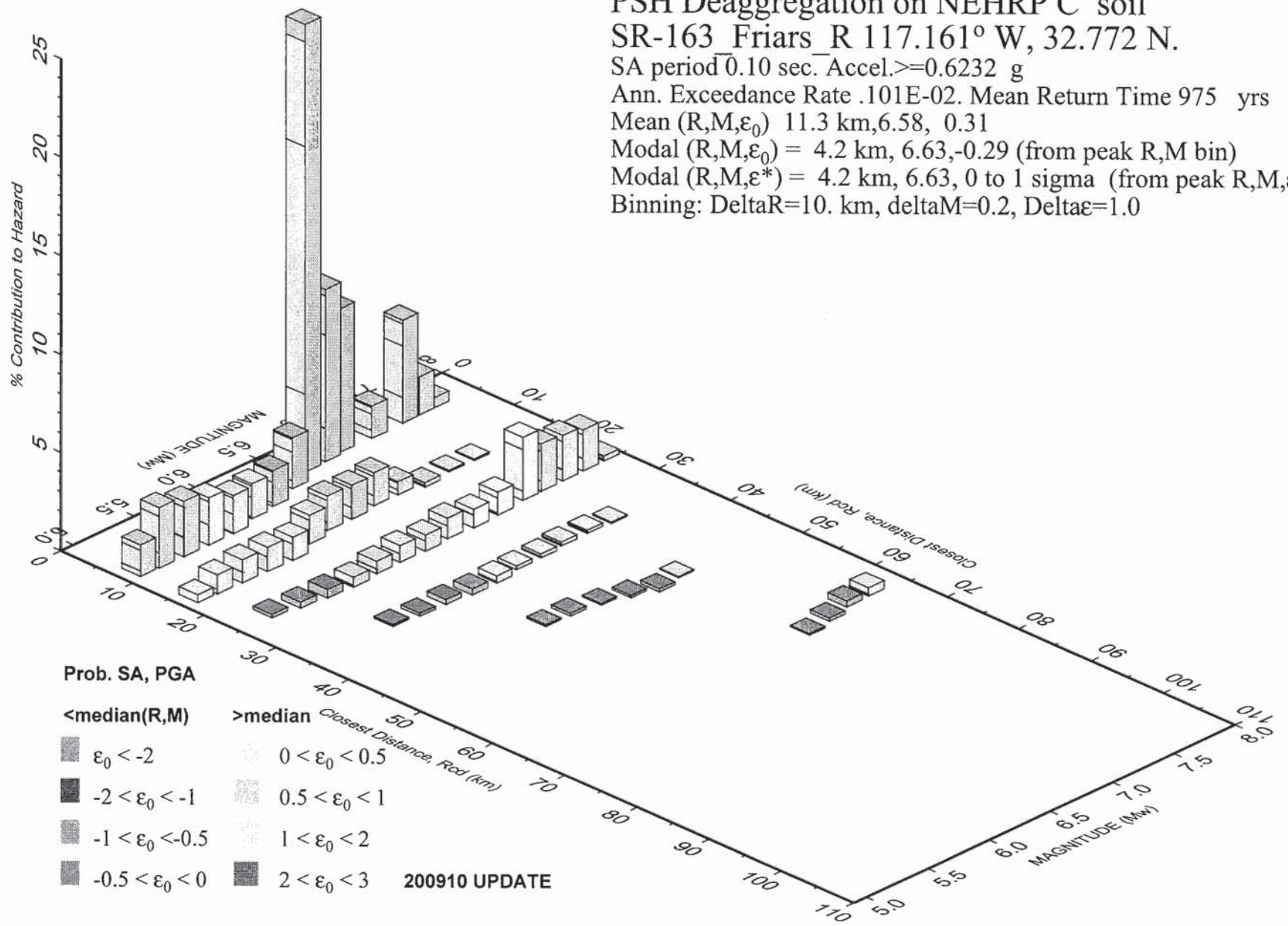
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 11.3 km,6.58, 0.31

Modal (R,M,ε_0) = 4.2 km, 6.63,-0.29 (from peak R,M bin)

Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

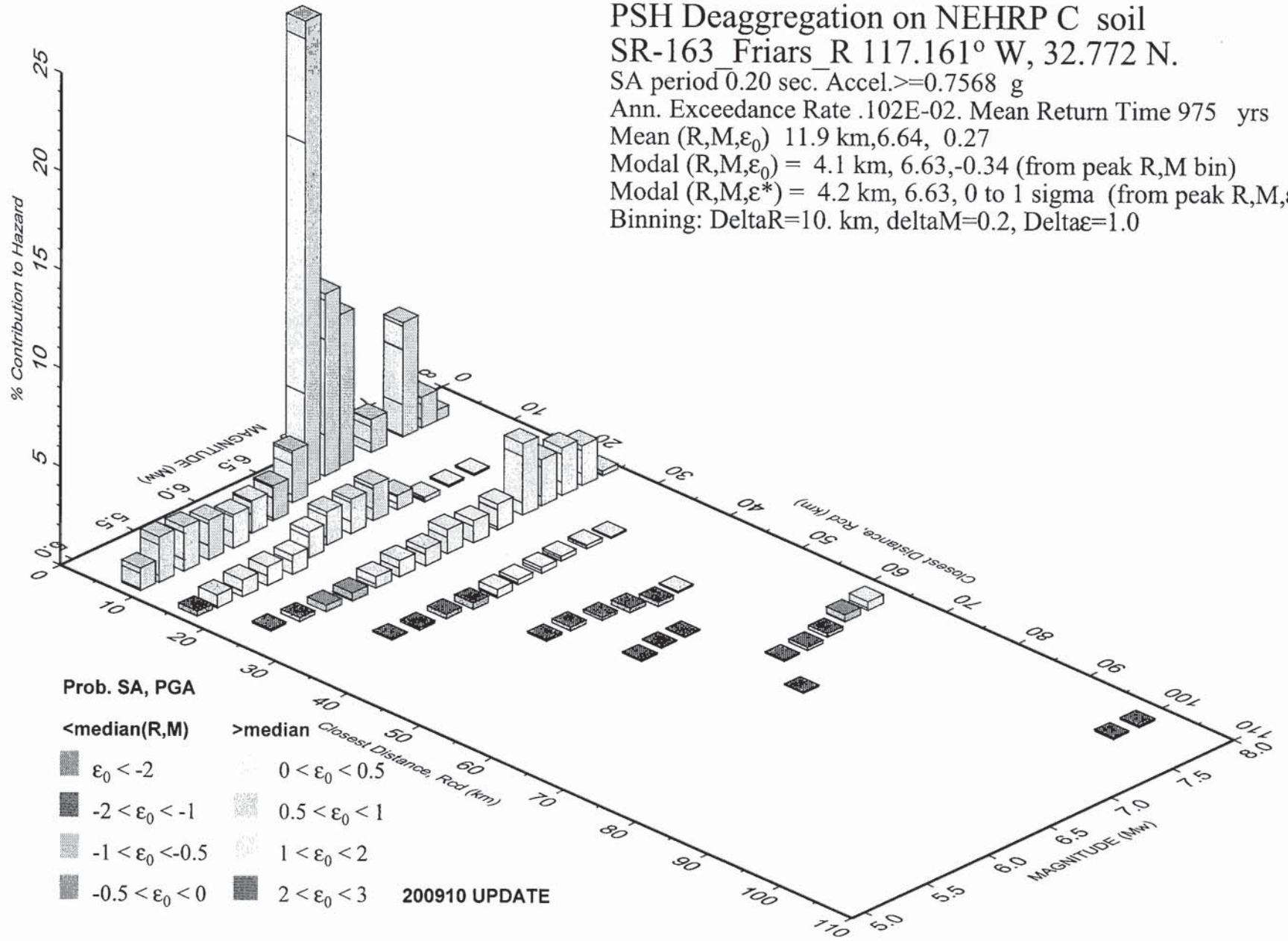
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:34:04 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

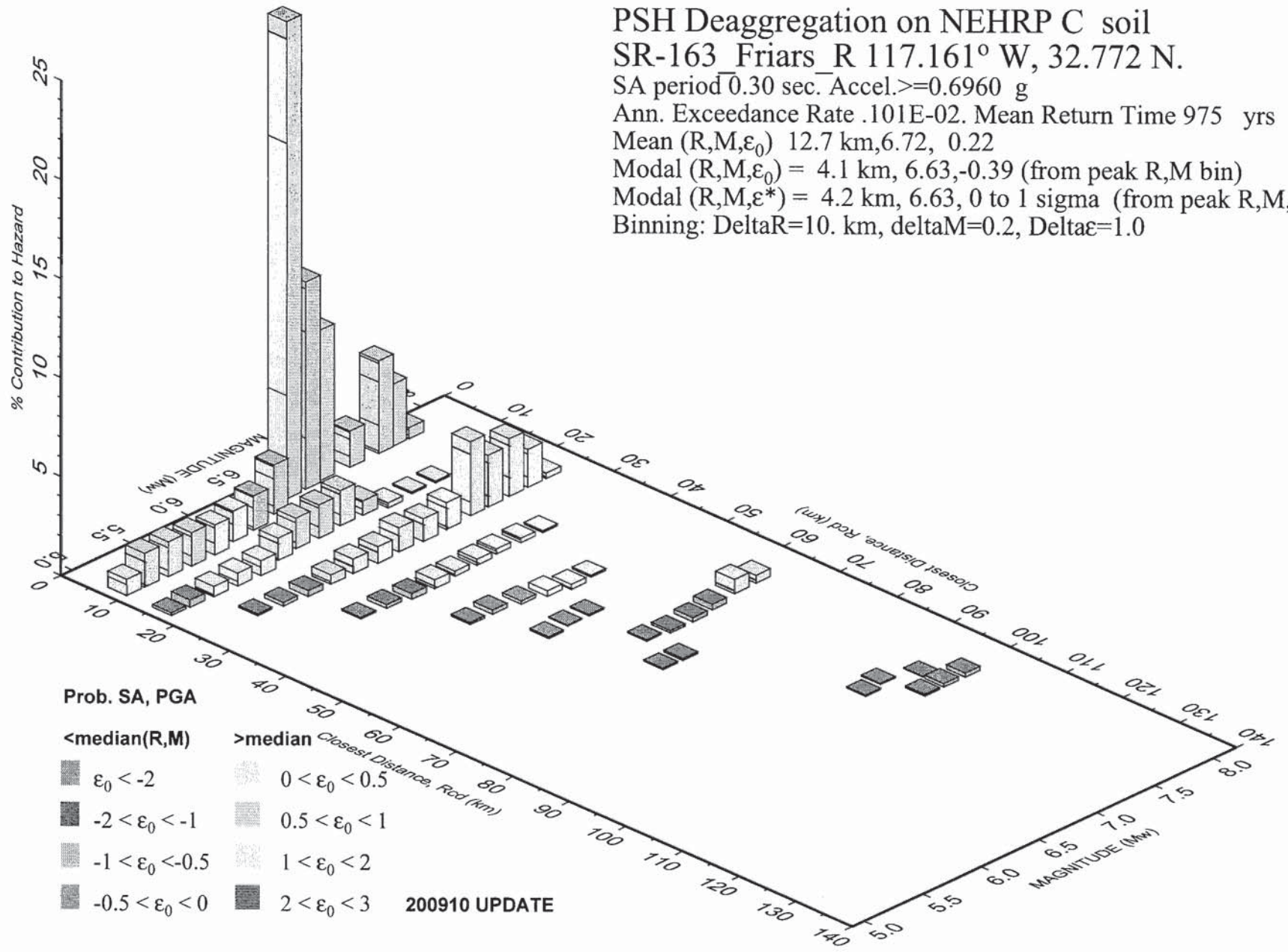
SA period 0.20 sec. Accel.>=0.7568 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.9 km,6.64, 0.27
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:36:42 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

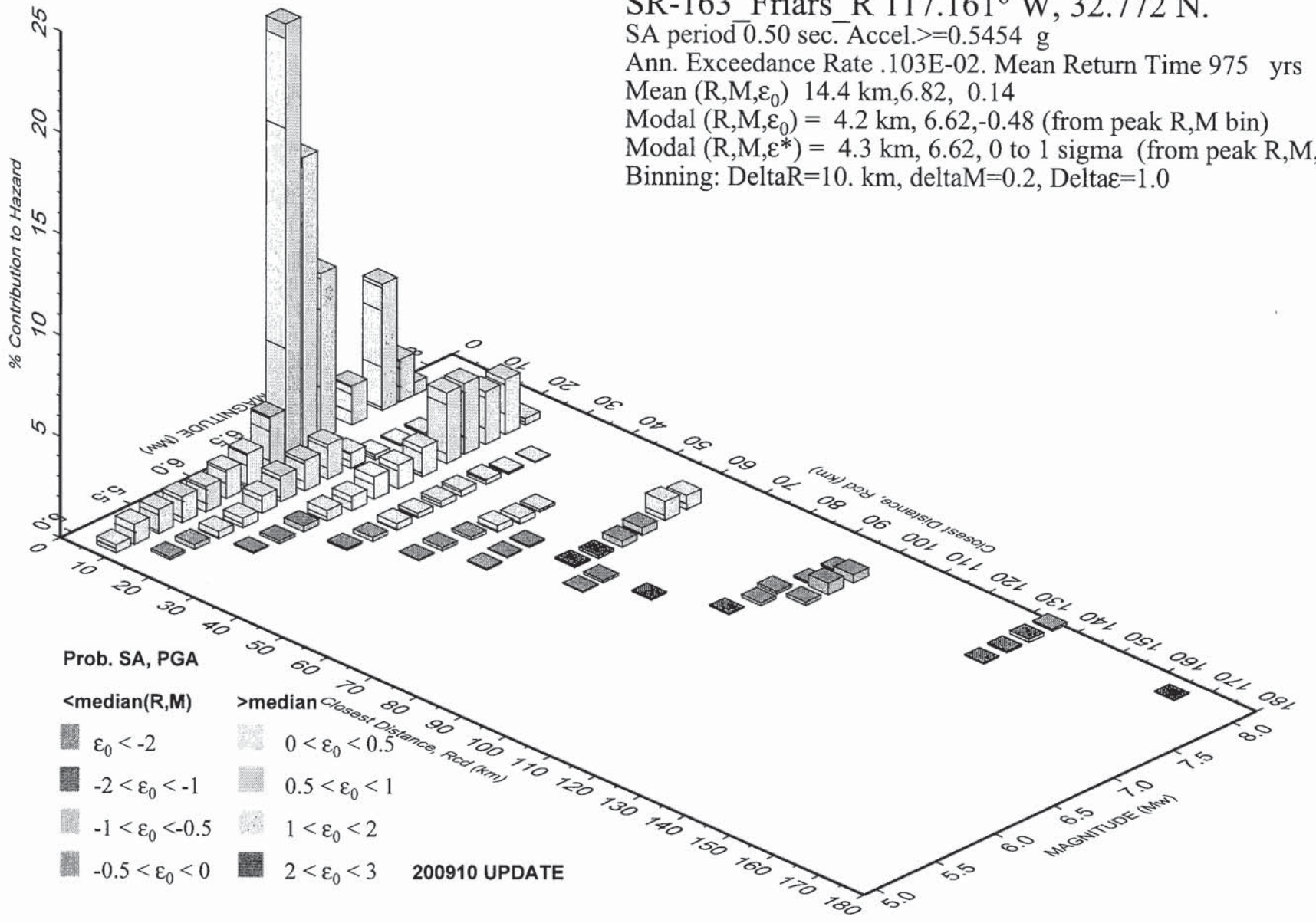
SA period 0.30 sec. Accel.>=0.6960 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.7 km,6.72, 0.22
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.39 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:39:24 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

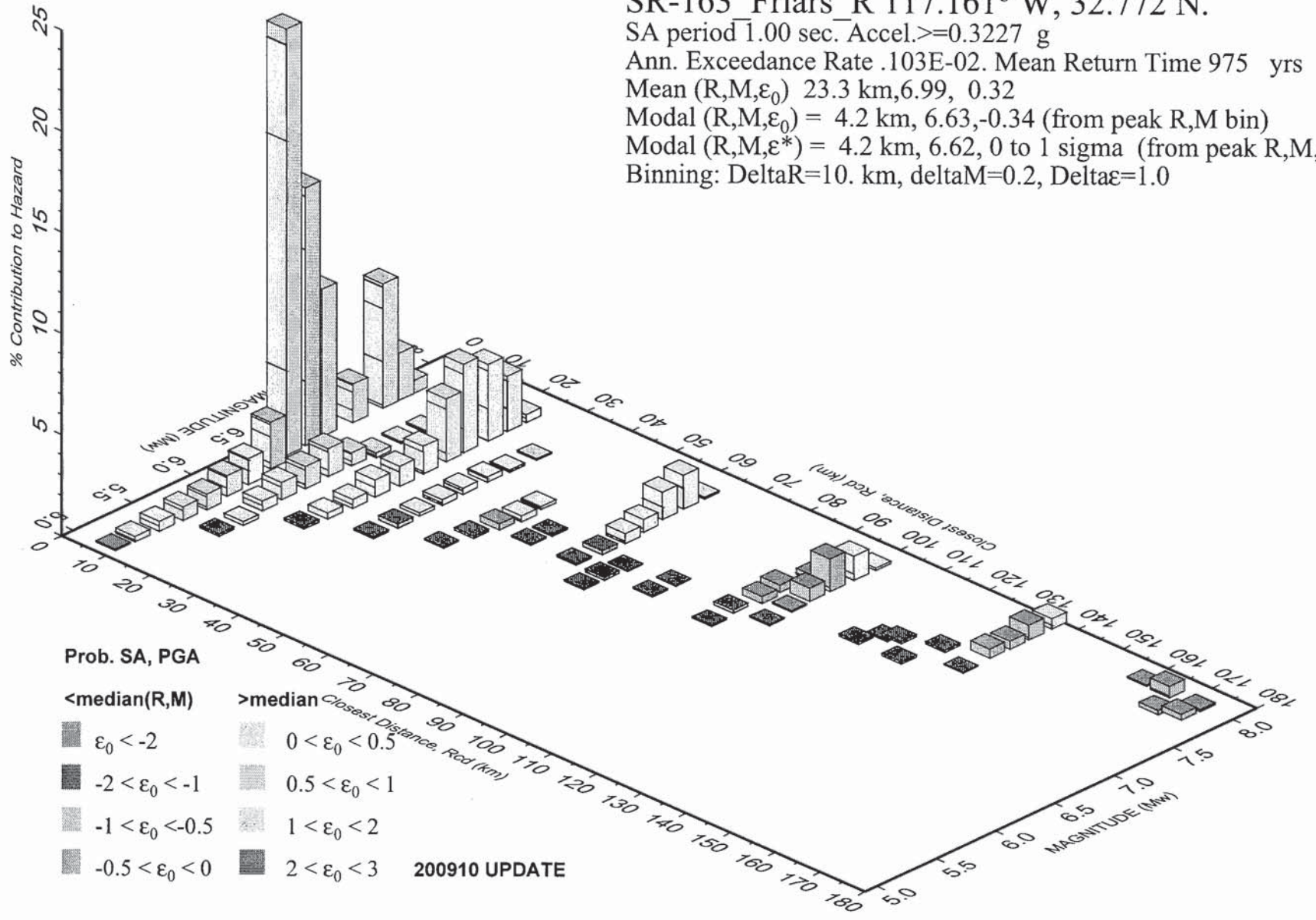
SA period 0.50 sec. Accel.>=0.5454 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.4 km,6.82, 0.14
Modal (R,M,ε_0) = 4.2 km, 6.62,-0.48 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:41:05 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

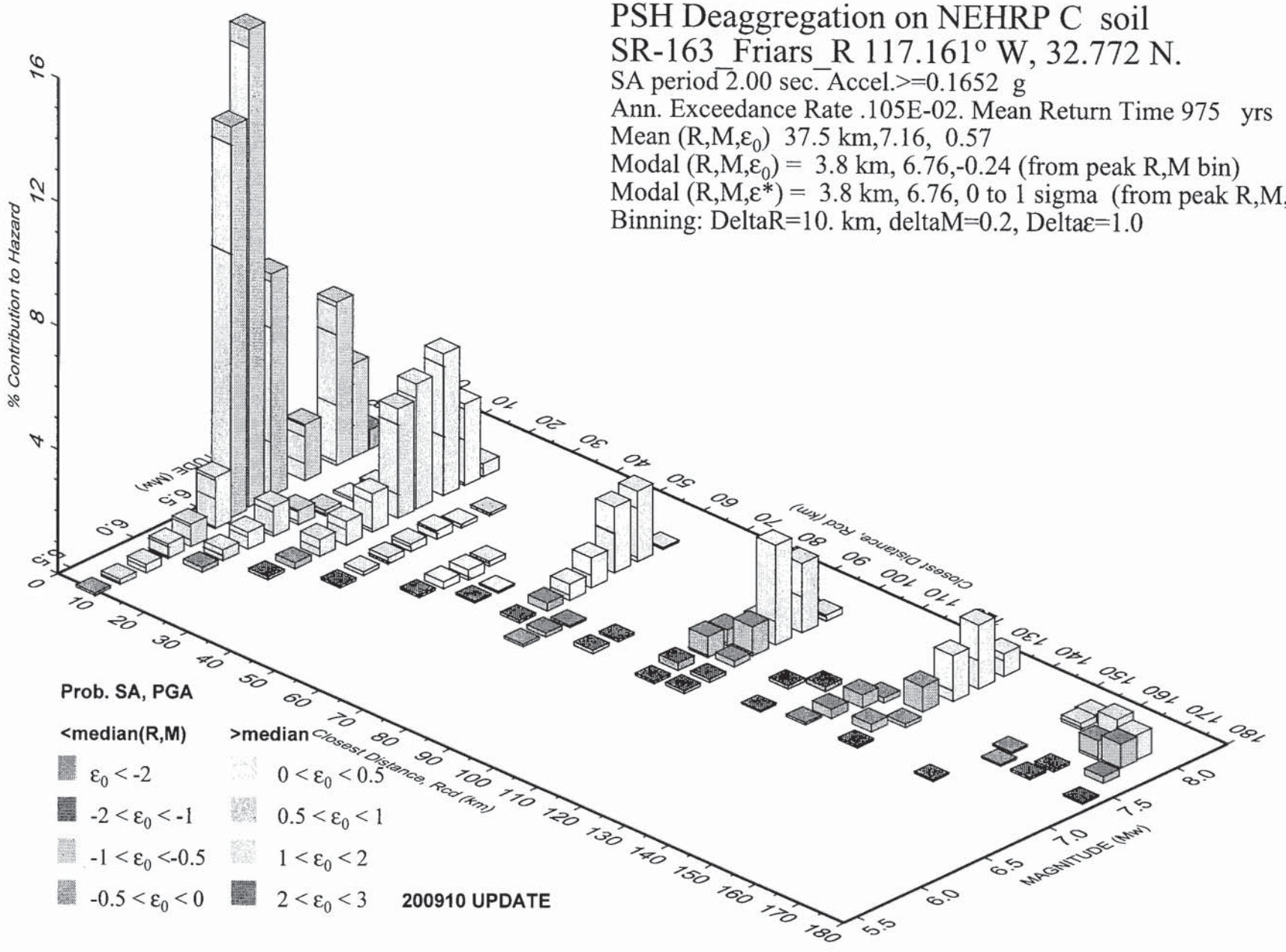
SA period 1.00 sec. Accel.>=0.3227 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.3 km,6.99, 0.32
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.34 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.62, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:46:44 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

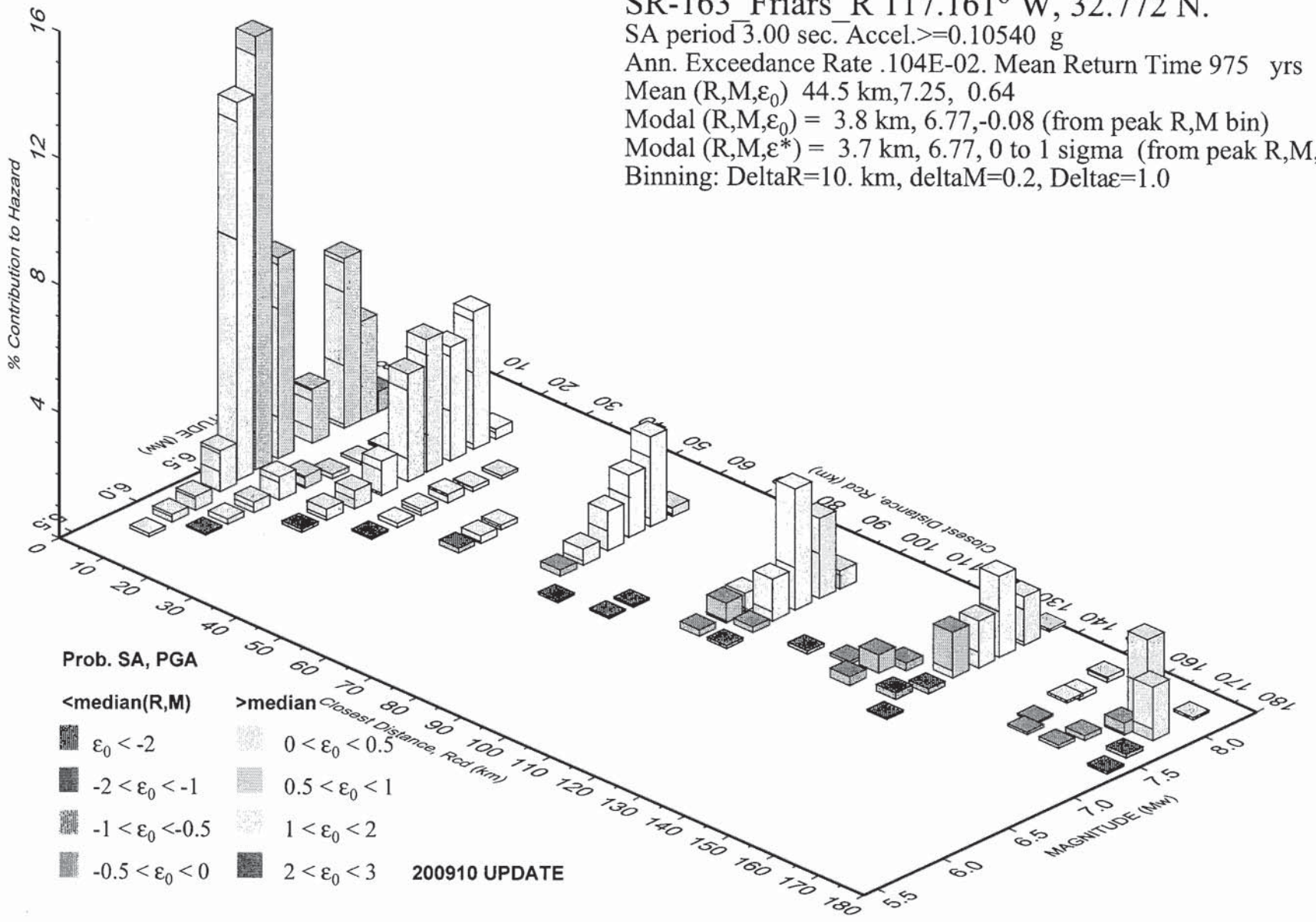
SA period 2.00 sec. Accel.>=0.1652 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.5 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.24 (from peak R,M bin)
Modal (R,M,ε*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 5 23:48:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 3.00 sec. Accel.>=0.10540 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.5 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.07516 g

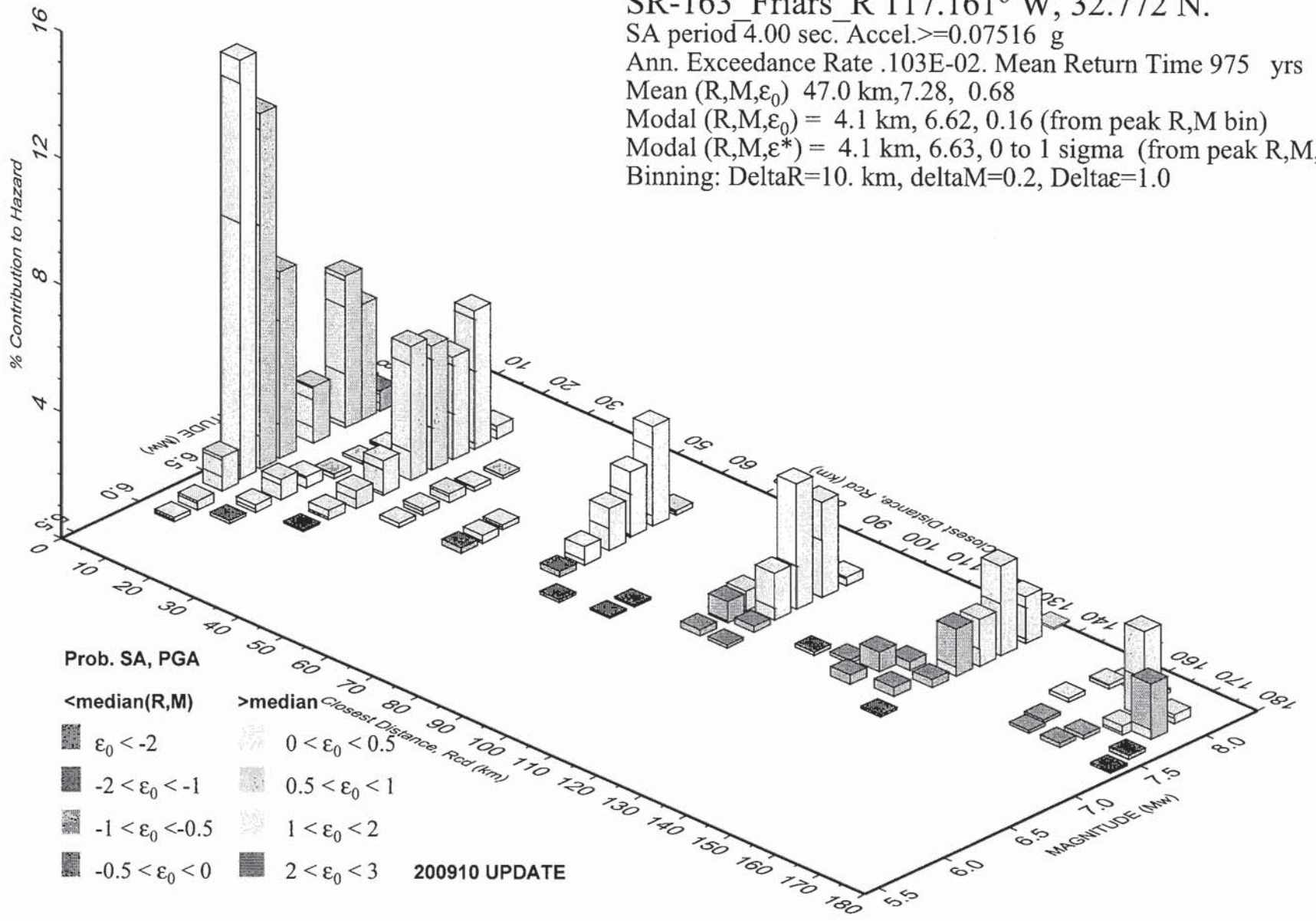
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs

Mean (R,M,ε_0) 47.0 km,7.28, 0.68

Modal (R,M,ε_0) = 4.1 km, 6.62, 0.16 (from peak R,M bin)

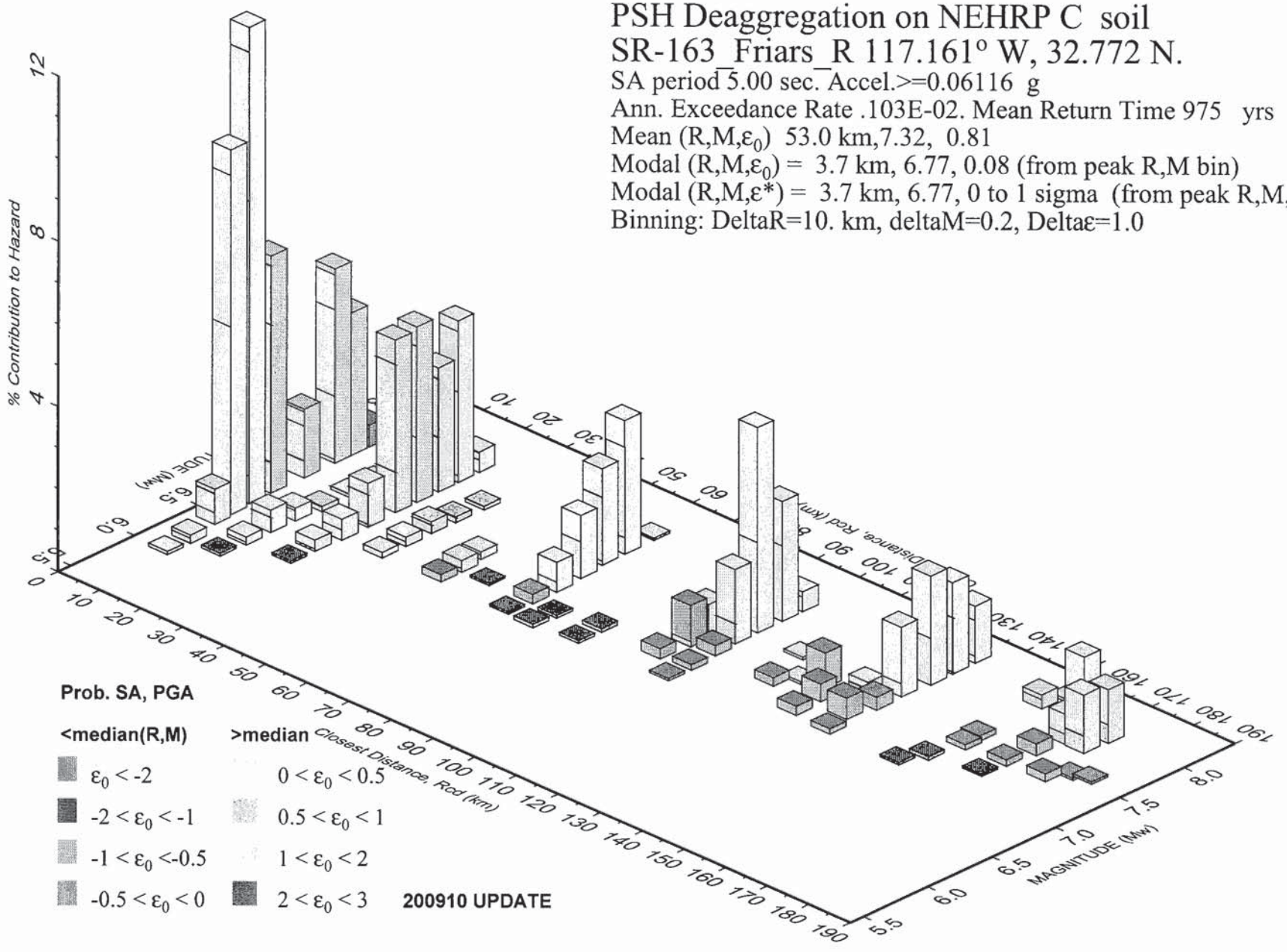
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)

Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

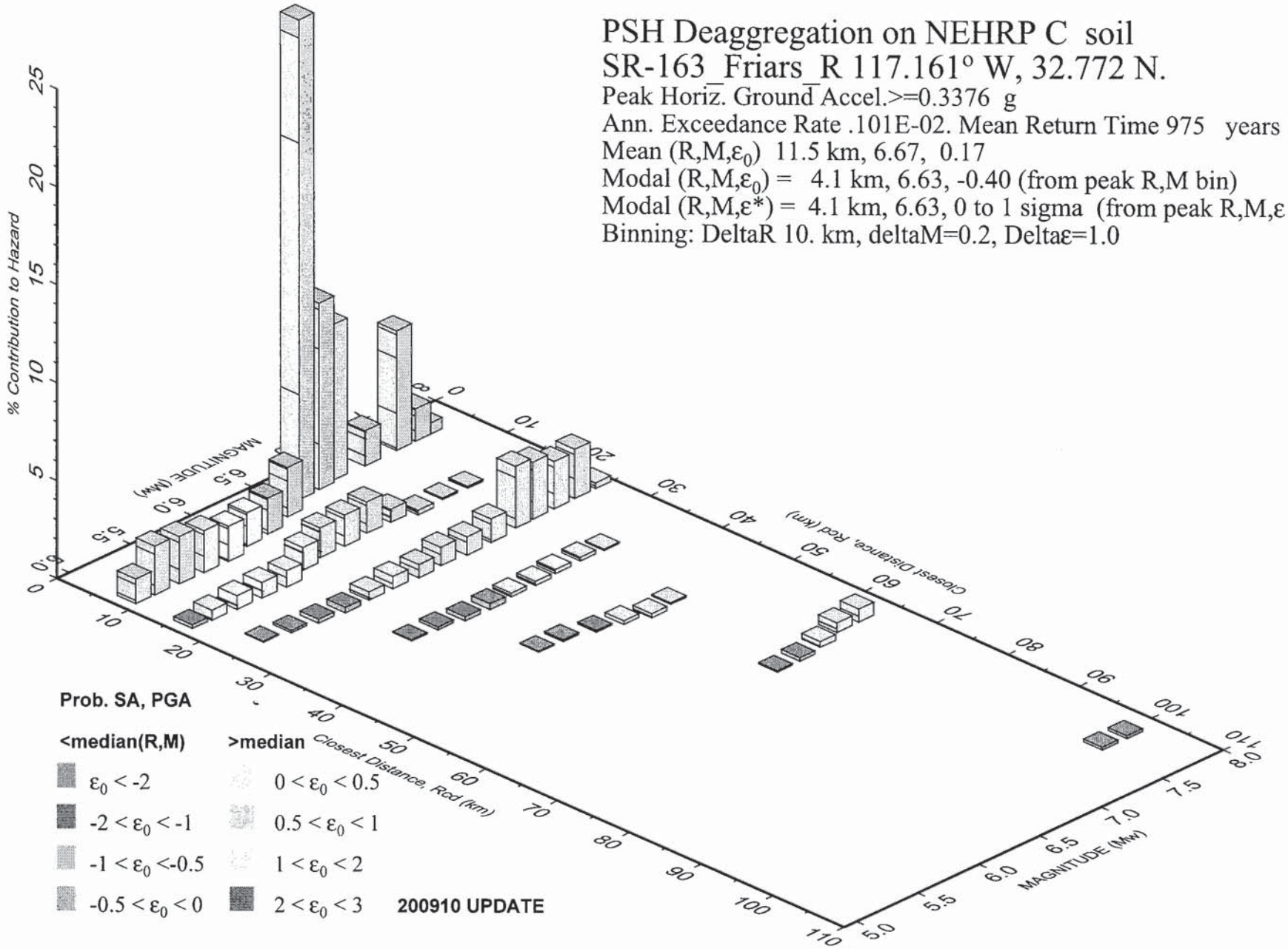


PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 5.00 sec. Accel.>=0.06116 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 53.0 km,7.32, 0.81
Modal (R,M,ε_0) = 3.7 km, 6.77, 0.08 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



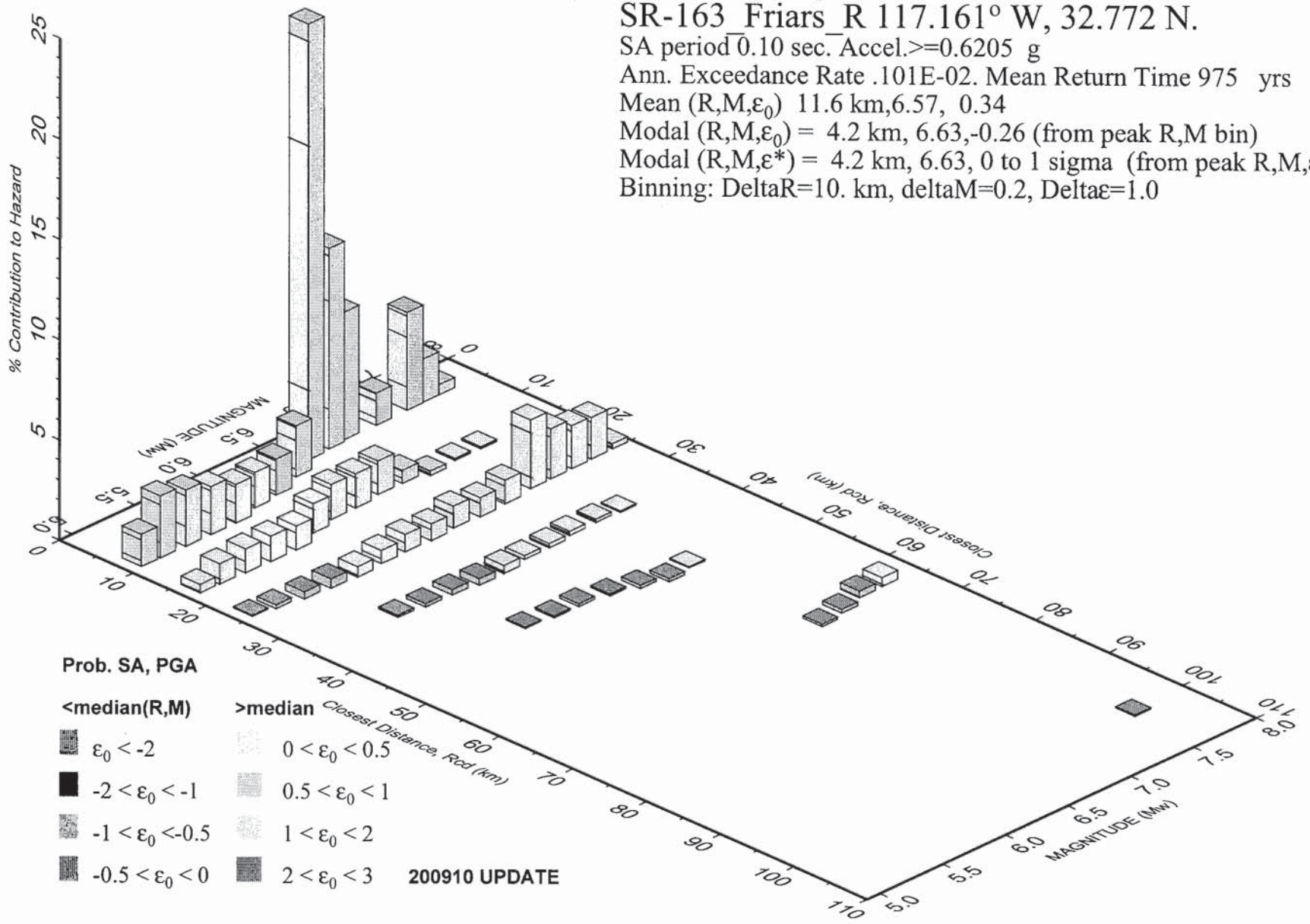
GMT 2012 Jul 5 23:54:48 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 420. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted



GMT 2012 Jul 5 23:57:26 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

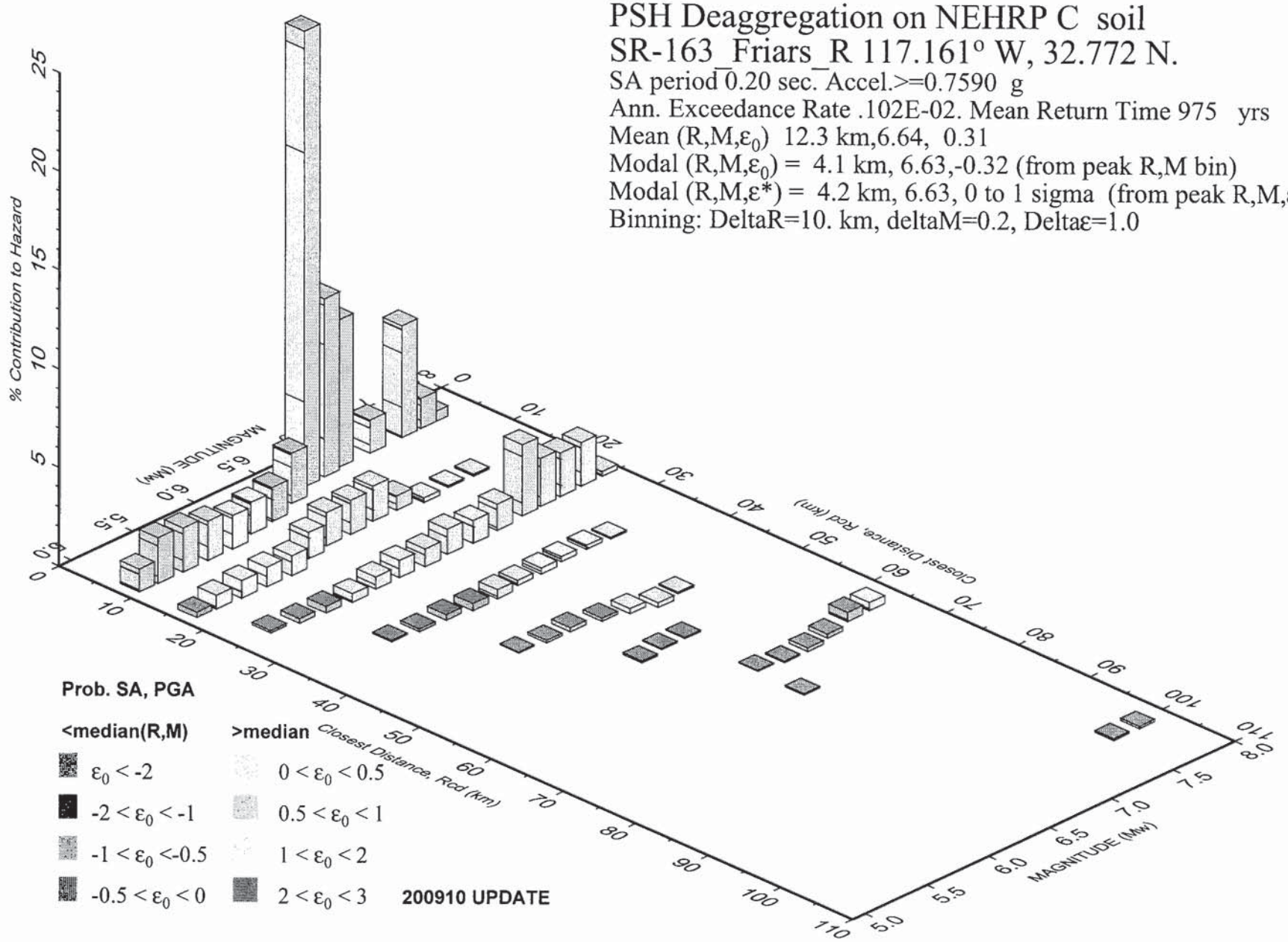
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.10 sec. Accel.>=0.6205 g
Ann. Exceedance Rate .101E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 11.6 km,6.57, 0.34
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.26 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

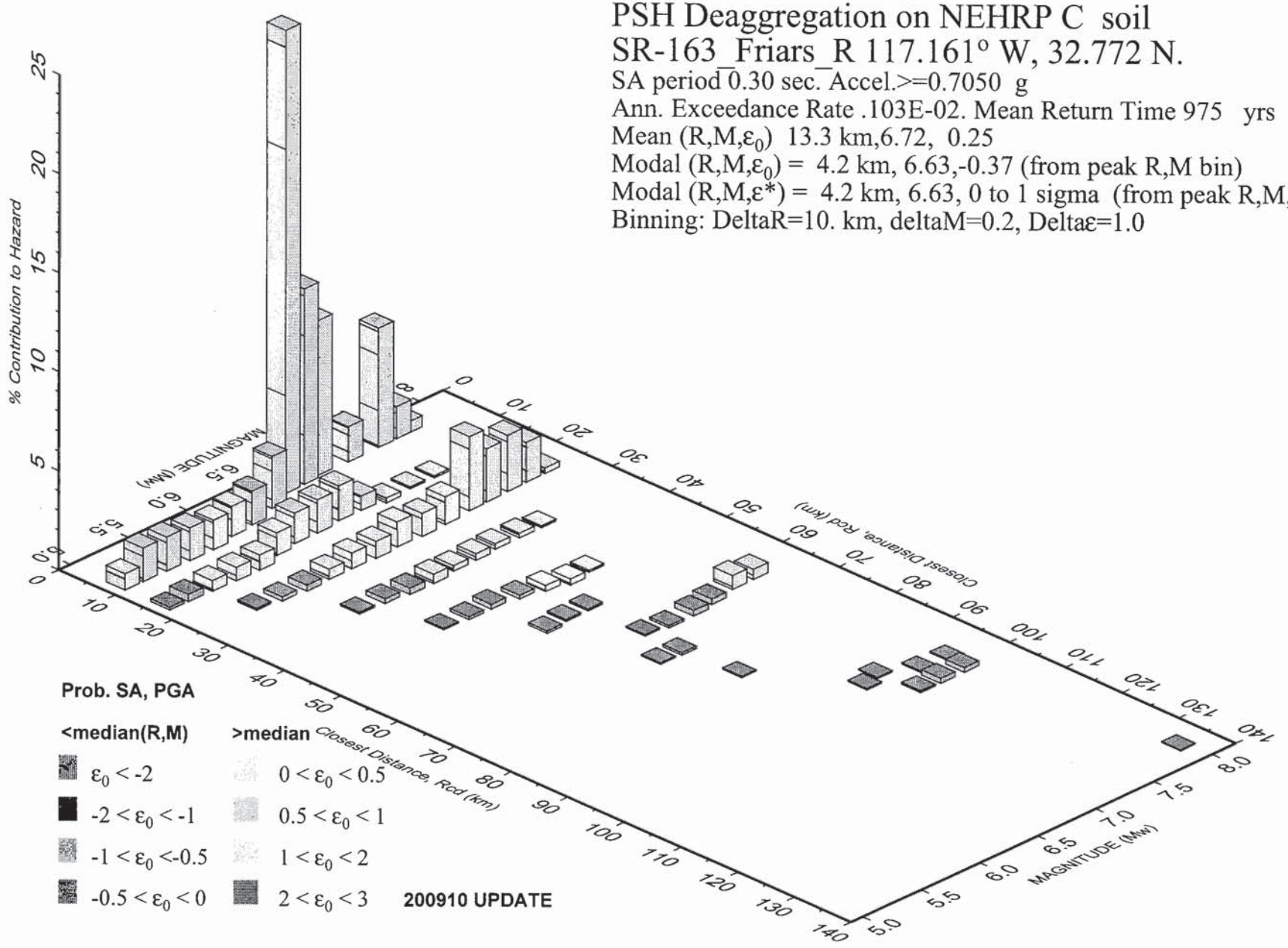
SA period 0.20 sec. Accel.>=0.7590 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 12.3 km,6.64, 0.31
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.32 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:00:19 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

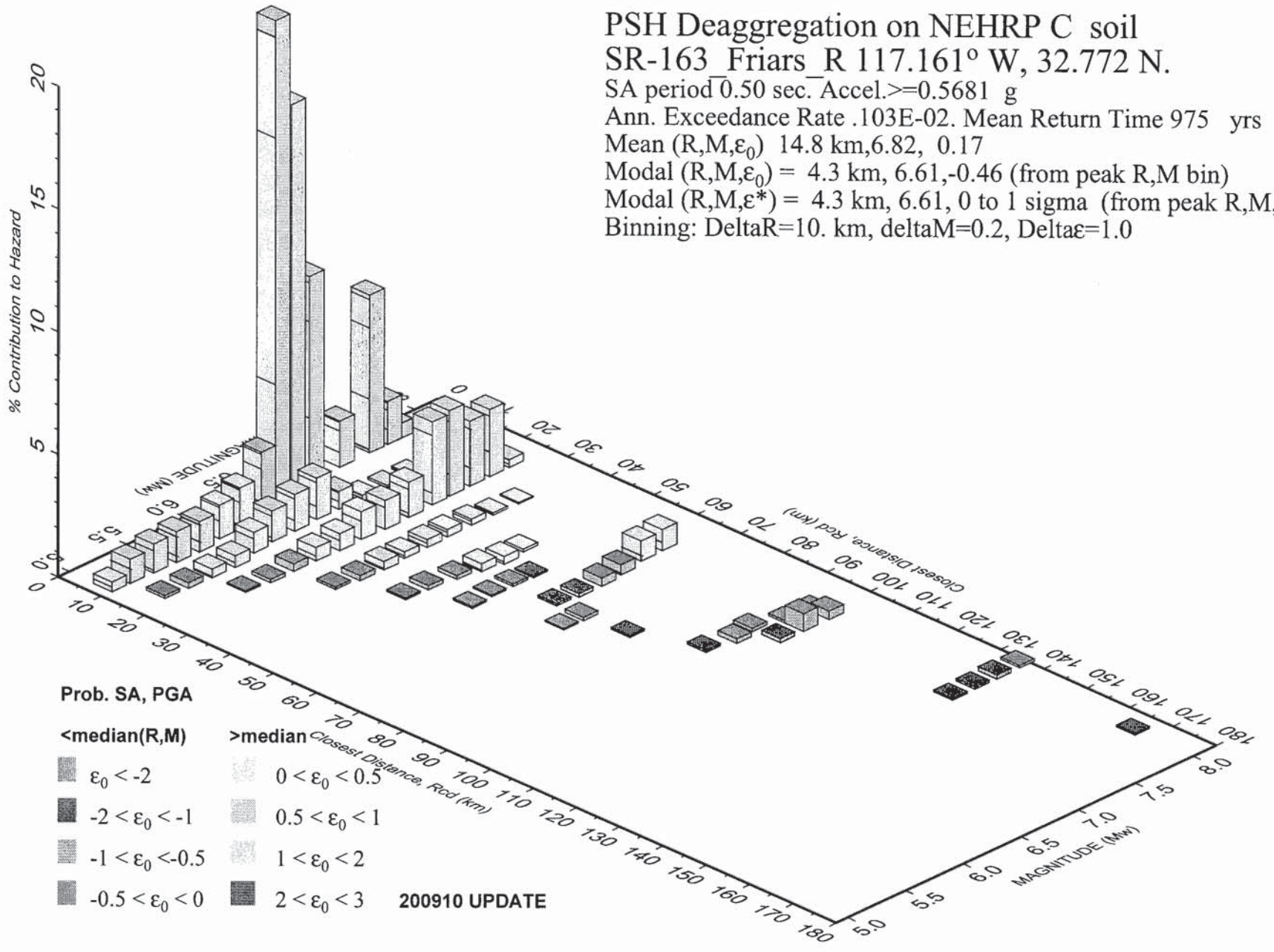
SA period 0.30 sec. Accel.>=0.7050 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 13.3 km,6.72, 0.25
Modal (R,M,ε_0) = 4.2 km, 6.63,-0.37 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:01:39 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 0.50 sec. Accel.>=0.5681 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 14.8 km,6.82, 0.17
Modal (R,M,ε_0) = 4.3 km, 6.61,-0.46 (from peak R,M bin)
Modal (R,M,ε^*) = 4.3 km, 6.61, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

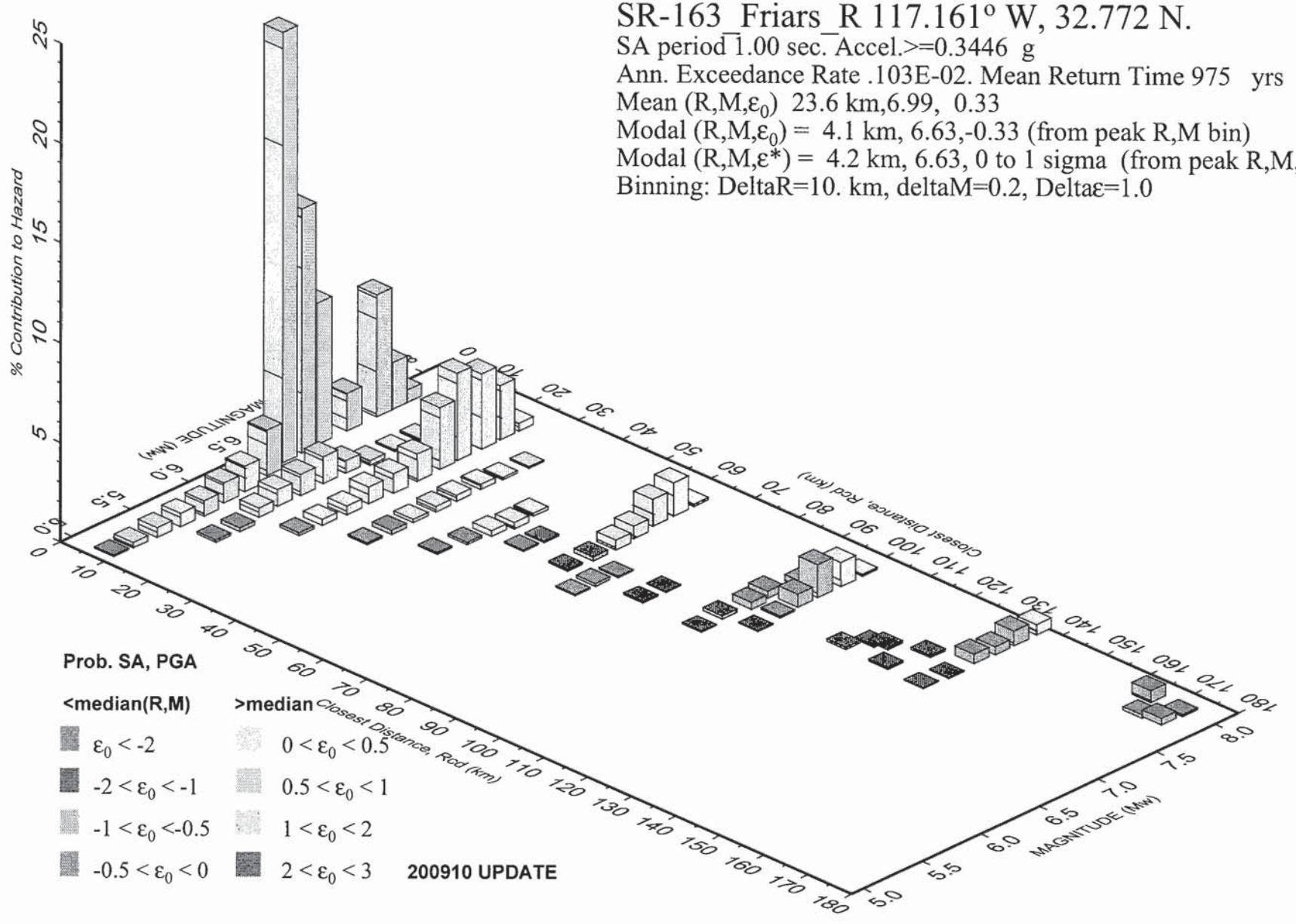


GMT 2012 Jul 6 00:04:36 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil

SR-163_Friars_R 117.161° W, 32.772 N.

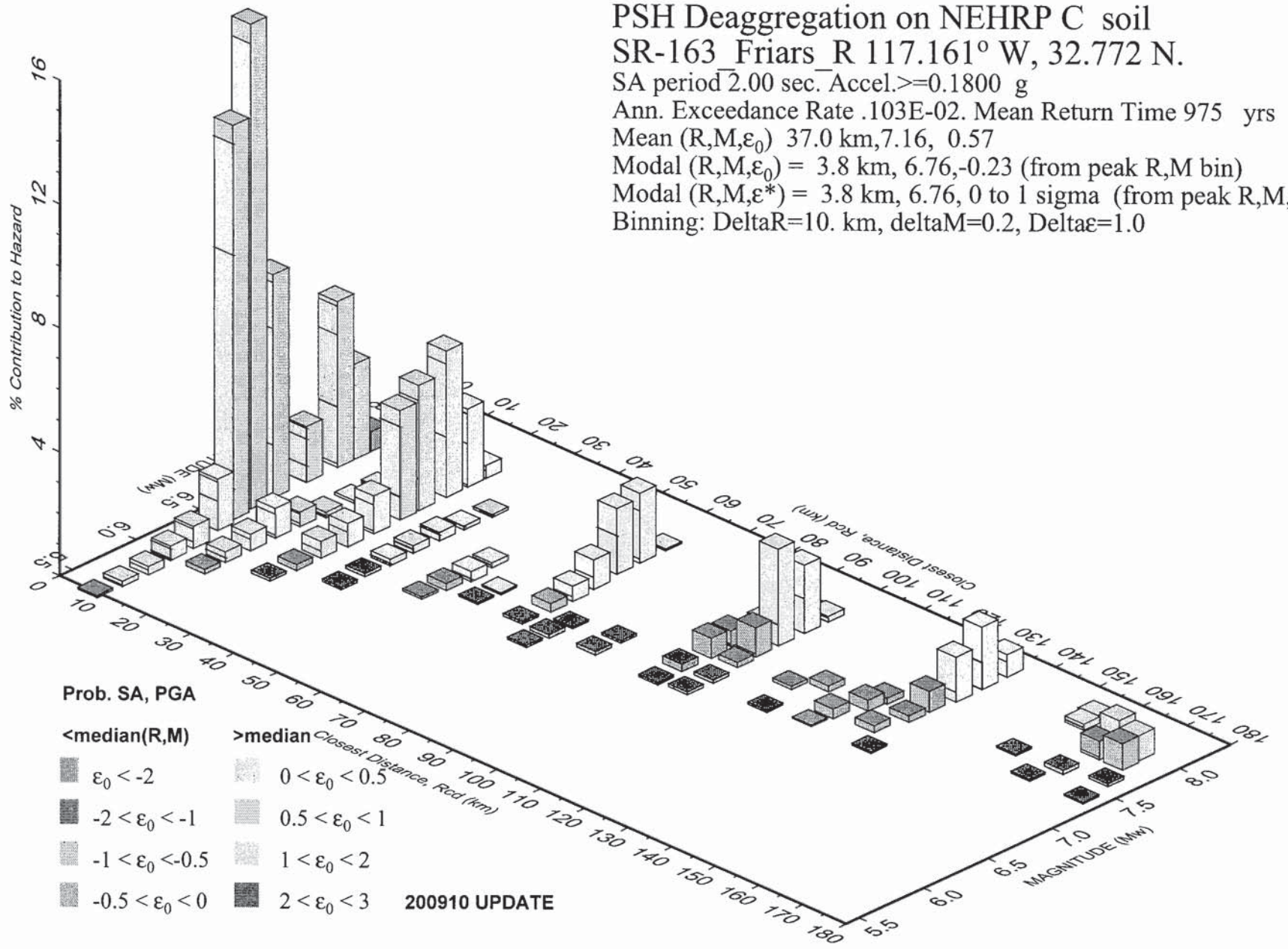
SA period 1.00 sec. Accel.>=0.3446 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 23.6 km,6.99, 0.33
Modal (R,M,ε_0) = 4.1 km, 6.63,-0.33 (from peak R,M bin)
Modal (R,M,ε^*) = 4.2 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:05:53 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

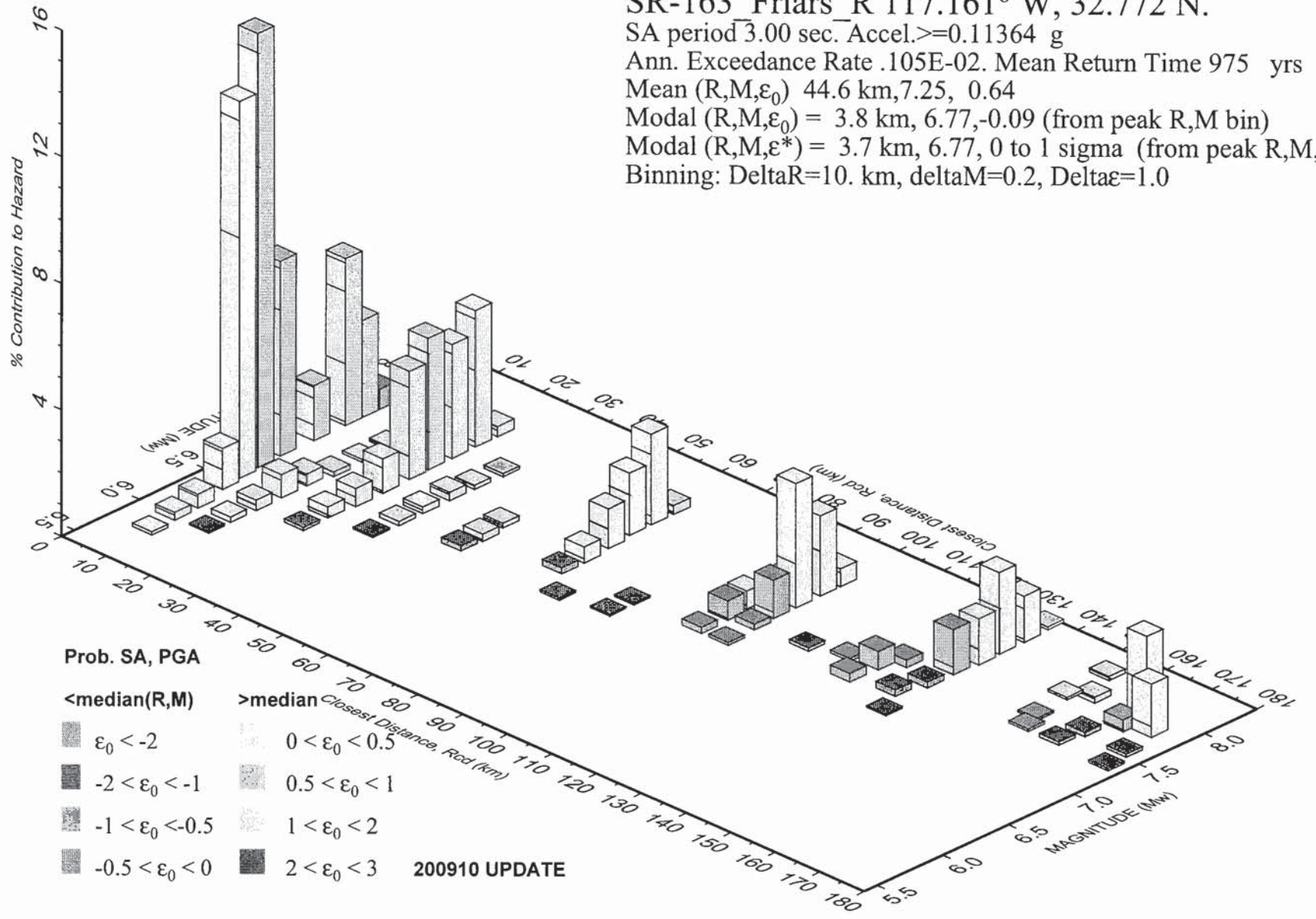
SA period 2.00 sec. Accel.>=0.1800 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 37.0 km,7.16, 0.57
Modal (R,M,ε_0) = 3.8 km, 6.76,-0.23 (from peak R,M bin)
Modal (R,M,ε^*) = 3.8 km, 6.76, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0



GMT 2012 Jul 6 00:07:37 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

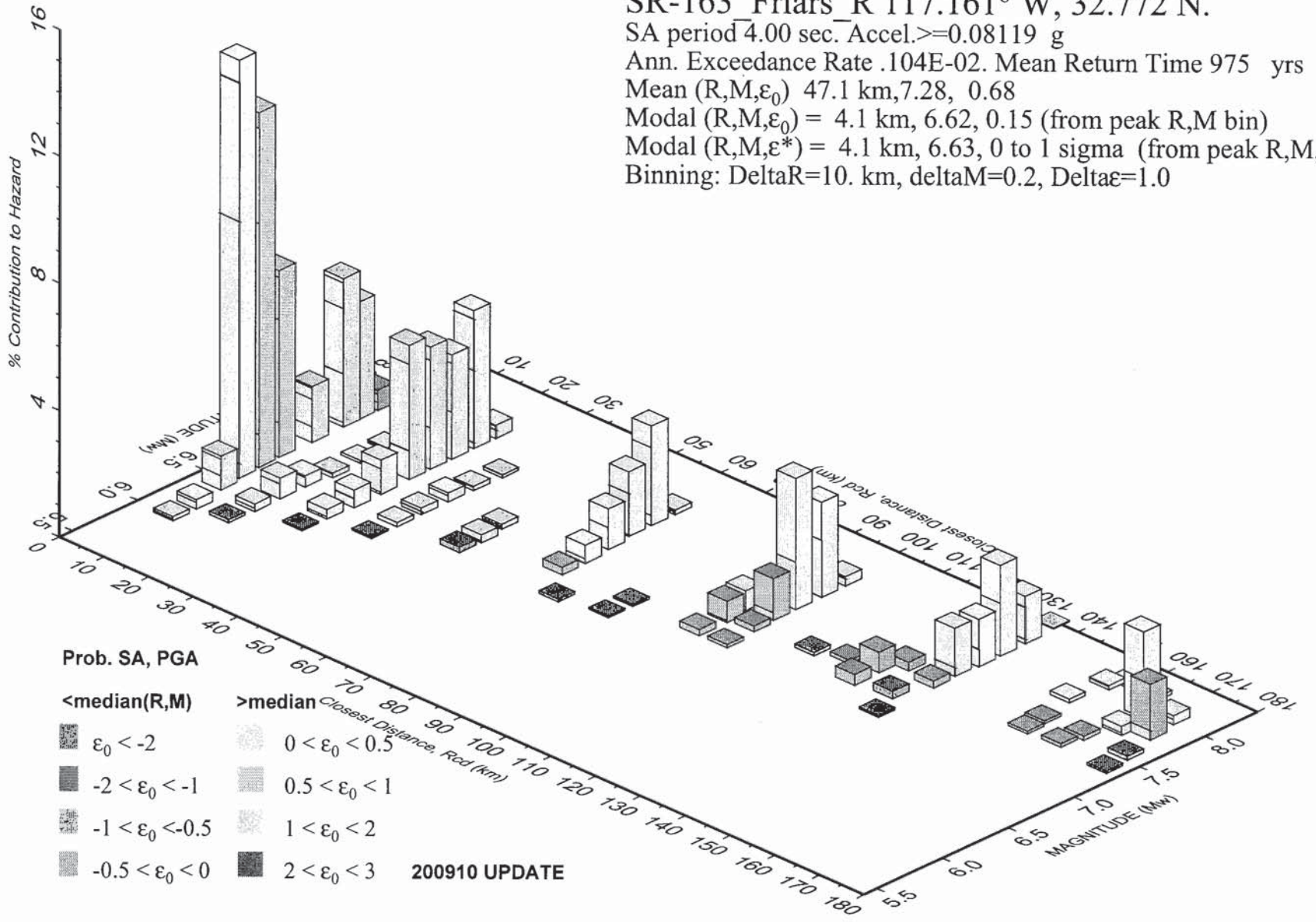
SA period 3.00 sec. Accel.>=0.11364 g
Ann. Exceedance Rate .105E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 44.6 km,7.25, 0.64
Modal (R,M,ε_0) = 3.8 km, 6.77,-0.09 (from peak R,M bin)
Modal (R,M,ε^*) = 3.7 km, 6.77, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0

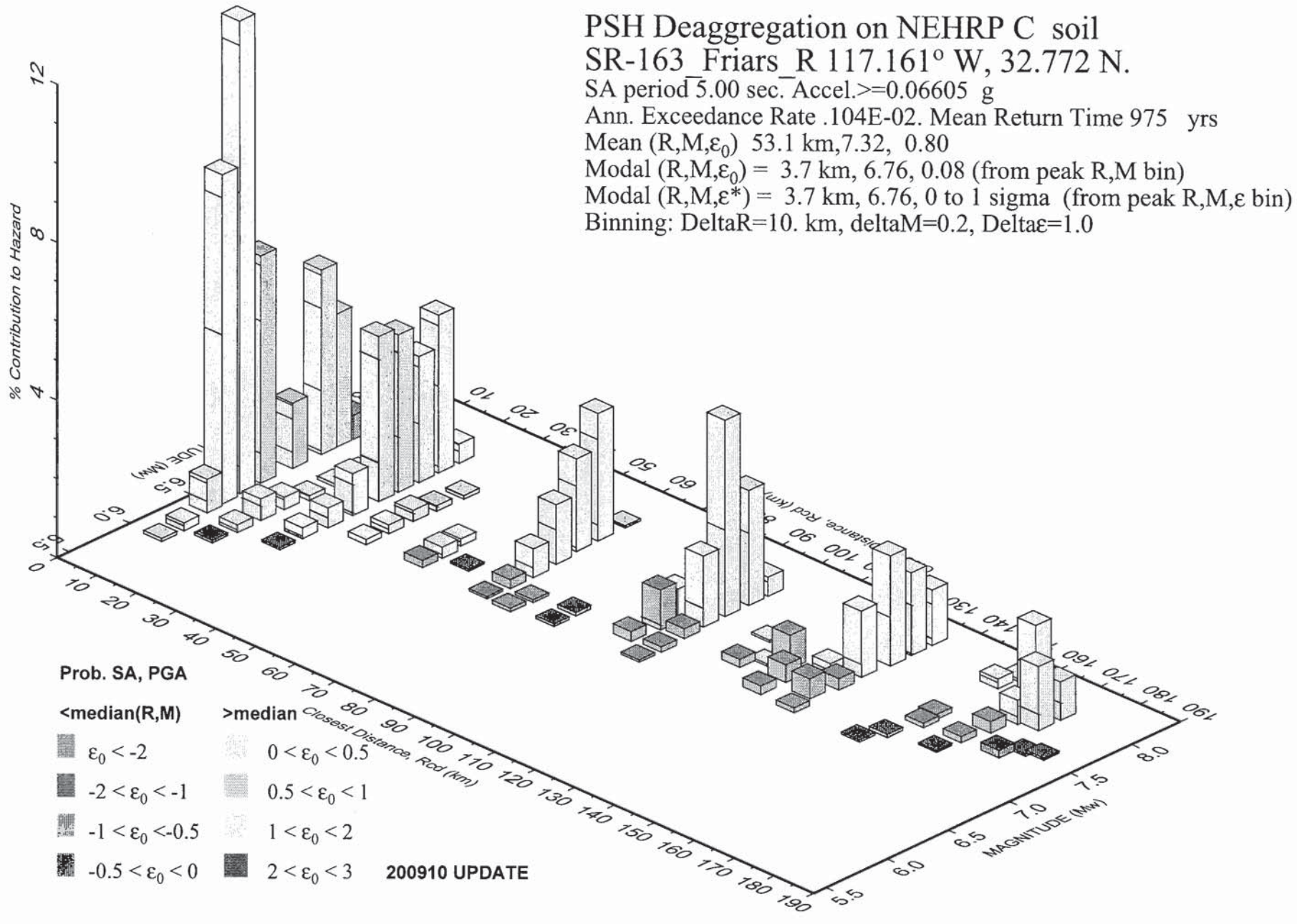


GMT 2012 Jul 6 00:08:54 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

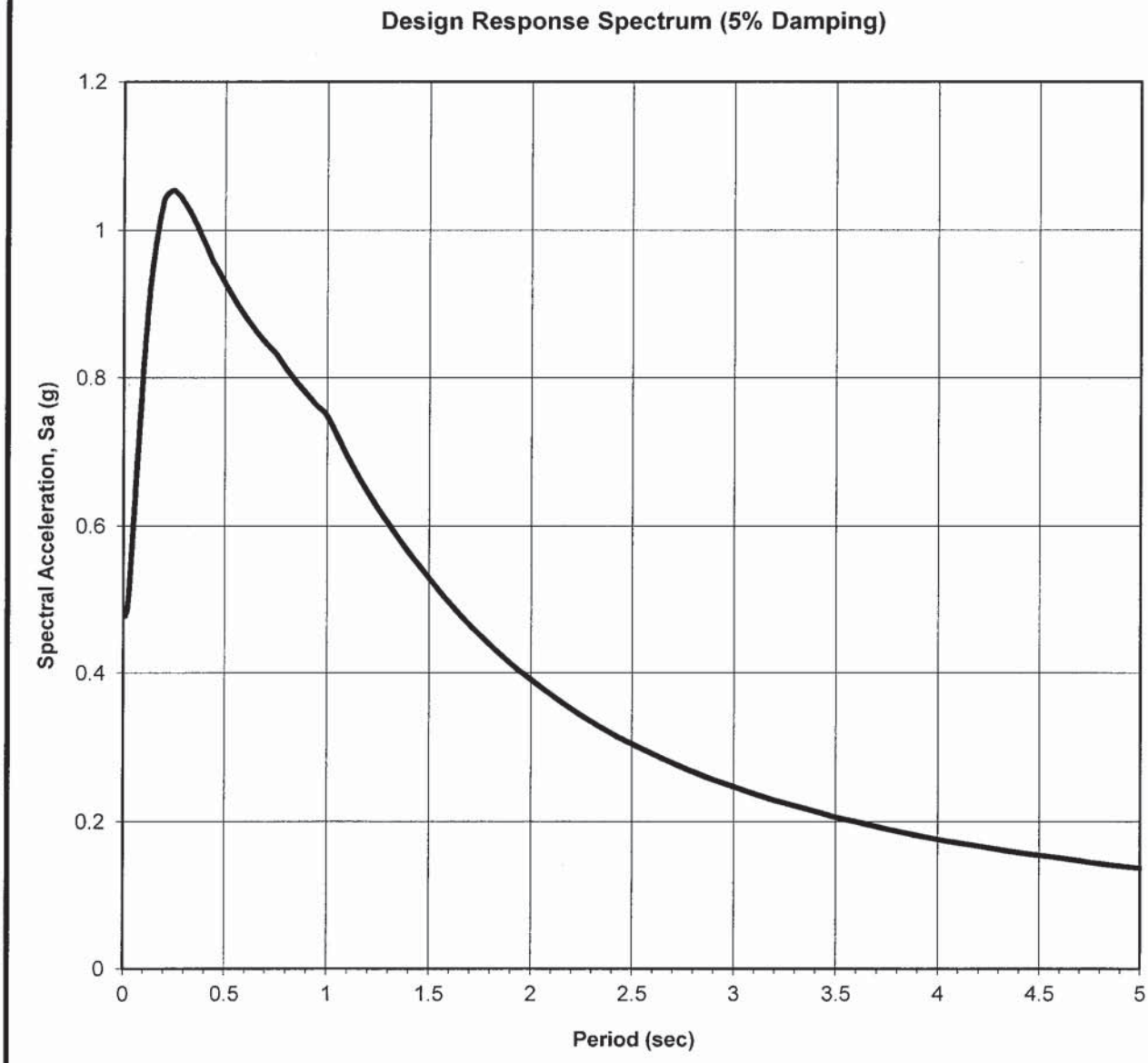
PSH Deaggregation on NEHRP C soil
SR-163_Friars_R 117.161° W, 32.772 N.

SA period 4.00 sec. Accel.>=0.08119 g
Ann. Exceedance Rate .104E-02. Mean Return Time 975 yrs
Mean (R,M,ε_0) 47.1 km,7.28, 0.68
Modal (R,M,ε_0) = 4.1 km, 6.62, 0.15 (from peak R,M bin)
Modal (R,M,ε^*) = 4.1 km, 6.63, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0





GMT 2012 Jul 6 00:11:50 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 380. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted


Design Response Spectrum (5% Damping)
Spectral Acceleration, Sa (g)
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Period (sec)

Vs30 = 380 m/s	
T (sec)	Design Envelop S (a)
0.01	0.474
0.02	0.483
0.022	0.489
0.025	0.497
0.029	0.508
0.03	0.511
0.032	0.519
0.035	0.53
0.036	0.534
0.04	0.55
0.042	0.558
0.044	0.565
0.045	0.57
0.046	0.574
0.048	0.582
0.05	0.59
0.055	0.61
0.06	0.631
0.065	0.651
0.067	0.659
0.07	0.671
0.075	0.691
0.08	0.711
0.085	0.732
0.09	0.752
0.095	0.771
0.1	0.79
0.11	0.825
0.12	0.856
0.13	0.884
0.133	0.891
0.14	0.907
0.15	0.928
0.16	0.948
0.17	0.966
0.18	0.982
0.19	0.996
0.2	1.008
0.22	1.019
0.24	1.026
0.25	1.028
0.26	1.027
0.28	1.025
0.29	1.022
0.3	1.019
0.32	1.013
0.34	1.006
0.35	1.001
0.36	0.997
0.38	0.987
0.4	0.977

Vs30 = 420 m/s	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

Envelope Data	
T (sec)	Design Envelop S (a)
0.01	0.478
0.02	0.487
0.022	0.493
0.025	0.502
0.029	0.514
0.03	0.518
0.032	0.526
0.035	0.538
0.036	0.543
0.04	0.56
0.042	0.569
0.044	0.577
0.045	0.582
0.046	0.586
0.048	0.595
0.05	0.604
0.055	0.627
0.06	0.65
0.065	0.672
0.067	0.681
0.07	0.694
0.075	0.716
0.08	0.738
0.085	0.76
0.09	0.781
0.095	0.802
0.1	0.822
0.11	0.858
0.12	0.891
0.13	0.92
0.133	0.927
0.14	0.944
0.15	0.965
0.16	0.985
0.17	1.002
0.18	1.018
0.19	1.031
0.2	1.043
0.22	1.05
0.24	1.054
0.25	1.054
0.26	1.051
0.28	1.046
0.29	1.041
0.3	1.037
0.32	1.028
0.34	1.018
0.35	1.012
0.36	1.007
0.38	0.994
0.4	0.982

0.42	0.967
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

0.42	0.97
0.44	0.957
0.45	0.952
0.46	0.946
0.48	0.934
0.5	0.922
0.55	0.892
0.6	0.866
0.65	0.843
0.667	0.836
0.7	0.822
0.75	0.804
0.8	0.782
0.85	0.762
0.9	0.744
0.95	0.727
1	0.711
1.1	0.656
1.2	0.609
1.3	0.567
1.4	0.529
1.5	0.495
1.6	0.462
1.7	0.433
1.8	0.407
1.9	0.383
2	0.362
2.2	0.324
2.4	0.293
2.5	0.28
2.6	0.268
2.8	0.246
3	0.227
3.2	0.21
3.4	0.196
3.5	0.189
3.6	0.183
3.8	0.172
4	0.162
4.2	0.153
4.4	0.145
4.6	0.138
4.8	0.132
5	0.126

0.42	0.97
0.44	0.957
0.45	0.953
0.46	0.948
0.48	0.938
0.5	0.928
0.55	0.904
0.6	0.883
0.65	0.864
0.667	0.858
0.7	0.847
0.75	0.832
0.8	0.812
0.85	0.794
0.9	0.778
0.95	0.762
1	0.748
1.1	0.693
1.2	0.645
1.3	0.603
1.4	0.564
1.5	0.529
1.6	0.495
1.7	0.465
1.8	0.438
1.9	0.413
2	0.391
2.2	0.351
2.4	0.318
2.5	0.304
2.6	0.291
2.8	0.267
3	0.247
3.2	0.229
3.4	0.214
3.5	0.206
3.6	0.2
3.8	0.187
4	0.176
4.2	0.167
4.4	0.158
4.6	0.151
4.8	0.143
5	0.137

Abut 1

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B3 (1968)			A-B-5 (2003)																										Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	25		25	100		100																									63	0.08	333.4	0.015		
5	10	5	26		26	100		100																									63	0.08	334.18	0.01496		
10	15	5	100		100	100		100																									100	0.05	382.09	0.01309		
15	20	5	100		100	100		100																									100	0.05	382.09	0.01309		
20	25	5	100		100	100		100																									100	0.05	382.09	0.01309		
25	30	5	100		100	100		100																									100	0.05	382.09	0.01309		
30	35	5	100		100	100		100																									100	0.05	382.09	0.01309		
35	40	5	100		100	100		100																									100	0.05	382.09	0.01309		
40	45	5	100		100	100		100																									100	0.05	382.09	0.01309		
45	50	5	100		100	100		100																									100	0.05	382.09	0.01309		
50	55	5	100		100	100		100																									100	0.05	382.09	0.01309		
55	60	5	100		100	100		100																									100	0.05	382.09	0.01309		
60	65	5	100		100	100		100																									100	0.05	382.09	0.01309		
65	70	5	100		100	100		100																									100	0.05	382.09	0.01309		
70	75	5	100		100	100		100																									100	0.05	382.09	0.01309		
75	80	5	100		100	100		100																									100	0.05	382.09	0.01309		
80	85	5	100		100	100		100																									100	0.05	382.09	0.01309		
85	90	5	100		100	100		100																									100	0.05	382.09	0.01309		
90	95	5	100		100	100		100																									100	0.05	382.09	0.01309		
95	100	5	100		100	100		100																									100	0.05	382.09	0.01309		
	sum	100																															Weighted Avg N	94.40	V_{s30}	377		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 421 m/s

Say 420 m/s

Bent 2

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B6 (1963)			B2 (1968)			A-B-2 (2003)																								Cohesionless Soils			
																																SPT			CP
From	To	Di	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	24		24	15		15	14		14																						18	0.28	231.1	0.02163		
5	10	5	15		15	17		17		11	8																						13	0.38	212.54	0.02352		

VI

10	15	5	12		12	40		40		14	10																					21	0.24	241.65	0.02069		
15	20	5	100		100	100		100		50	35																					78	0.06	355.97	0.01405		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
35	40	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
40	45	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
45	50	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
50	55	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	100																														Weighted Avg N	56.58	V_{s30}	346		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 384 m/s

Say 380 m/s

Abut 3

SR-163 Friars Rd OC; Project No. G1447-52-01

Depth, ft			B1 (1963)			B1 (1968)			A-B-44 (2012)																								Cohesionless Soils					
																																	SPT			CP		
From	To	DI	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	SPT	Cal	N	Avg N	di/Ni	Vi, m/s	Di/Vi	q_t, MPa	σ'_{vo}, MPa
0	5	5	5		5	5		5		100	100																					37	0.14	285.6	0.01751		
5	10	5	7		7	4		4		100	100																					37	0.14	286.38	0.01746		
10	15	5	50		50	6		6		100	100																					52	0.10	316.09	0.01582		
15	20	5	100		100	20		20		100	100																					73	0.07	349.22	0.01432		
20	25	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
25	30	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
30	35	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		

35	40	5	100		100	100		100		54	38																					79	0.06	357.19	0.014		
40	45	5	100		100	100		100		42	29																					76	0.07	353.49	0.01414		
45	50	5	100		100	100		100		44	31																					77	0.06	354.11	0.01412		
50	55	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
55	60	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
60	65	5	100		100	100		100		100	100																					100	0.05	382.09	0.01309		
65	70	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
70	75	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
75	80	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
80	85	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
85	90	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
90	95	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
95	100	5	100		100	100		100	100		100																					100	0.05	382.09	0.01309		
	sum	**100**																														**Weighted Avg N**	**78.17**	V_{s30}	**360**		

Notes:

1) Standard Penetration Resistance N based on 2007 CBC Equation 16A-42

2) A conversion factor of 0.7 is assumed from Cal N to SPT N.

3) Blow count with limited penetration/refusal was estimated with linear relationship for 12" penetration rate, but not to exceed 100.

4) Soil profile type based on current Caltrans Seismic Design Criteria

Soil Profile Type CLASS C

Use Avg 402 m/s

Say **380** m/s

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	344.4	0.0145	407.7	0.012264724
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	345.3	0.0145	408.7	0.012233589
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	396	V_{s30}	466
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
r		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	226.1	0.0221	272.4	0.018352752
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	205.4	0.0243	248.4	0.020124774

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	238.0	0.021	286.1	0.017475108
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	371.3	0.0135	438.1	0.011412336
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	358	V_{s30}	423
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS D		CLASS C

		Cohesive Soils									Young Sedimentary Rocks	
T		Su				CPT			SPT		SPT	
Vi, m/s	Di/Vi	Su	Pa	Vi, m/s	Di/Vi	q_t, kPa	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi	Vi, m/s	Di/Vi
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	288.4	0.0173	343.9	0.014539214
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	289.2	0.0173	344.9	0.014497301
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	323.9	0.0154	384.4	0.013005841
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	363.2	0.0138	429.0	0.011655002
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073

0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	372.7	0.0134	439.8	0.011369297
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	368.3	0.0136	434.8	0.011500478
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	369.1	0.0135	435.6	0.011478178
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
0	#DIV/0!			#DIV/0!	#DIV/0!		0	#DIV/0!	402.7	0.0124	473.6	0.010557073
V_{s30}	#DIV/0!			V_{s30}	#DIV/0!		V_{s30}	#DIV/0!	V_{s30}	376	V_{s30}	444
	#DIV/0!				#DIV/0!			#DIV/0!		CLASS C		CLASS C

GEOCON

Hammer Energy Correction Factors

Reference: Youd, et al, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Environmental Engineering, October, 2001, Vol. 127, No. 10

Project Name: Friars Road/SR 163 Date: 11/6/2012

Project Number: G1447-52-01

Hole Diameter, Inches: 8 Hole Diameter Correction, C_B: 1.15

Average Unit Weight, γ (pcf): 120

Adjustment Factor for 350 LB Hammer Above Groundwater 1.00 <-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples

Adjustment Factor for 350 LB Hammer Below Groundwater 1.00 <-- Enter 1.0 if an adjustment is not required; Applied to "MC" Samples

Approximate Depth to Groundwater 20

*Auto, Cathead, or Downhole Hammer

					Adjust for each GWT Level		Energy Correction, C_E (1.0 Safe-T-Driver/Cathead, 1.3 Automatic)				
Sample	Depth, Feet	Field Blow Count (per Foot)	Type of Sampler (MC or SPT)	Hammer Type* (A/C/D)	Equiv. SPT Blow Count, N	σ'_v, psf	Overburden Pressure Correction, C_N	Energy Ratio Correction, C_E	Rod Length Correction, C_R	Sampling Correction, C_S	N1|60 Blowcounts (Pror to Fines)
A-03-002: 5	5.0	14	SPt	a	14.0	600.0	1.70	1.3	0.75	1.10	29.35
A-03-002: 7	7.0	11	MC	a	7.3	840.0	1.54	1.3	0.80	1.00	13.53
A-03-002: 10.5	10.5	14	MC	a	9.3	1260.0	1.26	1.3	0.85	1.00	14.94
A-03-002: 13	13.0	50	MC	a	33.3	1560.0	1.13	1.3	0.85	1.00	47.96
A-03-002: 15	15.0	100	MC	a	66.7	1800.0	1.05	1.3	0.85	1.00	89.30
A-03-002: 20	20.0	100	SPT	a	100.0	2400.0	0.91	1.3	0.95	1.10	100.00
A-03-002: 25	25.0	100	SPT	a	100.0	2688.0	0.86	1.3	0.95	1.10	100.00
A-03-002: 30	30.0	100	SPT	a	100.0	2976.0	0.82	1.3	1.00	1.10	100.00
A-03-002: 33	33.0	100	SPT	a	100.0	3148.8	0.80	1.3	1.00	1.10	100.00
A-03-002: 34.5	34.5	100	SPT	a	100.0	3235.2	0.79	1.3	1.00	1.10	100.00

Liquefaction Analysis Using SPT

Project Name: Friars Road/SR 163
Project Number: G1447-52-01
Boring: A-03-002

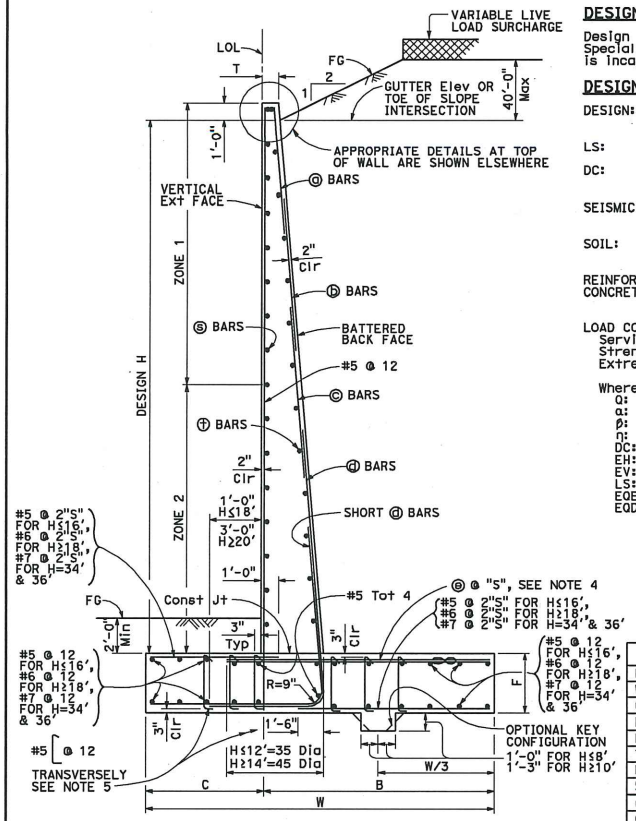
a_{max}/g 0.48
Magnitude 7.50
Groundwater Depth, Ft 20.0
Reference Pressure, p_a 2000
Unit Weight of Water 62.4
Soil Unit Weight, pcf 120

Include Kσ (Y/N) N
Use NCEER $CRR_{7.5}$ (1) or Rauch $CRR_{7.5}$ (2) 2
Minimum Factor of Safety for Liquefaction 1

MWF Idriss(1997) = $(M)^{2.56}/10^{2.24}$ From Graph

Depth, ft	N_1[60]	Fines Content, FC (%)	N_1[60], Adj. for Fines	σ, psf	σ', psf	r_d	$K_σ$	NCEER $CRR_{7.5}$	RAUCH $CRR_{7.5}$	CSR M=7.5	Liquefaction Potential	Factor of Safety	Volumetric Strain, %	Settlement, in.
1	29	15	32.9	120.0	120.0	1.00	1.00	0.800	0.800	0.312	Above GWT	2.564		
2	29	15	32.9	240.0	240.0	1.00	1.00	0.800	0.800	0.311	Above GWT	2.570		
3	29	15	32.9	360.0	360.0	0.99	1.00	0.800	0.800	0.311	Above GWT	2.576		
4	29	15	32.9	480.0	480.0	0.99	1.00	0.800	0.800	0.310	Above GWT	2.582		
5	29	15	32.9	600.0	600.0	0.99	1.00	0.800	0.800	0.309	Above GWT	2.588		
6	14	35	21.8	720.0	720.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.776		
7	14	35	21.8	840.0	840.0	0.99	1.00	0.239	0.239	0.308	Above GWT	0.777		
8	15	35	23.0	960.0	960.0	0.98	1.00	0.255	0.257	0.307	Above GWT	0.837		
9	15	35	23.0	1080.0	1080.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.839		
10	15	35	23.0	1200.0	1200.0	0.98	1.00	0.255	0.257	0.306	Above GWT	0.841		
11	15	35	23.0	1320.0	1320.0	0.98	1.00	0.255	0.257	0.305	Above GWT	0.843		
12	50	35	65.0	1440.0	1440.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.629		
13	50	35	65.0	1560.0	1560.0	0.97	1.00	0.800	0.800	0.304	Above GWT	2.635		
14	89	35	111.8	1680.0	1680.0	0.97	1.00	0.800	0.800	0.303	Above GWT	2.641		
15	89	35	111.8	1800.0	1800.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.646		
16	89	35	111.8	1920.0	1920.0	0.97	1.00	0.800	0.800	0.302	Above GWT	2.652		
17	89	35	111.8	2040.0	2040.0	0.96	1.00	0.800	0.800	0.301	Above GWT	2.659		
18	89	35	111.8	2160.0	2160.0	0.96	1.00	0.800	0.800	0.300	Above GWT	2.665		
19	89	35	111.8	2280.0	2280.0	0.96	1.00	0.800	0.800	0.299	Above GWT	2.672		
20	89	35	111.8	2400.0	2400.0	0.96	1.00	0.800	0.800	0.299	NL	2.679		
21	100	35	125.0	2520.0	2457.6	0.95	1.00	0.800	0.800	0.305	NL	2.620		
22	100	35	125.0	2640.0	2515.2	0.95	1.00	0.800	0.800	0.312	NL	2.567		
23	100	35	125.0	2760.0	2572.8	0.95	1.00	0.800	0.800	0.318	NL	2.519		
24	100	35	125.0	2880.0	2630.4	0.95	1.00	0.800	0.800	0.323	NL	2.477		
25	100	35	125.0	3000.0	2688.0	0.94	1.00	0.800	0.800	0.328	NL	2.439		
26	100	35	125.0	3120.0	2745.6	0.94	1.00	0.800	0.800	0.333	NL	2.404		
27	100	35	125.0	3240.0	2803.2	0.93	1.00	0.800	0.800	0.337	NL	2.374	0.75	0.09
28	100	35	125.0	3360.0	2860.8	0.93	1.00	0.800	0.800	0.341	NL	2.347	0.75	0.09
29	100	35	125.0	3480.0	2918.4	0.93	1.00	0.800	0.800	0.344	NL	2.323	0.75	0.09
30	100	35	125.0	3600.0	2976.0	0.92	1.00	0.800	0.800	0.348	NL	2.302	0.75	0.09
31	100	0	100.0	3720.0	3033.6	0.92	1.00	0.800	0.800	0.350	NL	2.284	0.75	0.09
32	100	0	100.0	3840.0	3091.2	0.91	1.00	0.800	0.800	0.353	NL	2.268	0.75	0.09
33	100	0	100.0	3960.0	3148.8	0.90	1.00	0.800	0.800	0.355	NL	2.255		
34	100	0	100.0	4080.0	3206.4	0.90	1.00	0.800	0.800	0.356	NL	2.245		
35	100	0	100.0	4200.0	3264.0	0.89	1.00	0.800	0.800	0.358	NL	2.237		

Total Settlement, S_{LIQ} (in.) = 0.54
Total Liquifiable Layers = 6



TYPICAL SECTION

NOTES:

1. For details not shown and drainage notes see RSP B3-5
2. For wall stem joint details see B0-3 3-3 and B0-3 3-4
3. At ⓓ and short ⓓ bars:
   H ≤ 6', no splices are allowed within 1'-8" above the top of footing.
   H > 6', no splices are allowed within H/4 above the top of footing.
4. Bundle ⓔ bars for H ≥ 26'.
5. Hook stirrups around & space with alternating transverse reinforcement at 2 x "S".

DESIGN CONDITIONS:

Design H may be exceeded by 6" before going to the next size. Special footing design is required where foundation material is incapable of supporting bearing stress listed in the table.

DESIGN NOTES:

DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition with California Amendments

LS: Varied surcharge on level ground surface

DC: Stem Architectural Treatment of thickness up to 6" of concrete (75 psf) considered

SEISMIC: $k_h = 0.2$, $k_v = 0.0$

SOIL: $\phi = 34°$, $\gamma = 120$ pcf

REINFORCED CONCRETE: $f'c = 3{,}600$ psi, $fy = 60{,}000$ psi

LOAD COMBINATIONS AND LIMIT STATES:

Service I	$Q = 1.00DC+1.00EV+1.00EH+1.00LS$
Strength I	$Q = \alpha DC+\beta EV+\eta EH+1.75LS$
Extreme I	$Q = 1.00DC+1.00EV+1.00EH+1.00EQD+1.00EQE$

Where:

Q:	Force Effects
α:	1.25 or 0.90, Whichever Controls Design
β:	1.35 or 1.00, Whichever Controls Design
η:	1.50 or 0.90, Whichever Controls Design
DC:	Dead Load of Structure Components
EH:	Horizontal Earth Fill Pressure
EV:	Vertical Earth Pressure from Earth Fill Weight
LS:	Live Load Surcharge
EQE:	Seismic Earth Pressure
EQD:	Soil and Structural and Nonstructural Components Inertia

SYMBOLS:

TO ACCOMPANY PLANS DATED _____

Ser - service limit state I
Str - strength limit state I
Ext - extreme event limit state I
B' - effective footing width (ft)
q_0 - net bearing stress (ksf), OG assumed to be FG at toe
q_0 - gross uniform bearing stress (ksf)
h1 = Top of footing to top of short ⓓ bar
h2 = Top of footing to top of ⓓ bar
h3 = Top of footing to top of ⓒ bar
h4 = Top of footing to top of ⓑ bar
Zone 1 = Top half of stem height
Zone 2 = Bottom half of stem height
⊂⊃ - Bundle of two bars

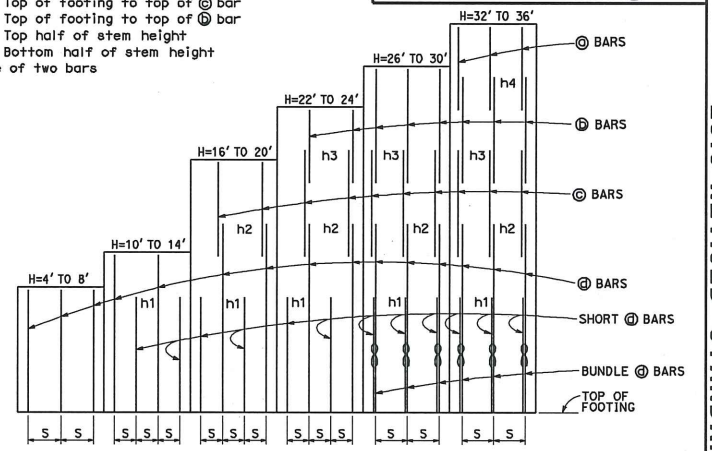
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

Gary Wong
REGISTERED CIVIL ENGINEER

April 20, 2012
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Gary Wang — No. C58298 — Exp. 6-30-12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.



ELEVATION

TABLE OF REINFORCING STEEL, DIMENSIONS AND DATA

DESIGN H	4'	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'	34'	36'
W	6'-0"	7'-6"	9'-6"	11'-0"	12'-6"	15'-6"	17'-3"	19'-6"	21'-9"	23'-6"	26'-0"	28'-1"	30'-3"	31'-6"	33'-0"	34'-8"	35'-11"
C	2'-0"	2'-6"	3'-3"	3'-6"	4'-3"	5'-0"	5'-3"	5'-9"	6'-9"	7'-3"	8'-3"	8'-9"	9'-0"	9'-6"	10'-0"	10'-10"	11'-3"
B	4'-0"	5'-0"	6'-3"	7'-6"	8'-3"	10'-6"	12'-0"	13'-9"	15'-0"	16'-3"	17'-9"	19'-4"	21'-3"	22'-0"	23'-0"	23'-10"	24'-8"
F	1'-6"	1'-6"	2'-0"	2'-3"	2'-6"	2'-8"	2'-10"	3'-0"	3'-4"	3'-6"	3'-6"	3'-7"	3'-7"	3'-9"	3'-9"	4'-0"	4'-4"
T	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	11½"	1'-2"	1'-5"	1'-10"	2'-3"	2'-9"
BATTER	½: 12	½: 12	½: 12	½: 12	½: 12	⅝: 12	⅝: 12	¾: 12	⅞: 12	1 : 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12	1⅛: 12
SPACING "S"	16"	12"	10"	7"	7"	7"	7"	7"	7"	6"	6"	10"	8"	7"	7"	7"	7"
ⓐ BARS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	#5	#5	#5
ⓑ BARS	-	-	-	-	-	-	-	-	-	#5	#5	#5	#5	#5	#7	#7	#7
ⓒ BARS	-	-	-	-	-	-	#6	#6	#6	#7	#8	#8	#8	#8	#9	#9	#9
ⓓ BARS	#5	#5	#6	#6	#7	#8	#9	#10	#10	#10	#11	#11	#11	#11	#11	#11	#11
ⓔ BARS	#5	#5	#6	#6	#7	#8	#9	#10	#10	#10	#11	#11	#11	#11	#11	#11	#11
h1	-	-	-	5'-3"	6'-4"	7'-6"	8'-9"	9'-9"	11'-0"	11'-3"	11'-6"	10'-3"	11'-9"	12'-3"	12'-6"	13'-3"	13'-8"
h2	-	-	-	-	-	-	12'-8"	15'-6"	17'-0"	16'-6"	17'-3"	18'-0"	17'-6"	17'-4"	14'-10"	15'-9"	16'-4"
h3	-	-	-	-	-	-	-	-	-	18'-9"	21'-3"	21'-3"	22'-4"	22'-8"	18'-0"	18'-6"	19'-6"
h4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26'-3"	27'-4"	28'-6"
No. of Toe Stirrups	0	0	0	0	0	0	0	0	0	0	0	5	5	6	7	8	9
No. of Heel Stirrups	0	0	0	0	0	0	0	0	4	6	7	8	10	10	11	11	11
ZONE 1 ⓢ BARS	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#6 @ 10	#6 @ 10
ZONE 2 ⓢ BARS	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 18	#5 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#7 @ 12	#7 @ 12	#7 @ 12	#7 @ 12	#7 @ 10	#7 @ 10
ZONE 1 ⓣ BARS	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 12	#4 @ 12	#4 @ 12	#5 @ 12	#5 @ 12	#5 @ 12
ZONE 2 ⓣ BARS	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 18	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#4 @ 12	#5 @ 12	#5 @ 12	#5 @ 12	#6 @ 12	#6 @ 12	#6 @ 12
Ser: B', q_0	4.0, 0.9	5.5, 1.0	9.3, 1.0	10.9, 1.3	12.3, 1.5	14.8, 1.9	16.6, 2.1	18.7, 2.4	20.6, 2.7	22.3, 3.0	24.2, 3.3	26.1, 3.5	28.2, 3.9	29.6, 4.0	31.1, 4.2	32.7, 4.4	34.1, 4.6
Str: B', q_0	2.2, 2.2	3.5, 2.2	5.1, 2.3	6.3, 2.6	7.6, 2.7	12.9, 3.1	14.3, 3.6	16.5, 3.9	19.4, 4.5	20.7, 4.8	22.5, 5.2	24.3, 5.6	26.2, 6.0	27.5, 6.3	28.8, 6.6	30.3, 6.9	31.8, 7.2
Ext: B', q_0	2.3, 3.4	2.7, 4.4	3.6, 5.0	3.8, 6.5	4.5, 7.0	7.0, 6.1	7.6, 6.9	9.3, 7.0	11.0, 7.1	11.8, 7.6	14.1, 7.4	15.6, 7.7	17.1, 8.0	17.2, 8.7	18.1, 9.0	19.0, 9.4	19.4, 10.0

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL TYPE 1 (CASE 2)

NO SCALE

RSP B3-1B DATED APRIL 20, 2012 SUPPLEMENTS THE STANDARD PLANS BOOK DATED 2010.

REVISED STANDARD PLAN RSP B3-1B

3-30-12

2010 REVISED STANDARD PLAN RSP B3-1B

Project Name:	Friars Road
Project No.	G1447-52-01
Date:	7-Nov-12
Support Location:	East Abutment Wall

Determination of Elastic Settlement

Vertical Stress of Loaded Area (Allowable Bearing Capacity (ksf)):	**qo =**	3.9	qpn = 3.9 ksf qpn > 2.1 ksf, therefore GOOD!
Poisson's Ratio (taken at 1/3 to 2/3 B):	**v =**	0.25	
Young's Modulus, ksf (taken at 1/3 to 2/3 B):	**Es =**	1500	
Footing Length (feet)	**L =**	79	
Footing Width (feet)	**B =**	17	
Footing Contact Area (ft^2) =	**A =**	1343	
L/B =	**L/B =**	4.647059	
Combined Shape/Rigidity Factor (from Table 4.4.7.2.2B)	**Bz =**	1.06	

Elastic Settlement:	**0.084271**	**(feet)**
	1.011249	**(inches)**
	25.68572	**(mm)**

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SDVOSB . DVBE

Memorandum

February 29, 2016

SCST No. 1111191P
Report 8

Mary Elizabeth Northeimer, PE
Project Engineer
Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Subject: FOUNDATION REPORT FOR SOLDIER PILE RETAINING WALLS
RW73 LOCATIONS 1 AND 2 AND RW245 STA 10+00 TO 10+88.5
SR-163/FRIARS ROAD INTERCHANGE
POST MILES 4.1 TO 4.9
CONTRACT NO. 11-085781
PROJECT ID 1100000064
SAN DIEGO, CALIFORNIA

Dear Ms. Northeimer:

1. INTRODUCTION

In response to your request, we prepared this Foundation Report (FR) for the subject retaining walls that will be specially designed soldier pile retaining walls. We understand that the soldier pile walls will be constructed to minimize impacts to existing utilities and structures located adjacent to the walls.

1.1. Proposed Structure

The soldier pile retaining walls will have pre-cast concrete panels and cast-in-place concrete faces. The walls will retain between 5 feet and 12½ feet of soil. The grade behind the walls will range from level to a 2:1 (horizontal:vertical) slope.

1.2. Scope of Work

Our scope of work for the preparation of this report included performing a literature review in an effort to obtain geological and geotechnical data pertaining to the planned walls. For our analyses and preparation of this report, we used the information presented in the project Geotechnical Design Report (GDR), Reference 35.

Field Exploration: Boring A-12-046, drilled during the GDR investigation, is located in the vicinity of the planned walls. Figure 4A presents the Log of Test Borings sheet with boring A-12-046.

2. FINDINGS

2.1. Site Description

SR-163 is generally oriented in a north-south direction and Friars Road crosses over SR-163. The project site extends along SR-163 between Station 211+00 and Station 316+00 and along Friars Road between Station 51+00 and 85+00. The mainline of this portion of SR-163 is comprised of a divided highway with 4 northbound lanes and 4 southbound lanes. The Friars Road interchange includes an overcrossing with on- and off-ramps in the northbound and southbound directions to both eastbound and westbound Friars Road. The overcrossing is supported on two abutments and one bent.

The southern portion of the project area crosses Mission Valley, a floodplain landform of the San Diego River. Several bents support the San Diego River Bridge. Water flows within the riverbed and will rise during flood events. The remaining portion of the project traverses up the northern flank of Mission Valley. Embankments ranging up to approximately 23 feet in height and cut slopes, ranging up to approximately 100 feet in depth, are located along the roadway alignments.

The planned soldier pile retaining walls will be located northeast of the northbound on-ramp to SR-163 and north of Friars Road, adjacent to a storm drain channel and an existing parking lot. Figure 1 presents a site vicinity map. Figures 2A and 2B show the planned wall locations.

2.2. Regional Geology and Site Seismicity

The project site is located within the coastal plain of the Peninsular Range Geomorphic Province of California. The Peninsular Ranges are a group of mountain ranges that extend 900 miles from the Transverse Ranges and the Los Angeles Basin in Southern California to the southern tip of Mexico's Baja California. The southern segment of the Peninsular Ranges in Southern California is referred to as the San Diego Embayment. The San Diego Embayment consists of thick sequences of marine and non-marine sediments. The sedimentary rocks within the San Diego Embayment form an eastward thinning wedge of continental margin deposits that extend from Oceanside to the US-Mexico border.

The site is located in a seismically active area. The closest known active fault is the Rose Canyon fault zone (San Diego section), which is located about 2.3 miles (3.7 kilometers) west-southwest of the site. The site is not located in an Alquist-Priolo Earthquake Fault Zone, and there are no unzoned faults Holocene or younger that underlie or project toward the site (USGS, 2012). Therefore, the probability of fault rupture is low.

3. GEOTECHNICAL CONDITIONS

3.1. Site Geology

The project site is located in the Coastal Plains Physiographic Province of San Diego County and is underlain by the Tertiary-age Friars Formation (Tf), Stadium Conglomerate (Tst), Quaternary-age very old paralic deposits (Qvop), alluvium (Qya) and fill (Qaf). The planned soldier pile retaining walls will retain fill placed during mass grading for the Murray Canyon Bridge that crosses Friars Road. The soldier piles will obtain support from the alluvial soils. Descriptions of the subsurface materials anticipated along the wall alignments are presented below. Figure 3 presents the regional geology in the vicinity of the site. Figures 4A and 4B present the Log of Test Borings (LOTB) in the vicinity of the walls.

Fill: Fill soils underlie much of the site and are associated with the existing improvements. These materials consist of clayey and silty sand with cobbles that were most likely derived from excavation in the Stadium Conglomerate and alluvium. The depth of the fill in the vicinity of the soldier pile walls is estimated to range up to about 12 feet in thickness.

Alluvium: Alluvial sediments associated with the San Diego River and the tributary drainage canyons that enter the river plain underlie most of the project area. The alluvial deposits are anticipated to attain thicknesses in excess of 80 feet toward the southern portion of the project alignment. The thickness of the alluvium decreases near the hillsides. The alluvial deposits consist of gray, brown and tan, interbedded sand, gravel, cobble, silt and clay. It is anticipated that abundant gravel and cobbles up to about 12 inches in size exist within the alluvial sediments.

3.2. Groundwater

We observed groundwater in borings drilled within alluvial areas. The groundwater elevation ranged in elevation between about 12 feet above Mean Sea Level (MSL) and about 38 MSL. Groundwater levels are expected to fluctuate seasonally in the alluvial areas. Groundwater in the vicinity of the planned walls is anticipate at the approximate elevation of the adjacent storm drain channel bottom.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Passive Pressure

Passive pressure for the design of the retaining walls can be taken as 300 pounds per square per foot of depth. This pressure can be increased by ⅓ for seismic loading. An internal friction angle of 34 degrees can be used to determine the nominal sliding resistance between soil and concrete cast against soil for the foundation.

4.2. Active Pressure

The active soil pressure for the design of unrestrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 40 pounds per cubic foot (pcf). An increase in soil pressure equivalent to an additional 2 feet of retained soil can be used to account for transient loads that may include traffic loads or temporary conditions. Alternatively, surcharge loads can be determined in accordance with Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications with Caltrans Amendments. If any other surcharge loads are anticipated, the project geotechnical engineer should be contacted for the necessary increase in soil pressure. The project designer should provide waterproofing specifications and details. These pressures assume a granular drained backfill condition.

4.3. Seismic Pressure

The following equivalent fluid weights can be used for the seismic design of retaining walls.

Condition	Equivalent Fluid Weight – Seismic
Active	55 pounds per cubic foot
At-Rest	75 pounds per cubic foot
Passive	390 pounds per cubic foot

The equivalent fluid weights for seismic loading were determined using the Mononobe-Okabe method presented in Appendix A11 of the AASHTO LRFD Bridge Design Specifications with California Amendments. The at-rest condition was estimated using an increase ratio similar to the active condition. The horizontal acceleration coefficient of 0.23 (50% of the peak ground acceleration of 0.45g) was used to determine the seismic earth pressures. The resultant of the seismic active and at-rest pressures should be applied at a depth of 0.5H from the top of the wall where H is equal to the total height of the wall.

4.4. Retaining Wall Backfill

Excavated material and import soil used as wall backfill should meet the specifications for Caltrans structure backfill. The Engineer should the approve proposed imported soil prior to transport to the site.

4.5. Drainage

The earth pressures recommended above do not include hydrostatic pressures. A drainage system consisting of geocomposite drain strips placed between the wall and the retained soil discharging through weep holes at the base of the wall would provide acceptable drainage to relief hydrostatic pressures.

4.6. Corrosion

The on-site materials tested for the preparation of the GDR indicated the site is not underlain by corrosive materials.

4.7. Construction Considerations

The contractor may encounter difficulties during drilling of soldier piles due to the presence of cobbles and boulders. Caving conditions are likely to occur. Groundwater elevation in the drilled shafts should be expected to coincide with the flow line elevation of the adjacent drainage channel. Drilled holes will most likely require dewatering or the placement of concrete in wet conditions. Dewatering may require temporarily re-routing the flowing water.

5. LIMITATIONS

The characterization of geotechnical conditions along the wall alignments and presented in this report are based on the review of the design information provided, proposed project features, geologic maps, geologic literature, archival reports, exploration by SCST, and laboratory testing. The evaluations and recommendations contained in this report are based on the information discovered and data gathered. If conditions are encountered during the project that appear to differ from the conditions conveyed in this report, or if construction difficulties related to soil conditions are encountered, the project's Resident Engineer should be contacted to assist with the assessment of the prevailing geotechnical conditions and to assist in formulating appropriate strategies to facilitate project completion. Should project design features vary significantly from those described in this report, an updated report should be prepared by SCST to address the geotechnical considerations.

6. REFERENCES

1) California Building Code, 2010, Chapter 16, and Maps of Known and Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.
2) California Department of Transportation, April 2005, Bridge Design Aids Manual.
3) California Department of Transportation, May 2012, Bridge Design Details Manual.
4) California Department of Transportation, November 2008, Bridge Design Specifications Manual.
5) California Department of Transportation, May 2012, Highway Design Manual.
6) California Department of Transportation, 2010, Standard Specifications.
7) California Department of Transportation, "Corrosion Guidelines, Version 2.0," November 2012.
8) California Department of Transportation, "Soil and Rock Logging, Classification, and Presentation Manual", Division of Engineering Services, Geotechnical Services, June 2010.
9) California Department of Transportation, "Guidelines for Preparing Geotechnical Design Reports, Version 1.3", December 2006.
10) California Department of Transportation, Externally Financed Projects Branch Information and Procedures Guide.

11) California Department of Transportation Seismic Design Criteria Version 1.6

12) California Amendments (to the AASHTO LRFD Bridge Design Specifications, Fourth Edition.

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16) Anderson, J.G.; R.K. and Agnew, D.C., 1989, Past and Possible Future Earthquakes of Significance to the San Diego Region, Earthquake Spectra, Volume 5, No. 2, 1989.

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26) Southern California Soil & Testing, Inc., "Structure Foundation Report, Friars Road at SR 163" dated July 9, 2009 (SCS&T Project # 0311116-4R2).

27) Southern California Soil & Testing, Inc., "Geotechnical Design Report, Friars Road at State Route 163, Bridge Number 57-595, 11-SD-163-R069-84, E/A No. 11-085780, San Diego, California"; dated January 6, 2004 (SCS&T No. 0311116-3).

28) Southern California Soil & Testing, Inc., "Preliminary Geologic Review, Friars Road at SR 163" dated September 22, 2003 (SCS&T Project # 0311116-1).

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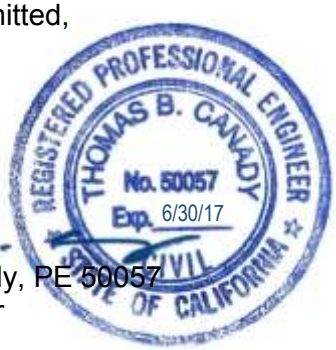
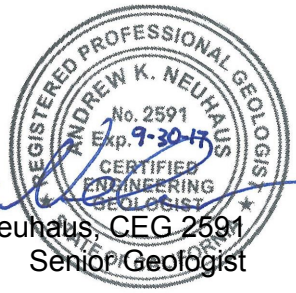
If you have any questions, please call us at (619) 280-4321.

Respectfully submitted,
SCST, INC.





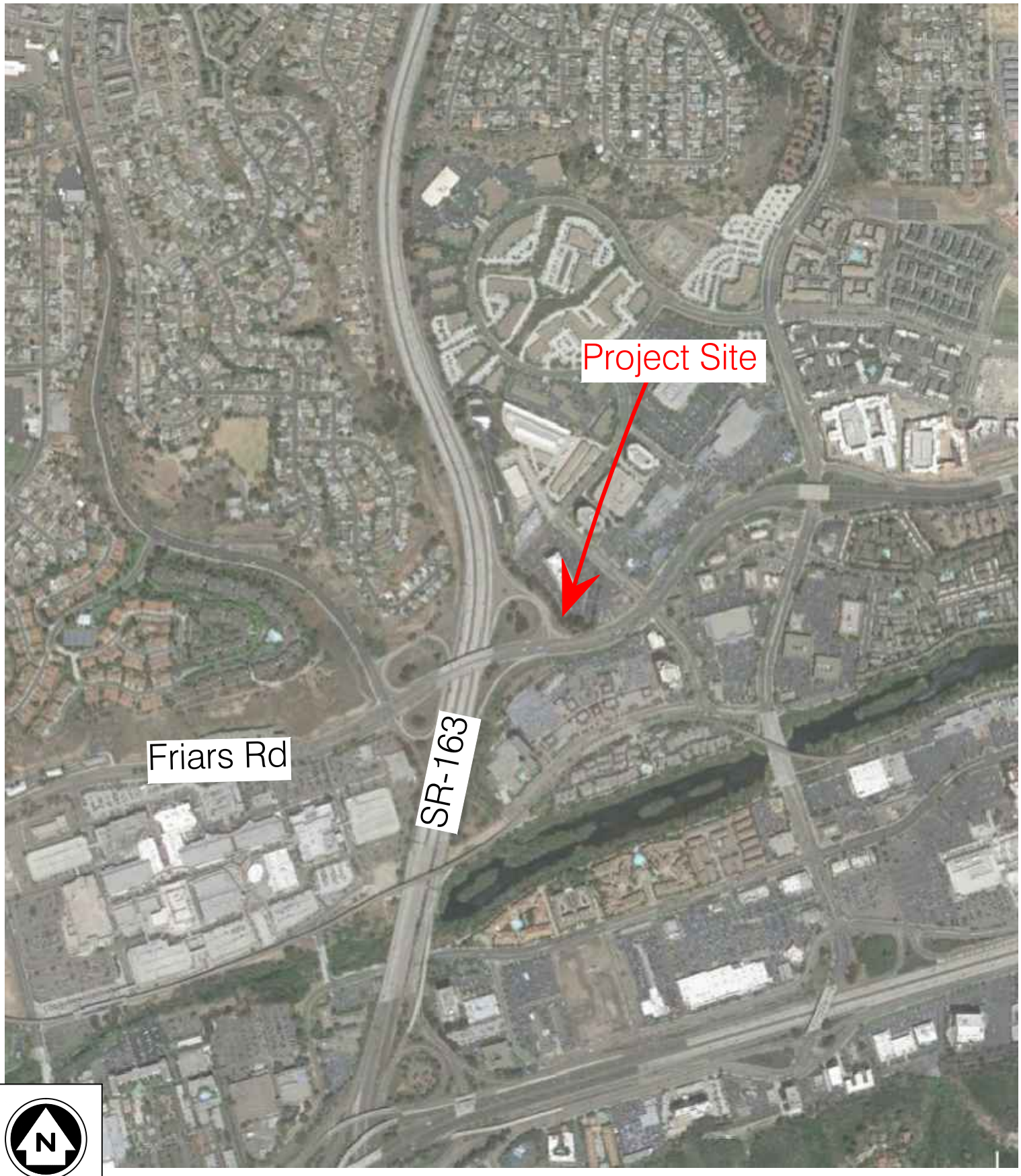
Thomas B. Canady, PE 50057
Principal Engineer

Andrew K. Neuhaus, CEG 2591
Senior Geologist

TBC:AKN:aw

Attachments:
Figure 1 - Site Vicinity Map
Figures 2A and 2B - Retaining Wall Plans
Figure 3 - Regional Geology and Fault Map
Figures 4A and 4B - Log of Test Borings

(1) Addressee via e-mail at mnortheimer@dokkenengineering.com
(1) Charles Tornaci via e-mail at ctornaci@dokkenengineering.com

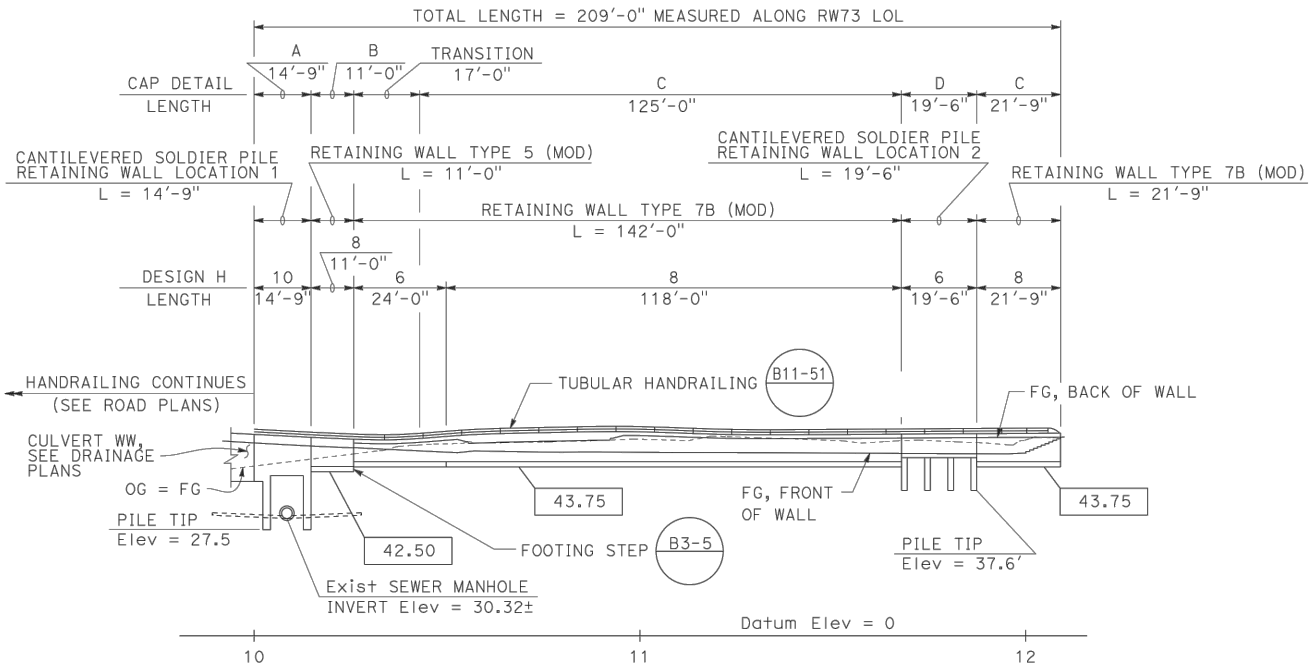


SCST, Inc.

SITE VICINITY MAP
SR-163/Friars Road Interchange
San Diego, California

Date: February, 2016
By: JCU
Job No.: 1111191P-8

Figure: 1



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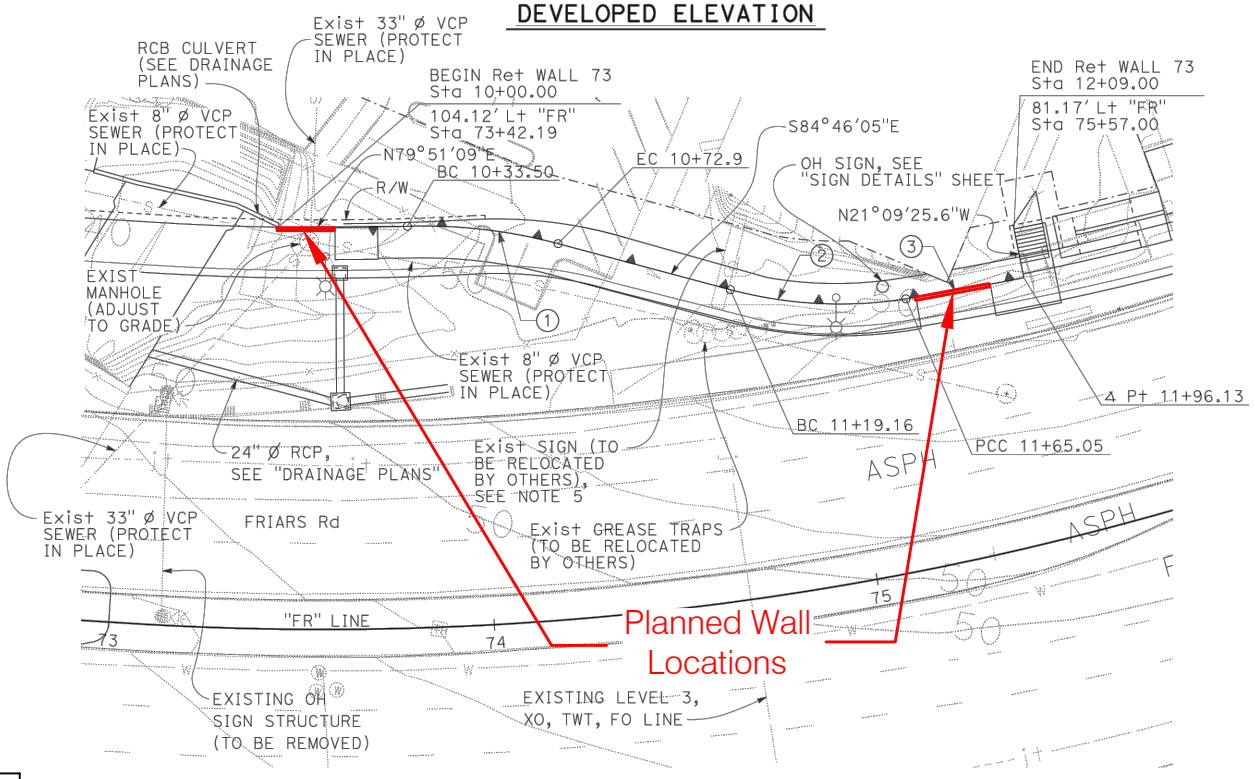

NOTE: Not to Scale

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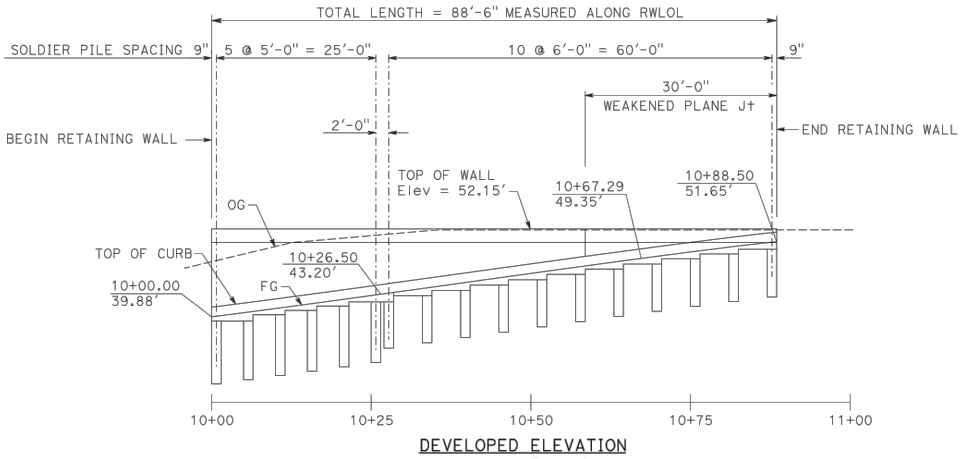

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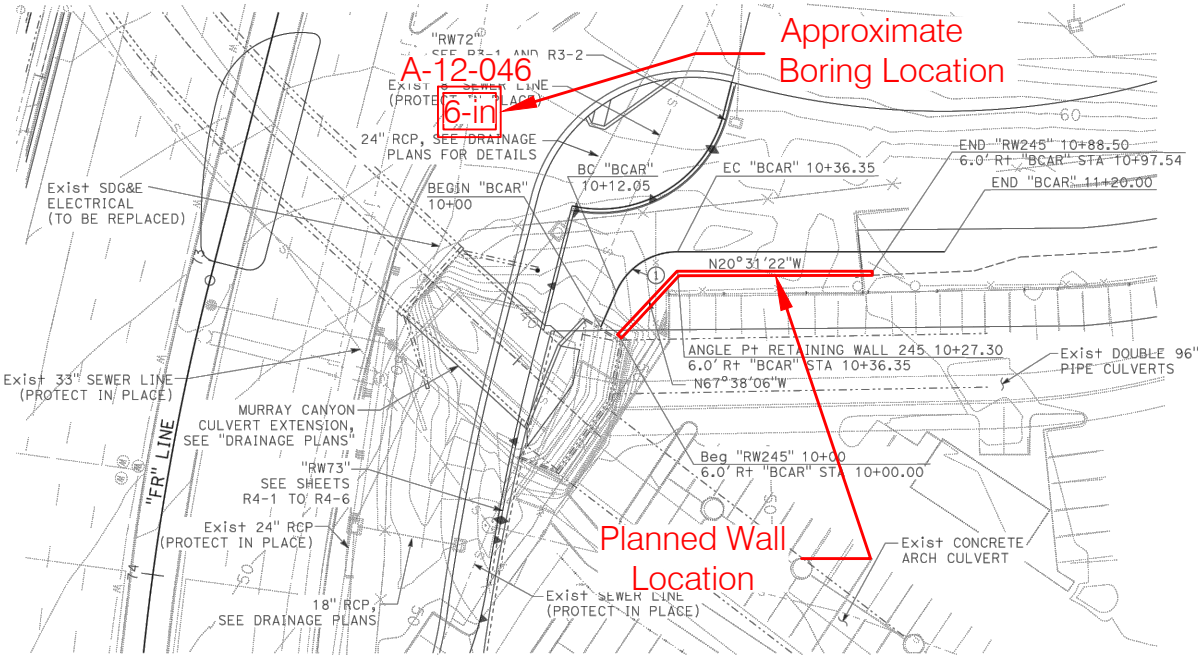

NOTE: Not to Scale

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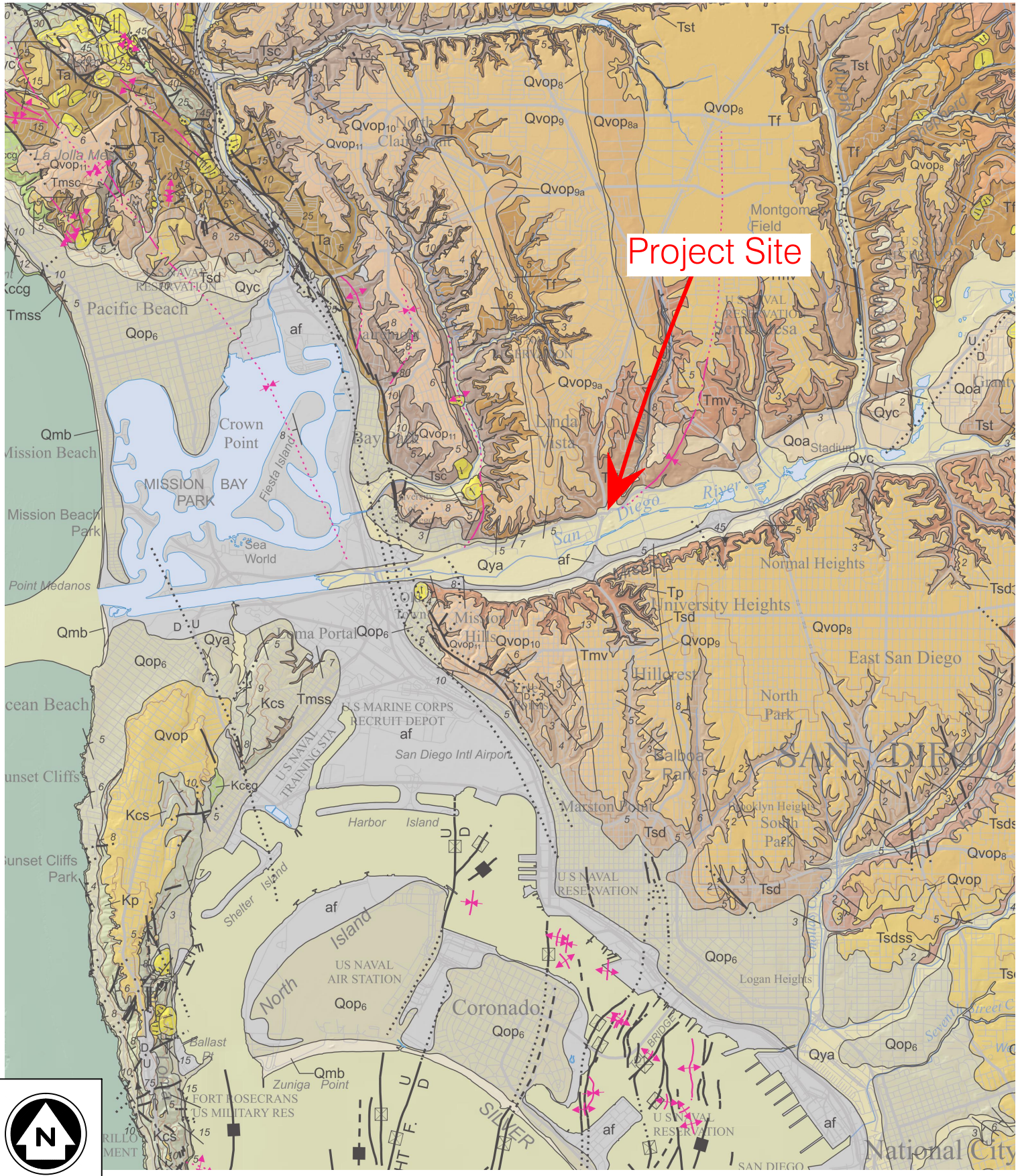

SCST, Inc.	REGIONAL GEOLOGY AND FAULT MAP SR-163/Friars Road Interchange San Diego, California	Date: February, 2016 By: JCU Job No.: 1111191P-8	Figure: 3

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	163	4.1/4.9	XXX	XXX

CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — THOMAS B. CANADY — No. 50057 — Exp. 6-30-17 — CIVIL — STATE OF CALIFORNIA

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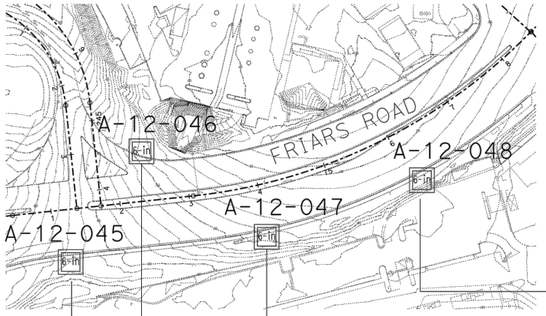
525 B Street, Suite 750
San Diego, CA 92101

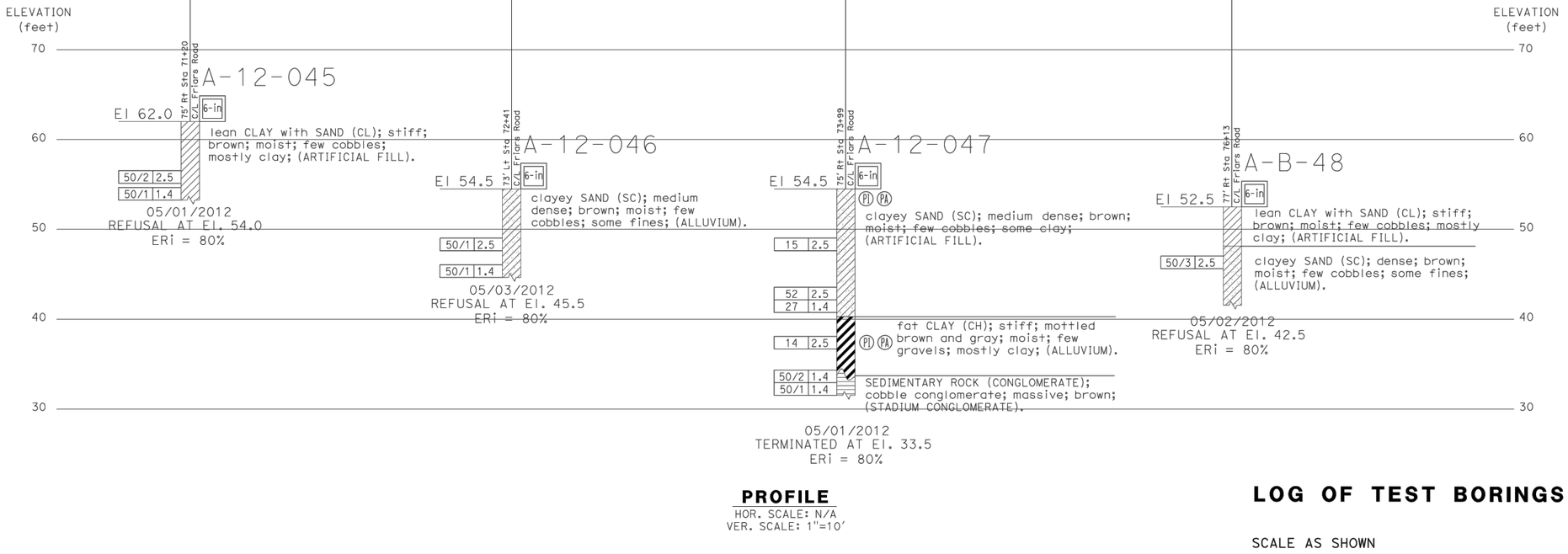
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

LOG OF TEST BORINGS

SCALE AS SHOWN

LAST REVISION 02-10-16 | DATE PLOTTED => 10-FEB-2016 | TIME PLOTTED => 13:12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS THOMAS
CALCULATED-DESIGNED BY | CHECKED BY
MASON HANCOCK | FORTUNATO ENRIQUEZ
REVISED BY | DATE REVISED

BORDER LAST REVISED 7/2/2010 | USERNAME => BillGates | DGN FILE => 1100000064ql005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 2763 | PROJECT NUMBER & PHASE 11000000641

SCST, Inc.

LOG OF TEST BORINGS
SR-163/Friars Road Interchange
San Diego, California

Date: February, 2016
By: JCU
Job No.: 111119P1-8

Figure: 4A

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	163	4.1/4.9	XXX	XXX

CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — THOMAS B. CANADY — No. 50057 — Exp. 6-30-17 — CIVIL — STATE OF CALIFORNIA

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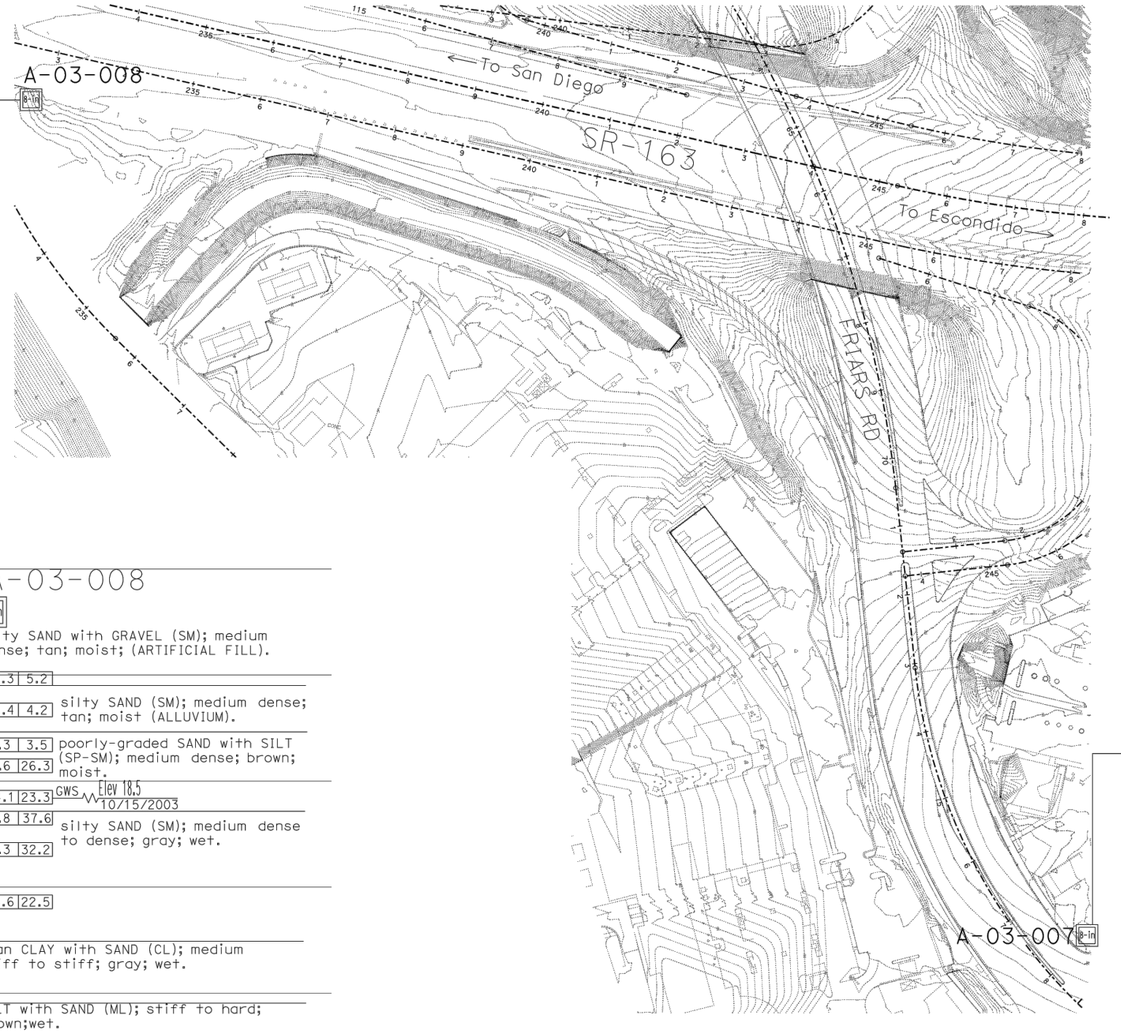
SOUTHERN CALIFORNIA SOIL & TESTING, INC.
6280 Riverdale Street
San Diego, CA 92120

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



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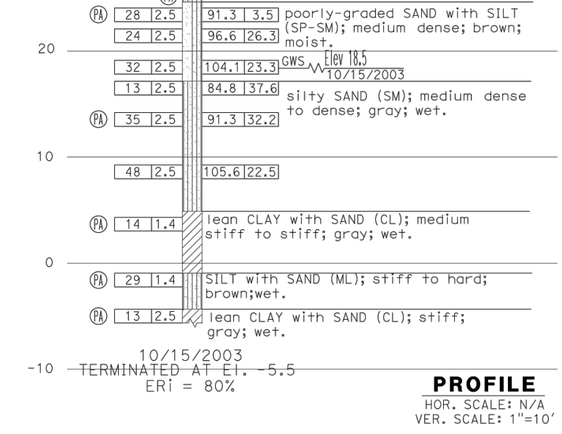

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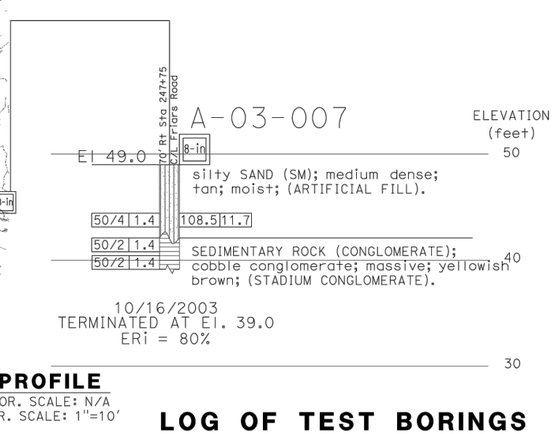

PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

LOG OF TEST BORINGS

SCALE AS SHOWN

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS THOMAS
CALCULATED-DESIGNED BY:
CHECKED BY: MASON HANCOCK
REVISED BY: FORTUNATO ENRIQUEZ
DATE REVISED:
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

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SCST, Inc.

LOG OF TEST BORINGS
SR-163/Friars Road Interchange
San Diego, California

Date: February, 2016
By: JCU
Job No.: 111119P1-8

Figure: 4B

SOUTHERN CALIFORNIA SOIL & TESTING, INC.
A California Certified Small Business Enterprise (SBE)

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PAVEMENT STUDY REPORT
FRIARS ROAD WIDENING
SR 163/FRIARS ROAD INTERCHANGE
MODIFICATION PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

PREPARED FOR:

MR. GERARD LUMABAS
DOKKEN ENGINEERING
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SAN DIEGO, CALIFORNIA 92123

PREPARED BY:

SOUTHERN CALIFORNIA SOIL & TESTING, INC.
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August 14, 2012

SCS&T No. 1111191P
Report No. 2

Mr. Gerard Lumabas
Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Subject: PAVEMENT STUDY REPORT
FRIARS ROAD WIDENING
SR-163/FRIARS ROAD INTERCHANGE MODIFICATION
PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

This letter transmits Southern California Soil & Testing Inc.'s (SCS&T) report describing the pavement study performed for the widening of Friars Road in the city of San Diego, California. SCS&T performed the field investigation and prepared this report in general conformance with the scope of work presented in SCS&T's proposal dated September 3, 2010.

If you have any questions concerning this report, or need additional information, please call us at (619) 280-4321.

Respectfully Submitted,
SOUTHERN CALIFORNIA SOIL & TESTING, INC.

REGISTERED PROFESSIONAL ENGINEER
SHIH-HSUN LIANG
R.C.E. 73932
Exp. 06/30/13
CIVIL
STATE OF CALIFORNIA

Shih-Hsun Liang (Eddie Liang), PE 73932
Staff Engineer
Date Signed 8-14-12
EL:GBF:aw

(8) Addressee

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
NO. 2752
EXP. 09-30-12
GEOTECHNICAL
STATE OF CALIFORNIA

Garrett B. Fountain, GE 2752
Principal Geotechnical Engineer
DATE SIGNED 8.14.2012

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EXECUTIVE SUMMARY

This report presents the findings and conclusions of the pavement study performed by Southern California Soil & Testing, Inc. (SCS&T) for the widening of Friars Road in the city of San Diego, California.

We understand that Friars Road will be widened between Avenida De Las Tiendas and Frazee Road. The pavement study consisted of performing a subsurface exploration, sampling subgrade soils, testing collected samples in the laboratory, analyzing the data, developing design recommendations, and preparing this report. Additionally, Falling Weight Deflectometer (FWD) Testing was performed.

An SCS&T geologist observed the drilling of 12 cores through the existing pavement and obtained subgrade soil samples for laboratory testing. The existing pavement sections encountered along Friars Road consist of asphalt concrete underlain by aggregate base. The asphalt concrete ranged between 4 inches and 8 inches thick at the locations cored. The aggregate base ranged between 8 inches and 19½ inches thick. The subgrade is comprised of silty and clayey sand with gravel, and clayey gravel with silt and sand. Selected subgrade samples were tested to evaluate pertinent engineering properties and pavement support characteristics to assist in the development of geotechnical conclusions and recommendations.

Distress was observed along the westbound lanes of Friars Road east of SR-163. The distress consists of cracking that appears to reflect trench lines for utilities. In our opinion, grind and overlay of the existing pavement along Friars Road as part of the widening improvements is feasible. Recommendations for overlaying Friars Road and new pavement sections are contained in the body of this report.

1. INTRODUCTION

1.1 GENERAL

This report presents the findings and conclusions of the pavement study performed by Southern California Soil & Testing, Inc. (SCS&T) for the widening of Friars Road in the city of San Diego, California.

We understand that Friars Road will be widened between Avenida De Las Tiendas and Frazee Road. The pavement study consisted of performing a subsurface exploration, sampling subgrade soils, testing collected samples in the laboratory, analyzing the data, developing design recommendations, and preparing this report. Additionally, Falling Weight Deflectometer (FWD) Testing was performed.

1.2 SCOPE OF WORK

The scope of work performed by SCS&T consisted of the following:

1. Drilling 12 cores through existing pavements and sampling subgrade soils encountered;
2. Performing laboratory tests on selected soil samples;
3. Presenting our findings regarding the existing structural section (including wearing surface types and thickness, base types and thickness, subgrade material types and soil classification);
4. Calculating the proposed flexible pavement section recommendations;
5. Providing recommendations for compaction; subgrade preparation; and
6. Preparation of this report.

2. FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

An SCS&T geologist observed the drilling of 12 cores through the existing pavement section and obtained subgrade soil samples for laboratory testing. A truck mounted rig equipped with a solid-flight auger drilled the core holes to a depth of about 3 feet below the existing ground surface. Figures 2 and 3 present the approximate core locations. Appendix I presents a summary of the subsurface conditions encountered in the core locations. Soils are classified according to the Unified Soil Classification System, presented on Figure I-1. Selected samples from the corings were tested to evaluate pertinent classification and engineering properties and enable development of geotechnical conclusions and recommendations. Additionally, Falling Weight Deflectometer (FWD) Testing was performed.

The core holes were backfilled and compacted with native soils and capped with Portland cement concrete immediately after obtaining soil samples.

2.2 LABORATORY TESTING

Laboratory tests consisted of grain size distributions, and R-value tests. Brief descriptions of the laboratory test procedures and the test results are presented in Appendix II.

2.3 FALLING WEIGHT DEFLECTOMETER TESTING

The Falling Weight Deflectometer (FWD) is a non-destructive hydraulic test apparatus that measures the stiffness of a pavement by applying a dynamic load. The deflection at the point where the force is applied is measured and compared to the tolerable deflection as determined by the Caltrans Highway Design Manual. The Caltrans specified deflection reduction at the surface, as percent, is then calculated and equated to the thickness of asphalt needed to bring the measured deflection during the FWD test within a tolerable deflection. FWD tests were performed along Friars Road between Avenida De Las Tiendas and Frazee Road on May 28, 2012. Appendix III presents the test results.

3. SITE CONDITIONS

3.1 SURFACE CONDITIONS

The surface of Friars Road is paved with asphalt concrete. Distress was observed along the westbound lanes of Friars Road east of SR-163. The distress consists of cracking that appears to reflect trench lines for utilities.

Gutters are located along both sides of Friars Road. Surface drainage is well developed. The final grades required for drainage and related improvements, and the current City of San Diego street design standards or other applicable standards, will affect the selection of the new pavement section and overlay thickness.

3.2 EXISTING PAVEMENT COMPONENT THICKNESSES

The existing pavement sections encountered consist of asphalt concrete underlain by aggregate base. The asphalt concrete ranged between 4 inches and 8 inches thick at the locations cored. The aggregate base ranged between 8 inches and 19½ inches thick at the locations cored. The subgrade is comprised of silty and clayey sand with gravel, and clayey gravel with silt and sand. Table 1 presents the existing pavement sections measured at 12 locations along Friars Road. Figure I-2 in Appendix I presents a summary of the existing pavement component thicknesses and relevant data.

Table 1 – Existing Pavement Sections

Core Identification	Location Description	Asphalt Concrete Thickness, inches	Aggregate Base Thickness, inches
C-1	Eastbound Friars Road, West of SR 163	7	8
C-2	Eastbound Friars Road, West of SR 163	7	9
C-3	Eastbound Friars Road, West of SR 163	4	8
C-4	Eastbound Friars Road, East of SR 163	4	8 ½
C-5	Eastbound Friars Road, East of SR 163	4½	19½
C-6	Eastbound Friars Road, East of SR 163	6	10
C-7	Westbound Friars Road, East of SR 163	5½	10½
C-8	Westbound Friars Road, East of SR 163	4½	18½
C-9	Westbound Friars Road, East of SR 163	4½	8½
C-10	Westbound Friars Road, West of SR 163	5	9
C-11	Westbound Friars Road, West of SR 163	8	9
C-12	Westbound Friars Road, West of SR 163	7	8

3.3 SUBSURFACE CONDITIONS

Fill consisting of loose to medium dense silty and clayey sand with gravel, and clayey gravel with silt and sand was encountered below the pavement sections at all the core locations. In general, the fill was moist at the time of the field exploration program.

No groundwater was encountered in the core holes. No caving was observed within our core locations.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 SUBGRADE PREPARATION AND GRADING

Where the pavement is to be constructed, the subgrade surface exposed following removal of the existing pavement components and any excavation required to reach final subgrade should be checked by the Engineer. Any areas judged unsuitable for pavement support by the Engineer should be excavated to expose firm material as determined by the Engineer.

The surface exposed by pavement removal and excavation, if any, should be scarified to a depth of 12 inches, moisture conditioned to near optimum moisture content and compacted to at least 95% relative compaction. The optimum moisture content and maximum dry density for the determination of relative compaction should be based on the Caltrans test method 216. A geotextile such as Tensar® TX-5 or equivalent can be placed on the prepared subgrade to assist in the support of the pavement section where determined appropriate by the Engineer.

Existing soils that are free of organic material and that do not contain rocks larger than 6 inches in maximum dimension will be suitable for placement as compacted fill in over-excavated areas. Imported soils, if any, should not contain organic material or rocks greater than 3 inches in maximum dimension. Imported material should have an Expansion Index of 20 or less and should be approved by the Engineer prior to placement.

New fill soils, if any, and base courses for pavements, should be placed in 6-inch to 8-inch loose lifts, moisture conditioned to near optimum moisture content and compacted to at least 95% relative compaction.

4.2 PAVEMENT STRUCTURAL SECTIONS

A total of five R-value tests were performed on representative subgrade samples obtained from the core locations and previous borings along Friars Road. Additional tests should be performed during final grading, when actual subgrade materials can be determined. Dokken Engineering provided Traffic Indices (TIs). Based on this information, the flexible pavement structural sections were calculated. Table 2 presents these pavement sections.

Table 2 – Pavement Recommendations

Location	Traffic Index	R-Value used for design	Asphalt Concrete Thickness, inches	Aggregate Base[Note 1] Thickness, inches
Friars Road	12.5	20	8	24
Ulric Street	10.5	30	7	15
Frazee Road	10.5	20	7	18½

Note 1: Aggregated base shall in conform to Class 2 Aggregate Base in Section 26-1.02 of the Standard Specifications of The State of California Department of Transportation.

The project designers can also consider alternate pavement sections. Final pavement alternatives will be developed in consultation with Dokken Engineering, Caltrans and city representatives. Unsuitable subgrade material should be removed and replaced with suitable material as identified by the project geotechnical engineer. The removal should extend to a depth beyond the influence of the planned construction.

4.3 PAVEMENT SECTION REHABILITATION ALTERNATIVES

4.3.1 Removal and Replacement of Existing Pavement Section

In our opinion, the existing pavement section along Frazee Road is considered inadequate for the anticipated traffic conditions, TI of 10.5. Removal and replacement of the existing pavement section is an acceptable rehabilitation alternative. The new pavement section recommended for Frazee Road is presented in Table 2.

4.3.2 Cold Milling and Placement of a New Asphalt Concrete Surface

In our opinion, the FWD testing results along Friars Road are within the Caltrans specified tolerable deflection and are considered adequate for the anticipated traffic load. Additionally, the pavement section observed along Ulric Street is performing adequately. In our opinion, cold milling and placement of a new asphalt concrete (AC) along Friars Road and Ulric Street is an acceptable rehabilitation alternative. However, concrete backfilled utility lines are exposed on the surface of Ulric Street.

Rehabilitation of the roadways through street-wide cold milling and placement of a new asphalt concrete wearing surface is a feasible rehabilitation alternative. However, localized areas of pavement removal and replacement should be expected. Street-wide cold milling should

extend to a depth of at least 2 inches. It is suggested that a paving fabric such as GlasGrid® or an equivalent be used as part of the overlay construction option. Existing pavement thicknesses will vary, care should be taken to ensure the milling machine does not loosen the underlying materials. Subsequent to grinding all observable cracks should be filled prior to placement of the new AC surface. Additionally, complete reconstruction should be performed areas that appear un-stable as determined by the engineer. The removed AC material should then be replaced with at least 2 inches of asphalt concrete, cross slopes permitting.

4.4 GEOTECHNICAL ENGINEERING DURING CONSTRUCTION

The geotechnical engineer should review project plans and specifications prior to bidding and construction to check that the intent of the recommendations in this report has been incorporated. Observations and tests should be performed during construction. If the conditions encountered during construction differ from those anticipated based on the subsurface exploration program, the presence of the geotechnical engineer during construction will enable an evaluation of the exposed conditions and modifications of the recommendations in this report or development of additional recommendations in a timely manner.

5. CLOSURE

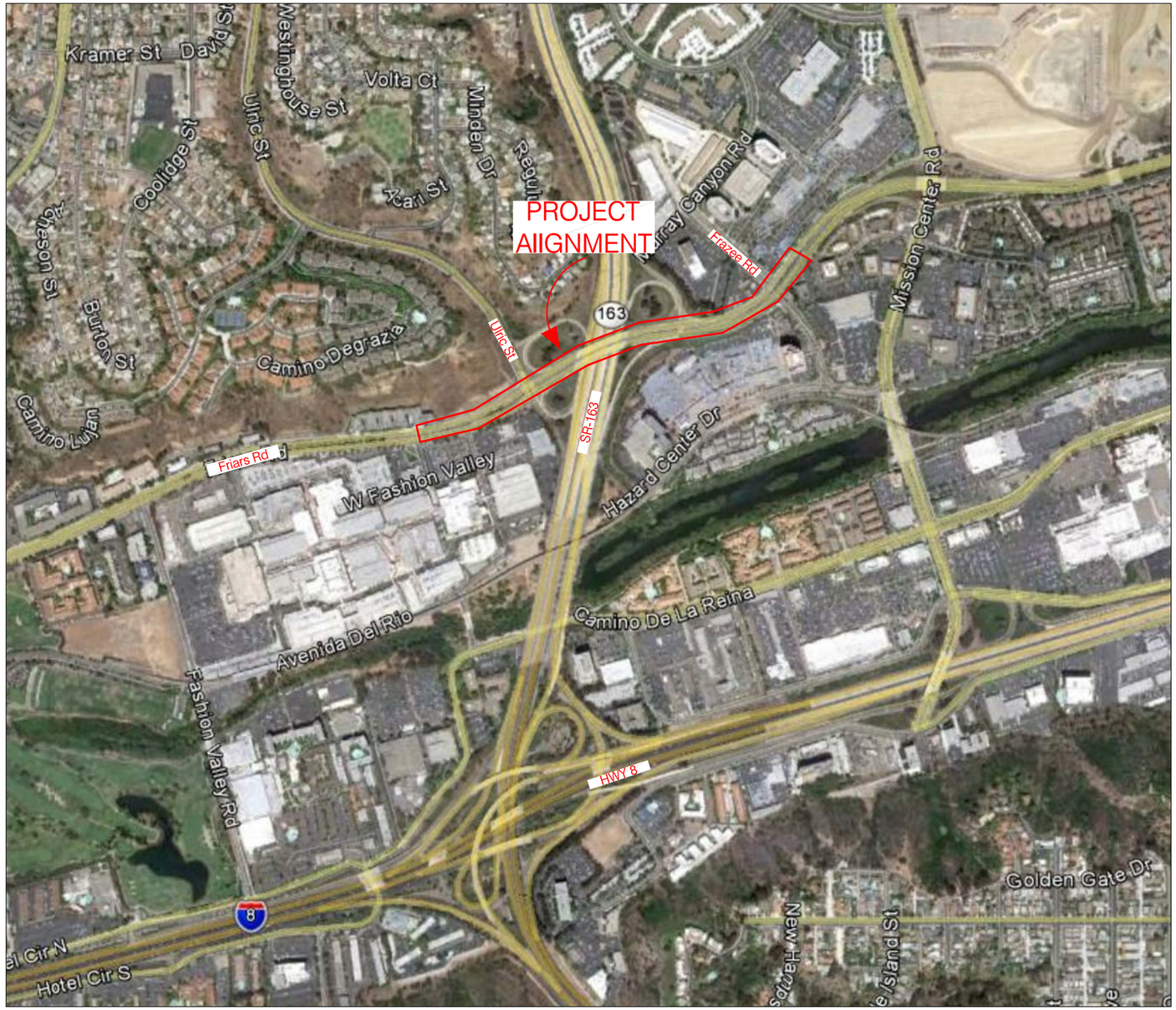
SCS&T should be advised of any changes in the project scope so that the recommendations contained in this report can be evaluated with respect to the revised plans. The findings in this report are valid as of the date of this report. Changes in the condition of the roadways can occur with time. In addition, changes in the standards of practice and government regulations can occur. Thus, the findings in this report may be invalidated wholly or in part by changes beyond our control. This report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations to site conditions at that time.

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. Subsurface conditions can vary from those encountered at the test boring or coring locations, and our data, interpretations, and recommendations are based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but will not be responsible for interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of any kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

6. REFERENCES

1. *"Geotechnical Design Report, SR-163/Friars Road Interchange Modification, PM 3.8-5.8, EA Number 11225-085781, EFIS PID 1100000064, San Diego, California"; prepared by Southern California Soil & Testing, Inc., dated July 23, 2012 (SCS&T No. 1111191-1).*
2. California Department of Transportation, May 2012, Highway Design Manual.

ALIGNMENT LOCATION MAP



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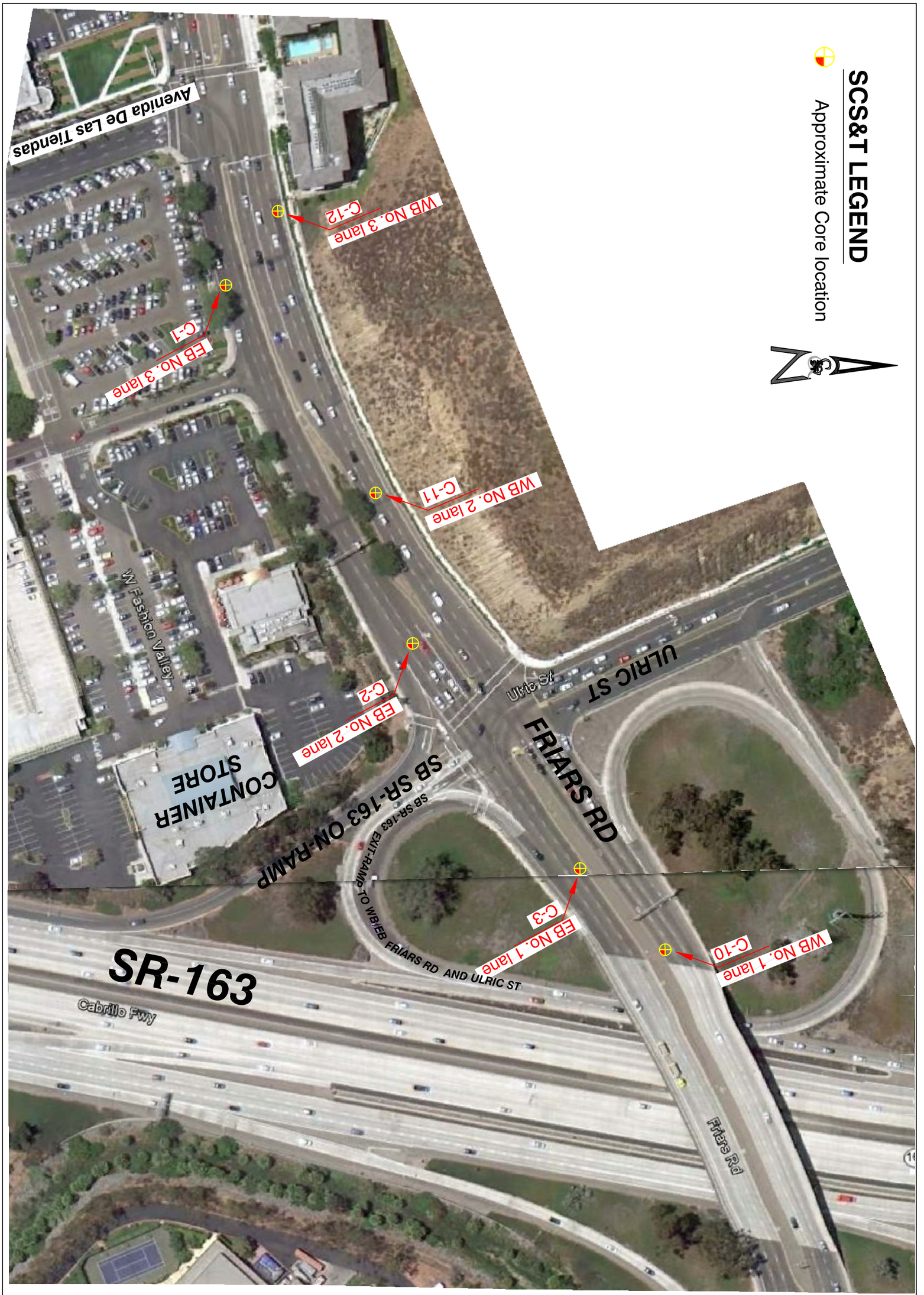
Date:	7/16/ 2012
By:	EL
Job No.:	1111191-2
Scale:	NOT TO SCALE

ALIGNMENT LOCATION MAP

SR-163 AND FRIARS ROAD WIDENING

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
1

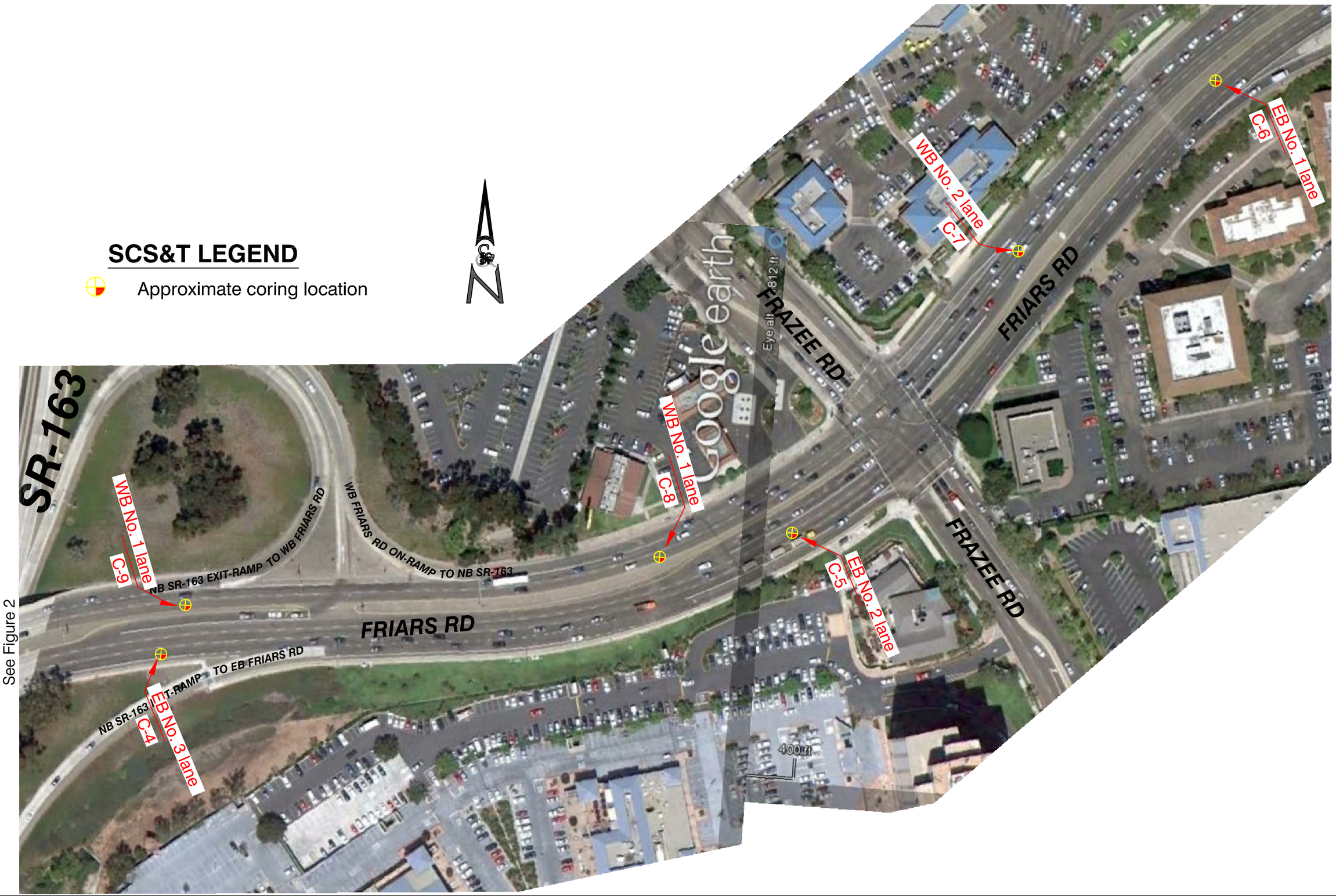


See Figure 3

Figure: 2	SOUTHERN CALIFORNIA SOIL & TESTING, INC.	CORING LOCATION MAP SR-163 AND FRIARS ROAD WIDENING	Date: 7 /16/ 2012 By: AKN/EL Job No.: 1111191-2 Scale: NOT TO SCALE

SCS&T LEGEND

Approximate coring location



See Figure 2

Date: 7 /16/ 2012
By: AKN/EL
Job No.: 1111191-2
Scale: NOT TO SCALE

CORING LOCATION MAP

SR-163 AND FRIARS ROAD WIDENING

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
3

APPENDIX I

TEST CORING SUMMARY

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION		GROUP SYMBOL	TYPICAL NAMES
I. COARSE GRAINED, more than 50% of material is larger than No. 200 sieve size.			
GRAVELS More than half of coarse fraction is larger than No. 4 sieve size but smaller than 3".	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		GC	Clayey gravels, poorly graded gravel-sand, clay mixtures.
SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS	SW	Well graded sand, gravelly sands, little or no fines.
		SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, poorly graded sand and silty mixtures.
		SC	Clayey sands, poorly graded sand and clay mixtures.
II. FINE GRAINED, more than 50% of material is smaller than No. 200 sieve size.			
	SILTS AND CLAYS (Liquid Limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, sandy silt or clayey-silt-sand mixtures with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays or low plasticity.
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity.
III. HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

▽ - Water level at time of excavation or as indicated
⊠ - Bulk Sample
AL - Atterberg Limits
CAL - Modified California pentration test sampler
CK - Undisturbed chunk sample
CL - Chloride
CON - Consolidation
COR - Corrosivity Test
- Sulfate
- Chloride
- pH and Resistivity

DS - Direct Shear
EI - Expansion Index
MS - Maximum Size of Particle
MAX - Maximum Density
pH - pH & Resistivity
RC - Relative Compaction
RV - R Value
SA - Sieve Analysis
SC - Sand Cone
SF - Sulfate & Chloride
SPT - Standard penetration test sampler
ST - Shelby Tube
TX - Triaxial Compression
UC - Unconfined Compression

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD WIDENING		
	By: EL	Date:	7/24/2012
	Job Number: 1111191-2	Figure:	I-1

Core Identification	Street	Nearest Cross Street	Approximate Coring Location	Wearing Surface Type	Wearing Surface Thickness, inches	Aggregate Base Course Thickness, inches	USCS	Summary of Subgrade Condition
C-1	Friars Road	Avenida De Las Tiendas	Eastbound Number 3 lane[note 1]	Asphalt Concrete	7	8	SC	**Fill** - Clayey Sand.
C-2	Friars Road	Ulric Street	Eastbound Number 2 lane	Asphalt Concrete	7	9	SC	**Fill -** Clayey Sand.
C-3	Friars Road	State Rounte 163	Eastbound Number 1 lane	Asphalt Concrete	4	8	SM	**Fill** - Silty Sand.
C-4	Friars Road	State Rounte 163	Eastbound Number 3 lane	Asphalt Concrete	4	8½	GC	**Fill** - Clayey Gravel with Sand.
C-5	Friars Road	Frazee Road	Eastbound Number 2 lane	Asphalt Concrete	4½	19½	SC	**Fill** - Clayey Sand with Gravel.
C-6	Friars Road	Frazee Road	Eastbound Number 1 lane	Asphalt Concrete	6	10	GM	**Fill** - Silty Gravel.
C-7	Friars Road	Frazee Road	Westbound Number 2 lane	Asphalt Concrete	5½	10½	GC	**Fill** - Clayey Gravel with Sand.
C-8	Friars Road	Frazee Road	Westbound Number 1 lane	Asphalt Concrete	4½	18½	GC	**Fill** - Clayey Gravel with Sand.
C-9	Friars Road	State Route 163	Westbound Number 1 lane	Asphalt Concrete	4½	8½	SC	**Fill** - Clayey Sand with Garevl.
C-10	Friars Road	State Route 163	Westbound Number 1 lane	Asphalt Concrete	5	9	GC	**Fill** - Clayey Gravel with Sand.
C-11	Friars Road	Ulric Street	Westbound Number 2 lane	Asphalt Concrete	8	9	GW-GM	**Fill** - Well-graded Gravel with Silt and Sand.
C-12	Friars Road	Avenida De Las Tiendas	Westbound Number 3 lane	Asphalt Concrete	7	8	SC	**Fill** - Clayey Sand.

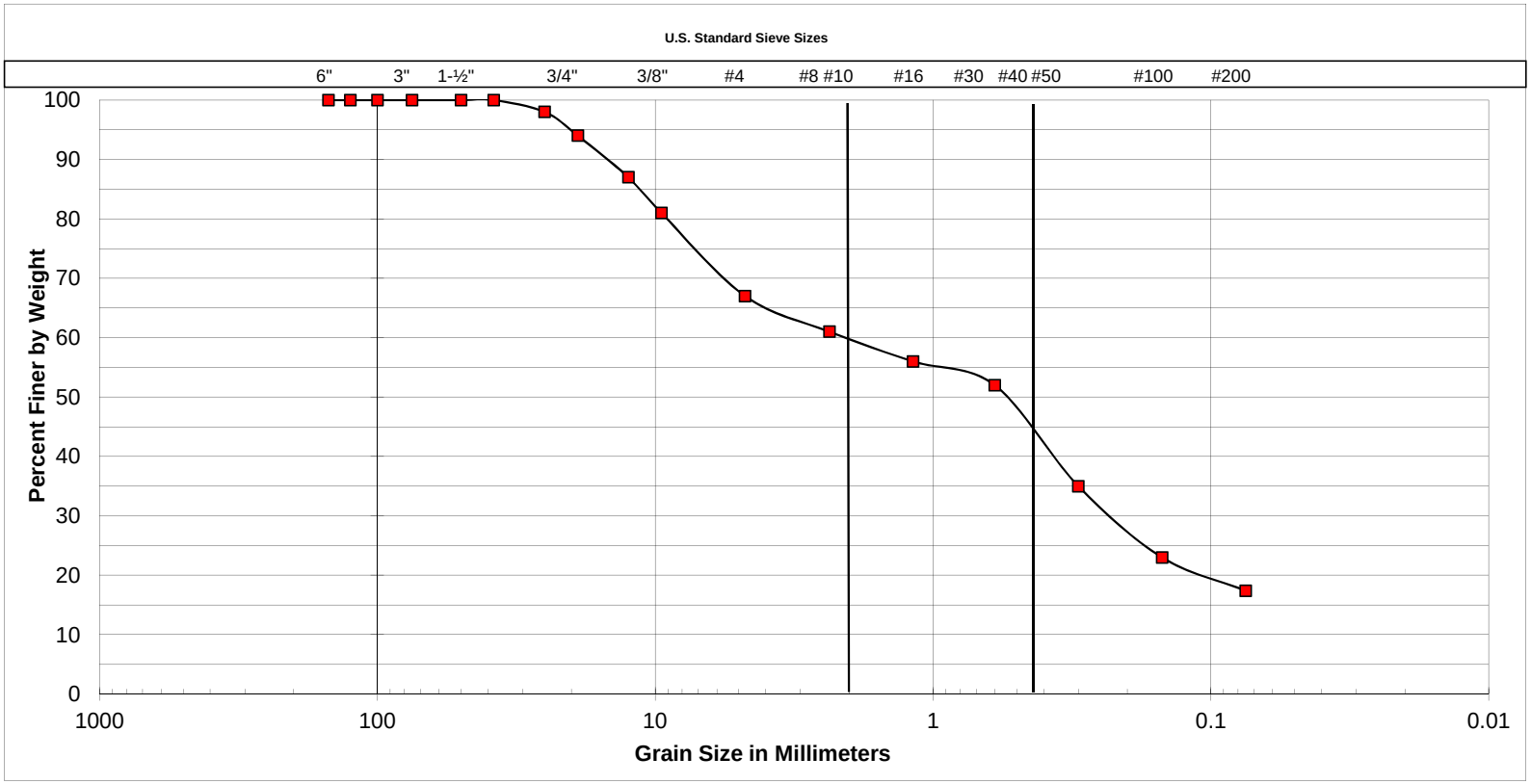
Note 1: Number 3 lane is the most outer travel lane within the same traffic diection.

APPENDIX II
LABORATORY TEST RESULTS

SUMMARY

The laboratory test program was design to fit the specific need of this project and was limited to testing on-site materials. A brief description of each type of test is presented below. Results are given on the following pages:

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.
- **GRAIN SIZE DISTRIBUTION:** The grain size distributions were determined for 4 samples in accordance with ASTM D 422. The results are presented on Figures II-1 through II-4.
- **R-VALUE:** R-values were determined for representative subgrade soils in accordance with California Test 301. The results are summarized on Figure II-5.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
C-3 subgrade

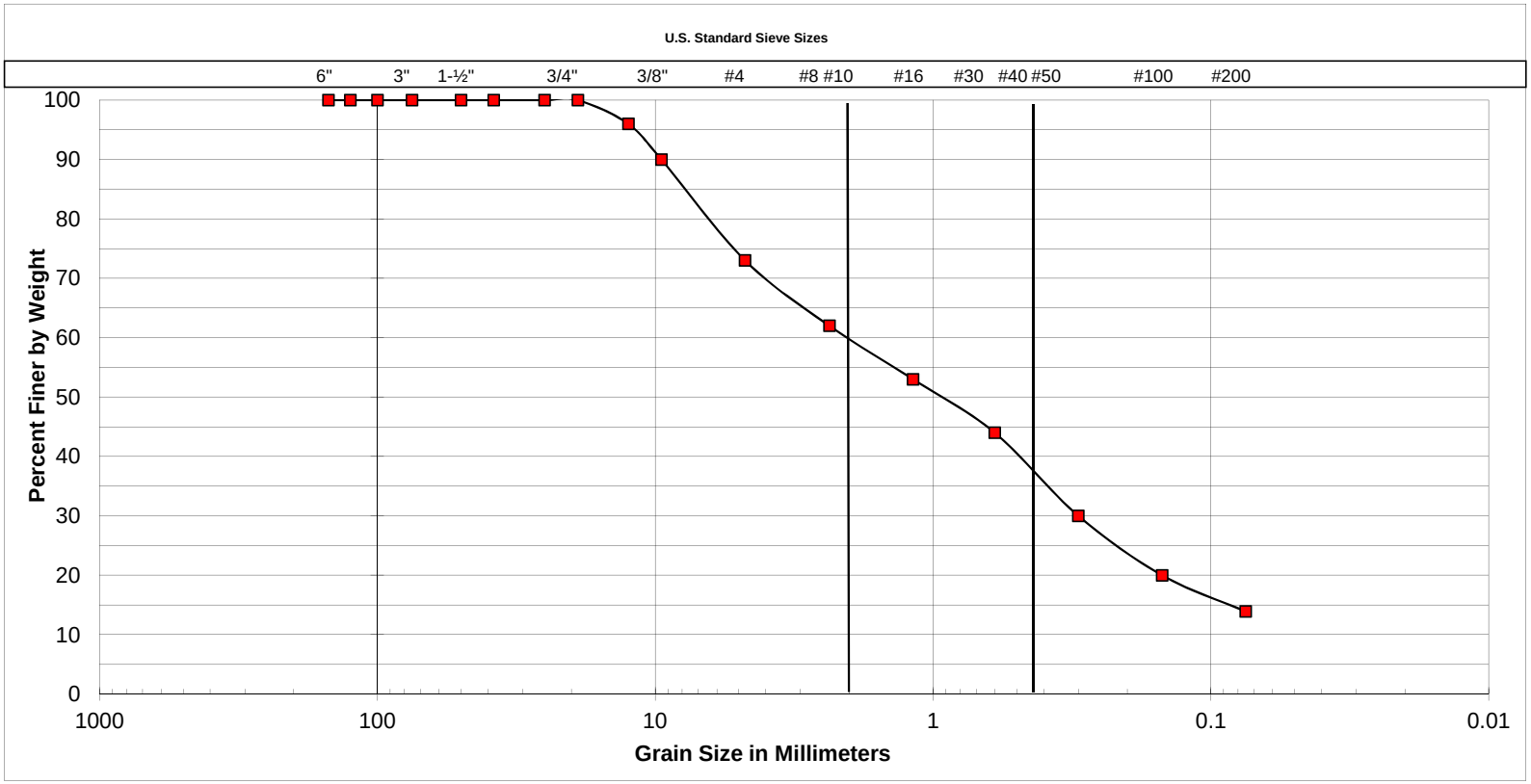
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	26
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD WIDENING

BY:	AKN/EL	DATE:	7/24/2012
JOB NUMBER:	1111191-2	FIGURE:	II-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
C-5 subgrade

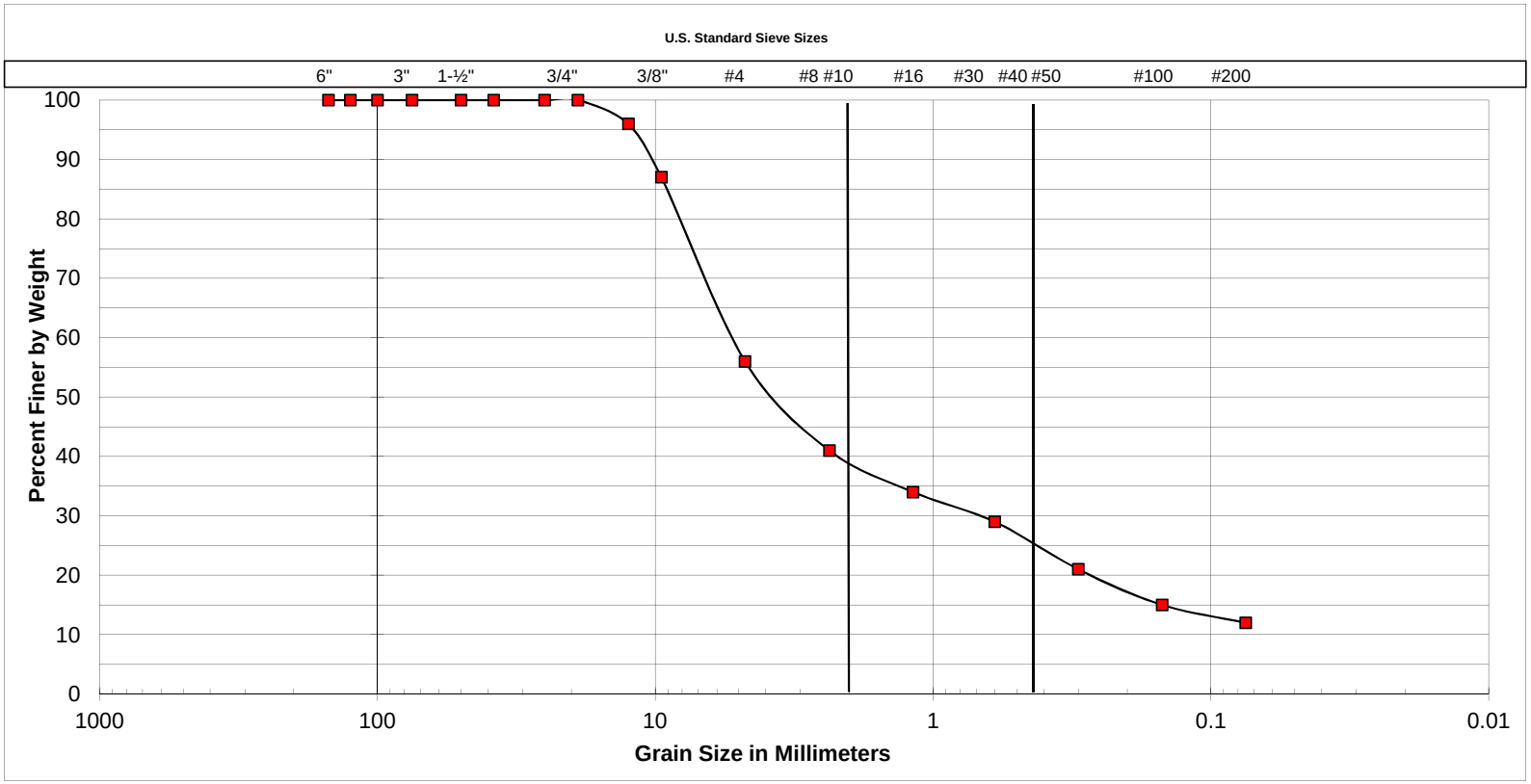
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	29
PLASTIC LIMIT	20
PLASTICITY INDEX	9

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD WIDENING

BY:	AKN/EL	DATE:	7/24/2012
JOB NUMBER:	1111191-2	FIGURE:	II-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
C-9 subgrade

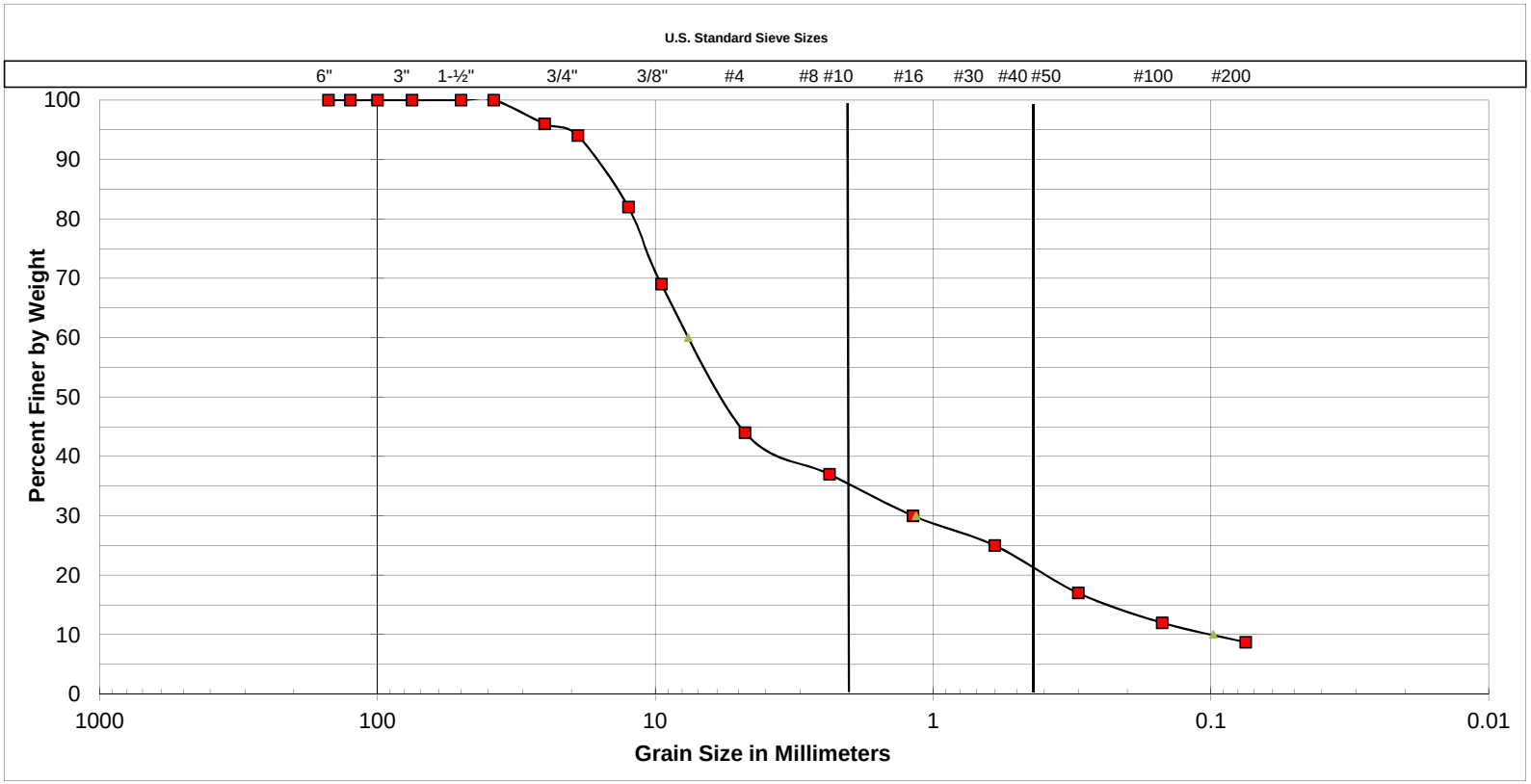
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	28
PLASTIC LIMIT	19
PLASTICITY INDEX	9

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD WIDENING

BY:	AKN/EL	DATE:	7/24/2012
JOB NUMBER:	1111191-2	FIGURE:	II-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
C-11 subgrade

UNIFIED SOIL CLASSIFICATION:	GW-GM
DESCRIPTION	WELL GRADED GRAVEL with SILT and SAND

ATTERBERG LIMITS	
LIQUID LIMIT	27
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	7/24/2012
JOB NUMBER:	1111191-2	FIGURE:	II-4

R - Value

Caltran Test 301

SAMPLE IDENTIFICATION	DESCRIPTION	R- Value
C-6 subgrade	Silty SAND with GRAVEL	71
C-10 subgrade	Clayey SAND with GRAVEL	30
A-03-007 at 1 foot to 4½ feet[Note1]	Tan silty SAND	22
A-12-030 at 1 foot to 5 feet[Note 1]	Brown clayey SAND	37
A-12-033 at 1 foot to 5 feet[Note 1]	Brown clayey SAND	53

Note 1: "Geotechnical Design Report, SR-163/Friars Road Interchange Modification, PM 3.8-5.8, EA Number 11225-085781, EFIS PID 1100000064, San Diego, California"; prepared by Southern California Soil & Testing, Inc., dated July 18, 2012 (SCS&T No. 1111191-1).

APPENDIX III
FALLING WEIGHT DEFLECTOMETER TESTING RESULTS

LABELLE • MARVIN INC

PAVEMENT ENGINEERING, DESIGN, INSPECTION & TESTING

Friars Road

Location: Friars Road | Frazee Road to Ave. De Las Tiendas | Date: 2012-05-28 22:52:25
Project: 38168

Friars Road Westbound Lane 1

00+00

Friars Road Westbound Lane 1
Pvt Temp: 0° F

Notes: Begin Testing Friars Road; Friars Road Westbound Lane 1; CL of Frazee Road

GPS: 0.00000° Lat, 0.00000° Lon
Limit ☐ NIS ☐

00+49

Friars Road Westbound Lane 1
Pvt Temp: 0° F

Notes: Median, Raised

GPS: 0.00000° Lat, 0.00000° Lon
Limit ☐ NIS ☐

01+06 (test 1)

Friars Road Westbound Lane 1
Pvt Temp: 102.5° F

Notes:

Avg FWD1: 6.00667

GPS: 32.77252° Lat, -117.15762° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	6.07	4.45	3.92	3.3	2.85	2.17	1.6	1.23	4.06	4.9
8.79	5.99	4.43	3.88	3.27	2.83	2.17	1.59	1.21	4.09	4.9
8.72	5.96	4.43	3.9	3.28	2.82	2.16	1.6	1.24	4.13	4.87

02+02 (test 2)

Friars Road Westbound Lane 1
Pvt Temp: 101.8° F

Notes:

Avg FWD1: 7.53333

GPS: 32.77237° Lat, -117.15788° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	7.55	5.71	4.95	3.97	3.26	2.33	1.53	1.07	5.69	6.76
8.89	7.54	5.71	4.93	4	3.25	2.29	1.54	1.07	5.68	6.69
8.91	7.51	5.73	4.95	3.98	3.3	2.31	1.53	1.11	5.69	6.73

02+28

Friars Road Westbound Lane 1
Pvt Temp: 0° F

Notes: Lateral Trench

GPS: 32.77237° Lat, -117.15788° Lon
Limit ☐ NIS ☐

03+02 (test 3)

Friars Road Westbound Lane 1
Pvt Temp: 101.4° F

Notes:

Avg FWD1: 13.7033

GPS: 32.77224° Lat, -117.15816° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.69	13.88	10.46	8.91	6.86	5.2	3.33	2.28	1.72	10.61	12.47
8.74	13.65	10.36	8.85	6.8	5.21	3.37	2.28	1.77	10.48	12.25
8.72	13.58	10.36	8.84	6.79	5.22	3.43	2.33	1.82	10.42	12.23

03+59
Notes: Lateral Trench

Friars Road Westbound Lane 1
Pvt Temp: 0° F
GPS: 32.77224° Lat, -117.15816° Lon
Limit ☐ NIS ☐

04+00 (test 4)
Notes:
Avg FWD1: 14.04

Friars Road Westbound Lane 1
Pvt Temp: 103.6° F
GPS: 32.77214° Lat, -117.15846° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	14.21	10.48	8.83	6.78	5.28	3.38	2.4	1.81	11.44	13.17
8.69	14.03	10.44	8.84	6.79	5.33	3.42	2.39	1.84	11.22	12.91
8.76	13.88	10.4	8.82	6.81	5.34	3.45	2.42	1.87	11.1	12.76

05+11 (test 5)
Notes:
Avg FWD1: 5.3

Friars Road Westbound Lane 1
Pvt Temp: 102.9° F
GPS: 32.77207° Lat, -117.15881° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.16	5.35	4.3	3.85	3.2	2.67	2.17	1.6	1.23	4.15	4.76
9.03	5.29	4.27	3.79	3.16	2.64	2.16	1.55	1.25	4.11	4.73
9.11	5.26	4.25	3.79	3.18	2.65	2.14	1.59	1.28	4.1	4.66

05+98 (test 6)
Notes:
Avg FWD1: 5.15333

Friars Road Westbound Lane 1
Pvt Temp: 105.1° F
GPS: 32.77204° Lat, -117.15909° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.01	5.2	3.93	3.38	2.67	2.15	1.31	0.78	0.65	3.8	4.52
8.91	5.14	3.9	3.35	2.65	2.12	1.3	0.78	0.6	3.73	4.43
8.94	5.12	3.89	3.35	2.68	2.11	1.28	0.78	0.6	3.7	4.42

06+94 (test 7)
Notes:
Avg FWD1: 4.92333

Friars Road Westbound Lane 1
Pvt Temp: 105.1° F
GPS: 32.77201° Lat, -117.15940° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.08	4.93	3.91	3.56	3.09	2.66	2.01	1.35	1.22	3.9	4.39
9.03	4.93	3.92	3.57	3.06	2.67	2.04	1.35	0.91	3.92	4.32
9.11	4.91	3.91	3.57	3.08	2.68	2.04	1.36	0.94	3.89	4.33

07+23
Notes: CL of 163 North Onramp

Friars Road Westbound Lane 1
Pvt Temp: 0° F
GPS: 32.77201° Lat, -117.15940° Lon
Limit ☐ NIS ☐

08+06 (test 8)

Notes: Longitudinal Cracks

Avg FWD1: 3.89

Friars Road Westbound Lane 1
Pvt Temp: 102.5° F
GPS: 32.77197° Lat, -117.15975° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.06	3.9	3.05	2.8	2.46	2.15	1.72	1.18	0.87	2.77	3.34
8.98	3.86	3	2.78	2.45	2.12	1.76	1.16	0.82	2.67	3.33
9.11	3.91	3.03	2.81	2.46	2.13	1.78	1.19	0.87	2.73	3.33

09+02 (test 9)

Notes:

Avg FWD1: 4.73

Friars Road Westbound Lane 1
Pvt Temp: 102.5° F
GPS: 32.77193° Lat, -117.16006° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	4.78	3.62	3.21	2.71	2.33	1.81	1.15	0.81	3.51	4.08
8.96	4.69	3.59	3.18	2.65	2.28	1.77	1.14	0.82	3.45	4.06
9.03	4.72	3.6	3.22	2.7	2.34	1.82	1.17	8.2	3.47	4.06

10+02 (test 10)

Notes:

Avg FWD1: 5.77333

Friars Road Westbound Lane 1
Pvt Temp: 104.4° F
GPS: 32.77188° Lat, -117.16038° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	5.76	4.29	3.83	3.19	2.66	1.96	1.27	0.71	4.41	5.02
8.91	5.8	4.34	3.82	3.24	2.72	2.02	1.29	0.9	4.45	5.06
8.94	5.76	4.35	3.84	3.22	2.7	2.01	1.28	6.98	4.44	5.05

10+95 (test 11)

Notes: Lateral Cracks

Avg FWD1: 11.1767

Friars Road Westbound Lane 1
Pvt Temp: 103.6° F
GPS: 32.77182° Lat, -117.16067° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	11.33	8.98	7.87	6.42	5.13	2.88	1.49	0.8	9.15	10.37
8.67	11.14	8.88	7.81	6.37	5.07	2.97	1.52	1.02	9.11	10.21
8.74	11.06	8.84	7.78	6.34	5.07	2.89	1.52	0.95	9	10.11

11+05

Notes: Begin Bridge

Friars Road Westbound Lane 1
Pvt Temp: 0° F
GPS: 32.77182° Lat, -117.16067° Lon
Limit ☐ NIS ☐

14+96

Notes: End Bridge

Friars Road Westbound Lane 1
Pvt Temp: 0° F
GPS: 32.77182° Lat, -117.16067° Lon
Limit ☐ NIS ☐

16+00 (test 12)

Notes:

Avg FWD1: 3.36333

Friars Road Westbound Lane 1
Pvt Temp: 98.5° F
GPS: 32.77125° Lat, -117.16216° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10

9.06	3.37	2.58	2.31	1.93	1.67	1.28	0.85	0.59	2.46	2.83
9.01	3.35	2.52	2.28	1.96	1.68	1.38	0.87	0.59	2.4	2.8
9.13	3.37	2.54	2.3	1.94	1.66	1.3	0.82	0.56	2.43	2.82

17+03 (test 13)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 99.6° F

Avg FWD1: 4.65667

GPS: 32.77109° Lat, -117.16244° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.13	4.67	3.52	3.15	2.68	2.23	1.61	1.2	0.83	3.79	4.35
9.08	4.66	3.55	3.12	2.65	2.24	1.67	1.22	0.84	3.81	4.33
9.03	4.64	3.55	3.15	2.66	2.22	1.65	1.2	0.83	3.75	4.32

18+01 (test 14)

Friars Road Westbound Lane 1

Notes: Slight Raveling, Near Traffic Sensors

Pvt Temp: 97.4° F

Avg FWD1: 7.41

GPS: 32.77095° Lat, -117.16270° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	7.45	5.84	5.08	4.03	3.32	2.26	1.47	1.03	5.57	6.56
8.86	7.38	5.82	5.04	4.02	3.34	2.27	1.44	1.02	5.58	6.51
8.94	7.4	5.83	5.05	4.01	3.32	2.29	1.47	1.02	5.57	6.51

18+90

Friars Road Westbound Lane 1

Notes: CL of Ulric Street

Pvt Temp: 0° F

GPS: 32.77095° Lat, -117.16270° Lon

Limit ☐ NIS ☐

19+98 (test 15)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 101.8° F

Avg FWD1: 3.54333

GPS: 32.77065° Lat, -117.16324° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.18	3.59	2.63	2.34	1.99	1.66	1.4	0.92	0.62	2.56	2.95
9.11	3.54	2.59	2.32	1.94	1.66	1.38	0.91	0.66	2.59	2.88
9.2	3.5	2.58	2.29	1.95	1.68	1.4	0.9	0.65	2.52	2.86

21+07 (test 16)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 101.8° F

Avg FWD1: 4.52

GPS: 32.77050° Lat, -117.16354° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.25	4.55	3.45	3.06	2.54	2.16	1.64	1.22	0.86	3.41	3.97
9.16	4.54	3.44	3.05	2.53	2.15	1.62	1.2	0.89	3.44	3.94
9.11	4.47	3.42	3.02	2.5	2.15	1.6	1.2	0.89	3.32	3.9

21+91

Friars Road Westbound Lane 1

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77050° Lat, -117.16354° Lon

Limit ☐ NIS ☐

22+09 (test 17)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 85° F

Avg FWD1: 3.17667

GPS: 32.77037° Lat, -117.16383° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.23	3.19	2.34	2.11	1.86	1.64	1.35	0.98	0.72	2.25	2.61
9.25	3.2	2.33	2.12	1.84	1.63	1.33	0.99	0.75	2.23	2.6
9.11	3.14	2.3	2.09	1.88	1.63	1.33	0.97	0.72	2.23	2.58

23+05 (test 18)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 104° F

Avg FWD1: 4.41333

GPS: 32.77026° Lat, -117.16412° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.01	4.47	2.53	2.27	1.88	1.58	1.31	0.87	0.73	2.49	2.97
9.11	4.42	2.52	2.27	1.89	1.58	1.33	0.85	0.66	2.46	2.95
9.11	4.35	2.55	2.25	1.88	1.57	1.29	0.86	0.63	2.45	2.97

24+08 (test 19)

Friars Road Westbound Lane 1

Notes: LTP

Pvt Temp: 104.7° F

Avg FWD1: 3.67

GPS: 32.77017° Lat, -117.16443° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.16	3.72	2.21	1.87	1.47	1.16	0.98	0.49	0.29	2.05	2.63
9.03	3.64	2.18	1.86	1.46	1.15	1	0.51	0.29	2.03	2.6
9.11	3.65	2.17	1.88	1.48	1.14	1	0.49	0.29	2.02	2.58

25+03 (test 20)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 105.8° F

Avg FWD1: 5.38

GPS: 32.77009° Lat, -117.16473° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.89	5.4	4.12	3.59	2.92	2.33	1.77	1.03	0.69	4.49	5.02
8.89	5.36	4.09	3.57	2.93	2.3	1.79	1.03	0.7	4.42	4.93
8.89	5.38	4.1	3.59	2.92	2.31	1.79	1.03	0.69	4.44	4.96

25+24

Friars Road Westbound Lane 1

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77009° Lat, -117.16473° Lon

Limit ☐ NIS ☐

26+01 (test 21)

Friars Road Westbound Lane 1

Notes:

Pvt Temp: 108.4° F

Avg FWD1: 8.73333

GPS: 32.77004° Lat, -117.16504° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	8.83	6.87	6.07	5.02	4.12	2.92	1.87	1.18	7.06	8.03
8.86	8.63	6.76	5.96	4.91	4.02	2.91	1.85	1.14	6.9	7.82
8.96	8.74	6.83	6.05	5	4.1	2.92	1.86	1.14	6.94	7.93

27+30

Friars Road Westbound Lane 1

Notes: CL of Ave. De Las Tiendas

Pvt Temp: 0° F

GPS: 32.77004° Lat, -117.16504° Lon

Limit ☐ NIS ☐

Frairs Road Eastbound Lane 1

00+00
Notes: Frairs Road Eastbound Lane 1; CL of Avenida De Las Tiendas

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77004° Lat, -117.16504° Lon
Limit ☐ NIS ☐

00+79
Notes: Median, Raised

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77004° Lat, -117.16504° Lon
Limit ☐ NIS ☐

01+15 (test 22)
Notes: Alligator Cracks

Avg FWD1: 9.65

Frairs Road Eastbound Lane 1
Pvt Temp: 109.5° F
GPS: 32.76994° Lat, -117.16503° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.69	9.67	8.44	7.91	7.07	6.31	5.01	3.71	2.64	8.68	9.19
8.67	9.64	8.43	7.9	7.04	6.27	4.99	3.73	2.62	8.62	9.16
8.79	9.64	8.45	7.93	7.07	6.29	4.97	3.73	2.65	8.65	9.23

01+99 (test 23)
Notes: Alligator Cracks in LWT

Avg FWD1: 8.15333

Frairs Road Eastbound Lane 1
Pvt Temp: 108° F
GPS: 32.76998° Lat, -117.16477° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	8.21	6.79	6.32	5.61	5.03	4.12	3.11	2.34	6.73	7.5
8.62	8.08	6.68	6.24	5.5	4.96	4.07	3.08	2.3	6.57	7.33
8.79	8.17	6.8	6.34	5.62	5.05	4.11	3.14	2.35	6.66	7.4

03+09 (test 24)
Notes:

Avg FWD1: 7.03333

Frairs Road Eastbound Lane 1
Pvt Temp: 108° F
GPS: 32.77007° Lat, -117.16442° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	7.06	5.54	5.29	4.83	4.37	3.58	2.53	1.83	5.41	5.88
8.94	7.05	5.52	5.3	4.82	4.35	3.51	2.54	1.68	5.44	5.87
8.79	6.99	5.52	5.26	4.82	4.37	3.54	2.52	1.69	5.38	5.84

03+33
Notes: Begin Patch

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77007° Lat, -117.16442° Lon
Limit ☐ NIS ☐

03+56
Notes: End Patch

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77007° Lat, -117.16442° Lon

Limit ☐ NIS ☐

04+00 (test 25)

Frairs Road Eastbound Lane 1

Notes: Next to Catch Basin

Pvt Temp: 108.4° F

Avg FWD1: 6.92667

GPS: 32.77015° Lat, -117.16414° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	7.01	5.99	5.48	4.81	4.21	3.15	2.25	1.57	5.94	6.58
8.94	6.9	5.88	5.41	4.73	4.12	3.11	2.19	1.54	5.81	6.43
8.91	6.87	5.86	5.41	4.73	4.14	3.11	2.2	1.54	5.81	6.45

05+10 (test 26)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 110.2° F

Avg FWD1: 2.62

GPS: 32.77027° Lat, -117.16382° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.98	2.62	1.87	1.65	1.4	1.24	0.97	0.68	0.48	1.68	2.21
9.13	2.65	1.87	1.66	1.39	1.23	0.97	0.68	0.5	1.64	2.19
8.96	2.59	1.81	1.59	1.37	1.22	0.93	0.65	0.49	1.67	2.15

05+44

Frairs Road Eastbound Lane 1

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77027° Lat, -117.16382° Lon

Limit ☐ NIS ☐

06+08 (test 27)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 109.9° F

Avg FWD1: 2.99

GPS: 32.77040° Lat, -117.16354° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.98	3	2.3	2.12	1.91	1.7	1.48	1.07	0.79	2.28	2.59
8.91	3	2.28	2.13	1.93	1.69	1.48	1.06	0.83	2.27	2.57
8.94	2.97	2.28	2.12	1.9	1.67	1.48	1.09	0.81	2.24	2.53

06+98

Frairs Road Eastbound Lane 1

Notes: LTP

Pvt Temp: 0° F

GPS: 32.77040° Lat, -117.16354° Lon

Limit ☐ NIS ☐

06+98 (test 28)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 109.9° F

Avg FWD1: 3.39

GPS: 32.77052° Lat, -117.16329° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	3.42	2.57	2.39	2.16	1.98	1.72	1.38	1.1	2.53	2.94
9.03	3.38	2.56	2.37	2.11	1.94	1.72	1.37	1.11	2.51	2.91
8.94	3.37	2.56	2.36	2.11	1.92	1.73	1.33	1.1	2.51	2.86

07+96 (test 29)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 110.2° F

Avg FWD1: 4.23333

GPS: 32.77067° Lat, -117.16302° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.98	4.28	3.18	2.81	2.34	1.97	1.55	1.1	0.81	3.18	3.7
8.89	4.23	3.11	2.77	2.33	1.95	1.55	1.09	0.79	3.16	3.67
9.01	4.19	3.12	2.8	2.31	1.95	1.54	1.11	0.81	3.18	3.67

08+58

Notes: CL of Ulric Street

Frairs Road Eastbound Lane 1

Pvt Temp: 0° F

GPS: 32.77067° Lat, -117.16302° Lon

Limit ☐ NIS ☐

09+11 (test 30)

Notes: Lateral Cracks

Avg FWD1: 15.0833

Frairs Road Eastbound Lane 1

Pvt Temp: 111.7° F

GPS: 32.77084° Lat, -117.16272° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.74	15.16	12.03	10.66	8.68	7.15	4.84	3.36	2.49	11.52	13.35
8.79	15.08	12.04	10.73	8.67	7.17	4.86	3.32	2.47	11.48	13.23
8.79	15.01	11.95	10.62	8.63	7.11	4.81	3.33	2.48	11.4	13.18

10+03 (test 31)

Notes:

Avg FWD1: 9.31333

Frairs Road Eastbound Lane 1

Pvt Temp: 112.1° F

GPS: 32.77098° Lat, -117.16246° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	9.45	7.32	6.43	5.09	4.03	2.65	1.61	1.1	7.34	8.49
8.91	9.32	7.27	6.37	5.04	4.04	2.62	1.61	1.11	7.27	8.35
8.91	9.17	7.2	6.29	4.96	3.98	2.62	1.57	1.12	7.09	8.24

11+02 (test 32)

Notes:

Avg FWD1: 8.51

Frairs Road Eastbound Lane 1

Pvt Temp: 112.4° F

GPS: 32.77113° Lat, -117.16220° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	8.61	6.59	5.58	4.34	3.42	2.29	1.24	0.74	6.5	7.52
8.86	8.5	6.54	5.56	4.3	3.39	2.31	1.26	0.78	6.44	7.41
8.81	8.42	6.48	5.5	4.28	3.37	2.26	1.22	0.79	6.39	7.35

12+02 (test 33)

Notes: Lateral Cracks

Avg FWD1: 16.2233

Frairs Road Eastbound Lane 1

Pvt Temp: 110.2° F

GPS: 32.77127° Lat, -117.16192° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.74	16.56	13.76	12.3	9.72	7.57	4.35	2.34	1.45	13.03	14.85
8.74	16.25	13.58	12.14	9.64	7.5	4.31	2.35	1.42	12.92	14.61
8.64	15.86	13.33	11.92	9.44	7.33	4.23	2.28	1.43	12.49	14.27

12+14

Notes: Begin Bridge

Frairs Road Eastbound Lane 1

Pvt Temp: 0° F

GPS: 32.77127° Lat, -117.16192° Lon

Limit ☐ NIS ☐

16+12
Notes: End Bridge

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77127° Lat, -117.16192° Lon
Limit ☐ NIS ☐

17+03 (test 34)
Notes: Lateral Cracks
Avg FWD1: 6.00333

Frairs Road Eastbound Lane 1
Pvt Temp: 111.7° F
GPS: 32.77179° Lat, -117.16042° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.08	5.99	4.56	4	3.27	2.82	2.09	1.48	1.1	4.26	5.16
9.11	6	4.61	4.02	3.32	2.82	2.11	1.52	1.08	4.29	5.18
9.11	6.02	4.62	4.02	3.3	2.82	2.08	1.47	1.08	4.22	5.16

17+20
Notes: LTP

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77179° Lat, -117.16042° Lon
Limit ☐ NIS ☐

18+06 (test 35)
Notes: Longitudinal Cracks
Avg FWD1: 13.1033

Frairs Road Eastbound Lane 1
Pvt Temp: 111° F
GPS: 32.77185° Lat, -117.16009° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	13.24	9.63	8.11	6.26	4.85	3.17	1.99	1.41	10.1	11.89
8.94	13.09	9.58	8.13	6.26	4.88	3.25	2.01	1.4	10.05	11.71
8.96	12.98	9.55	8.05	6.25	4.86	3.19	2.01	1.43	9.95	11.6

19+05 (test 36)
Notes:
Avg FWD1: 17.1233

Frairs Road Eastbound Lane 1
Pvt Temp: 112.1° F
GPS: 32.77188° Lat, -117.15977° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	17.36	13.01	11.02	8.45	6.49	3.92	2.42	1.71	13.39	15.6
8.94	17.18	12.93	11	8.44	6.51	3.93	2.41	1.73	13.27	15.4
8.86	16.83	12.75	10.83	8.33	6.42	3.88	2.37	1.68	13.05	15.15

20+07 (test 37)
Notes: CL of 163 North Onramp
Avg FWD1: 7.24667

Frairs Road Eastbound Lane 1
Pvt Temp: 108° F
GPS: 32.77192° Lat, -117.15945° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	7.26	5.49	4.93	4.19	3.55	2.74	1.83	1.38	5.46	6.51
9.03	7.28	5.52	4.97	4.2	3.55	2.77	1.84	1.35	5.36	6.43
8.94	7.2	5.5	4.92	4.18	3.54	2.76	1.83	1.32	5.3	6.33

21+03 (test 38)
Notes:
Avg FWD1: 6.02333

Frairs Road Eastbound Lane 1
Pvt Temp: 109.5° F
GPS: 32.77195° Lat, -117.15914° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.54	6	4.71	4.27	3.73	3.26	2.41	1.53	1.07	5.03	5.66
8.59	6.04	4.75	4.3	3.74	3.25	2.42	1.55	1.1	5.04	5.67
8.69	6.03	4.72	4.3	3.76	3.25	2.43	1.55	1.08	5.02	5.68

22+02 (test 39)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 109.9° F

Avg FWD1: 12.8

GPS: 32.77199° Lat, -117.15882° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	12.93	10.06	8.66	6.8	5.35	3.39	2.11	1.51	9.84	11.46
8.76	12.71	9.97	8.61	6.74	5.32	3.4	2.08	1.5	9.71	11.23
8.81	12.76	10.02	8.66	6.79	5.32	3.39	2.1	1.5	9.79	11.3

23+04 (test 40)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 107.3° F

Avg FWD1: 5.87333

GPS: 32.77204° Lat, -117.15849° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.91	5.95	4.21	3.64	2.85	2.34	1.83	1.23	0.94	4.16	5.12
8.79	5.87	4.18	3.58	2.83	2.34	1.82	1.24	0.94	4.19	5.04
8.74	5.8	4.15	3.56	2.8	2.31	1.81	1.26	0.98	4.08	4.96

23+77

Frairs Road Eastbound Lane 1

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77204° Lat, -117.15849° Lon

Limit ☐ NIS ☐

24+07 (test 41)

Frairs Road Eastbound Lane 1

Notes: Near Traffic Sensors

Pvt Temp: 109.1° F

Avg FWD1: 7.79333

GPS: 32.77213° Lat, -117.15818° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	7.86	5.79	4.97	3.84	3.06	2.07	1.46	1.17	5.58	6.77
9.01	7.89	5.87	4.99	3.86	3.09	2.17	1.47	1.15	5.47	6.74
8.81	7.63	5.71	4.85	3.73	2.89	2	1.36	1.05	5.27	6.54

25+03 (test 42)

Frairs Road Eastbound Lane 1

Notes:

Pvt Temp: 110.2° F

Avg FWD1: 5.14667

GPS: 32.77224° Lat, -117.15790° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.35	5.17	3.93	3.4	2.82	2.39	1.9	1.21	0.81	4.1	4.77
8.45	5.14	3.86	3.4	2.82	2.36	1.86	1.19	0.8	4.03	4.73
8.4	5.13	3.91	3.4	2.83	2.38	1.88	1.2	0.85	4.1	4.67

25+15

Frairs Road Eastbound Lane 1

Notes: Lateral Trench, LTP

Pvt Temp: 0° F

GPS: 32.77224° Lat, -117.15790° Lon

Limit ☐ NIS ☐

Frairs Road Eastbound Lane 1

26+08 (test 43)

Notes: Alligator Cracks, Lateral Cracks

Avg FWD1: 5.32333

Pvt Temp: 110.6° F
GPS: 32.77240° Lat, -117.15761° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	5.37	3.62	3.1	2.47	2.01	1.45	0.88	0.57	3.54	4.33
9.08	5.36	3.66	3.14	2.51	2.05	1.47	0.89	0.57	3.53	4.29
8.79	5.24	3.57	3.07	2.48	1.99	1.46	0.88	0.58	3.49	4.23

27+40

Notes: CL of Frazee Road

Frairs Road Eastbound Lane 1
Pvt Temp: 0° F
GPS: 32.77240° Lat, -117.15761° Lon
Limit ☐ NIS ☐

Friars Road Westbound Lane 2

00+00

Notes: Friars Road Westbound Lane 2; CL of Frazee Road

Friars Road Westbound Lane 2
Pvt Temp: 0° F
GPS: 32.77240° Lat, -117.15761° Lon
Limit ☐ NIS ☐

00+59 (test 44)

Notes:

Avg FWD1: 5.56

Friars Road Westbound Lane 2
Pvt Temp: 107.7° F
GPS: 32.77262° Lat, -117.15754° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.01	5.61	3.89	3.31	2.63	2.2	1.77	1.14	0.86	3.95	4.94
8.96	5.56	3.88	3.3	2.64	2.21	1.77	1.1	0.84	3.96	4.89
9.01	5.51	3.88	3.29	2.63	2.2	1.8	1.14	0.83	3.91	4.85

01+61 (test 45)

Notes: Lateral Cracks

Avg FWD1: 12.1767

Friars Road Westbound Lane 2
Pvt Temp: 106.2° F
GPS: 32.77245° Lat, -117.15780° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	12.32	10.12	8.77	6.83	5.2	2.96	1.82	1.19	8.79	10.45
8.89	12.19	10.04	8.68	6.75	5.18	3.01	1.86	1.23	8.71	10.31
8.81	12.02	9.93	8.6	6.72	5.14	2.94	1.84	1.22	8.63	10.2

02+27

Notes: Lateral Trench

Friars Road Westbound Lane 2
Pvt Temp: 0° F
GPS: 32.77245° Lat, -117.15780° Lon
Limit ☐ NIS ☐

02+55 (test 46)

Notes:

Avg FWD1: 16.0267

Friars Road Westbound Lane 2
Pvt Temp: 106.9° F
GPS: 32.77232° Lat, -117.15806° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.52	16.16	11.99	10.12	7.61	5.81	3.63	2.22	1.88	12.5	14.47

8.64	16.06	12	10.14	7.66	5.87	3.67	2.25	1.63	12.44	14.29
8.67	15.86	11.86	10.06	7.6	5.81	3.61	2.22	1.6	12.22	14.03

03+53
Notes: Lateral Trench

Friars Road Westbound Lane 2
Pvt Temp: 0° F
GPS: 32.77232° Lat, -117.15806° Lon
Limit ☐ NIS ☐

03+68 (test 47)
Notes: Alligator Cracks, Alligator Cracks in LWT
Avg FWD1: 18.0733

Friars Road Westbound Lane 2
Pvt Temp: 108° F
GPS: 32.77219° Lat, -117.15840° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	18.41	13.09	10.77	7.8	5.78	3.26	2.24	1.8	12.89	15.3
8.67	17.93	12.83	10.63	7.72	5.74	3.3	2.23	1.77	12.64	14.93
8.59	17.88	12.89	10.68	7.83	5.87	3.39	2.36	1.92	12.65	14.91

04+60 (test 48)
Notes:
Avg FWD1: 7.31333

Friars Road Westbound Lane 2
Pvt Temp: 110.2° F
GPS: 32.77212° Lat, -117.15868° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	7.38	5.2	4.47	3.53	2.99	2.25	1.72	1.38	5.75	6.61
8.72	7.27	5.17	4.42	3.5	2.99	2.24	1.7	1.36	5.66	6.48
8.74	7.29	5.15	4.41	3.49	2.95	2.23	1.69	1.33	5.62	6.48

05+63 (test 49)
Notes:
Avg FWD1: 3.24333

Friars Road Westbound Lane 2
Pvt Temp: 106.9° F
GPS: 32.77208° Lat, -117.15901° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.64	3.25	2.57	2.32	1.97	1.69	1.21	0.77	0.56	2.57	2.89
8.67	3.23	2.52	2.31	1.96	1.66	1.18	0.8	0.57	2.56	2.85
8.67	3.25	2.51	2.3	1.98	1.67	1.18	0.79	0.59	2.56	2.84

06+45 (test 50)
Notes: Near Traffic Sensors
Avg FWD1: 4.63333

Friars Road Westbound Lane 2
Pvt Temp: 108.8° F
GPS: 32.77205° Lat, -117.15928° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	4.68	3.92	3.63	3.21	2.8	2.11	1.44	0.94	3.87	4.27
8.89	4.65	3.93	3.61	3.16	2.8	2.15	1.47	0.98	3.88	4.25
8.74	4.57	3.9	3.57	3.12	2.73	2.07	1.43	0.97	3.81	4.17

07+12
Notes: CL of 163 North Onramp

Friars Road Westbound Lane 2
Pvt Temp: 0° F
GPS: 32.77205° Lat, -117.15928° Lon
Limit ☐ NIS ☐

07+65 (test 51)
Notes:

Friars Road Westbound Lane 2
Pvt Temp: 111° F

Avg FWD1: 3.51667

GPS: 32.77201° Lat, -117.15966° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	3.53	2.71	2.48	2.22	1.95	1.54	1.11	11.97	2.79	3.01
8.72	3.47	2.67	2.46	2.21	1.9	1.51	1.09	0.74	2.71	2.93
8.84	3.55	2.7	2.5	2.24	1.94	1.57	1.12	0.77	2.77	2.98

08+50 (test 52)

Notes:

Friars Road Westbound Lane 2

Pvt Temp: 109.5° F

Avg FWD1: 3.74

GPS: 32.77198° Lat, -117.15993° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.03	3.77	2.76	2.54	2.21	1.92	1.48	1.02	0.72	2.82	3.18
8.86	3.73	2.77	2.5	2.2	1.87	1.5	1.04	0.74	2.83	3.12
8.89	3.72	2.76	2.49	2.16	1.87	1.46	1.01	0.73	2.8	3.11

09+60 (test 53)

Notes:

Friars Road Westbound Lane 2

Pvt Temp: 108° F

Avg FWD1: 4.50667

GPS: 32.77193° Lat, -117.16028° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	4.47	3.36	3	2.53	2.05	1.53	0.97	0.71	3.36	3.77
8.72	4.54	3.39	3.03	2.55	2.08	1.58	1	0.7	3.41	3.82
8.81	4.51	3.36	3.02	2.55	2.07	1.48	0.97	0.7	3.38	3.82

10+50 (test 54)

Notes:

Friars Road Westbound Lane 2

Pvt Temp: 107.3° F

Avg FWD1: 4.14333

GPS: 32.77187° Lat, -117.16057° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	4.19	3.19	2.92	2.53	2.12	1.64	1.09	0.76	3.29	3.72
8.94	4.13	3.19	2.89	2.48	2.12	1.62	1.06	0.74	3.24	3.66
8.84	4.11	3.2	2.9	2.46	2.09	1.64	1.04	0.73	3.29	3.68

10+94

Notes: Begin Bridge

Friars Road Westbound Lane 2

Pvt Temp: 0° F

GPS: 32.77187° Lat, -117.16057° Lon

Limit ☐ NIS ☐

14+81

Notes: End Bridge

Friars Road Westbound Lane 2

Pvt Temp: 0° F

GPS: 32.77187° Lat, -117.16057° Lon

Limit ☐ NIS ☐

15+57 (test 55)

Notes:

Friars Road Westbound Lane 2

Pvt Temp: 104.7° F

Avg FWD1: 4.43667

GPS: 32.77133° Lat, -117.16207° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.89	4.45	3.49	3.14	2.68	2.25	1.53	1	0.7	3.66	4.05
8.76	4.45	3.43	3.12	2.61	2.26	1.52	1.01	0.66	3.59	3.96
8.74	4.41	3.4	3.11	2.62	2.25	1.52	1.02	0.67	3.58	3.93

16+53 (test 56)

Friars Road Westbound Lane 2

Notes:

Pvt Temp: 106.9° F

Avg FWD1: 3.82333

GPS: 32.77119° Lat, -117.16233° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	3.8	3	2.7	2.27	1.91	1.45	0.94	0.69	3.04	3.44
8.94	3.83	3.02	2.69	2.24	1.9	1.47	0.98	0.68	3.02	3.43
8.94	3.84	3.02	2.69	2.25	1.9	1.45	0.97	0.7	3.02	3.4

17+55 (test 57)

Friars Road Westbound Lane 2

Notes:

Pvt Temp: 104.7° F

Avg FWD1: 4.04667

GPS: 32.77104° Lat, -117.16261° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.69	4.1	2.71	2.24	1.84	1.6	1.39	0.84	0.54	2.88	3.45
8.69	4.05	2.68	2.25	1.81	1.56	1.36	0.85	0.49	2.83	3.43
8.54	3.99	2.66	2.21	1.81	1.55	1.33	0.8	0.58	2.83	3.38

18+29 (test 58)

Friars Road Westbound Lane 2

Notes: Near Traffic Sensors

Pvt Temp: 97.4° F

Avg FWD1: 10.98

GPS: 32.77093° Lat, -117.16281° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	11.04	8.19	6.89	5.06	3.94	2.43	1.28	0.79	7.73	9.42
8.76	11.02	8.21	6.9	5.04	3.9	2.43	1.28	0.8	7.66	9.38
8.69	10.88	8.11	6.87	5.03	3.89	2.44	1.26	0.78	7.6	9.26

18+81

Friars Road Westbound Lane 2

Notes: CL of Ulric Street

Pvt Temp: 0° F

GPS: 32.77093° Lat, -117.16281° Lon

Limit ☐ NIS ☐

19+60 (test 59)

Friars Road Westbound Lane 2

Notes:

Pvt Temp: 109.9° F

Avg FWD1: 4.48333

GPS: 32.77073° Lat, -117.16317° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	4.5	3.22	2.81	2.32	1.92	1.48	0.96	0.65	3.17	3.77
8.96	4.47	3.23	2.82	2.32	1.94	1.51	0.97	0.66	3.08	3.72
9.06	4.48	3.24	2.84	2.33	1.96	1.48	0.96	0.67	3.12	3.72

20+57 (test 60)

Friars Road Westbound Lane 2

Notes: Near Manhole

Pvt Temp: 106.6° F

Avg FWD1: 6.32667

GPS: 32.77059° Lat, -117.16343° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
9.18	6.41	4.44	3.96	3.35	2.9	2.49	1.67	1.25	4.3	5.03
9.16	6.32	4.39	3.93	3.35	2.9	2.47	1.62	1.2	4.27	4.96
9.06	6.25	4.41	3.92	3.31	2.89	2.48	1.64	1.21	4.29	4.94

21+53 (test 61)

Friars Road Westbound Lane 2

Notes:

Pvt Temp: 108° F

Avg FWD1: 4.02333

GPS: 32.77046° Lat, -117.16371° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	4.07	3.22	2.97	2.64	2.4	2.05	1.49	1.22	3.21	3.59
8.91	4	3.19	2.92	2.59	2.31	2	1.51	1.2	3.2	3.54
9.03	4	3.19	2.91	2.62	2.35	2.02	1.52	1.18	3.2	3.53

21+86

Notes: Lateral Trench

Friars Road Westbound Lane 2

Pvt Temp: 0° F

GPS: 32.77046° Lat, -117.16371° Lon

Limit ☐ NIS ☐

22+58 (test 62)

Notes: Longitudinal Cracks

Avg FWD1: 3.93333

Friars Road Westbound Lane 2

Pvt Temp: 107.7° F

GPS: 32.77033° Lat, -117.16402° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.91	3.96	2.43	2.12	1.83	1.62	1.35	0.91	0.62	2.28	2.82
8.91	3.92	2.4	2.14	1.82	1.63	1.29	0.9	0.66	2.31	2.83
8.98	3.92	2.45	2.18	1.84	1.61	1.36	0.9	0.63	2.32	2.81

23+49 (test 63)

Notes: Longitudinal Cracks, Near Patch

Avg FWD1: 5.68667

Friars Road Westbound Lane 2

Pvt Temp: 105.5° F

GPS: 32.77024° Lat, -117.16429° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.89	5.71	4.44	4.01	3.41	2.93	2.32	1.62	1.19	4.53	4.99
8.89	5.67	4.43	4	3.42	2.94	2.32	1.63	1.18	4.54	5
8.96	5.68	4.46	4.03	3.44	2.96	2.33	1.64	1.22	4.53	5.03

24+53 (test 64)

Notes:

Avg FWD1: 2.96

Friars Road Westbound Lane 2

Pvt Temp: 107.7° F

GPS: 32.77015° Lat, -117.16461° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	2.92	2.13	2.02	1.83	1.67	1.54	1.1	0.79	2.09	2.32
8.91	2.99	2.16	2.03	1.88	1.71	1.58	1.11	0.82	2.08	2.36
8.91	2.97	2.15	2.06	1.9	1.72	1.57	1.12	0.83	2.1	2.35

25+14

Notes: Lateral Trench

Friars Road Westbound Lane 2

Pvt Temp: 0° F

GPS: 32.77015° Lat, -117.16461° Lon

Limit ☐ NIS ☐

25+59 (test 65)

Notes:

Avg FWD1: 7.8

Friars Road Westbound Lane 2

Pvt Temp: 108° F

GPS: 32.77008° Lat, -117.16494° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	7.9	5.88	5.04	3.93	3.1	2.12	1.24	0.81	5.84	6.84
8.86	7.75	5.77	4.96	3.88	3.05	2.11	1.19	0.78	5.72	6.71
8.86	7.75	5.79	4.98	3.88	3.04	2.12	1.19	0.82	5.7	6.74

27+24
Notes: CL of Avenida De Las Tiendas

Friars Road Westbound Lane 2
Pvt Temp: 0° F
GPS: 32.77008° Lat, -117.16494° Lon
Limit ☐ NIS ☐

Friars Road Eastbound Lane 2

00+00
Notes: Friars Road Eastbound Lane 2; CL of Avenida De Las Tiendas

Friars Road Eastbound Lane 2
Pvt Temp: 0° F
GPS: 32.77008° Lat, -117.16494° Lon
Limit ☐ NIS ☐

00+68 (test 66)
Notes:
Avg FWD1: 14.8633

Friars Road Eastbound Lane 2
Pvt Temp: 108° F
GPS: 32.76990° Lat, -117.16515° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.52	15.34	11.13	9.24	6.84	4.92	2.5	1.26	0.82	12.01	14.11
8.52	14.88	10.86	9.04	6.75	4.85	2.52	1.29	0.8	11.69	13.61
8.4	14.37	10.53	8.79	6.52	4.71	2.4	1.22	0.78	11.25	13.14

01+61 (test 67)
Notes: Longitudinal Cracks
Avg FWD1: 9.93333

Friars Road Eastbound Lane 2
Pvt Temp: 111° F
GPS: 32.76994° Lat, -117.16485° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	10.12	7.76	6.75	5.38	4.21	2.61	1.64	1.16	7.49	8.78
8.59	9.89	7.58	6.63	5.26	4.19	2.57	1.66	1.18	7.3	8.56
8.69	9.79	7.58	6.59	5.23	4.17	2.58	1.64	1.19	7.23	8.49

02+55 (test 68)
Notes:
Avg FWD1: 5.48333

Friars Road Eastbound Lane 2
Pvt Temp: 110.2° F
GPS: 32.77000° Lat, -117.16456° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	5.52	4.52	4.1	3.46	2.93	2.3	1.47	1.02	4.6	5.04
8.86	5.49	4.47	4.05	3.43	2.9	2.35	1.47	1.01	4.52	4.97
8.76	5.44	4.45	4.02	3.4	2.85	2.32	1.46	1.02	4.52	4.91

03+55 (test 69)
Notes: Longitudinal Cracks
Avg FWD1: 8.60333

Friars Road Eastbound Lane 2
Pvt Temp: 106.6° F
GPS: 32.77008° Lat, -117.16425° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	8.77	6.29	5.69	4.72	3.8	2.6	1.44	0.84	6.33	7.04
8.59	8.52	6.16	5.56	4.62	3.72	2.53	1.46	0.83	6.2	6.89
8.59	8.52	6.19	5.56	4.65	3.73	2.55	1.45	0.84	6.16	6.87

04+62 (test 70)
Notes:

Friars Road Eastbound Lane 2
Pvt Temp: 105.5° F

Avg FWD1: 4.57667

GPS: 32.77019° Lat, -117.16393° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.74	4.61	3.26	2.81	2.23	1.74	1.33	0.85	0.57	3.35	3.96
8.67	4.51	3.21	2.75	2.17	1.71	1.28	0.83	0.52	3.26	3.88
8.89	4.61	3.28	2.8	2.22	1.76	1.34	0.84	0.54	3.33	3.92

05+39

Notes: Lateral Trench

Friars Road Eastbound Lane 2

Pvt Temp: 0° F

GPS: 32.77019° Lat, -117.16393° Lon

Limit ☐ NIS ☐

05+59 (test 71)

Notes:

Friars Road Eastbound Lane 2

Pvt Temp: 89.4° F

Avg FWD1: 3.74

GPS: 32.77031° Lat, -117.16365° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.64	3.77	1.57	1.41	1.27	1.13	0.98	0.63	0.53	1.4	1.92
8.69	3.73	1.56	1.43	1.26	1.13	1.01	0.66	0.44	1.44	1.9
8.69	3.72	1.59	1.43	1.29	1.12	1.01	0.65	0.45	1.42	1.86

06+64 (test 72)

Notes: Longitudinal Cracks

Friars Road Eastbound Lane 2

Pvt Temp: 106.9° F

Avg FWD1: 4.03667

GPS: 32.77045° Lat, -117.16336° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	4.05	3.06	2.75	2.37	2.06	1.64	1.24	0.9	3.19	3.59
8.76	4.03	3.07	2.73	2.34	2.05	1.65	1.24	0.94	3.21	3.58
8.72	4.03	3.05	2.71	2.34	2.02	1.63	1.21	0.89	3.19	3.53

07+55 (test 73)

Notes:

Friars Road Eastbound Lane 2

Pvt Temp: 109.5° F

Avg FWD1: 3.39667

GPS: 32.77059° Lat, -117.16311° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	3.38	2.36	2.11	1.86	1.62	1.39	1.03	0.79	2.44	2.78
8.89	3.42	2.41	2.14	1.88	1.63	1.46	1.03	0.8	2.52	2.81
8.76	3.39	2.34	2.13	1.87	1.66	1.44	1.05	0.79	2.46	2.75

08+59

Notes: CL of Ulric Street

Friars Road Eastbound Lane 2

Pvt Temp: 0° F

GPS: 32.77059° Lat, -117.16311° Lon

Limit ☐ NIS ☐

09+50 (test 74)

Notes: Lateral Cracks

Friars Road Eastbound Lane 2

Pvt Temp: 108.8° F

Avg FWD1: 6.71333

GPS: 32.77088° Lat, -117.16258° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	6.76	5.12	4.48	3.67	3.08	2.21	1.42	0.99	5.14	5.94
8.86	6.71	5.1	4.47	3.67	3.07	2.21	1.42	0.97	5.16	5.9
8.74	6.67	5.05	4.41	3.61	3.03	2.16	1.37	0.99	5.1	5.81

10+76 (test 75)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 107.3° F

Avg FWD1: 13.1767

GPS: 32.77106° Lat, -117.16224° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	13.29	9.97	8.31	6.27	4.64	2.66	1.4	0.97	10.32	11.86
8.62	13.11	9.91	8.29	6.26	4.62	2.69	1.41	1.1	10.2	11.66
8.69	13.13	9.91	8.33	6.29	4.68	2.7	1.38	0.87	10.18	11.62

11+51 (test 76)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 107.7° F

Avg FWD1: 7.31

GPS: 32.77118° Lat, -117.16203° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.64	7.32	5.45	4.68	3.64	2.88	1.87	1.21	0.8	5.34	6.4
8.84	7.36	5.5	4.7	3.67	2.9	1.88	1.25	0.8	5.41	6.4
8.62	7.25	5.4	4.62	3.64	2.87	1.85	1.22	0.83	5.3	6.29

12+00

Friars Road Eastbound Lane 2

Notes: Begin Bridge

Pvt Temp: 0° F

GPS: 32.77118° Lat, -117.16203° Lon

Limit ☐ NIS ☐

15+99

Friars Road Eastbound Lane 2

Notes: End Bridge

Pvt Temp: 0° F

GPS: 32.77118° Lat, -117.16203° Lon

Limit ☐ NIS ☐

16+58 (test 77)

Friars Road Eastbound Lane 2

Notes: Lateral Cracks

Pvt Temp: 110.6° F

Avg FWD1: 6.34667

GPS: 32.77173° Lat, -117.16053° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.98	6.33	4.47	3.75	2.93	2.36	1.92	1.3	0.93	4.46	5.32
9.01	6.35	4.51	3.79	2.95	2.37	1.91	1.3	0.9	4.45	5.24
9.13	6.36	4.52	3.8	2.97	2.39	1.92	1.33	0.91	4.43	5.23

17+57 (test 78)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 111.3° F

Avg FWD1: 5.33333

GPS: 32.77179° Lat, -117.16022° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	5.36	3.77	3.28	2.73	2.3	1.8	1.18	0.85	3.66	4.47
8.94	5.3	3.8	3.3	2.76	2.3	1.84	1.18	0.8	3.6	4.36
8.98	5.34	3.85	3.33	2.73	2.31	1.84	1.14	0.79	3.61	4.4

18+57 (test 79)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 110.2° F

Avg FWD1: 10.8567

GPS: 32.77184° Lat, -117.15990° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	10.98	7.54	6.21	4.56	3.41	2.17	1.3	0.95	8.76	10.3
8.5	10.78	7.42	6.12	4.49	3.38	2.21	1.31	0.98	8.6	10.14
8.52	10.81	7.46	6.13	4.47	3.4	2.19	1.27	0.91	8.57	10.12

19+62 (test 80)

Friars Road Eastbound Lane 2

Notes: Longitudinal Cracks

Pvt Temp: 108° F

Avg FWD1: 7.69667

GPS: 32.77187° Lat, -117.15956° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.69	7.76	5.48	4.59	3.5	2.76	1.73	1.01	0.64	5.75	6.85
8.69	7.67	5.42	4.55	3.47	2.75	1.7	1.03	0.62	5.75	6.76
8.67	7.66	5.45	4.56	3.48	2.78	1.7	1.02	0.62	5.73	6.78

20+54 (test 81)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 107.3° F

Avg FWD1: 6.25333

GPS: 32.77190° Lat, -117.15926° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.5	6.22	4.47	3.85	3.03	2.41	1.68	0.89	0.57	4.78	5.6
8.42	6.22	4.46	3.81	3.02	2.4	1.66	0.92	0.54	4.7	5.57
8.57	6.32	4.56	3.87	3.1	2.45	1.73	0.95	0.56	4.78	5.62

21+51 (test 82)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 106.6° F

Avg FWD1: 6.02667

GPS: 32.77193° Lat, -117.15895° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.72	6.04	4.39	3.76	2.93	2.35	1.58	0.96	0.67	4.21	5.16
8.74	6.03	4.41	3.79	2.94	2.35	1.55	0.96	0.66	4.19	5.13
8.74	6.01	4.41	3.78	2.92	2.33	1.58	0.93	0.66	4.24	5.14

22+50 (test 83)

Friars Road Eastbound Lane 2

Notes:

Pvt Temp: 105.5° F

Avg FWD1: 5.37667

GPS: 32.77198° Lat, -117.15863° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.89	5.45	4.17	3.62	2.95	2.42	1.8	1.18	0.89	4.11	4.72
8.81	5.31	4.06	3.6	2.89	2.42	1.75	1.13	0.92	4.04	4.59
8.84	5.37	4.1	3.63	2.94	2.42	1.75	1.15	0.9	4.06	4.65

23+56 (test 84)

Friars Road Eastbound Lane 2

Notes: Longitudinal Cracks

Pvt Temp: 108° F

Avg FWD1: 6.38

GPS: 32.77206° Lat, -117.15830° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	6.44	4.75	4.13	3.27	2.65	1.99	1.32	1.06	4.64	5.34
8.72	6.37	4.72	4.05	3.22	2.62	1.94	1.33	1.01	4.61	5.27
8.62	6.33	4.69	4.05	3.21	2.62	1.94	1.31	1.01	4.55	5.25

23+72

Friars Road Eastbound Lane 2

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77206° Lat, -117.15830° Lon

Limit ☐ NIS ☐

24+57 (test 85)

Notes: Longitudinal Cracks

Avg FWD1: 5.29333

Friars Road Eastbound Lane 2
Pvt Temp: 110.2° F
GPS: 32.77216° Lat, -117.15800° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.54	5.28	3.74	3.2	2.51	2.02	1.54	0.9	0.66	3.62	4.35
8.57	5.29	3.78	3.22	2.52	2.05	1.57	0.92	0.66	3.61	4.32
8.69	5.31	3.8	3.25	2.53	2.07	1.55	0.91	0.64	3.63	4.36

25+13

Notes: Lateral Trench

Friars Road Eastbound Lane 2
Pvt Temp: 0° F
GPS: 32.77216° Lat, -117.15800° Lon
Limit ☐ NIS ☐

25+50 (test 86)

Notes:

Avg FWD1: 4.36667

Friars Road Eastbound Lane 2
Pvt Temp: 108.4° F
GPS: 32.77229° Lat, -117.15774° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	4.41	2.89	2.45	1.99	1.68	1.2	0.78	0.55	2.87	3.56
8.59	4.38	2.9	2.49	2	1.67	1.21	0.81	0.58	2.87	3.57
8.57	4.31	2.9	2.46	1.99	1.65	1.2	0.82	0.55	2.87	3.49

26+52 (test 87)

Notes:

Avg FWD1: 5.6

Friars Road Eastbound Lane 2
Pvt Temp: 111.7° F
GPS: 32.77245° Lat, -117.15748° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	5.64	4.35	3.87	3.21	2.74	2.08	1.47	1.01	4.36	5.07
8.79	5.59	4.31	3.84	3.17	2.72	2.07	1.44	1.01	4.29	4.97
8.79	5.57	4.31	3.84	3.16	2.75	2.07	1.46	1	4.29	4.94

27+37

Notes: CL of Frazee Road

Friars Road Eastbound Lane 2
Pvt Temp: 0° F
GPS: 32.77245° Lat, -117.15748° Lon
Limit ☐ NIS ☐

Friars Road Westbound Lane 3

00+00

Notes: Friars Road Westbound Lane 3; CL of Frazee Road

Friars Road Westbound Lane 3
Pvt Temp: 0° F
GPS: 32.77245° Lat, -117.15748° Lon
Limit ☐ NIS ☐

00+57

Notes: Curb and Gutter

Friars Road Westbound Lane 3
Pvt Temp: 0° F
GPS: 32.77245° Lat, -117.15748° Lon
Limit ☐ NIS ☐

01+05 (test 88)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 109.9° F

Avg FWD1: 7.14333

GPS: 32.77257° Lat, -117.15768° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.79	7.26	5.36	4.62	3.67	2.97	2.14	1.4	0.99	5.26	6.28
8.74	7.06	5.25	4.52	3.63	2.91	2.1	1.37	0.98	5.14	6.09
8.81	7.11	5.3	4.59	3.64	2.97	2.13	1.39	0.98	5.18	6.09

02+02 (test 89)

Friars Road Westbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 111.7° F

Avg FWD1: 7.04667

GPS: 32.77242° Lat, -117.15794° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.91	7.02	5.44	4.7	3.75	3.06	2.12	1.42	0.92	5.33	6.08
8.98	7.05	5.47	4.77	3.78	3.07	2.15	1.42	0.96	5.44	6.14
9.01	7.07	5.5	4.77	3.8	3.08	2.11	1.42	0.94	5.39	6.13

03+23 (test 90)

Friars Road Westbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks, Near Manhole; Lane becomes freeway onramp

Pvt Temp: 111° F

Avg FWD1: 15.6933

GPS: 32.77227° Lat, -117.15829° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	15.97	11.83	10.01	7.48	5.54	3.21	2.2	1.75	11.79	14.13
8.5	15.59	11.66	9.88	7.39	5.52	3.13	2.24	1.75	11.53	13.78
8.59	15.52	11.68	9.92	7.42	5.51	3.15	2.24	1.76	11.48	13.71

09+80

Friars Road Westbound Lane 3

Notes: Lane 3 returns

Pvt Temp: 0° F

GPS: 32.77227° Lat, -117.15829° Lon

Limit ☐ NIS ☐

10+12 (test 91)

Friars Road Westbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 111.3° F

Avg FWD1: 4.53333

GPS: 32.77192° Lat, -117.16047° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.59	4.51	3.48	3.08	2.6	2.19	1.63	1.02	0.74	3.19	3.7
8.57	4.52	3.48	3.09	2.6	2.2	1.63	1.03	0.73	3.2	3.69
8.57	4.57	3.5	3.13	2.63	2.22	1.65	1.04	0.72	3.2	3.7

10+83

Friars Road Westbound Lane 3

Notes: Begin Bridge

Pvt Temp: 0° F

GPS: 32.77192° Lat, -117.16047° Lon

Limit ☐ NIS ☐

14+70

Friars Road Westbound Lane 3

Notes: End Bridge

Pvt Temp: 0° F

GPS: 32.77192° Lat, -117.16047° Lon
Limit ☐ NIS ☐

15+07 (test 92)

Friars Road Westbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 107.3° F

Avg FWD1: 5.54667

GPS: 32.77142° Lat, -117.16196° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	5.53	4.06	3.59	2.93	2.38	1.72	0.95	0.61	4.04	4.87
8.76	5.57	4.1	3.6	2.95	2.38	1.7	0.96	0.59	4.08	4.88
8.76	5.54	4.09	3.61	2.9	2.38	1.71	0.96	0.62	4.04	4.86

16+08 (test 93)

Friars Road Westbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 108° F

Avg FWD1: 5.16333

GPS: 32.77128° Lat, -117.16224° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	5.15	3.87	3.43	2.88	2.39	1.63	1.05	0.7	3.8	4.41
8.79	5.19	3.9	3.45	2.9	2.4	1.65	1.07	0.7	3.81	4.39
8.72	5.15	3.86	3.45	2.87	2.37	1.67	1.03	0.68	3.79	4.39

17+07 (test 94)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 108.8° F

Avg FWD1: 3.98667

GPS: 32.77113° Lat, -117.16250° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.96	4.02	2.83	2.54	2.2	1.97	1.54	1.16	0.81	2.86	3.33
8.89	3.95	2.83	2.55	2.2	1.97	1.53	1.15	0.81	2.8	3.27
8.91	3.99	2.85	2.54	2.26	1.97	1.61	1.18	0.79	2.84	3.29

18+01 (test 95)

Friars Road Westbound Lane 3

Notes: Near Traffic Sensors

Pvt Temp: 106.9° F

Avg FWD1: 13.21

GPS: 32.77099° Lat, -117.16276° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.25	13.46	10.05	8.27	6	4.18	2.48	1.53	0.92	10.41	12.14
8.25	13.21	9.96	8.24	6	4.18	2.52	1.49	0.93	10.34	11.99
8.23	12.96	9.83	8.15	5.93	4.11	2.45	1.48	0.94	7.05	11.77

18+79

Friars Road Westbound Lane 3

Notes: CL of Ulric Street

Pvt Temp: 0° F

GPS: 32.77099° Lat, -117.16276° Lon

Limit ☐ NIS ☐

20+03 (test 96)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 116.5° F

Avg FWD1: 4.62

GPS: 32.77070° Lat, -117.16332° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	4.62	4	3.87	3.58	3.28	2.62	1.91	1.36	3.76	4.1
9.03	4.64	4.04	3.91	3.57	3.28	2.63	1.91	1.34	3.74	4.1
9.06	4.6	4.03	3.88	3.56	3.28	2.66	1.92	1.35	3.76	4.08

21+11 (test 97)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 112.8° F

Avg FWD1: 4.53333

GPS: 32.77054° Lat, -117.16361° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	4.56	3.78	3.51	3.09	2.69	2.18	1.6	1.41	3.76	4.1
8.79	4.54	3.74	3.46	3.03	2.68	2.17	1.59	1.2	3.75	4.05
8.72	4.5	3.72	3.44	3.04	2.66	2.16	1.58	1.15	3.7	4.05

21+86

Friars Road Westbound Lane 3

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77054° Lat, -117.16361° Lon

Limit ☐ NIS ☐

22+13 (test 98)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 115.7° F

Avg FWD1: 3.42

GPS: 32.77041° Lat, -117.16391° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	3.4	3.17	3.03	2.82	2.56	2.17	1.58	1.18	3.04	3.19
8.96	3.42	3.18	3.07	2.84	2.6	2.21	1.63	1.16	3	3.21
9.06	3.44	3.21	3.11	2.85	2.65	2.26	1.65	1.22	3.03	3.21

23+01 (test 99)

Friars Road Westbound Lane 3

Notes:

Pvt Temp: 117.9° F

Avg FWD1: 6.12

GPS: 32.77031° Lat, -117.16417° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	6.13	4.92	4.55	4.02	3.62	3.22	2.28	1.74	5.09	5.5
8.84	6.11	4.88	4.52	4.01	3.65	3.23	2.26	1.72	5.03	5.46
8.84	6.12	4.91	4.55	4.02	3.66	3.2	2.27	1.74	5.07	5.48

23+15

Friars Road Westbound Lane 3

Notes: Begin Patch

Pvt Temp: 0° F

GPS: 32.77031° Lat, -117.16417° Lon

Limit ☐ NIS ☐

24+02 (test 100)

Friars Road Westbound Lane 3

Notes: On Patch

Pvt Temp: 118.7° F

Avg FWD1: 4.81

GPS: 32.77022° Lat, -117.16448° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.74	4.83	4.44	4.2	3.83	3.44	2.99	2.13	1.77	4.75	4.94
8.84	4.78	4.38	4.14	3.8	3.42	2.95	2.09	1.52	4.74	4.87
8.89	4.82	4.4	4.21	3.83	3.46	2.98	2.12	1.53	4.77	4.9

25+04 (test 101)

Friars Road Westbound Lane 3

Notes: On Patch

Pvt Temp: 120.8° F

Avg FWD1: 6.18667

GPS: 32.77014° Lat, -117.16479° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	6.26	5.7	5.37	4.83	4.34	3.52	2.48	1.72	6.65	6.61
8.72	6.12	5.56	5.23	4.71	4.22	3.4	2.39	1.7	6.45	6.44
8.86	6.18	5.6	5.28	4.74	4.26	3.42	2.43	1.72	6.49	6.49

25+80
Notes: End Patch

Friars Road Westbound Lane 3
Pvt Temp: 0° F
GPS: 32.77014° Lat, -117.16479° Lon
Limit ☐ NIS ☐

26+09 (test 102)
Notes: Near Traffic Sensors
Avg FWD1: 10.4633

Friars Road Westbound Lane 3
Pvt Temp: 120.5° F
GPS: 32.77008° Lat, -117.16513° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	10.5	8.64	7.69	6.28	5.08	3.32	1.87	1.12	8.22	9.39
8.59	10.35	8.54	7.56	6.22	5.02	3.3	1.87	1.12	8.11	9.22
8.84	10.54	8.7	7.71	6.32	5.13	3.37	1.92	1.15	8.21	9.37

27+13
Notes: CL of Avenida De Las Tiendas

Friars Road Westbound Lane 3
Pvt Temp: 0° F
GPS: 32.77008° Lat, -117.16513° Lon
Limit ☐ NIS ☐

Friars Road Eastbound Lane 3

00+00
Notes: Friars Road Eastbound Lane 3; CL of Avenida De Las Tiendas

Friars Road Eastbound Lane 3
Pvt Temp: 0° F
GPS: 32.77008° Lat, -117.16513° Lon
Limit ☐ NIS ☐

00+61
Notes: Curb and Gutter

Friars Road Eastbound Lane 3
Pvt Temp: 0° F
GPS: 32.77008° Lat, -117.16513° Lon
Limit ☐ NIS ☐

01+03 (test 103)
Notes:
Avg FWD1: 4.60667

Friars Road Eastbound Lane 3
Pvt Temp: 75.8° F
GPS: 32.76987° Lat, -117.16504° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	4.63	3.11	2.68	2.14	1.76	1.53	1.06	0.82	3.12	3.9
8.86	4.6	3.12	2.69	2.15	1.8	1.5	1.08	0.88	3.15	3.85
9.01	4.59	3.1	2.69	2.17	1.83	1.47	1.06	0.83	3.16	3.88

02+07 (test 104)
Notes: Longitudinal Cracks
Avg FWD1: 8.94

Friars Road Eastbound Lane 3
Pvt Temp: 108.8° F
GPS: 32.76993° Lat, -117.16471° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	9.05	6.84	5.96	4.82	3.93	2.79	1.71	1.2	6.86	7.95
8.67	8.85	6.74	5.91	4.77	3.9	2.67	1.67	1.16	6.71	7.77
8.76	8.92	6.81	5.96	4.84	3.93	2.69	1.72	1.2	6.79	7.82

03+03 (test 105)

Friars Road Eastbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 116.5° F

Avg FWD1: 7.21667

GPS: 32.77000° Lat, -117.16442° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	7.26	6.2	5.77	5.07	4.55	3.51	2.47	1.66	5.94	6.45
8.74	7.16	6.09	5.7	5.03	4.46	3.49	2.45	1.62	5.86	6.4
8.84	7.23	6.16	5.74	5.05	4.5	3.52	2.45	1.63	5.89	6.46

04+07 (test 106)

Friars Road Eastbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 63.7° F

Avg FWD1: 7.45

GPS: 32.77009° Lat, -117.16409° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.69	7.43	5.4	4.88	4.18	3.61	2.74	1.98	1.39	5.95	6.72
8.81	7.51	5.44	4.92	4.23	3.64	2.76	1.99	1.46	5.91	6.74
8.74	7.41	5.37	4.85	4.17	3.58	2.75	1.98	1.36	5.89	6.64

05+06 (test 107)

Friars Road Eastbound Lane 3

Notes:

Pvt Temp: 71° F

Avg FWD1: 4.48

GPS: 32.77020° Lat, -117.16380° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.89	4.53	3.47	3.08	2.55	2.11	1.64	1.01	0.68	3.78	4.2
8.76	4.47	3.4	3.02	2.49	2.08	1.6	1.02	0.64	3.68	4.11
8.69	4.44	3.39	2.99	2.48	2.08	1.59	1	7.53	3.7	4.1

05+46

Friars Road Eastbound Lane 3

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77020° Lat, -117.16380° Lon

Limit ☐ NIS ☐

06+03 (test 108)

Friars Road Eastbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 111.3° F

Avg FWD1: 4.44

GPS: 32.77033° Lat, -117.16352° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	4.46	3.39	2.99	2.6	2.19	1.77	1.21	0.84	3.3	3.78
8.79	4.42	3.36	3.01	2.56	2.21	1.76	1.21	0.85	3.25	3.77
8.79	4.44	3.38	3.02	2.58	2.16	1.78	1.2	0.85	3.26	3.78

07+09 (test 109)

Friars Road Eastbound Lane 3

Notes:

Pvt Temp: 113.9° F

Avg FWD1: 3.34

GPS: 32.77048° Lat, -117.16323° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	3.38	2.37	2.16	1.85	1.64	1.48	1.02	0.91	2.23	2.68

8.81	3.32	2.35	2.1	1.84	1.63	1.5	1	0.77	2.18	2.6
8.79	3.32	2.35	2.12	1.81	1.65	1.51	1.01	0.77	2.16	2.61

08+01 (test 110)

Notes: Longitudinal Cracks

Avg FWD1: 4.16667

Friars Road Eastbound Lane 3
Pvt Temp: 115.7° F
GPS: 32.77062° Lat, -117.16298° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	4.14	3	2.73	2.4	2.14	1.82	1.21	0.85	2.96	3.37
8.96	4.21	3.06	2.79	2.45	2.14	1.85	1.21	0.85	2.98	3.41
8.94	4.15	3.04	2.77	2.43	2.16	1.82	1.19	0.83	2.94	3.35

08+66

Notes: CL of Ulric Street

Friars Road Eastbound Lane 3
Pvt Temp: 0° F
GPS: 32.77062° Lat, -117.16298° Lon
Limit ☐ NIS ☐

09+10 (test 111)

Notes:

Avg FWD1: 5.67667

Friars Road Eastbound Lane 3
Pvt Temp: 112.1° F
GPS: 32.77078° Lat, -117.16269° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.81	5.72	4.47	4.02	3.45	2.99	2.38	1.57	1.11	4.72	5.24
8.74	5.68	4.47	4.01	3.47	2.95	2.39	1.57	1.14	4.68	5.17
8.74	5.63	4.45	3.99	3.43	2.96	2.39	1.56	1.11	4.64	5.13

10+08 (test 112)

Notes:

Avg FWD1: 7.65

Friars Road Eastbound Lane 3
Pvt Temp: 108.8° F
GPS: 32.77093° Lat, -117.16242° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.74	7.68	5.81	5.08	3.95	3.12	2.08	1.25	0.83	5.93	6.62
8.59	7.58	5.77	5.01	3.9	3.07	2.04	1.22	0.77	5.85	6.56
8.84	7.69	5.87	5.12	3.99	3.15	2.06	1.27	0.82	5.95	6.67

11+10 (test 113)

Notes:

Avg FWD1: 7.99

Friars Road Eastbound Lane 3
Pvt Temp: 106.9° F
GPS: 32.77108° Lat, -117.16215° Lon
Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.59	8	5.74	4.65	3.41	2.61	1.66	0.95	0.65	5.55	6.61
8.67	7.94	5.73	4.63	3.4	2.55	1.64	0.95	0.63	5.49	6.55
8.79	8.03	5.76	4.69	3.43	2.59	1.66	0.96	0.63	5.55	6.62

12+00

Notes: Begin Bridge

Friars Road Eastbound Lane 3
Pvt Temp: 0° F
GPS: 32.77108° Lat, -117.16215° Lon
Limit ☐ NIS ☐

15+96

Notes: End Bridge

Friars Road Eastbound Lane 3
Pvt Temp: 0° F

GPS: 32.77108° Lat, -117.16215° Lon
Limit ☐ NIS ☐

16+15 (test 114)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks

Pvt Temp: 113.9° F

Avg FWD1: 6.15667

GPS: 32.77166° Lat, -117.16066° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.86	6.19	4.82	4.36	3.7	3.17	2.27	1.38	1	4.96	5.56
8.86	6.14	4.83	4.36	3.68	3.13	2.28	1.37	0.97	4.95	5.5
8.91	6.14	4.83	4.35	3.69	3.16	2.26	1.39	0.97	4.95	5.51

17+07 (test 115)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks

Pvt Temp: 116.8° F

Avg FWD1: 4.99667

GPS: 32.77173° Lat, -117.16038° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.94	5.04	3.76	3.41	2.95	2.57	1.89	1.33	1.03	3.58	4.24
8.81	4.96	3.69	3.34	2.91	2.5	1.86	1.31	1.44	3.59	4.19
8.84	4.99	3.73	3.36	2.9	2.54	1.87	1.3	0.94	3.53	4.2

18+13 (test 116)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 120.8° F

Avg FWD1: 12.5533

GPS: 32.77178° Lat, -117.16004° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.76	12.75	9.66	8.13	6.1	4.61	2.78	1.57	0.99	9.58	11.04
8.62	12.38	9.43	7.95	5.97	4.51	2.73	1.53	1.03	9.35	10.74
8.81	12.53	9.61	8.1	6.04	4.61	2.78	1.53	1.02	9.45	10.89

19+05 (test 117)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 120.1° F

Avg FWD1: 6.09333

GPS: 32.77182° Lat, -117.15974° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.98	6.18	4.52	3.91	3.17	2.61	1.88	1.17	0.7	4.7	5.44
8.81	6.06	4.46	3.86	3.13	2.61	1.87	1.16	0.7	4.61	5.34
8.86	6.04	4.43	3.84	3.09	2.61	1.82	1.14	0.7	4.57	5.34

20+08 (test 118)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 116.5° F

Avg FWD1: 10.38

GPS: 32.77185° Lat, -117.15941° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.62	10.48	7.09	6.04	4.61	3.43	2.05	1.1	0.64	7.62	8.89
8.59	10.34	7.01	5.99	4.55	3.38	2.07	1.08	0.63	7.54	8.79
8.64	10.32	7.03	5.99	4.57	3.38	2.1	1.1	0.65	7.51	8.76

21+04 (test 119)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 115° F

Avg FWD1: 8.43667

GPS: 32.77188° Lat, -117.15910° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10

8.54	8.53	6.46	5.72	4.72	3.93	2.68	1.51	0.83	6.73	7.63
8.4	8.34	6.34	5.64	4.6	3.86	2.63	1.5	0.81	6.57	7.48
8.57	8.44	6.42	5.7	4.71	3.89	2.65	1.52	0.83	6.66	7.56

22+02 (test 120)

Friars Road Eastbound Lane 3

Notes: Lateral Cracks, Longitudinal Cracks

Pvt Temp: 112.8° F

Avg FWD1: 5.83667

GPS: 32.77192° Lat, -117.15879° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	5.85	4.02	3.44	2.77	2.27	1.78	1.09	0.75	4.29	5.07
8.76	5.85	4.09	3.47	2.76	2.29	1.83	1.12	0.77	4.28	5.07
8.72	5.81	4.06	3.48	2.77	2.25	1.81	1.11	0.79	4.29	5.06

23+06 (test 121)

Friars Road Eastbound Lane 3

Notes: Longitudinal Cracks

Pvt Temp: 111.7° F

Avg FWD1: 12.27

GPS: 32.77199° Lat, -117.15846° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.4	12.37	8.33	6.66	4.62	3.2	1.69	1	0.78	8.74	10.76
8.4	12.17	8.22	6.61	4.57	3.16	1.65	1.01	0.76	8.62	10.56
8.54	12.27	8.3	6.66	4.6	3.17	1.69	1.01	0.79	8.66	10.61

24+02 (test 122)

Friars Road Eastbound Lane 3

Notes:

Pvt Temp: 114.3° F

Avg FWD1: 10.8733

GPS: 32.77207° Lat, -117.15817° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.5	10.79	7.64	6.25	4.62	3.5	2.24	1.44	1.17	7.97	9.48
8.5	10.81	7.68	6.32	4.67	3.52	2.3	1.49	1.21	7.96	9.47
8.72	11.02	7.78	6.41	4.72	3.58	2.31	1.5	1.17	8.11	9.61

24+42

Friars Road Eastbound Lane 3

Notes: RTP

Pvt Temp: 0° F

GPS: 32.77207° Lat, -117.15817° Lon

Limit ☐ NIS ☐

25+02 (test 123)

Friars Road Eastbound Lane 3

Notes:

Pvt Temp: 113.9° F

Avg FWD1: 8.53333

GPS: 32.77218° Lat, -117.15788° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.42	8.55	6.17	5.32	4.27	3.51	2.45	1.63	1.14	7.37	8.32
8.28	8.45	6.08	5.26	4.21	3.44	2.41	1.64	1.12	7.29	8.2
8.5	8.6	6.22	5.36	4.28	3.51	2.47	1.67	1.16	7.34	8.3

25+21

Friars Road Eastbound Lane 3

Notes: Lateral Trench

Pvt Temp: 0° F

GPS: 32.77218° Lat, -117.15788° Lon

Limit ☐ NIS ☐

26+00 (test 124)

Friars Road Eastbound Lane 3

Notes:

Pvt Temp: 113.5° F

Avg FWD1: 4.47333

GPS: 32.77233° Lat, -117.15761° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.84	4.53	3.06	2.6	2.1	1.7	1.28	0.83	0.5	3.04	3.66
8.84	4.47	3.05	2.58	2.1	1.7	1.26	0.78	0.49	2.96	3.63
8.81	4.42	3.02	2.57	2.06	1.7	1.25	0.81	0.48	2.96	3.58

26+87 (test 125)

Friars Road Eastbound Lane 3

Notes: Near Traffic Sensors

Pvt Temp: 113.5° F

Avg FWD1: 7.91667

GPS: 32.77248° Lat, -117.15739° Lon

Limit ☐ NIS ☐

Force	FWD1	FWD2	FWD3	FWD4	FWD5	FWD6	FWD7	FWD8	FWD9	FWD10
8.67	8.01	6.02	5.29	4.48	3.71	2.67	1.64	1.4	5.95	7.09
8.67	7.89	5.96	5.24	4.39	3.67	2.65	1.62	1.02	5.8	6.89
8.69	7.85	5.98	5.26	4.41	3.67	2.64	1.6	1.09	5.83	6.87

27+50

Friars Road Eastbound Lane 3

Notes: CL of Frazee Road

Pvt Temp: 0° F

GPS: 32.77248° Lat, -117.15739° Lon

Limit ☐ NIS ☐

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September 30, 2013

SCS&T No. 1111191P
Report 7R

Mr. Gerard Lumabas
Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Subject: ADDENDUM REPORT
RW 10 STATION 10+00 TO 10+88.5
SR-163/FRIARS ROAD INTERCHANGE MODIFICATION
PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

Reference: "*Revised February 28, 2013 Geotechnical Design Report, SR-163/Friars Road Interchange Modification, PM 3.8-5.8, EA Number 11225-085781, EFIS PID 1100000064, San Diego, California*"; prepared by Southern California Soil and Testing, Inc. dated February 28, 2013. (SCS&T 1111191-1R2)

Dear Mr. Lumabas:

In accordance with your request, Southern California Soil and Testing, Inc. (SCS&T) prepared this letter as an addendum to the referenced report. We understand retaining wall (RW) 10 has been added to the subject project. The purpose of this addendum is to verify the recommendations contained in the geotechnical design report can be used for the design of RW-10.

8.5 EARTH RETAINING SYSTEMS

8.5.1 Foundations

Shallow spread footings founded in compacted fill, competent alluvium, very old paralic deposits or Stadium Conglomerate can be used to support of the majority of the planned retaining walls. However, RW 10 will consist of a soldier-beam and lagging wall supported on CIDH piles. The recommendations presented in this report can be used for the design of RW 10. Additionally, Appendix I presents L-Pile analyses performed specifically for the RW 10. Standard plan conditions are applicable to the walls presented in Table 3. Table 3 presents the retaining wall foundation type recommendations.

Table 3 - Retaining Wall Recommendations

Wall Identification	Wall Station	Height Feet (H)	Foundation Type	Minimum Embedment Depth to Bottom of Footing (Feet)	Ground Line	Friction Angle (Φ) Degrees
RW #55	"FR" 55+18.98 to 56+29.99	4.0-5.0	Spread Footing	4	Case 1	30
RW #72	"FR-1" 247+37.32 to "FR" 73+67.41	7.0-15.0	Spread Footing	4	Case 1	30
RW #74	"FR" 73+67.41 to 75+56.77	5.0-7.0	Spread Footing	4	Case 1	30
RW #75	"FR" 75+81.62 to 78+05.11	6.0-7.0	Spread Footing	4	Case 1	30
RW #76	"FR" 75+64.79 to 75+87.65	4.0-5.0	Spread Footing	4	Case 1	30
RW #109	"FR-4" 108+95.89 to 114+99.93	4.0-5.0	Spread Footing	4	Case 1	30
RW #216	"R3" 264+49.75 to "CW" 98+74.83	4.0-7.0	Spread Footing	4	Case 1	30
RW #245	"FR-7" 245+22.38 to 245+69.37	29.0-38.0	Spread Footing	7	Case 1	30
RW #247	"FR-7" 247+25.00 to 247+75.00	5.0-6.0	Spread Footing	4	Case 2	30

Case 1: Level ground on both sides of the wall
Case 2: Level ground on the traffic side of the wall, sloping ground no steeper than 2:1 on opposite side.

8.5.2 Passive Pressure

Passive pressure for the design of retaining walls can be taken as 300 pounds per square per foot of depth. This pressure can be increased by ⅓ for seismic loading. An internal friction angle of 30 degrees can be used to determine the nominal sliding resistance between soil and concrete cast against soil for the foundation.

8.5.3 Active Pressure

The active soil pressure for the design of unrestrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 40 pounds per cubic foot (pcf). An increase in soil pressure equivalent to an additional 2 feet of retained soil can be used to account for transient loads that may include traffic loads or temporary conditions. Alternatively surcharge loads can be determined in accordance with Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications with Caltrans Amendments. If any other surcharge loads are anticipated, the project geotechnical engineer should be contacted for the necessary increase in soil pressure. The project designer should provide waterproofing specifications and details. These pressures assume a granular drained backfill condition.

8.5.4 At-Rest Pressure

The at-rest soil pressure for the design of restrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 55 pounds per cubic foot (pcf). An increase in soil pressure equivalent to an additional 2 feet of retained soil can be used to account for transient loads that may include traffic loads or temporary conditions. Alternatively, surcharge loads can be determined in accordance with Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications with Caltrans Amendments.

A granular and drained backfill condition has been assumed. If any other surcharge loads are anticipated, the project geotechnical engineer should be contacted for the necessary increase in soil pressure.

8.5.5 Seismic Pressure

The following equivalent fluid weights can be used for the seismic design of the retaining walls.

Condition	Equivalent Fluid Weight – Seismic
Active	55 pounds per cubic foot
At-Rest	75 pounds per cubic foot
Passive	390 pounds per cubic foot

The equivalent fluid weights for seismic loading were determined using the Mononobe-Okabe method presented in Appendix A11 of the AASHTO LRFD Bridge Design Specifications. The at-rest condition was estimated using an increase ratio similar to the active condition. The horizontal acceleration coefficient of 0.23 (50% of the peak ground acceleration of 0.45g) in the Mononobe -Okabe method presented in Appendix A11 of the AASHTO LRFD Bridge Design Specifications. The resultant of the seismic active and at-rest pressures should be applied at a depth of ½H from the top of the wall where H is equal to the total height of the wall.

If you have any questions or need additional information, please call me at (619) 280-4321.

Respectfully Submitted,
SOUTHERN CALIFORNIA SOIL AND TESTING, INC.

Garrett B. Fountain, GE 2752
Vice President, Principal Geotechnical Engineer

GBF:aw

Attachment: Appendix I

(1) Mary E. Northeimer via e-mail at mnortheimer@dokkenengineering.com
(1) Addressee via e-mail at glumabas@dokkenengineering.com

APPENDIX I

SOUTHERN CALIFORNIA SOIL & TESTING, INC.
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July 18, 2013

SCS&T No. 1111191P
Report 6

Mr. Gerard Lumabas
Dokken Engineering
5675 Ruffin Road, Suite 250
San Diego, California 92123

Subject: L-PILE ANALYSIS
RW 245 STATION 10+00 TO 10+88.5
SR-163/FRIARS ROAD INTERCHANGE MODIFICATION
PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

In accordance with your request, Southern California Soil and Testing, Inc. (SCS&T) prepared this letter to present the results of the L-Pile® analyses SCS&T performed for the subject wall using the loads provided to us by Dokken Engineering. The main purpose of the analyses was to determine the expected embedment depths for the planned soldier piles. We understand the piles will consist of 18-inch diameter Cast-In-Place Drilled Hole(CIDH) piles. Appendix I presents the results of our analyses.

.If you have any questions or need additional information, please call me at (619) 280-4321.

Respectfully Submitted,
SOUTHERN CALIFORNIA SOIL AND TESTING, INC.

Garrett B. Fountain, GE 2752
Principal Geotechnical Engineer

GBF:gf

Attachments: Appendix I

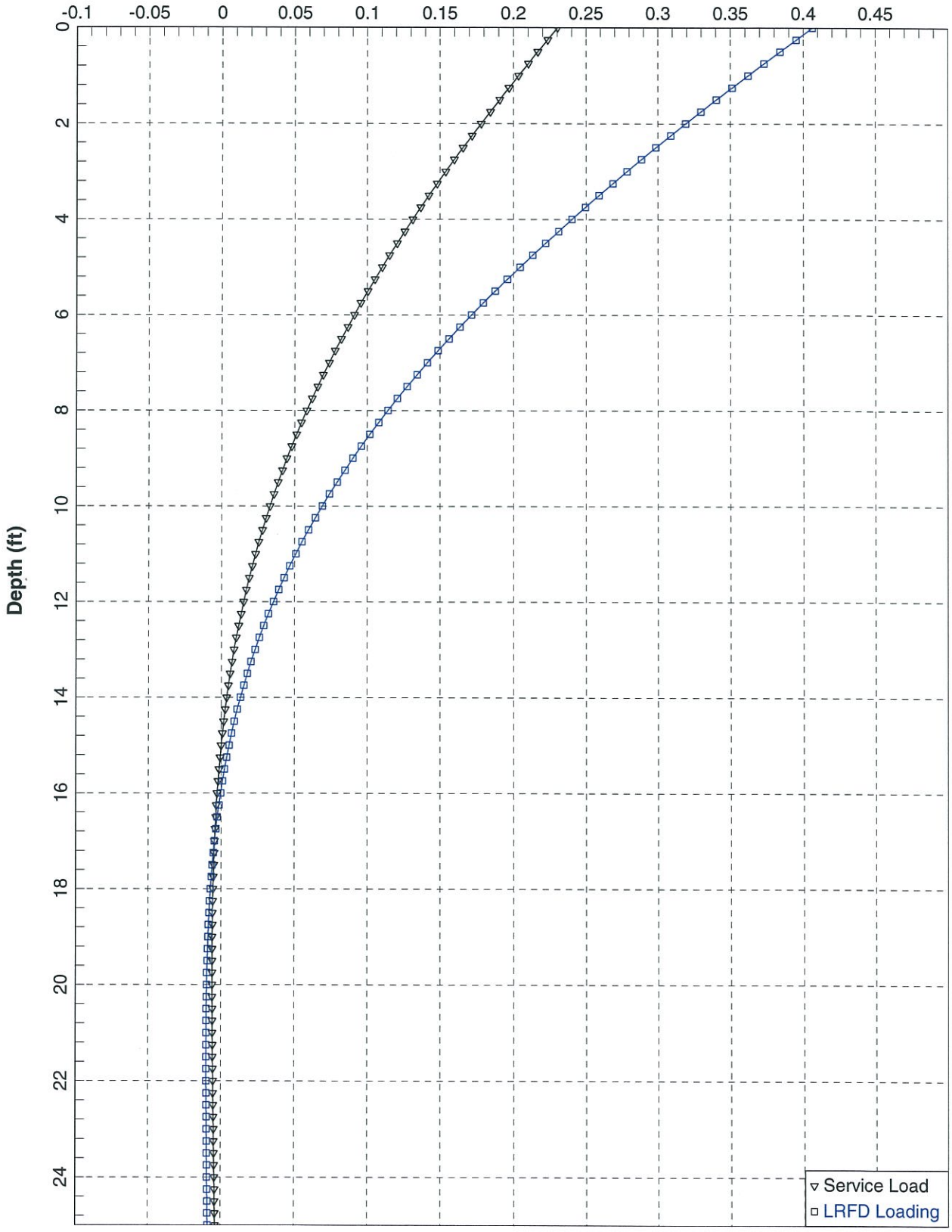
(1) Mary E. Northeimer <mnortheimer@dokkenengineering.com>
(1) Addressee via e-mail at glumabas@dokkenengineering.com

APPENDIX I

18-inch CIDH

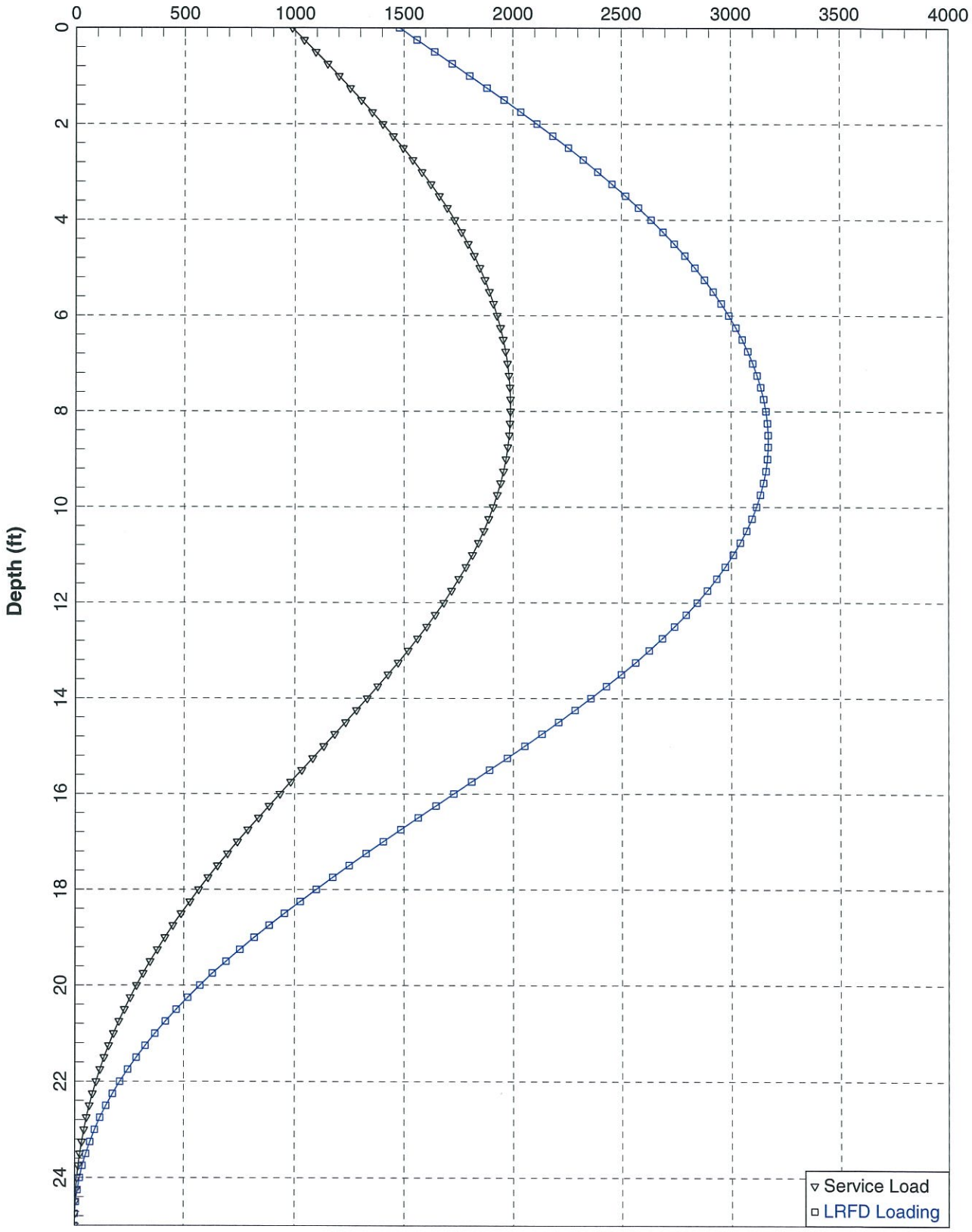
FRIARS ROAD SEGMENT 1

Lateral Deflection (in)



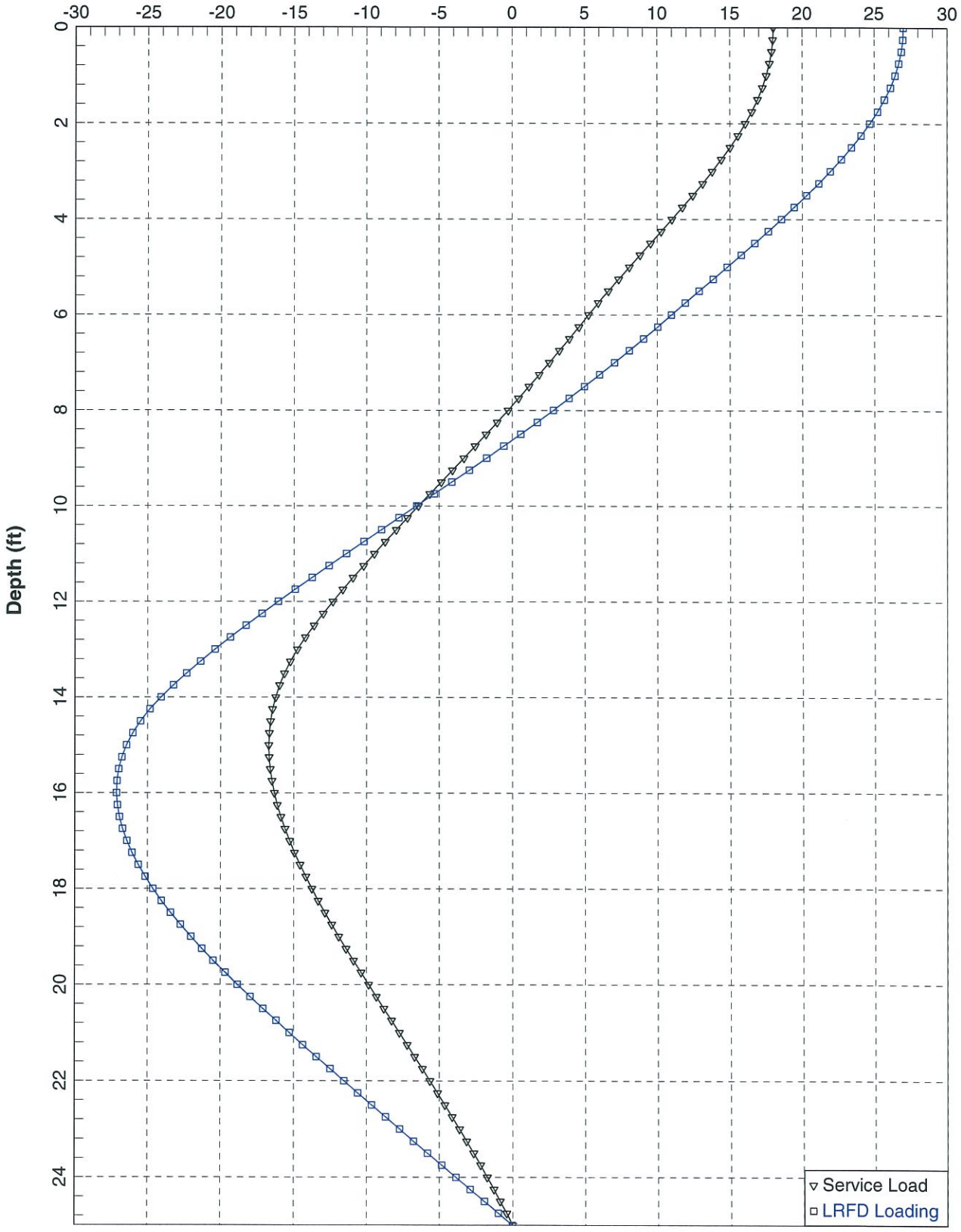
FRIARS ROAD SEGMENT 1

Bending Moment (in-kips)



FRIARS ROAD SEGMENT 1

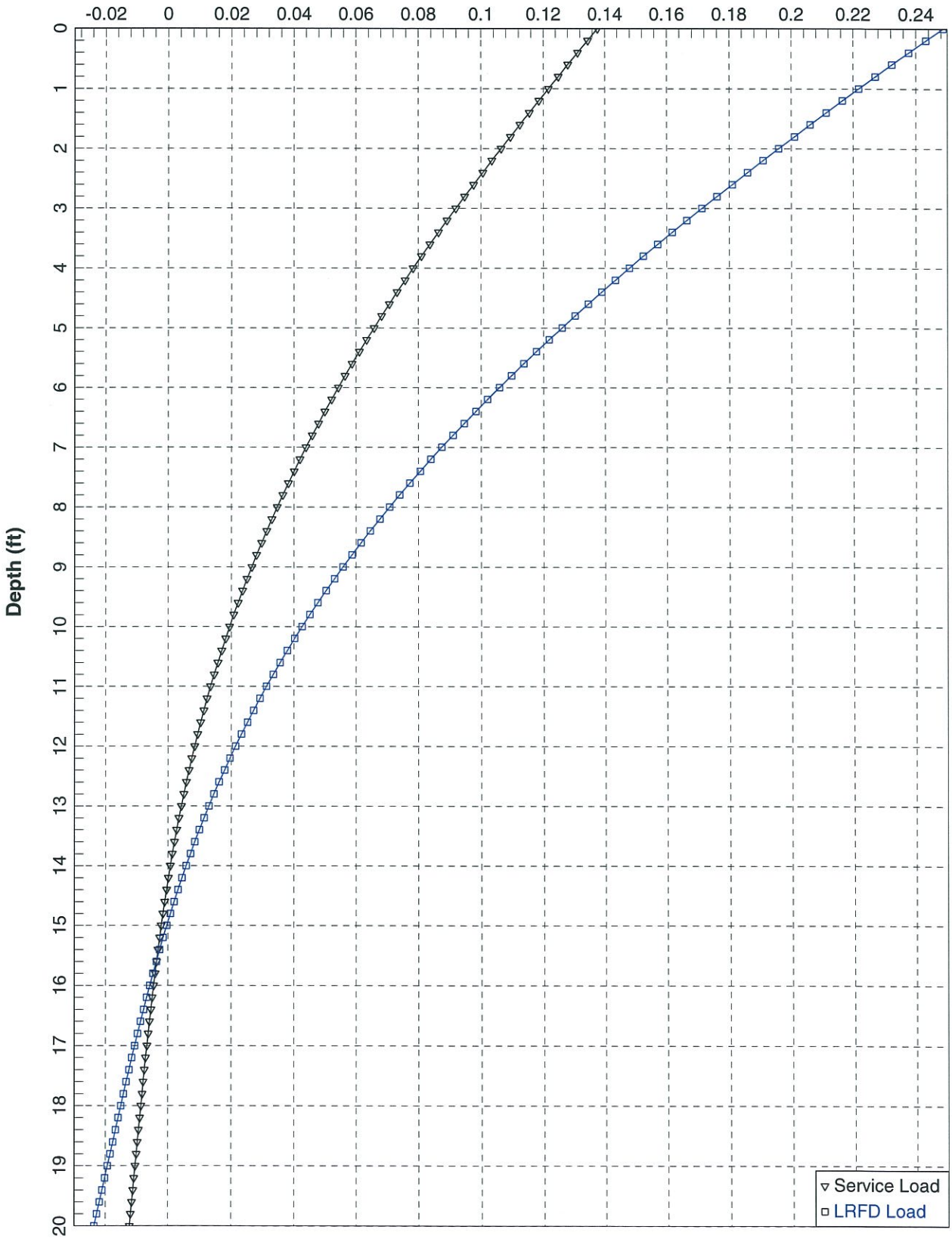
Shear Force (kips)

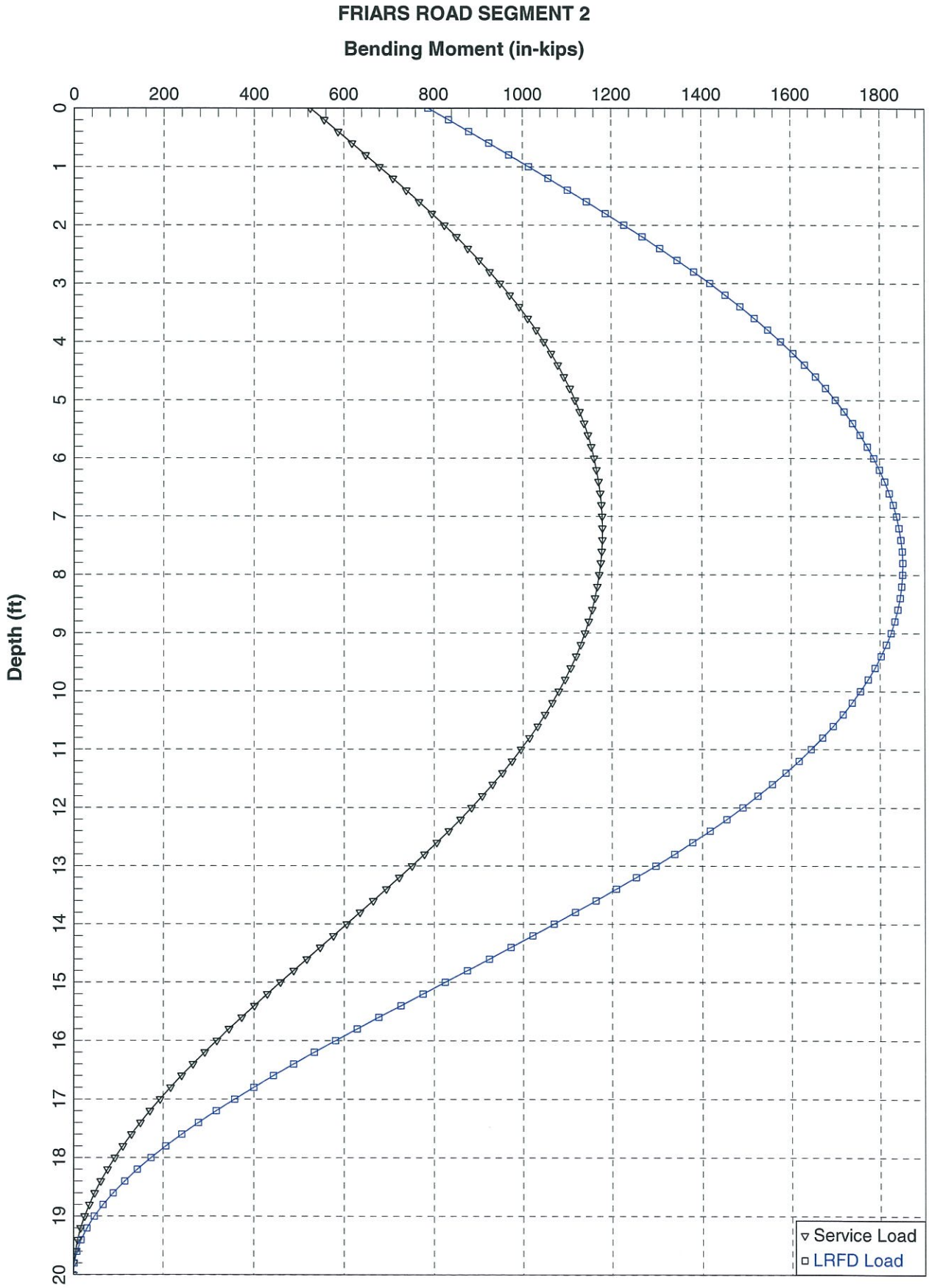


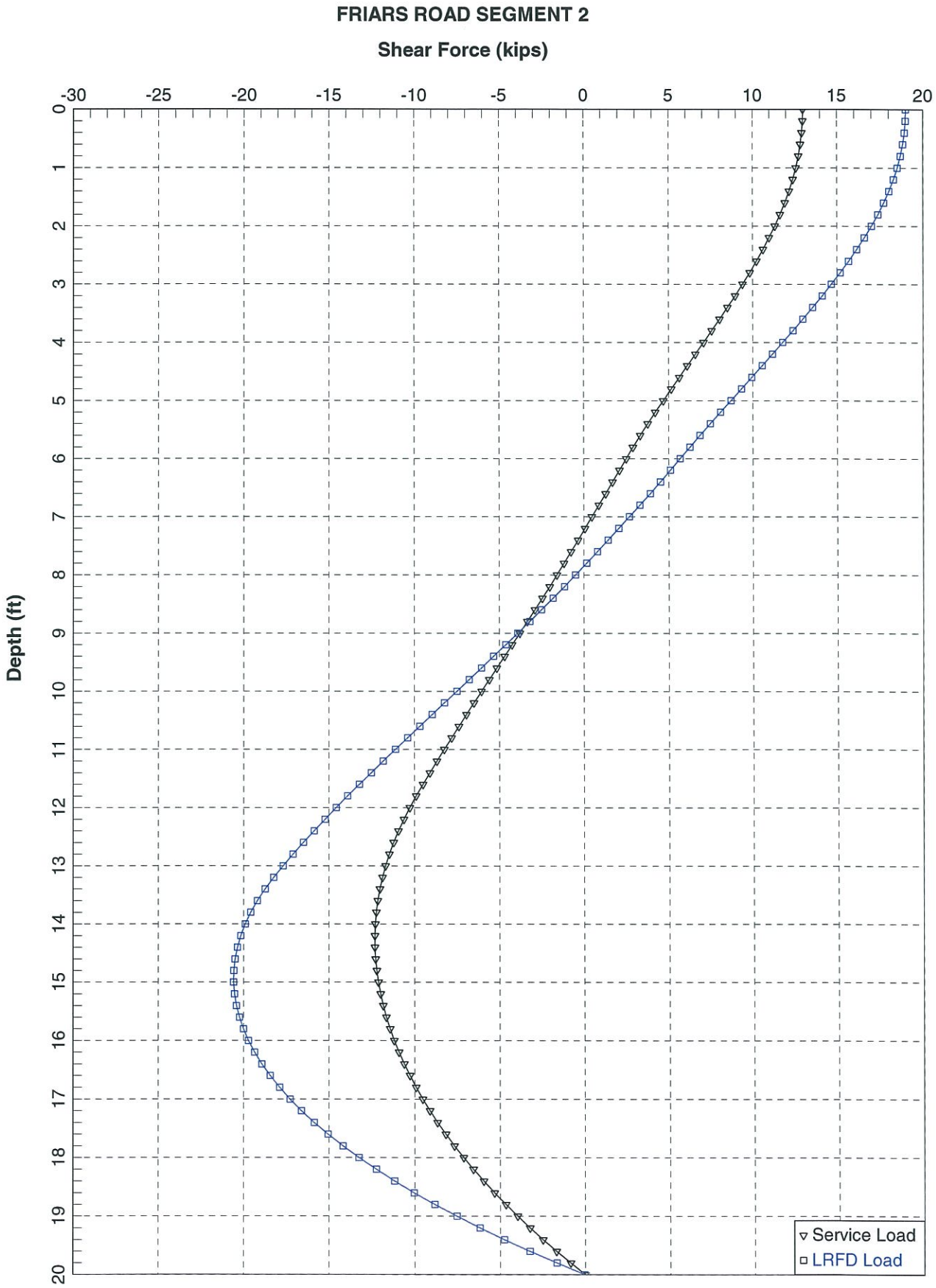
18-inch CIDH

FRIARS ROAD SEGMENT 2

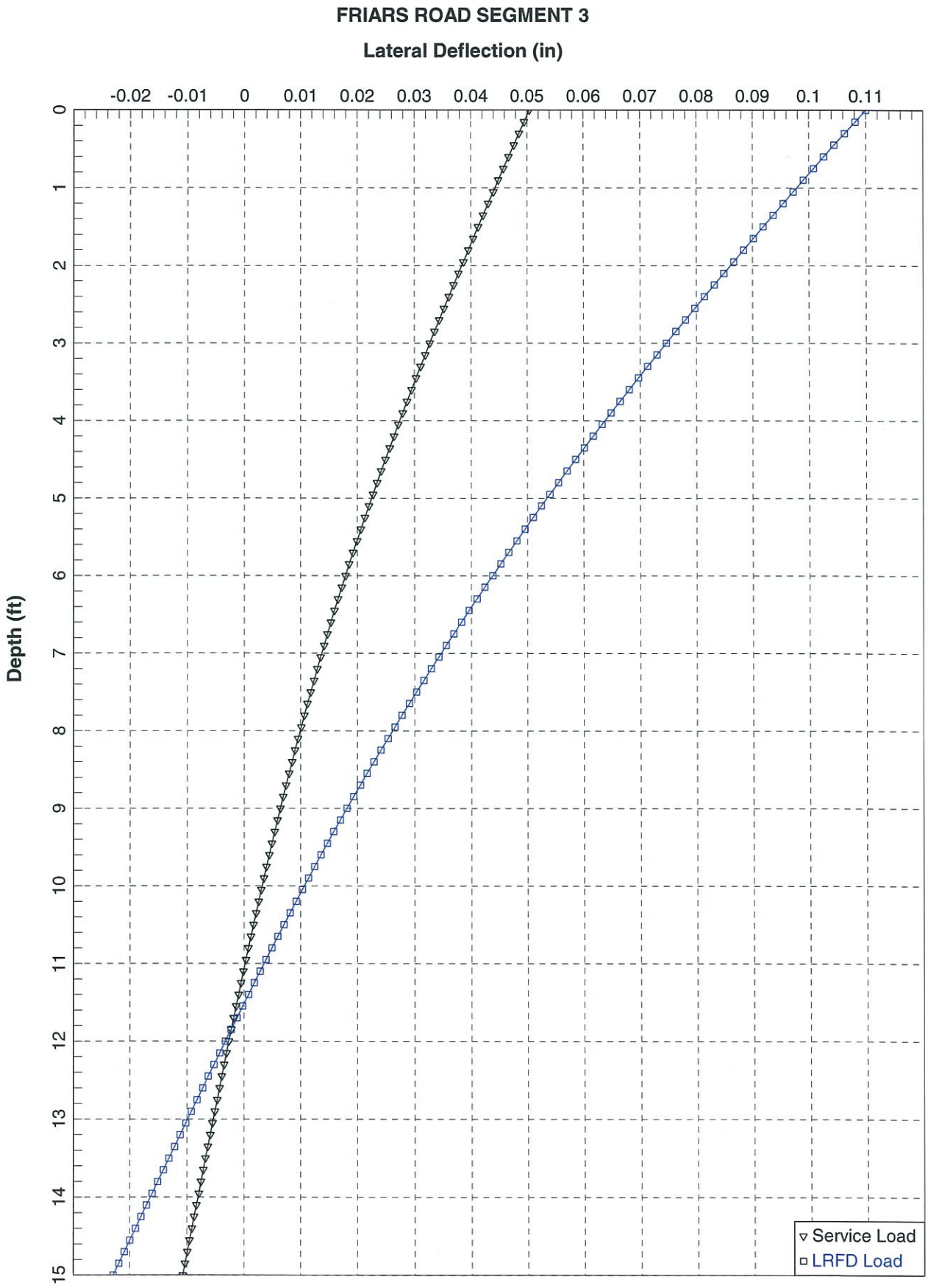
Lateral Deflection (in)




FRIARS ROAD SEGMENT 2
Bending Moment (in-kips)
0
200
400
600
800
1000
1200
1400
1600
1800
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Service Load
LRFD Load

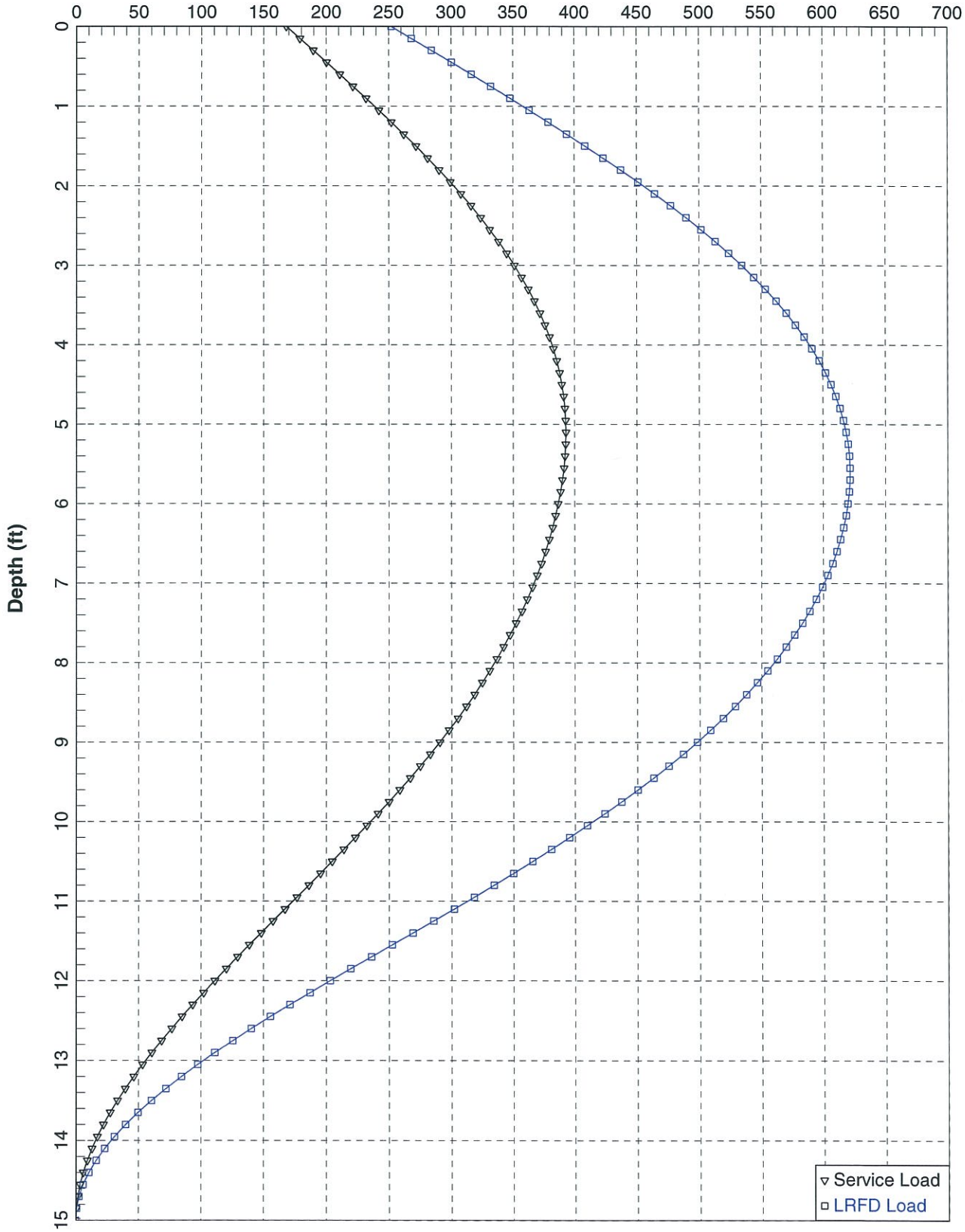

FRIARS ROAD SEGMENT 2
Shear Force (kips)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Service Load
LRFD Load

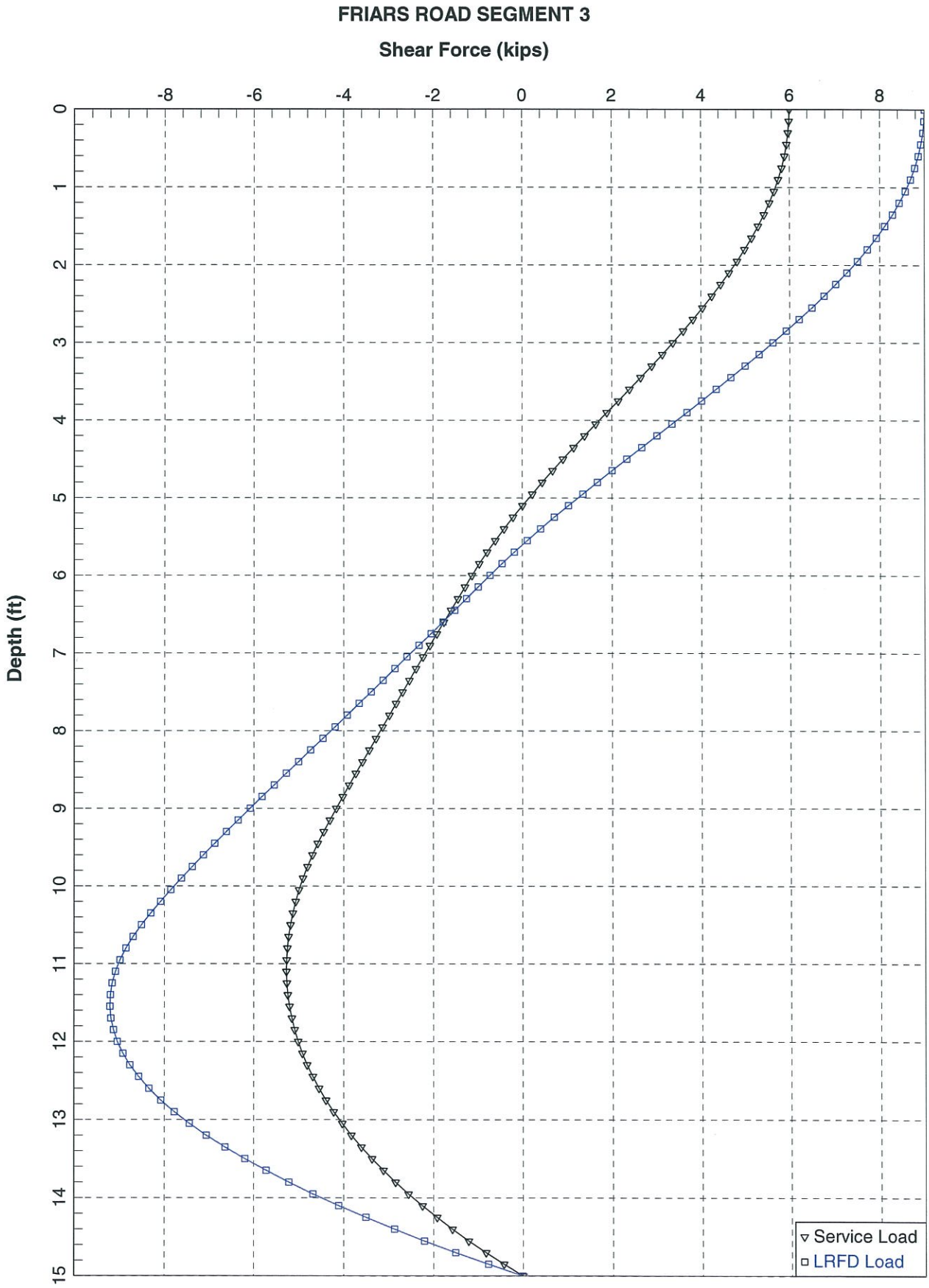
18-inch CIDH


FRIARS ROAD SEGMENT 3
Lateral Deflection (in)
-0.02 -0.01 0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1 0.11
Depth (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Service Load
LRFD Load

FRIARS ROAD SEGMENT 3

Bending Moment (in-kips)




FRIARS ROAD SEGMENT 3
Shear Force (kips)
-8
-6
-4
-2
0
2
4
6
8
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Service Load
LRFD Load

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REVISED FEBRUARY 28, 2013

GEOTECHNICAL DESIGN REPORT
SR 163/FRIARS ROAD
INTERCHANGE MODIFICATION
PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

PREPARED FOR:

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PREPARED BY:

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February 28, 2013

SCS&T No. 1111191P
Report No. 1R2

Mr. Gerard Lumabas
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Subject: REVISED GEOTECHNICAL DESIGN REPORT
SR – 163 FRIARS ROAD INTERCHANGE MODIFICATION
PM 3.8-5.8
EA NUMBER 11225-085781
EFIS PID 1100000064
SAN DIEGO, CALIFORNIA

Dear Mr. Lumabas:

This letter transmits Southern California Soil & Testing Inc.'s (SCS&T) report describing the geotechnical investigation performed for the Friars Road at State Route 163 improvements in San Diego, California. SCS&T performed the field investigation and prepared this report in general conformance with the scope of work presented in SCS&T's proposal dated September 3, 2010. This report has been prepared as a revised report. The recommendations presented in this report supersede all previous reports. SCS&T prepared the revised report in response to comments prepared by Brian Hinman, Caltrans reviewer.

If you have any questions concerning this report, or need additional information, please call us at (619) 280-4321.

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation by Southern California Soil and Testing, Inc. (SCS&T) for the City of San Diego Friars Road Overcrossing at State Route 163 interchange project in San Diego, California. Figure I-1 presents a site vicinity map. The modifications are planned to be designed and constructed in 3 phases. The phases are:

- **Phase 1**
  - Widen Friars Road and Bridge (Tie-Back Walls);
  - Improve Frazee Road and Avenida de Las Tiendas;
  - Improve Freeway Ramp Connections;
  - Construct temporary southbound SR-163 Auxiliary Lane;
  - Construct sound walls.
- **Phase 2**
  - Construct new collector bridge;
  - Construct new fly-over bridge from Ulric Street;
  - Construct soil nail wall along southbound lane of SR-163;
  - Construct south bound off-ramp;
  - Construct sound walls.
- **Phase 3**
  - Construct permanent SB SR-163 auxiliary lanes;
  - Construct new north bound SR-163 on ramp with auxiliary lanes.

The main geotechnical considerations affecting the design and construction of the planned modification are the:

- Slopes with inclinations greater that 2:1(horizontal:vertical) that have experienced surficial failures;
- Liquefaction of the materials within the San Diego River plain;
- Excavation of materials with more than 30% cobbles and boulders.

This report has been prepared as a revised report. The recommendations presented in this report supersede all previous reports. SCS&T prepared the revised report in response to comments prepared by Brian Hinman, Caltrans reviewer.

1. INTRODUCTION

1.1. PROJECT DESCRIPTION

This Geotechnical Design Report (GDR) presents the results of the geotechnical investigation by Southern California Soil and Testing, Inc. (SCS&T) for the City of San Diego Friars Road Overcrossing at State Route 163 interchange project in San Diego, California, hereafter referred to as project. Figure I-1 presents a site vicinity map. The project is planned to be designed and constructed in 3 phases. The phases are:

- **Phase 1**
    - Widen Friars Road and Bridge (Ground Anchor Walls);
    - Improve Frazee Road and Avenida de Las Tiendas;
    - Improve Freeway Ramp Connections;
    - Constructing temporary southbound SR-163 Auxiliary Lane;
    - Constructing sound walls.
- **Phase 2**
    - Construct new collector bridge;
    - Construct new fly-over bridge from Ulric Street;
    - Construct soil nail wall along southbound lane of SR-163;
    - Construct south bound off-ramp;
    - Construct sound walls.
- **Phase 3**
    - Construct permanent SB SR-163 auxiliary lanes;
    - Construct new north bound SR-163 on ramp with auxiliary lanes.

SCS&T anticipates grading will include cuts and fills along the planned re-alignment of the on- and off-ramps, widening of Friars Road and construction of a new bridge over the San Diego River. Fills will be up to about 23 feet high at the abutments. Excavations within the existing cut slopes in the northwest quadrant of the interchange of SR-163 and Friars Road will include the construction of a soil nail wall. The widening of the on- off-ramps and re-alignment of the roadways will include construction of retaining walls.

The purpose of this GDR is to document subsurface geotechnical conditions, provide engineering evaluation of site conditions, and provide recommendations relevant to the design and construction of the project features. This report establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions.

This report is intended for use by the project design engineer, construction personnel, bidders and contractors.

This GDR is based on site reconnaissance, research of archived resources, subsurface exploration, and engineering analyses. This GDR was prepared in accordance with the

guidelines set forth in the *Caltrans: Guidelines for Preparing Geotechnical Design Report, Version 1.3, December 2006*.

SCS&T prepared a GDR, Structure Foundation Report, and Preliminary Structure Foundation Reports for this project between 2003 and 2009. The scope of the project has changed to include a bridge over the San Diego River and a flyover from Ulric Street since the preparation of the 2003 GDR.

2. EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

SR-163 is oriented in a north-south direction and Friars Road crosses over SR-163. The project site extends along SR-163 between Station 211+00 and Station 316+00 and along Friars Road between Station 51+00 and 85+00. Figure I-2 presents a site plan. The mainline of this portion of SR-163 is comprised of a divided highway with 4 northbound lanes and 4 southbound lanes. The Friars Road interchange includes an overcrossing with on- and off-ramps in the northbound and southbound directions to both eastbound and westbound Friars Road. The overcrossing is supported on 2 abutments and 1 bent.

The southern portion of the project area crosses Mission Valley, a floodplain landform of the San Diego River. Several bents support the San Diego River Bridge. Water flows within the riverbed and will rise during flood events. The remaining portion of the project traverses up the northern flank of Mission Valley. Embankments ranging up to approximately 23 feet in height and cut slopes, ranging up to approximately 100 feet in depth, are located along the roadway alignments.

2.1. EXISTING FACILITIES

Existing facilities along the project alignment include the Friars Road overcrossing, SR-163 Bridge over the San Diego River, fill embankments, graded slopes, underground utilities and highway drainage units. The project site is surrounded by residential developments, retail shopping, and hotels.

2.2. EXISTING ROADWAY

In the project area, SR-163 consists of an 8-lane Portland Cement Concrete (PCC) freeway with asphalt concrete(AC) paved shoulders. The existing median is paved with AC and concrete barriers divide the northbound and southbound lanes. The Friars Road interchange is a 4 quadrant interchange. The traveled way as well as the shoulders of the on- and off- ramps are paved with AC.

In the project area Friars Road consists of a 6-lane AC road. Pavement distress is moderate and is most likely the result of utility repairs and age. SCS&T prepared a pavement rehabilitation report as part of this project.

2.3. EXISTING CUT, FILL AND NATURAL SLOPES

Cut slopes and natural slopes are located within the northwest quadrant of the project, north of Friars Road, west of SR-163. The slopes range in inclination from about 1:1(horizontal:vertical) to 2:1(horizontal:vertical). In general, the slopes are comprised of fill over very old paralic deposits and/or Stadium Conglomerate. This fill is most likely associated with the construction of the tract of single-family residences located at the top of the slopes. SCS&T representatives observed surficial instability on slopes steeper than 1½:1(horizontal:vertical). Surficial failures along the slopes typically occur during rain events. Our analyses indicate the cut and natural slopes have an adequate factor-of-safety in respect to global stability. Appendix VI presents our analyses.

Existing fill slopes along the project alignment range in height from about 5 feet to about 20 feet. The tallest fill slope is located along the east side of the northbound lane between stations 200+00 and 300+00.

Fill slopes appear to be comprised of material derived from nearby cuts of formational material. Surface reconnaissance and the subsurface data gathered indicate the material is generally comprised of medium dense silty and clayey sands with cobbles. The majority of the fill slopes are vegetated.

2.4. EXISTING DEVELOPMENT

Land adjacent to the project is developed with residential, retail and commercial facilities. Residential development is located north of Friars Road and west of SR-163 in the northwest quadrant. The Fashion Valley Mall is located in the southwest quadrant, south of Friars Road and west of SR-163.

Commercial developments consisting of office buildings retail centers, and a hotel are located at the northeast and southeast quadrants. The slopes adjoining the project have been cut or filled for construction of the existing SR-163 alignment or development. The grading and development abuts the state right-of-way.

2.5. EXISTING UTILITIES

Utilities present within the limits of the project include underground water, sewer, gas, electrical and telecommunication lines; and overhead transmission lines. Utilities that traverse the project alignment of SR-163 are concentrated along the Friars Road overcrossing.

2.6. EXISTING PAVEMENT SECTIONS

Table 1 presents the existing pavement sections measured at 12 core locations along Friars Road.

Table 1 – Existing Pavement Sections

Core Identification	Location Description	Asphalt Concrete Thickness (inches)	Aggregate Base Thickness (inches)
C-1	Eastbound Friars Road, West of SR 163	7	8
C-2	Eastbound Friars Road, West of SR 163	7	9
C-3	Eastbound Friars Road, West of SR 163	4	8
C-4	Eastbound Friars Road, East of SR 163	4	8 ½
C-5	Eastbound Friars Road, East of SR 163	4 ½	19 ½
C-6	Eastbound Friars Road, East of SR 163	6	10
C-7	Westbound Friars Road, East of SR 163	5 ½	10 ½
C-8	Westbound Friars Road, East of SR 163	4 ½	18 ½
C-9	Westbound Friars Road, West of SR 163	4 ½	8 ½
C-10	Westbound Friars Road, West of SR 163	5	9
C-11	Westbound Friars Road, West of SR 163	8	9
C-12	Westbound Friars Road, West of SR 163	7	8

No significant distress was observed along the existing on- and off-ramps. Distress was observed along westbound Friars Road east of SR-163. The distress consists of cracking that appears to reflect trench lines for subsurface utilities.

2.7. PROPOSED IMPROVEMENTS

The project is planned to be designed and constructed in 3 phases. The phases are:

- **Phase 1**
  - Widen Friars Road and Bridge (Ground Anchor Walls);
  - Improve Frazee Road and Avenida de Las Tiendas;
  - Improve Freeway Ramp Connections;
  - Constructing temporary southbound SR-163 Auxiliary Lane;
  - Constructing sound walls.
- **Phase 2**
  - Construct new collector bridge;
  - Construct new fly-over bridge from Ulric Street;

- Construct soil nail wall along southbound lane of SR-163;
- Construct south bound off-ramp;
- Construct sound walls.

- **Phase 3**
  - Construct permanent SB SR-163 auxiliary lanes;
  - Construct new north bound SR-163 on ramp with auxiliary lanes.

SCS&T anticipates grading will include cuts and fills along the planned re-alignment of the on- and off-ramps, widening of Friars Road and construction of a new bridge over the San Diego River. Fills will be up to about 23 feet high at the abutments. Excavations within the existing cut slopes in the northwest quadrant of the interchange of SR-163 and Friars Road will include the construction of a soil nail wall and standard retaining walls.

2.8. PROPOSED ROADWAY

The on- off- ramps will include realignments and widening. The northbound SR-163 off-ramp and the northbound SR-163 on-ramp will be widened and realigned. The southbound SR-163 off-ramp will be realigned. The southbound SR-163 on-ramp will be re-aligned and a fly-over from Ulric Street onto southbound SR-163 is also planned. An auxiliary lane is planned along southbound SR-163.

Friars road will also be widened to accommodate additional lanes.

2.9. PROPOSED SLOPES

The project will include the grading of cut and fill slopes to accommodate the widening and realignment of roadways. Fill slopes are planned as part of the embankment construction. All fill slopes are planned to be constructed at 2:1(horizontal:vertical) or flatter. A 1:1(horizontal:vertical) cut slope is planned along the toe of the existing 1¼:1(horizontal:vertical) cut slope located at the northwest quadrant of the site, adjacent to the southbound shoulder of SR-163 between Station 248+75 and 261+00. Our analysis (Appendix VI) indicates the slope will have an adequate factor-of-safety in respect to global stability. However, the existing slope as well as the planned 1:1(horizontal:vertical) are subject to surficial sloughing and erosion.

2.10. PROPOSED BRIDGES

The Friars Road overcrossing will be widened with 2 additional 12-foot lanes in each direction. A fly-over structure is planned from Ulric Street onto southbound SR-163. Additionally, a new bridge is planned along southbound SR-163 between Friars Road and Interstate-8.

2.11. PROPOSED EARTH RETAINING SYSTEMS

The use of both Caltrans standard retaining walls and special design walls are proposed for the project. The retaining walls are necessary in areas where the proposed re-alignments and widenings are constrained by limited right-of-way and steepened slopes. Caltrans standard

retaining walls proposed for the project include Retaining Wall-55(RW-55), RW-72, RW-74, RW-75, RW-76, RW-109, RW-216,RW-245 and RW-247. Caltrans standard retaining walls are addressed in this GDR. The planned location, wall type, and height are presented in Section 8.0 of this report.

2.12. PROPOSED SOIL NAIL WALL

A soil nail wall is planned along the southbound side of SR-163 between Station 247+00 and 261+50. The wall is planned to range between about 10 feet and 50 feet in height. The purpose of the soil nail wall is to allow for the widening of SR-163 for the construction of auxiliary lanes.

2.13. PROPOSED CULVERTS

Extension of the existing Murray Canyon Culvert is proposed on the north side of Friars Road near the northbound on-ramp. The Murray Canyon Culvert Extension will be a standard plan double box culvert, with a 14-foot high x 25-foot wide opening to convey drainage. The interior of the culvert will be lined with a 3-foot thick layer of Rock Slope Protection to protect the natural earth lined channel from scour. The Rock Slope Protection lining will extend beyond the culvert inlet, and will continue into the existing lining of the Murray Canyon Bridge. It is anticipated that the earth over the top of culvert will be a maximum of 3½ feet. The overall dimension of the culvert will be roughly 16 feet by 28 feet (which includes the depths/widths of the culvert roof, invert, and walls), and will extend roughly 48 feet from the inlet of the existing Murray Canyon Bridge. The culvert extension will also have 14 feet high wing walls that extend about 15 feet.

2.14. PROPOSED SOUND WALLS/BERMS

Sound walls are proposed along SR-163 from Genesee Avenue to just south of Friars Road. The sound walls range in height from 6 feet to 14 feet.

2.15. PROPOSED OVERHEAD SIGN

Eleven (11) overhead signs are proposed as part of this project. Six (6) overhead signs, of which five (5) are lightweight single-post and one (1) is a lightweight butterfly structure, will be located along Friars Road. There will be one (1) lightweight structure located on Ulric Street facing southbound traffic, and one (1) truss structure located along southbound SR-163 just north of the loop off-ramp. There are also three (3) proposed bridge mounted structures that will be located on the Friars Road Overcrossing facing northbound traffic.

The design of appropriate CIDH pile foundations for each sign may be found in the Standard Plans.

3. PERTINENT REPORTS AND INVESTIGATIONS

A list of pertinent investigations and reports is presented below.

- Southern California Soil & Testing, Inc., "*Preliminary Geologic Review, Friars Road at SR 163*" dated September 22, 2003 (SCS&T Project No. 0311116-1).
- Southern California Soil & Testing, Inc., "*Geotechnical Design Report, Friars Road at State Route 163, Bridge Number 57-595, 11-SD-163-R069-84, E/A No. 11-085780, San Diego, California*", dated January 6, 2004 (SCS&T No. 0311116-3).
- Southern California Soil & Testing, Inc., "*Structure Foundation Report, Friars Road at SR 163*" dated July 9, 2009 (SCS&T Project No. 0311116-4R2).

4. PHYSICAL SETTING

The following section describes the physical setting of the project including: the climate topography and drainage; man-made features of engineering and construction significance; regional geology and seismicity; and soil survey mapping.

4.1. CLIMATE

San Diego has a Mediterranean to semi-arid climate that is characterized by warm, dry summers and mild winters with some rain. San Diego has mild mostly dry weather with approximately 200 days above 70 degree Fahrenheit. The extended summer and dry period lasts from May to October. Temperatures are mild to warm in the summer. High temperatures during the summer range between 70 and 78 degrees Fahrenheit. Low temperatures during the summer range between 55 and 66 degrees Fahrenheit. Temperatures exceed 90 degrees Fahrenheit approximately 4 days a year. Winter is the rainy period and lasts from November to April. Temperatures are mild with periods of moderate to heavy precipitation. High temperatures during the winter range between 66 and 70 degrees Fahrenheit. Low temperatures during winter range between 50 and 56 degrees Fahrenheit. On average there are approximately 10 inches of rainfall in San Diego annually. However, precipitation may range from 3 inches to 30 inches during any given year.

4.2. TOPOGRAPHY AND DRAINAGE

Elevations along the SR-163 mainline range from approximately 25 feet above mean sea level (MSL) at the southern end of the project alignment to approximately 385 feet MSL at the northern end. An existing cut slope comprised of formational material commonly identified as Stadium Conglomerate is located northwest of the existing overcrossing. The slope ranges between about 30 feet and 100 feet in height at inclinations of between about 1:1 (horizontal:vertical) and 1½:1(horizontal:vertical). Generally, the project descends from the northwest to the southeast.

Numerous utility lines are located in the project area. Vegetation is comprised of various ground coverings, mature trees and shrubs, and some native grasses.

Drainage is accomplished via sheet flow and swales that direct run-off toward drainage inlets to storm drains. Additionally, the southern portion of the project crosses the San Diego River that flows from east to west.

Approximately 50 feet of vertical cut will need to be performed along the toe of the slope located northwest of the existing overcrossing. We understand the project designer has planned a soil nail wall at this location. Additional cuts less than 10 feet in depth are planned along the north and south sides of Friars Road as part of the widening. Fills ranging between about 5 feet and 23 feet are planned as part of the embankment and on- and off-ramp improvements.

4.3. MAN-MADE AND NATURAL FEATURES OF ENGINEERING AND CONSTRUCTION SIGNIFICANCE

The main features affecting construction are the existing cut slope located in the northwest quadrant of the Friars Road and SR-163 interchange, and the San Diego River located at the southern portion of the project. These features will require special site construction and foundation considerations. Numerous utility lines are located in the project area as well as a light rail track along the north side of the San Diego River.

4.4. REGIONAL GEOLOGY AND SEISMICITY

The project site is located within the coastal plain of the Peninsular Range Geomorphic Province of California. The Peninsular Ranges are a group of mountain ranges that extend nine hundred-miles from the Transverse Ranges and the Los Angeles Basin in Southern California to the southern tip of Mexico's Baja California. The southern segment of the Peninsular Ranges in Southern California is referred to as the San Diego Embayment. The San Diego Embayment consists of thick sequences of marine and non-marine sediments. The sedimentary rocks within the San Diego Embayment form an eastward thinning wedge of continental margin deposits that extend from Oceanside to the US-Mexico border.

The fault most likely to have a significant impact on the site is the Newport-Inglewood West Fault located approximately 1½ miles west of the site at its closest approach. The Newport-Inglewood West Fault is capable of producing a 7.0 magnitude earthquake (California Seismic Hazard Map 1996, Mualchin, L.). The Palos Verde Coronado Banks Fault is approximately 4 miles west of the site. The Palos Verde Coronado Banks Fault is capable of producing a 7.5 magnitude earthquake. The Elsinore Fault Zone (Julian Segment) is approximately 40 miles northeast of the site. The Elsinore Fault Zone (Julian Segment) is capable of producing a 7.5 magnitude earthquake.

4.5. SOIL SURVEY MAPPING

SCS&T did not perform soil survey mapping for this project.

5. EXPLORATION

A surface and subsurface investigation was conducted to help characterize the soil conditions present within the project alignment such as the presence of groundwater, depth and quality of artificial fills, and other conditions that could impact the design or construction of the proposed project features.

5.1. DRILLING AND SAMPLING

Fifty exploratory borings were drilled to depths of between about 6½ feet and 125 feet below the existing ground surface using hollow-stem auger and rotary drilling methods. Additionally, 5 cone penetration tests (CPT's) were performed. Figure I-2 presents the approximate locations of borings and CPT's. Drilling was performed under the direction of a SCS&T geologist who also logged the test borings and obtained samples for examination and laboratory testing. Disturbed samples were obtained from cuttings and during Standard Penetration Testing. Standard Penetration Tests were performed by driving a 1.4-inch, inner diameter sampler with a 140-pound hammer. Relatively undisturbed samples were obtained in the borings by driving a 2½-inch, inner diameter, sampler with a 140-pound hammer. Blow counts for the last 12 inches of an 18-inch drive (or less) were recorded and are noted on the Log of Test Borings (LOTB).

The logs of the test borings are contained in Appendix III. Subsurface materials are classified in accordance with the Caltrans "Soil and Rock Logging Classification Manual, 2010." Appendix IV presents the CPT results.

5.2. GEOLOGIC MAPPING

The project site geologic overview map is presented on Figure I-3 and Figure I-4. Figure I-5 presents a modified version of the California Division of Mines and Geology, Geologic Map of the San Diego 30' X 60' Quadrangle, California by Michael P. Kennedy and Siang S. Tan, 2008.

Fill, alluvium, very old paralic deposits, Stadium Conglomerate and Friars Formation underlie the project area. Figures I-3 and I-4 present the approximate limits of each of these geologic units. Figures II-1 through II-3 show geologic cross sections.

5.3. GEOPHYSICAL STUDIES

No geophysical studies were conducted for the preparation of this GDR.

5.4. INSTRUMENTATION

No instrumentation was performed for the preparation of this GDR.

5.5. EXPLORATION NOTES

All borings were backfilled with bentonite chips or a cement/bentonite slurry. When borings were performed along the shoulder or traveled way, bentonite chips were used to fill the drill hole below the pavement elevation and then asphalt or concrete was used to repair the pavement section.

SCS&T representatives did not observe any potentially hazardous materials during our study.

Difficult drilling due to flowing sands and cobbles were encountered in the borings performed at the center bent location of the Friars Road overcrossing.

6. GEOTECHNICAL TESTING

The sections below describe the in-situ and laboratory testing program performed for the proposed project.

6.1. IN-SITU TESTING

Standard Penetration Tests (SPT) and Modified California Samplers were used during the subsurface investigation to collect disturbed and undisturbed samples for use in laboratory analysis. SPT were performed using a CME Auto Hammer. SPT were performed approximately every 5 feet during the drilling of each boring. SPT followed ASTM D 1586 using a 140 pound hammer with a free fall of 30 inches.

Cone penetration testing(CPT) was used in locations with deep alluvial material that is liquefiable. The CPT was performed in accordance with ASTM D 5778.

6.2. LABORATORY TESTING

Selected samples were tested to evaluate pertinent classification and engineering properties. The program included in-situ dry density and moisture content determinations, grain-size analyses, consolidation tests, direct shear tests, R-value determinations, and corrosivity tests. Dry density and moisture content test results are shown on the LOTB in Appendix III. Descriptions of test procedures and laboratory test results are contained in Appendix V

7. GEOTECHNICAL CONDITIONS

The following section describes geotechnical conditions that will affect the project.

7.1. SITE GEOLOGY

The project site is located in the Coastal Plains Physiographic Province of San Diego County and is underlain by the Tertiary-age Friars Formation (Tf), Stadium Conglomerate (Tst), Quaternary-age very old paralic deposits (Qvop), alluvium (Qal), and areal fill (Qaf). The approximate distribution of these materials, shown on Figures I-3 and I-4, is based on our surface reconnaissance, log of test borings, and review of historical aerial photographs along with local geology and topographic maps. Figure I-5 presents a portion of a local geology map.

7.1.1. Lithology

Fill: Fill materials underlie much of the site and are associated with the existing improvements. These materials are estimated to range to in excess of 30 feet in thickness.

Alluvium: Alluvial sediments associated with the San Diego River plain (Mission Valley) and the tributary drainage canyons that enter the river plain underlie most of the project area. The alluvial deposits are anticipated to attain thicknesses in excess of 80 feet toward the southern portion of the project alignment. The thickness of the alluvium decreases near the hillsides. The alluvial deposits consist of gray, brown and tan, interbedded, sand, gravel, cobble, silt, and clay. It is anticipated that abundant gravel and cobble up to about 12 inches in diameter exist within the alluvial sediments.

Very old paralic deposits: Very old paralic deposits cap the mesas/hillsides located in the northwestern portion of the project. The very old paralic deposits consist of reddish brown, well cemented, poorly sorted, sandy cobble with siltstone and sandstone matrices. It is anticipated that gravel and cobble up to about 12 inches in diameter exist within the very old paralic deposits.

Stadium Conglomerate: The Stadium Conglomerate is the primary bedrock unit underlying the very old paralic deposits in the north and alluvial deposits in the southern portion of the project. The conglomerate is exposed on the surface of the cut slopes. The Stadium Conglomerate is comprised of dense to very dense, moist, brown, tannish-brown, and reddish- brown, sandy cobble with cross-bedded lenses of medium to coarse sandstone. Boulders, ranging up to approximately 24 inches in diameter, do occur within the Stadium Conglomerate. Locally, the Stadium Conglomerate is moderately to well cemented.

Friars Formation: The Friars Formation underlies the Stadium Conglomerate within the San Diego River Plain. The Friars Formation is comprised of non-marine and lagoonal sandstone interbedded with layers of siltstone and claystone. The Friars formation contains zones with varying degrees of cementation.

7.1.2. Structure

The sedimentary formations found along coastal San Diego are generally flat lying and laterally continuous for long distances. In the area of SR-163 the very old paralic deposits, Stadium Conglomerate and Friars Formation are generally flat.

No active faults have been identified that transect the project site. Figure I-6 presents a section of the City of San Diego Seismic Safety Study (1995) that shows potentially active faults in the vicinity of the project site.

Much of Southern California, including the San Diego County area, is characterized by a series of Quaternary-age fault zones that typically consist of several individual en echelon faults generally striking in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as active while others are classified as potentially active according to the criteria of the California Geologic Survey. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). Potentially active faults have demonstrated movement during the Pleistocene Epoch (11,000 to 1.6 million years before the present), but no movement during Holocene time.

7.1.3. Existing Slope Stability

The project alignment is located within developed properties. Natural or unaltered slopes do not appear to exist within the Caltrans right-of-way but exist within adjoining properties. Slopes steeper than 1½:1(horizontal:vertical) within the project area have experienced surficial sloughing. Specifically, the slope located at the northwest quadrant of the site is at an inclination of about 1¼:1(horizontal:vertical) at its steepest inclination. Our analyses indicate this slope is globally stable. However, the slope has experienced surficial failures. Existing slopes at inclination of 2:1(horizontal:vertical) appear to be performing adequately.

7.2. SUBSURFACE CONDITIONS

The following sections describe the relevant geotechnical conditions that impact project design and excavations.

7.2.1. Soil

Sedimentary materials underlie the entire project and are exposed on the surface in areas previously excavated for existing improvements. The sedimentary materials are comprised of interbeded siltstone, claystone, sandstone and cemented cobble conglomerate occurring locally. The siltstone and claystones are hard. The sandstone and cobble conglomerate are dense. These formational materials will provide suitable support for roadways and retaining structures.

Alluvial sediments associated with the San Diego River plain (Mission Valley) and the tributary drainage canyons that enter the river plain underlie most of the project area. The alluvial deposits consist of gray, brown and tan, interbedded, sand, gravel, cobble, silt, and clay. The alluvium is moist and ranges between medium dense to dense. The alluvium is considered suitable for the support of embankments, and standard plan retaining walls.

Fill forms the embankments and portions of the SR-163 and Friars Road alignments. The fill consists of moist, medium dense silty and clayey sand with cobble. The alluvium is considered suitable for the support of embankments, and standard plan retaining walls.

7.2.2. Groundwater

SCS&T representatives observed groundwater in borings performed within alluvial areas. The groundwater elevation ranged in elevation between 12 feet above Mean Sea Level(MSL) and 38 MSL. Groundwater levels are expected to fluctuate seasonally in the alluvial areas.

7.2.3. Corrosion

SCS&T obtained soil samples for corrosivity testing. Figures V-68 and V-69 of Appendix V present the test results.

7.3. SURFACE WATER

Drainage is accomplished via sheet flow and swales that direct run-off toward drainage inlets to storm drains. The San Diego River transects the southern portion of the site flowing in an east to west direction. This river flows continuously throughout the year. Additionally, flooding can occur during large rain events.

7.3.1. Scour

SCS&T representatives did not observe any scour within the San Diego River. However, the alluvium within the flood plain can be considered scourable.

7.3.2. Erosion

SCS&T representatives observed erosion in the cut slopes located at the northwest quadrant of the site. Slopes steeper than 2:1(horizontal:vertical) can be considered susceptible to erosion.

7.4. SITE SEISMICITY

The fault most likely to have a significant impact on the site is the Newport-Inglewood West Fault located approximately 1½ miles west of the site at its closest approach. The Newport-Inglewood West Fault is capable of producing a 7.0 magnitude earthquake (California Seismic Hazard Map 1996, Mualchin, L.). The Palos Verde Coronado Banks Fault is approximately 4 miles west of the site. The Palos Verde Coronado Banks Fault is capable of producing a 7.5 magnitude earthquake. The Elsinore Fault Zone (Julian Segment) is approximately 40 miles northeast of the site. No active or potentially active faults cross the alignment. The area is not susceptible to surface rupture.

8. GEOTECHNICAL ANALYSIS AND DESIGN

The following section describes the geotechnical analyses, parameters, and design criteria that should be used by project designers.

8.1. DYNAMIC ANALYSIS AND DESIGN

Fill, alluvium and formational materials underlie the project site. The alluvium located within the San Diego River Plain is potentially liquefiable. CPT's performed at the site measured a shear wave velocity of about 260 meters per second for the alluvium within the San Diego River Plain. The formational materials underlying the site can be considered to be a Type D material. Preliminary acceleration response spectrum's were determined using Caltrans ARS Online (V1.0.4). Appendix VI presents the results.

8.2. LIQUEFACTION ANALYSIS

Liquefaction occurs when loose, saturated, generally fine sands and silts experience strong ground motions such as those produced by earthquakes. The soils lose shear strength and become liquid. Four conditions must be present for liquefaction to occur:

- The soil is below the groundwater table, i.e., saturated;
- The soil is composed predominantly of poorly graded sands;
- The soil is loose to medium dense;
- The soil is subject to a sufficient magnitude and duration of ground shaking.

Liquefaction beneath the overcrossing is very unlikely due to the dense nature of materials below the interchange. However, the materials encountered along the southern portion of the alignment that crosses the San Diego River Plain can be considered liquefiable. Appendix VI presents our liquefaction analyses. Table 2 presents a summary of our liquefaction analyses.

Table 2 - Estimated Liquefaction Settlement

Identification	Analytical Depth (feet)	Estimated Vertical Settlement (inches)		Estimated Lateral Spreading[3] (inches)	
		NCEER 09/ R&W 98[1]	I&B 08[2]	NCEER 09/ R&W 98	I&B 08
CPT-1	55½	11½	12½	144	124[3]
CPT-2	59½	6	6	47	36½
CPT-3	56	9	9½	106	90
CPT-4	62½	9	10½	112½	93½
CPT-5	69	8	7½	76	64
R-12-034	80	-	14½	N/A	30½
R-12-038	77	-	11½	N/A	23½
R-12-040	81	-	10	N/A	19
R-12-041	81	-	11½	N/A	27½
A-03-008	40	-	½	N/A	1

Note (1): Analysis method reference in Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT, Canadian Geotechnical Journal, 1998, Vol. 35, August; Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833.
Note (2): Analysis method reference in Idriss, I.M. and Boulanger, R.W., 2008. Soil Liquefaction During Earthquake, EERI, April.
Note (3): Based on site sloping condition.

8.3. CUTS AND EXCAVATIONS

Existing and proposed slopes were described in Section 2.0. This section presents analyses used to determine the stability, rippability and grading factors of materials in proposed cuts or excavations.

8.3.1. Stability

Abutments

Generally, fill slopes associated with the abutments should be constructed at a 2:1 (horizontal:vertical) inclination. The slope surface should consist of uniform, well-compacted soils in order to minimize the potential for erosion.

SCS&T performed slope stability analyses using GStabl7V.2 software on the north-south cross section of Abutment 3. Information from test borings A-03-003 and A-03-010 was used for the analysis. The analysis indicated a factor of safety of 2.7 under static conditions. A Pseudo-Static analysis indicated a factor of safety of 1.7. A horizontal acceleration of .23g was used for the pseudo-static analysis. Appendix VI presents slope stability calculations.

Permanent Cut Slopes

Cut slopes associated with new on- and off-ramps are anticipated at the northwest quadrant of the site. However, the final location, height, and inclination of cut slopes are unknown at this time. It is anticipated that the slope surface will consist of cobble and sandstone associated with the Stadium Conglomerate. Maintenance of the slope faces and construction of rock fall barrier, such as a Caltrans Type 60 Concrete Barrier, to contain loose cobbles will be needed. The existing cut slope has an inclination of about 1¼:1(horizontal:vertical). We understand the toe of the existing slope will be excavated at an inclination of 1:1(horizontal:vertical). We expect that this excavation will exposed dense, well-cemented sandstone and cobble conglomerate. Our analyses indicate the slope will have an adequate factor-of-safety in respect to global stability. However, surficial instability should be expected. Appendix VI presents slope stability calculations for this cut slope.

Temporary Cut Slopes

Temporary cut slopes may be defined as slopes that exist for a limited duration to facilitate construction of project features. The configurations of temporary excavations are proposed by the Contractor and subject to the approval of the Engineer. Conceptual temporary cut slopes proposed by the Contractor should follow the guidelines set forth in the Caltrans Trenching and Shoring Manual and in Section 11.0

8.3.2. Excavation Characteristics

The majority of the fill, alluvium, very old paralic deposits, Stadium Conglomerate and Friars Formation are considered rippable with heavy-duty equipment in good working order. However, well-cemented zones should be expected within the very old paralic deposits and Stadium Conglomerate. These areas will require rock-breaking equipment, similar to a D9 with a single-shank ripper.

Flowing sands, cobbles and boulders should be expected during drilling. Casing and/or drilling mud will most likely be needed to maintain open drilled shafts.

8.3.3. Grading Factors

Excavated native materials placed as fill for the abutments and ramps are estimated to shrink approximately 5 percent in volume for earthwork estimating purposes. Boulder size materials may be stockpiled for use in landscaping or appropriately handled in accordance with the Standard Specifications.

8.4. EMBANKMENTS

In order to provide the embankment width necessary to accommodate freeway and ramp widening, additional embankment fill will be placed atop existing fill slopes at some locations. Observation of the performance of existing embankments and the computer program GSTABL7 with Stedwin v.2 were used to evaluate the stability of the embankments.

Fill slopes inclined at an inclination of 2:1(horizontal:vertical) or flatter have an adequate factor-of-safety in respect to global and surficial stability.

Fill slopes up to about 23 feet in height are anticipated at the abutments. Existing soils beneath planned embankment areas are granular and will compress rapidly under new fill loads. Post-construction surface settlement due to static loads is expected to be less than 2 inches. Appendix VI presents our analyses. Settlement is expected to be complete within approximately 30 days after fill loads are applied. Settlement should be monitored. Construction can begin before the 30-day settlement period if measurements indicate settlement is essentially complete.

8.5. EARTH RETAINING SYSTEMS

8.5.1. Foundations

Shallow spread footings founded in compacted fill, competent alluvium, very old paralic deposits or Stadium Conglomerate can be used to support of the majority of the planned retaining walls. Standard plan conditions are applicable to the walls presented in Table 3. Table 3 presents the retaining wall foundation type recommendations.

Table 3 - Retaining Wall Recommendations

Wall Identification	Wall Station	Height Feet (H)	Foundation Type	Ground Line	Friction Angle (Φ) Degrees
RW #55	"FR" 55+18.98 to 56+29.99	4.0-5.0	Spread Footing	Case 1	30
RW #72	"FR-1" 247+37.32 to "FR" 73+67.41	7.0-15.0	Spread Footing	Case 1	30
RW #74	"FR" 73+67.41 to 75+56.77	5.0-7.0	Spread Footing	Case 1	30
RW #75	"FR" 75+81.62 to 78+05.11	6.0-7.0	Spread Footing	Case 1	30
RW #76	"FR" 75+64.79 to 75+87.65	4.0-5.0	Spread Footing	Case 1	30
RW #109	"FR-4" 108+95.89 to 114+99.93	4.0-5.0	Spread Footing	Case 1	30
RW #216	"R3" 264+49.75 to "CW" 98+74.83	4.0-7.0	Spread Footing	Case 1	30
RW #245	"FR-7" 245+22.38 to 245+69.37	29.0-38.0	Spread Footing	Case 1	30
RW #247	"FR-7" 247+25.00 to 247+75.00	5.0-6.0	Spread Footing	Case 2	30

Case 1: Level ground on both sides of the wall
Case 2: Level ground on the traffic side of the wall, sloping ground no steeper than 2:1 on opposite side.

8.5.2. Passive Pressure

Passive pressure for the design of retaining walls can be taken as 300 pounds per square per foot of depth. This pressure can be increased by 1/3 for seismic loading. An internal friction angle of 30 degrees can be used to determine the nominal sliding resistance between soil and concrete cast against soil for the foundation.

8.5.3. Active Pressure

The active soil pressure for the design of unrestrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 40 pounds per cubic foot (pcf). An increase in soil pressure equivalent to an additional 2 feet of retained soil can be used to account for transient loads that may include traffic loads or temporary conditions. Alternatively surcharge loads can be determined in accordance with Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications with Caltrans Amendments. If any other surcharge loads are anticipated, the project geotechnical engineer should be contacted for the necessary increase in soil pressure. The project designer should provide waterproofing specifications and details. These pressures assume a granular drained backfill condition.

8.5.4. At-Rest Pressure

The at-rest soil pressure for the design of restrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 55 pounds per cubic foot (pcf). An increase in soil pressure equivalent to an additional 2 feet of retained soil can be used to account for transient loads that may include traffic loads or temporary conditions. Alternatively, surcharge loads can be determined in accordance with Article 3.6.1.2 of the AASHTO LRFD Bridge Design Specifications with Caltrans Amendments.

A granular and drained backfill condition has been assumed. If any other surcharge loads are anticipated, the project geotechnical engineer should be contacted for the necessary increase in soil pressure.

8.5.5. Seismic Pressure

The following equivalent fluid weights can be used for the seismic design of the retaining walls.

Condition	Equivalent Fluid Weight – Seismic
Active	55 pounds per cubic foot
At-Rest	75 pounds per cubic foot
Passive	390 pounds per cubic foot

The equivalent fluid weights for seismic loading were determined using the Mononobe-Okabe method presented in Appendix A11 of the AASHTO LRFD Bridge Design Specifications. The at-rest condition was estimated using an increase ratio similar to the active condition. The horizontal acceleration coefficient of 0.23 (50% of the peak ground acceleration of 0.45g) in the Mononobe -Okabe method presented in Appendix A11 of the AASHTO LRFD Bridge Design Specifications. The resultant of the seismic active and at-rest pressures should be applied at a depth of ½H from the top of the wall where H is equal to the total height of the wall.

8.6. SOUND WALLS

8.6.1. Foundations

Compacted fill, alluvium, very old paralic deposits or Stadium Conglomerate can be used to support the planned sound walls. The foundation systems for the planned sound walls located at the top of the slopes at the northwest quadrant of the site will most likely encounter cobbles greater than 6 inches in maximum dimension and ground surfaces that slope at inclinations steeper than 2:1(horizontal:vertical). Based on Caltrans Geotechnical Manual, July 2010, cast-in-drilled-hole (CIDH) foundations are the most cost effective alternative. The project designer should perform a constructability review prior to determining the final foundation type. Table 4 presents the sound wall foundation-type recommendations.

Table 4 - Sound Wall Recommendations

Wall Identification	Wall Station	Height (H) (Feet)	Foundation Type	Ground Line[1]	Friction Angle (Φ) Degrees
SW B9	"CE" 236+48.03 to 237+55.78	6.0	Spread	Case 1	30
SW B8	"MD" 255+76.66 to "FR-5" 250+60.93	8	CIDH	Case 2	30
SW B7	"RG" 254+27.66 to "LB" 268+88.79	8.0	CIDH	Case 2	30
B6	"CO" 271+57.48 to "TA" 281+41.43	8.0	CIDH	Case 2	30
SW B5A	"SR-163" 265+22.21 to 266+29.56	14.0	Spread	Case 2	30
SW B5B	"SR-163" 278+64.74 to 282+01.09	14.0	Spread	Case 2	30
SW B4	"SR-163" 281+38.08 to 290+56.54	8.0	CIDH	Case 2	30
SWB3	"JD2" 291+73.65 to "SR-163" 300+98.85	8.0	CIDH	Case 2	30
SWB2	"SR-163" 299+02.20 to 304+30.91	12.0	CIDH	Case 2	30
SWB1	"GR" 311+03.44 to 315+89.20	8.0	Spread	Case 2	30

Case 1: Level ground on both sides of the wall
Case 2: Level ground on the traffic side of the wall, sloping ground no steeper than 2:1 on opposite side.

8.7. OVERHEAD SIGN FOUNDATIONS

Eleven (11) overhead signs are proposed as part of this project. Six (6) overhead signs, of which five (5) are lightweight single-post and one (1) is a lightweight butterfly structure, will be located along Friars Road. There will be one (1) lightweight structure located on Ulric Street facing southbound traffic, and one (1) truss structure located along southbound SR-163 just north of the loop off-ramp. There are also three (3) proposed bridge mounted structures that will be located on the Friars Road Overcrossing facing northbound traffic.

The design of appropriate CIDH pile foundations for each sign may be found in the Standard Plans.

In general, the subsurface conditions at the overhead sign locations are suitable for standard CIDH pile foundations. Groundwater and caving should be expected for excavation in alluvium and fill. No caving is expected during pile excavation in the very old paralic deposits or Stadium Conglomerate. Concretions are likely to be encountered for signs drilled along Ulric Street and southbound SR-163 just north of the loop off-ramp.

9. MATERIAL SOURCES

No off-site material source has been identified for this project. Material generated from on-site excavations will consist of primarily silty and clayey sand with cobbles and boulders derived from very old paralic deposits and Stadium Conglomerate. The soil generated on-site is expected to be suitable for use as structure backfill after removal of oversize rocks.

10. MATERIAL DISPOSAL

Examples of material unsuitable embankment subgrade or fill include organic mud, highly expansive clay, stockpiled trash, and debris. The geotechnical site review suggests that the majority of the material excavated can be used as fill.

Material generated during construction that is found to be unsuitable for use as roadway subgrade, embankment fill, or topsoil should be placed in a suitable location within the project limits or properly disposed.

11. RECOMMENDATIONS

11.1. PERMANENT CUT SLOPES

Permanent cut slope in fill should be excavated at an inclination of 2:1(horizontal:vertical) or flatter. Permanent cut slopes in competent very old paralic deposits or Stadium Conglomerate can be excavated at an inclination of 1:1(horizontal:vertical) or flatter up to height of 12½ feet. Above a height of 12½ feet permanent cut slopes that expose competent very old paralic deposits or Stadium Conglomerate can be excavated at an inclination of 2:1(horizontal:vertical) or flatter.

Cut slopes associated with new on- and off-ramps are anticipated at the northwest quadrant of the site. However, the final location, height, and inclination of cut slopes are unknown at this time. It is anticipated that the slope surface will consist of cobble and sandstone associated with the Stadium Conglomerate. Maintenance of the slope faces and construction of rock fall barrier, such as a Caltrans Type 60 Concrete Barrier, to contain loose cobbles will be needed. The existing cut slope has an inclination of about 1¼:1(horizontal:vertical). We understand the toe (12½ feet above the bottom of the slope) of the existing slope will be excavated at an inclination of 1:1(horizontal:vertical). We expect that this excavation will expose dense, well-cemented sandstone and cobble conglomerate. Our analyses indicate the slope will have an adequate factor-of-safety in respect to global stability. However, surficial instability should be expected. Appendix VI presents slope stability calculations for this cut slope.

11.2. TEMPORARY CUT SLOPES

Under no circumstance should temporary cut slopes in fill be excavated at and inclination greater than 1:1(horizontal:vertical). Temporary excavations that expose competent very old

paralic deposits or Stadium Conglomerate can be excavated at an inclination of ½:1(horizontal:vertical) up to a height of 10 feet. Above a height of 10 feet temporary cut slopes that expose competent very old paralic deposits or Stadium Conglomerate can be excavated at an inclination of 1:1(horizontal:vertical). Under no circumstance should temporary cut slopes over a height of 10 feet be excavated at an inclination steeper than 1:1(horizontal:vertical).

For construction of the soil nail wall, temporary excavations can be excavated vertically up to a height of 5 feet.

11.3. PERMANENT FILL SLOPES

Fill slopes should be constructed at an inclination of 2:1(horizontal:vertical) or flatter.

11.4. UN-SUITABLE MATERIAL

SCS&T expects materials with more than 30% cobble and boulders will be excavated. This material will most likely need to be screened or crushed for use as structure fill.

11.5. REMEDIAL GRADING

Remedial grading is expected to be required along the southbound side of SR-163 between Stations 279+00 and 293+00. The existing loose fill and alluvium will need to be excavated and replaced as engineered fill. It is expected that about 10,000 cubic yards of material will need to be excavated.

11.6. PAVEMENT STRUCTURAL SECTIONS

Eleven R-value tests were performed on bulk samples obtained from the borings. These samples are considered to be reasonably representative of materials likely to comprise final pavement subgrades along the ramp and mainline alignment (see Appendix V). The lowest R-value measured in the tests was 19. Additional tests should be performed during final grading, when actual subgrade materials can be determined. Dokken Engineering provided Traffic Indices (TIs). Based on this information, the flexible pavement structural sections were calculated. Table 5 presents the preliminary pavement section recommendations.

Table 5- Pavement Recommendations

FRIARS ROAD AT SR 163 IMPROVEMENTS				
Location	**Traffic Index**	**R-Value used for design**	**AC Pavement Section**	**JPCP Pavement Section**
Friars Road	12.5	20	8in HMA / 24in AB	10.0 in JPCP /3in HMA-A /7.5in AS
SR-163 Auxiliary Lanes	12.0	40	8in HMA / 14in AB	10.0 in JPCP /3in HMA-A /7.5in AS
Ulric Street	10.5	30	7in HMA / 15in AB	10.0 in JPCP / 16in Cl 2 AB
SR-163 Inside Lanes	11.5	40	7.5in HMA / 13in AB	10.0 in JPCP /3in HMA-A /7.5in AS
SR-163 Outside Lanes	13.5	40	8.5in HMA / 16in AB	10.0 in JPCP /3in HMA-A /8.5in AS
SR-163 Shoulders	8.5	40	5in HMA / 10in AB	8.5 in JPCP /12in AB
SR-163 (Friars Flyover/Undercrossing)	11	40	7in HMA / 13in AB	10.0 in JPCP /16in AB
SR-163 (Friars Flyover/Undercrossing) Shoulders	8	40	5in HMA / 10in AB	8.5 in JPCP /12in AB
Ramps	10	40	6in HMA / 11.5in AB	9.0 in JPCP /12in AB
Ramps Shoulders	8	40	5in HMA / 8in AB	8.5 in JPCP /12in AB
Collector-Distributor	11	30	7in HMA / 16.5in AB	10 in JPCP /16in AB
Collector-Distributor Shoulders	8	30	5in HMA / 11in AB	8.5 in JPCP /12in AB

HMA – Hot Mix Asphalt
HMA-A = Hot Mix Asphalt (TYPE A)
JPCP – Jointed Plain Concrete Pavement (with lateral support) Table 623.1E Caltrans Highway Design Manual
AB – Class 2 Aggregate Base
AS – Class 4 Aggregate Subbase

Alternate pavement sections can also be considered. Final pavement alternatives will be developed in consultation with Dokken Engineering, Caltrans and city representatives. Unsuitable subgrade material should be removed and replaced with suitable material as identified by the project geotechnical engineer. The removal should extend to a depth beyond the influence of the planned construction.

11.7. INFILTRATION RATE

An infiltration basin is proposed to be located within the loop off-ramp in the northeast quadrant of the interchange. The basin is proposed to hold 0.5 acre-feet of volume with a maximum surface area of 0.3 acres.

To verify that the soils at the proposed basin site are suitable for infiltration, an SCS&T representative performed an infiltration test at the proposed basin site on August 15, 2012. A single test hole was excavated to a depth of approximately 24 inches below the existing ground surface. The test was performed in accordance with ASTM D 3385. The soil encountered in the test location is classified as a poorly graded gravel with silt and sand in accordance with ASTM D 2487. An infiltration rate of approximately 1 inch per hour was measured. Table 6 presents the field test data.

Table 6
Infiltration Field Test Data

Time Interval	Time (hr:min)	Dt Total Minutes	Inner Ring Elev H(in.)	Inner Ring ΔH (in.)	Annular Ring Elev H(in.)	Annular Ring ΔH (in.)	Flow Qf ΔH*Vr		Infiltration Rate Inner in/hr	Infiltration Rate Outer in/hr
1 - Start	12:00		14		18		796.5	outer		5
End	12:30	30.00	11	3	13.5	4.5	235.5	inner	4	
2 - Start	12:30		14		18		442.5	outer		3
End	13:00	30.00	12.5	1.5	15.5	2.5	117.75	inner	2	
3 - Start	13:00		14		18		442.5	outer		3
End	13:30	30.00	13	1	15.5	2.5	78.5	inner	1	
4 - Start	13:30		14		18		398.25	outer		2
End	14:00	30.00	13	1	15.75	2.25	78.5	inner	1	
5 - Start	14:00		14		18		354	outer		2
End	14:30	30.00	13	1	16	2	78.5	inner	1	
6 - Start	14:30		14		18		309.75	outer		2
End	15:00	30.00	13	1	16.25	1.75	78.5	inner	1	

Based on the results of the infiltration test, the soil observed at the planned basin site is acceptable for the purposes of constructing an infiltration basin. The resident engineer should observe the bottom of the planned basin during construction to verify sandy material is present.

12. DESIGN ADVISORIES

1. The material derived from excavations in the fill, alluvium, very old paralic deposits, and Stadium Conglomerate within the project will be suitable for use as embankment fill. It is expected that excavations in the conglomerate will expose cobbles and boulders.
2. The subsurface conditions at each of the proposed overhead sign locations are suitable for Caltrans Standard CIDH pile foundations.

13. CONSTRUCTION CONSIDERATIONS

1. The on-site soils may generally be excavated with conventional heavy equipment in good working order. It should be expected that the presence of cobble and concretions may create occasional difficulties during drilling and trenching operations. Trenching and drilling operations should be capable of excavating through hard concretions.
2. The total volume of concretions excavated on the project is not expected to exceed 500 cubic yards. Excavated concretions will need to be crushed and/or screened prior to use as engineered fill.
3. Approximately 25,000 cubic yards of excavated material will need to be crushed and/or screened prior to use as engineered fill.
4. Groundwater and caving should be expected within drilled shafts in the fill, alluvium and formational material.
5. Temporary cut slopes proposed by the contractor should follow the guidelines set forth in the Caltrans Trenching and Shoring Manual.

   Under no circumstance should temporary cut slopes in fill be excavated at and inclination greater than 1:1(horizontal:vertical). Temporary excavations that expose competent very old paralic deposits or Stadium Conglomerate can be excavated at an inclination of ½:1(horizontal:vertical) up to a height of 10 feet. Above a height of 10 feet temporary cut slopes that expose competent very old paralic deposits or Stadium Conglomerate can be excavated at an inclination of 1:1(horizontal:vertical). Under no circumstance should temporary cut slopes over a height of 10 feet be excavated at an inclination steeper than 1:1(horizontal:vertical).

   For construction of the soil nail wall, temporary excavations can be excavated vertically up to a height of 5 feet.

14. ACTUAL VS. REPORTED SITE CONDITIONS

The characterization of geotechnical conditions along the project alignment and presented in this report are based on the review of the design information provided, proposed project features, as-built plans, geologic maps, geologic literature, archival reports, exploration by SCS&T, and laboratory testing. The evaluations and recommendations contained in this reports, exploration by SCS&T, and laboratory testing. The evaluations and recommendations contained in this report are based on the information discovered and data gathered. If conditions are encountered during the project that appear to differ from the conditions conveyed in this report, or if construction difficulties related to soil conditions are encountered, the project's Resident Engineer should be contacted to assist with the assessment of the prevailing geotechnical conditions and to assist in formulating appropriate strategies to facilitate project completion.

Should project design features vary significantly from those described in this report an updated GDR should be prepared by SCS&T to address the geotechnical considerations.

15. REFERENCES

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APPENDIX I

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	ALIGNMENT VICINITY MAP FRIARS ROAD AT STATE ROUTE 163 San Diego, California	Date: 6/7/2012 By: AKN/EL Job No.: 1111191-1 Scale: Not To Scale	Figure: I-1

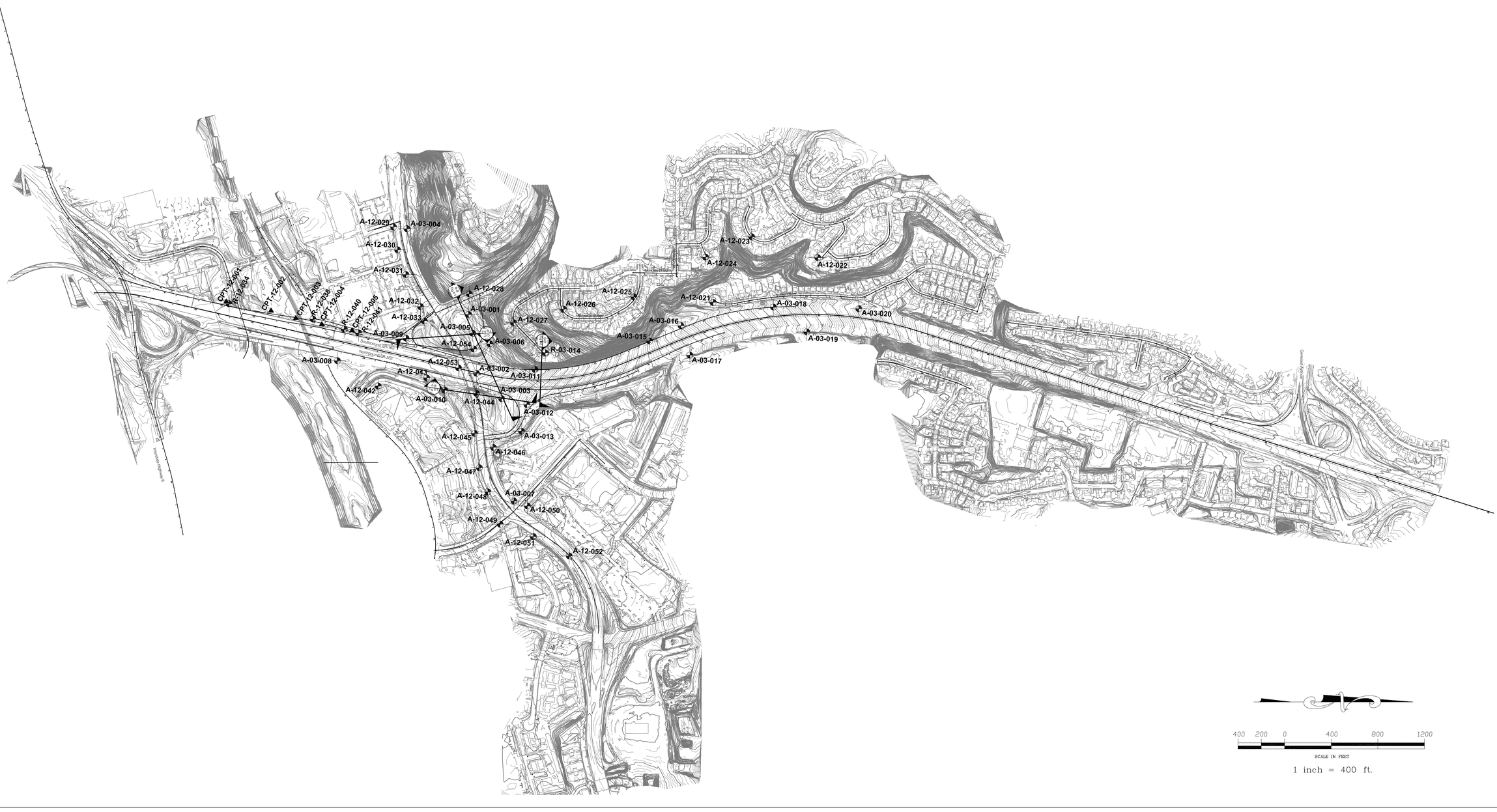
SCS&T LEGEND

A-12-054 — Approximate Location of Auger Boring

R-12-041 — Approximate Location of Rotary Drilled Boring

CPT-12-5 — Approximate Location of Cone Penetration Test Boring

D-D' Fig II-2 — Approximate Location of Cross Section



Date: 6 /25/ 2012
By: EL/AKN
Job No.: 1111191-1
Scale: 1 inch = 400 feet

BORING LOCATION MAP
FRIARS ROAD AT STATE ROUTE 163

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
I-2

GEOLOGIC MAP

FRIARS ROAD AT STATE ROUTE 163

Match Line (See Figure I-4)

Qaf/Tst
Qaf/Qcol
Qaf/Qvop
Tst
Qaf/Qal
Qaf/Qvop
Tst
Tst
Qaf/Qal
Qal/Tst
Camino De La Reina
Avenida Del Rio
Avenida Del Rio
Ulric Street
Friars Road
Minden Drive
Minden Drive
Regulus Street
Veita Court
Linbrook Dr.
Southbound SR-163
Northbound SR-163
Hazard Center Drive
Murray Canyon Road
Frazee Road
Interstate Highway 8

SCS&T LEGEND

Qaf	Fill
Qal	Alluvium
Qcol	Colluvium
Qvop	Very Old Paralic Deposits
Tst	Stadium Conglomerate
⌒	Approximate limit of geology contact
- - - - -	Approximate alignment of planned soundwall
(4)	Estimated fill/slopewash thickness in feet

200 100 0 200 400 600

SCALE IN FEET

1 inch = 200 ft.

Date: 6/27/2012
By: EL
Job No.: 1111191-1
Scale: 1 inch = 200 feet

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Figure: I-3

SCS&T LEGEND

Q_{af}	Fill
Q_{al}	Alluvium
Q_{col}	Colluvium
Q_{vop}	Very Old Paralic Deposits
T_{mv}	Mission Valley Fromation
T_{st}	Stadium Conglomerate
	Approximate limit of geology contact
	Approximate alignment of planned soundwall
(4)	Estimated fill/slopewash thickness in feet

Match Line (See Figure I-3)

Courtney Drive
Crandall Drive
Cardigan Way
Tait Street
Hanford Drive
Judson Street
Gateshead Street
Judson Court
Fulton Street
Genesee Avenue

200 100 0 200 400 600
SCALE IN FEET
1 inch = 200 ft.

Date: 6 /25/ 2012
By: EL
Job No.: 1111191-1
Scale: 1 inch = 200 feet

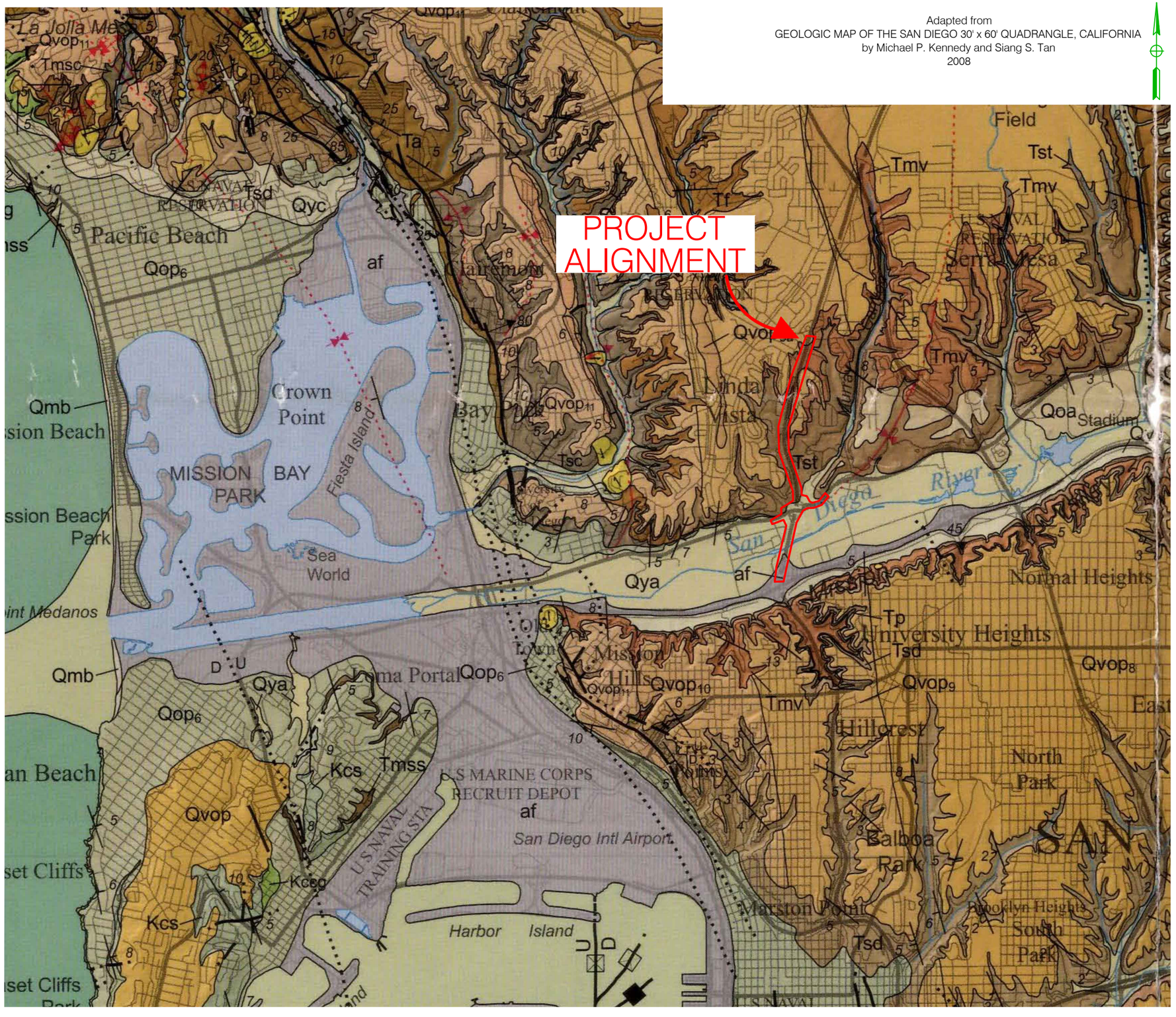
GEOLOGY MAP

FRIARS ROAD AT STATE ROUTE 163

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Figure:
I-4

Adapted from
GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA
by Michael P. Kennedy and Siang S. Tan
2008



ABBREVIATED EXPLANATION

Approximate stratigraphic relationships only;
see pamphlet and CMU (Plate 2) for more detailed information

MODERN SURFICIAL DEPOSITS

- af — Artificial fill (late Holocene)
- Qw — Wash deposits (late Holocene)
- Qls — Landslide deposits, undivided (Holocene and Pleistocene)
- Qmb — Marine beach deposits (late Holocene)
- Qpe — Paralic estuarine deposits (late Holocene)
- Qmo — Undivided marine deposits in offshore region (late Holocene)
- Qcf — Canyon fill deposits in offshore region (late Holocene)

YOUNG SURFICIAL DEPOSITS

- Qya — Young alluvial flood-plain deposits (Holocene and late Pleistocene)
- Qyc — Young colluvial deposits (Holocene and late Pleistocene)
- Qct — Undivided canyon terrace deposits in offshore region (Holocene and Pleistocene)

OLD SURFICIAL DEPOSITS

- Qoa — Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
- Qop — Old paralic deposits, undivided (late to middle Pleistocene)
  - Qop_7 — Unit 7
  - Qop_6 — Unit 6
  - Qop_{2-4} — Units 2-4, undivided

VERY OLD SURFICIAL UNITS

- Qvoa — Very old alluvial flood-plain deposits, undivided (middle to early Pleistocene)
- Qvop — Very old paralic deposits, undivided (middle to early Pleistocene)
  - $Qvop_7$ — Unit 7
  - $Qvop_6$ — Unit 6
  - $Qvop_5$ — Unit 5
  - $Qvop_4$ — Unit 4
  - $Qvop_3$ — Unit 3
  - $Qvop_2$ — Unit 2
  - $Qvop_1$ — Unit 1
  - $Qvop_{13}$ — Unit 13
  - $Qvop_{12}$ — Unit 12
  - $Qvop_{11}$ — Unit 11
  - $Qvop_{10}$ — Unit 10
  - $Qvop_9$ — Unit 9
  - $Qvop_8$ — Unit 8
  - $Qvop_{11a}$ — Unit 11a
  - $Qvop_{10a}$ — Unit 10a
  - $Qvop_{9a}$ — Unit 9a
  - $Qvop_{8a}$ — Unit 8a

SEDIMENTARY AND VOLCANIC BEDROCK UNITS

- QTso — Undivided sediments and sedimentary rocks in offshore region (Holocene, Pleistocene, Pliocene and Miocene)
- Tsd — San Diego Formation (early Pleistocene and late Pliocene)
  - Tsd - undivided
  - Tsdcg - transitional marine and nonmarine pebble and cobble conglomerate
  - Tsdss - marine sandstone
- Tba — Basaltic-andesite dike (Miocene)
- Tmo — Undivided sedimentary rocks in offshore region (Miocene)
- Tmvo — Undivided volcanic rocks in offshore region (Miocene)
- Tmuo — Undivided volcanic and sedimentary rocks in offshore region (Miocene)
- To — Otay Formation (late Oligocene)
- Tp — Pomerado Conglomerate (middle Eocene)
  - Tpm - Miramar Sandstone Member
- Tmv — Mission Valley Formation (middle Eocene)
- Tst — Stadium Conglomerate (middle Eocene)
- Tf — Friars Formation (middle Eocene)
- Tsc — Scripps Formation (middle Eocene)
  - Tscu - upper unit
- Ta — Ardath Shale (middle Eocene)
- Tt — Torrey Sandstone (middle Eocene)
- Td — Delmar Formation (middle Eocene)
- Td+Tf — Delmar Formation and Friars Formation, undivided (middle Eocene)
- Tmss / Tmsc — Mount Soledad Formation (middle Eocene)
  - Tmss - sandstone
  - Tmsc - cobble conglomerate
- Teo — Undivided Eocene rocks in offshore region (Eocene)
- Kcs / Kccg — Cabrillo Formation (Upper Cretaceous)
  - Kcs - sandstone
  - Kccg - cobble conglomerate
- Kp — Point Loma Formation (Upper Cretaceous)
- Kl — Lusardi Formation (Upper Cretaceous)
- Kuo — Undivided rocks of the Rosario Group in the offshore area (Upper Cretaceous)

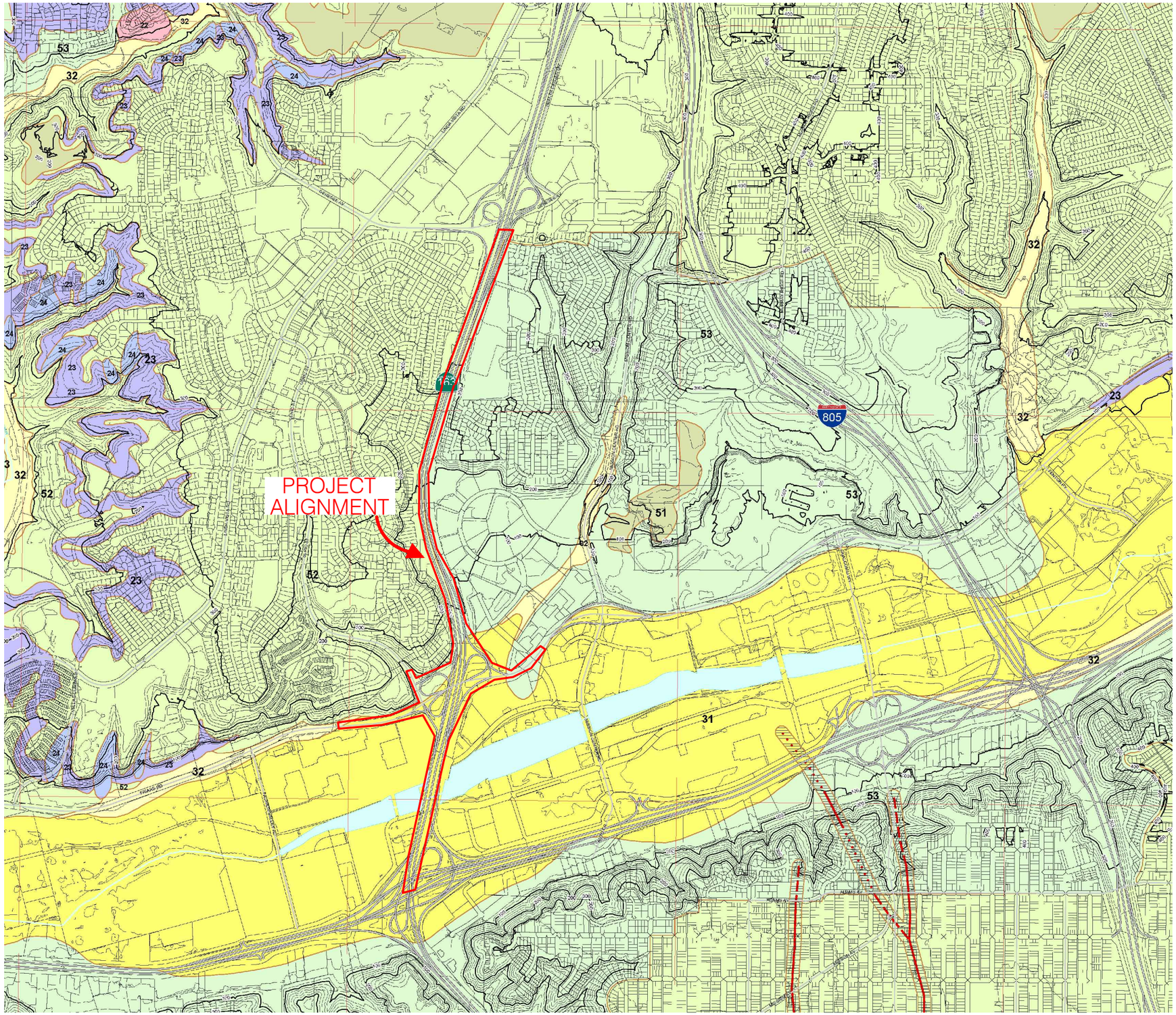
QUATERNARY (Holocene, Pleistocene) · TERTIARY (Pliocene, Miocene, Oligo-Miocene, Eocene) · Upper Cretaceous

Date: 6/28/2012
By: EL
Job No.: 1111191-1
Scale: NOT TO SCALE

LOCAL GEOLOGY MAP
FRIARS ROAD AT STATE ROUTE 163

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
I-5



Geologic Hazard Categories

FAULT ZONES

- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES

- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS

- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION

- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS

- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN

- 51 Level mesas -- underlain by terrace deposits and bedrock nominal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

N

Development Services Department

Feet

Meters

City of San Diego
SEISMIC SAFETY STUDY
Geologic Hazards and Faults

Date: 6/29/2012
By: EL
Job No.: 11111191-1

CITY OD SAN DIEGO
SEISMIC SAFETY MAP

FRIARS ROAD AT STATE ROUTE 163

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
I-6

SYMBOLS

URBANIZED AREA BOUNDARY

RELATIVE LANDSLIDE SUSCEPTIBILITY AREAS

1	2	3-1	3-2	4-1	4-2
Least Susceptible	Marginally Susceptible	Generally Susceptible		Most Susceptible	

Increasing Landslide Susceptibility

LANDSLIDES

Landslide

Questionable Landslide

LANDSLIDE HAZARDS IN THE NORTHERN PART OF THE SAN DIEGO METRPOLITAN AREA, SAN DIEGO COUNTY, CALIFORNIA

By Siang S. Tan

1995

LA JOLLA QUADRANGLE

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

LANDSLIDE HAZARD MAP

FRIARS ROAD AT STATE ROUTE 163

Date: 6/29/2012

By: EL

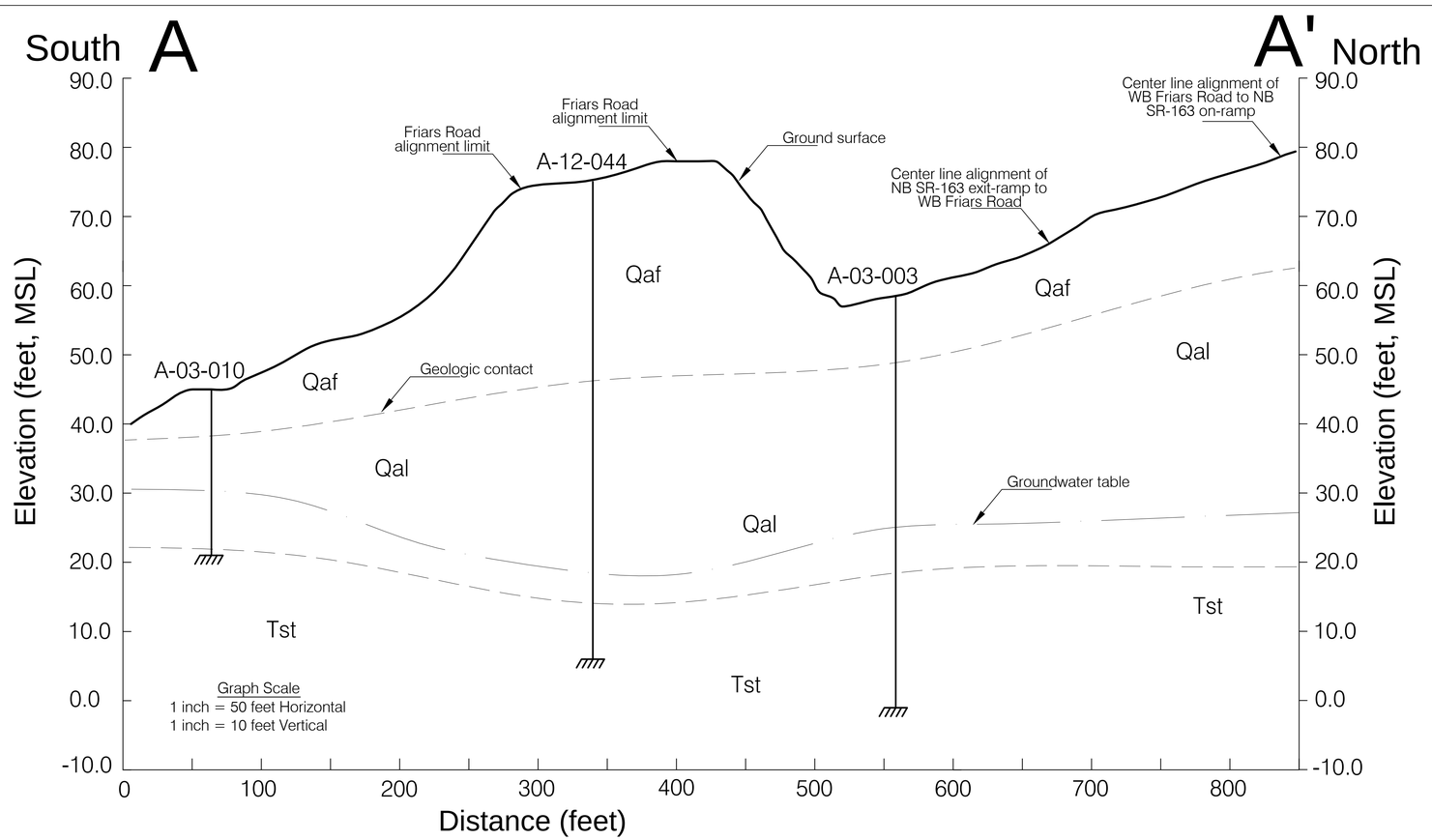
Job No.: 11111191-1

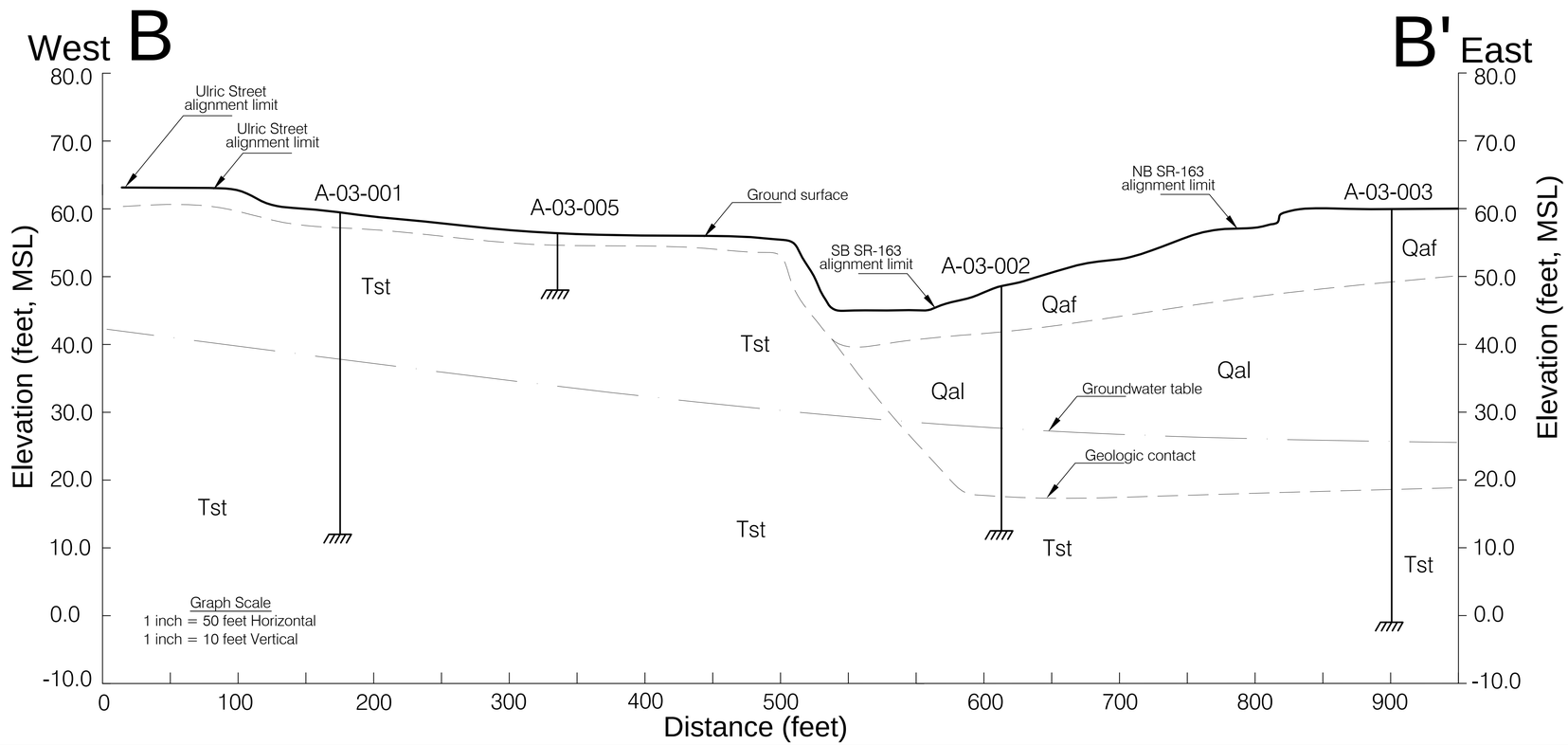
SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Figure:

I-7

APPENDIX II



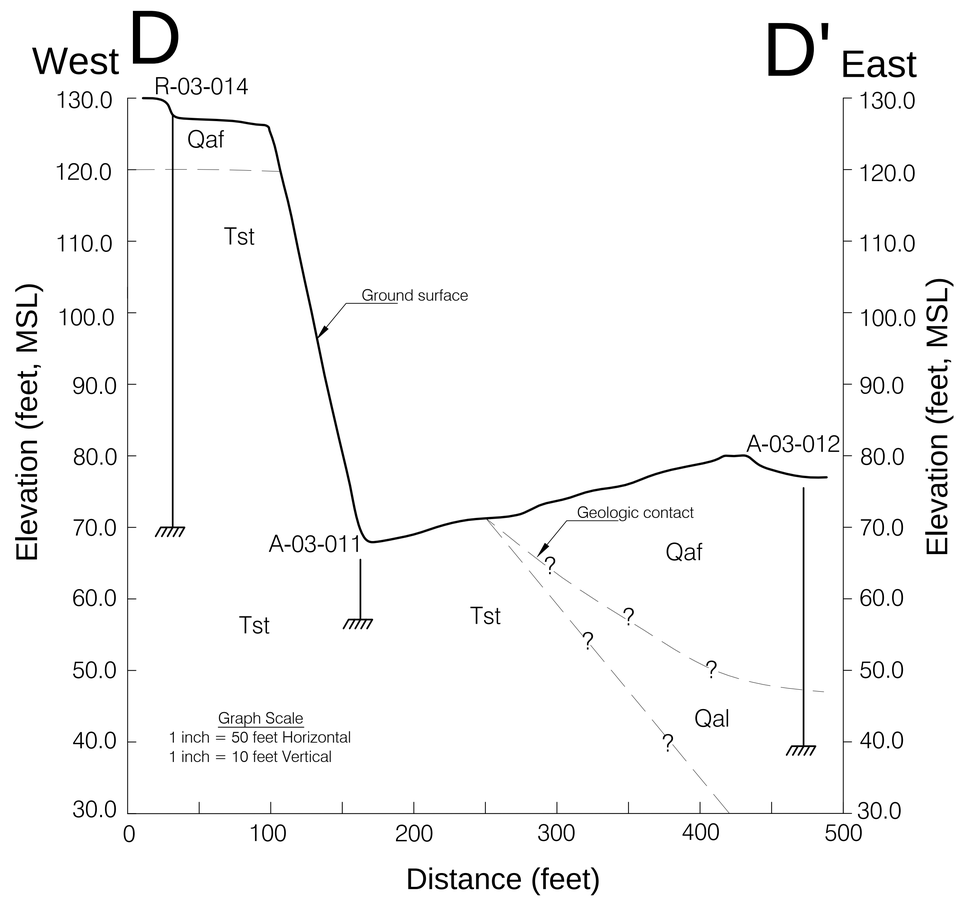


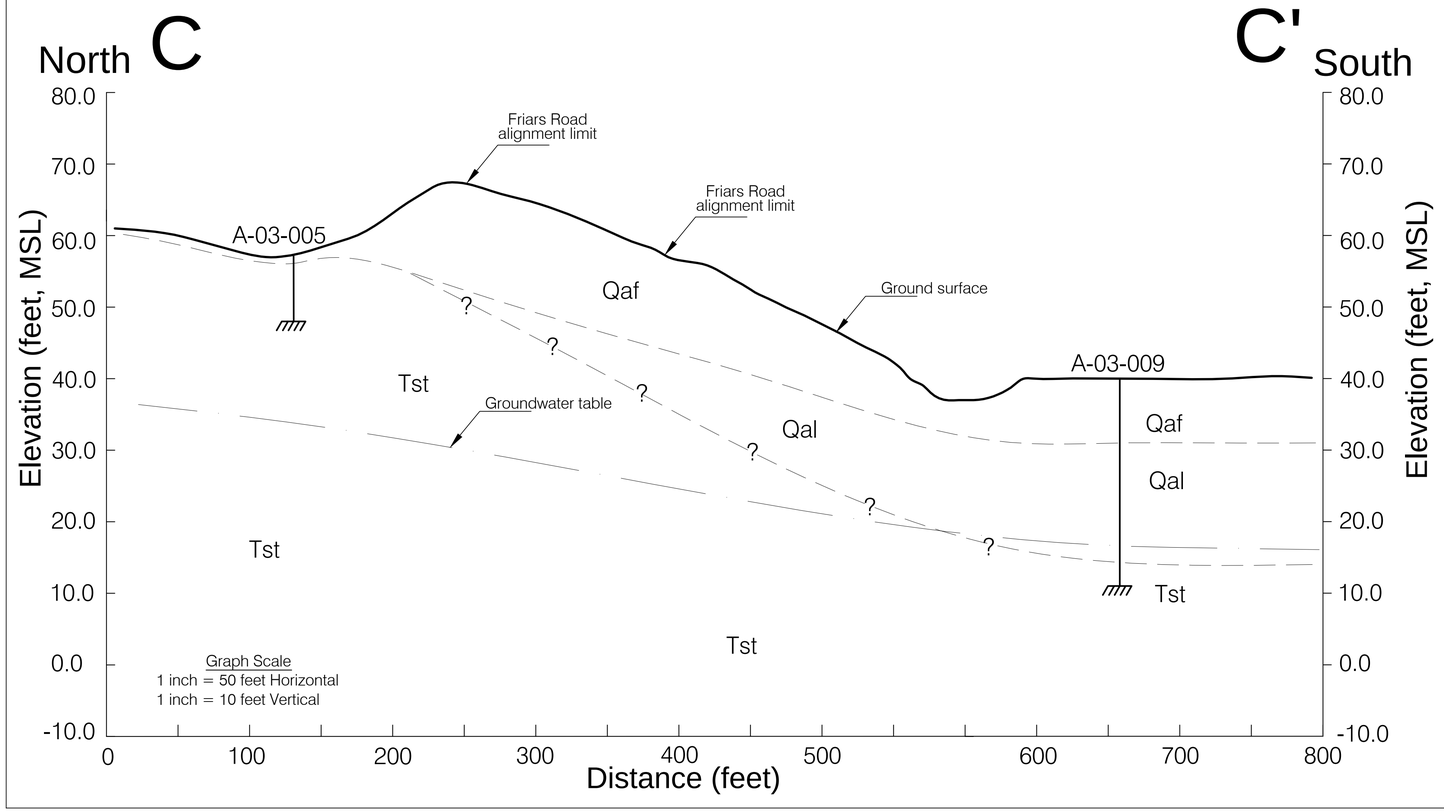
GEOLOGIC CROSS SECTIONS
A-A' AND B-B'
FRIARS ROAD AT STATE ROUTE 163

Date: 6 /25/ 2012
By: EL
Job No.: 1111191-1
Scale: (H)1 inch = 50 feet
(V)1 inch = 10 feet

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
II-1





Date: 6 /27/ 2012
By: EL
Job No.: 1111191-1
Scale: (H)1 inch = 50 feet
(V)1 inch = 10 feet

GEOLOGIC CROSS SECTIONS
C-C' AND D-D'
FRIARS ROAD AT STATE ROUTE 163

SOUTHERN CALIFORNIA
SOIL & TESTING, INC.

Figure:
II-2

APPENDIX III

REFERENCE: (1) CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010),

GROUP SYMBOLS AND NAMES

Graphic/Symbol		Group Names	Graphic/Symbol		Group Names
	GW	Well-graded GRAVEL Well-graded GRAVEL with SAND		CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
	GP	Poorly-graded GRAVEL Poorly-graded GRAVEL with SAND			
	GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND		CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
	GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)			
	GP-GM	Poorly-graded GRAVEL with SILT Poorly-graded GRAVEL with SILT and SAND		ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
	GP-GC	Poorly-graded GRAVEL with CLAY (or SILTY CLAY) Poorly-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)			
	GM	SILTY GRAVEL SILTY GRAVEL with SAND		OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
	GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND			
	GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND		OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
	SW	Well-graded SAND Well-graded SAND with GRAVEL			
	SP	Poorly-graded SAND Poorly-graded SAND with GRAVEL		CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
	SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL			
	SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)		MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
	SP-SM	Poorly-graded SAND with SILT Poorly-graded SAND with SILT and GRAVEL			
	SP-SC	Poorly-graded SAND with CLAY (or SILTY CLAY) Poorly-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)		OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
	SM	SILTY SAND SILTY SAND with GRAVEL			
	SC	CLAYEY SAND CLAYEY SAND with GRAVEL		OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
	SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL			
	PT	PEAT		OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
		COBBLES COBBLES and BOULDERS BOULDERS			

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content–% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (UC) Unconfined Compression–Soil (ASTM D 2166); Unconfined Compression–Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95-5.10	1	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER GARRETT B. FOUNTAIN No. GE 2752 Exp. 9/30/12 GEOTECHNICAL STATE OF CALIFORNIA

SCST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 in.)
Very Loose	0 – 5
Loose	5 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5% – 10%
Little	15% – 25%
Some	30% – 45%
Mostly	50% – 100%

PARTICLE SIZE

Description		Size (in.)
Boulder		Greater than 12
Cobble		3 – 12
Gravel	Coarse	3/4 – 3
	Fine	1/5 – 3/4
Sand	Coarse	1/16 – 1/5
	Medium	1/64 – 1/16
	Fine	1/300 – 1/64
Silt and Clay		Less than 1/300

SCS&T JOB No. 1111191P-1

ENGINEERING SERVICES | GEOTECHNICAL SERVICES

FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE

DRAWN BY: Andrew K. Neuhaus, PG

CHECKED BY: Garrett B. Fountain, GE

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH

BRIDGE NO. –

POST MILE 3.95-5.10

FRIARS ROAD & SR163
LOG OF TEST BORINGS

GS LOTB SOIL LEGEND

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) --

SHEET 1 OF 20

REFERENCE: (1) CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010),

CEMENTATION	
Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	2	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER GARRETT B. FOUNTAIN No. GE 2752 Exp. 9/30/12 GEOTECHNICAL STATE OF CALIFORNIA

SC ST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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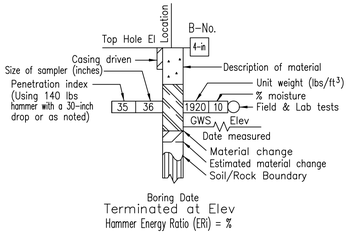
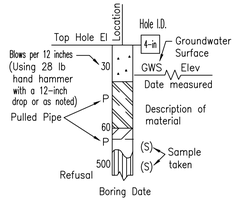
BOREHOLE IDENTIFICATION		
Symbol	Hole Type	Description
Size	A	Auger Boring (hollow or solid stem bucket)
Size	R RW RC P	Rotary drilled boring (conventional) Rotary drilled with self–casing wire–line Rotary core with continuously–sampled, self–casing wire–line Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1–inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778)
□	O	Other (note on LOTB)
Note: Size in inches.		

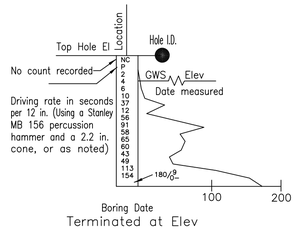
CONSISTENCY OF COHESIVE SOILS				
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)	Vane Shear Measurement, VS, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 – 0.25	0.25 – 0.5	0.12 – 0.25	0.12 – 0.25
Medium Stiff	0.25 – 0.5	0.5 – 1	0.25 – 0.5	0.25 – 0.5
Stiff	0.5 – 1	1 – 2	0.5 – 1	
Very Stiff	1 – 2	2 – 4	1 – 2	
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2



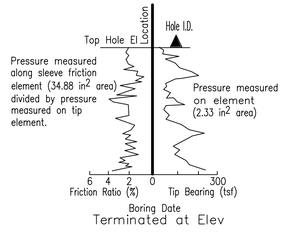
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

SCS&T JOB No. 1111191P–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. –	FRIARS ROAD & SR163
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE			POST MILE 3.95–5.10	LOG OF TEST BORINGS
GS LOTB SOIL LEGEND	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 2 OF 20

REFERENCE: (1) CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010),

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95-5.10	3	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SC ST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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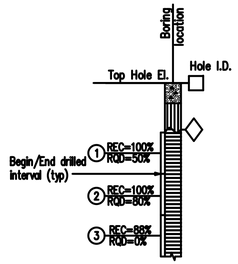
PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\Sigma \text{Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100\%$$

$$RQD = \frac{\Sigma \text{ Length of intact core pieces} \quad 4 \text{ in.} \geq}{\text{Total length of core run (in.)}} \times 100\%$$

RQD* Indicates soundness criteria not met.



FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 to 3 ft.
Moderately Fractured	Core lengths mostly from 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows.
Very Hard	Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows.
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic Features					General Characteristics
	Chemical Weathering–Discoloration and/or Oxidation		Mechanical Weathering–Grain Boundary Conditions (Disaggregation) Primarily for Granitics and Some Coarse–Grained Sediments	Texture and Leaching		
	Body of Rock	Fracture Surfaces		Texture	Leaching	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change	No leaching	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved	Minor leaching of some soluble minerals.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe–Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe–Mg minerals are altered to clay to some extent; or chemical alteration produces in–situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe–Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

SCS&T JOB No. 1111191P-1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. –	FRIARS ROAD & SR163
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, GE CHECKED BY: Garrett B. Fountain, GE			POST MILE 3.95–5.10	LOG OF TEST BORINGS
GS LOTB SOIL LEGEND	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 3 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	4	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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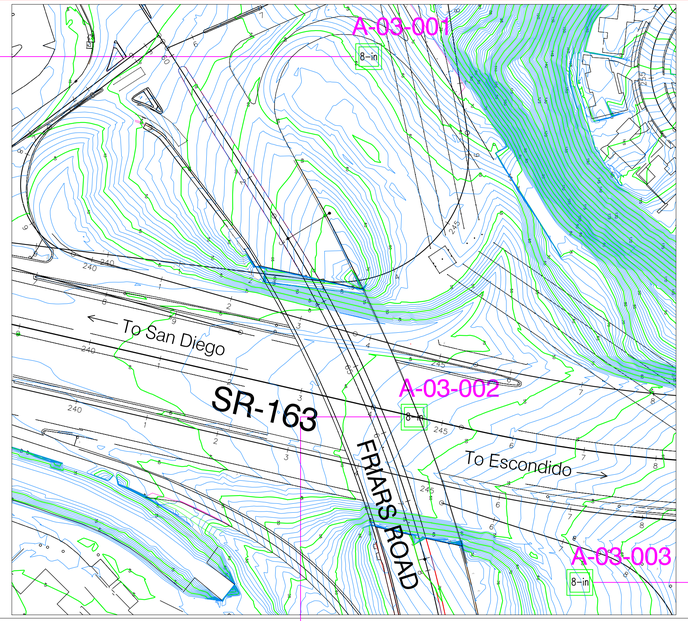
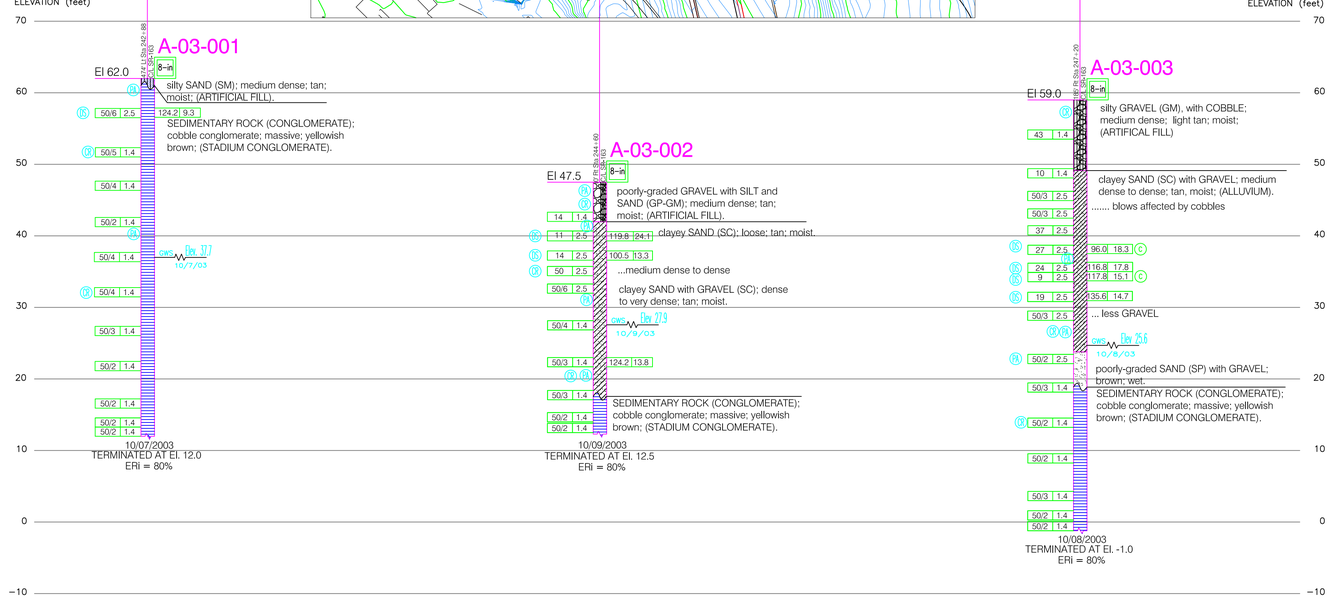


N

PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR–163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Garrett B. Fountain, GE				
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU EA		DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) -- / SHEET 4 / OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	5	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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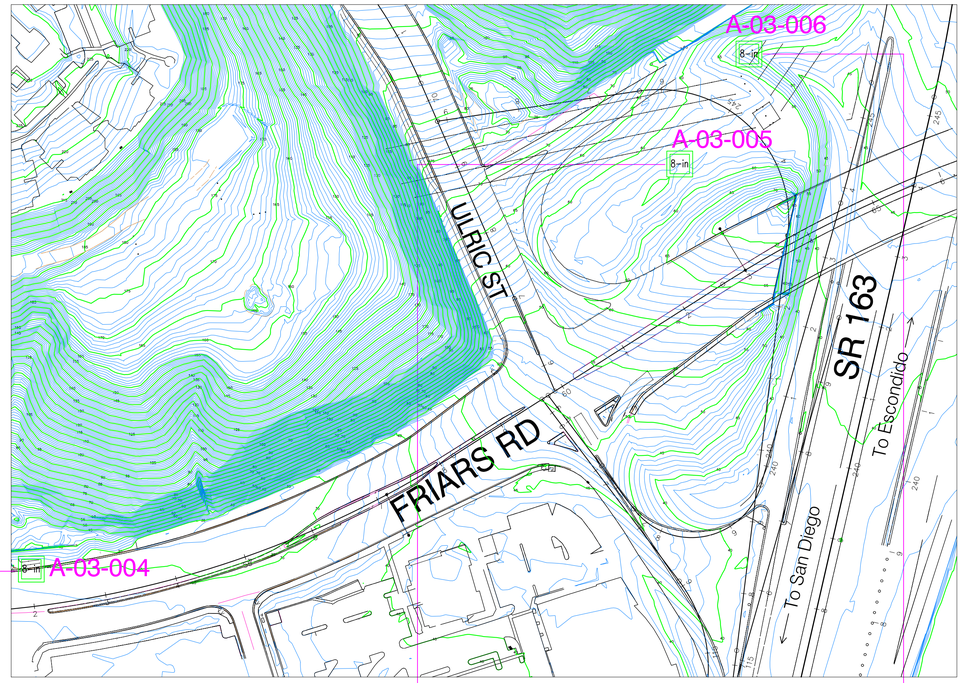
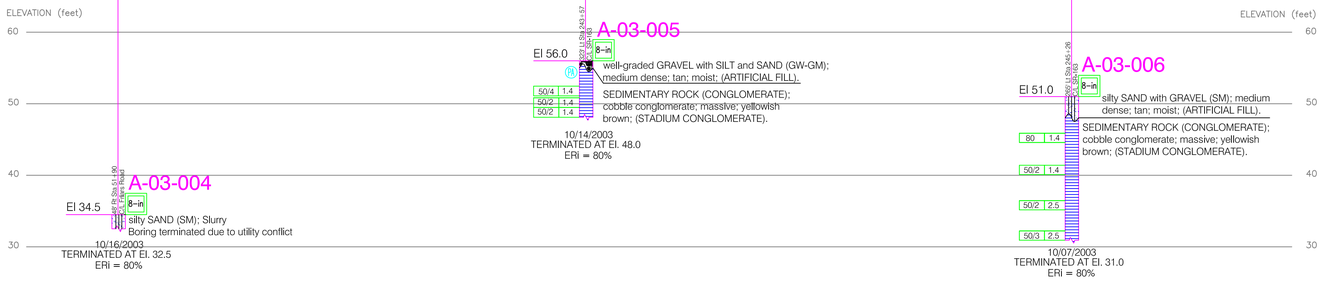


PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Garrett B. Fountain, GE				
	CHECKED BY: Garrett B. Fountain, GE					

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) --

SHEET 5 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	6	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

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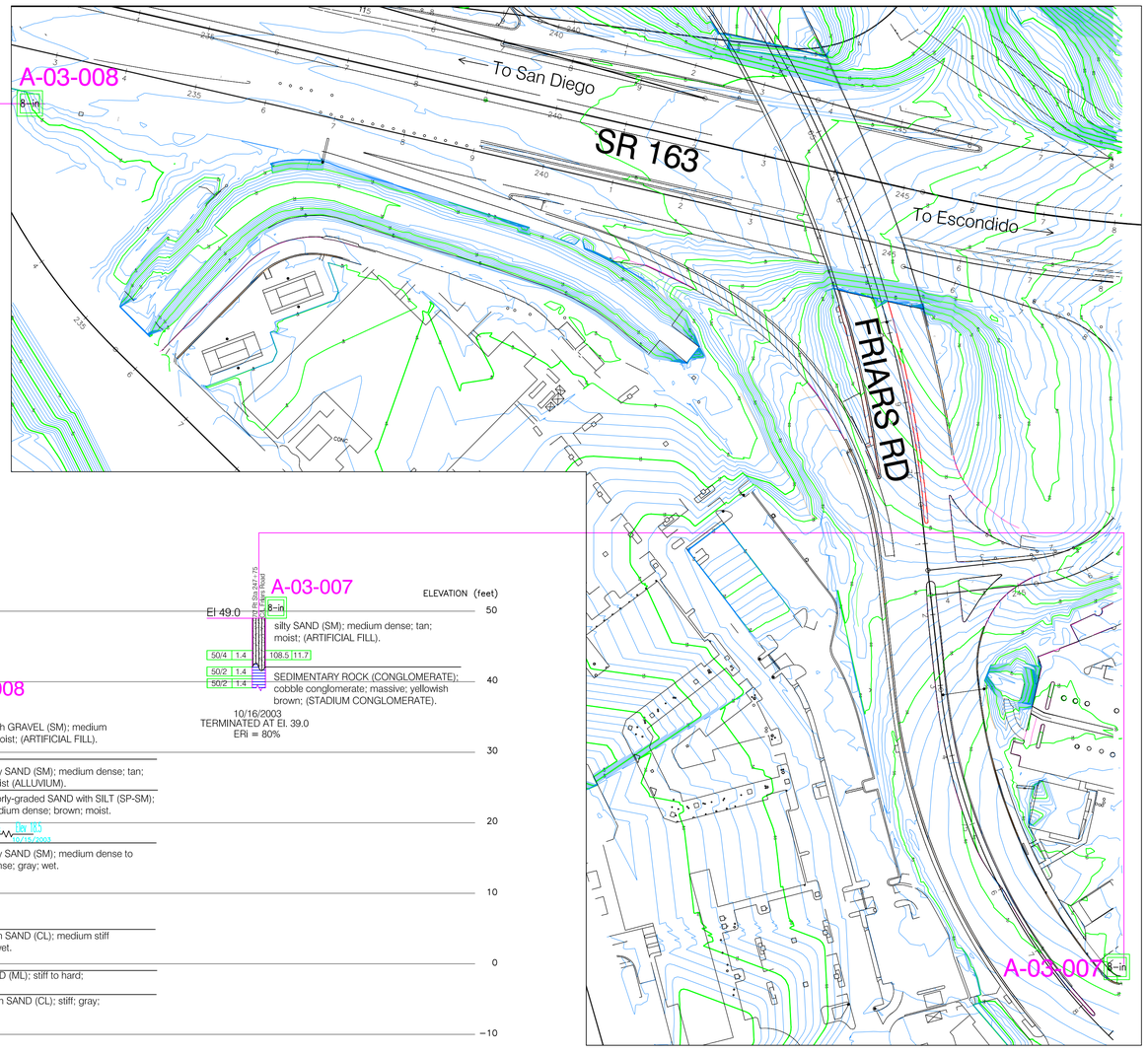
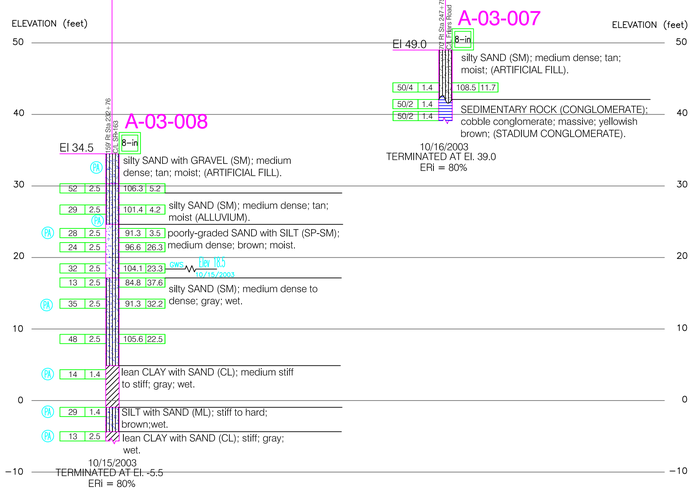
PLAN VIEW
SCALE: 1"=100'



BENCH MARK
CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Garrett B. Fountain, GE				
	CHECKED BY: Garrett B. Fountain, GE					
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) -- SHEET 6 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	7	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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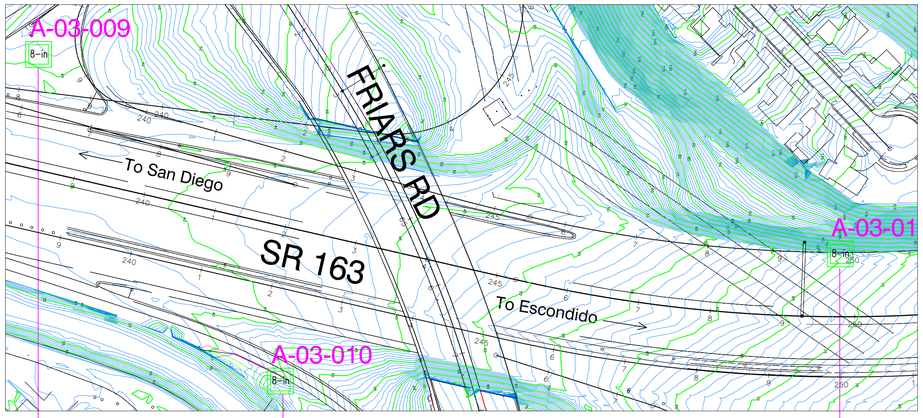

PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Garrett B. Fountain, GE	CU EA		

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
--										7	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	8	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

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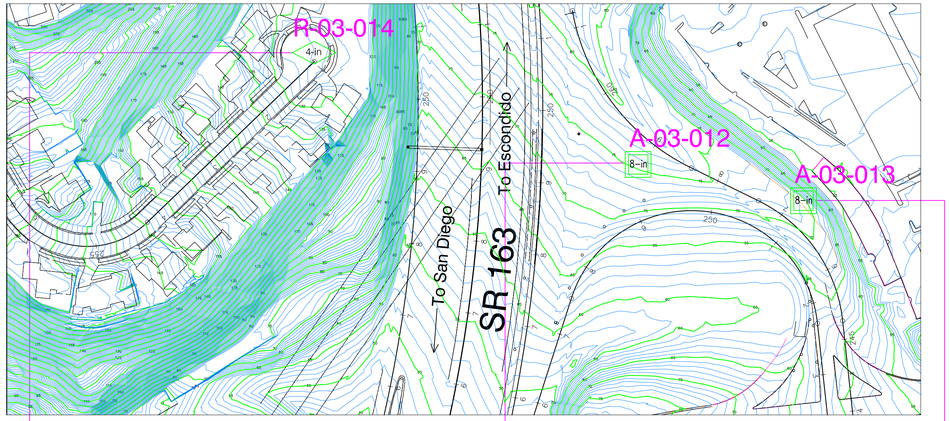
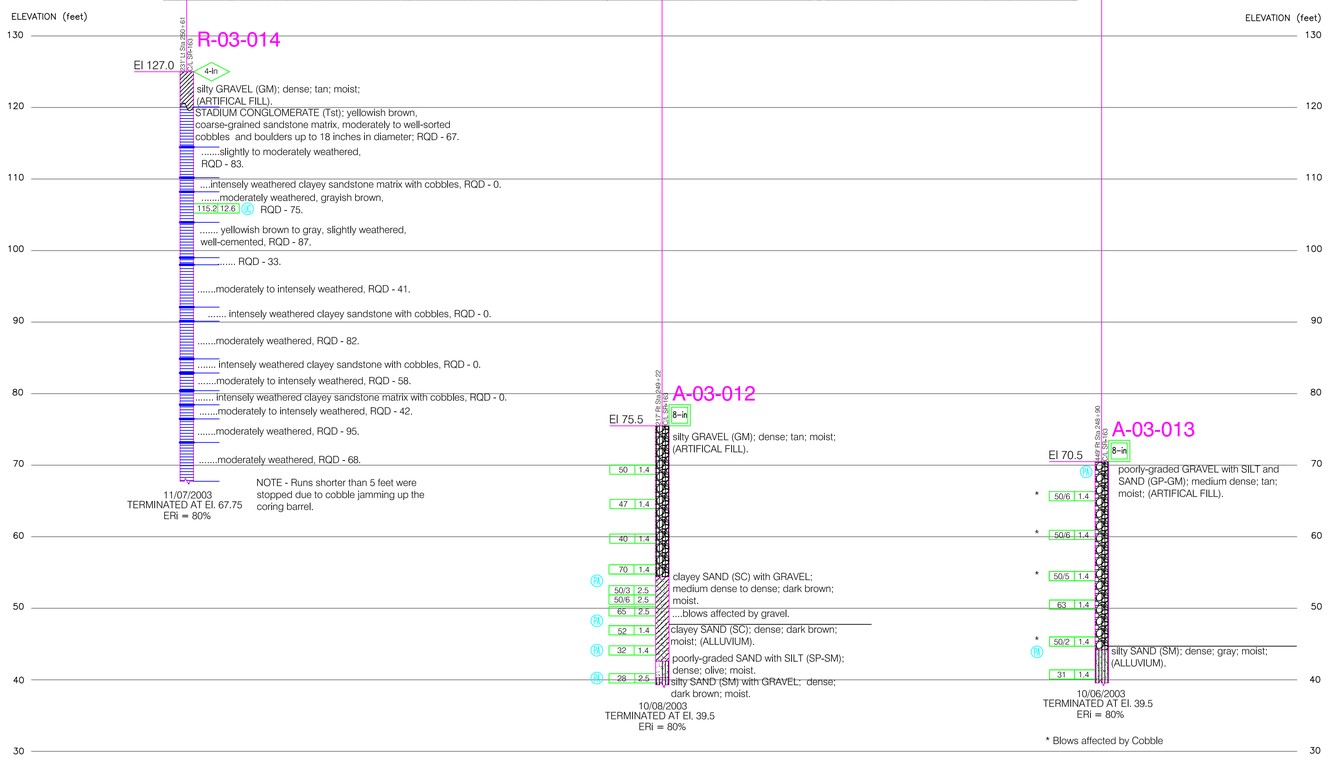


PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES				
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Garrett B. Fountain, GE	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 POST MILE 3.95–5.10

FRIARS ROAD AT SR163
LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
--	8	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	9	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER GARRETT B. FOUNTAIN No. GE 2752 Exp. 9/30/12 GEOTECHNICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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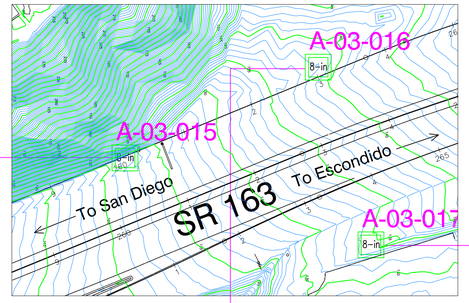
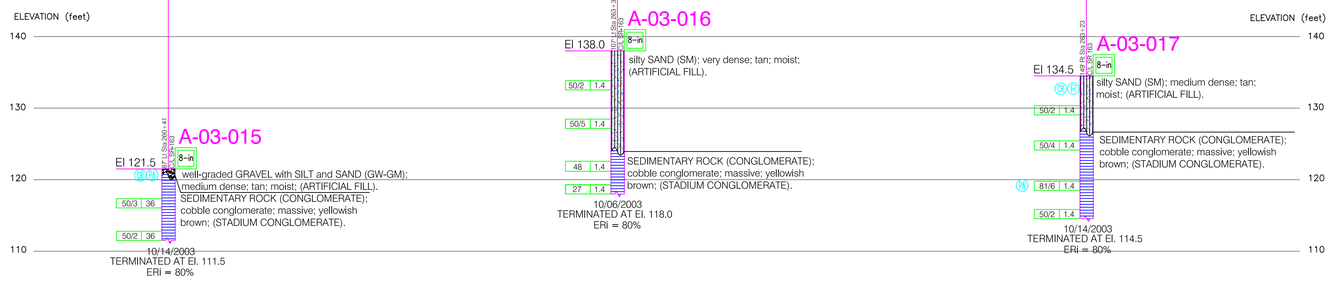
BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Garrett B. Fountain, GE				
	CHECKED BY: Garrett B. Fountain, GE					
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 9 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	10	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SCST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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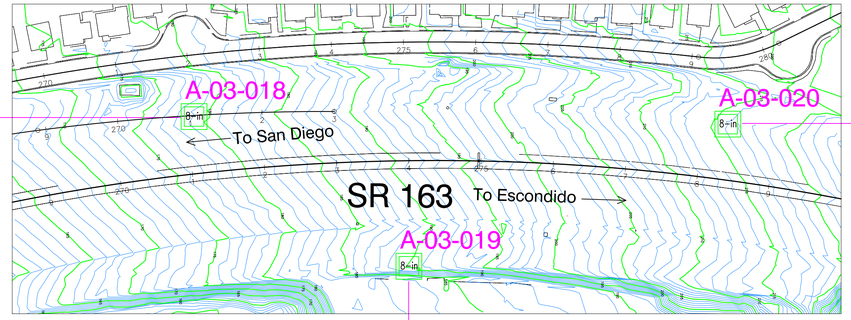
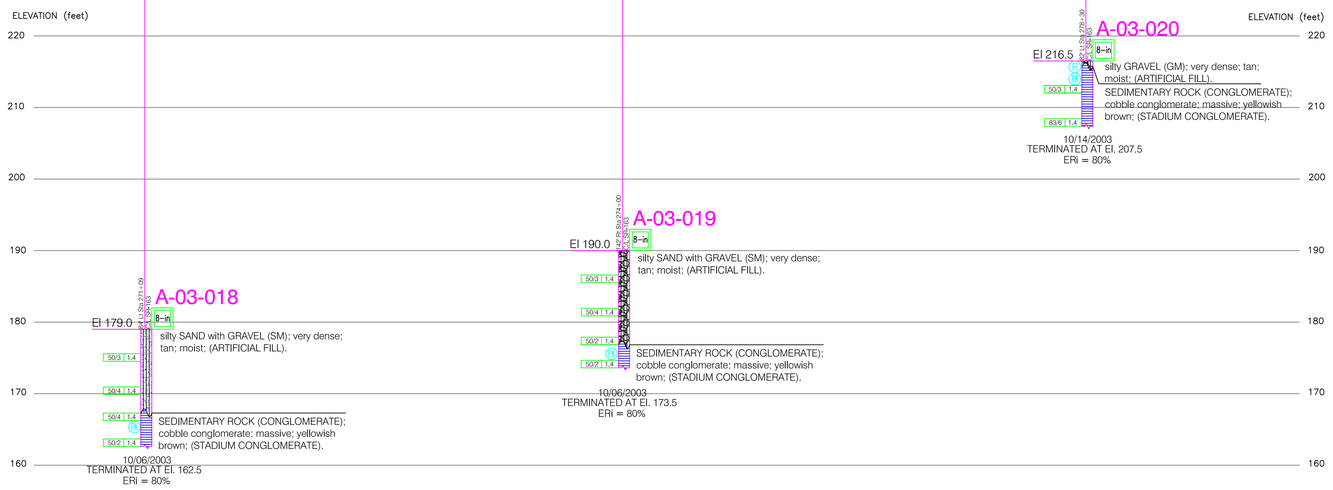


N

PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES		GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Garrett B. Fountain, GE					
	CHECKED BY: Garrett B. Fountain, GE						
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 10 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	11	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SC ST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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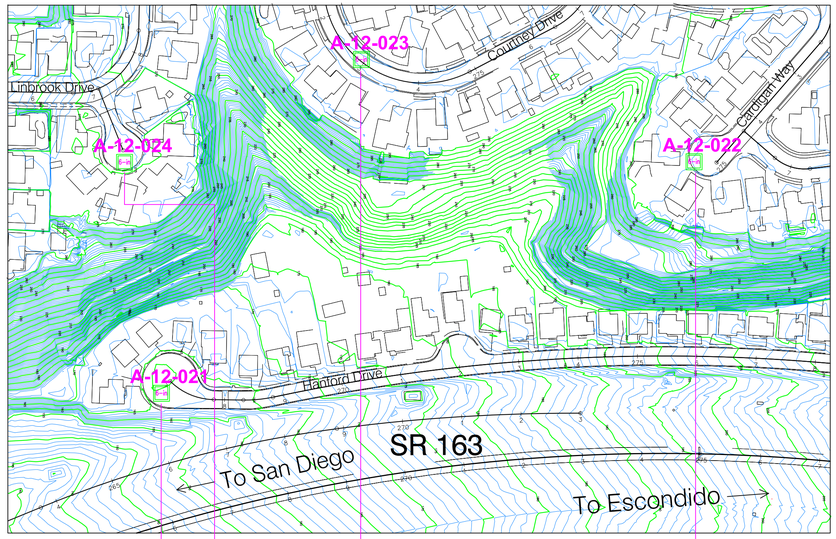
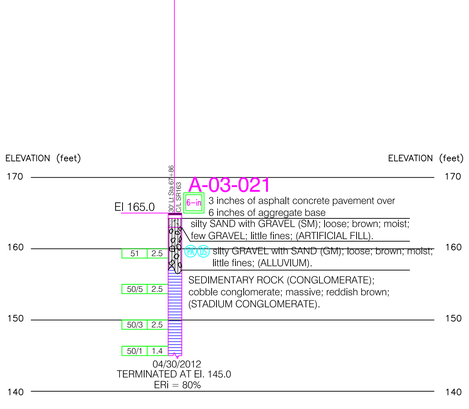
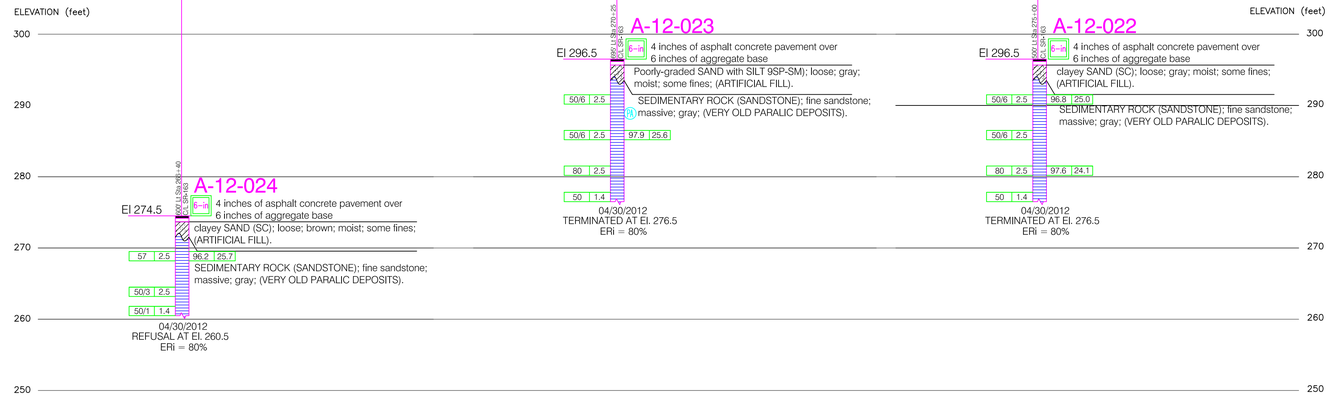
PLAN VIEW
SCALE: 1"=100'



BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.





SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES				
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Roy N. Butz, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Roy N. Butz, PG	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 POST MILE 3.95–5.10

FRIARS ROAD AT SR163
LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
--										11	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	12	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SC ST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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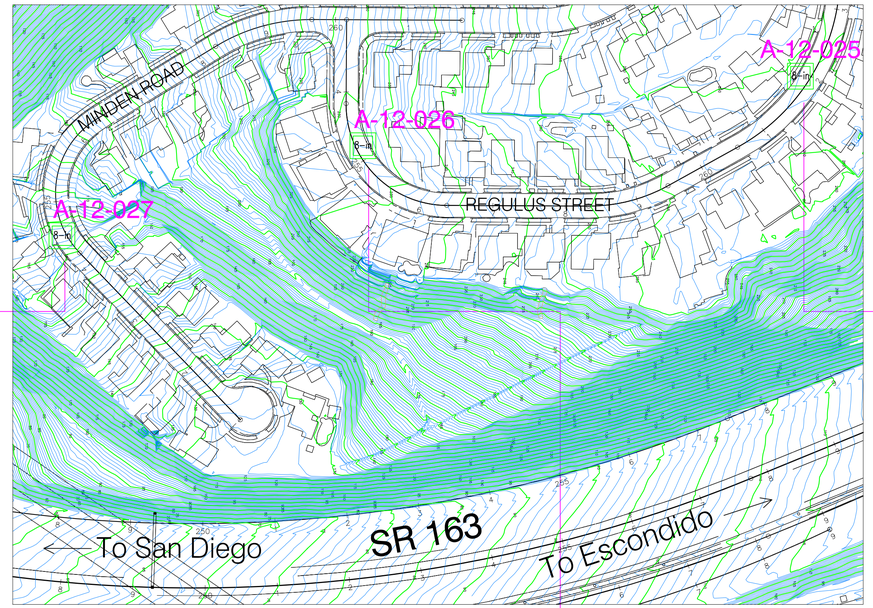
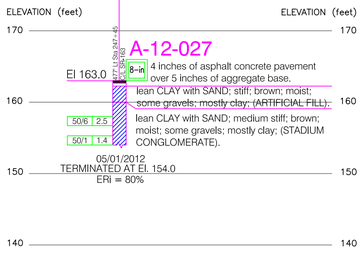
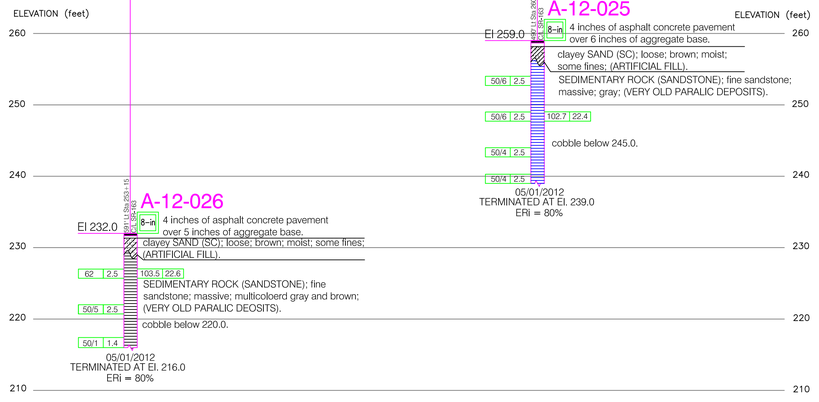
PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'





BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Roy N. Butz, PG		POST MILE 3.95–5.10	
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 12 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	13	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARRETT B. FOUNTAIN — No. GE 2752 — Exp. 9/30/12 — GEOTECHNICAL — STATE OF CALIFORNIA

SC ST SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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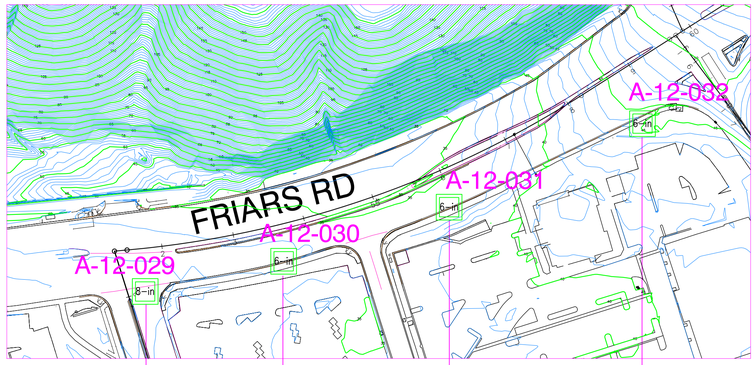
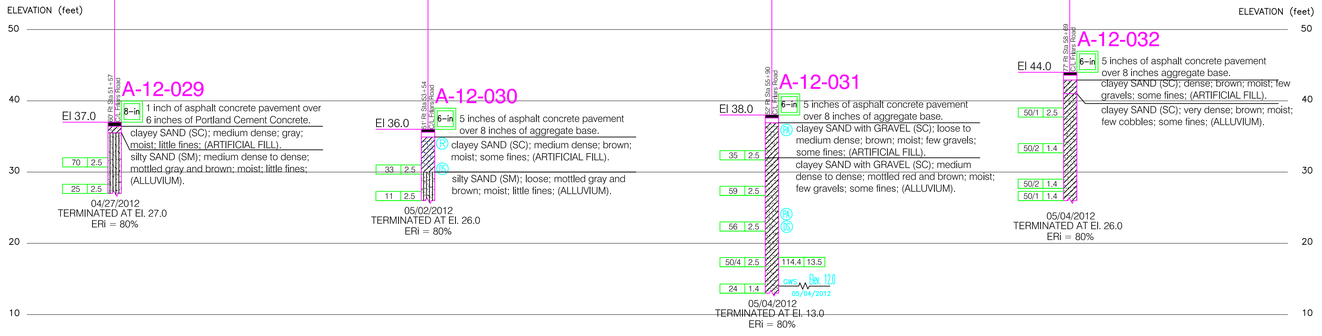
PLAN VIEW
SCALE: 1"=100'



BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY:		POST MILE 3.95–5.10	
	CHECKED BY: Garrett B. Fountain, GE	Andrew K. Neuhaus, PG			
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 13 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	14	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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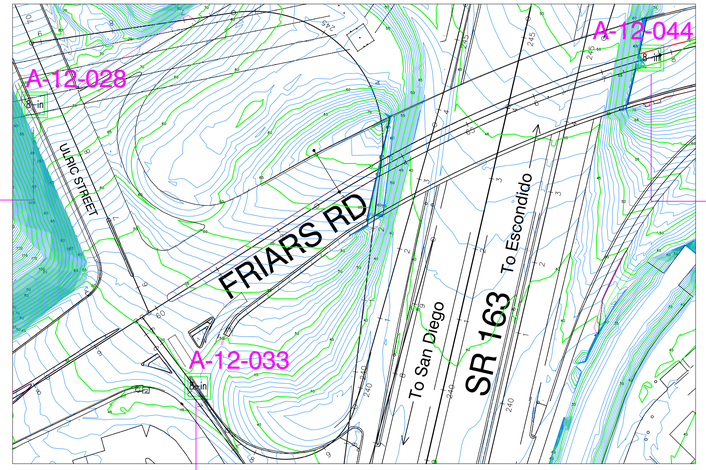
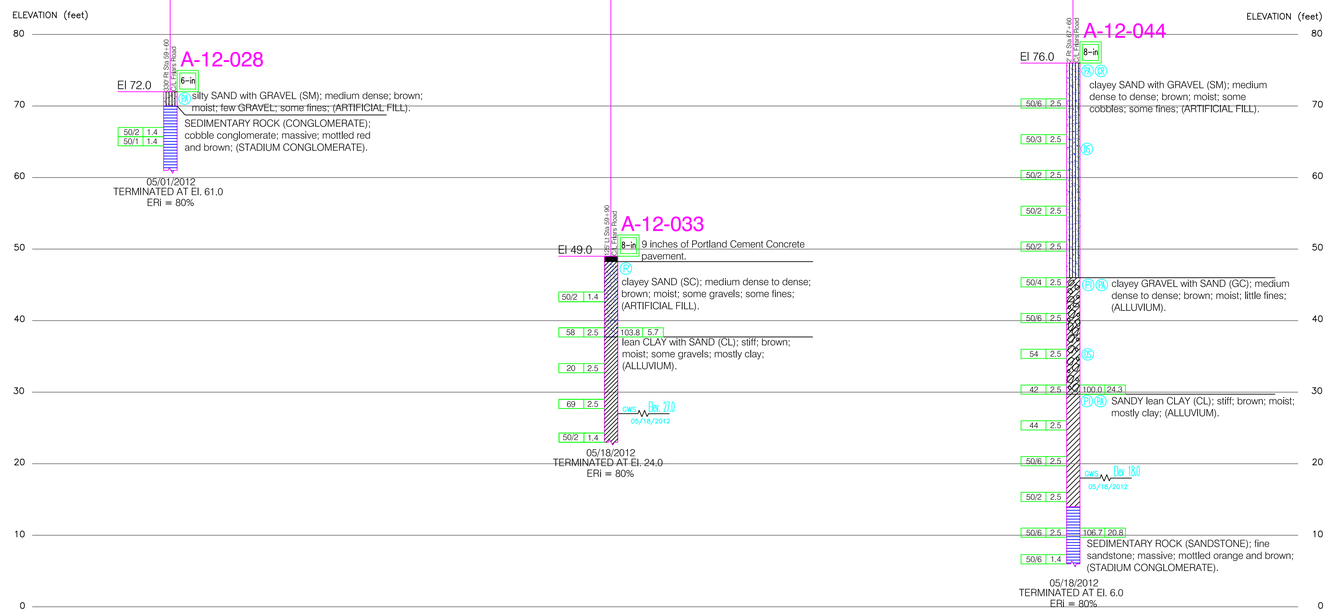


PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE

HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Roy N. Butz, PG			POST MILE 3.95–5.10	

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU FA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
--										14	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	15	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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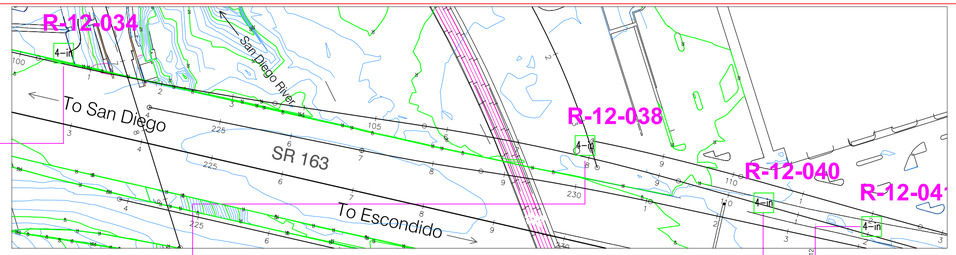
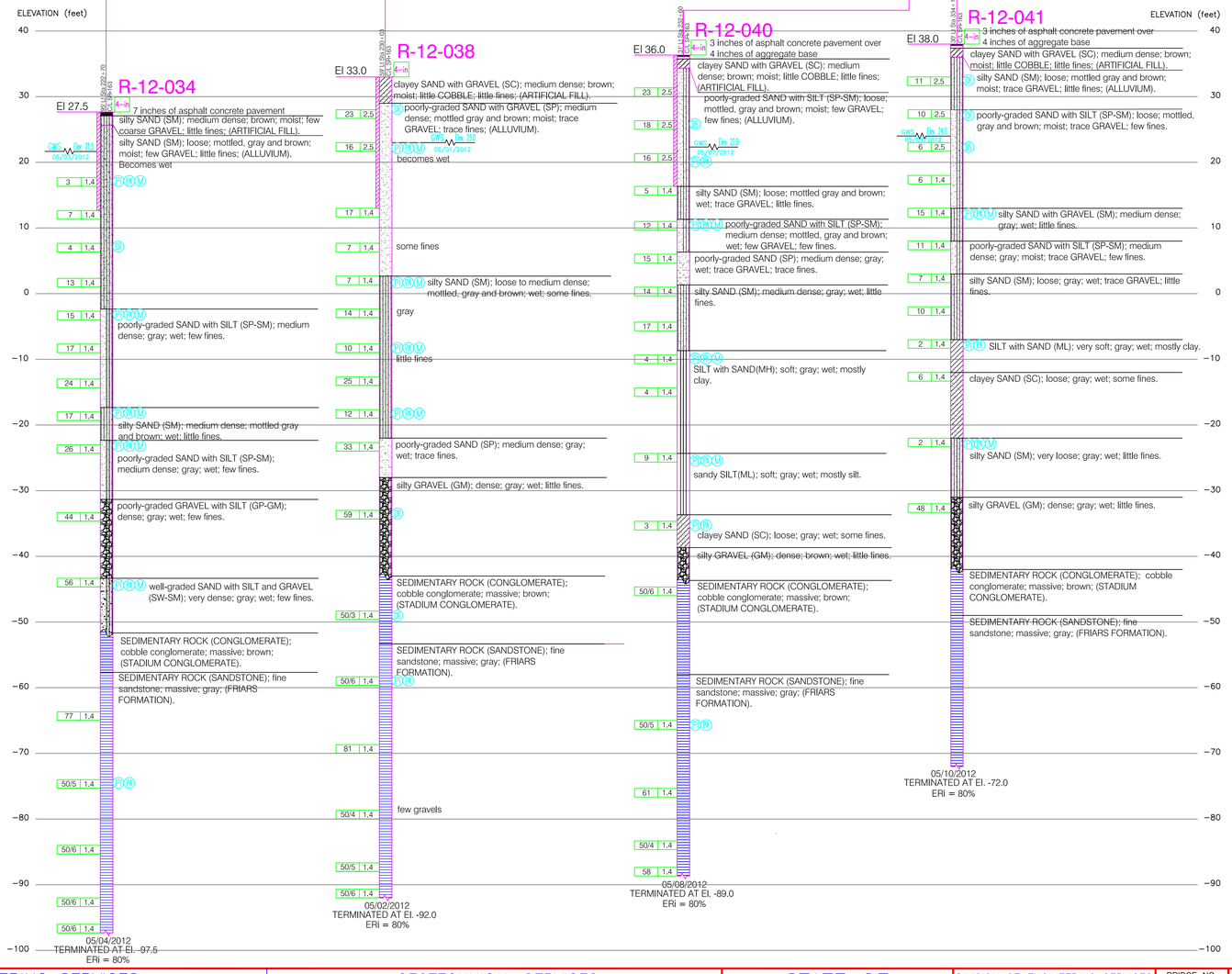


N

PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Andrew K. Neuhaus, PG			POST MILE 3.95–5.10	

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
--	15	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	16	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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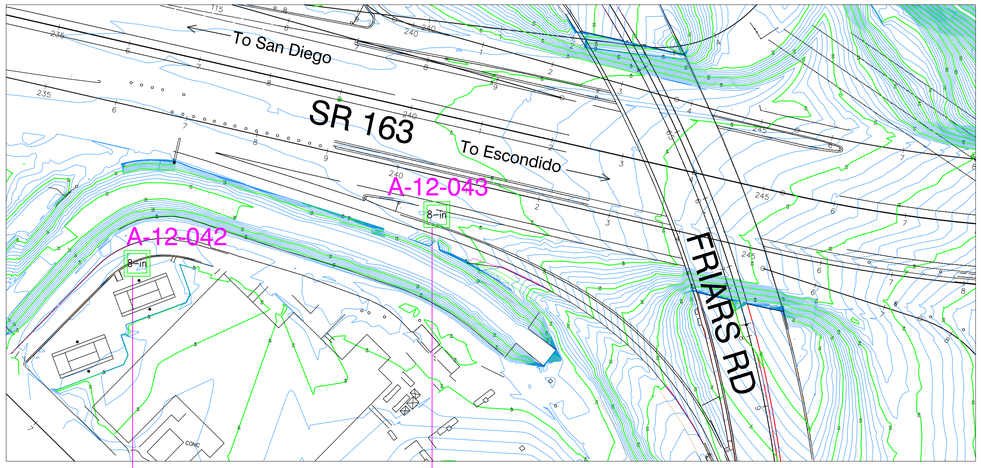
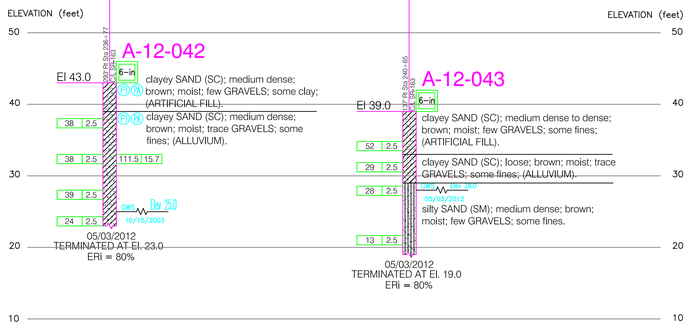
PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Roy N. Butz, PG			
	CHECKED BY: Garrett B. Fountain, GE				
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 16 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	17	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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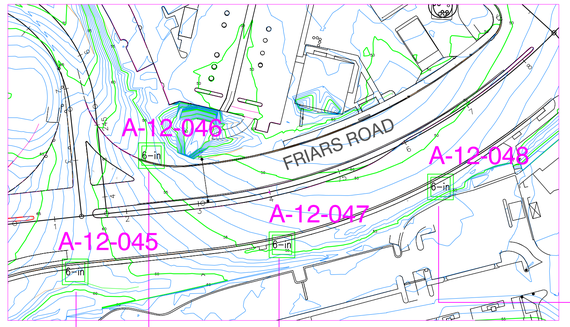
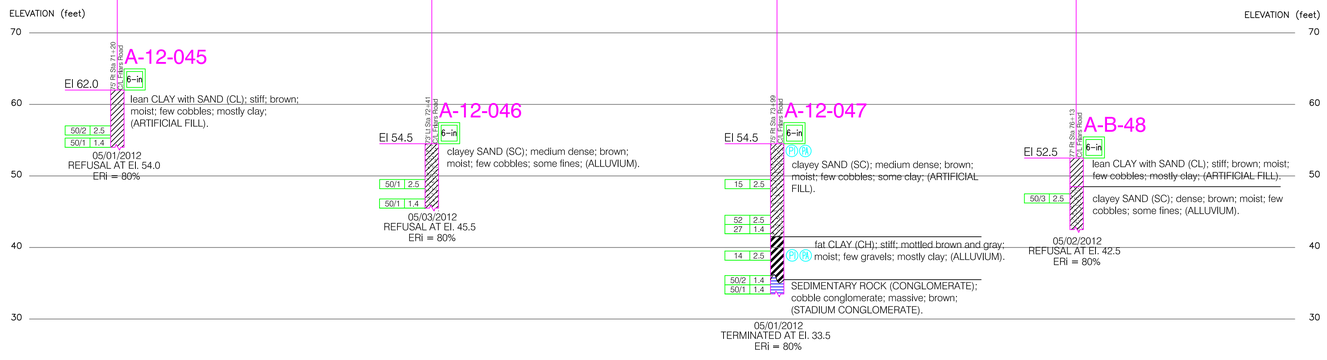


N

PLAN VIEW
SCALE: 1"=100'

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE FIELD INVESTIGATION BY: Roy N. Butz, PG				
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 17 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	18	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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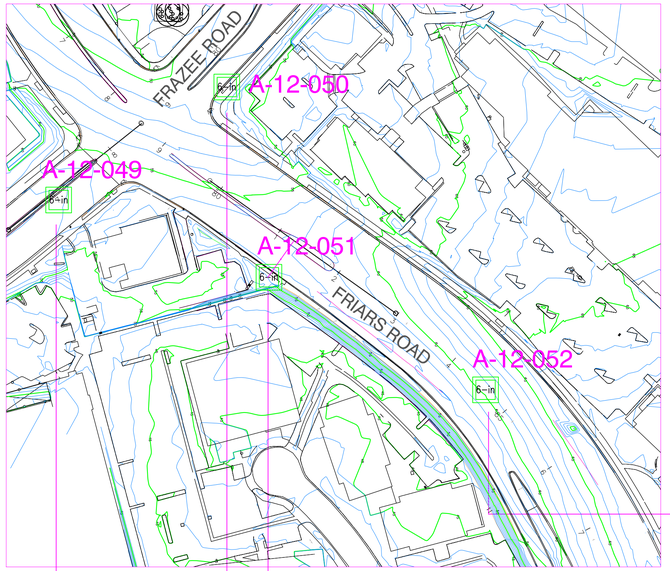
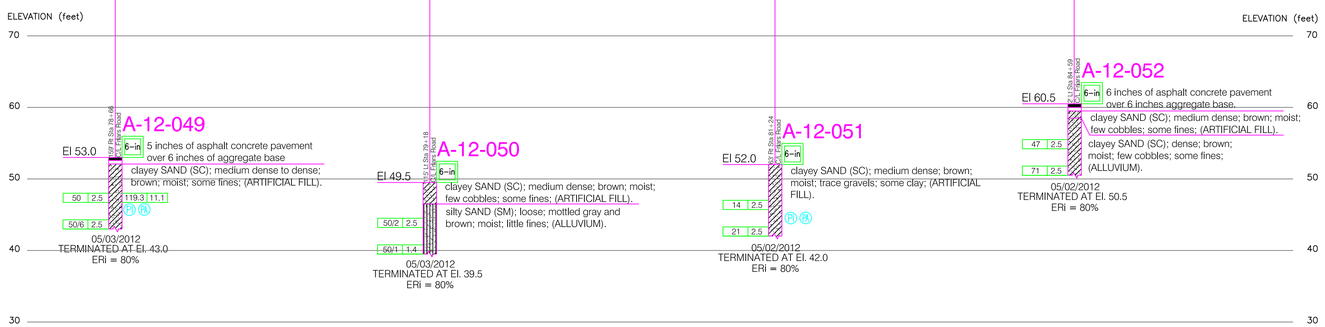


PLAN VIEW
SCALE: 1"=100'

BENCH MARK
CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595 / POST MILE 3.95–5.10	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG CHECKED BY: Garrett B. Fountain, GE	FIELD INVESTIGATION BY: Roy N. Butz, PG	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

SHEET 18 OF 20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	19	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/14
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

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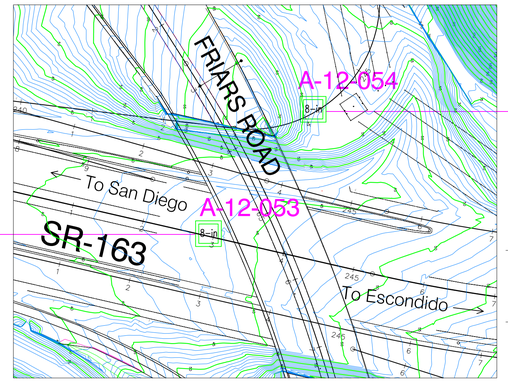
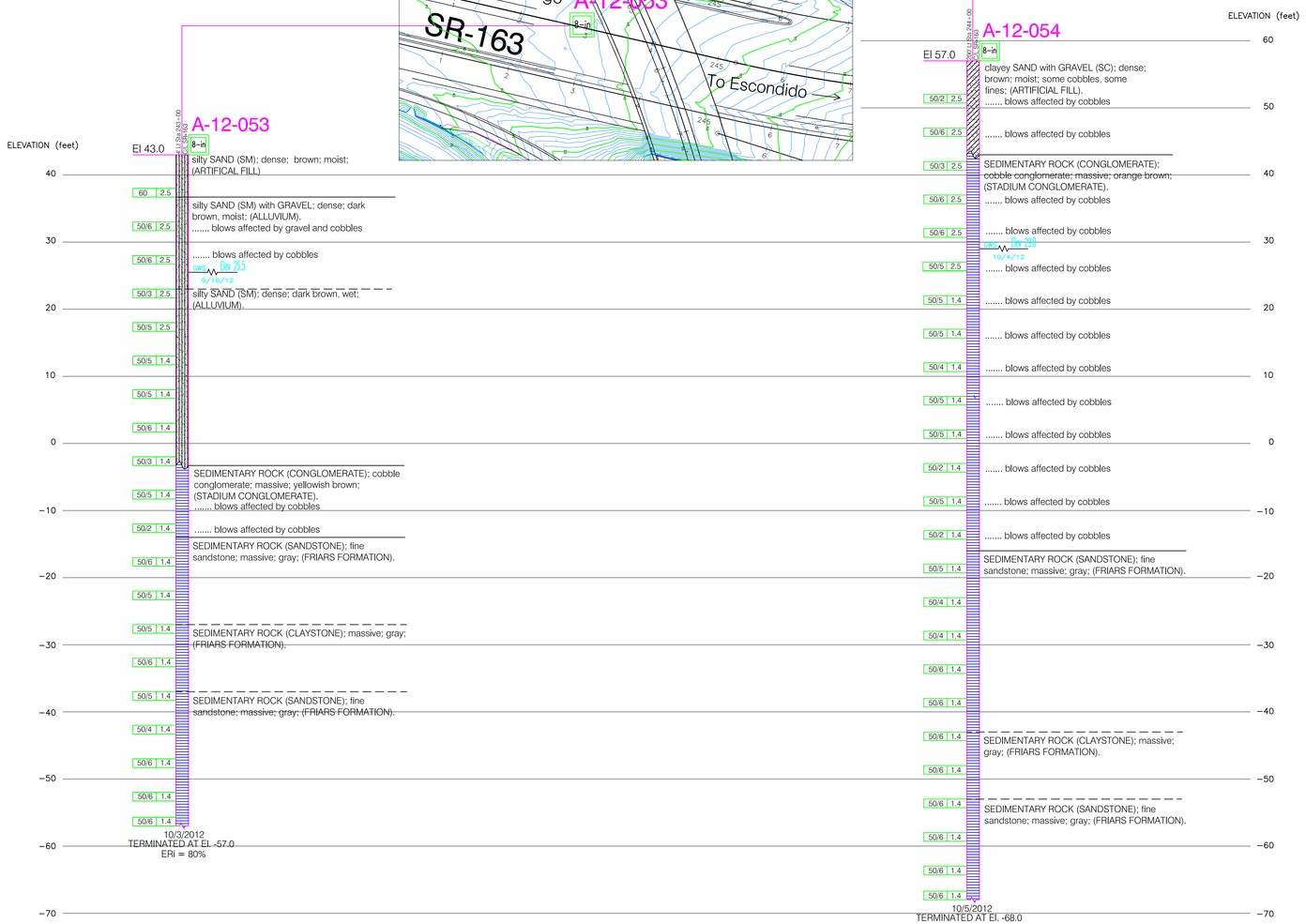
PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'



BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.

SCS&T JOB No. 1111191–5

ENGINEERING SERVICES	GEOTECHNICAL SERVICES			
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Eddie Liang, PE, Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Eddie Liang, PE; Andrew K. Neuhaus, PG	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH
	CHECKED BY: Garrett B. Fountain, GE			

BRIDGE NO.	FRIARS ROAD AT SR–163
57–595	LOG OF TEST BORINGS
POST MILE 3.95–5.10	

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS: 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
--	19	20

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	20	20

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

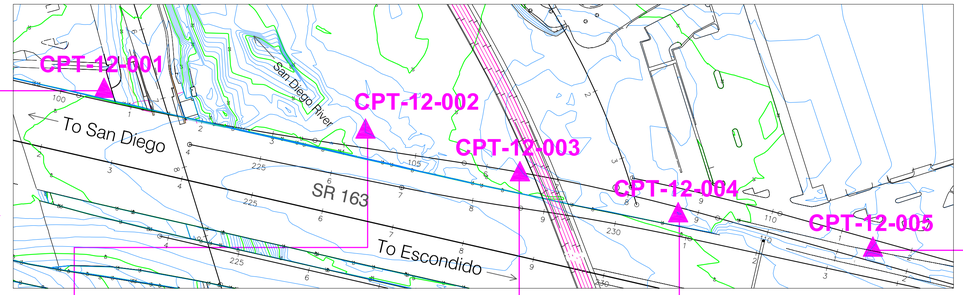
REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

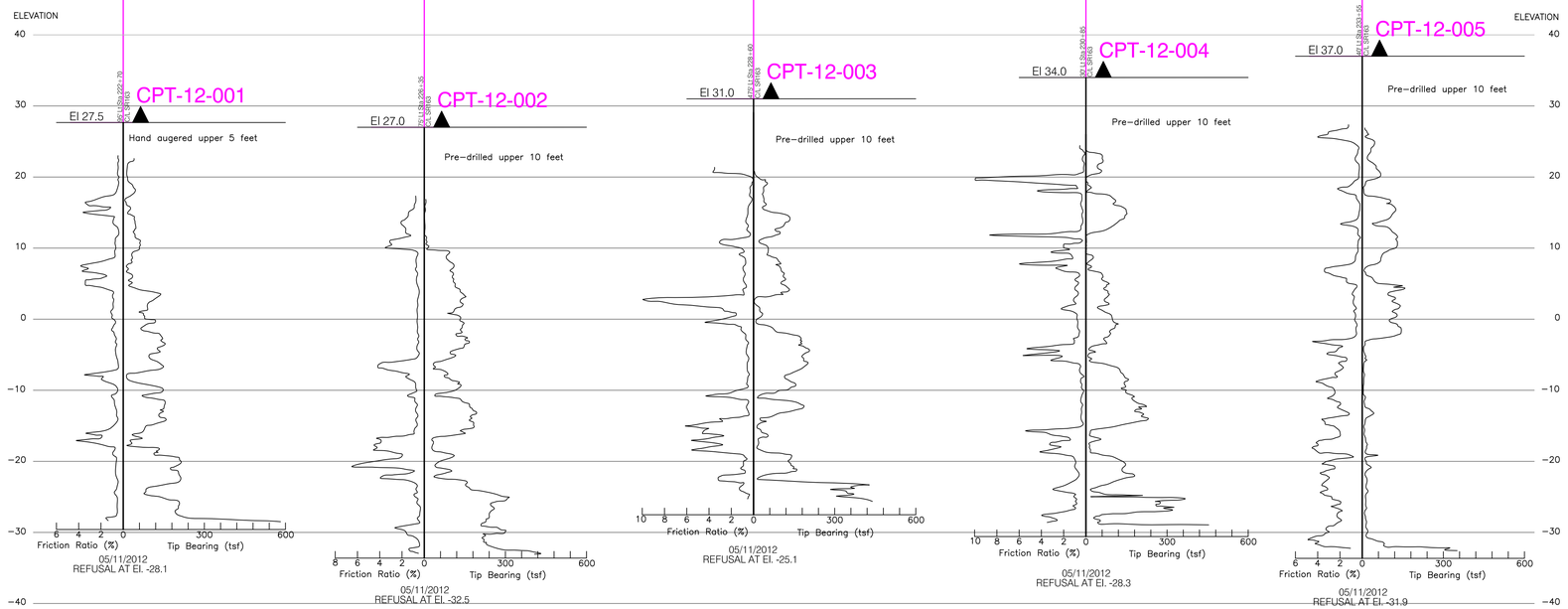
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

BENCH MARK

CDOT 163–4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR–163 northbound off–ramp to Friars Road eastbound.



PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191–1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57–595	FRIARS ROAD AT SR163 LOG OF TEST BORINGS
FUNCTIONAL SUPERVISOR Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Andrew K. Neuhaus, PG			POST MILE 3.95–5.10	
	CHECKED BY: Garrett B. Fountain, GE					
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU FA		DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) -- SHEET 20 OF 20

APPENDIX IV

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	163	3.95–5.10	1	1

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

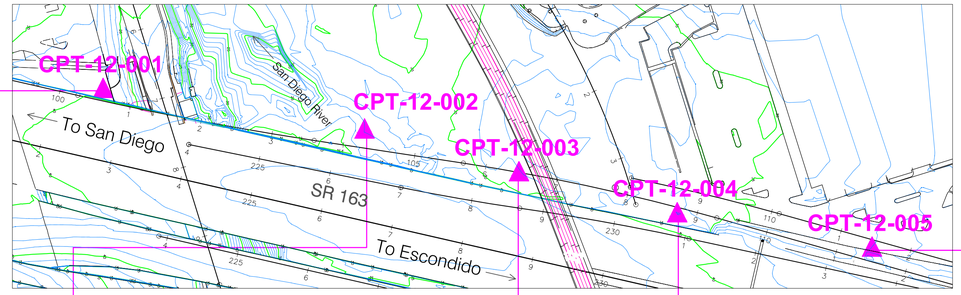
REGISTERED PROFESSIONAL ENGINEER
GARRETT B. FOUNTAIN
No. GE 2752
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFORNIA

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

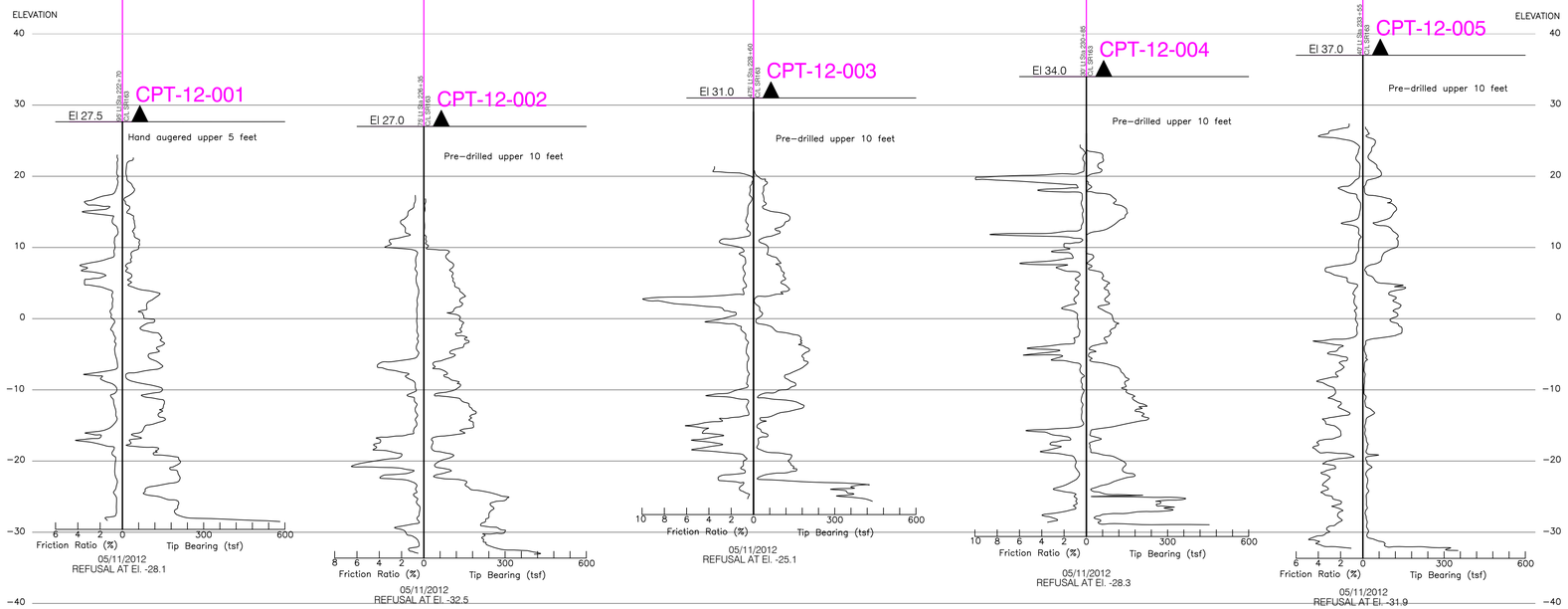
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

BENCH MARK

CDOT 163-4.4(#20) ELEV. 69.557 NAVD88 (FEET)
Monument located along the southerly shoulder of Friars Road approximiately 246 feet west of the terminus of the SR-163 northbound off-ramp to Friars Road eastbound.



PLAN VIEW
SCALE: 1"=100'



PROFILE
HOR. SCALE: N/A
VER. SCALE: 1"=10'

SCS&T JOB No. 1111191-1

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 57-595	FRIARS ROAD AT SR163
FUNCTIONAL SUPERVISOR: Garrett B. Fountain, GE	DRAWN BY: Andrew K. Neuhaus, PG	FIELD INVESTIGATION BY: Andrew K. Neuhaus, PG		POST MILE 3.95-5.10	LOG OF TEST BORINGS
	CHECKED BY: Garrett B. Fountain, GE				
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU EA	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) --	SHEET 1 OF 1

APPENDIX V
LABORATORY TESTING

The laboratory test program was designed to fit the specific needs of this project and was limited to testing on-site materials. A brief description of each type of test is presented below. Results are given on the following pages and on the boring logs in Appendix I.

Moisture contents and dry densities were determined for numerous relatively undisturbed samples. Results are listed on the log of test borings in Appendix III.

The grain size distributions of 66 samples were determined in general accordance with ASTM D 422. Results are plotted on Pages V-1 through V-66.

One-dimensional consolidation tests were performed on two relatively undisturbed samples in general accordance with ASTM D 2435. Results are shown on PageV-70 through V-71.

In addition to in-situ field tests, strength characteristics of the subsurface soils were determined in the laboratory by direct shear tests performed on seven relatively undisturbed samples. Specimens were submerged and tested at three normal loads. The direct shear tests were performed in general accordance with ASTM D 3080. Results are shown on Pages V-72 through V-83.

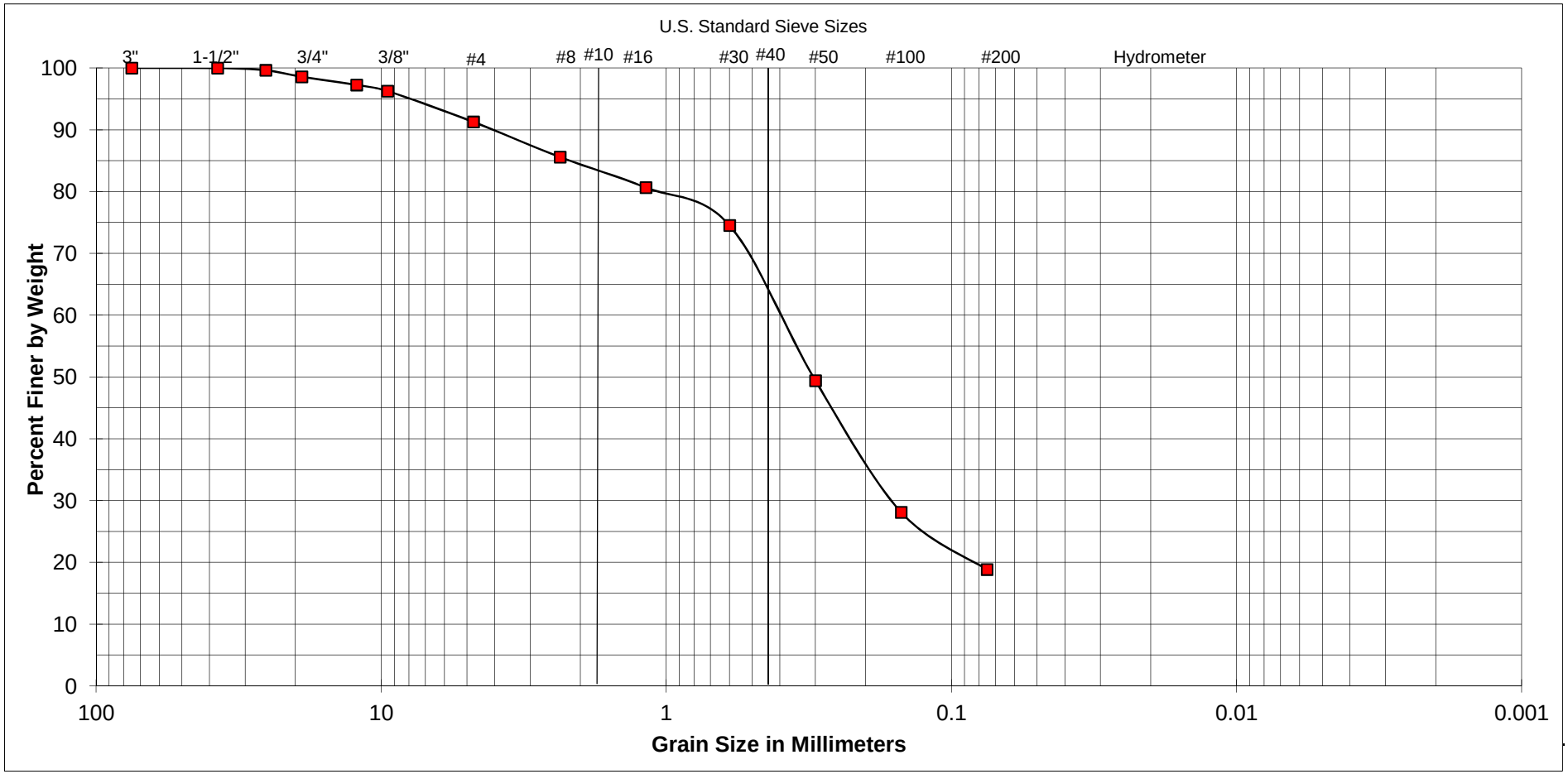
A maximum density and optimum moisture content test was performed in accordance with ASTM D 1557. Results are presented on Page V-67.

R-value tests were performed on eight samples of soil considered reasonably representative of final subgrade materials. The tests were performed in accordance with California Test 301 procedures. Results are presented on Page V-67.

Corrosivity tests were performed on 17 samples. The pH and minimum resistivity were determined in general accordance with California Test 643. Soluble sulfate content was determined in accordance with California Test 417. Total chloride ion content was determined in accordance with California Test 532. Results are presented on Page V-68 and V-69.

An Unconfined Compressive Strength test was performed on one sample. The strength was determined in general accordance with ASTM D 2938. Results are shown on Page V-84.

Soil samples not tested are now stored in our laboratory for future reference and analysis, if needed. Unless notified to the contrary, all samples will be disposed of 30 days from the date of this report.



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-001
SAMPLE LOCATION:	1 foot to 3 feet

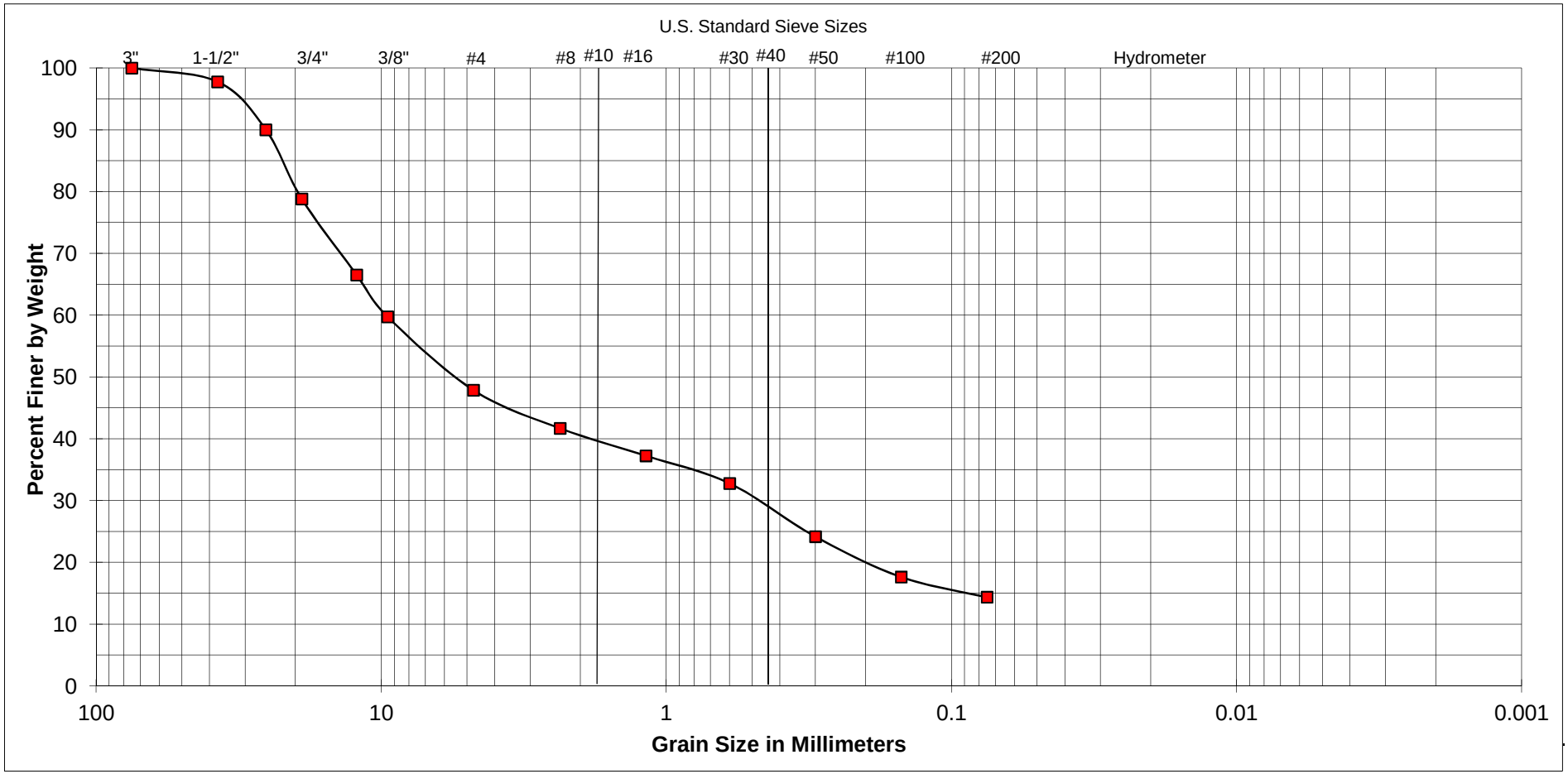
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-1



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-001
SAMPLE LOCATION:	21½ feet to 25 feet

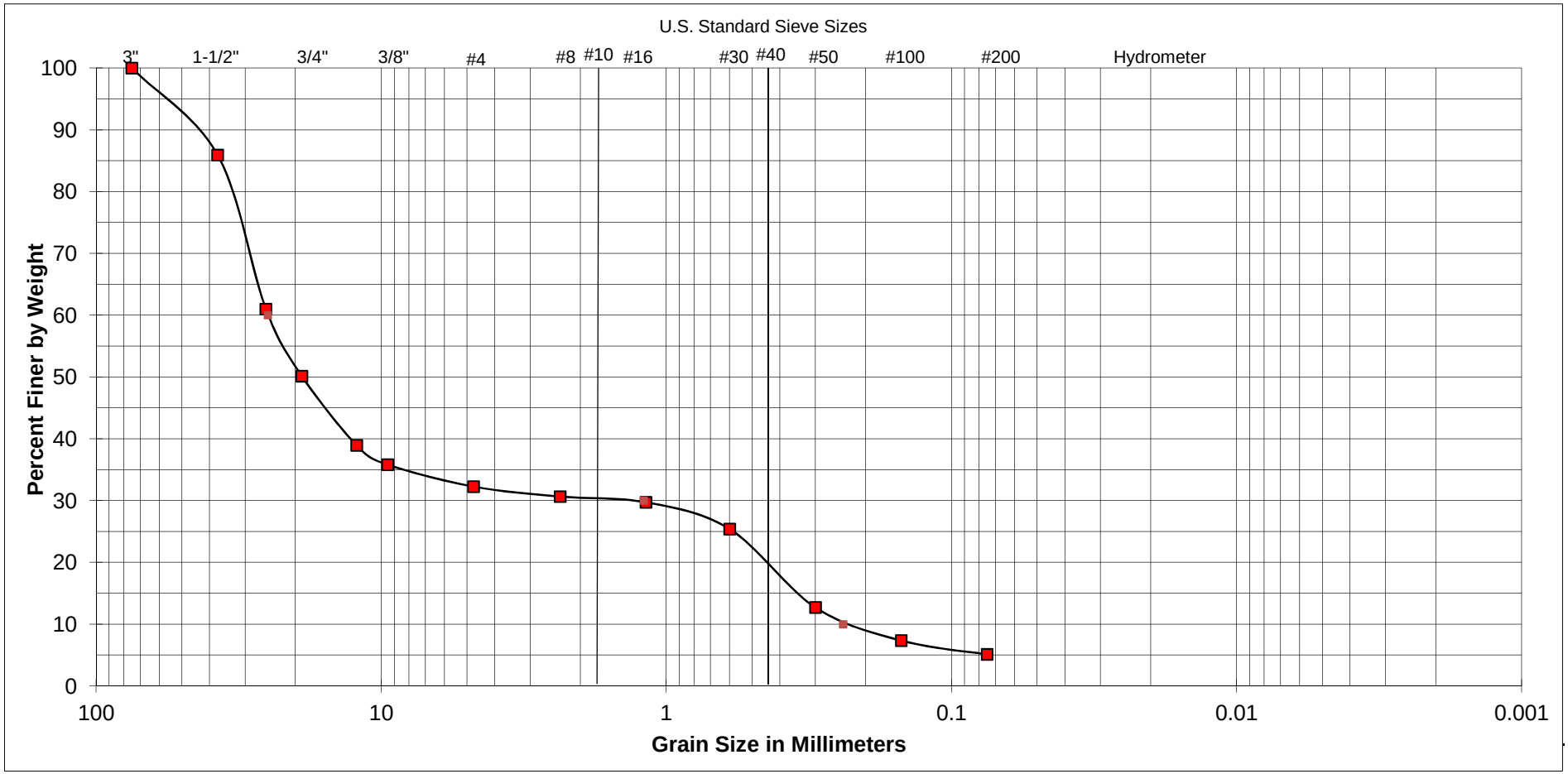
UNIFIED SOIL CLASSIFICATION:	GM
DESCRIPTION:	SILTY GRAVEL with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-2



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	1 foot to 3½ feet

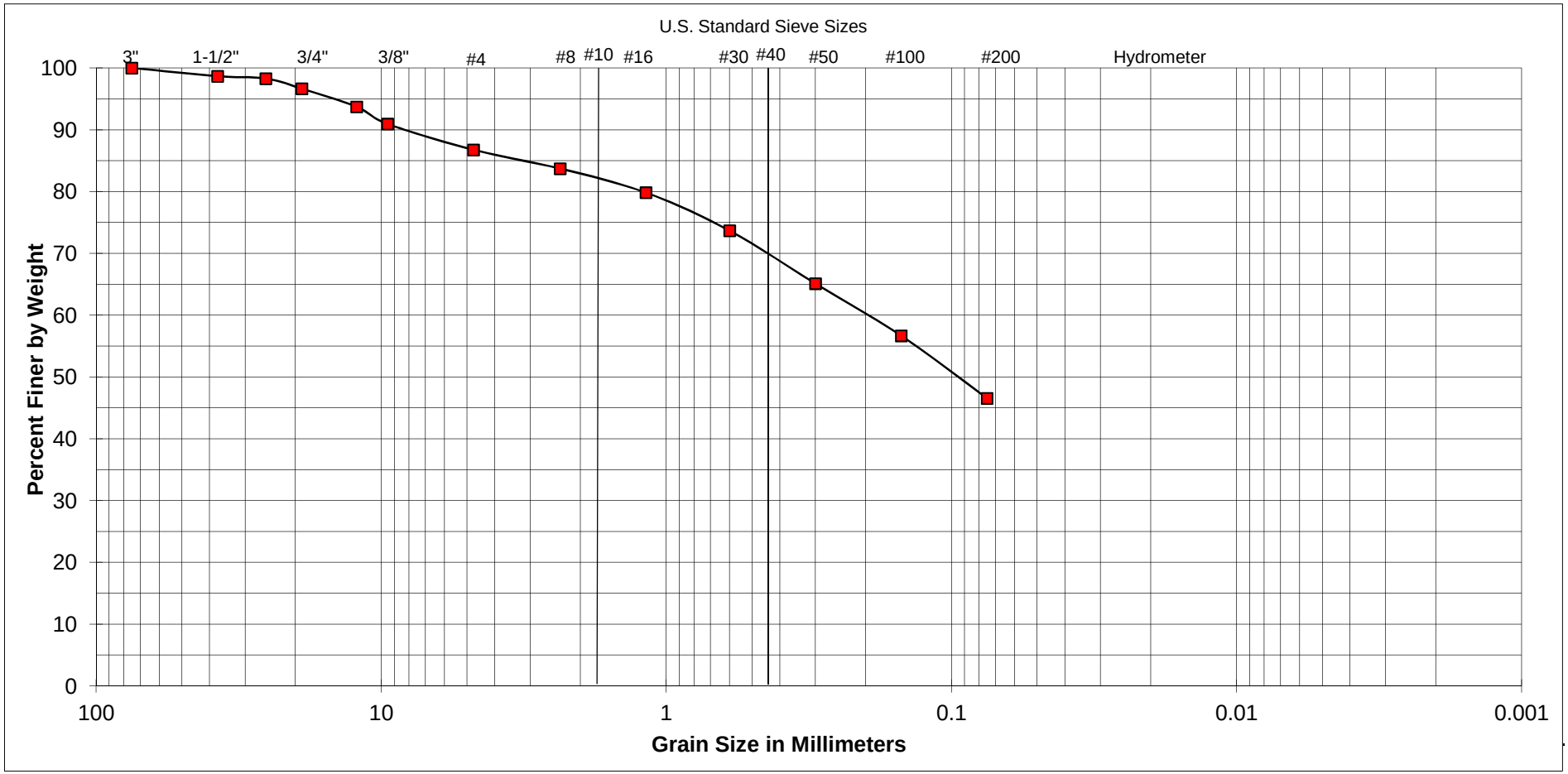
UNIFIED SOIL CLASSIFICATION:	GP-GM
DESCRIPTION:	POORLY-GRADED GRAVEL with SILT and SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-3



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	6 feet to 8 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	56
PLASTIC LIMIT:	24
PLASTICITY INDEX:	32

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-4

GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	17 feet to 20 feet

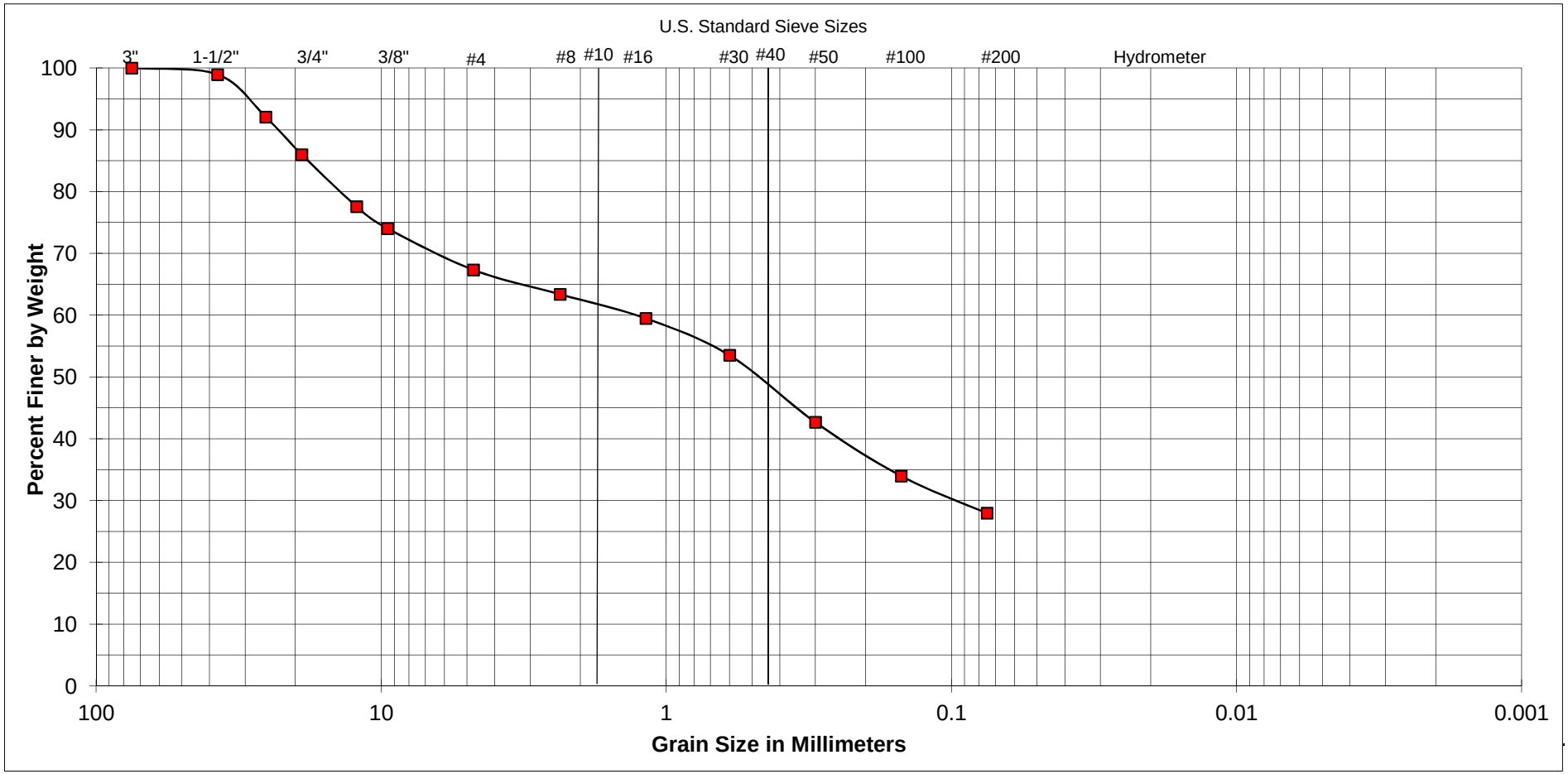
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-5



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-002
SAMPLE LOCATION:	26 feet to 28 feet

UNIFIED SOIL CLASSIFICATION: SC

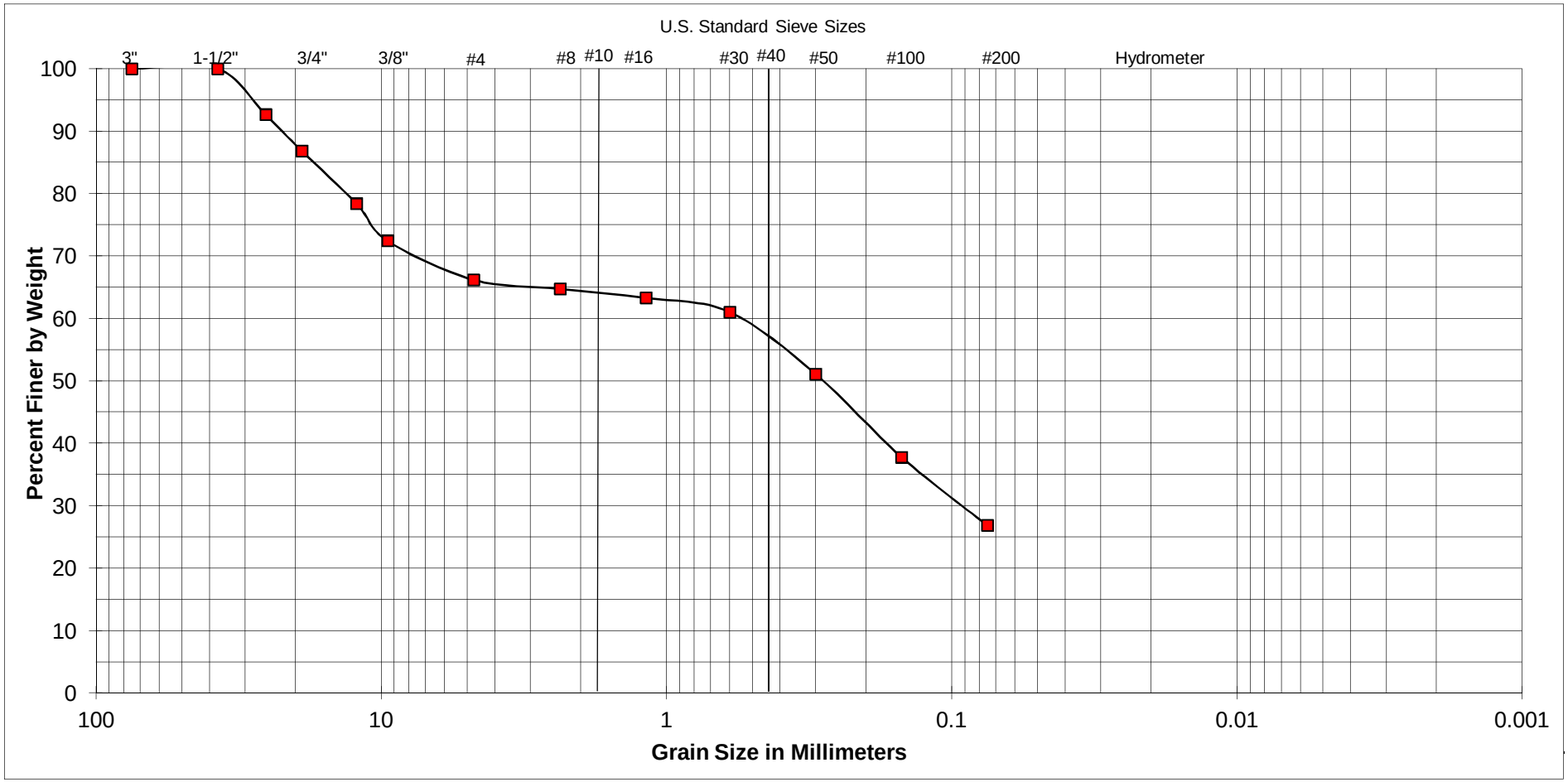
DESCRIPTION: CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	33
PLASTIC LIMIT:	21
PLASTICITY INDEX:	12

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE	V-6



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	21½ feet to 23 feet

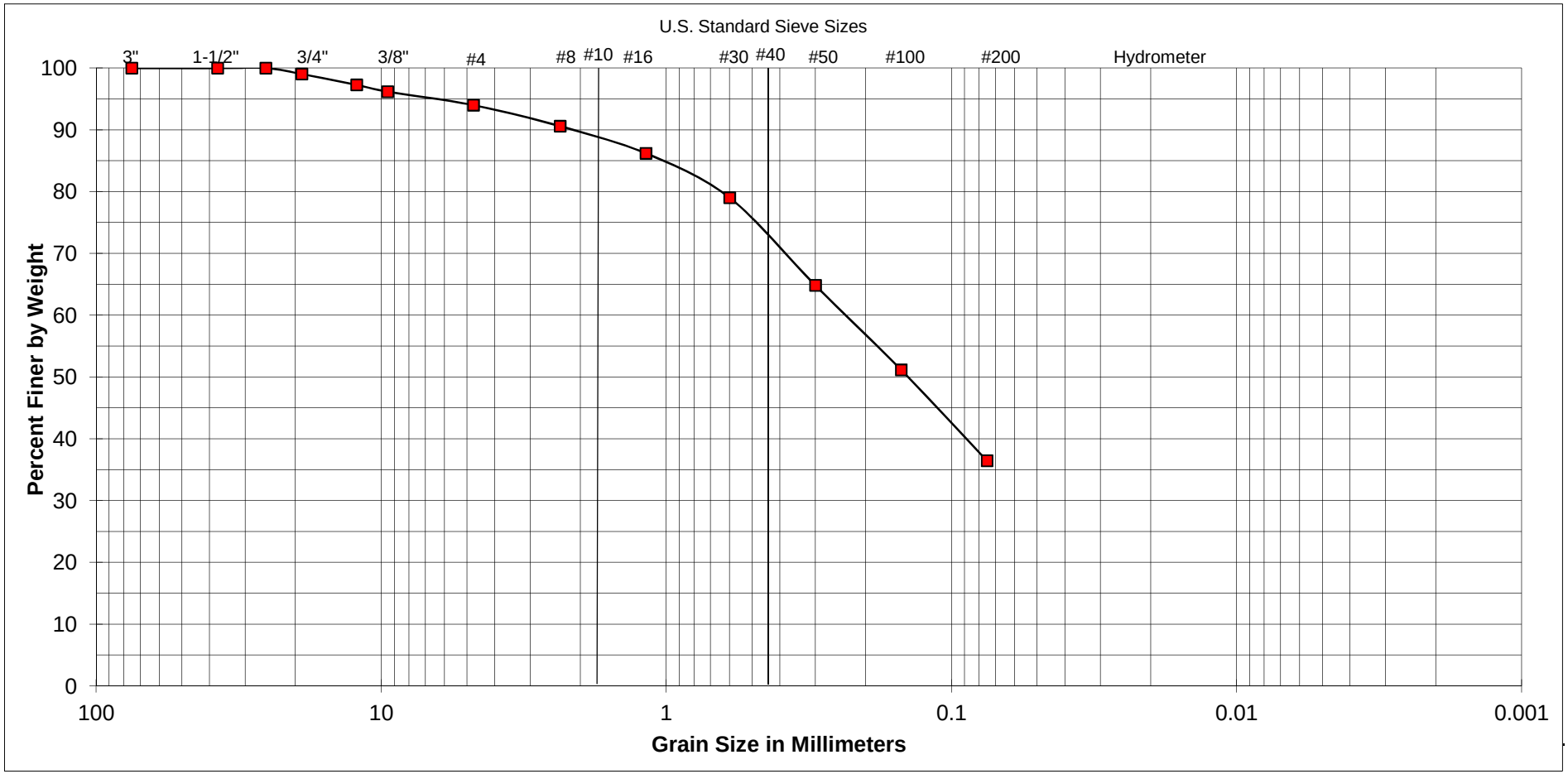
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-7



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	32½ f.t to 34½ ft.

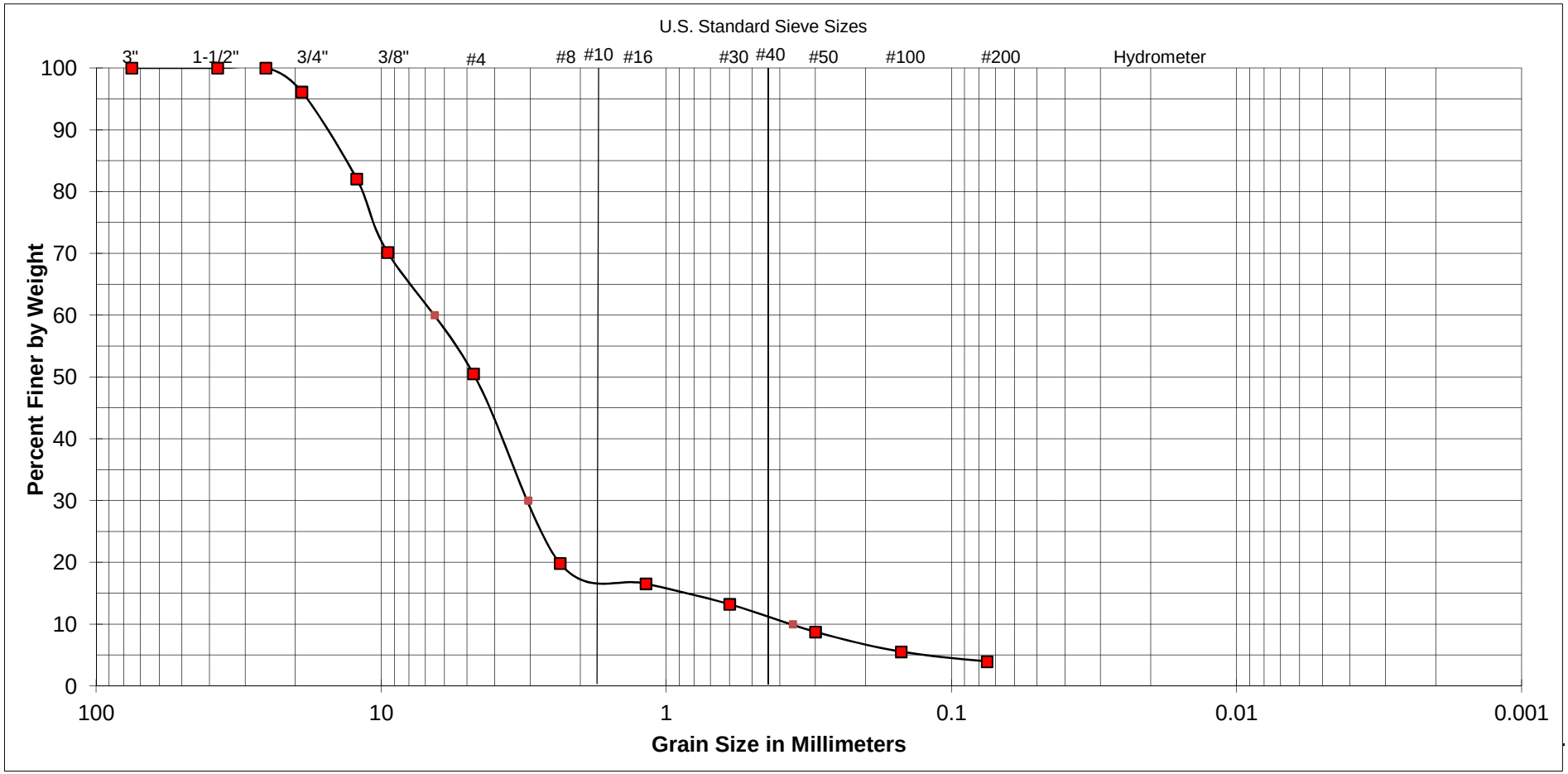
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-8



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-003
SAMPLE LOCATION:	35½ feet

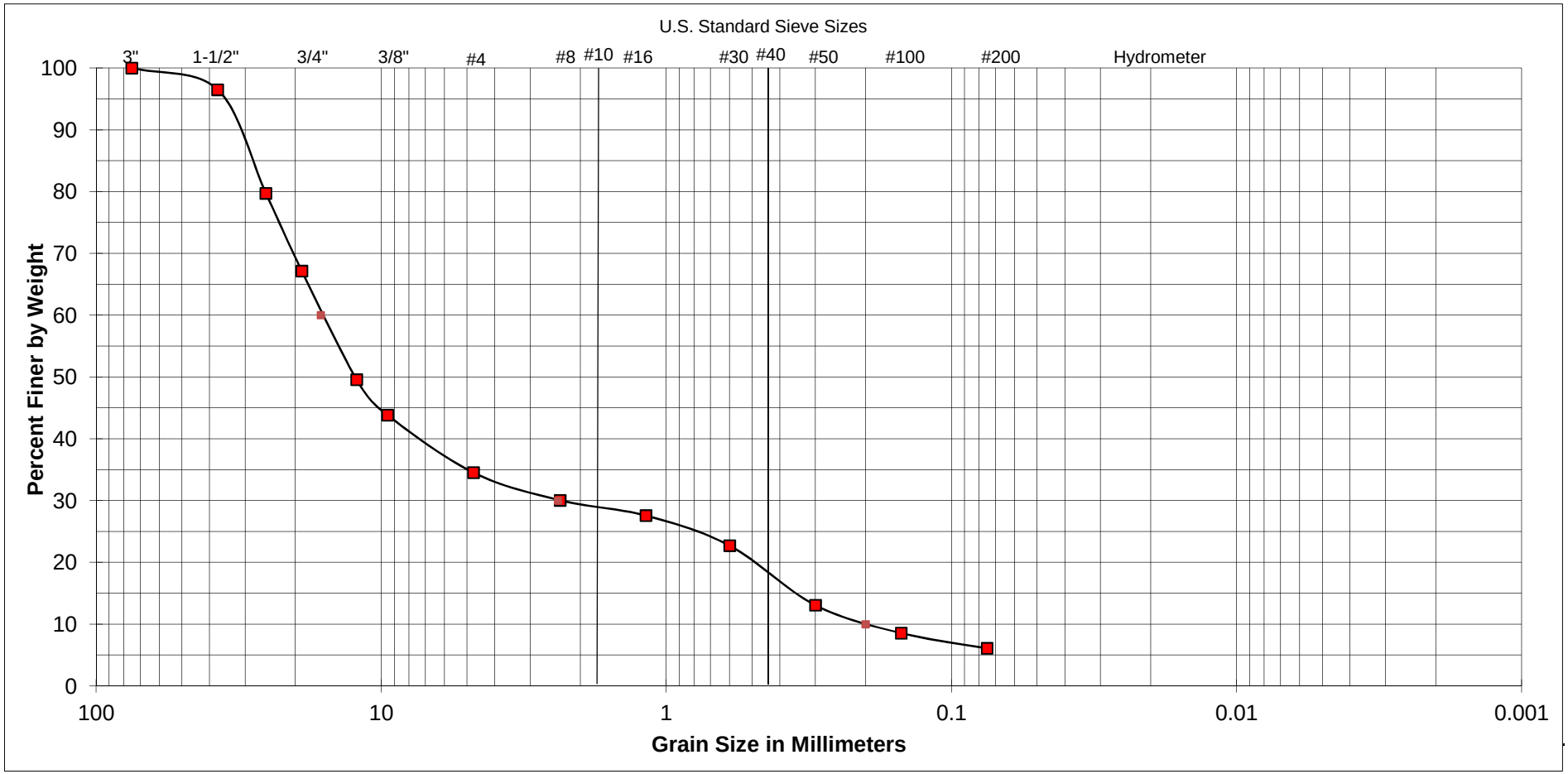
UNIFIED SOIL CLASSIFICATION:	SP
DESCRIPTION:	POORLY-GRADED SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-9



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-005
SAMPLE LOCATION:	1 foot to 3½ feet

UNIFIED SOIL CLASSIFICATION: GW-GM

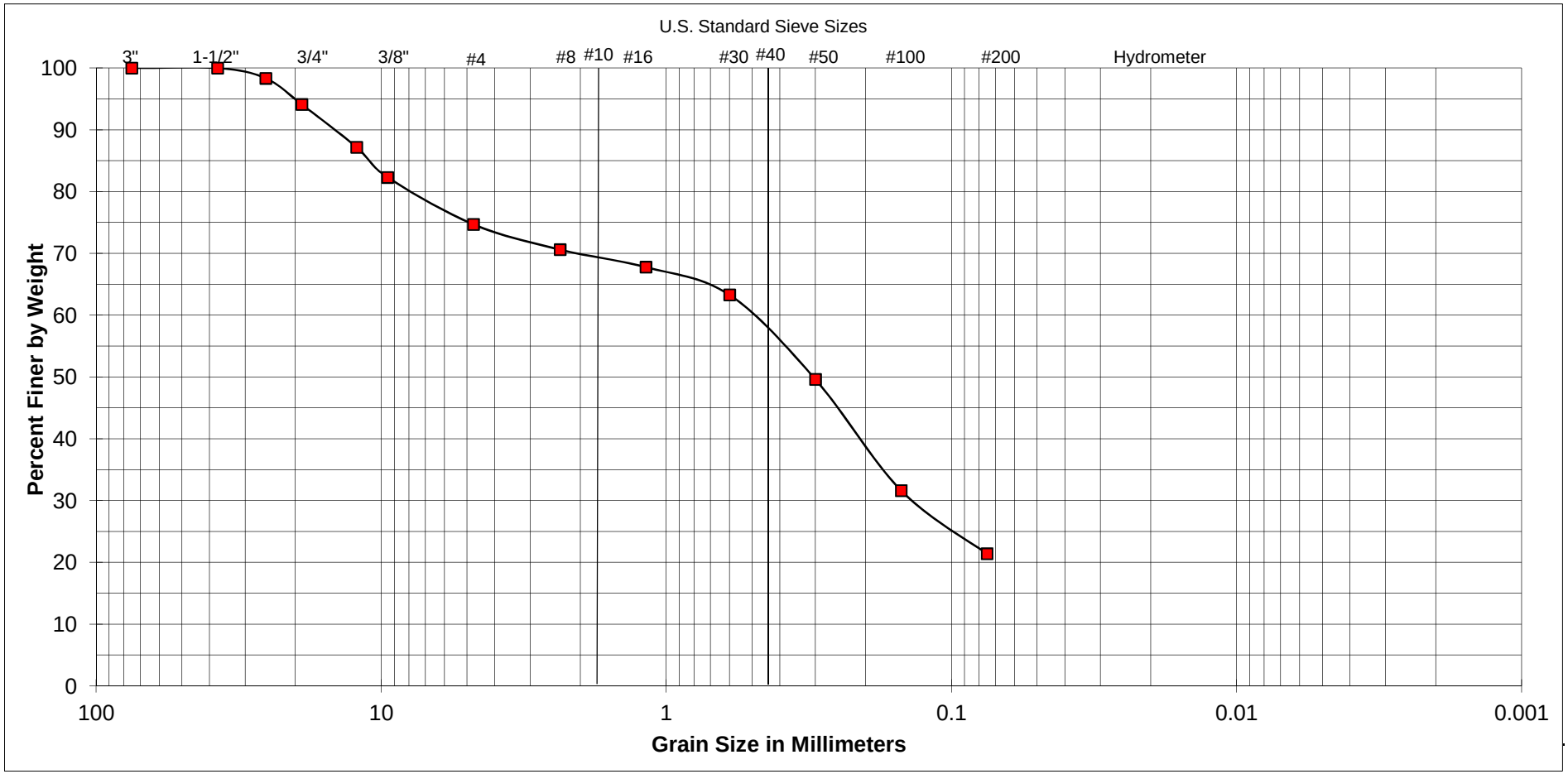
DESCRIPTION: WELL-GRADED GRAVEL with SILT and SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-10



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	1 foot to 4½ feet

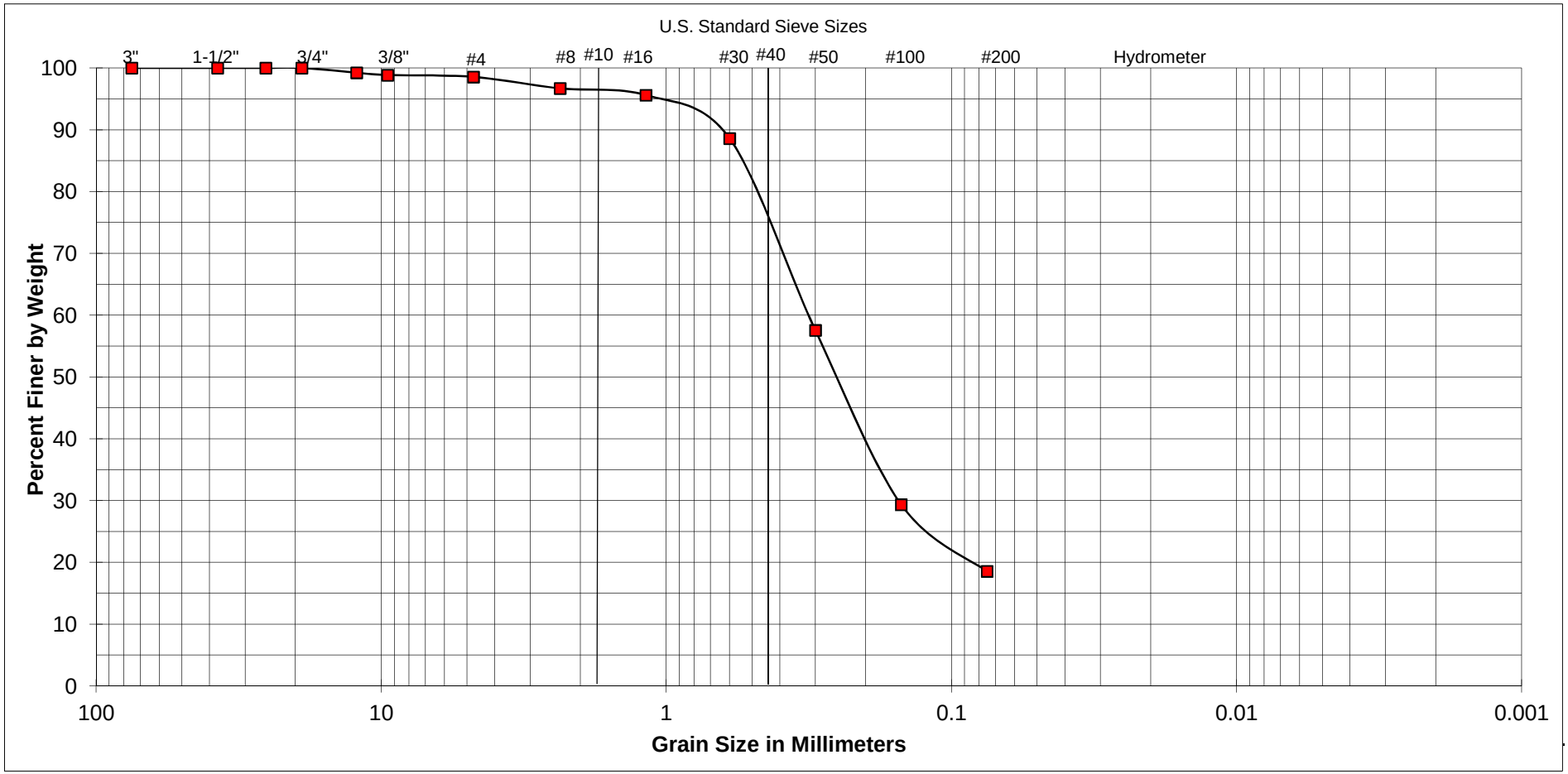
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-11



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	9 feet to 10 feet

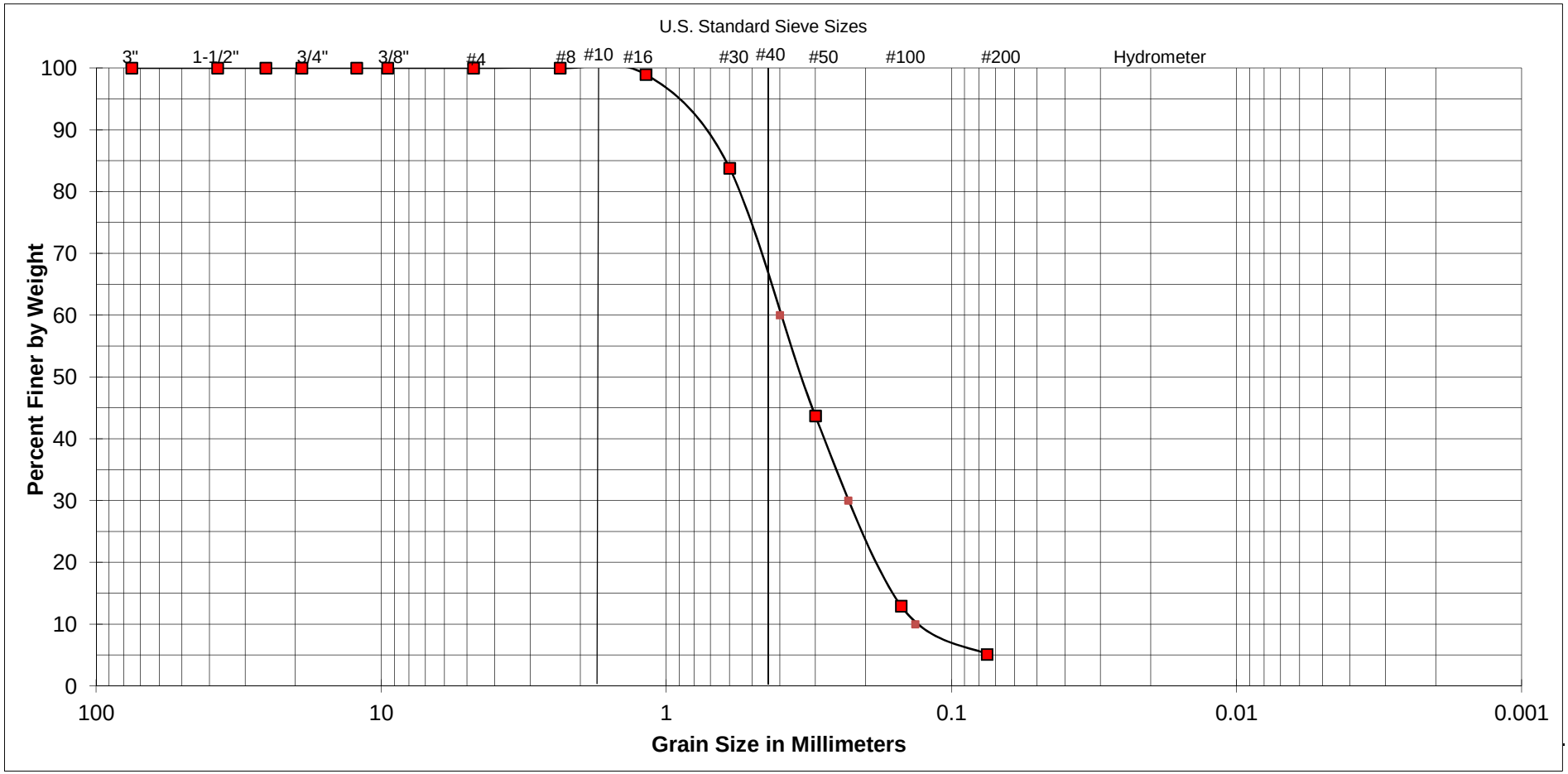
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-12



GRAVEL		SAND			FINES
COARSE	FINE	FINE	MEDIUM	COARSE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	10 feet

UNIFIED SOIL CLASSIFICATION: SP-SM

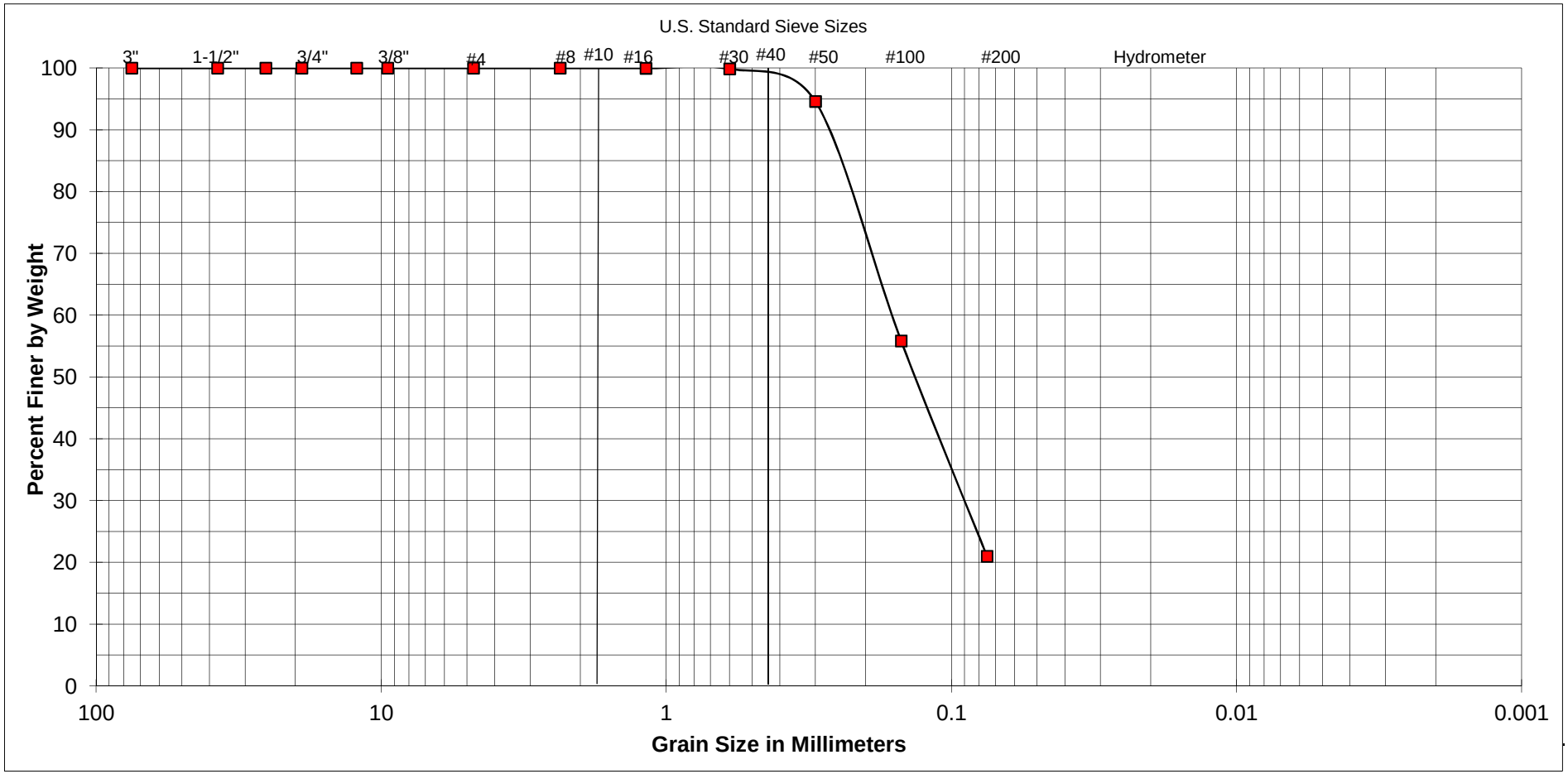
DESCRIPTION: POORLY-GRADED SAND with SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-13



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	20 feet

UNIFIED SOIL CLASSIFICATION: SM

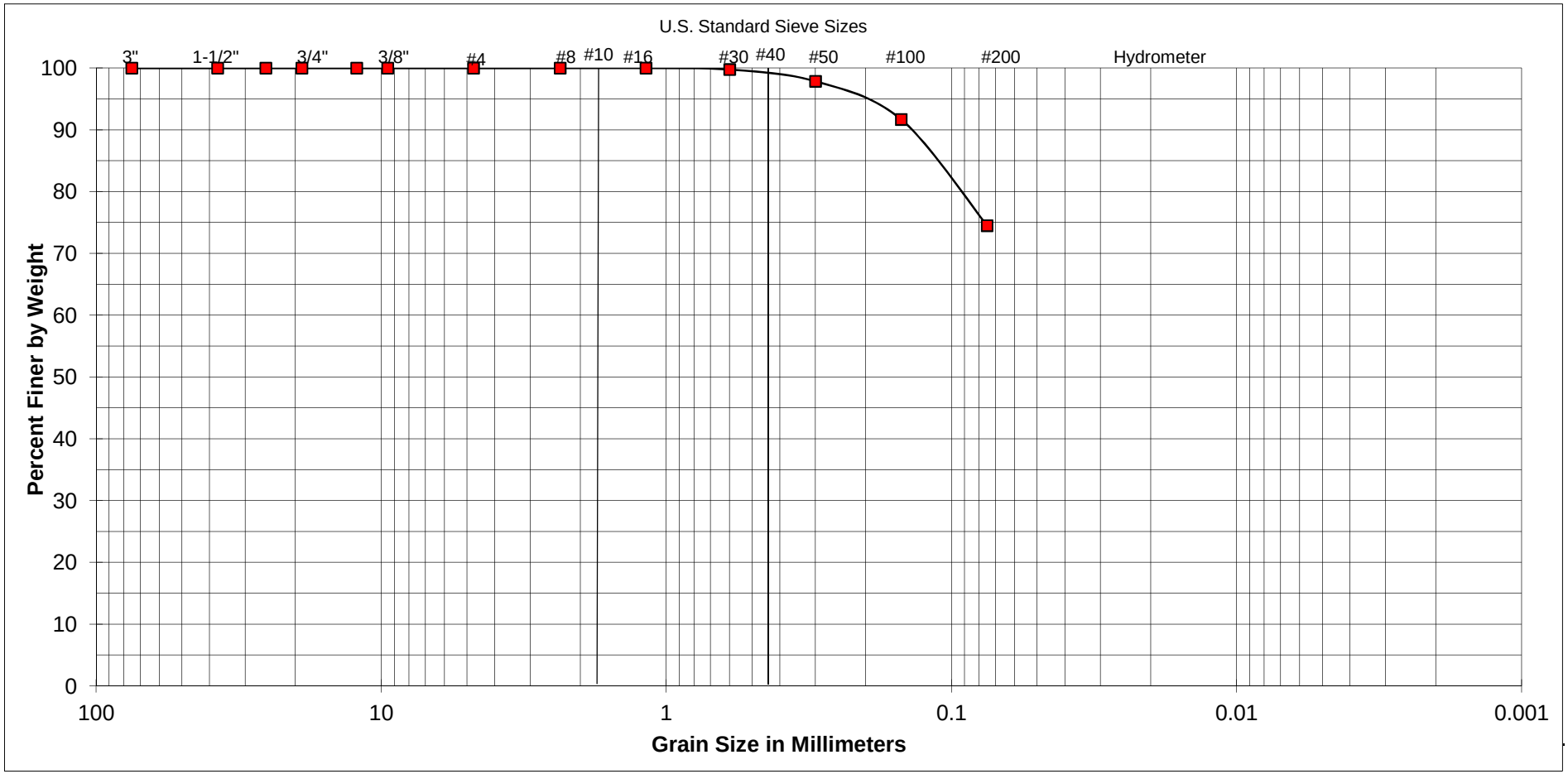
DESCRIPTION: SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	N/A
PLASTIC LIMIT:	N/A
PLASTICITY INDEX:	NP

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-14



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	30 feet

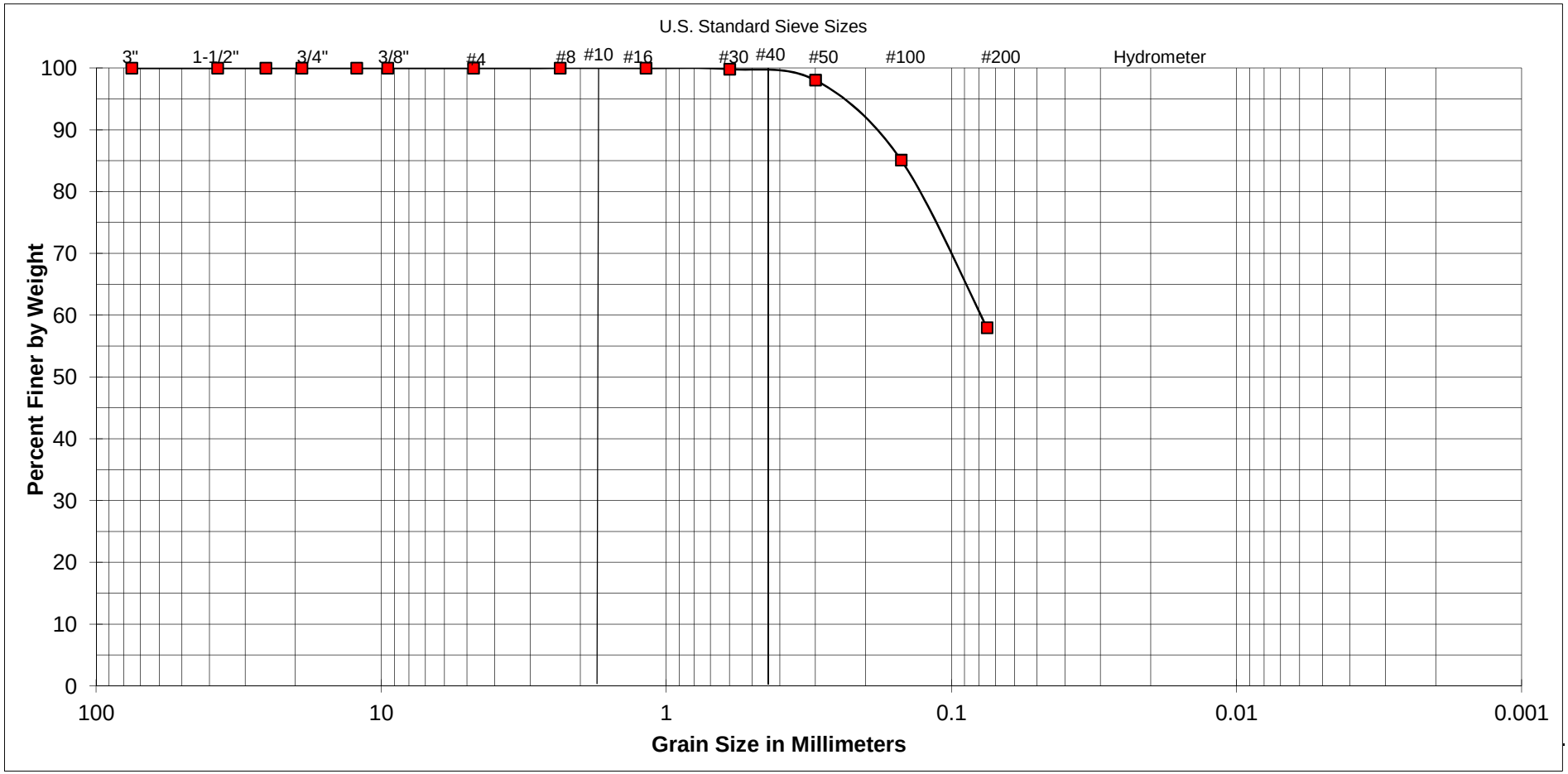
UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION:	LEAN CLAY with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	43
PLASTIC LIMIT:	23
PLASTICITY INDEX:	20

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-15



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	35½ feet

UNIFIED SOIL CLASSIFICATION: ML

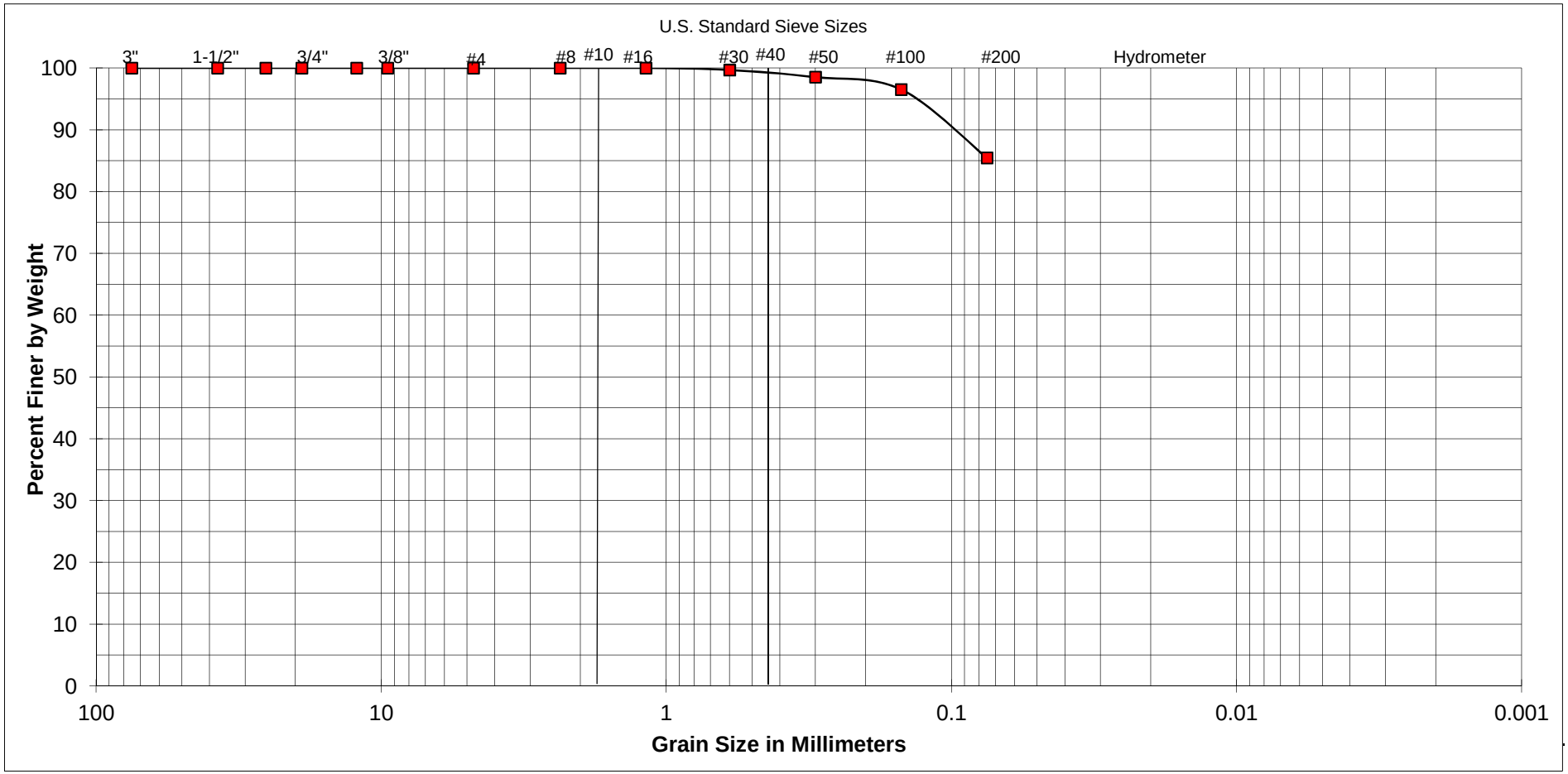
DESCRIPTION: SILT with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	37
PLASTIC LIMIT:	N/A
PLASTICITY INDEX:	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-16



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-008
SAMPLE LOCATION:	40 feet

UNIFIED SOIL CLASSIFICATION: CL

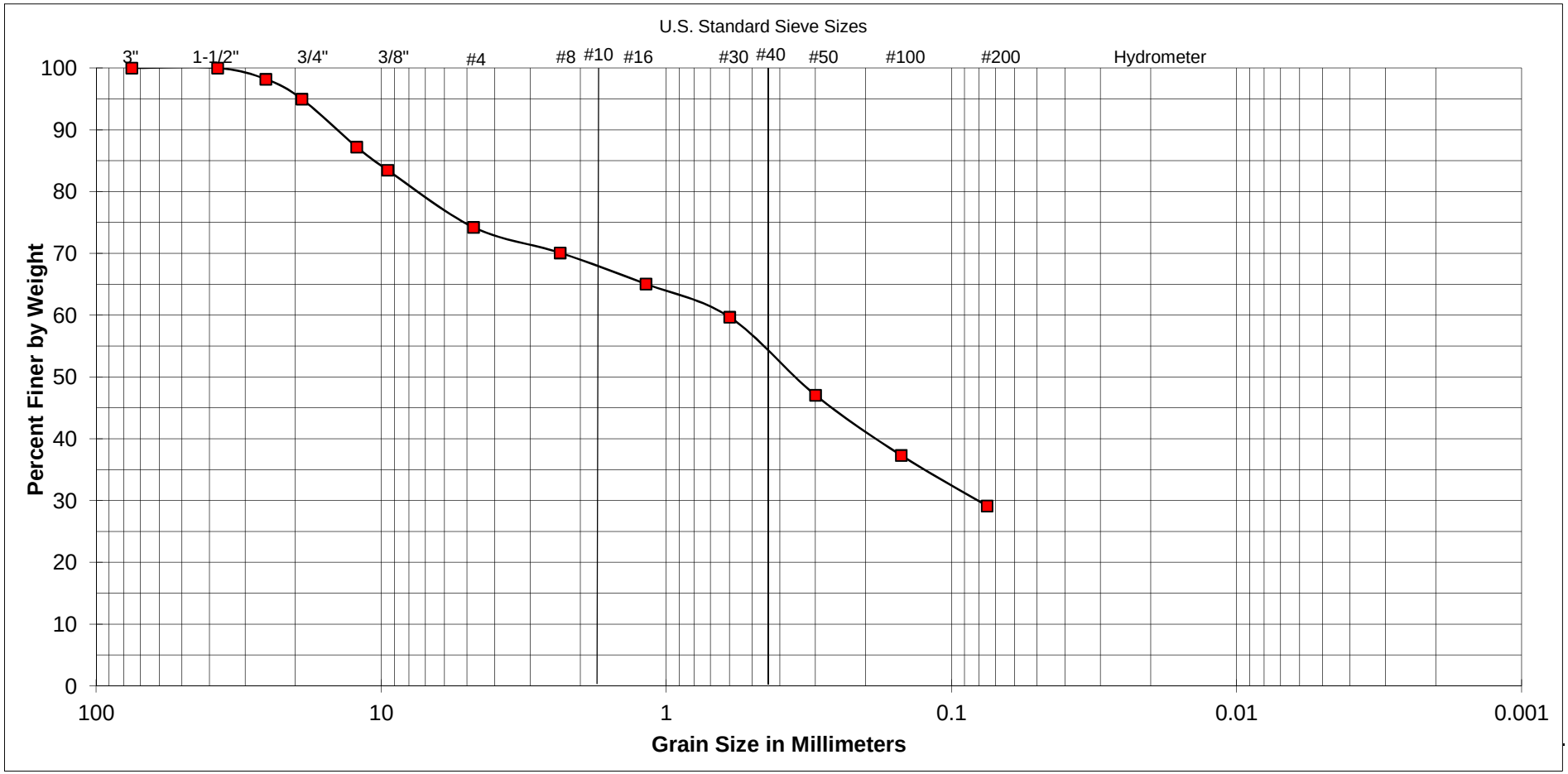
DESCRIPTION: LEAN CLAY with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	44
PLASTIC LIMIT:	23
PLASTICITY INDEX:	21

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-17



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-009
SAMPLE LOCATION:	11½ feet to 13½ feet

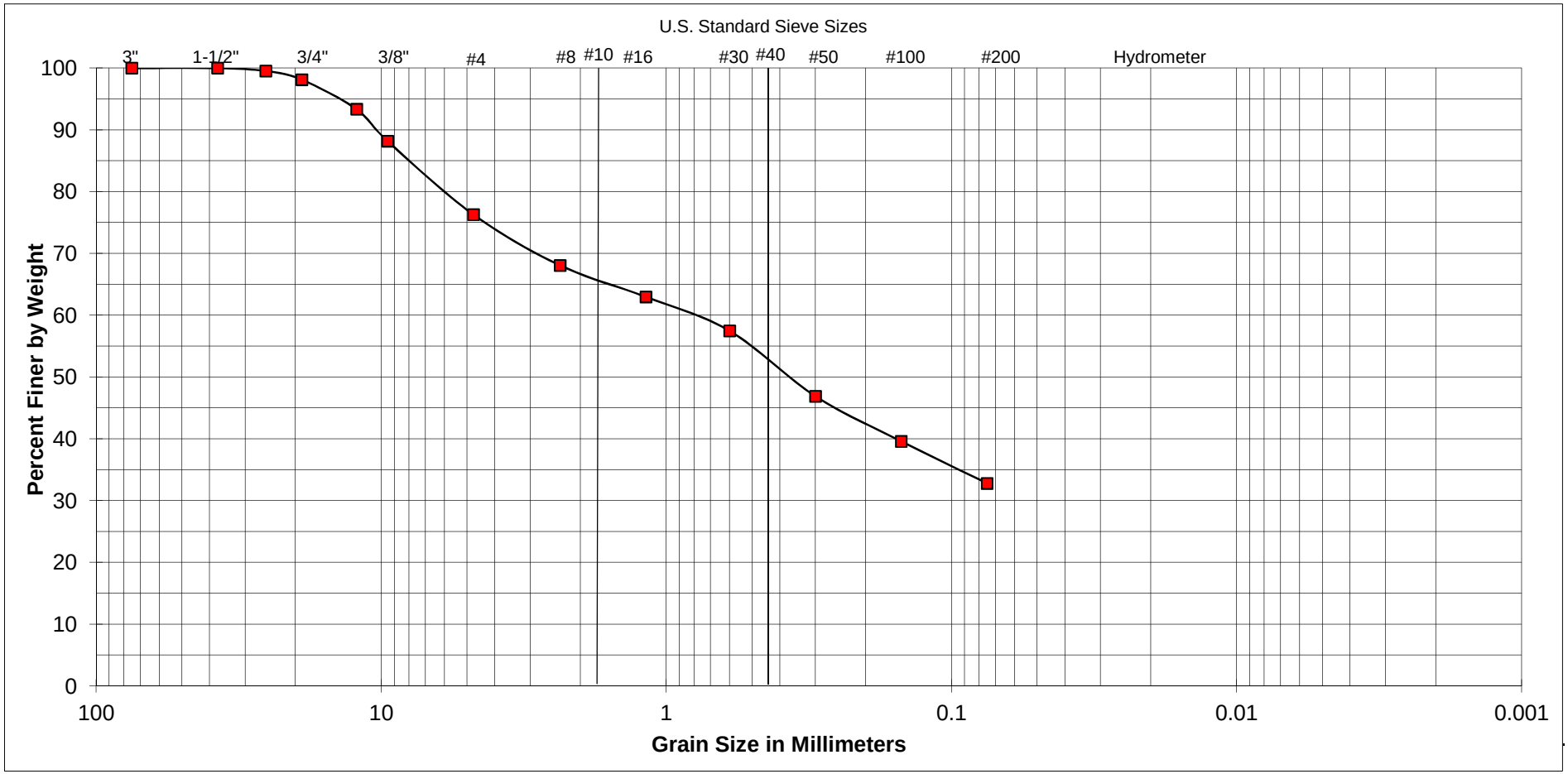
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-18



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-010
SAMPLE LOCATION:	9 feet to 11 feet

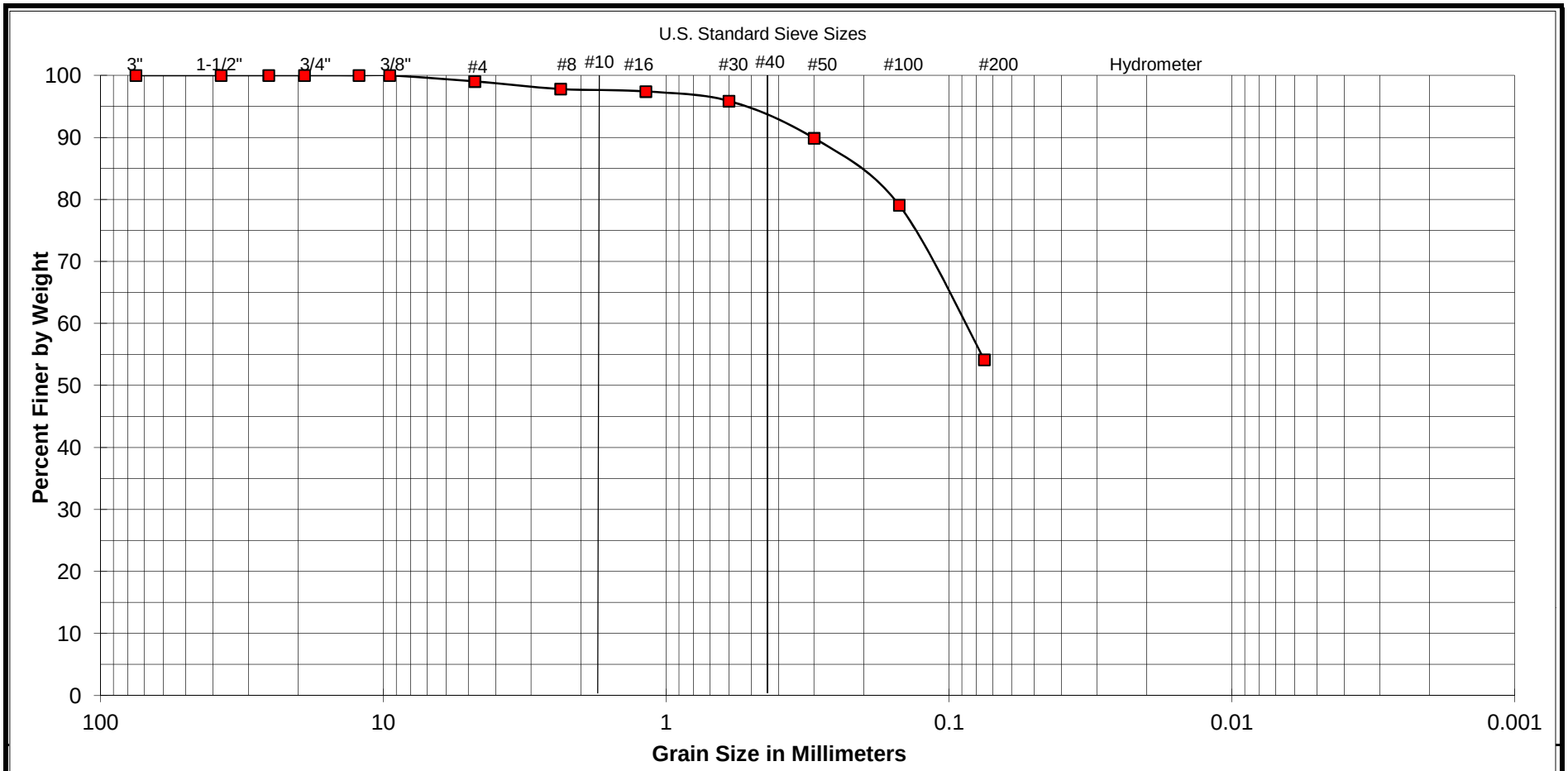
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-19



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-010
SAMPLE LOCATION:	12½ feet to 13½ feet

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	35
PLASTIC LIMIT:	22
PLASTICITY INDEX:	13

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	0311116	FIGURE:	V-20

GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-012
SAMPLE LOCATION:	20½ feet to 22½ feet

UNIFIED SOIL CLASSIFICATION: SC

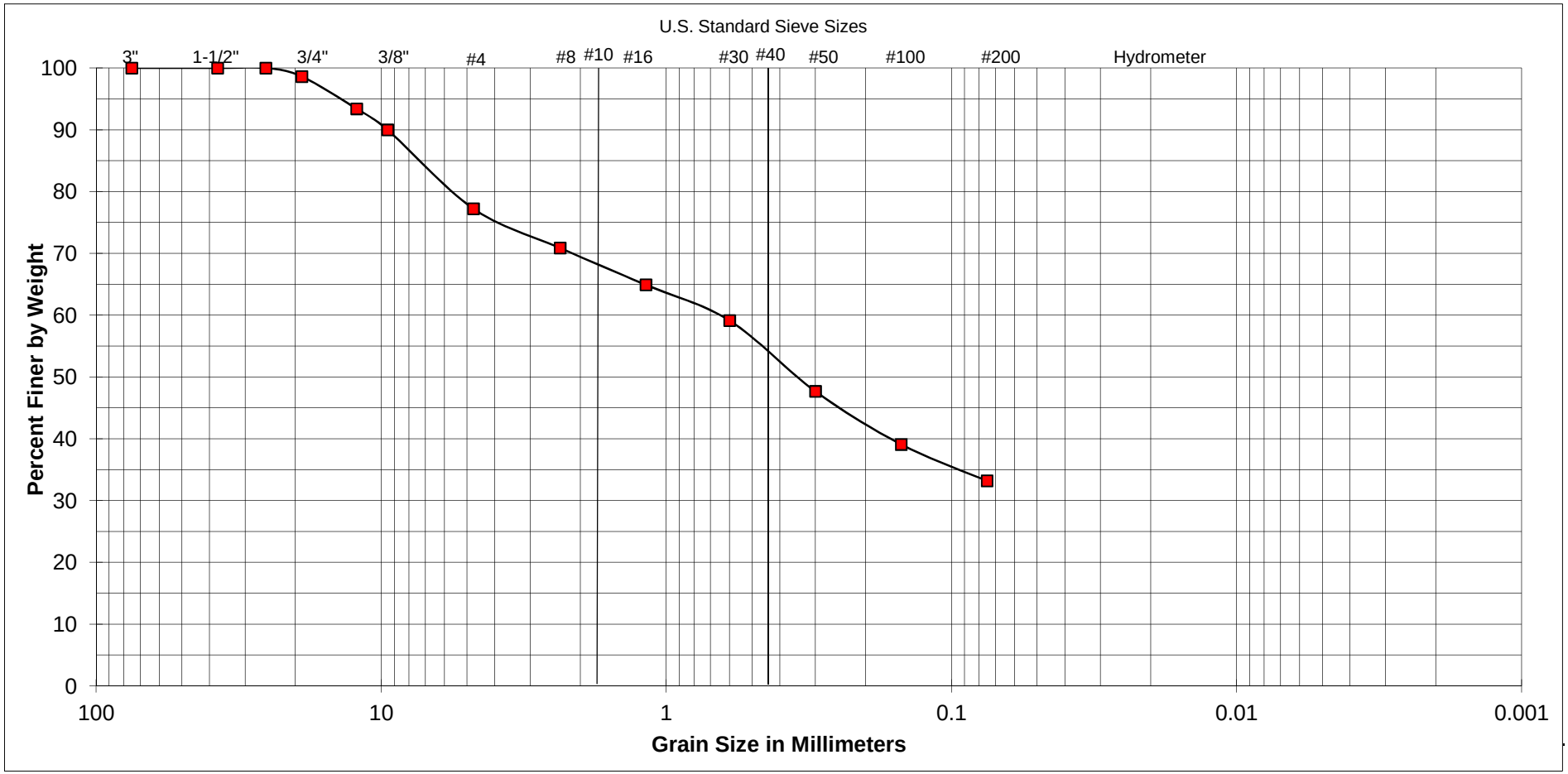
DESCRIPTION: CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	30
PLASTIC LIMIT:	14
PLASTICITY INDEX:	16

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-21



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-012
SAMPLE LOCATION:	28 feet to 29½ feet

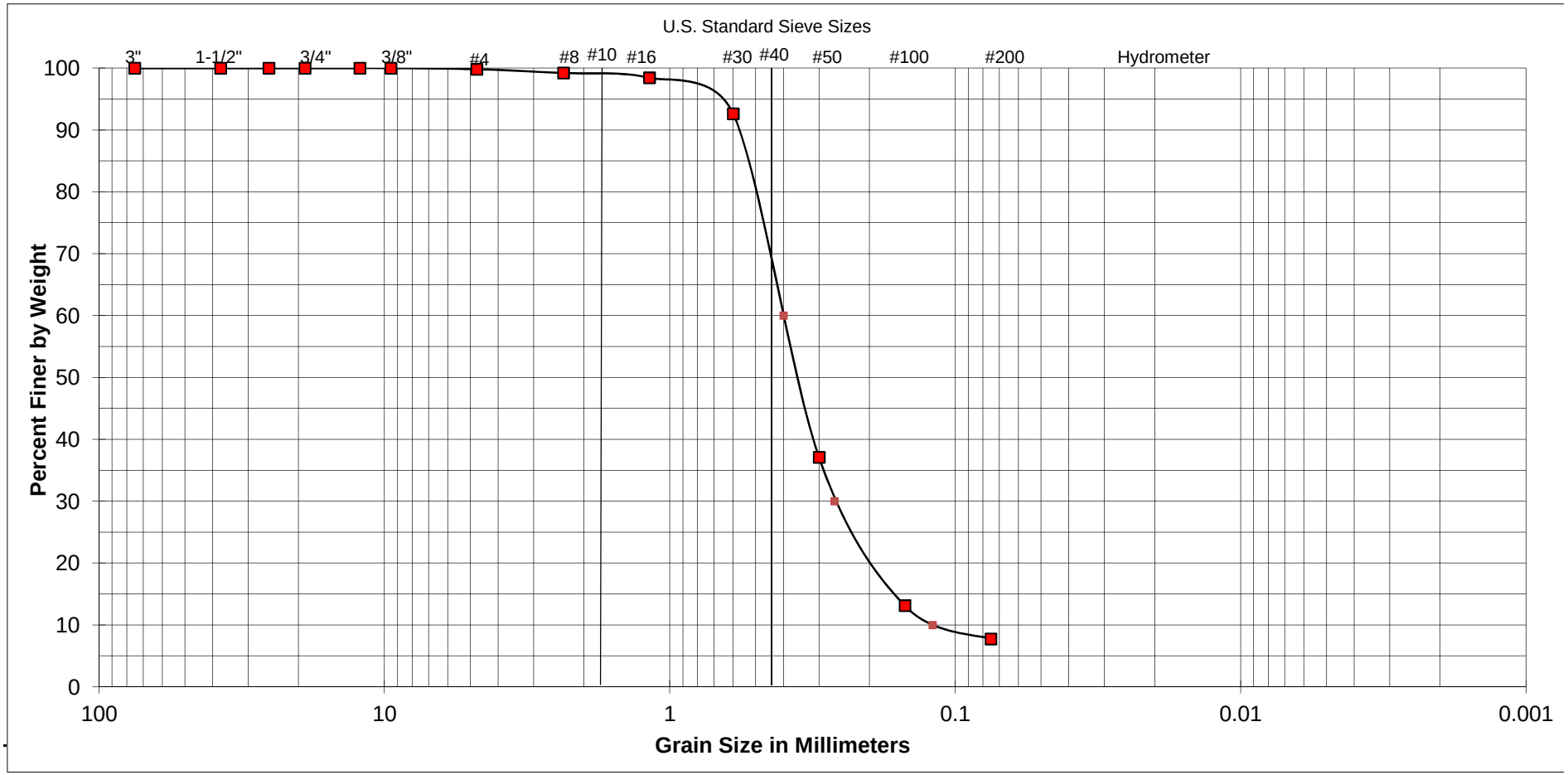
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION:	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	33
PLASTIC LIMIT:	17
PLASTICITY INDEX:	16

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-22



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-012
SAMPLE LOCATION:	33 feet

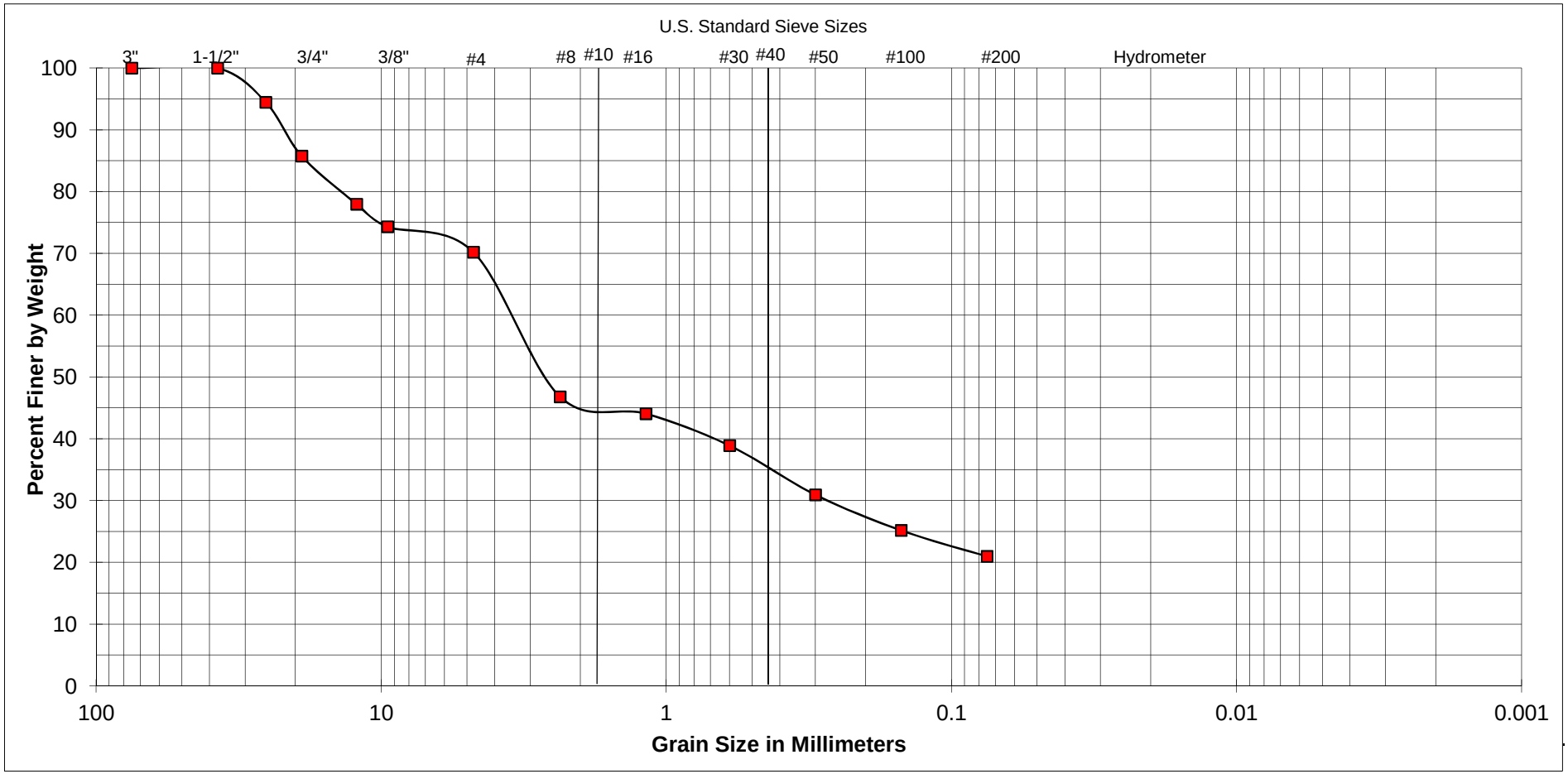
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION:	POORLY-GRADED SAND with SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	11111191-1	FIGURE:	V-23



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-012
SAMPLE LOCATION:	35 feet

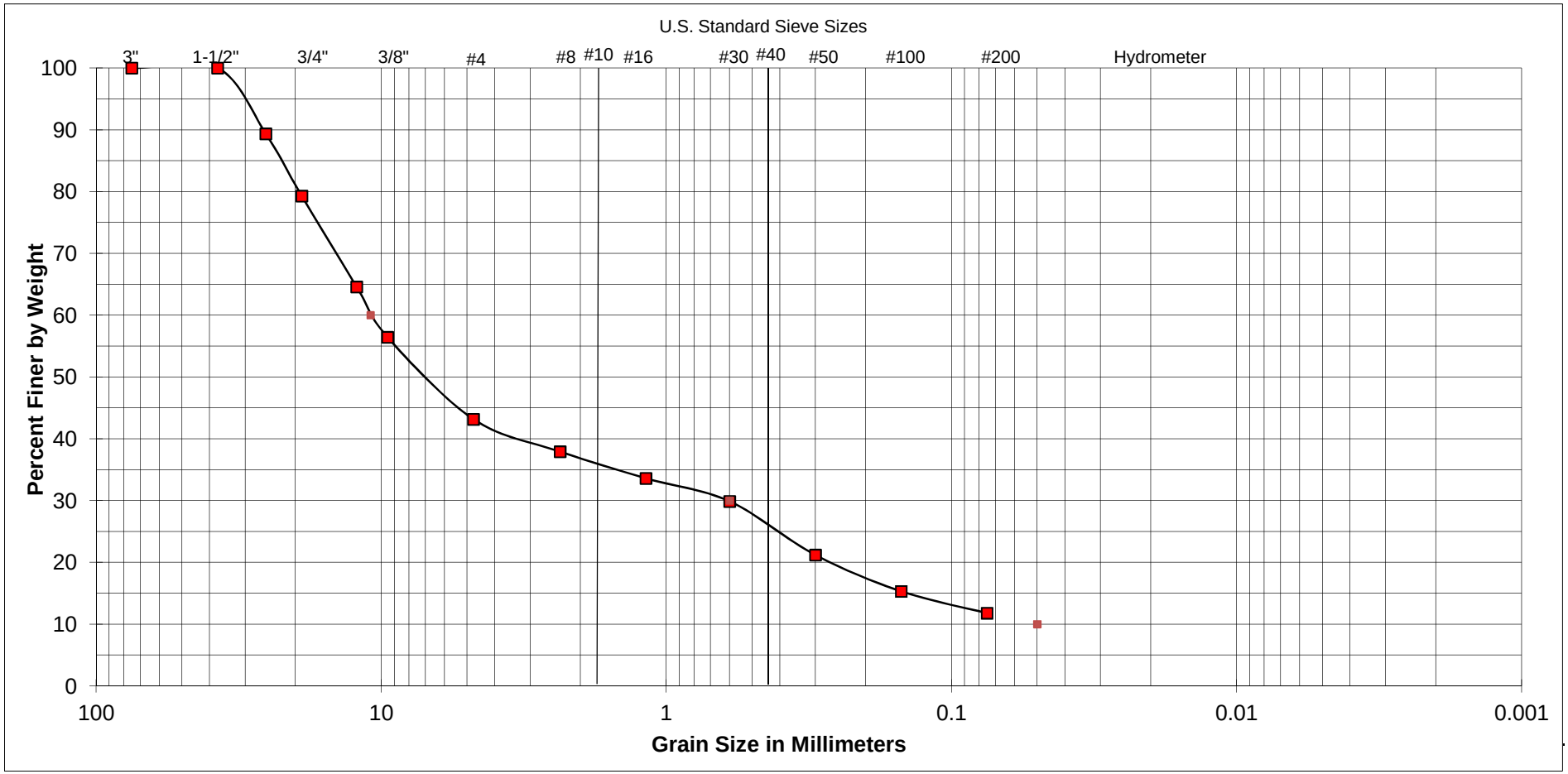
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-24



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-013
SAMPLE LOCATION:	1 foot to 3½ feet

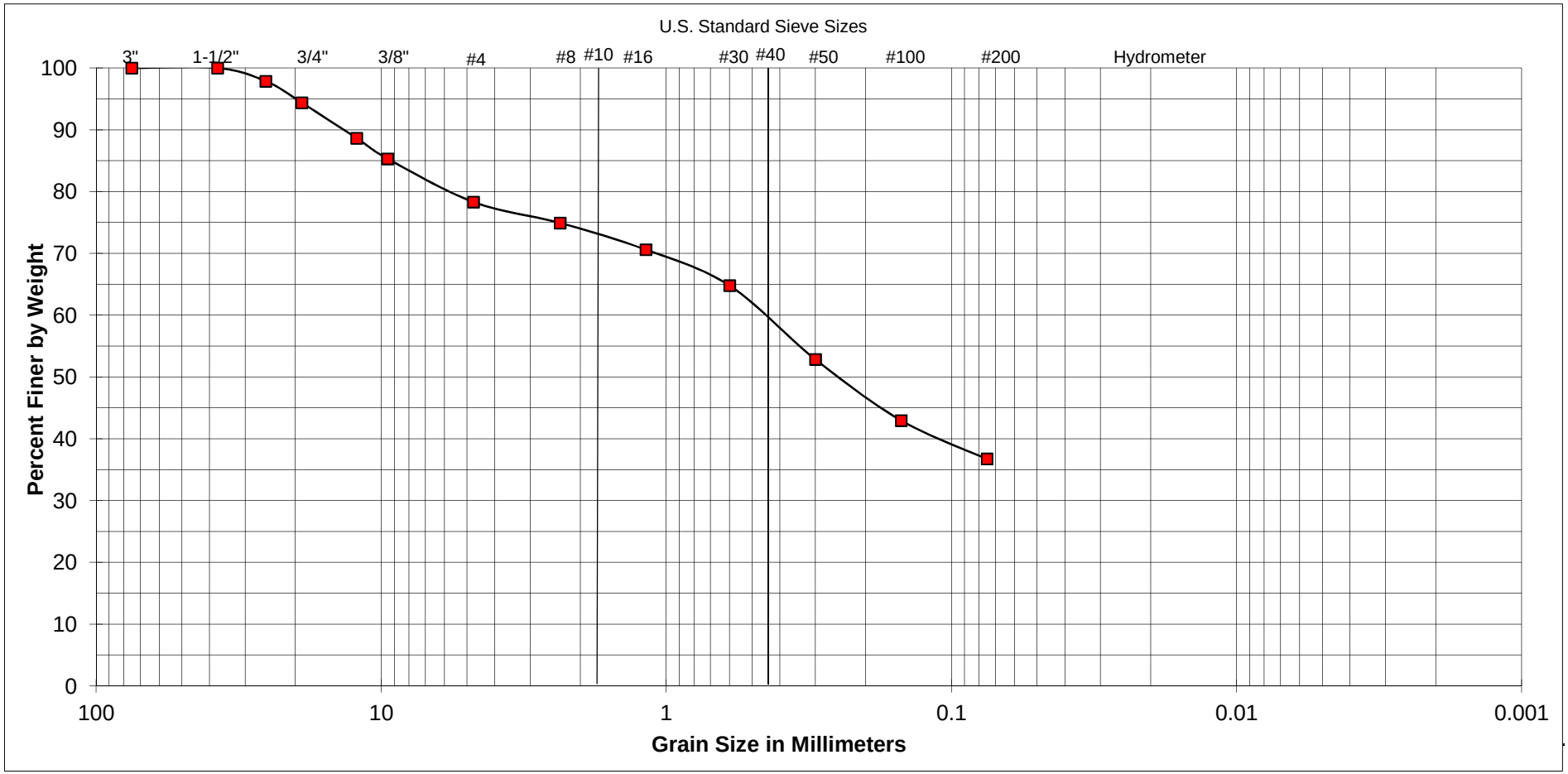
UNIFIED SOIL CLASSIFICATION:	GP-GM
DESCRIPTION:	POORLY-GRADED GRAVEL with SILT and SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-25



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-013
SAMPLE LOCATION:	26 feet to 29½ feet

UNIFIED SOIL CLASSIFICATION: SM

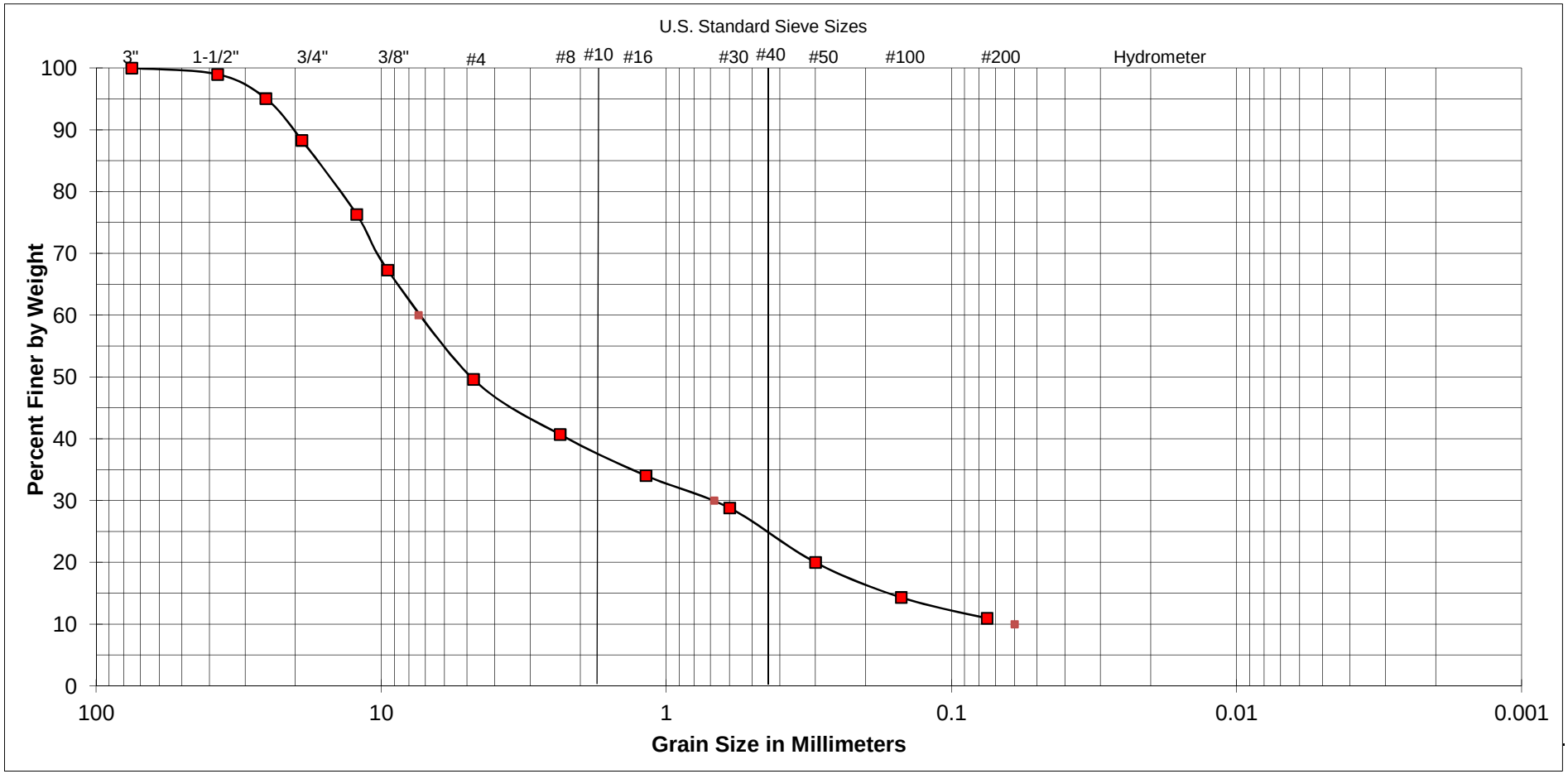
DESCRIPTION: SILT SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-26



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-015
SAMPLE LOCATION:	1 foot to 3½ feet

UNIFIED SOIL CLASSIFICATION: GW-GM

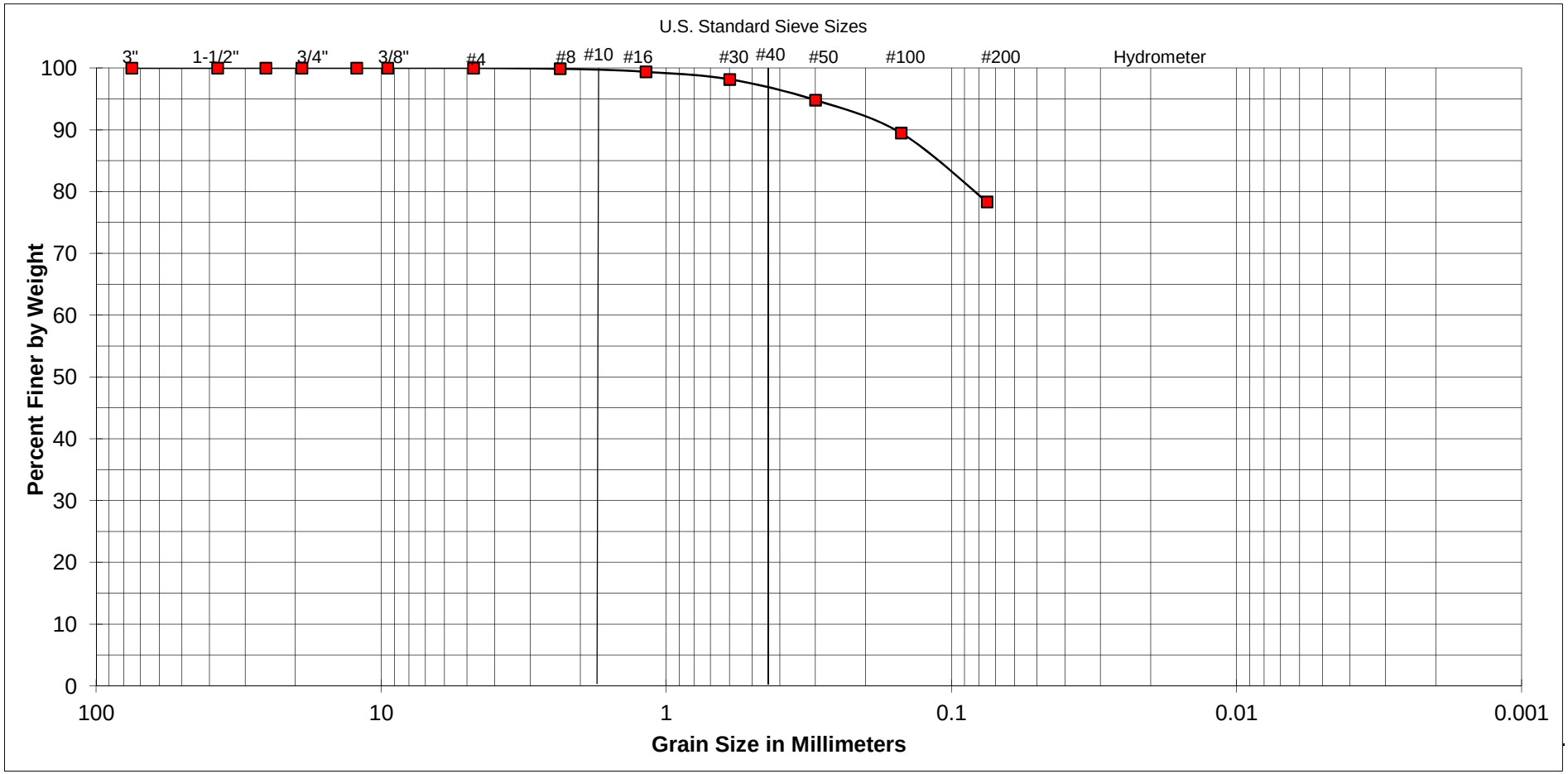
DESCRIPTION: WELL GRADED GRAVEL with SILT and SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-27



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-017
SAMPLE LOCATION:	15 feet

UNIFIED SOIL CLASSIFICATION: MH

DESCRIPTION: ELASTIC SILT with SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	51
PLASTIC LIMIT:	31
PLASTICITY INDEX:	20

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-28

GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-018
SAMPLE LOCATION:	11½ feet to 14 feet

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION:	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-29

GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-019
SAMPLE LOCATION:	16 feet to 18 feet

UNIFIED SOIL CLASSIFICATION: SM

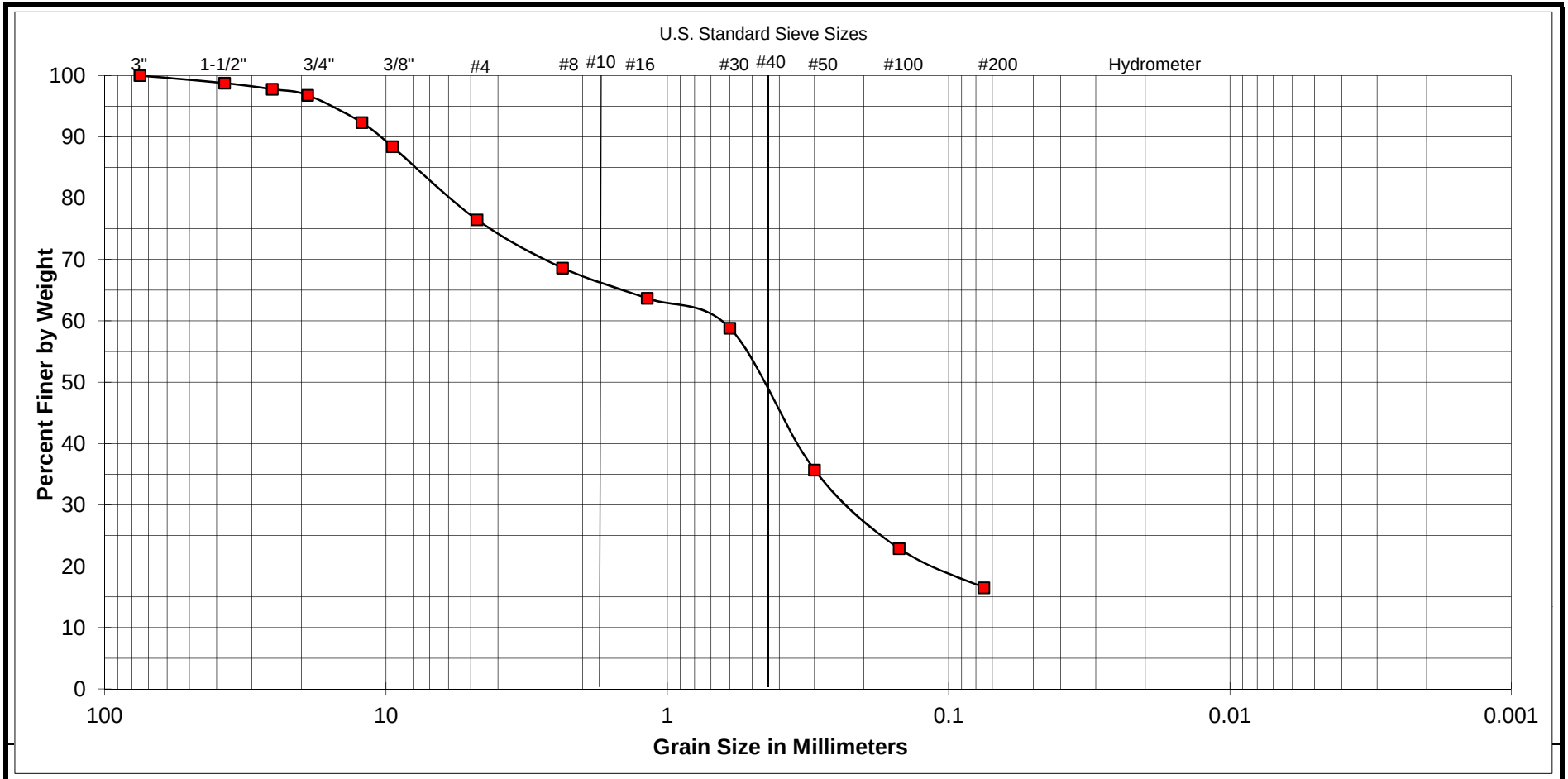
DESCRIPTION: SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-30



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION NUMBER:	A-03-020
SAMPLE LOCATION:	5 feet to 9 feet

UNIFIED SOIL CLASSIFICATION: SM

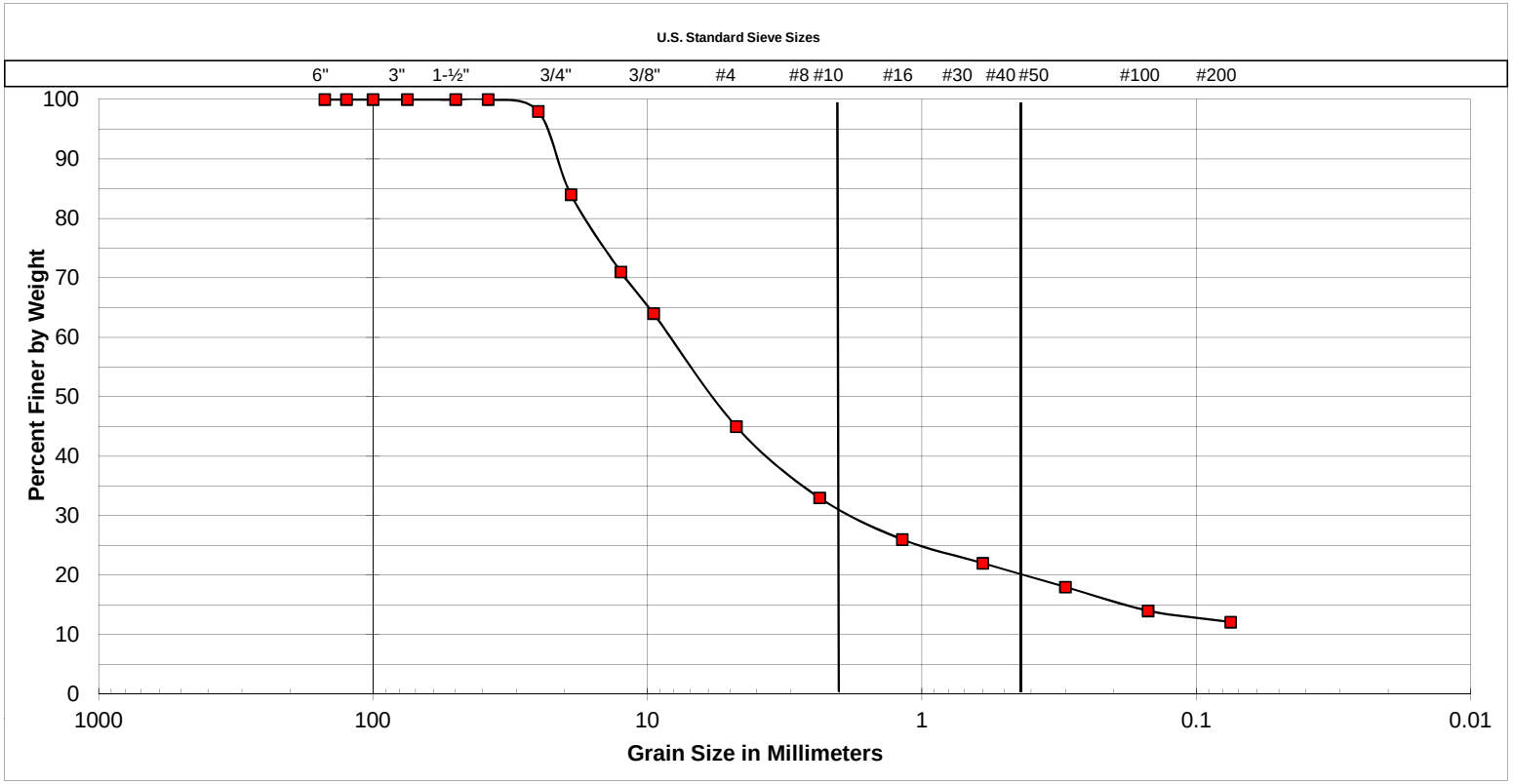
DESCRIPTION: SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT:	-
PLASTIC LIMIT:	-
PLASTICITY INDEX:	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	GF/EL	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-31



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-021 at 2 feet to 7 feet

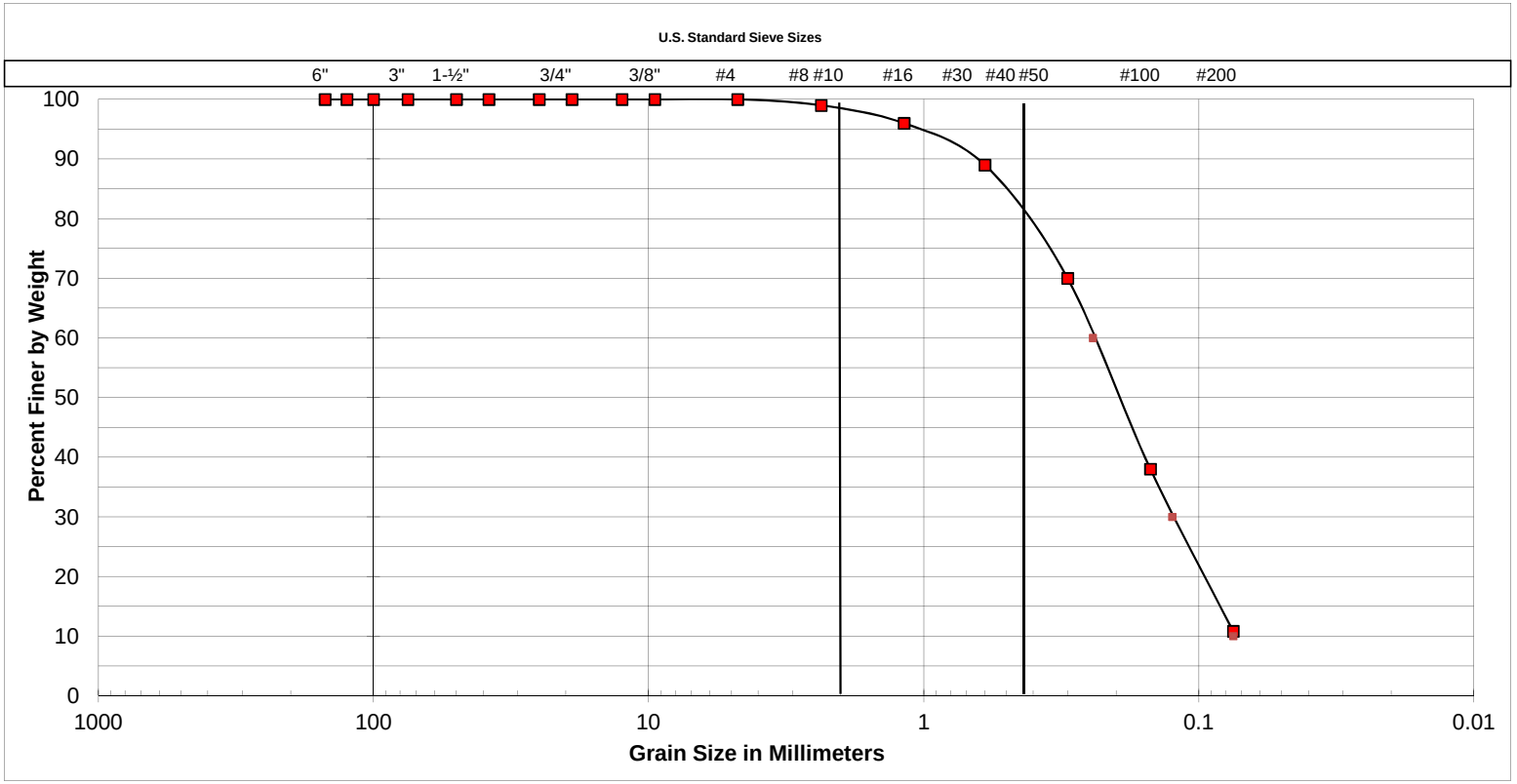
UNIFIED SOIL CLASSIFICATION:	GM
DESCRIPTION	SILTY GRAVEL with SAND

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-32



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-023 at 3 feet to 8 feet

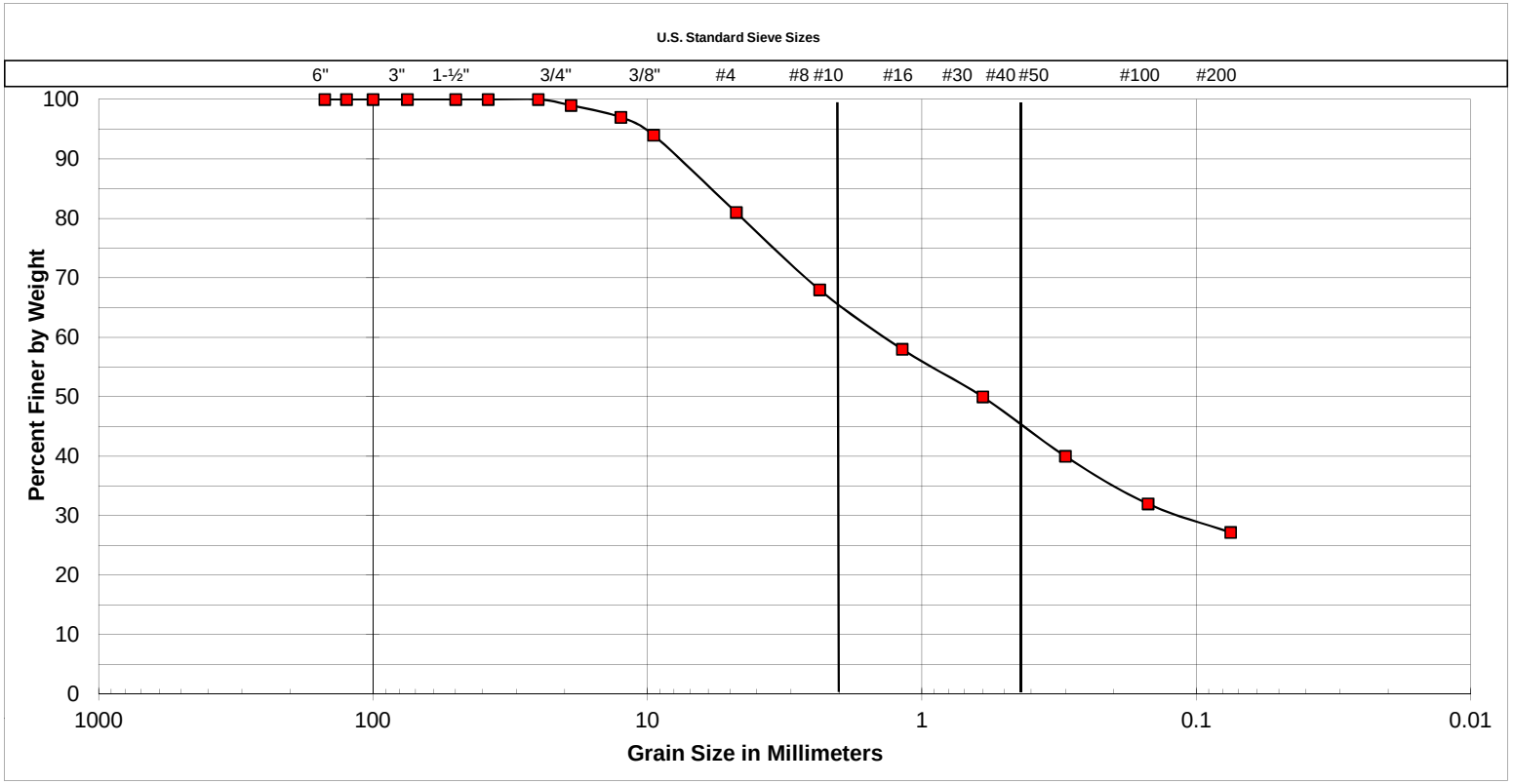
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION	POORLY-GRADED SAND with SILT

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AND STATE ROUTE 163

BY:	RB/AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-33



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-028 at 2 feet to 6 feet

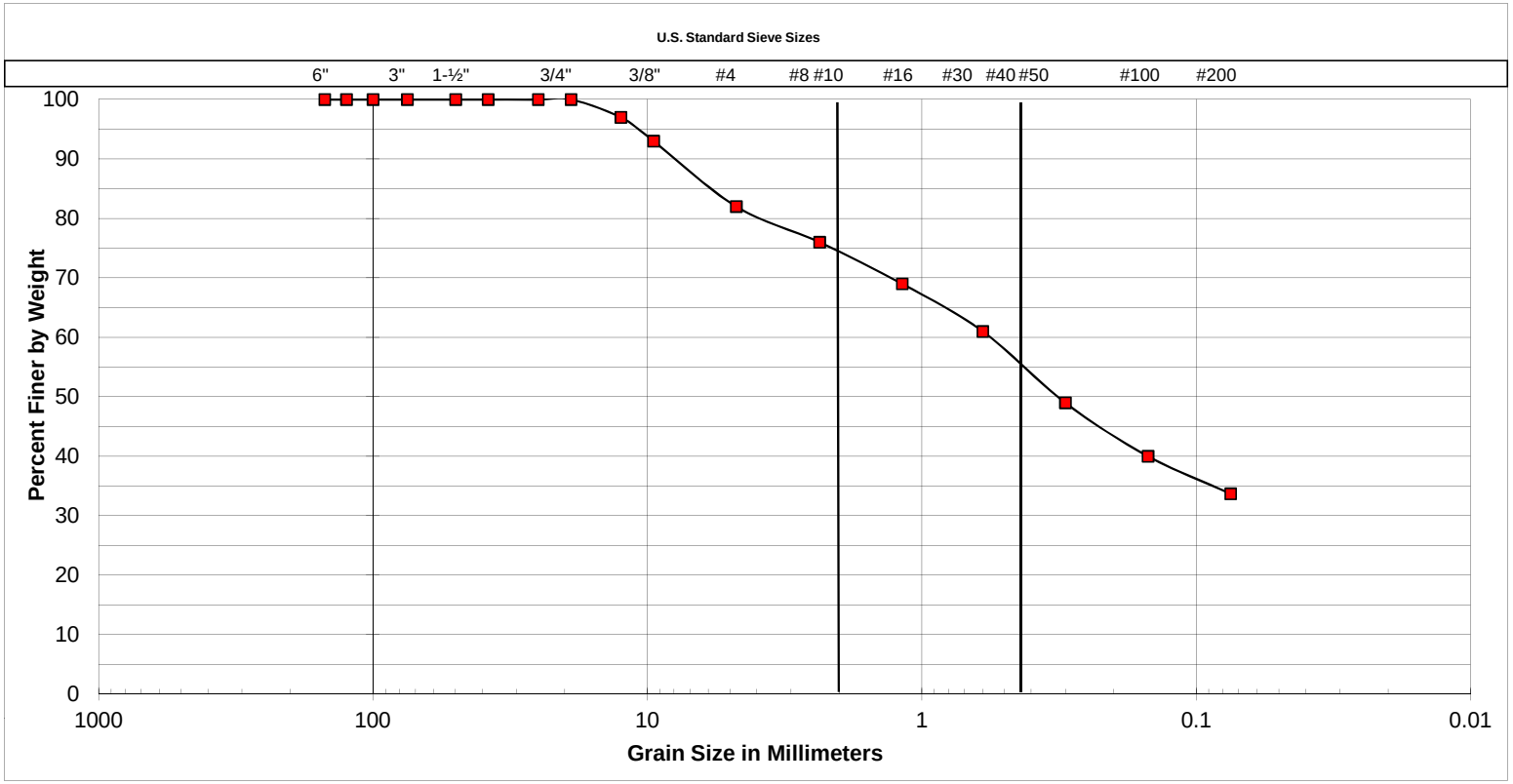
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AND STATE ROUTE 163

BY:	RB/AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-34



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-031 at 1 foot to 5 feet

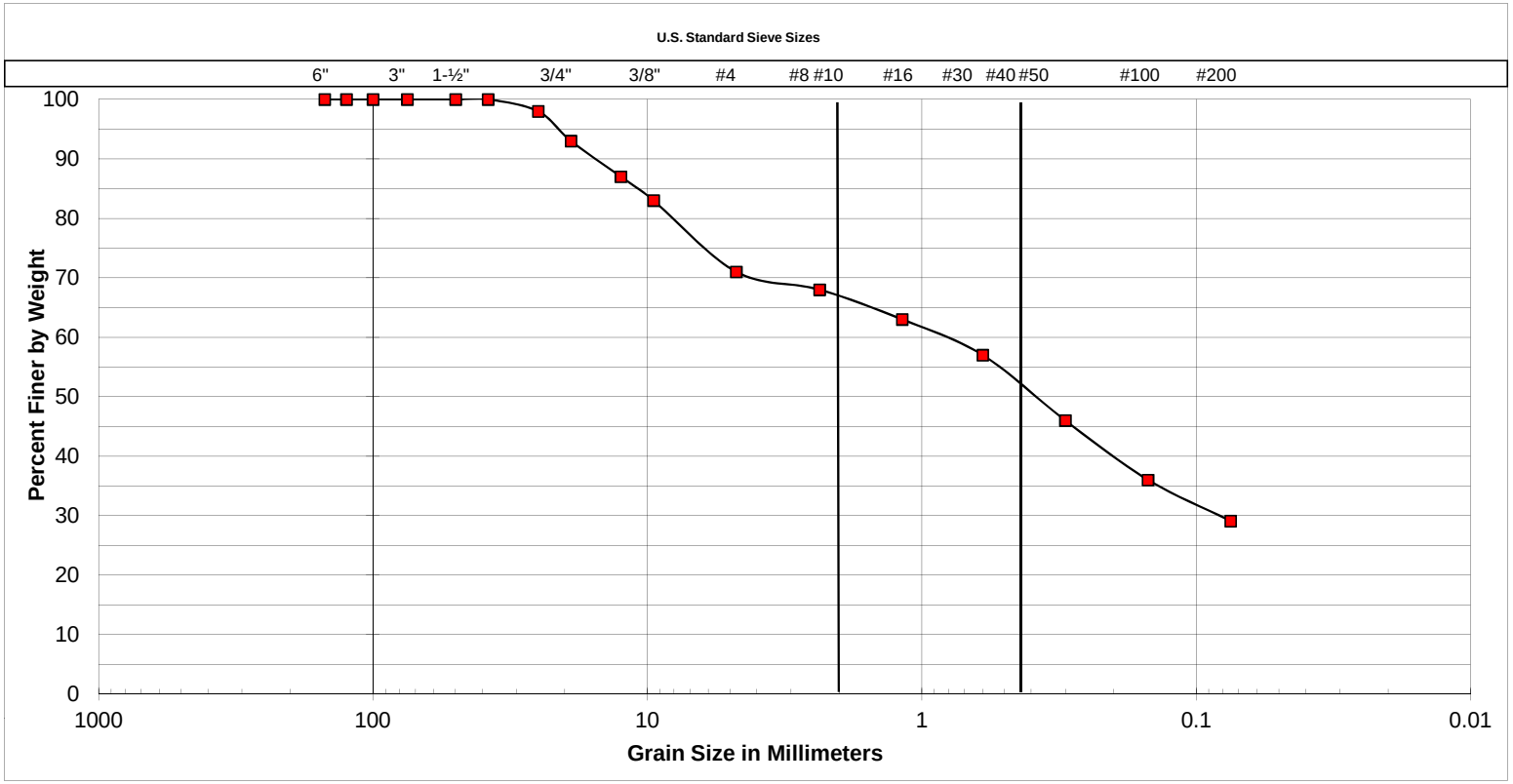
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-35



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-031 at 15 feet to 20 feet

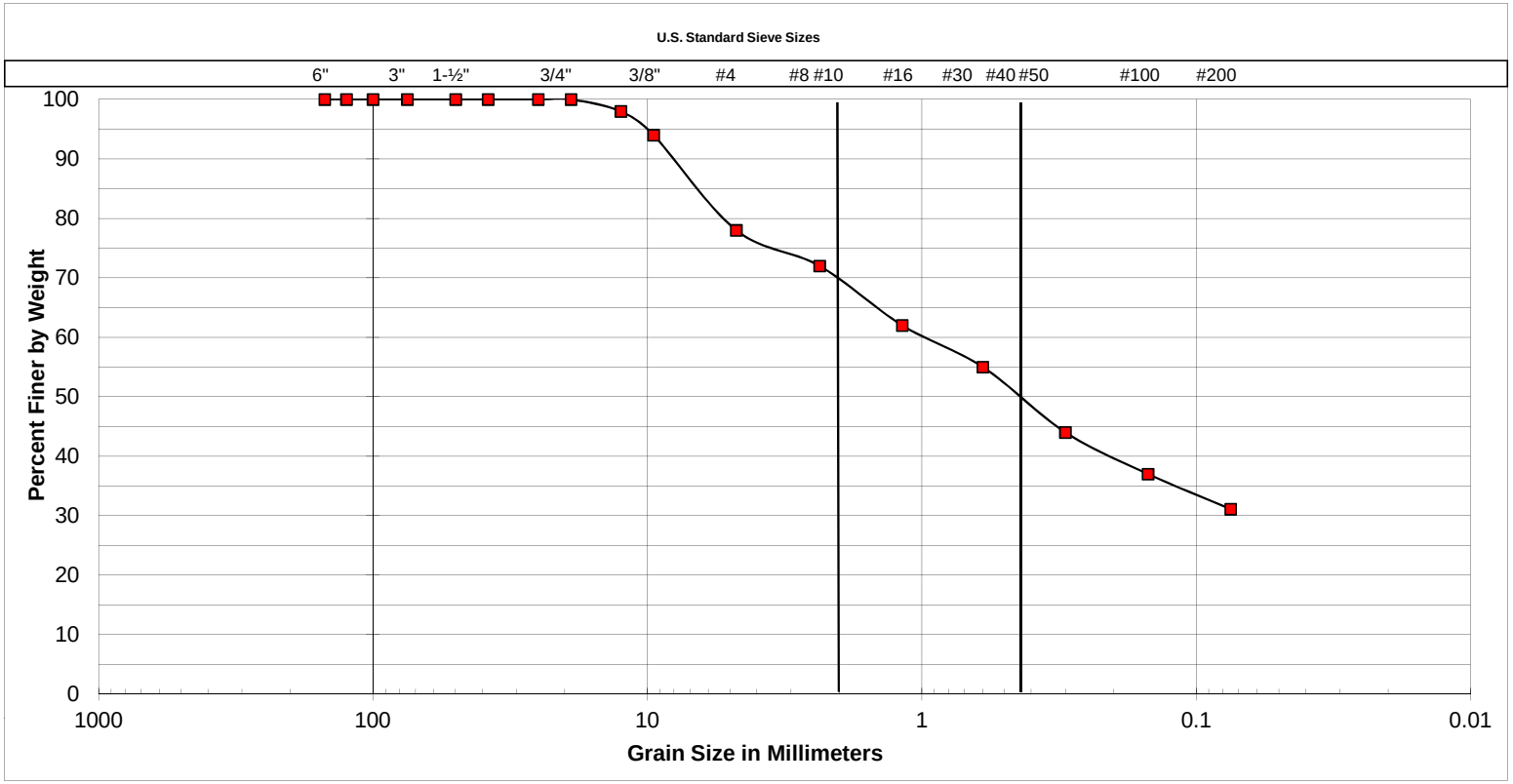
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-36



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-032 at 3 feet to 8 feet

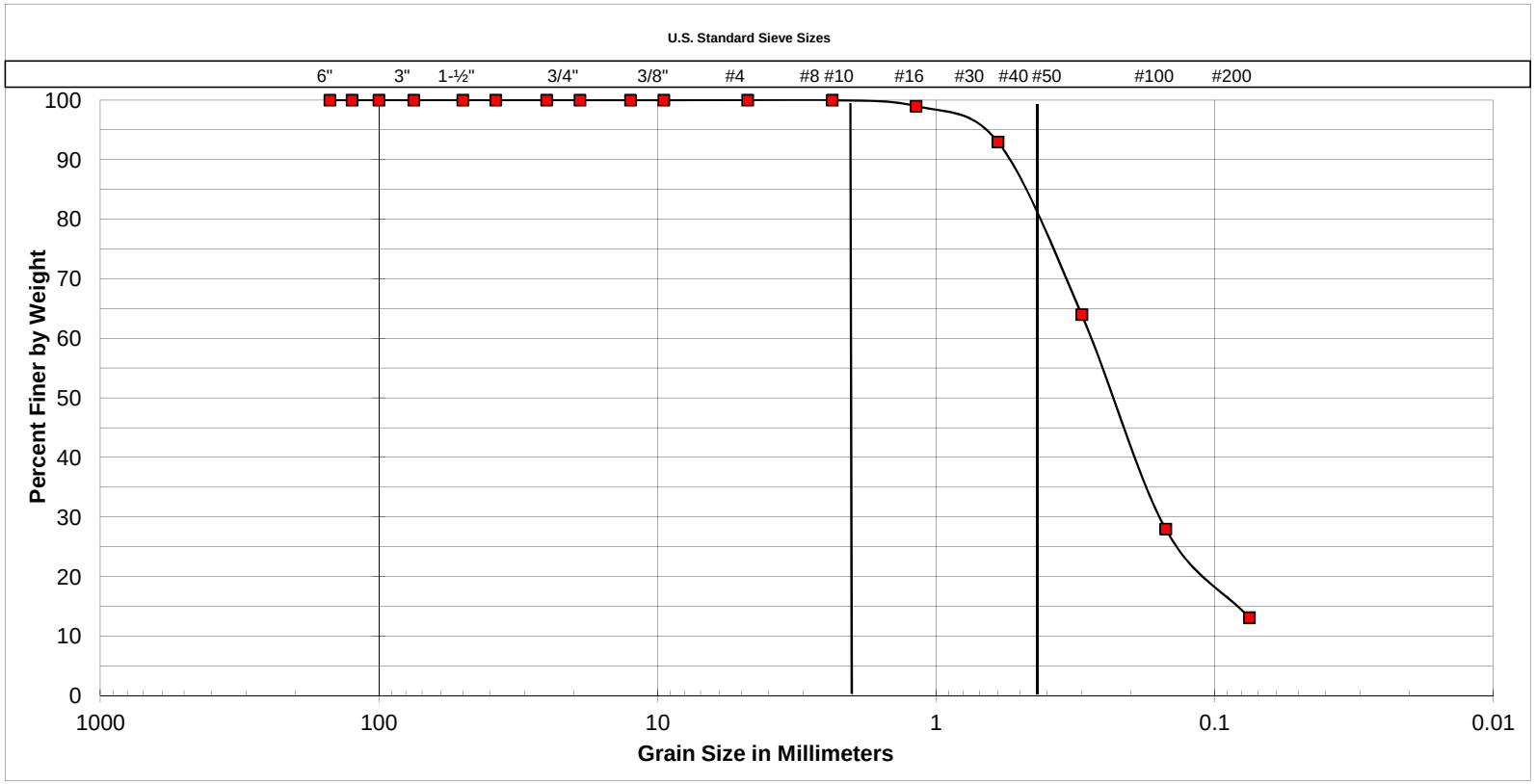
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-37



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 10 feet

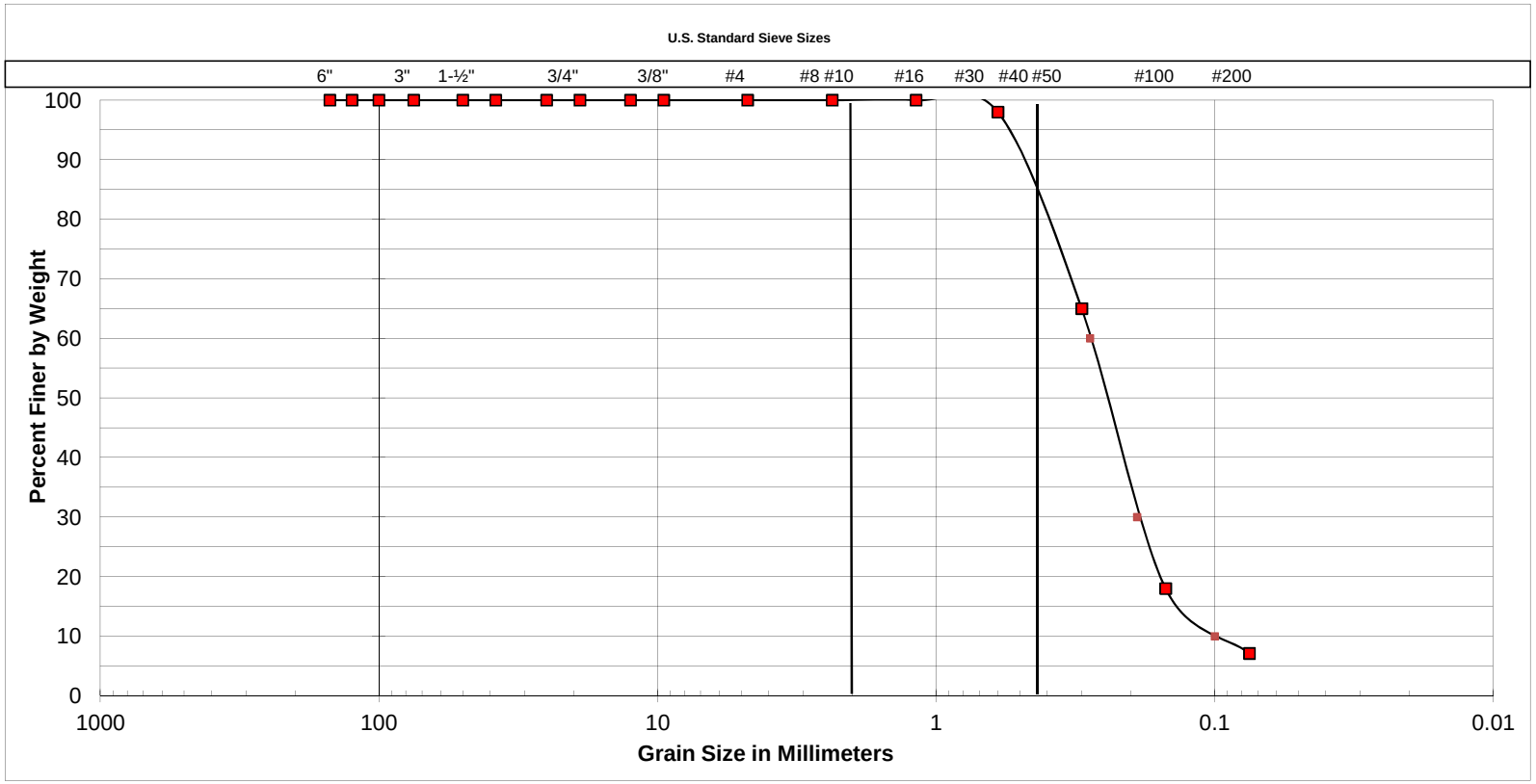
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	1.1

ATTERBERG LIMITS	
LIQUID LIMIT	22
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-38



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 30 feet

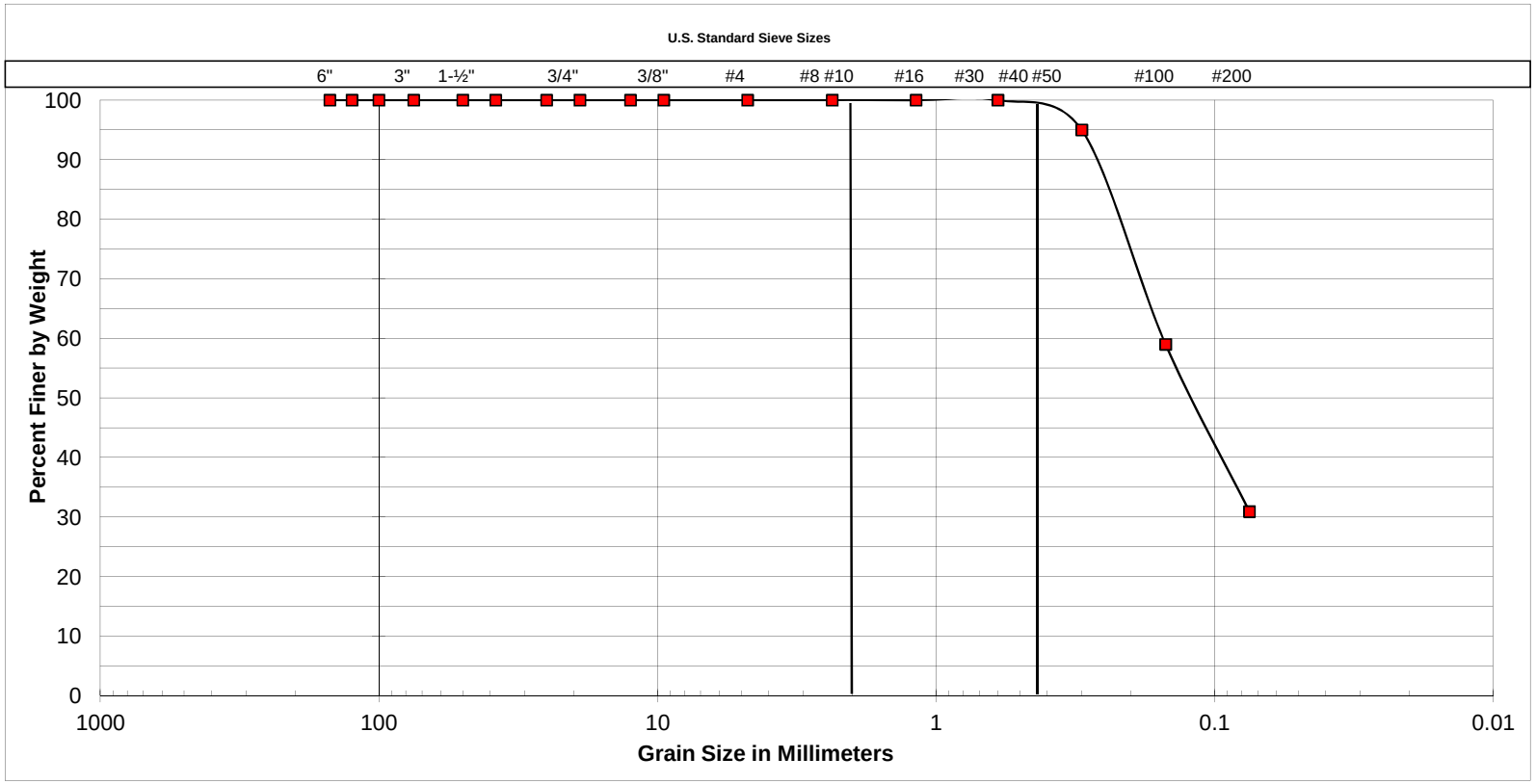
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION	POORLY-GRADED SAND with SILT
Wc/LL	1.1

ATTERBERG LIMITS	
LIQUID LIMIT	25
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-39



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 45 feet

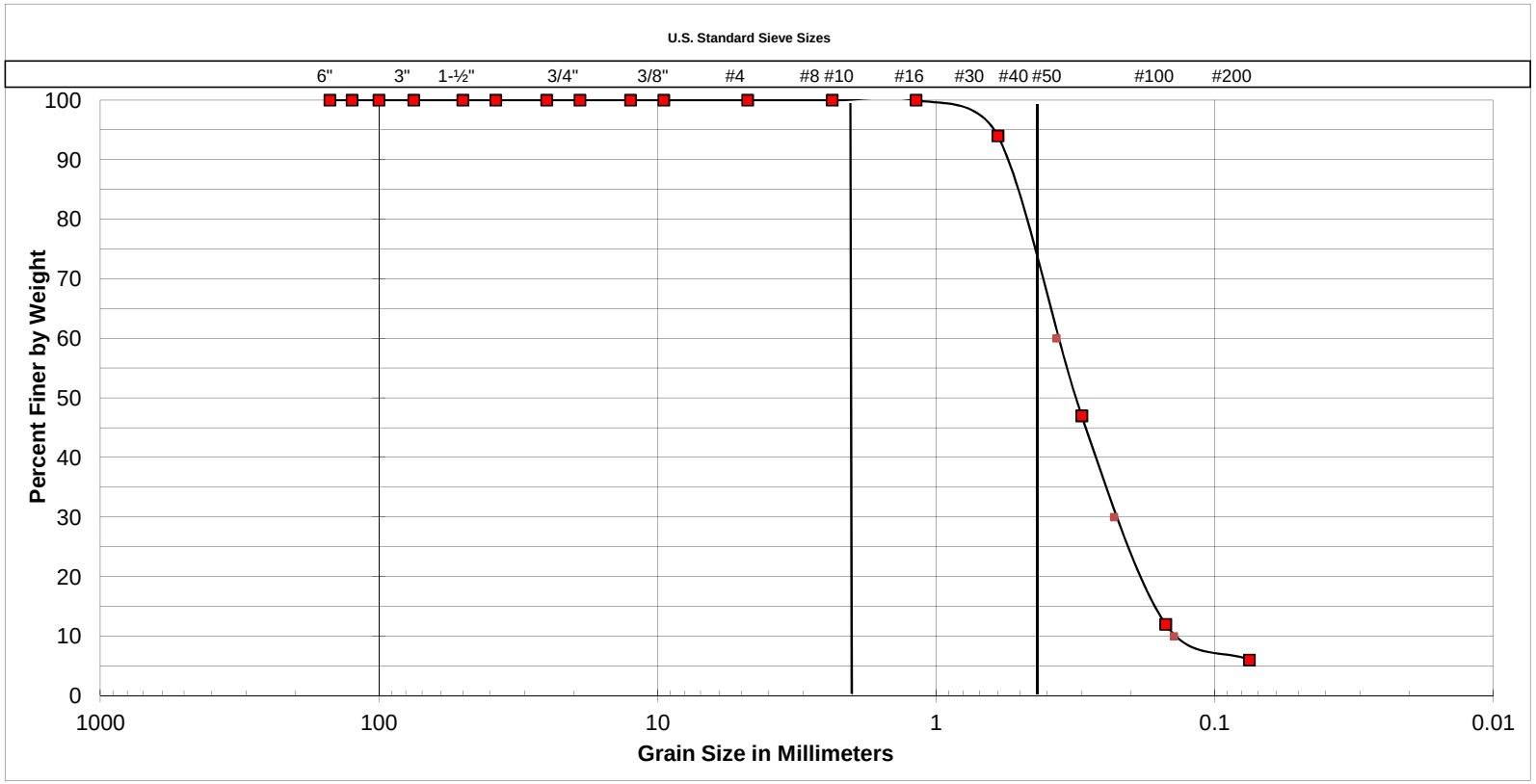
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	1.0

ATTERBERG LIMITS	
LIQUID LIMIT	30
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-40



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 50 feet

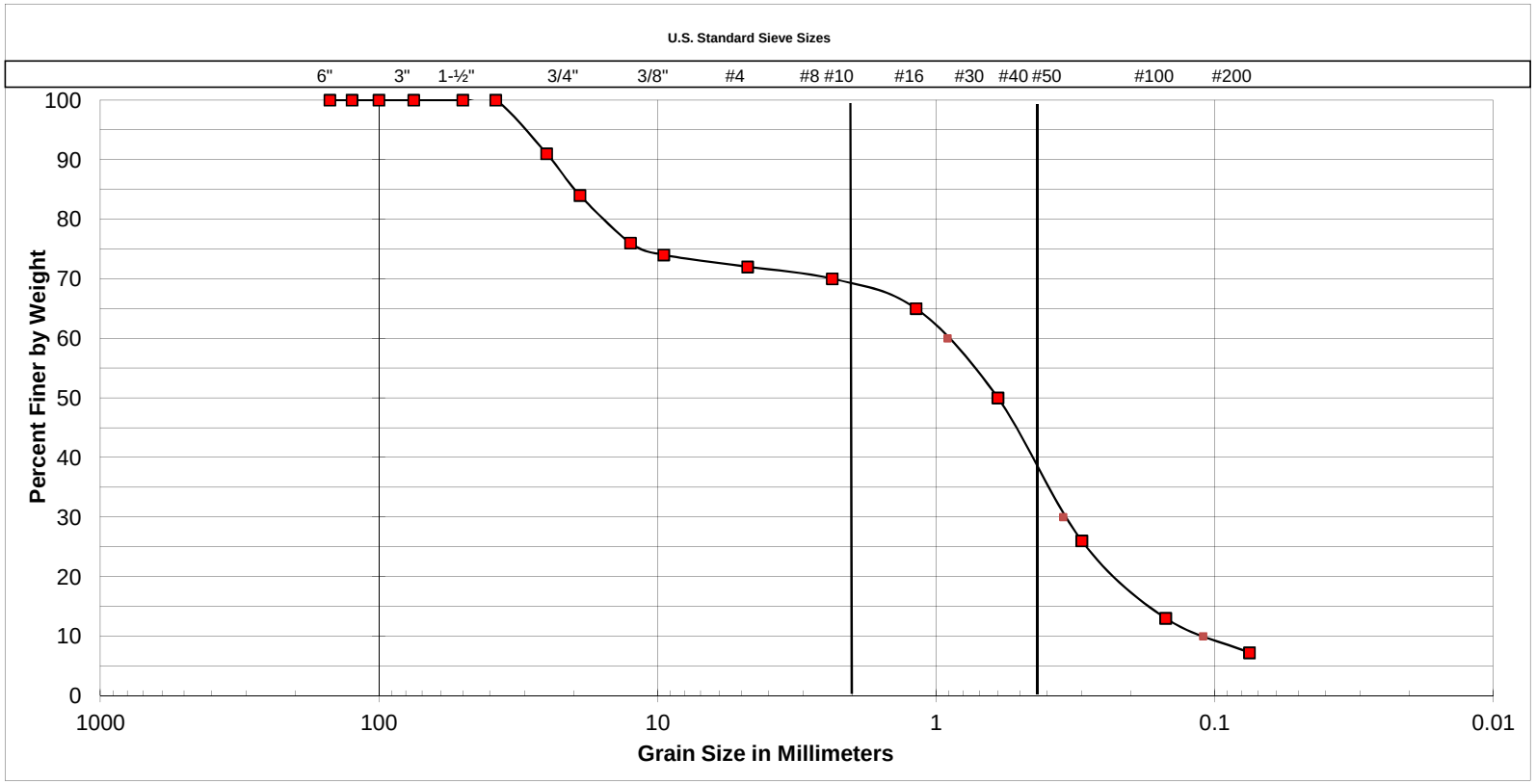
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION	POORLY-GRADED SAND with SILT
Wc/LL	1.1

ATTERBERG LIMITS	
LIQUID LIMIT	24
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-41



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 70 feet

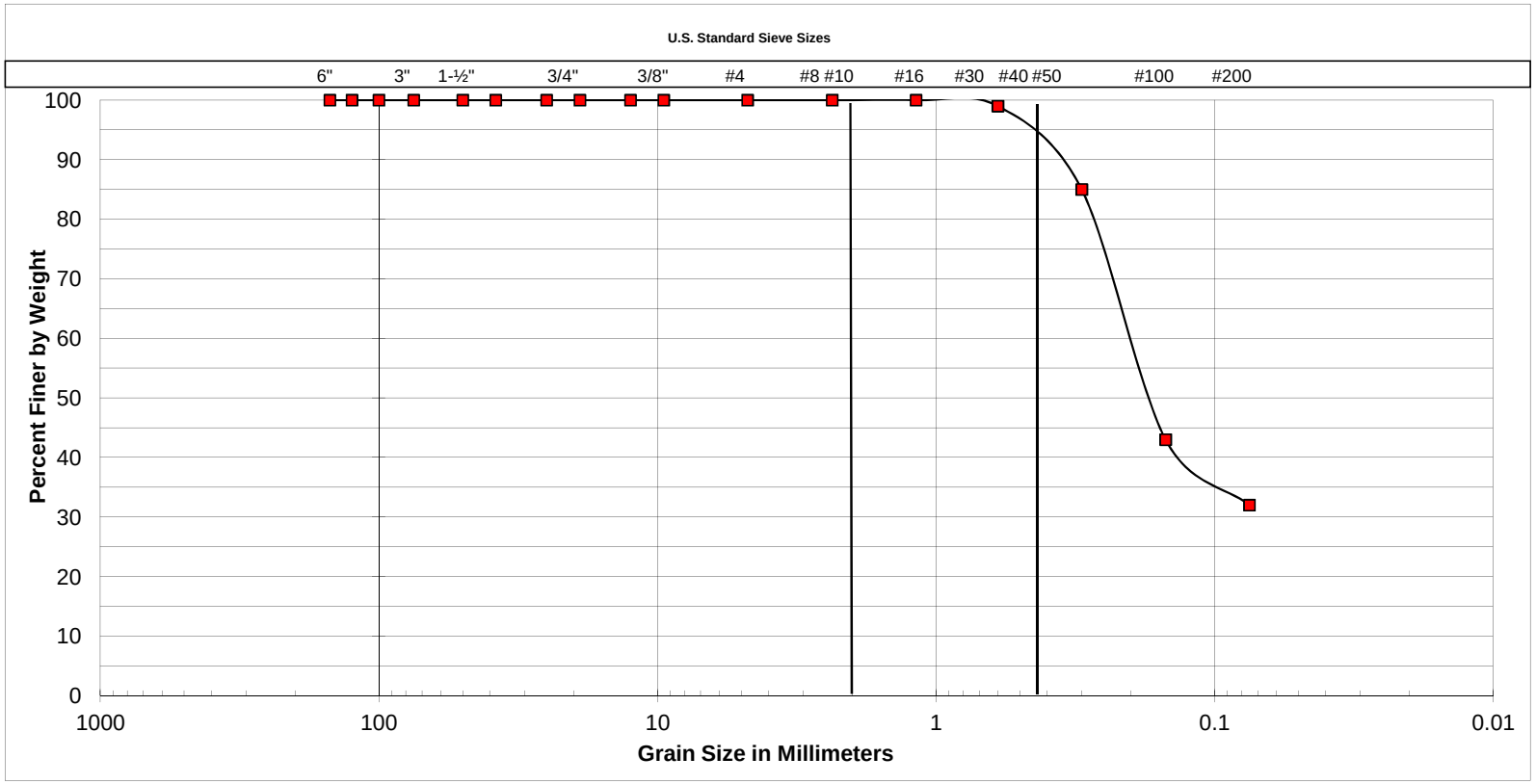
UNIFIED SOIL CLASSIFICATION:	SW-SM
DESCRIPTION	WELL GRADED SAND with SILT and GRAVEL
Wc/LL	0.7

ATTERBERG LIMITS	
LIQUID LIMIT	22
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-42



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-034 at 100 feet

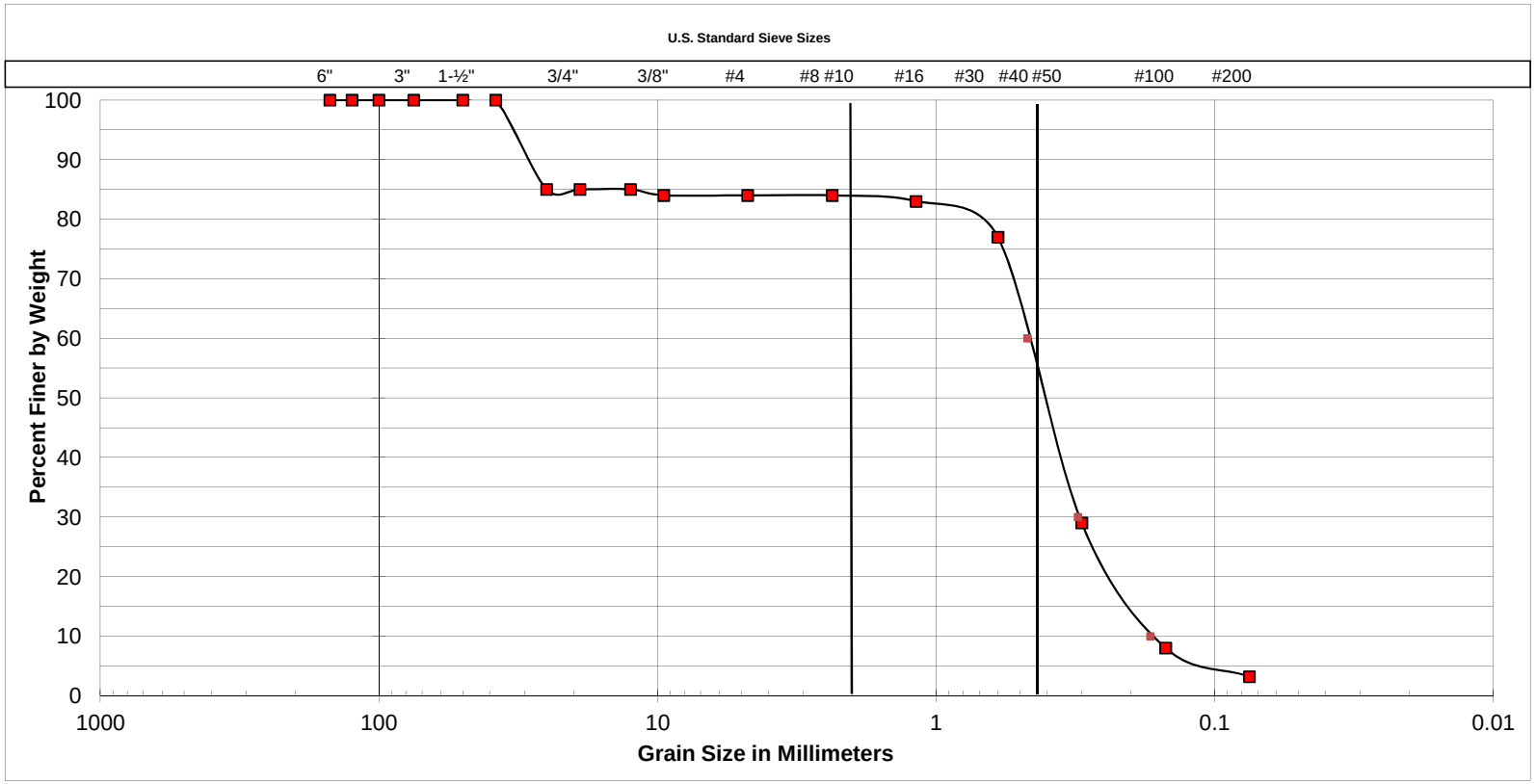
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	30
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-43



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-038 at 10 feet

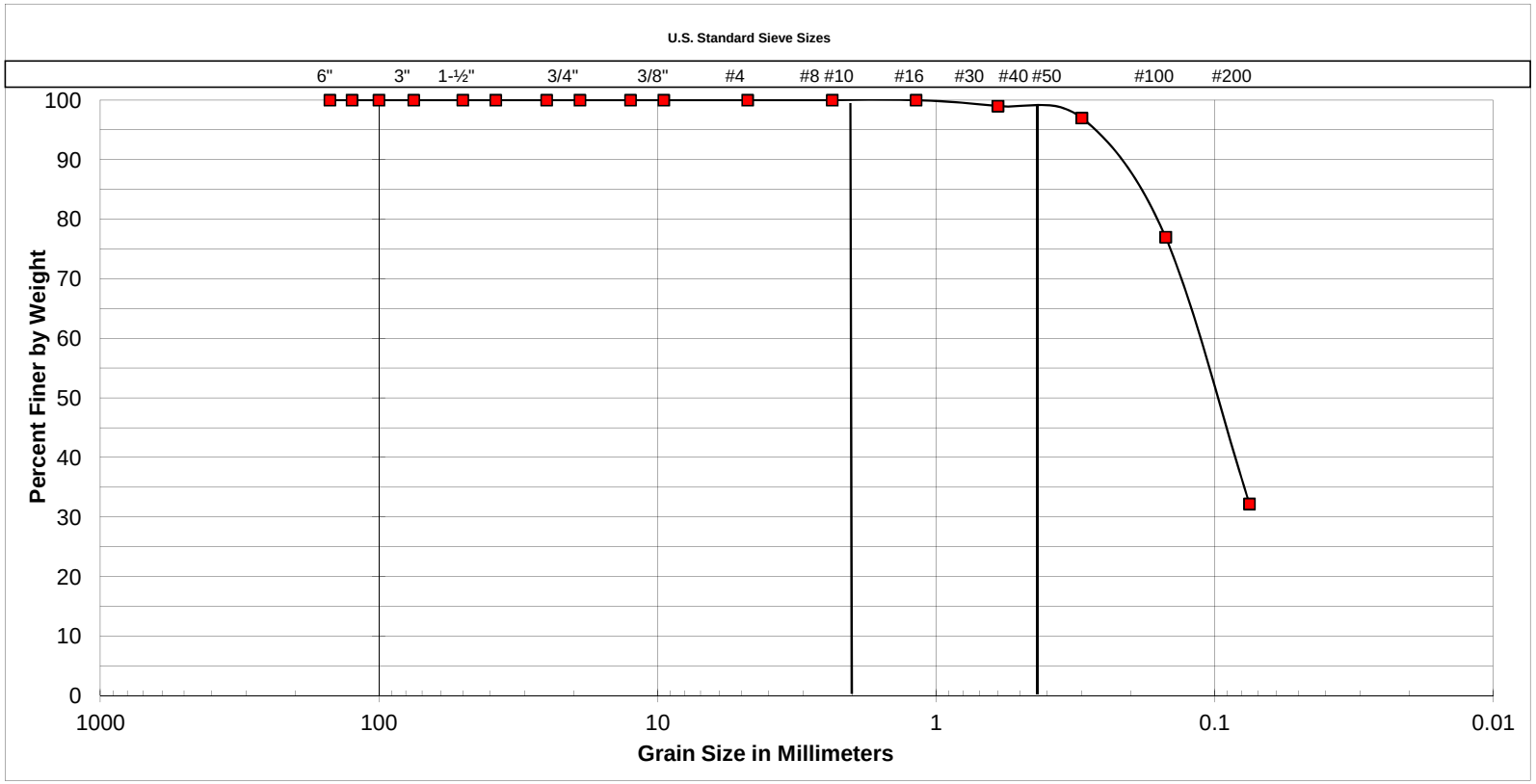
UNIFIED SOIL CLASSIFICATION:	SP
DESCRIPTION	POORLY-GRADED SAND
Wc/LL	0.7

ATTERBERG LIMITS	
LIQUID LIMIT	28
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-44



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-038 at 30 feet

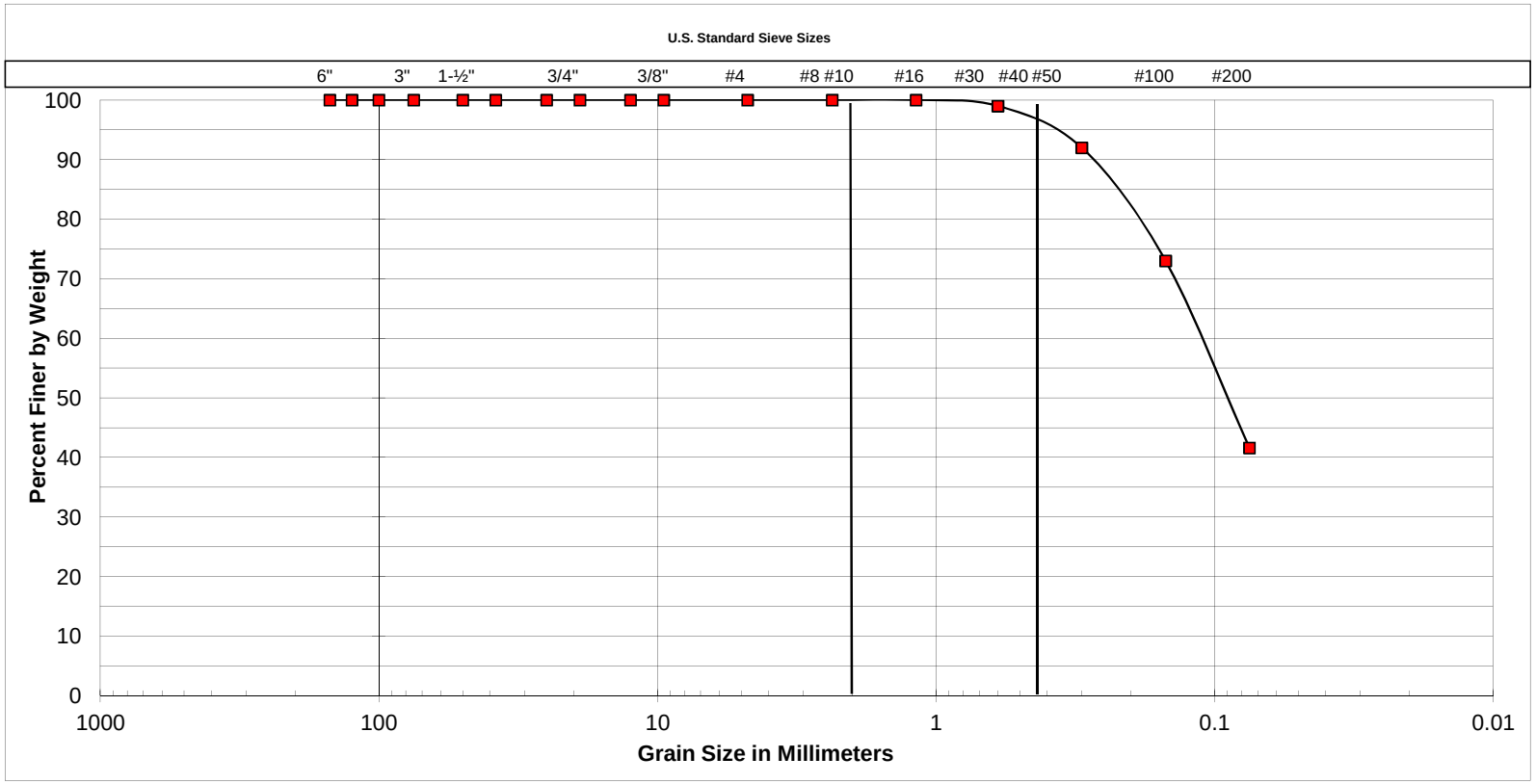
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	1.2

ATTERBERG LIMITS	
LIQUID LIMIT	33
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-45



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-038 at 40 feet

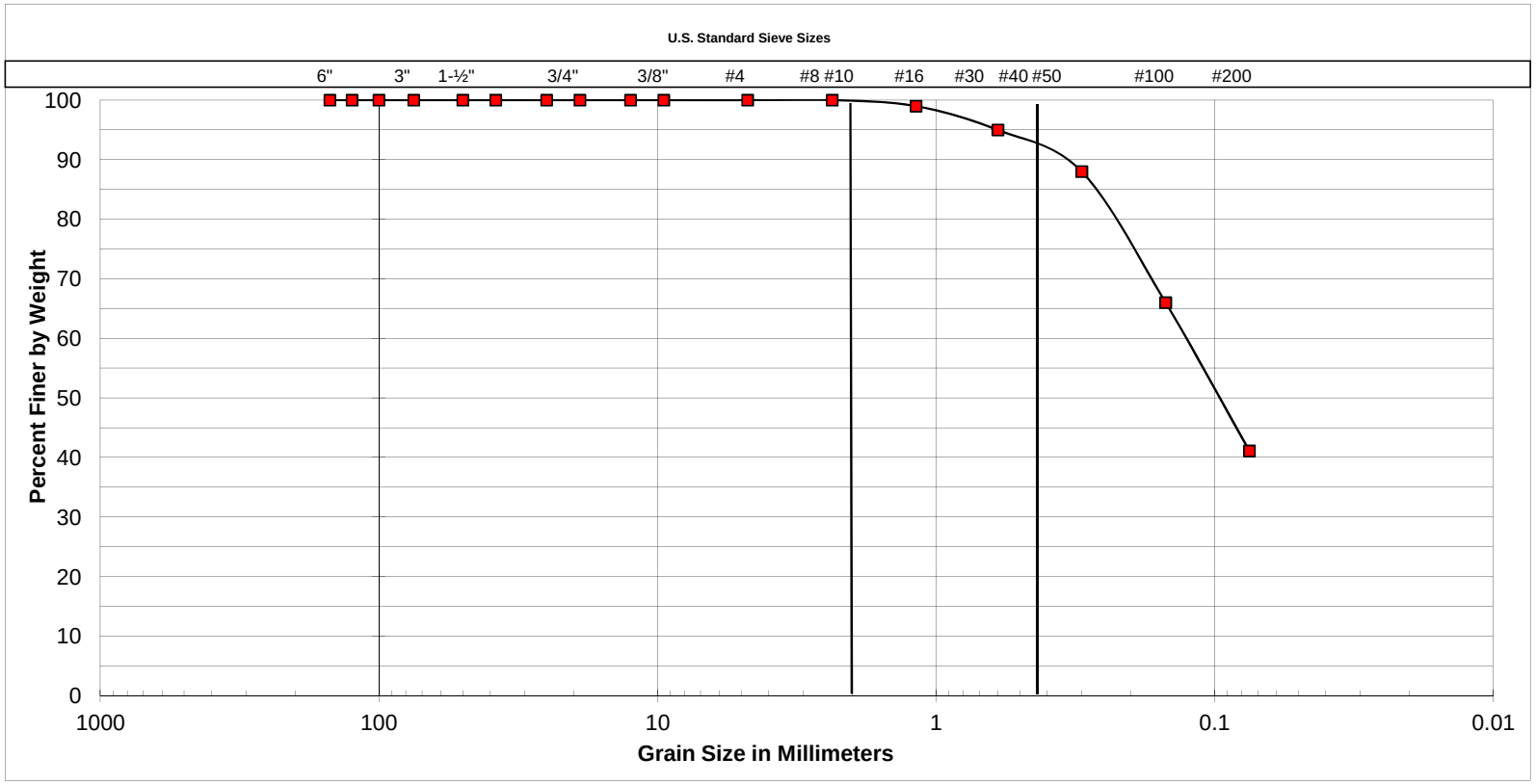
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	1.0

ATTERBERG LIMITS	
LIQUID LIMIT	30
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRAIRS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-46



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-038 at 50 feet

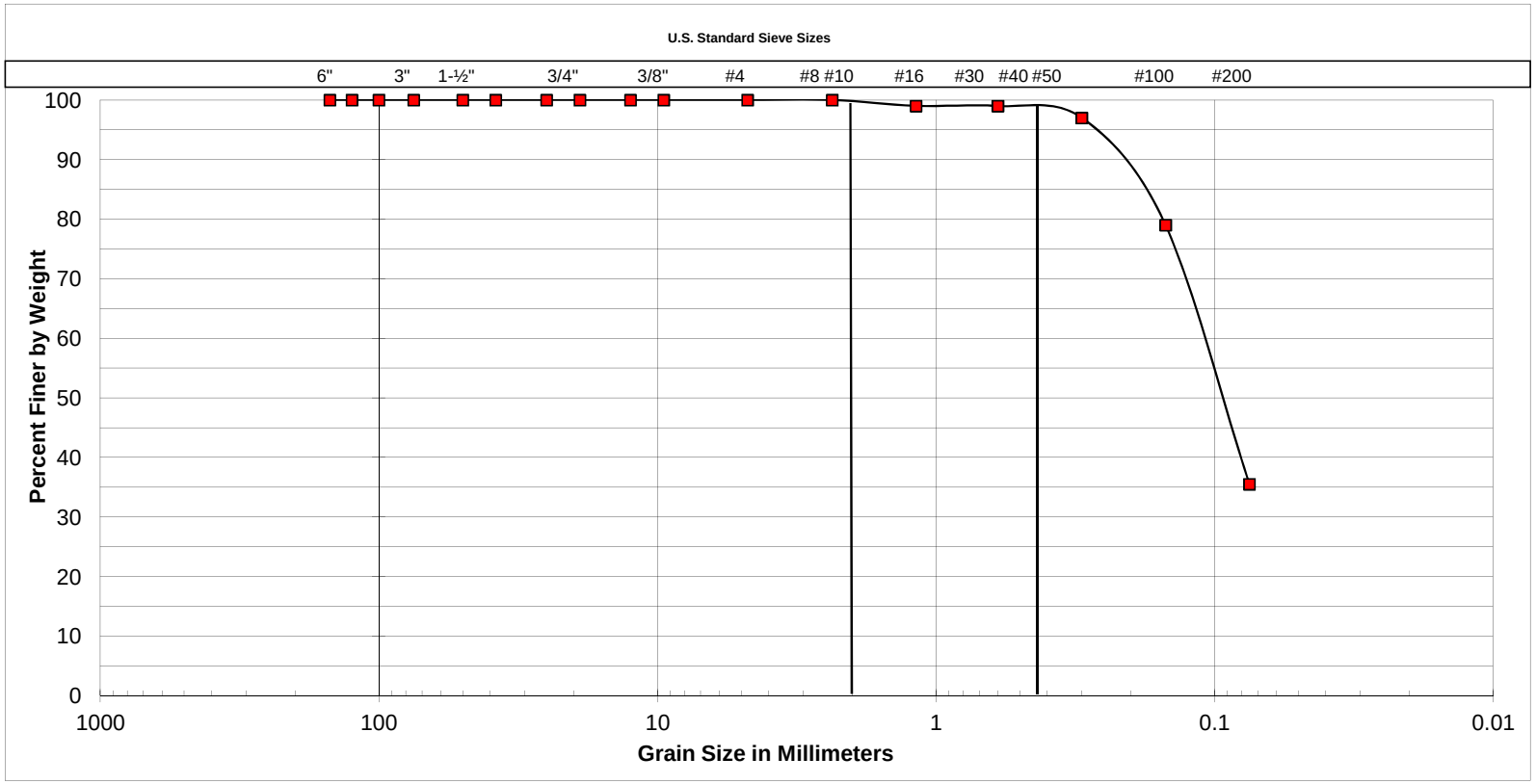
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	0.7

ATTERBERG LIMITS	
LIQUID LIMIT	31
PLASTIC LIMIT	23
PLASTICITY INDEX	8

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-47



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-038 at 90 feet

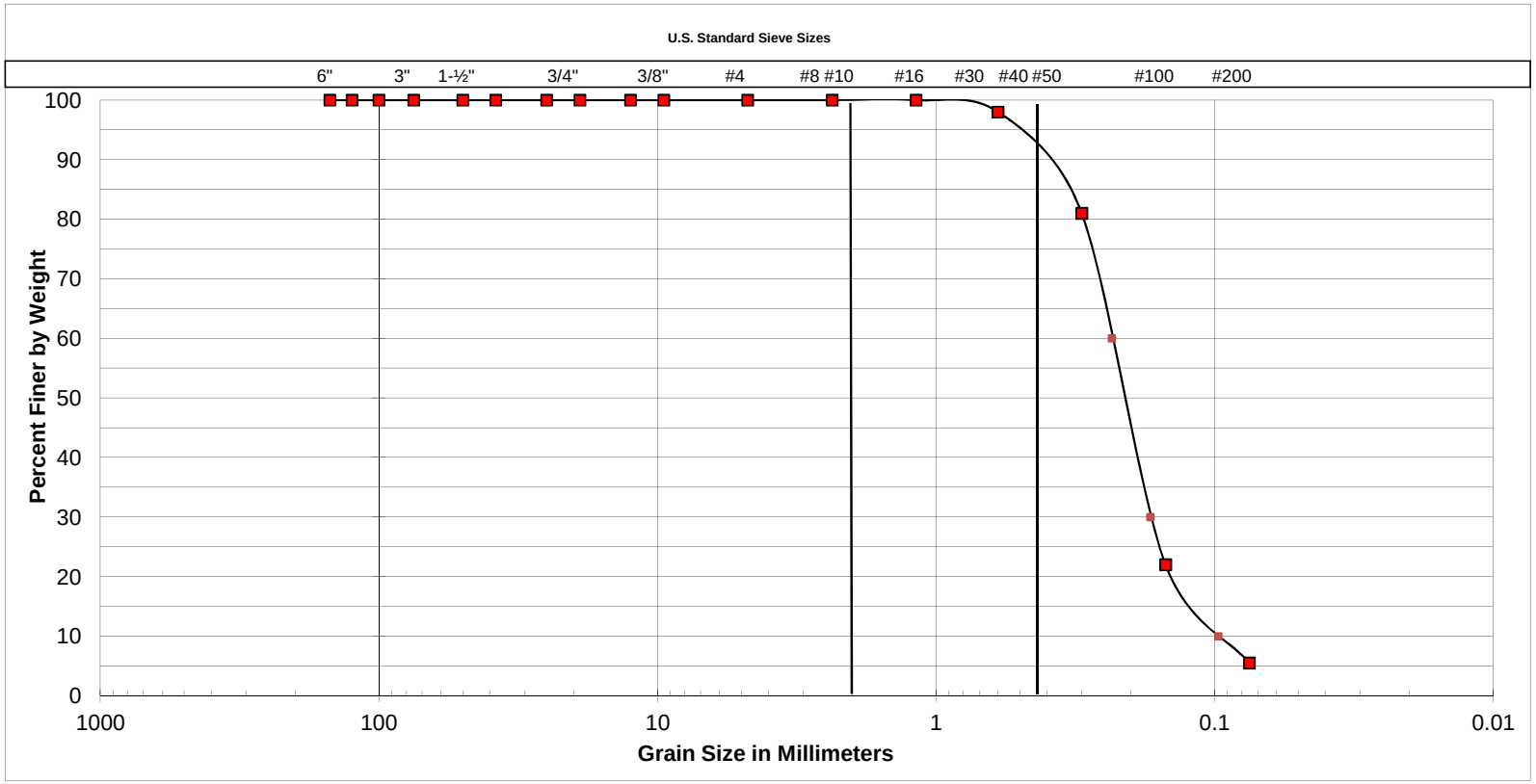
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	40
PLASTIC LIMIT	27
PLASTICITY INDEX	14

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-48



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 15 feet

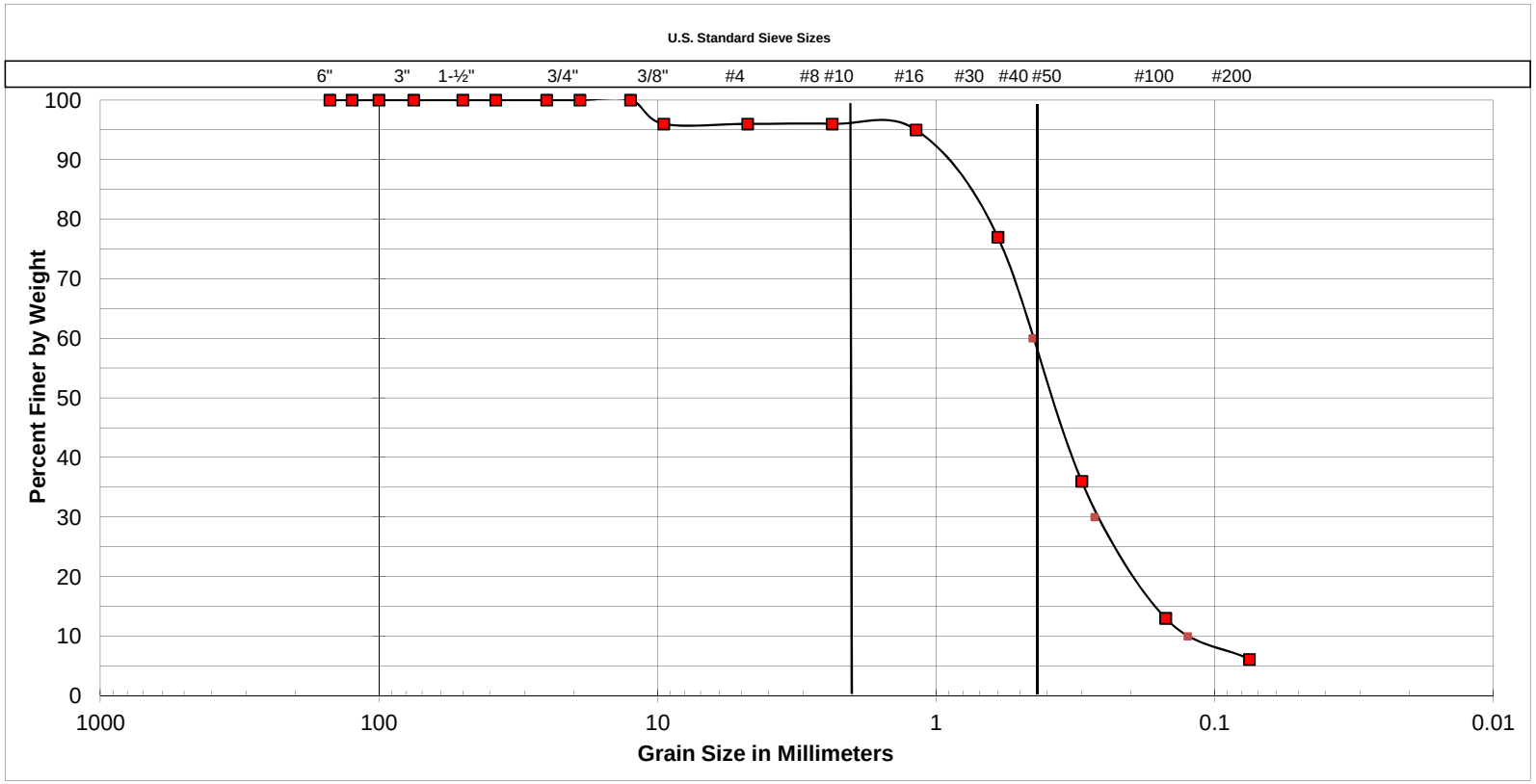
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION	POORLY-GRADED SAND with SILT

ATTERBERG LIMITS	
LIQUID LIMIT	30
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-49



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 25 feet

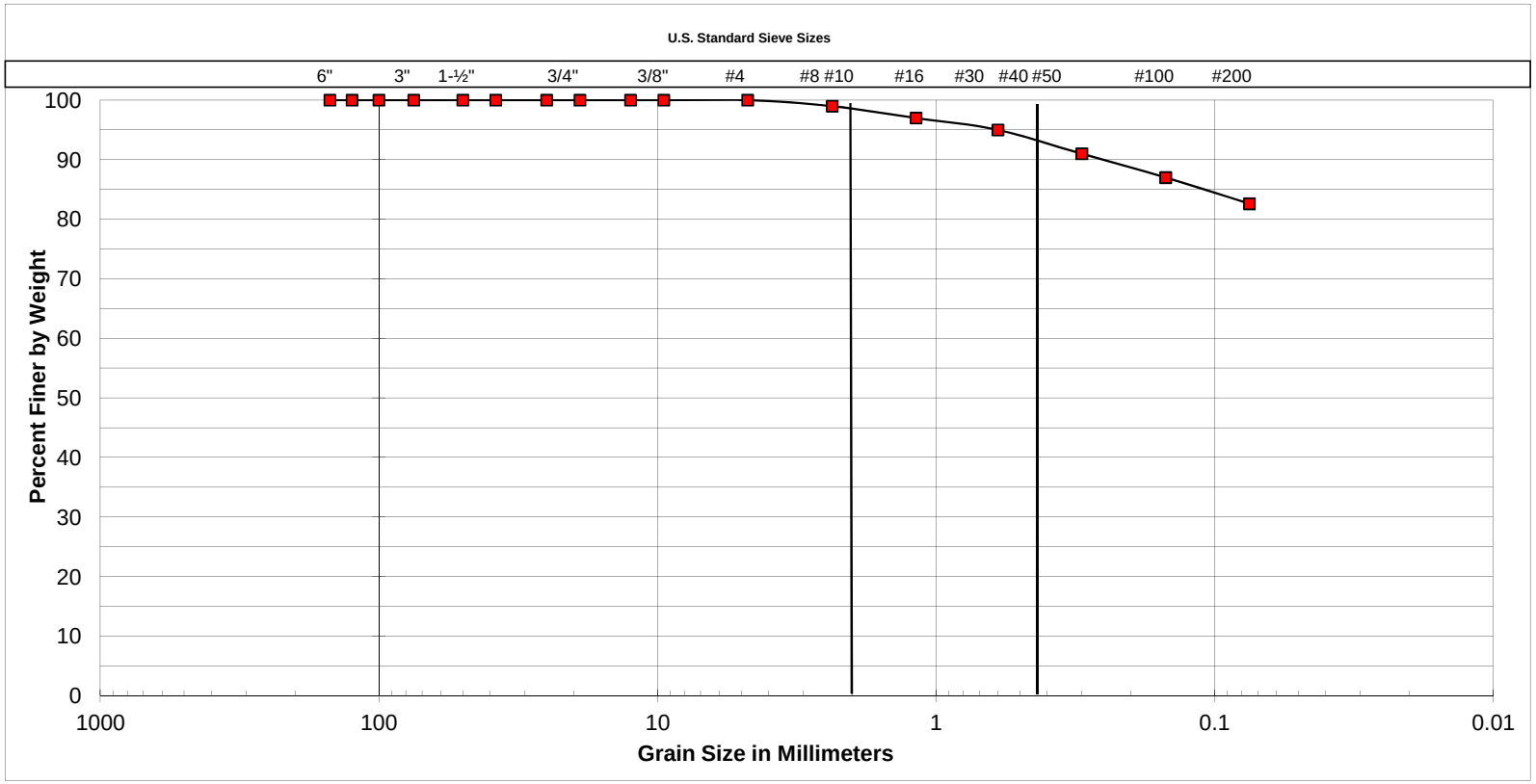
UNIFIED SOIL CLASSIFICATION:	SP-SM
DESCRIPTION	POORLY-GRADED SAND with SILT
Wc/LL	0.8

ATTERBERG LIMITS	
LIQUID LIMIT	27
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-50



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 45 feet

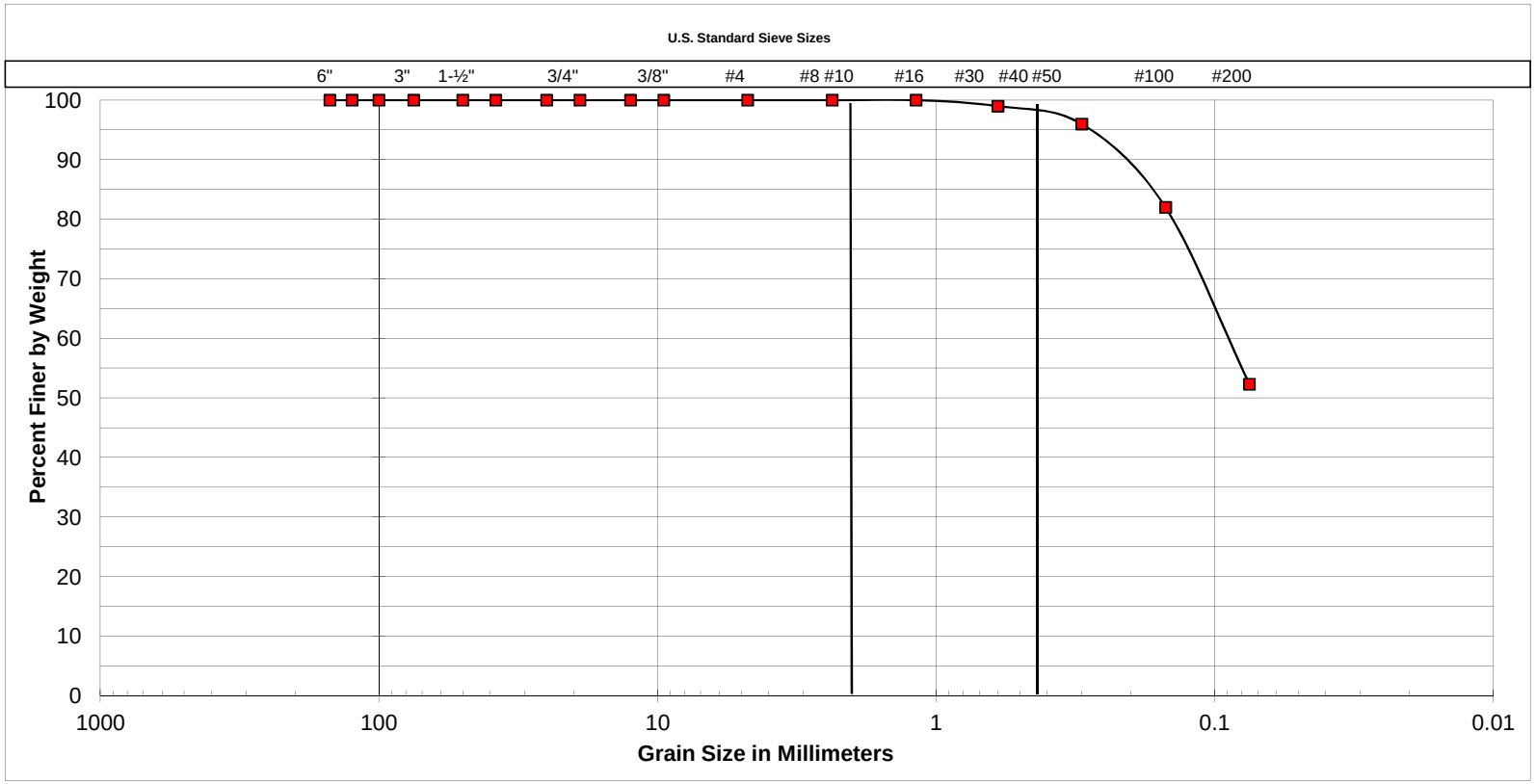
UNIFIED SOIL CLASSIFICATION:	MH
DESCRIPTION	ELASTIC SILT with SAND
Wc/LL	0.9

ATTERBERG LIMITS	
LIQUID LIMIT	67
PLASTIC LIMIT	36
PLASTICITY INDEX	31

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-51



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 60 feet

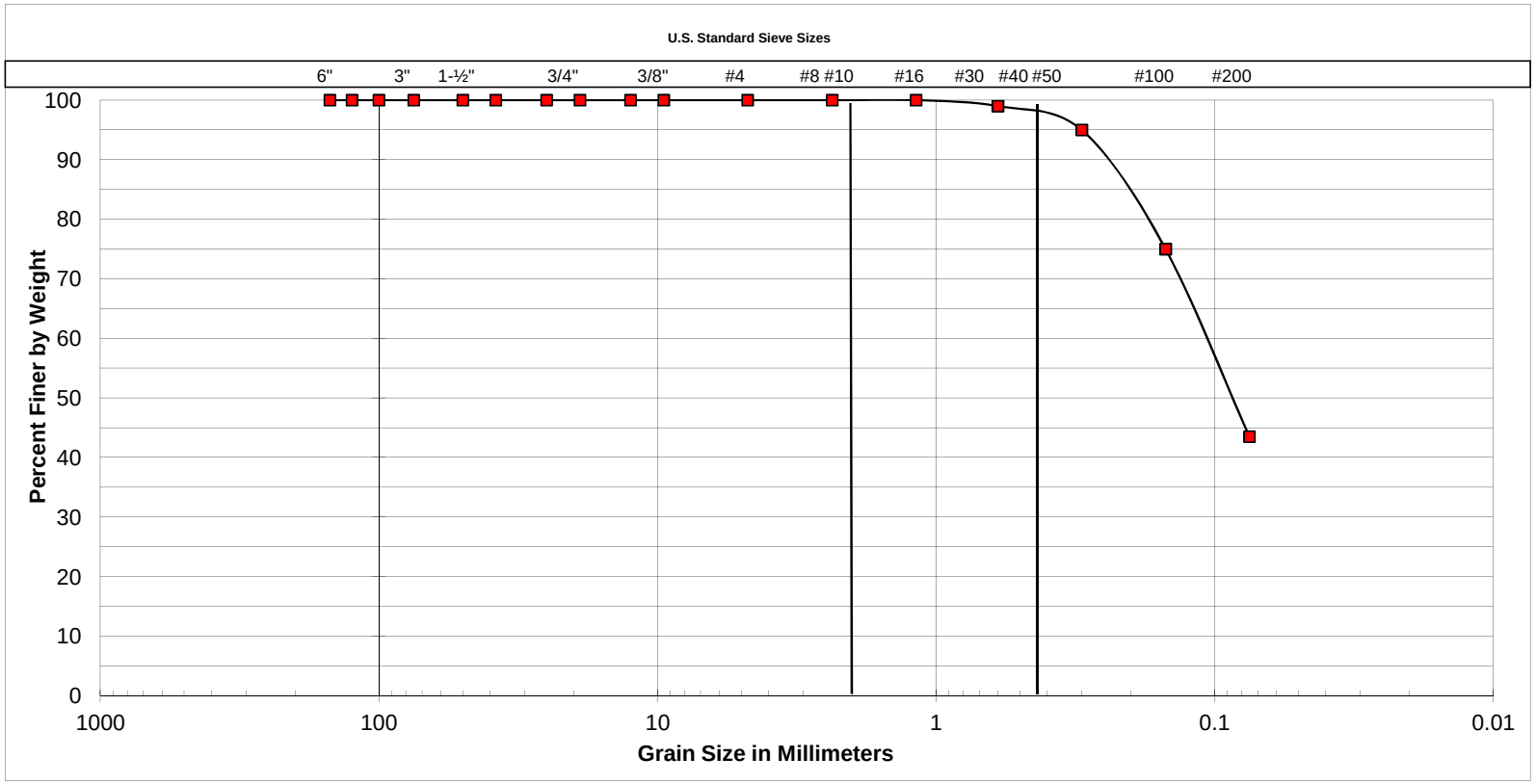
UNIFIED SOIL CLASSIFICATION:	ML
DESCRIPTION	SANDY SILT
Wc/LL	0.8

ATTERBERG LIMITS	
LIQUID LIMIT	31
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-52



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 70 feet

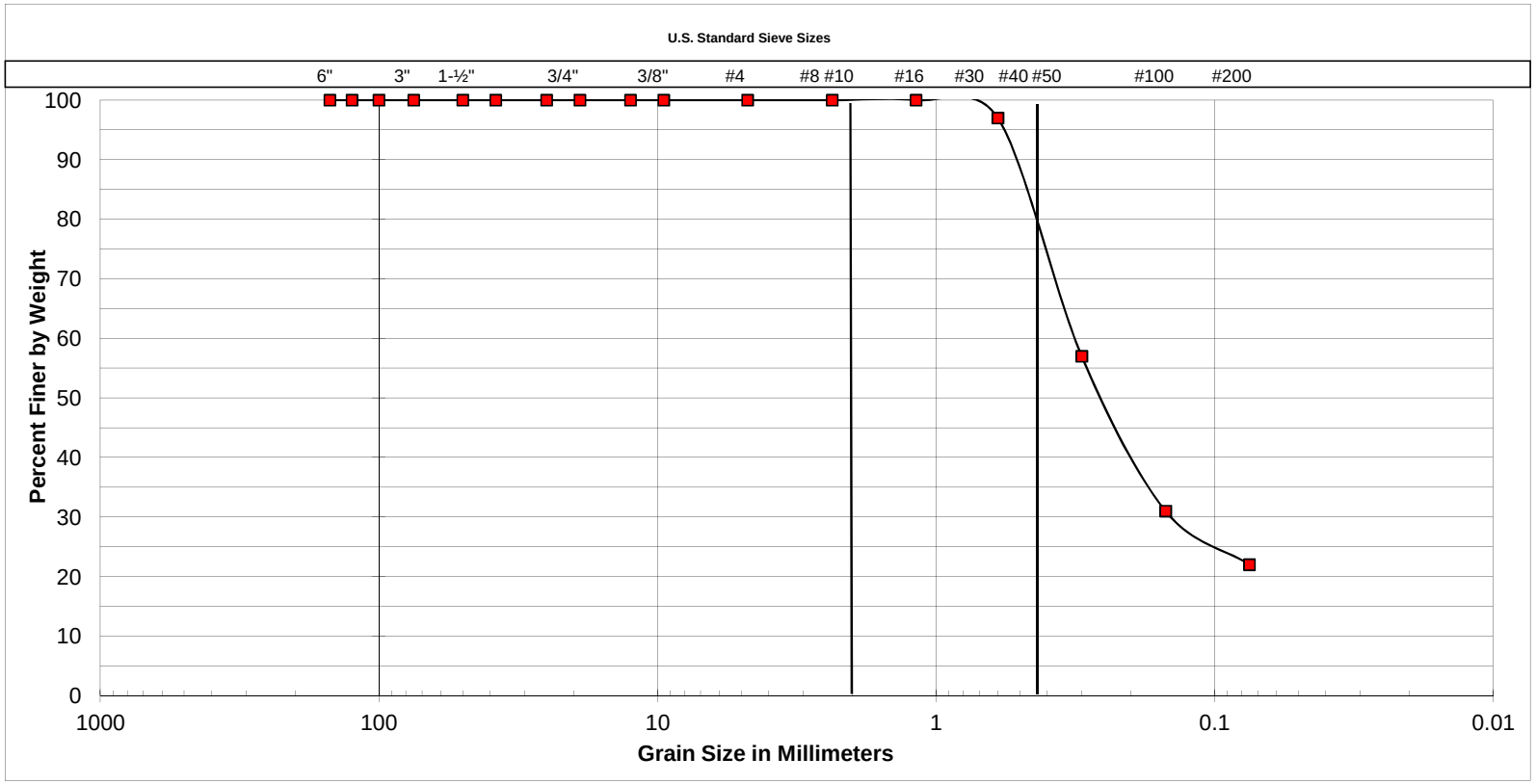
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	33
PLASTIC LIMIT	23
PLASTICITY INDEX	10

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-53



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-040 at 100 feet

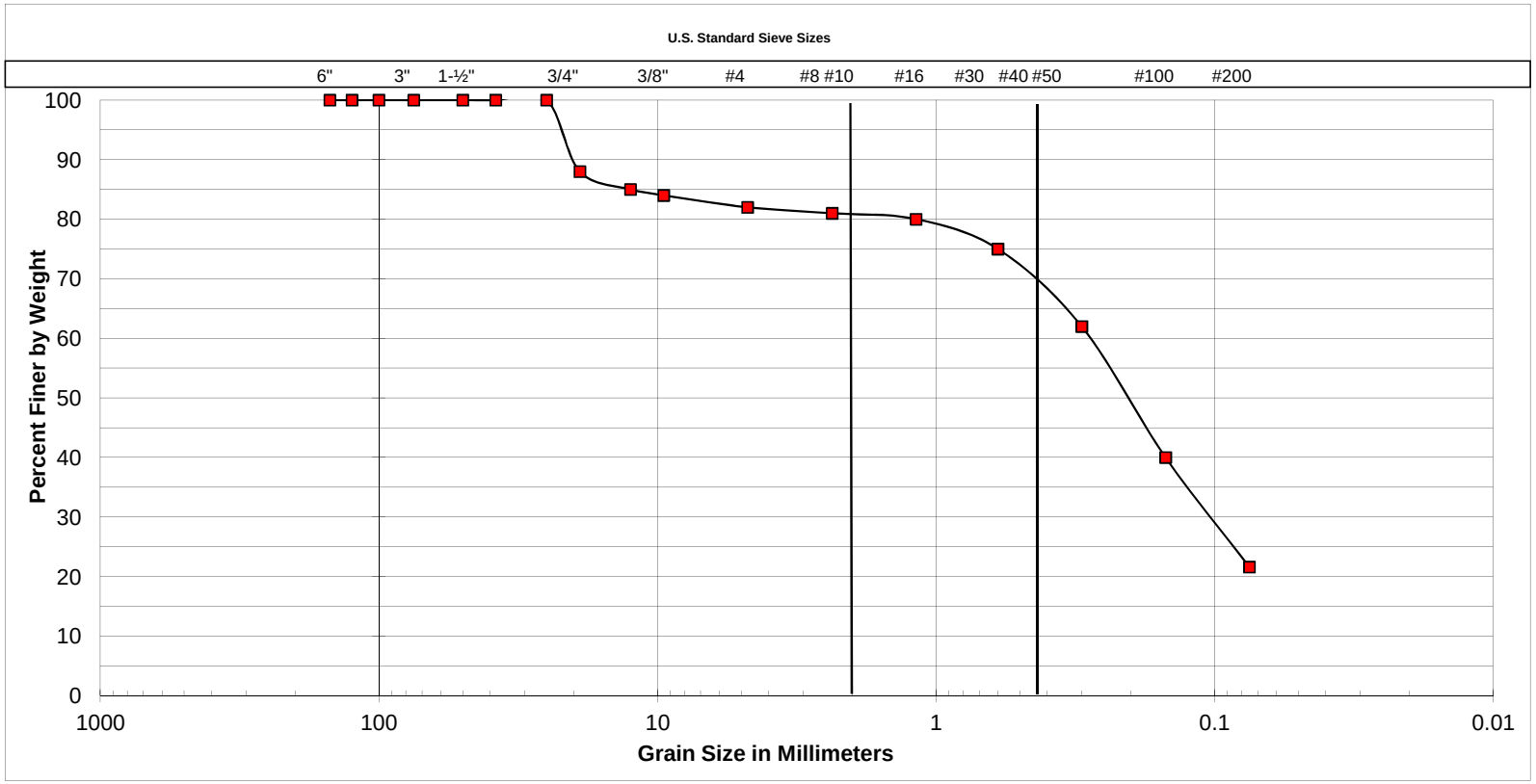
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	47
PLASTIC LIMIT	23
PLASTICITY INDEX	24

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-54



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-041 at 25 feet

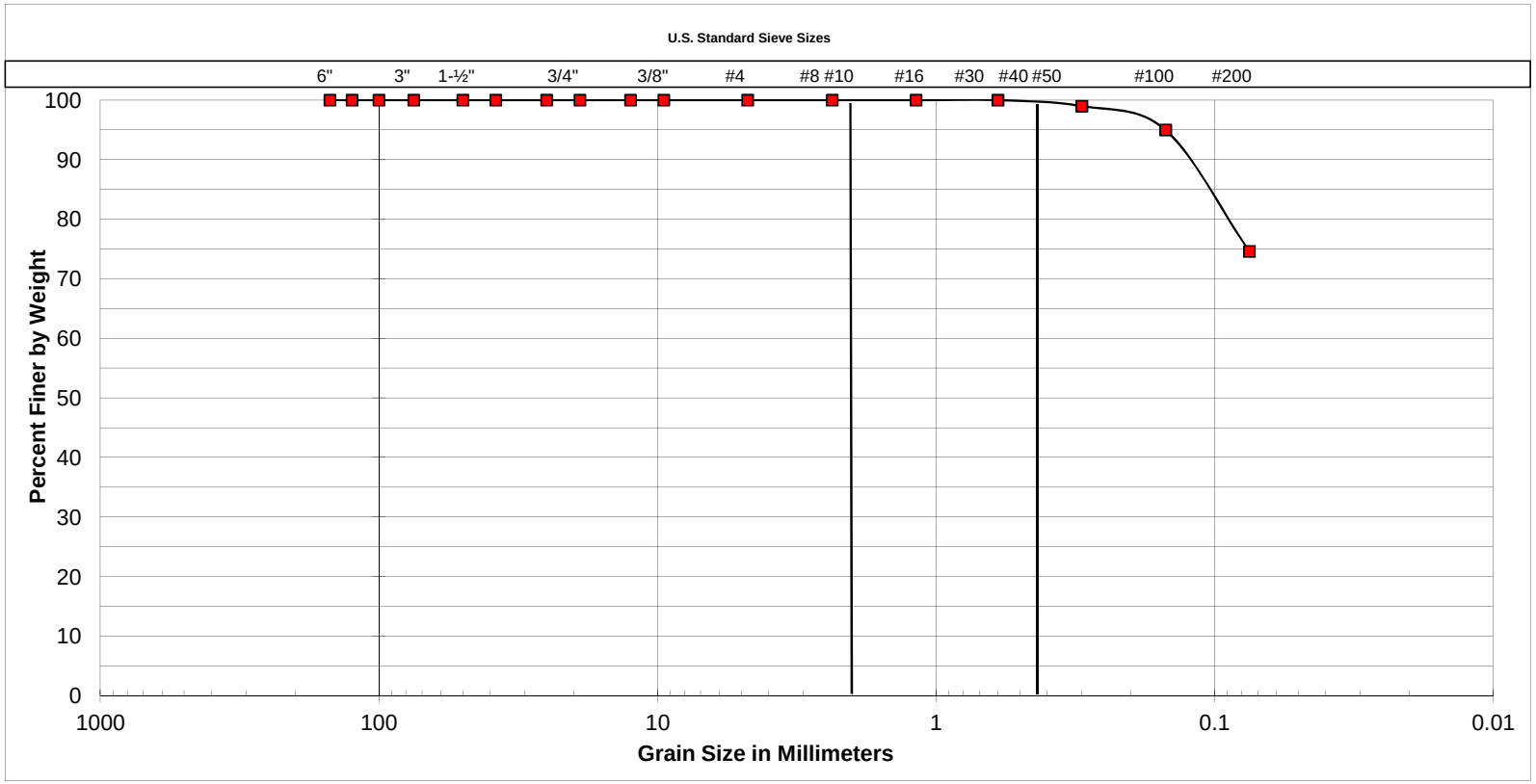
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND with GRAVEL
Wc/LL	1.0

ATTERBERG LIMITS	
LIQUID LIMIT	23
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-55



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-041 at 45 feet

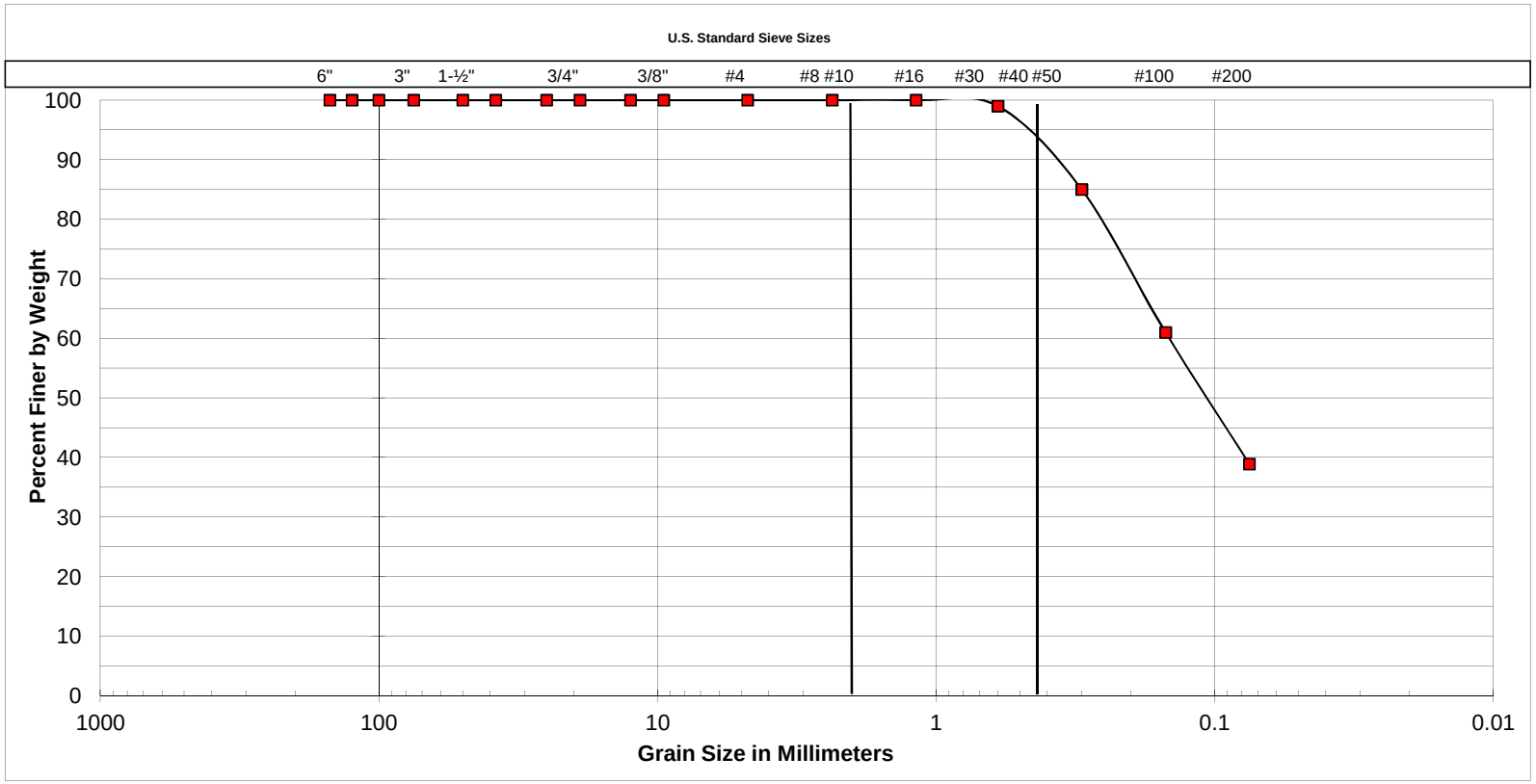
UNIFIED SOIL CLASSIFICATION:	ML
DESCRIPTION	SILT with SAND

ATTERBERG LIMITS	
LIQUID LIMIT	43
PLASTIC LIMIT	27
PLASTICITY INDEX	16

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-56



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
R-12-041 at 60 feet

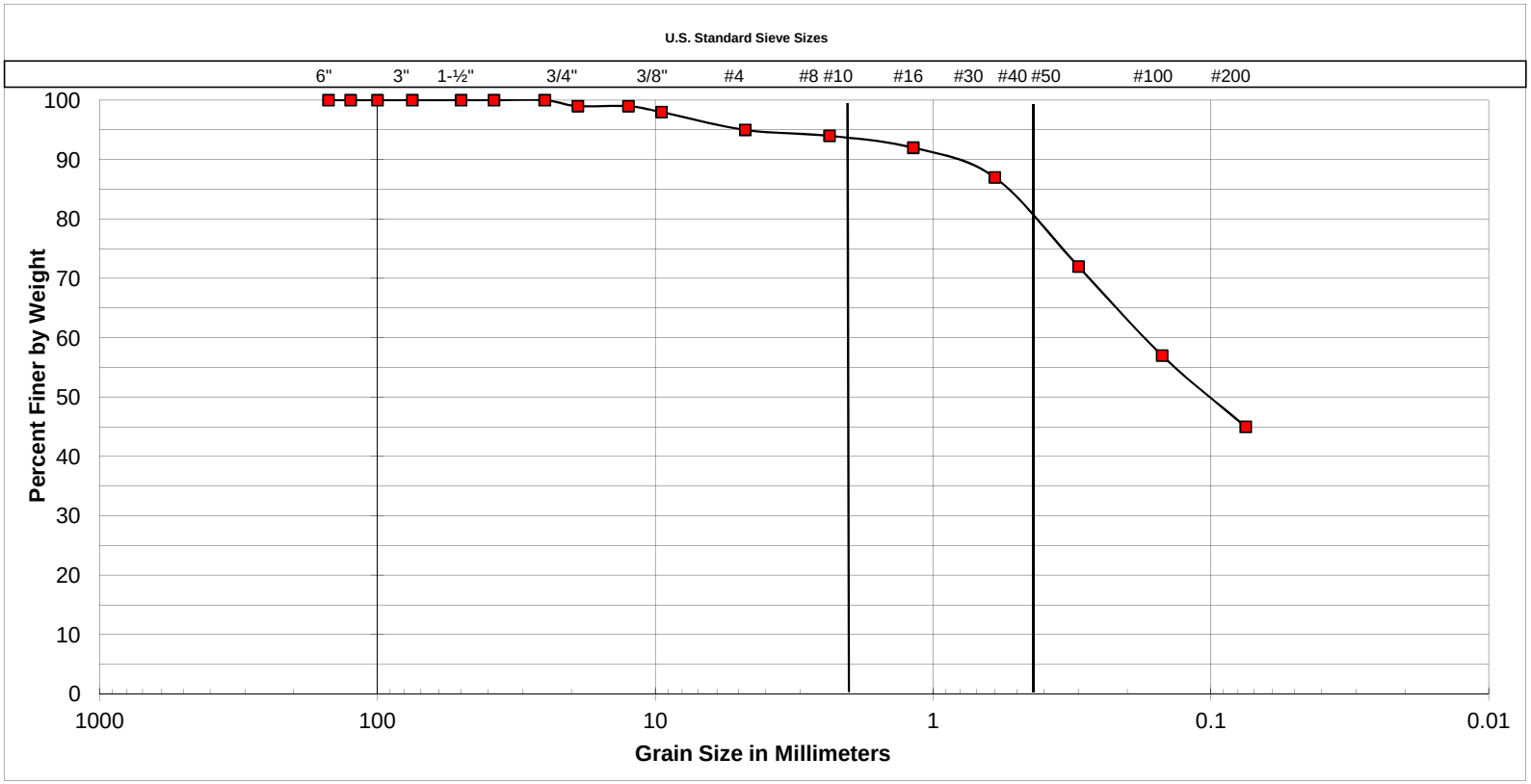
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND
Wc/LL	1.0

ATTERBERG LIMITS	
LIQUID LIMIT	25
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-57



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-042 at 1 foot to 4 feet

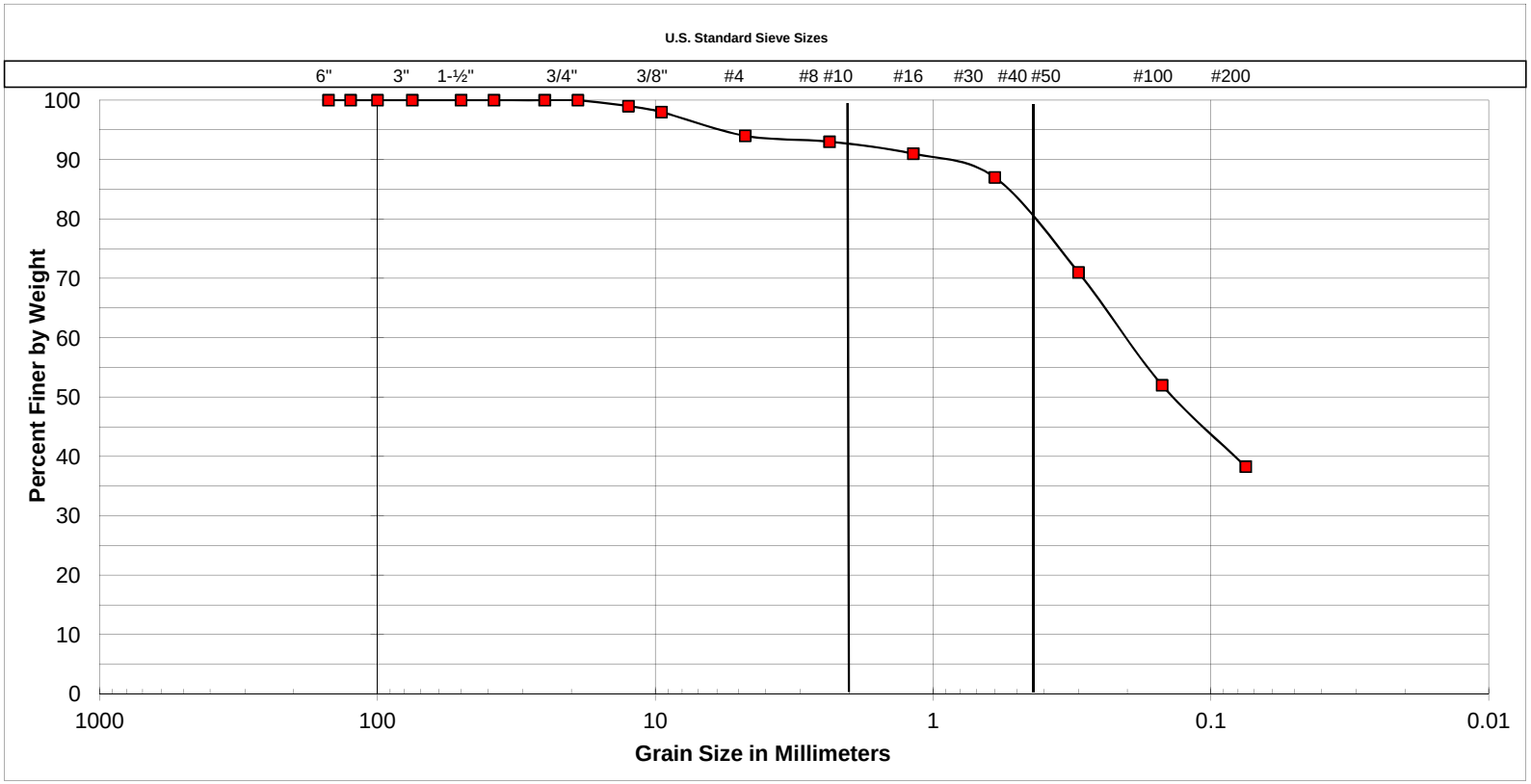
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	30
PLASTIC LIMIT	15
PLASTICITY INDEX	15

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-58



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-042 at 5 feet to 10 feet

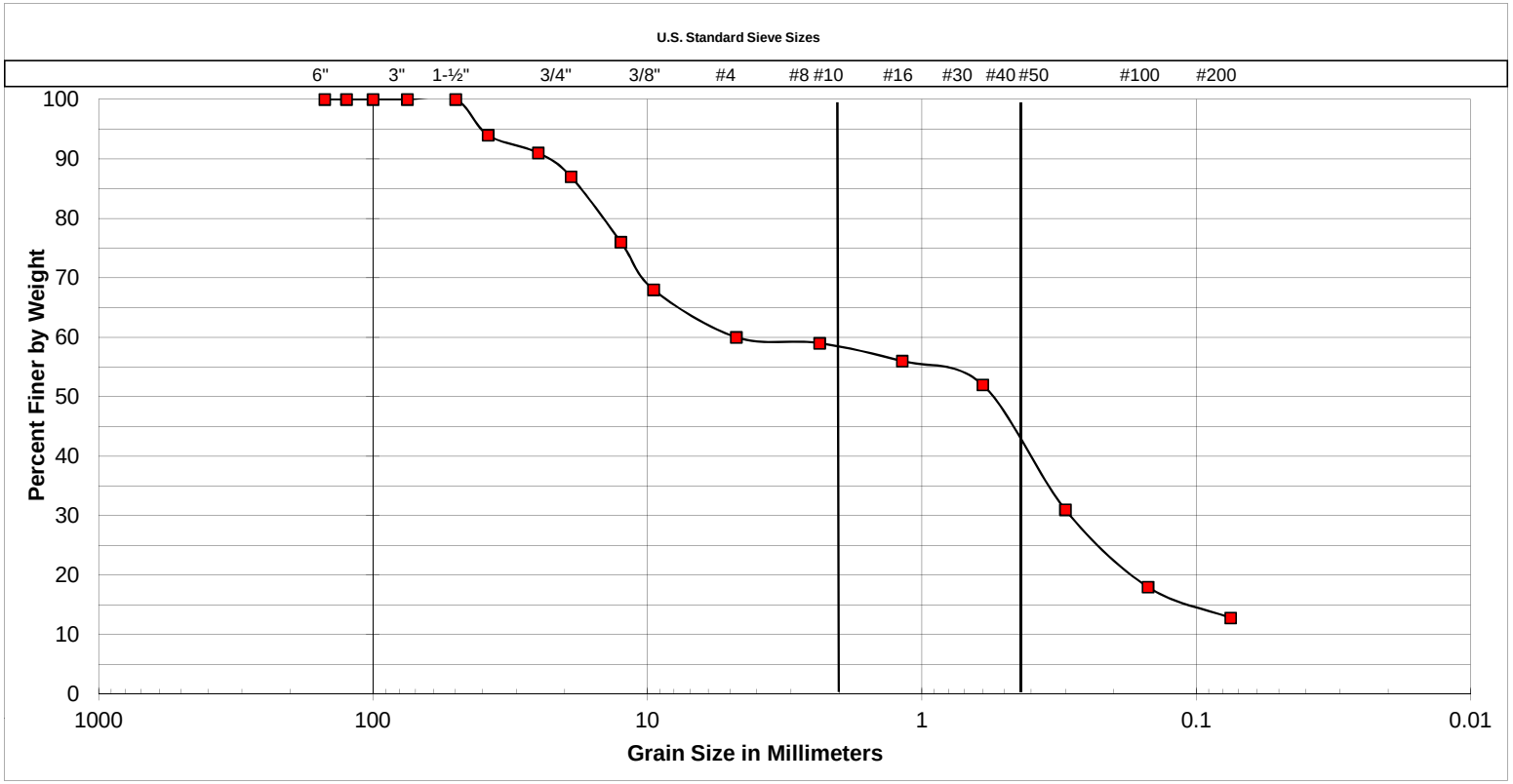
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	25
PLASTIC LIMIT	17
PLASTICITY INDEX	8

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-59



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 1 foot to 5 feet

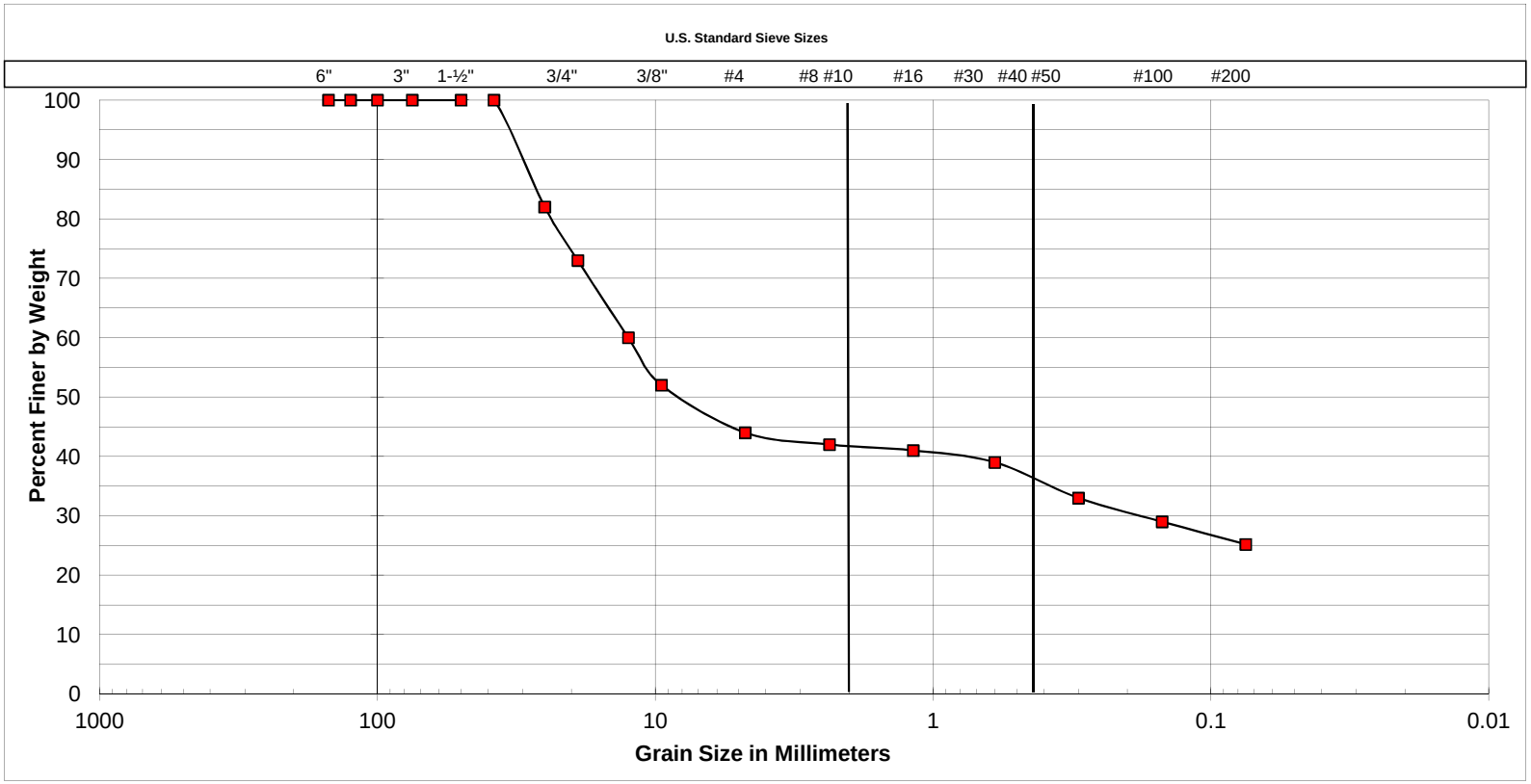
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-60



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 30 feet 35 feet

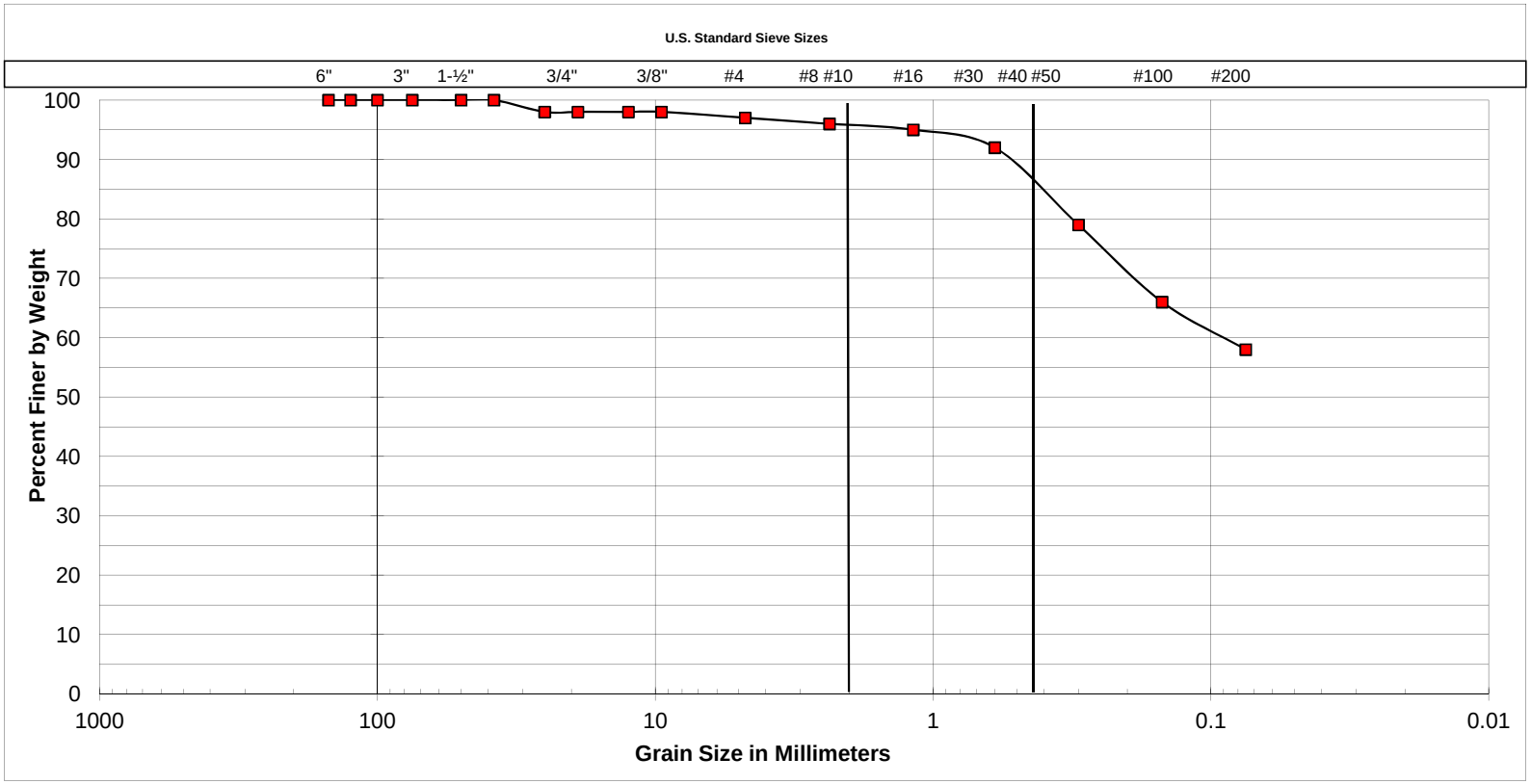
UNIFIED SOIL CLASSIFICATION:	GC
DESCRIPTION	CLAYEY GRAVEL with SAND

ATTERBERG LIMITS	
LIQUID LIMIT	49
PLASTIC LIMIT	20
PLASTICITY INDEX	29

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-61



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-044 at 45 feet to 50 feet

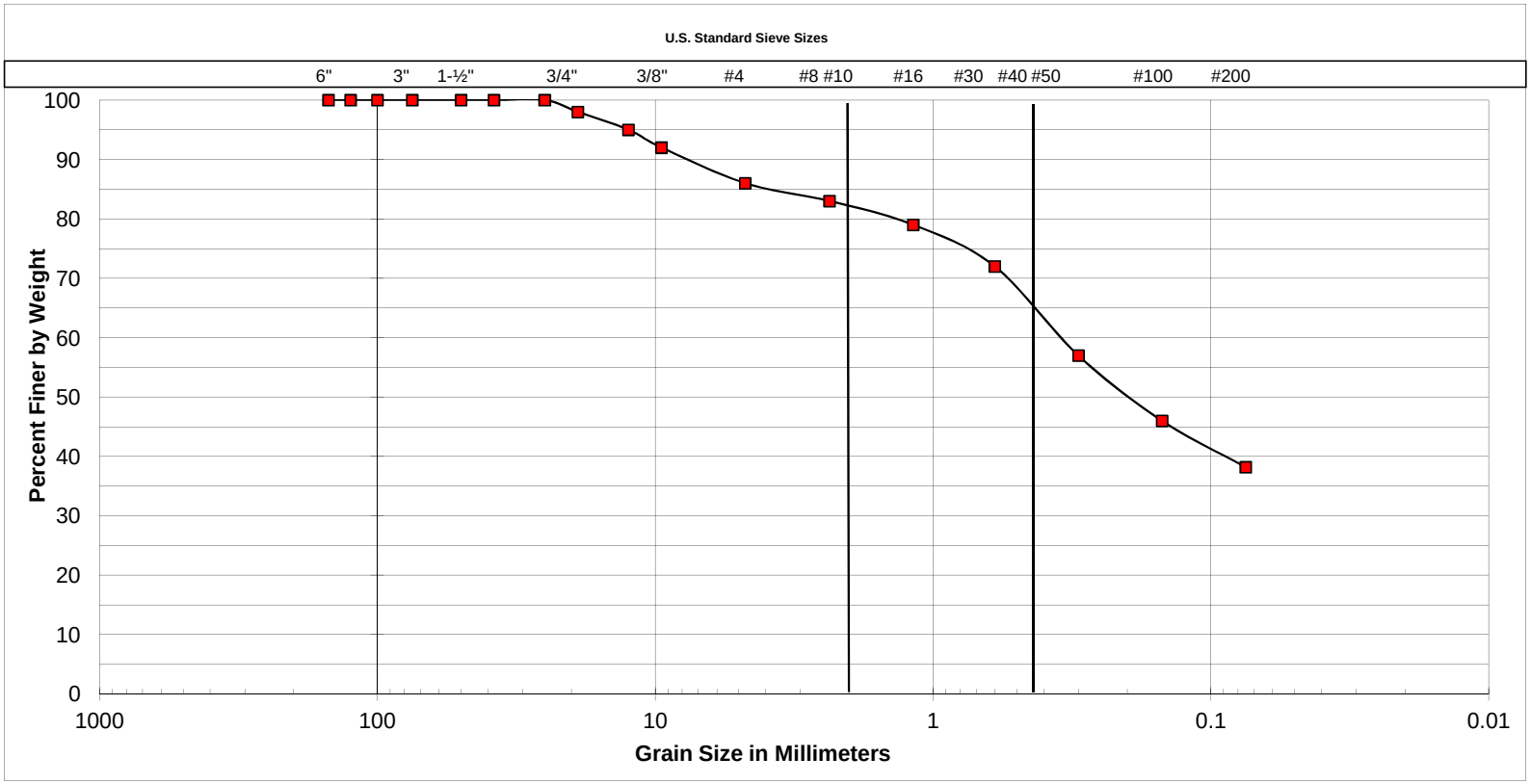
UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY LEAN CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	45
PLASTIC LIMIT	19
PLASTICITY INDEX	26

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-62



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-047 at 1 foot to 5 feet

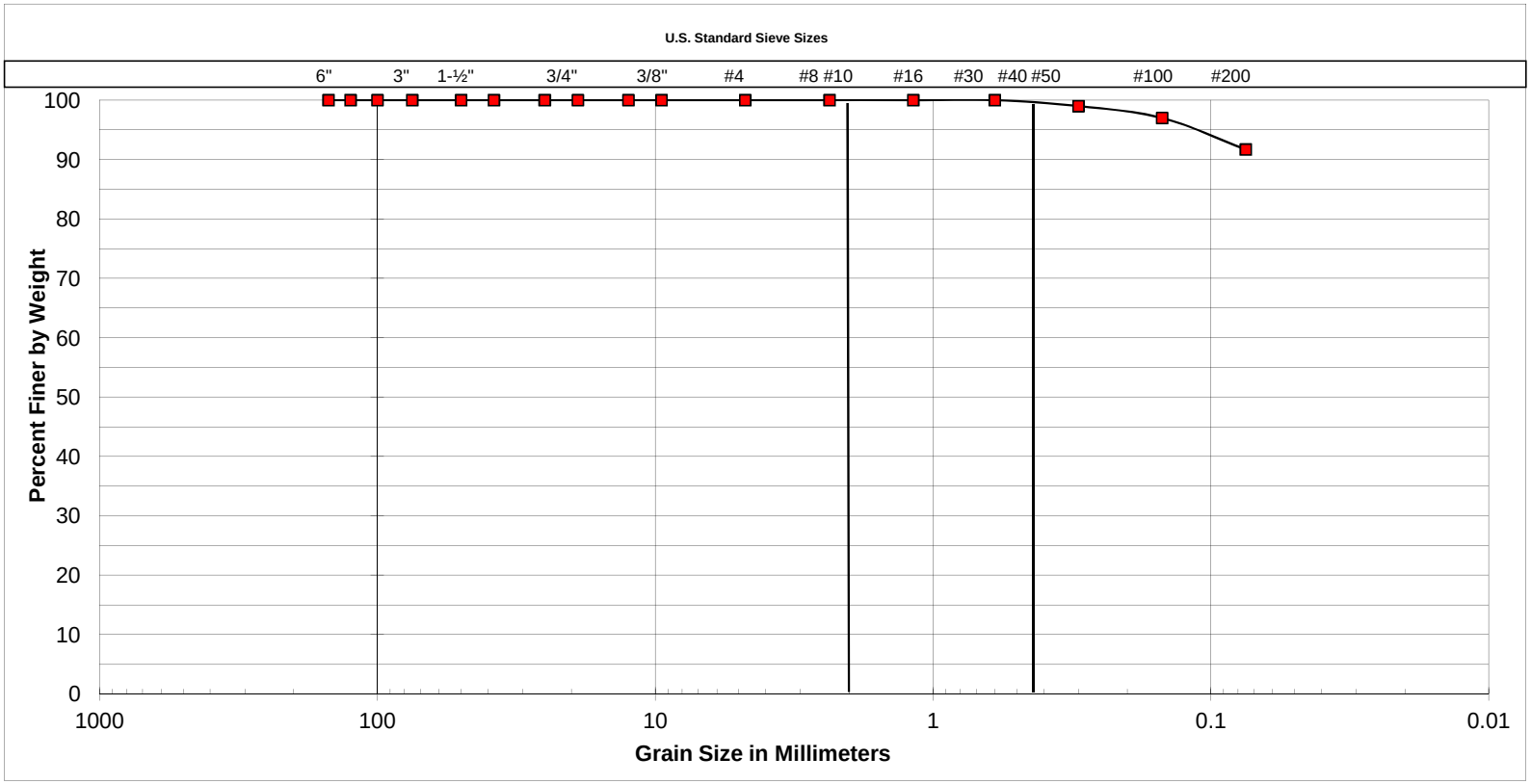
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	33
PLASTIC LIMIT	19
PLASTICITY INDEX	15

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-63



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-047 at 15 feet

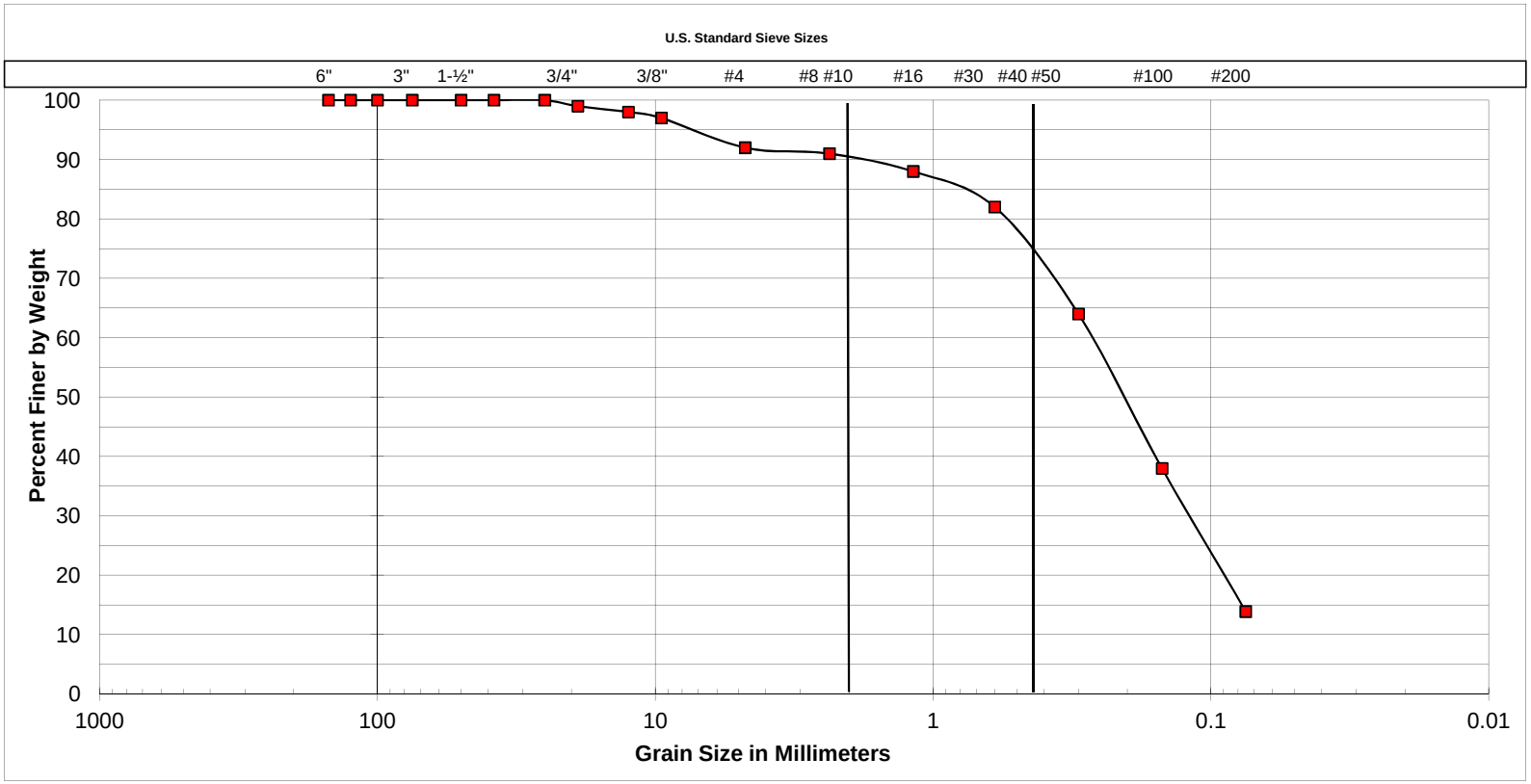
UNIFIED SOIL CLASSIFICATION:	CH
DESCRIPTION	FAT CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	73
PLASTIC LIMIT	34
PLASTICITY INDEX	39

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-64



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-049 at 5 feet to 10 feet

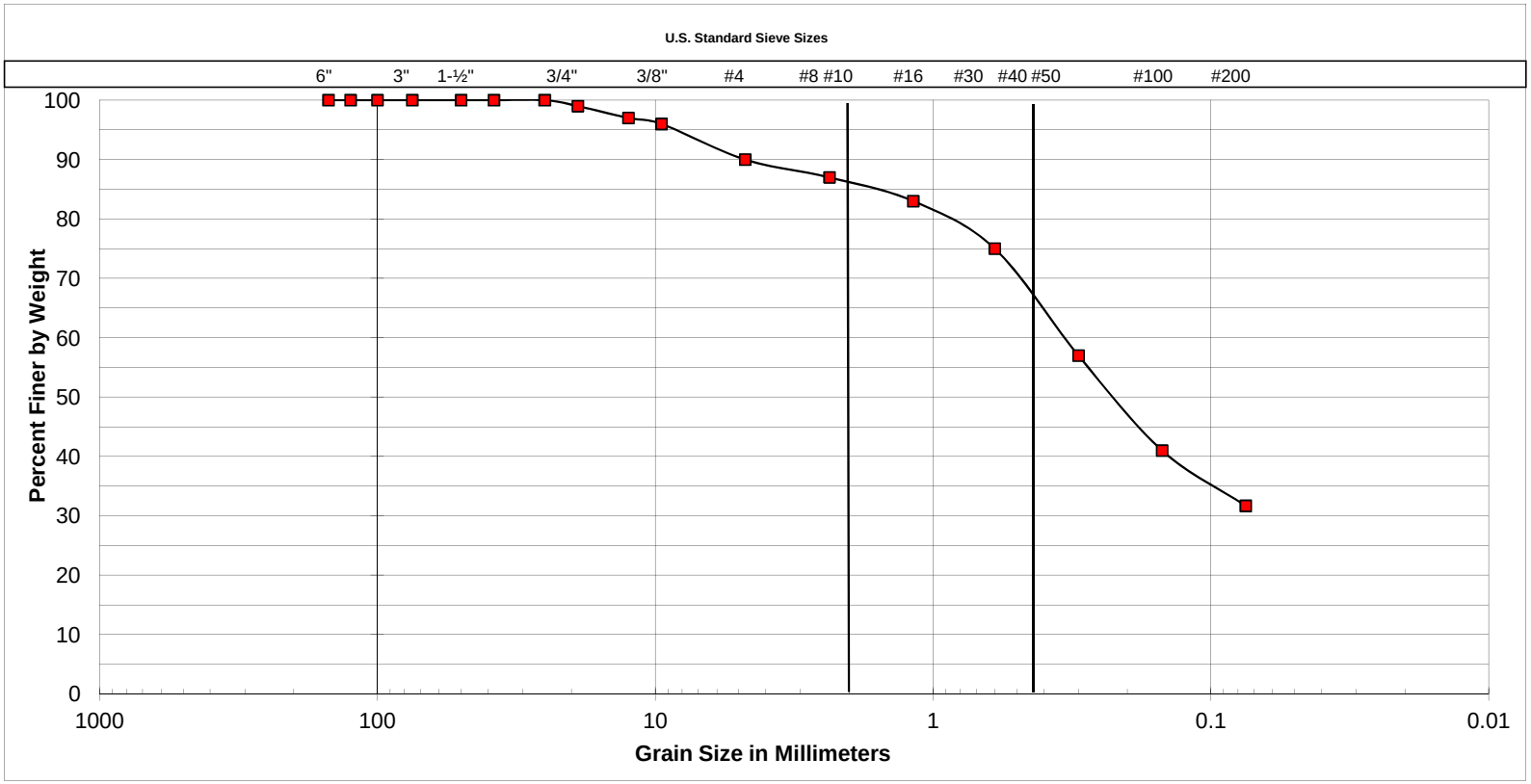
UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	29
PLASTIC LIMIT	16
PLASTICITY INDEX	13

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-65



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
A-12-051 at 5 feet to 10 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	34
PLASTIC LIMIT	18
PLASTICITY INDEX	16

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN/EL	DATE:	6/28/12
JOB NUMBER:	1111191-1	FIGURE:	V-66

MAXIMUM DENSITY & OPTIMUM MOISTURE CONTENT

METHOD ASTM - D1557

SAMPLE	DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE (pcf)
A-12-044 at 10 feet to 15 feet	Brown clayey SAND with GRAVEL	128.2	8.5

R - Value

Caltran Test 301

SAMPLE IDENTIFICATION	DESCRIPTION	R- Value
A-03-002 at 1 foot to 3½ feet	Tan poorly-graded GRAVEL with SILT	49
A-03-005 at 1 foot to 3½ feet	Yellowish brown well-graded GRAVEL with SILT and SAND	55
A-03-007 at 1 foot to 4½ feet	Tan silty SAND	22
A-03-008 at 1 foot to 4½ feet	Tan silty SAND with GRAVEL	56
A-03-009 at 1 foot to 4½ feet	Brown silty SAND with GRAVEL	19
A-03-011 at 1 foot to 4½ feet	Yellowish brown silty SAND	34
A-03-017 at 1 foot to 4½ feet	Tan silty SAND	75
A-03-020 at 1 foot to 4½ feet	Tan silty SAND	73
A-12-030 at 1 foot to 5 feet	Brown clayey SAND	37
A-12-033 at 1 foot to 5 feet	Brown clayey SAND	53
A-12-043 at 1 foot to 5 feet	Brown clayey SAND	40

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-03-001 at 10 feet	3100	6.7	0.001	0.002
A-03-001 at 30 feet	-	7.5	0.005	0.012
A-03-002 at 1 ft. to 3½ ft.	1870	8.7	0.007	0.001
A-03-002 at 12½ feet	-	9	0.001	-
A-03-002 at 26 ft. to 28 ft.	935	8.4	0.017	0.015
A-03-003 at 1 ft. to 3½ ft.	2204	8.1	0.008	0.007
A-03-003 at 32 ft. to 34 ft.	1336	7.7	0.025	0.006
A-03-003 at 45 feet	-	7.1	0.016	0.023
A-03-009 at 1 ft. to 3½ ft.	1536	8.8	0.007	0.003
A-03-012 at 1 ft. to 3½ ft.	1403	8.4	0.011	0.004
A-03-015 at 1 ft. to 3½ ft.	868	7.4	0.037	0.018
A-03-017 at 1 ft. to 3½ ft.	1136	8.9	0.049	0.003

ACI 318-05 Building Code Requirements for Structural Concrete
Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163			
BY:	GF/EL	DATE:	6/28/2012
JOB NUMBEF	1111191-1	FIGURE:	V-68

RESISTIVITY, pH, SOLUBLE SULFATE, CHLORIDE

Caltrans Corrosion Guidelines, Version 1.0 (September 2003)

SAMPLE IDENTIFICATION	RESISTIVITY (Ω-cm)	pH	SOLUBLE SULFATE (%)	CHLORIDE (%)
A-12-034 at 25 feet	1800	8.2	0.013	0.007
R-12-038 at 4 ft. to 9 ft.	2300	8.2	0.011	0.004
R-12-038 at 80 ft.	1500	8.8	0.017	0.005
R-12-041 at 10 ft.	1120	7.8	0.018	0.006
A-12-044 at 1 ft. to 5 ft.	1750	9.2	0.003	0.002

ACI 318-05 Building Code Requirements for Structural Concrete

Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil Percentage by Weight	Cement Type	Maximum Water-Cementitious Materials Ratio, By Weight, Normal Weight Aggregate Concrete	Minimum f'c, Normal-Weight and Lightweight Aggregate Concrete, psi
Negligible	0.00-0.10	-	-	-
Moderate	0.10-0.20	II,IP(MS),IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4000
Severe	0.20-2.00	V	0.45	4500
Very Severe	Over 2.00	V plus pozzolan	0.45	4500

Caltrans Corrosion Criteria

Corrosive Environment*	RESISTIVITY(Ω - cm)	pH	SOLUBLE SULFATE	CHLORIDE
	<1000	<5.5	>0.2	>0.05

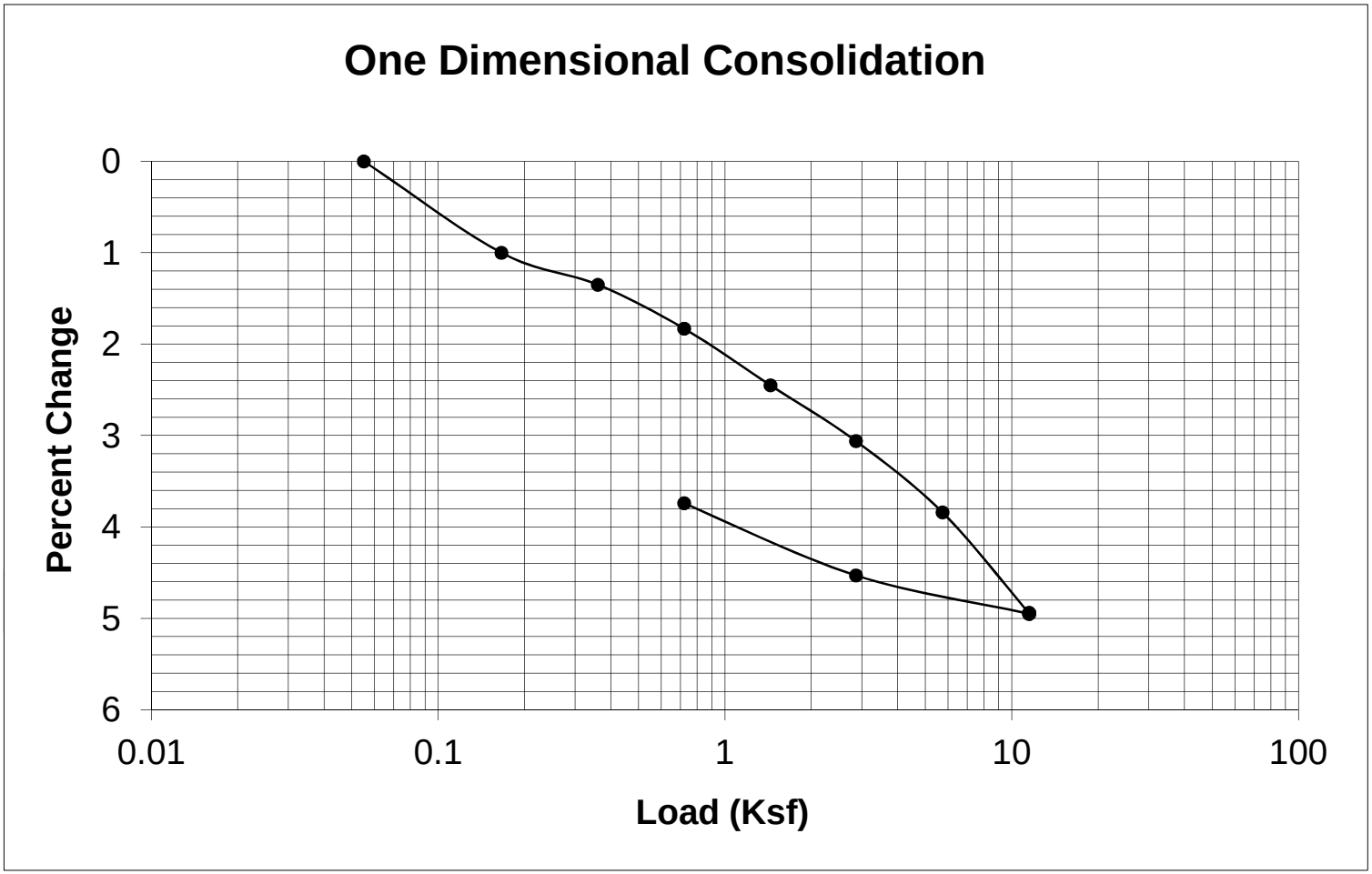
* Corrosive enivronment as determined by the California Department of Transportation Division of Engineering Services, Materials Engineering and testing Services Corrosion Technology Branch, 2003;Corrosion Guidelines Version 1.0, September 2003

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

FRIARS ROAD AT STATE ROUTE 163

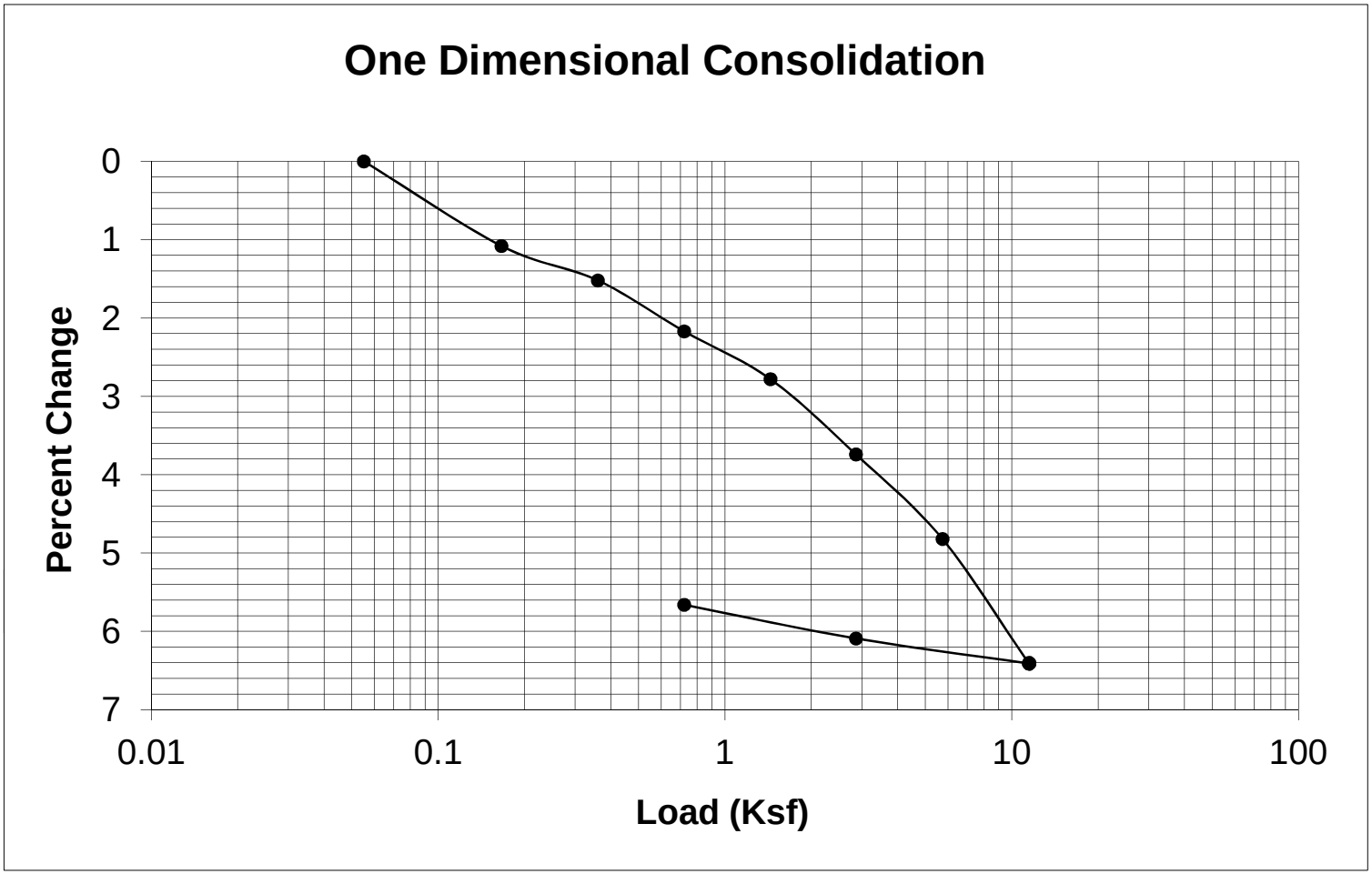
BY:	GF/EL	DATE:	6/28/2012
JOB NO.:	1111191-1	FIGURE:	V-69

A-03-003 at 20 feet



SOUTHERN CALIFORNIA SOIL AND TESTING	FRIARS ROAD AT STATE ROUTE 163		
	BY: AKN	DATE:	6/28/2012
	JOB NUMBER: 1111191-1	FIGURE:	V-70

A-03-003 at 25 feet

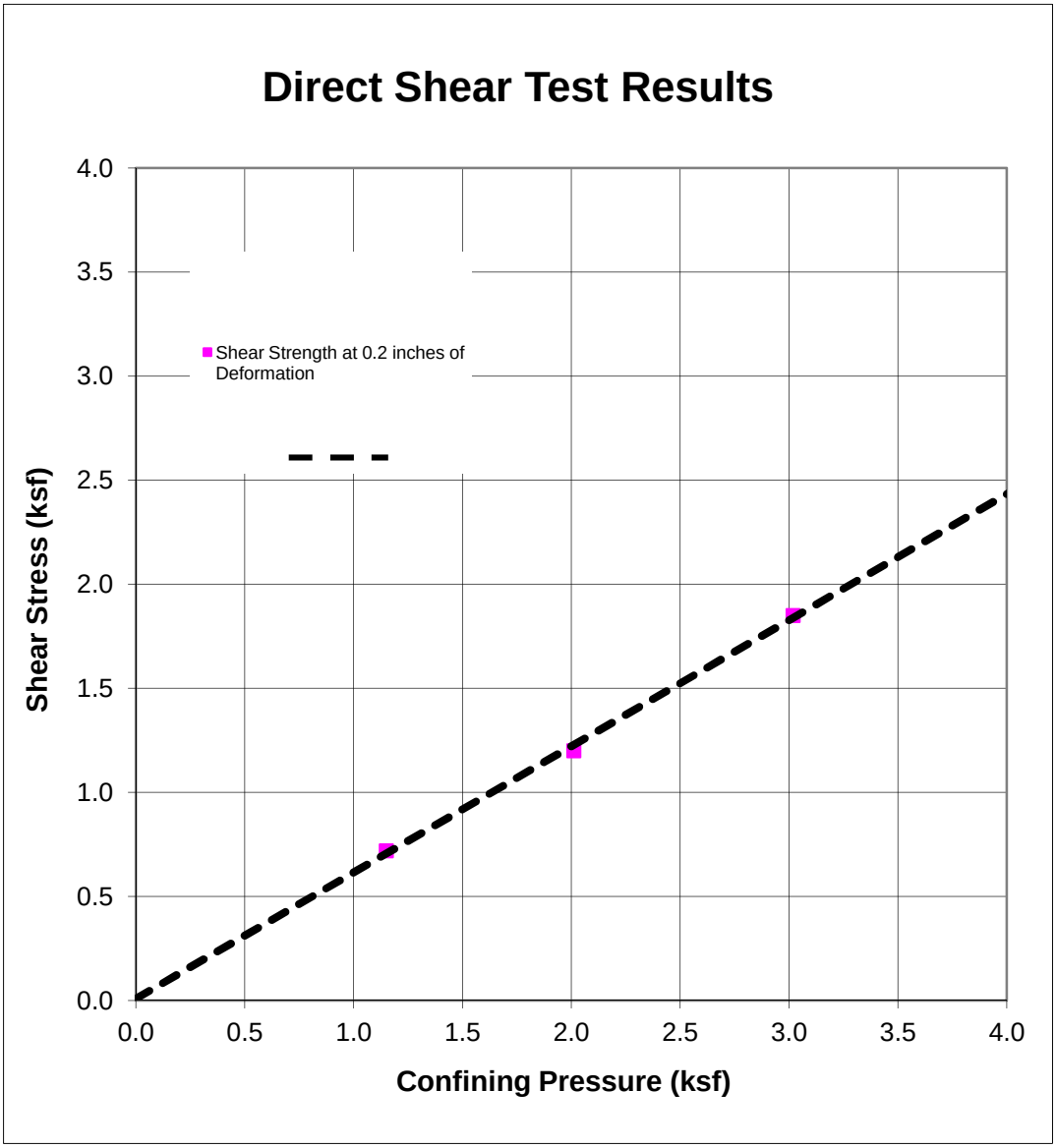


SC ST SOUTHERN CALIFORNIA SOIL AND TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	AKN	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-71

Direct Shear Test Results



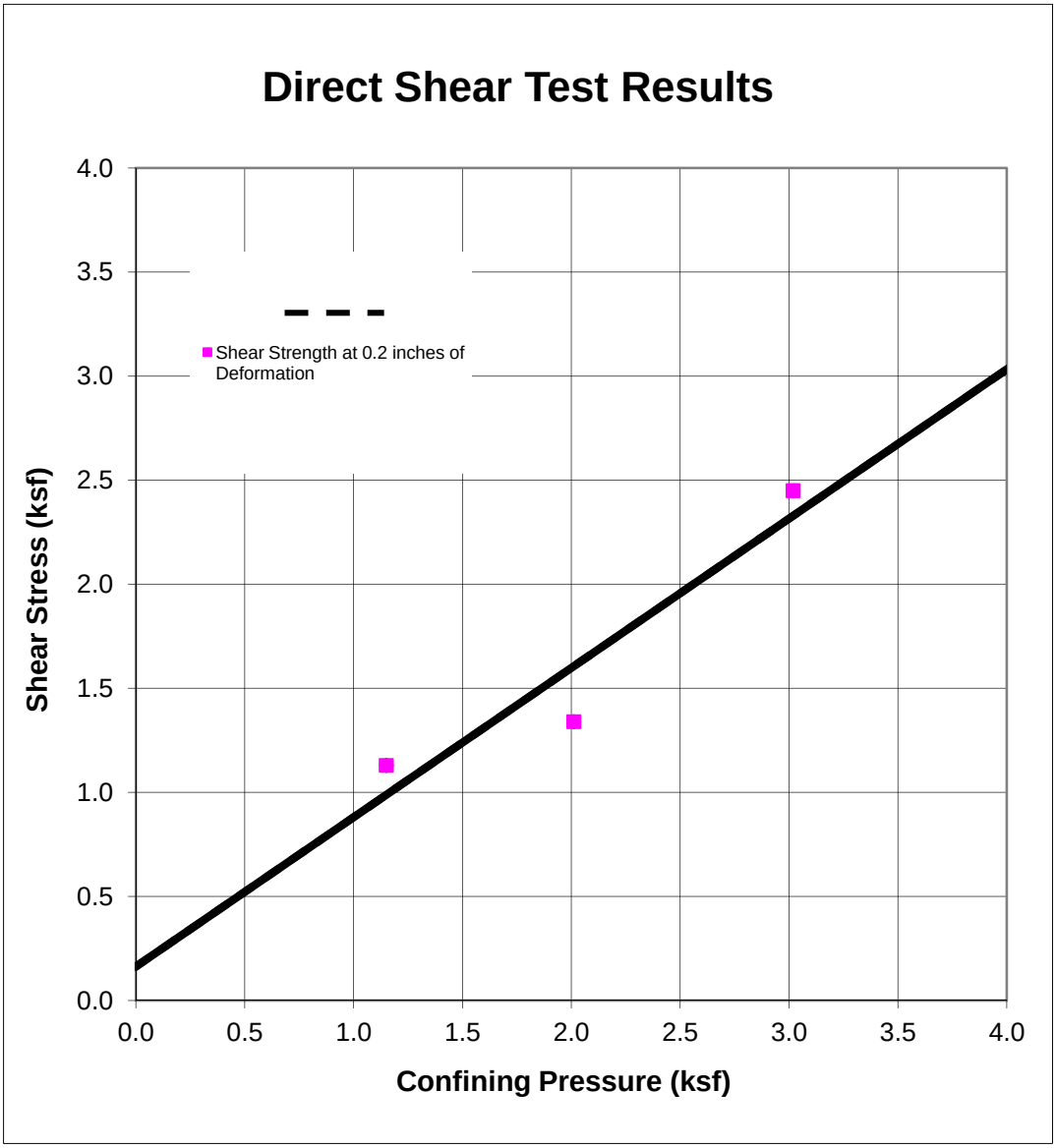
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-001 at 5 feet	silty SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	8

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-72

Direct Shear Test Results



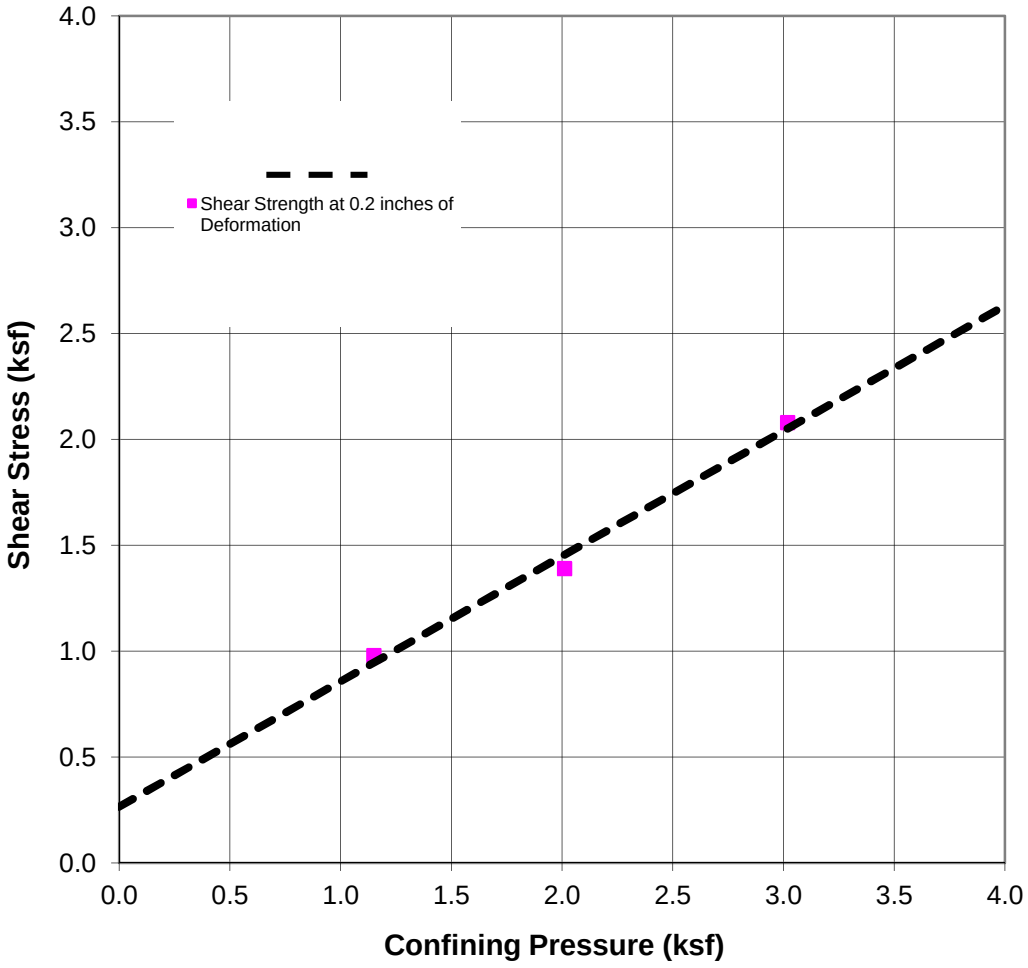
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 7.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		36	162

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-73

Direct Shear Test Results



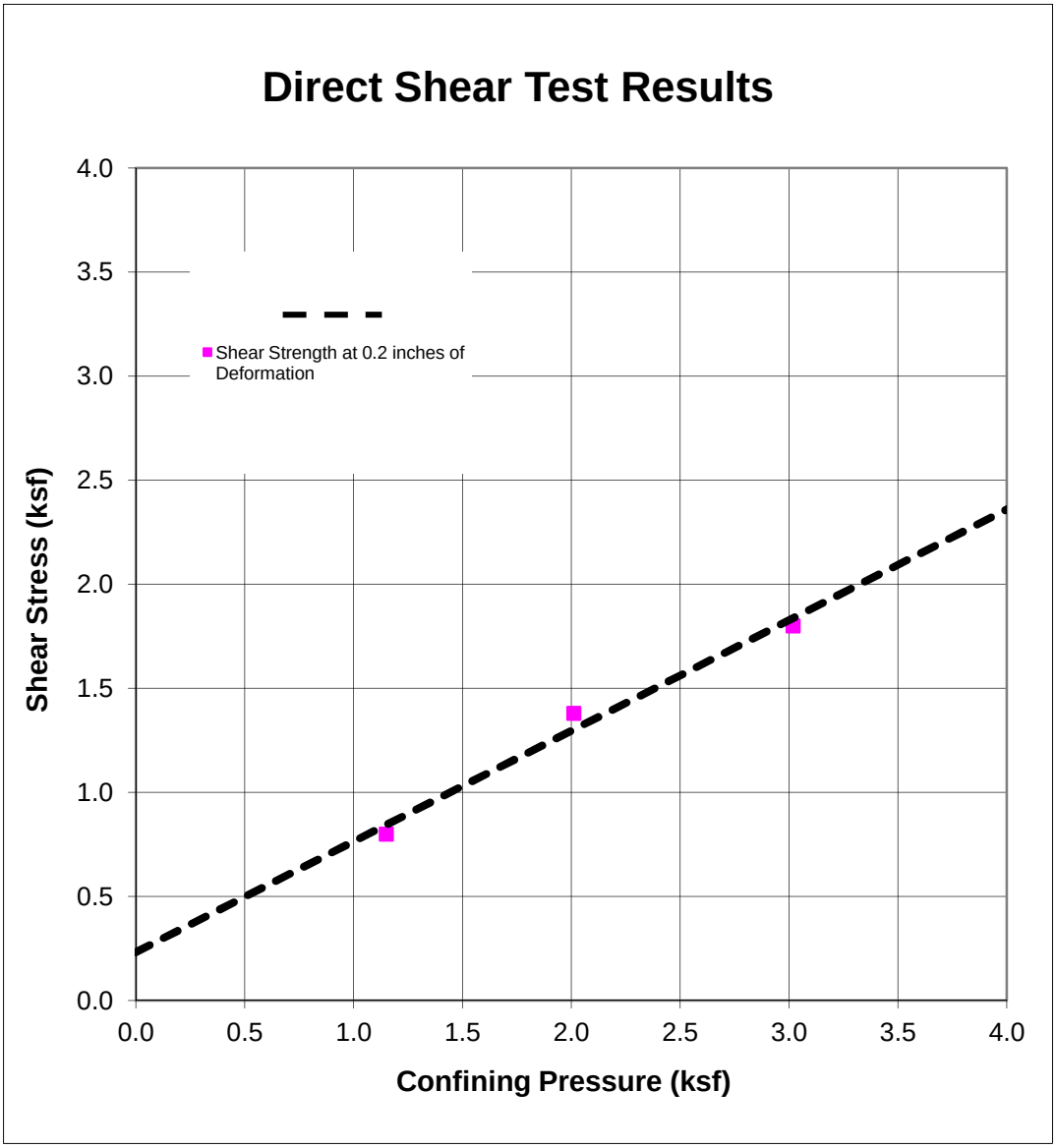
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-002 at 10 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	265

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-74

Direct Shear Test Results



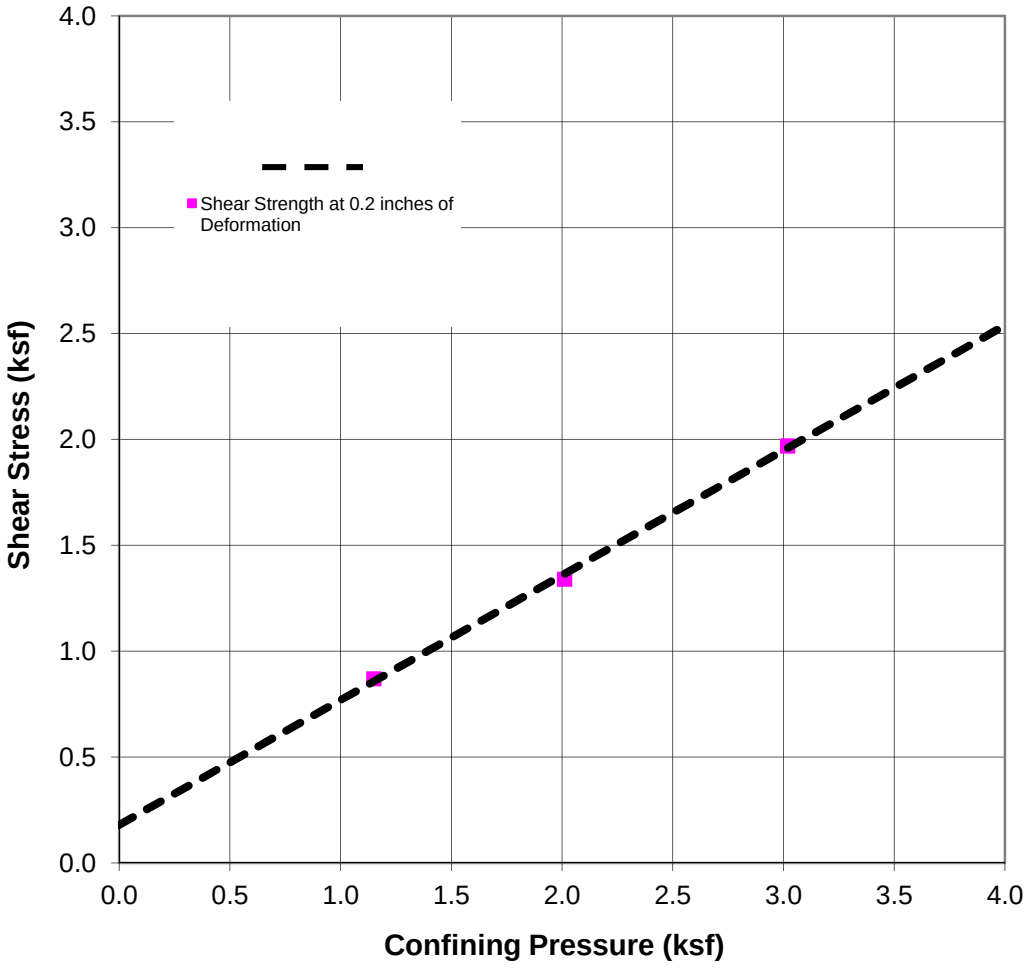
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 20 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		28	231

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-75

Direct Shear Test Results



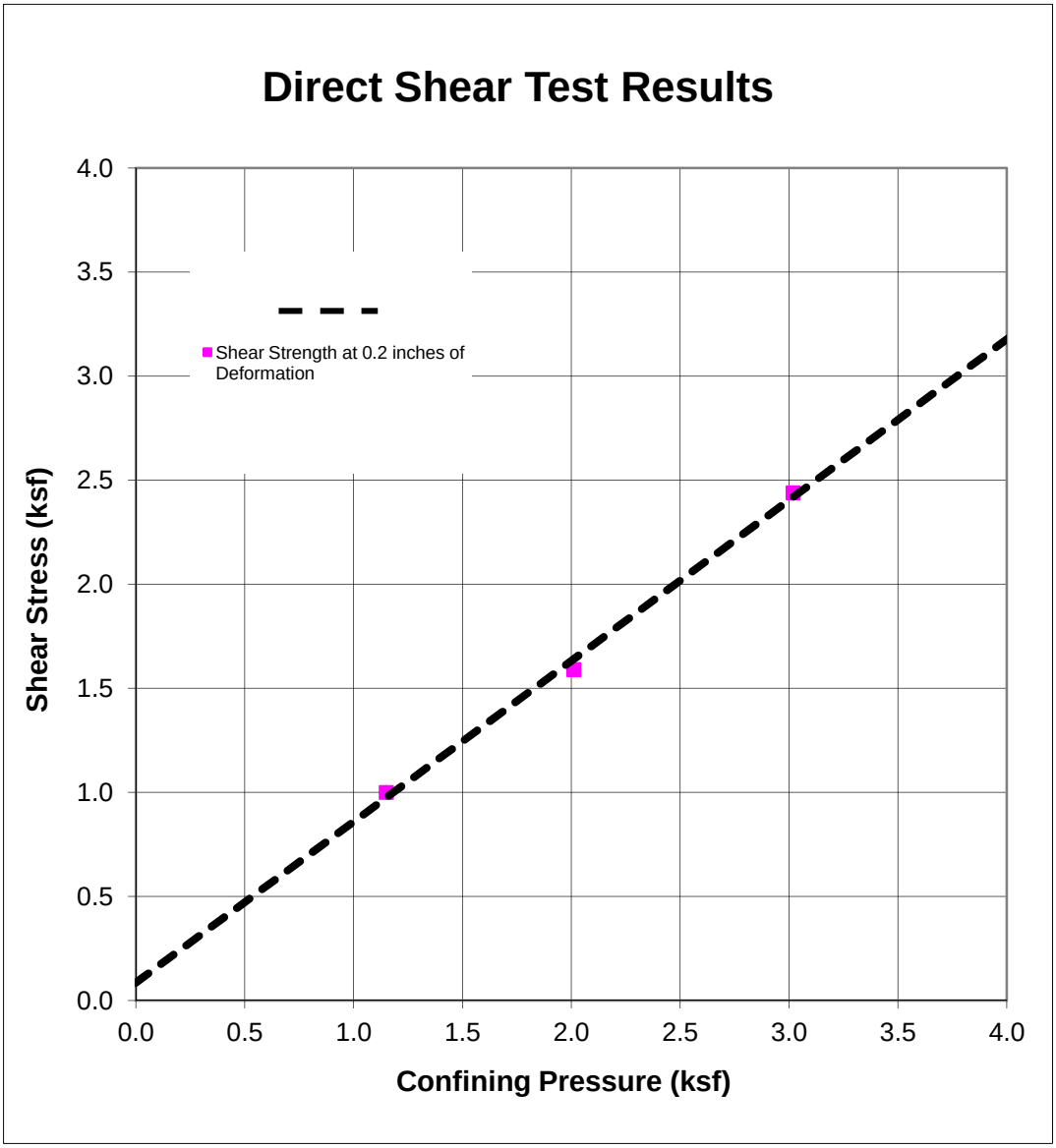
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 22 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		31	178

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-76

Direct Shear Test Results



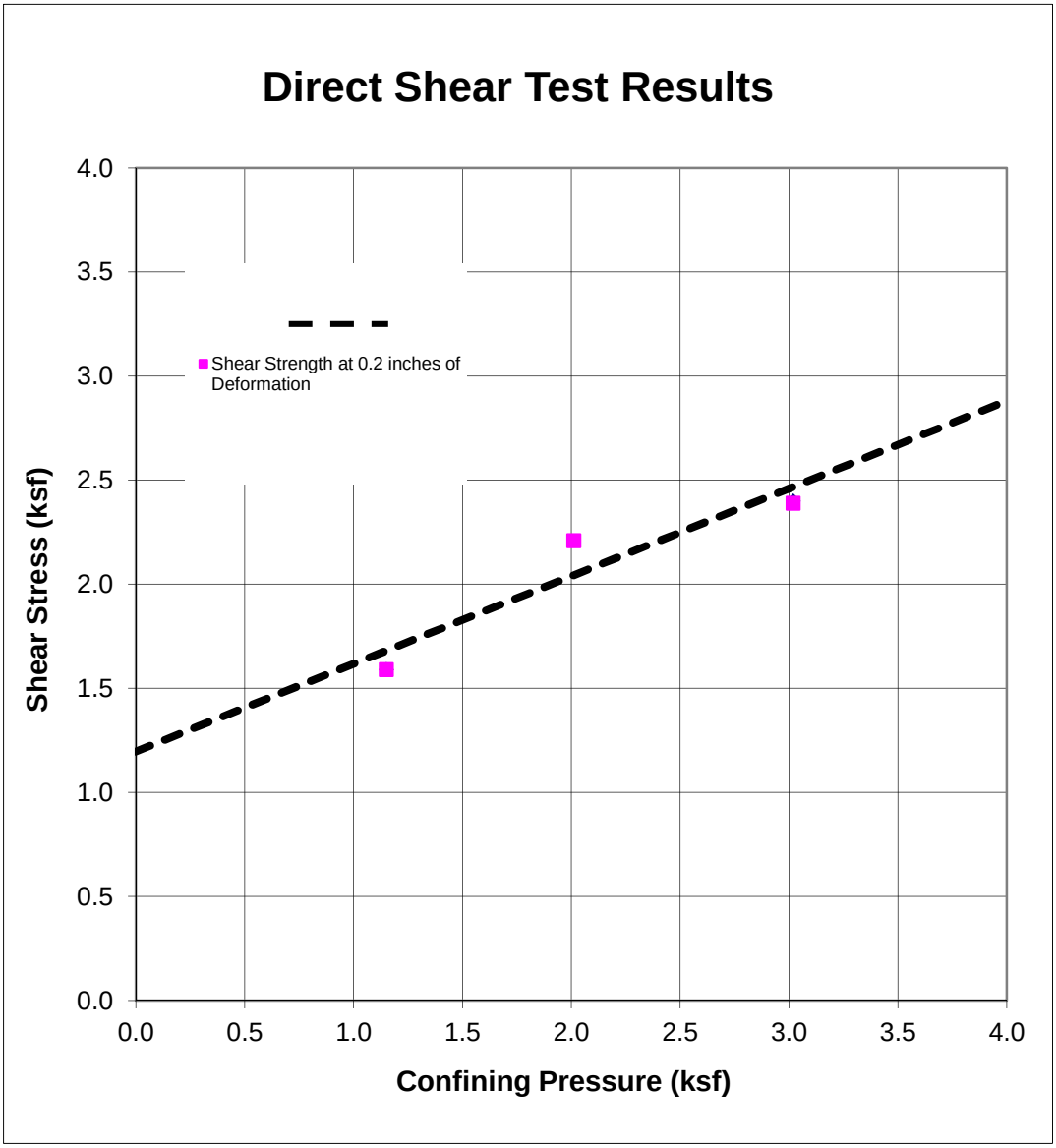
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 25 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		38	85

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-77

Direct Shear Test Results



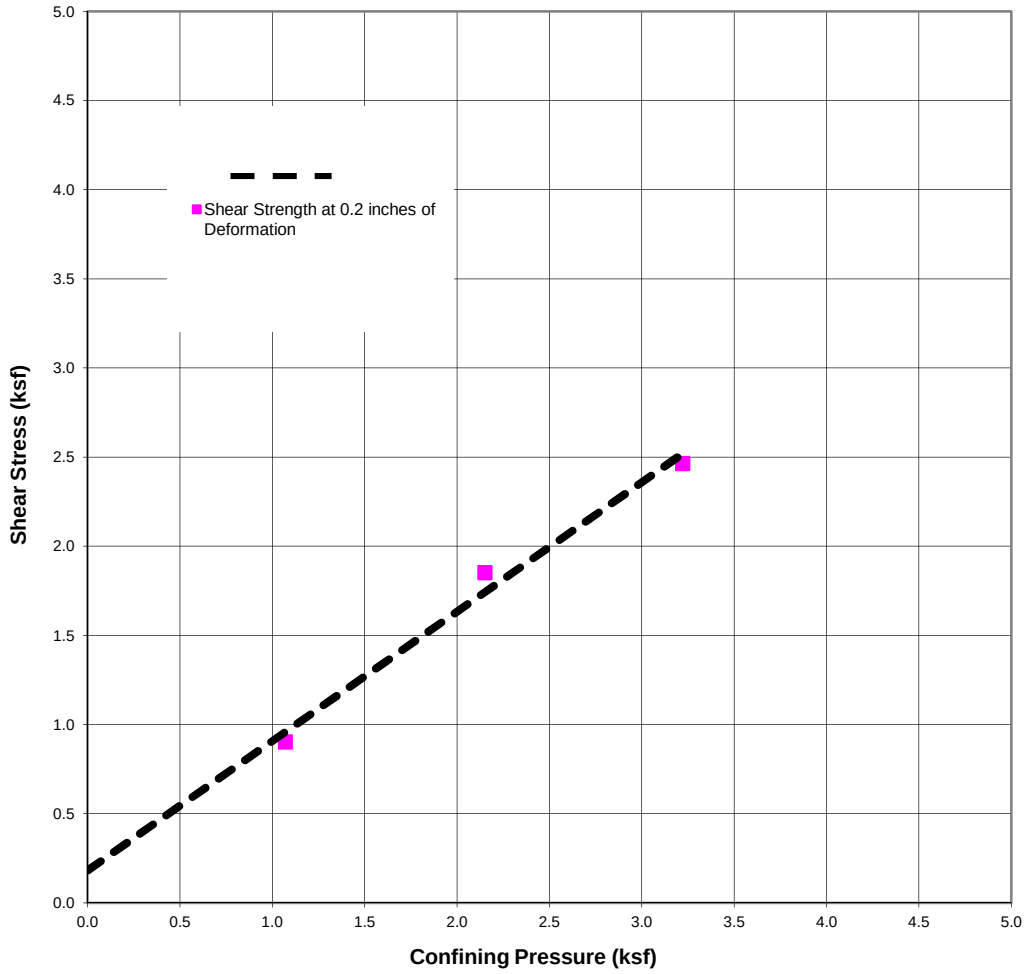
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-03-003 at 27.2 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		23	1196

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-78

Direct Shear Test Results



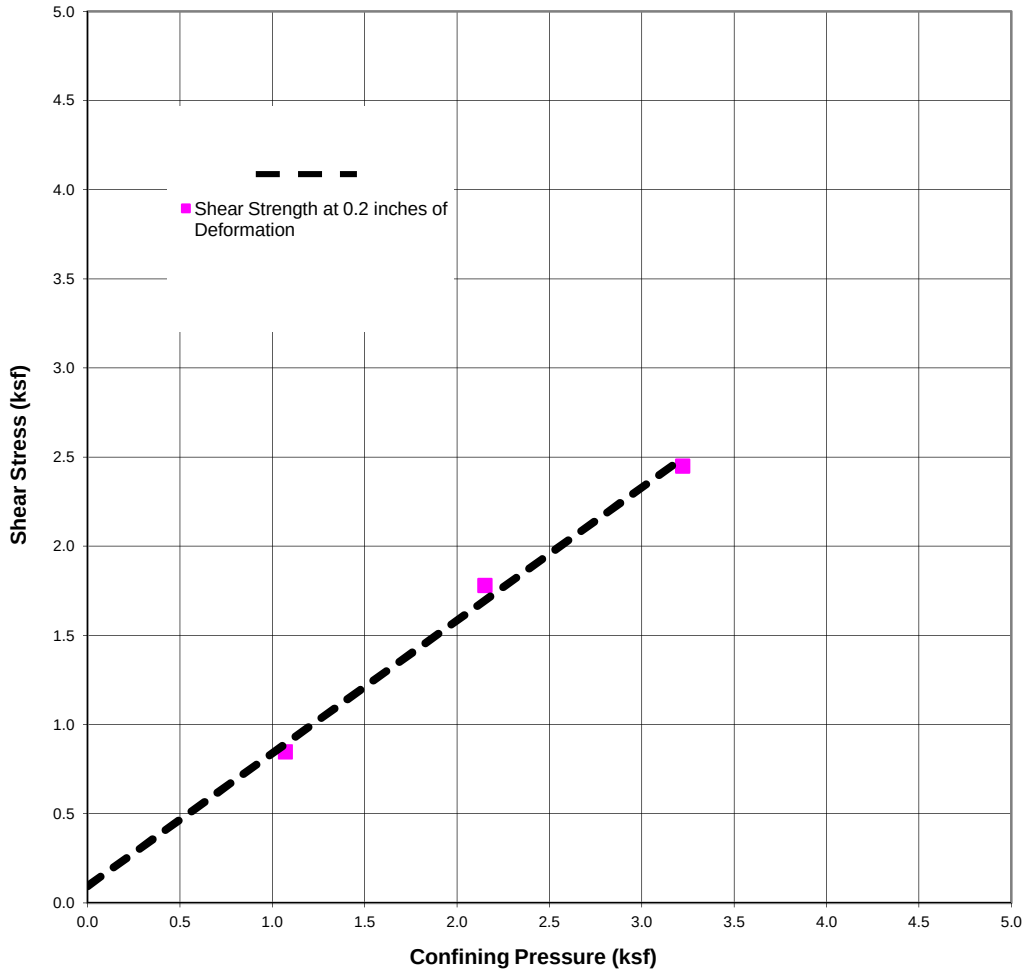
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-030 at 10 feet	clayey SAND (in-situ)		
Shear Strength at 0.2 inches of Deformation		36	182

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-79

Direct Shear Test Results



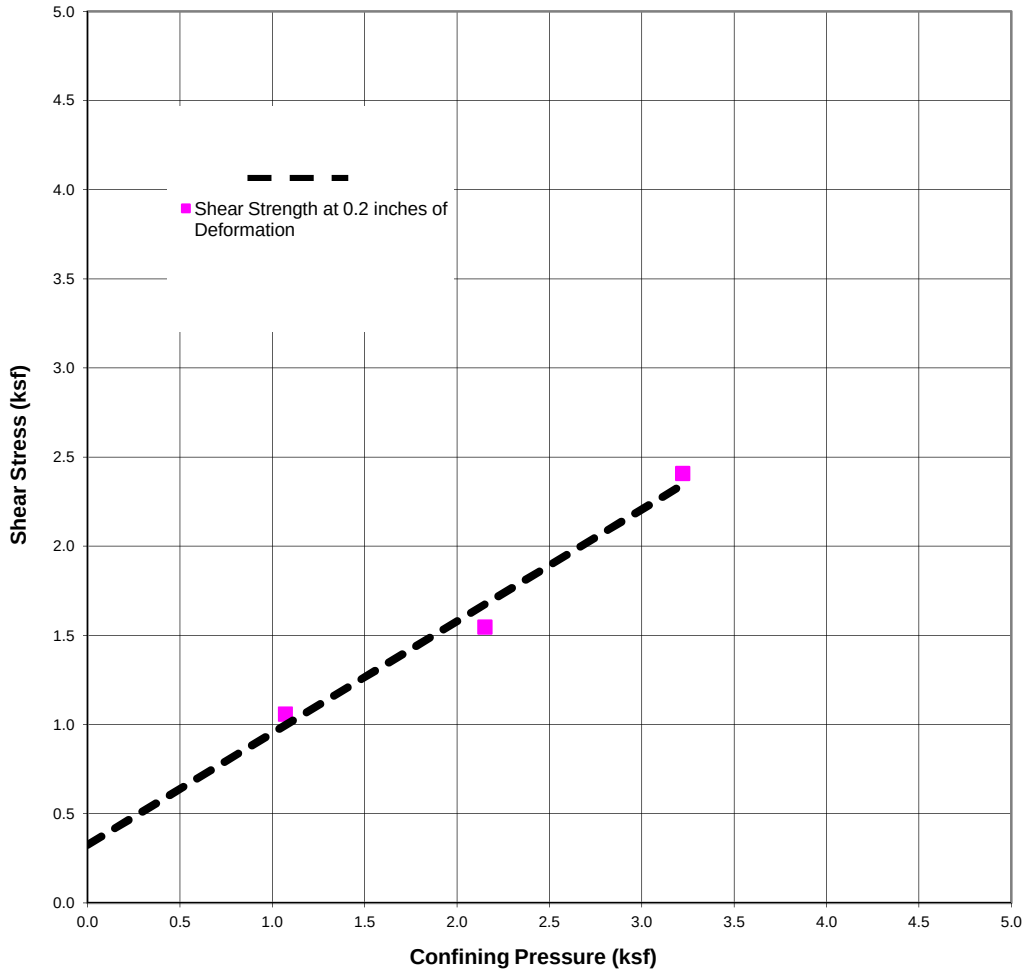
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
R-12-040 at 10 feet	poorly-graded SAND with SILT (in-situ)		
Shear Strength at 0.2 inches of Deformation		37	93

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-80

Direct Shear Test Results



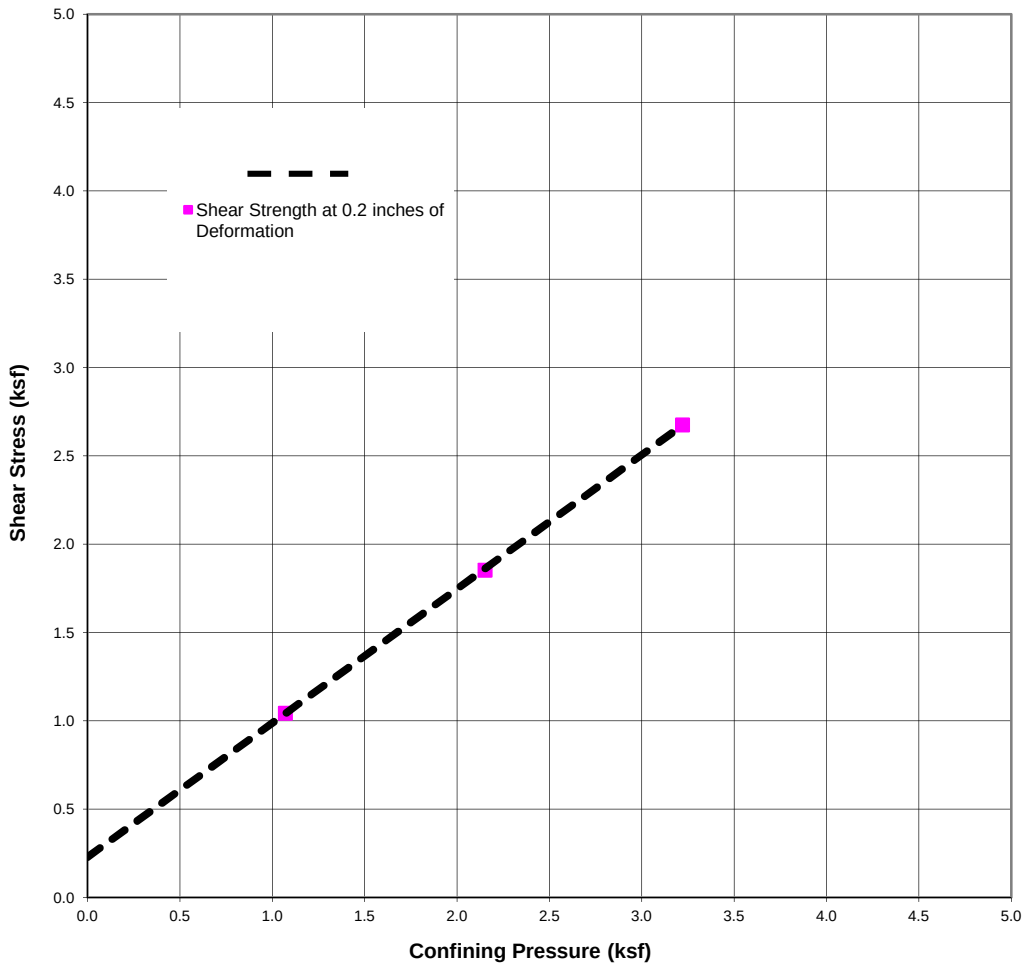
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
R-12-041 at 15 feet	poorly-graded SAND with SILT (in-situ)		
Shear Strength at 0.2 inches of Deformation		32	326

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-81

Direct Shear Test Results



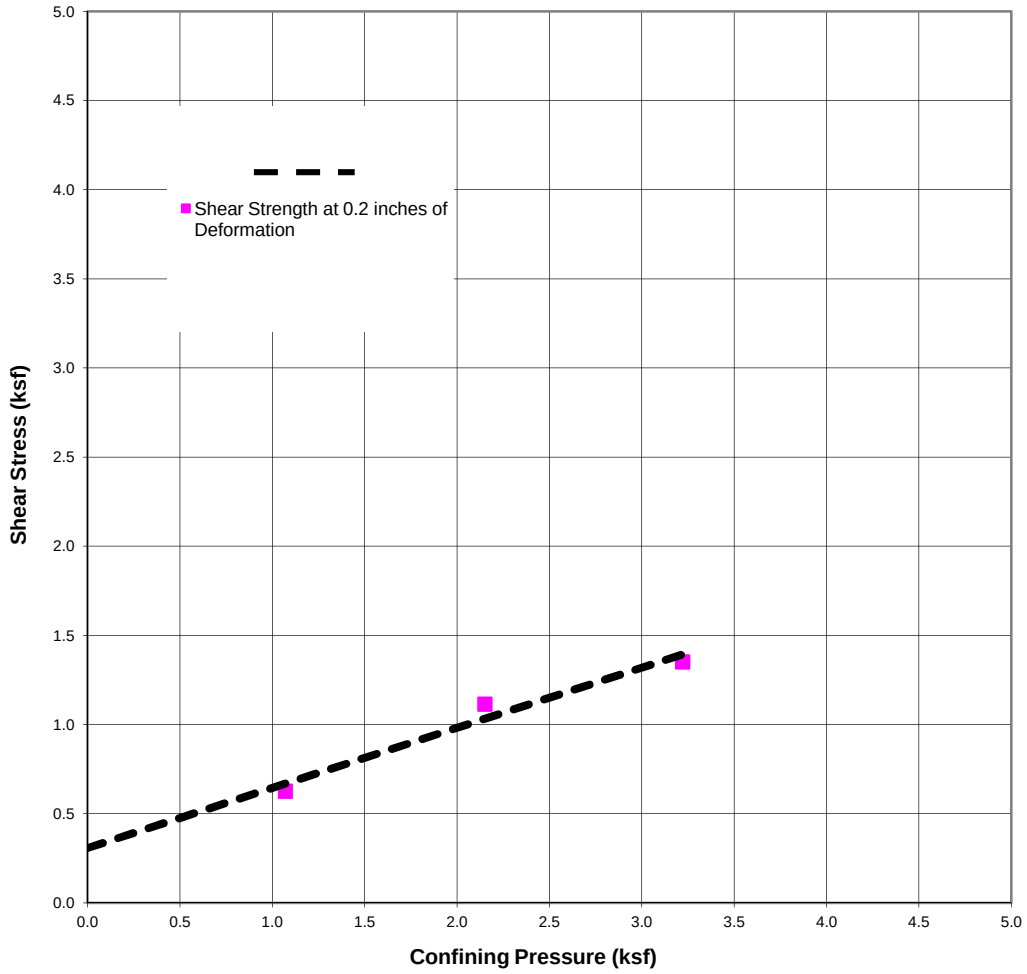
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 10 ft to 15 ft	silty SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		37	228

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-82

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
A-12-044 at 40 feet	clayey SAND with GRAVEL (in-situ)		
Shear Strength at 0.2 inches of Deformation		19	307

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY:	RNB	DATE:	6/28/2012
JOB NUMBER:	1111191-1	FIGURE:	V-83

UNCONFINED COMPRESSIVE STRENGTH

(ASTM 2938)

SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	UNCONFINED COMPRESSIVE STRENGTH (psi)
A-03-014 at 19 feet	115.2	12.6	29.1

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	FRIARS ROAD AT STATE ROUTE 163			
	By:	EL	Date:	7/2/2012
	Job No.:	1111191-1	Figure:	V-84

APPENDIX VI – TABLE OF CONTENTS

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Fill Settlement Analysis	1
Abutment Slope Stability Analysis	2 – 5
ARS Curve Results	6 – 13
Pavement Section Analysis	14 – 37
Liquefaction Analysis	38 – 90

FILL SETTLEMENT ANALYSIS

1 **Depth (ft)**	2 **USCS Soil Classif.**	3 **Ground-Water Depth** (ft)	4 **Total Unit Weight** (pcf)	5 **Total Stress** (psf)	6 **Pore Water Pressure** (psf)	7 **Effective Stress** (psf)	8 **Change Stress** (psf)	9 **Cc/ 1+e** 0.01	10 **Thickness of Layer** (ft)	11 **Layer Settlement** (in)	12 **Sum of Settlement** (in)
2	GM/SM	33.50	109.00	218.00	0	218.00	2900.00	0.01	2.00	2/7	2/7
4	GM/SM	33.50	109.00	436.00	0	436.00	2900.00	0.01	2.00	1/5	1/2
6	GM/SM	33.50	109.00	654.00	0	654.00	2900.00	0.01	2.00	1/6	2/3
8	GM/SM	33.50	109.00	872.00	0	872.00	2900.00	0.01	2.00	1/7	5/6
10	SC	33.50	96.00	1064.00	0	1064.00	2900.00	0.01	2.00	1/7	1
12	SC	33.50	96.00	1256.00	0	1256.00	2900.00	0.01	2.00	1/8	1
14	SC	33.50	96.00	1448.00	0	1448.00	2900.00	0.01	2.00	1/9	1 1/5
16	SC	33.50	96.00	1640.00	0	1640.00	2900.00	0.01	2.00	1/9	1 1/3
18	SC	33.50	96.00	1832.00	0	1832.00	2900.00	0.01	2.00	9/91	1 2/5
20	SC	33.50	96.00	2024.00	0	2024.00	2900.00	0.01	2.00	24/259	1 1/2
22	SC	33.50	96.00	2216.00	0	2216.00	2900.00	0.01	2.00	15/172	1 4/7
24	SC	33.50	96.00	2408.00	0	2408.00	2900.00	0.01	2.00	29/352	1 2/3
26	SC	33.50	96.00	2600.00	0	2600.00	2900.00	0.01	2.00	77/986	1 3/4
28	SC	33.50	96.00	2792.00	0	2792.00	2900.00	0.01	2.00	32/431	1 4/5
30	SC	33.50	96.00	2984.00	0	2984.00	2900.00	0.01	2.00	23/325	1 8/9
32	SC	33.50	96.00	3176.00	0	3176.00	2900.00	0.01	2.00	19/281	2
34	SW	33.50	130.00	3436.00	31.2	3404.80	2900.00	0.01	2.00	7/109	2
36	SW	33.50	130.00	3696.00	156	3540.00	2900.00	0.01	2.00	61/978	2
38	SW	33.50	130.00	3956.00	280.8	3675.20	2900.00	0.01	2.00	2/33	2 1/7
40	SW	33.50	130.00	4216.00	405.6	3810.40	2900.00	0.001	2.00	2/339	2 1/7
42	SW	33.50	130.00	4476.00	530.4	3945.60	2900.00	0.001	2.00	1/174	2 1/7
44	SW	33.50	130.00	4736.00	655.2	4080.80	2900.00	0.001	2.00	3/536	2 1/6
46	SW	33.50	130.00	4996.00	780	4216.00	2900.00	0.001	2.00	4/733	2 1/6
48	SW	33.50	130.00	5256.00	904.8	4351.20	2900.00	0.001	2.00	1/188	2 1/6
50	SM	33.50	102.00	5460.00	1029.6	4430.40	2900.00	0.001	2.00	2/381	2 1/6
52	SM	33.50	123.00	5706.00	1154.4	4551.60	2900.00	0.001	2.00	3/584	2 1/6
54	SM	33.50	123.00	5952.00	1279.2	4672.80	2900.00	0.001	2.00	4/795	2 1/5
56	SM	33.50	123.00	6198.00	1404	4794.00	2900.00	0.001	2.00	1/203	2 1/5
58	SM	33.50	123.00	6444.00	1528.8	4915.20	2900.00	0.001	2.00	1/207	2 1/5
60	SM	33.50	123.00	6690.00	1653.6	5036.40	2900.00	0.001	2.00	1/211	2 1/5
							TOTAL SETTLEMENT (in)				2

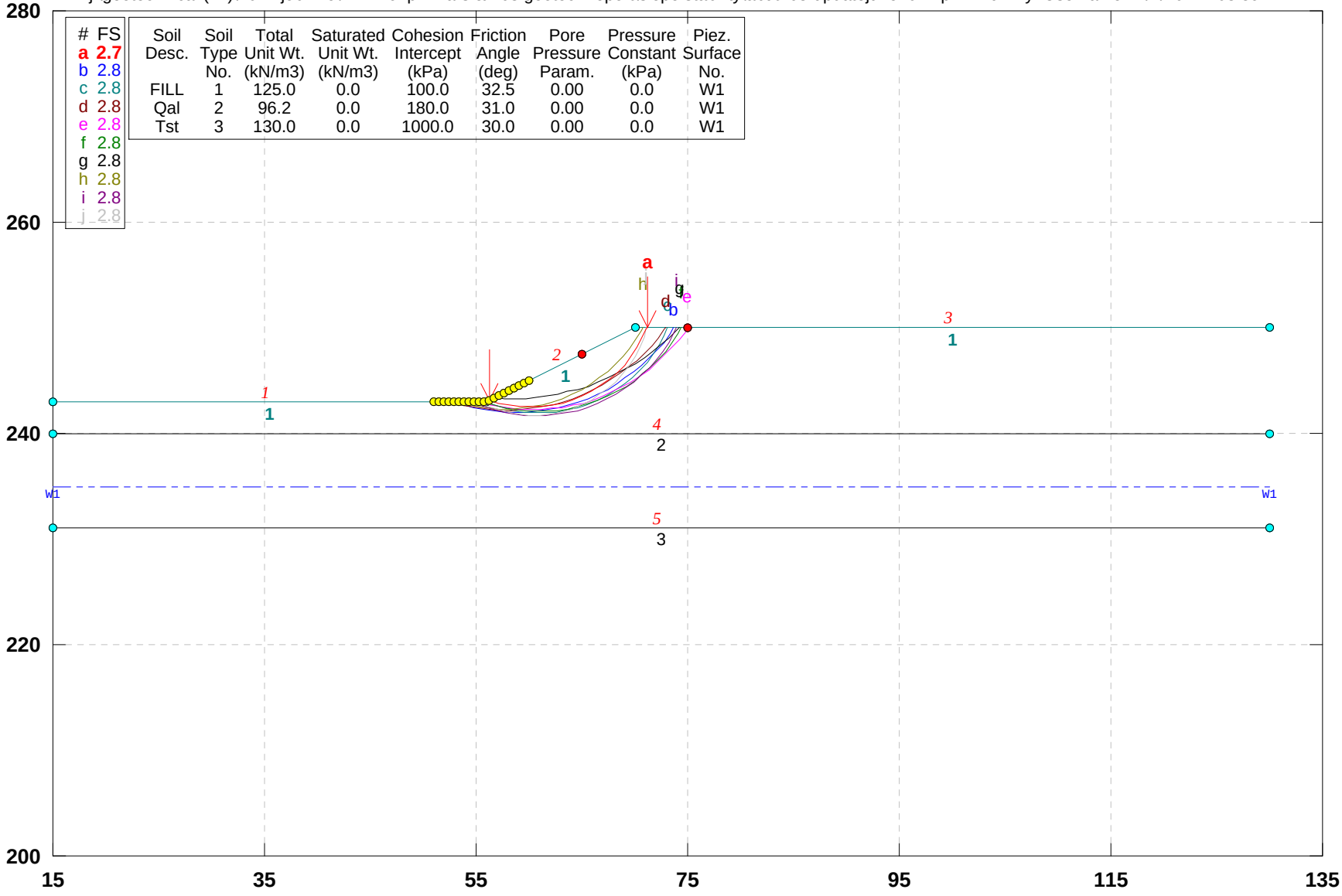
SOUTHEREN CALIFORNIA SOIL AND TESTING

FRIARS ROAD AT STATE ROUTE 163

By:	GF/SV/EL	Date:	07/02/12
Job No.:	1111191-1	Figure:	VI-1

Friars Road at SR-163 Over-Crossing Abutment 2:1 (H:V) Fill Slope

j:\geotechnical (11)\2011 job info\1111191p - friars & 163 geotech report\slope stability\abut163-updatejune2012.pl2 Run By: Username 7/2/2012 08:59AM



GSTABL7 v.2 FSmin=2.7

Safety Factors Are Calculated By The Modified Bishop Method

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Friars Road at SR-163 Over-Crossing Abutment 2:1 (H:V) Fill Slope

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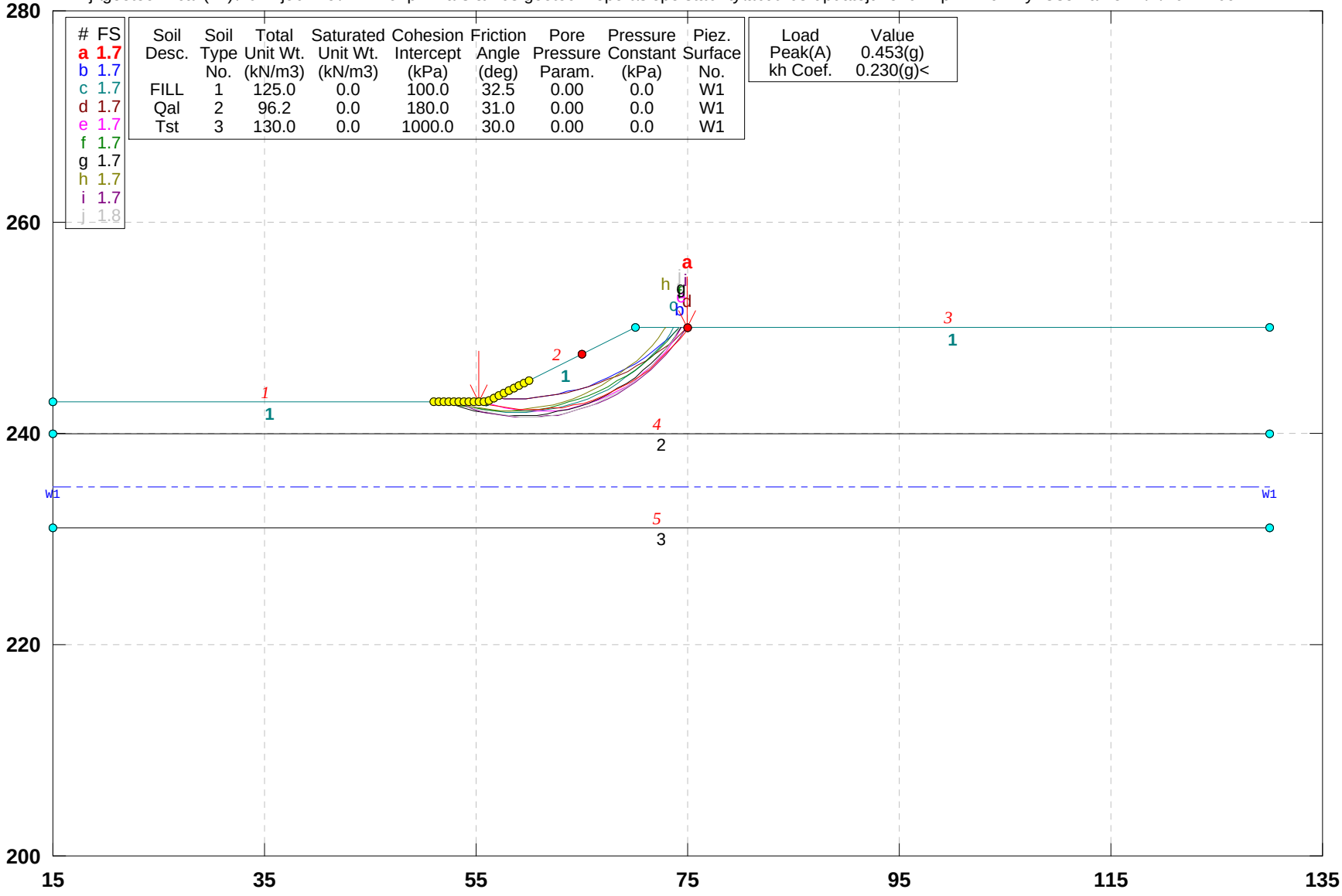


#	FS
a	1.7
b	1.7
c	1.7
d	1.7
e	1.7
f	1.7
g	1.7
h	1.7
i	1.7
j	1.8

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
FILL	1	125.0	0.0	100.0	32.5	0.00	0.0	W1
Qal	2	96.2	0.0	180.0	31.0	0.00	0.0	W1
Tst	3	130.0	0.0	1000.0	30.0	0.00	0.0	W1

Load	Value
Peak(A)	0.453(g)
kh Coef.	0.230(g)<

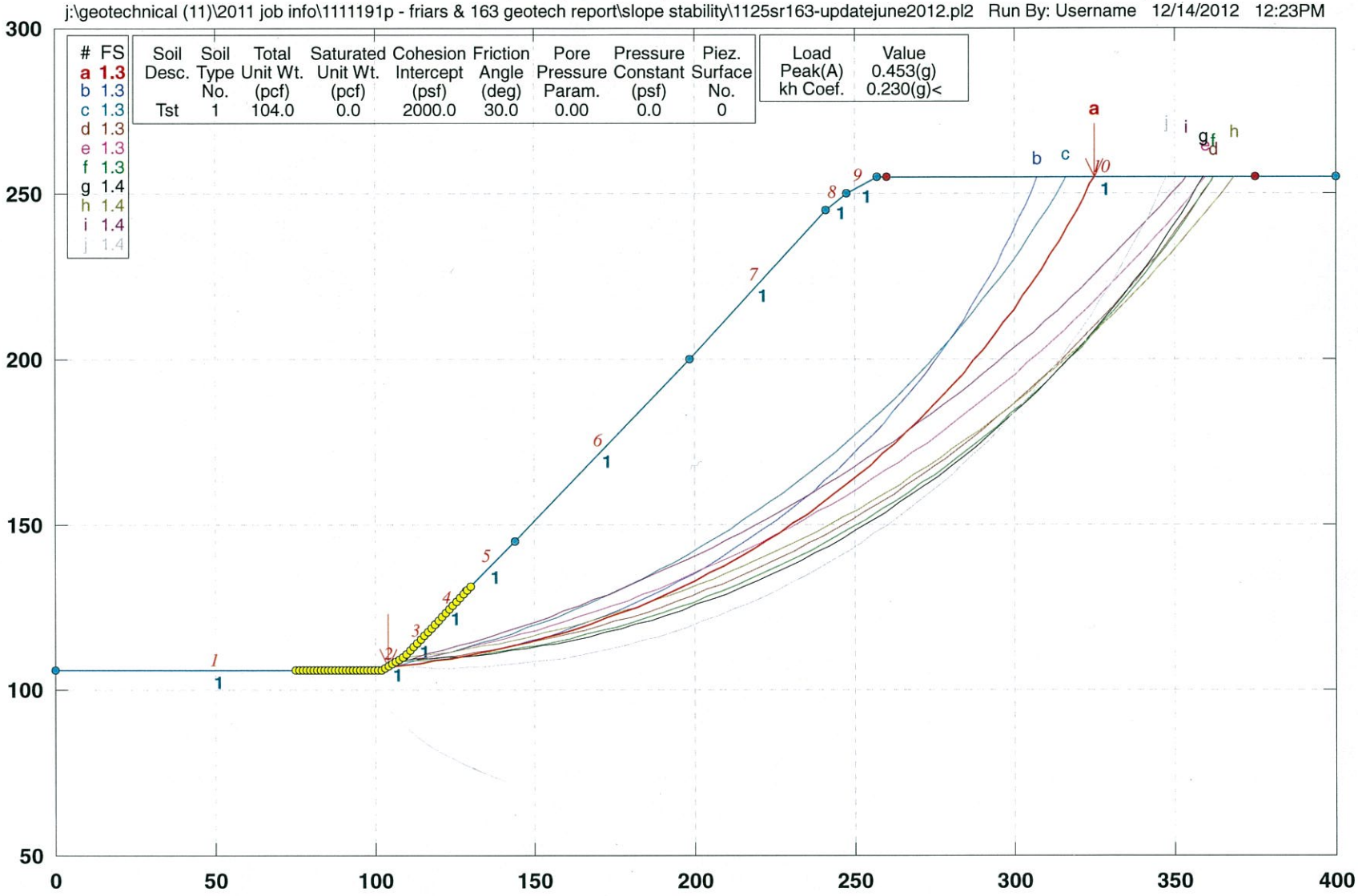
GSTABL7 v.2 FSmin=1.7

Safety Factors Are Calculated By The Modified Bishop Method

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Friars Road at SR 163 1:1(H:V)cut slope Northwest quadrant; existing/proposed

j:\geotechnical (11)\2011 job info\1111191p - friars & 163 geotech report\slope stability\1125sr163-updatejune2012.pl2 Run By: Username 12/14/2012 12:23PM



GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

Friars Road at SR 163 1:1(H:V)cut slope Northwest quadrant; existing/proposed

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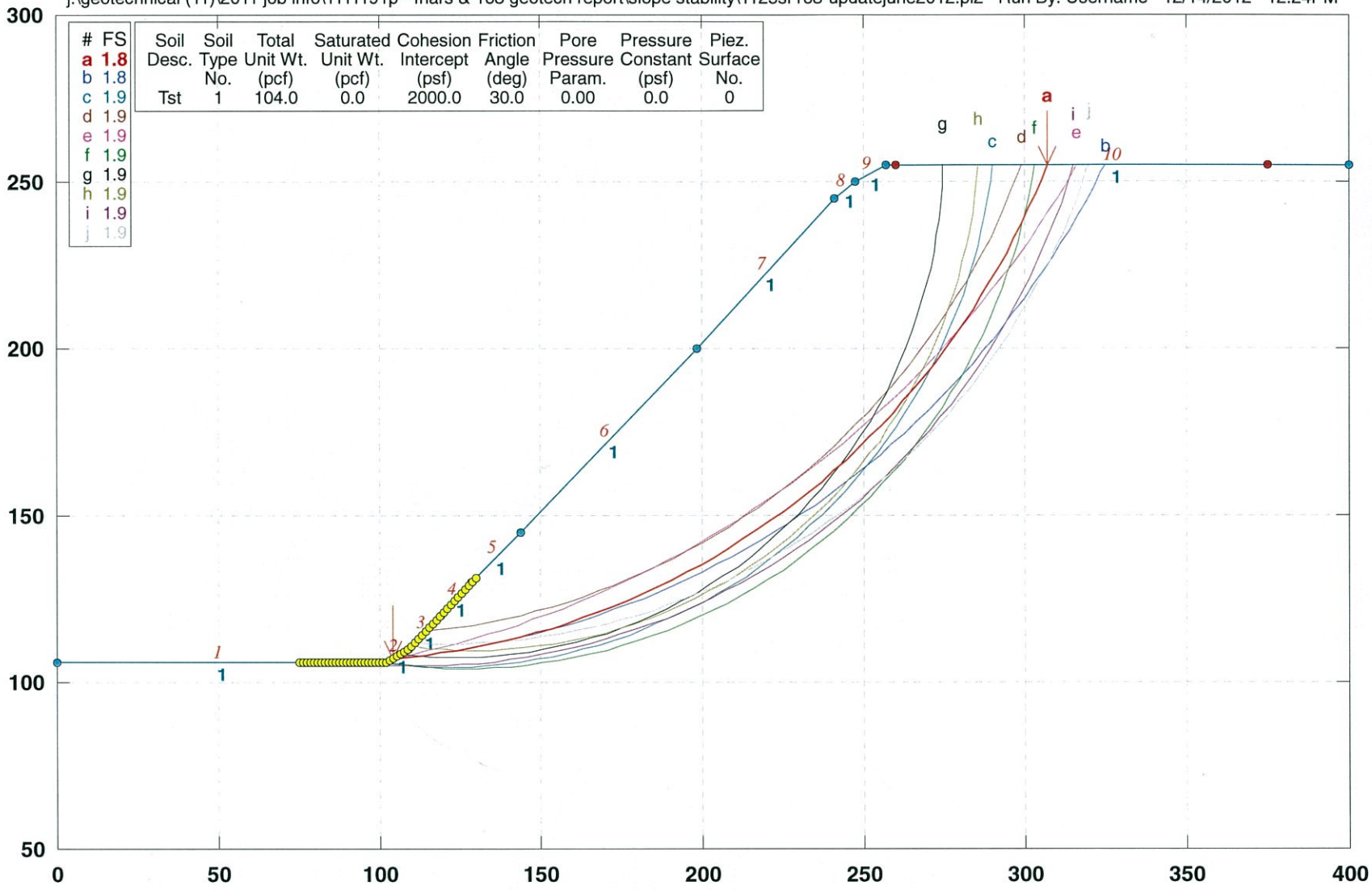

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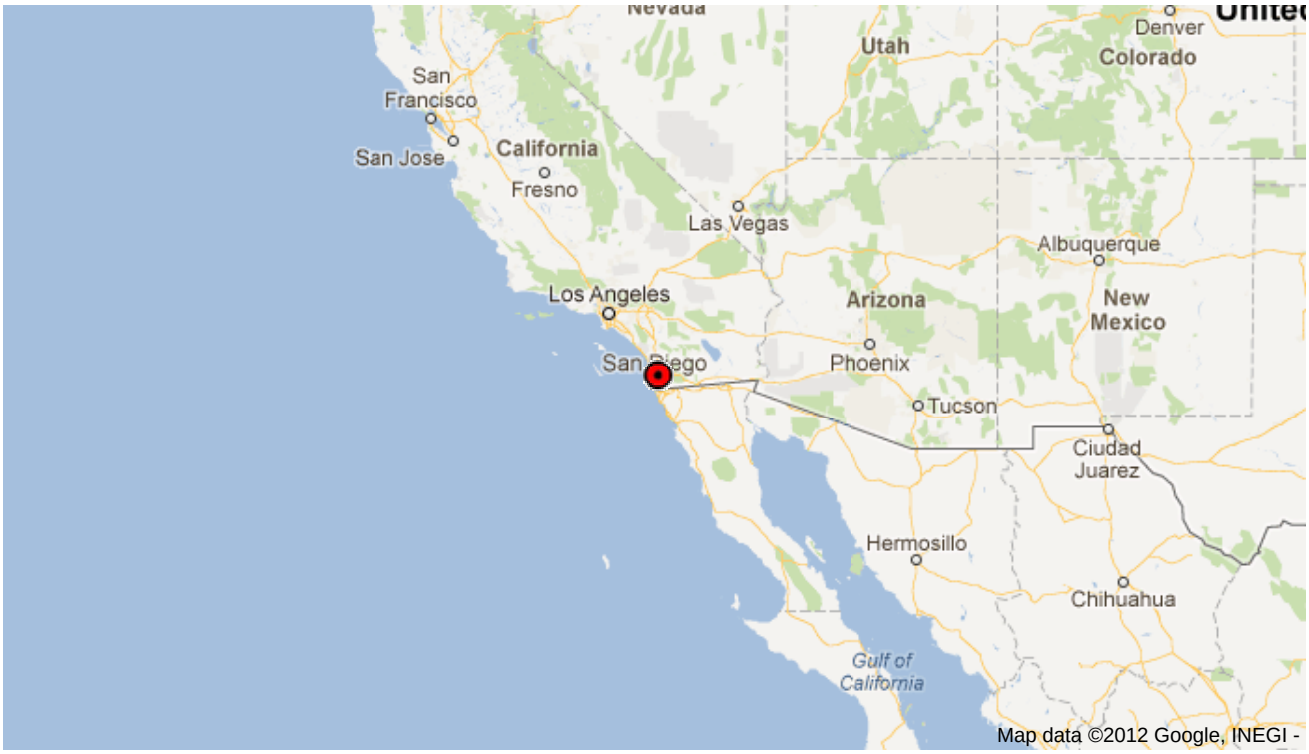
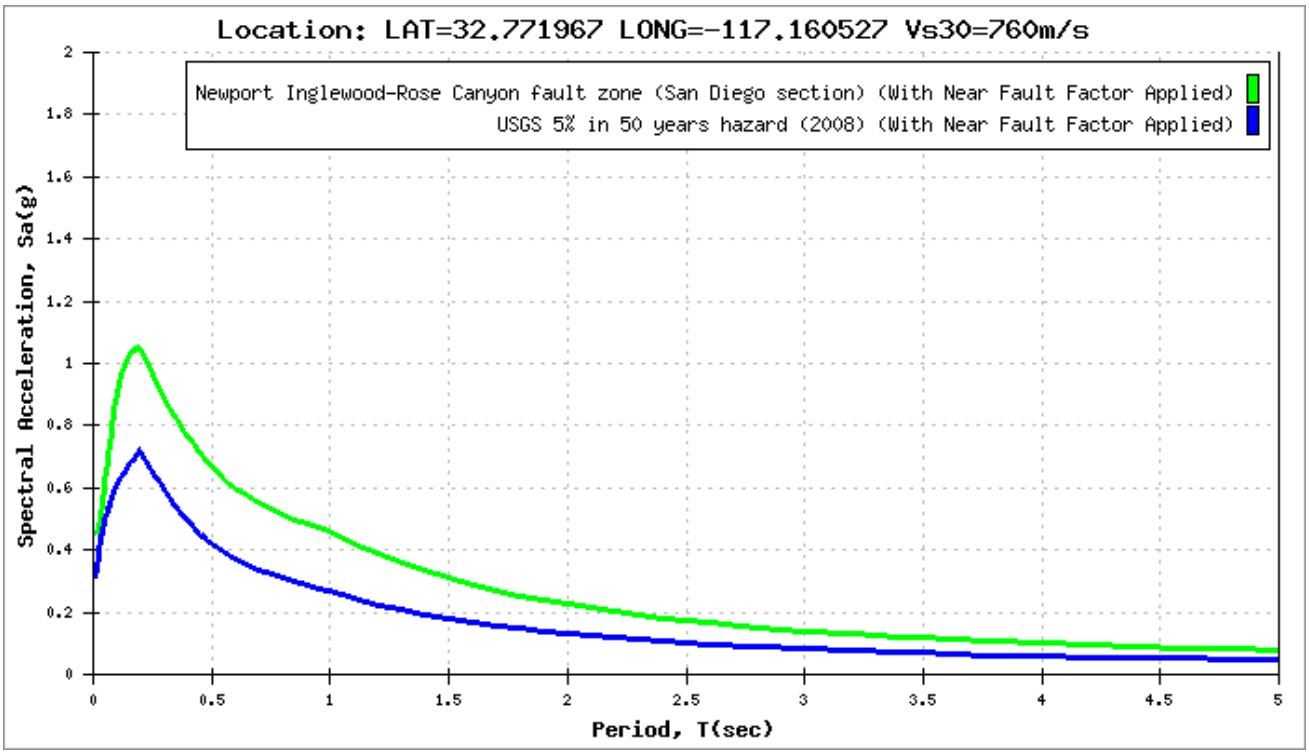
Safety Factors Are Calculated By The Modified Bishop Method

SELECT SITE LOCATION



CALCULATED SPECTRA



SITE DATA

VI-6

Shear Wave Velocity, Vs_{30}:	760 m/s
Latitude:	32.771967
Longitude:	-117.160527
Depth to Vs = 1.0 km/s:	24 m
Depth to Vs = 2.5 km/s:	2.00 km

DETERMINISTIC

Newport Inglewood-Rose Canyon fault zone (San Diego section)

Fault ID:	224
Maximum Magnitude (MMax):	7.5
Fault Type:	RLSS
Fault Dip:	90 Deg
Dip Direction:	V
Bottom of Rupture Plane:	13.00 km
Top of Rupture Plane(Ztor):	0.00 km
Rrup	3.59 km
Rjb:	3.59 km
Rx:	3.59 km
Fnorm:	0
Frev:	0

Period	SA(Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA(Final Spectrum)
0.01	0.453	1.000	1.000	0.453
0.02	0.463	1.000	1.000	0.463
0.022	0.470	1.000	1.000	0.470
0.025	0.481	1.000	1.000	0.481
0.029	0.496	1.000	1.000	0.496
0.03	0.501	1.000	1.000	0.501
0.032	0.512	1.000	1.000	0.512
0.035	0.529	1.000	1.000	0.529
0.036	0.535	1.000	1.000	0.535
0.04	0.558	1.000	1.000	0.558
0.042	0.570	1.000	1.000	0.570
0.044	0.582	1.000	1.000	0.582
0.045	0.589	1.000	1.000	0.589
0.046	0.595	1.000	1.000	0.595
0.048	0.607	1.000	1.000	0.607
0.05	0.620	1.000	1.000	0.620
0.055	0.652	1.000	1.000	0.652
0.06	0.684	1.000	1.000	0.684
0.065	0.715	1.000	1.000	0.715
0.067	0.727	1.000	1.000	0.727
0.07	0.744	1.000	1.000	0.744
0.075	0.773	1.000	1.000	0.773

0.08	0.800	1.000	1.000	0.800
0.085	0.826	1.000	1.000	0.826
0.09	0.851	1.000	1.000	0.851
0.095	0.874	1.000	1.000	0.874
0.1	0.896	1.000	1.000	0.896
0.11	0.932	1.000	1.000	0.932
0.12	0.963	1.000	1.000	0.963
0.13	0.988	1.000	1.000	0.988
0.133	0.994	1.000	1.000	0.994
0.14	1.008	1.000	1.000	1.008
0.15	1.023	1.000	1.000	1.023
0.16	1.033	1.000	1.000	1.033
0.17	1.039	1.000	1.000	1.039
0.18	1.044	1.000	1.000	1.044
0.19	1.046	1.000	1.000	1.046
0.2	1.047	1.000	1.000	1.047
0.22	1.014	1.000	1.000	1.014
0.24	0.983	1.000	1.000	0.983
0.25	0.967	1.000	1.000	0.967
0.26	0.949	1.000	1.000	0.949
0.28	0.917	1.000	1.000	0.917
0.29	0.900	1.000	1.000	0.900
0.3	0.884	1.000	1.000	0.884
0.32	0.858	1.000	1.000	0.858
0.34	0.832	1.000	1.000	0.832
0.35	0.820	1.000	1.000	0.820
0.36	0.808	1.000	1.000	0.808
0.38	0.784	1.000	1.000	0.784
0.4	0.761	1.000	1.000	0.761
0.42	0.741	1.000	1.000	0.741
0.44	0.720	1.000	1.000	0.720
0.45	0.711	1.000	1.000	0.711
0.46	0.702	1.000	1.000	0.702
0.48	0.683	1.000	1.000	0.683
0.5	0.667	1.000	1.000	0.667
0.55	0.618	1.000	1.020	0.631
0.6	0.577	1.000	1.040	0.600
0.65	0.542	1.000	1.060	0.574
0.667	0.531	1.000	1.067	0.566
0.7	0.511	1.000	1.080	0.552
0.75	0.484	1.000	1.100	0.532
0.8	0.459	1.000	1.120	0.514
0.85	0.437	1.000	1.140	0.498
0.9	0.417	1.000	1.160	0.484
0.95	0.399	1.000	1.180	0.471
1	0.382	1.000	1.200	0.459
1.1	0.350	1.000	1.200	0.420
1.2	0.323	1.000	1.200	0.387
1.3	0.299	1.000	1.200	0.358
1.4	0.278	1.000	1.200	0.333

1.5	0.259	1.000	1.200	0.310
1.6	0.241	1.000	1.200	0.289
1.7	0.226	1.000	1.200	0.271
1.8	0.212	1.000	1.200	0.254
1.9	0.199	1.000	1.200	0.239
2	0.188	1.000	1.200	0.226
2.2	0.168	1.000	1.200	0.201
2.4	0.152	1.000	1.200	0.182
2.5	0.144	1.000	1.200	0.173
2.6	0.138	1.000	1.200	0.166
2.8	0.127	1.000	1.200	0.152
3	0.117	1.000	1.200	0.140
3.2	0.108	1.000	1.200	0.130
3.4	0.101	1.000	1.200	0.121
3.5	0.098	1.000	1.200	0.117
3.6	0.095	1.000	1.200	0.114
3.8	0.089	1.000	1.200	0.107
4	0.084	1.000	1.200	0.100
4.2	0.079	1.000	1.200	0.095
4.4	0.075	1.000	1.200	0.090
4.6	0.072	1.000	1.200	0.086
4.8	0.068	1.000	1.200	0.082
5	0.065	1.000	1.200	0.078

PROBABILISTIC

Probabilistic Model
USGS Seismic Hazard Map(2008) 975 Year Return Period

Period	SA(Base Spectrum)	Basin Factor	Near Fault Factor (Applied)	SA(Final Spectrum)
0.01	0.309	1.000	1.000	0.309
0.02	0.379	1.000	1.000	0.379
0.022	0.390	1.000	1.000	0.390
0.025	0.405	1.000	1.000	0.405
0.029	0.423	1.000	1.000	0.423
0.03	0.428	1.000	1.000	0.428
0.032	0.436	1.000	1.000	0.436
0.035	0.447	1.000	1.000	0.447
0.036	0.451	1.000	1.000	0.451
0.04	0.465	1.000	1.000	0.465
0.042	0.472	1.000	1.000	0.472
0.044	0.479	1.000	1.000	0.479
0.045	0.482	1.000	1.000	0.482
0.046	0.485	1.000	1.000	0.485
0.048	0.491	1.000	1.000	0.491
0.05	0.497	1.000	1.000	0.497
0.055	0.511	1.000	1.000	0.511
0.06	0.524	1.000	1.000	0.524

0.065	0.537	1.000	1.000	0.537
0.067	0.542	1.000	1.000	0.542
0.07	0.549	1.000	1.000	0.549
0.075	0.560	1.000	1.000	0.560
0.08	0.571	1.000	1.000	0.571
0.085	0.581	1.000	1.000	0.581
0.09	0.591	1.000	1.000	0.591
0.095	0.601	1.000	1.000	0.601
0.1	0.610	1.000	1.000	0.610
0.11	0.624	1.000	1.000	0.624
0.12	0.637	1.000	1.000	0.637
0.13	0.649	1.000	1.000	0.649
0.133	0.652	1.000	1.000	0.652
0.14	0.660	1.000	1.000	0.660
0.15	0.671	1.000	1.000	0.671
0.16	0.681	1.000	1.000	0.681
0.17	0.691	1.000	1.000	0.691
0.18	0.701	1.000	1.000	0.701
0.19	0.710	1.000	1.000	0.710
0.2	0.718	1.000	1.000	0.718
0.22	0.687	1.000	1.000	0.687
0.24	0.660	1.000	1.000	0.660
0.25	0.647	1.000	1.000	0.647
0.26	0.636	1.000	1.000	0.636
0.28	0.614	1.000	1.000	0.614
0.29	0.604	1.000	1.000	0.604
0.3	0.595	1.000	1.000	0.595
0.32	0.569	1.000	1.000	0.569
0.34	0.546	1.000	1.000	0.546
0.35	0.535	1.000	1.000	0.535
0.36	0.525	1.000	1.000	0.525
0.38	0.506	1.000	1.000	0.506
0.4	0.489	1.000	1.000	0.489
0.42	0.473	1.000	1.000	0.473
0.44	0.458	1.000	1.000	0.458
0.45	0.451	1.000	1.000	0.451
0.46	0.444	1.000	1.000	0.444
0.48	0.431	1.000	1.000	0.431
0.5	0.420	1.000	1.000	0.420
0.55	0.385	1.000	1.020	0.393
0.6	0.356	1.000	1.040	0.371
0.65	0.332	1.000	1.060	0.352
0.667	0.324	1.000	1.067	0.346
0.7	0.311	1.000	1.080	0.335
0.75	0.292	1.000	1.100	0.321
0.8	0.275	1.000	1.120	0.308
0.85	0.261	1.000	1.140	0.297
0.9	0.248	1.000	1.160	0.287
0.95	0.236	1.000	1.180	0.278
1	0.225	1.000	1.200	0.270

1.1	0.204	1.000	1.200	0.245
1.2	0.187	1.000	1.200	0.224
1.3	0.172	1.000	1.200	0.207
1.4	0.160	1.000	1.200	0.192
1.5	0.149	1.000	1.200	0.179
1.6	0.140	1.000	1.200	0.167
1.7	0.131	1.000	1.200	0.157
1.8	0.124	1.000	1.200	0.149
1.9	0.117	1.000	1.200	0.141
2	0.111	1.000	1.200	0.133
2.2	0.100	1.000	1.200	0.119
2.4	0.090	1.000	1.200	0.108
2.5	0.086	1.000	1.200	0.103
2.6	0.082	1.000	1.200	0.098
2.8	0.075	1.000	1.200	0.090
3	0.069	1.000	1.200	0.083
3.2	0.064	1.000	1.200	0.077
3.4	0.060	1.000	1.200	0.072
3.5	0.058	1.000	1.200	0.069
3.6	0.056	1.000	1.200	0.067
3.8	0.052	1.000	1.200	0.062
4	0.049	1.000	1.200	0.059
4.2	0.047	1.000	1.200	0.056
4.4	0.045	1.000	1.200	0.054
4.6	0.043	1.000	1.200	0.051
4.8	0.041	1.000	1.200	0.049
5	0.040	1.000	1.200	0.048

Envelope Data

Period	**SA**
0.01	0.453
0.02	0.463
0.022	0.470
0.025	0.481
0.029	0.496
0.03	0.501
0.032	0.512
0.035	0.529
0.036	0.535
0.04	0.558
0.042	0.570
0.044	0.582
0.045	0.589
0.046	0.595
0.048	0.607

0.05	0.620
0.055	0.652
0.06	0.684
0.065	0.715
0.067	0.727
0.07	0.744
0.075	0.773
0.08	0.800
0.085	0.826
0.09	0.851
0.095	0.874
0.1	0.896
0.11	0.932
0.12	0.963
0.13	0.988
0.133	0.994
0.14	1.008
0.15	1.023
0.16	1.033
0.17	1.039
0.18	1.044
0.19	1.046
0.2	1.047
0.22	1.014
0.24	0.983
0.25	0.967
0.26	0.949
0.28	0.917
0.29	0.900
0.3	0.884
0.32	0.858
0.34	0.832
0.35	0.820
0.36	0.808
0.38	0.784
0.4	0.761
0.42	0.741
0.44	0.720
0.45	0.711
0.46	0.702
0.48	0.683
0.5	0.667
0.55	0.631
0.6	0.600
0.65	0.574
0.667	0.566
0.7	0.552
0.75	0.532
0.8	0.514
0.85	0.498

0.9	0.484
0.95	0.471
1	0.459
1.1	0.420
1.2	0.387
1.3	0.358
1.4	0.333
1.5	0.310
1.6	0.289
1.7	0.271
1.8	0.254
1.9	0.239
2	0.226
2.2	0.201
2.4	0.182
2.5	0.173
2.6	0.166
2.8	0.152
3	0.140
3.2	0.130
3.4	0.121
3.5	0.117
3.6	0.114
3.8	0.107
4	0.100
4.2	0.095
4.4	0.090
4.6	0.086
4.8	0.082
5	0.078

CALFP Ver. 1.1

Unit System = E

Title: Friars Road
Traffic Index (TI) = 12.5
R.Value of Subgrade (Native Soil) = 20
Required GE = 0003.20 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.88 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.60	00.16	00.15	01.60	00.24
00.20	01.60	00.32	00.25	01.60	00.40
00.30	01.60	00.48	00.35	01.60	00.56
00.40	01.60	00.64	00.45	01.60	00.72
00.50	01.60	00.80	00.55	01.62	00.89
00.60	01.67	01.00	00.65	01.72	01.12
00.70	01.76	01.23	00.75	01.80	01.35
00.80	01.84	01.47	00.85	01.88	01.60
00.90	01.91	01.72	00.95	01.95	01.85
01.00	01.98	01.98	01.05	02.01	02.11
01.10	02.04	02.24	01.15	02.07	02.38
01.20	02.10	02.52	01.25	02.13	02.66
01.30	02.16	02.81	01.35	02.19	02.96
01.40	02.21	03.09	01.45	02.24	03.25
01.50	02.27	03.41	01.55	02.29	03.55
01.60	02.32	03.71	01.65	02.34	03.86
01.70	02.36	04.01	01.75	02.39	04.18

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.75 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty

years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.65	00.00	01.90	00.00	00.00	00.01	0000.00	01.72
00.70	00.00	01.80	00.00	00.00	00.01	0000.00	01.76
00.75	00.00	01.70	00.00	00.00	00.02	0000.00	01.80
00.80	00.00	01.55	00.00	00.00	-00.02	0000.00	01.84
00.85	00.00	01.45	00.00	00.00	-00.01	0000.00	01.88
00.90	00.00	01.35	00.00	00.00	00.00	0000.00	01.91
00.95	00.00	01.20	00.00	00.00	-00.03	0000.00	01.95
01.00	00.00	01.10	00.00	00.00	-00.01	0000.00	01.98
01.05	00.00	01.00	00.00	00.00	00.01	0000.00	02.01
01.10	00.00	00.85	00.00	00.00	-00.02	0000.00	02.04
01.15	00.00	00.75	00.00	00.00	00.01	0000.00	02.07
01.20	00.00	00.60	00.00	00.00	-00.02	0000.00	02.10
01.25	00.00	00.50	00.00	00.00	00.01	0000.00	02.13

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: Ulric Street
Traffic Index (TI) = 10.5
R.Value of Subgrade (Native Soil) = 30
Required GE = 0002.35 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.74 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.75	00.18	00.15	01.75	00.26
00.20	01.75	00.35	00.25	01.75	00.44
00.30	01.75	00.53	00.35	01.75	00.61
00.40	01.75	00.70	00.45	01.75	00.79
00.50	01.75	00.88	00.55	01.77	00.97
00.60	01.82	01.09	00.65	01.87	01.22
00.70	01.92	01.34	00.75	01.96	01.47
00.80	02.01	01.61	00.85	02.05	01.74
00.90	02.09	01.88	00.95	02.12	02.01
01.00	02.16	02.16	01.05	02.20	02.31
01.10	02.23	02.45	01.15	02.26	02.60
01.20	02.30	02.76	01.25	02.33	02.91
01.30	02.36	03.07	01.35	02.39	03.23
01.40	02.42	03.39	01.45	02.45	03.55

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.45 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.

Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.55	00.00	01.25	00.00	00.00	-00.00	0000.00	01.77
00.60	00.00	01.15	00.00	00.00	00.01	0000.00	01.82
00.65	00.00	01.05	00.00	00.00	00.02	0000.00	01.87
00.70	00.00	00.90	00.00	00.00	-00.02	0000.00	01.92
00.75	00.00	00.80	00.00	00.00	-00.00	0000.00	01.96
00.80	00.00	00.70	00.00	00.00	00.03	0000.00	02.01
00.85	00.00	00.55	00.00	00.00	-00.00	0000.00	02.05
00.90	00.00	00.45	00.00	00.00	00.02	0000.00	02.09
00.95	00.00	00.35	00.00	00.00	00.05	0000.00	02.12
01.00	00.00	00.35	00.00	00.00	00.19	0000.00	02.16
01.05	00.00	00.35	00.00	00.00	00.34	0000.00	02.20
01.10	00.00	00.35	00.00	00.00	00.49	0000.00	02.23
01.15	00.00	00.35	00.00	00.00	00.63	0000.00	02.26

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 Inside Lanes
Traffic Index (TI) = 11.5
R.Value of Subgrade (Native Soil) = 40
Required GE = 0002.21 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.81 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.67	00.17	00.15	01.67	00.25
00.20	01.67	00.33	00.25	01.67	00.42
00.30	01.67	00.50	00.35	01.67	00.58
00.40	01.67	00.67	00.45	01.67	00.75
00.50	01.67	00.84	00.55	01.69	00.93
00.60	01.74	01.04	00.65	01.79	01.16
00.70	01.83	01.28	00.75	01.88	01.41
00.80	01.92	01.54	00.85	01.96	01.67
00.90	01.99	01.79	00.95	02.03	01.93
01.00	02.06	02.06	01.05	02.10	02.21
01.10	02.13	02.34	01.15	02.16	02.48
01.20	02.19	02.63	01.25	02.22	02.78
01.30	02.25	02.93	01.35	02.28	03.08
01.40	02.31	03.23	01.45	02.34	03.39
01.50	02.36	03.54	01.55	02.39	03.70
01.60	02.41	03.86	01.65	02.44	04.03

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.60 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.60	00.00	01.05	00.00	00.00	-00.01	0000.00	01.74
00.65	00.00	00.95	00.00	00.00	00.00	0000.00	01.79
00.70	00.00	00.85	00.00	00.00	00.01	0000.00	01.83
00.75	00.00	00.75	00.00	00.00	00.03	0000.00	01.88
00.80	00.00	00.60	00.00	00.00	-00.01	0000.00	01.92
00.85	00.00	00.50	00.00	00.00	00.01	0000.00	01.96
00.90	00.00	00.40	00.00	00.00	00.02	0000.00	01.99
00.95	00.00	00.35	00.00	00.00	00.11	0000.00	02.03
01.00	00.00	00.35	00.00	00.00	00.24	0000.00	02.06
01.05	00.00	00.35	00.00	00.00	00.38	0000.00	02.10
01.10	00.00	00.35	00.00	00.00	00.52	0000.00	02.13

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 Outside Lanes
Traffic Index (TI) = 13.5
R.Value of Subgrade (Native Soil) = 40
Required GE = 0002.59 ft

Title: SR-163 Outside Lanes
Traffic Index (TI) = 13.5
R.Value of Subgrade (Native Soil) = 40
Required GE = 0002.59 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.95 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.54	00.15	00.15	01.54	00.23
00.20	01.54	00.31	00.25	01.54	00.39
00.30	01.54	00.46	00.35	01.54	00.54
00.40	01.54	00.62	00.45	01.54	00.69
00.50	01.54	00.77	00.55	01.56	00.86
00.60	01.61	00.97	00.65	01.65	01.07
00.70	01.69	01.18	00.75	01.73	01.30
00.80	01.77	01.42	00.85	01.80	01.53
00.90	01.84	01.66	00.95	01.87	01.78
01.00	01.91	01.91	01.05	01.94	02.04
01.10	01.97	02.17	01.15	02.00	02.30
01.20	02.02	02.42	01.25	02.05	02.56
01.30	02.08	02.70	01.35	02.11	02.85
01.40	02.13	02.98	01.45	02.16	03.13
01.50	02.18	03.27	01.55	02.20	03.41
01.60	02.23	03.57	01.65	02.25	03.71
01.70	02.27	03.86	01.75	02.30	04.03
01.80	02.32	04.18	01.85	02.34	04.33
01.90	02.36	04.48	01.95	02.38	04.64

HMA Safety Factor (GE) = 0000.20 ft

HMA Ultimate Depth = 0001.90 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.70	00.00	01.30	00.00	00.00	00.02	0000.00	01.69
00.75	00.00	01.20	00.00	00.00	00.03	0000.00	01.73
00.80	00.00	01.05	00.00	00.00	-00.02	0000.00	01.77
00.85	00.00	00.95	00.00	00.00	-00.02	0000.00	01.80
00.90	00.00	00.85	00.00	00.00	-00.00	0000.00	01.84
00.95	00.00	00.75	00.00	00.00	00.01	0000.00	01.87
01.00	00.00	00.60	00.00	00.00	-00.02	0000.00	01.91
01.05	00.00	00.50	00.00	00.00	-00.00	0000.00	01.94
01.10	00.00	00.40	00.00	00.00	00.02	0000.00	01.97
01.15	00.00	00.35	00.00	00.00	00.09	0000.00	02.00
01.20	00.00	00.35	00.00	00.00	00.22	0000.00	02.02
01.25	00.00	00.35	00.00	00.00	00.36	0000.00	02.05
01.30	00.00	00.35	00.00	00.00	00.50	0000.00	02.08

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 Auxillery Lane
Traffic Index (TI) = 12.0
R.Value of Subgrade (Native Soil) = 40
Required GE = 0002.30 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.84 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.64	00.16	00.15	01.64	00.25
00.20	01.64	00.33	00.25	01.64	00.41
00.30	01.64	00.49	00.35	01.64	00.57
00.40	01.64	00.66	00.45	01.64	00.74
00.50	01.64	00.82	00.55	01.66	00.91
00.60	01.70	01.02	00.65	01.75	01.14
00.70	01.79	01.25	00.75	01.84	01.38
00.80	01.88	01.50	00.85	01.91	01.62
00.90	01.95	01.76	00.95	01.99	01.89
01.00	02.02	02.02	01.05	02.05	02.15
01.10	02.09	02.30	01.15	02.12	02.44
01.20	02.15	02.58	01.25	02.18	02.73
01.30	02.21	02.87	01.35	02.23	03.01
01.40	02.26	03.16	01.45	02.29	03.32
01.50	02.31	03.47	01.55	02.34	03.63
01.60	02.36	03.78	01.65	02.39	03.94

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.65 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.60	00.00	01.15	00.00	00.00	-00.02	0000.00	01.70
00.65	00.00	01.05	00.00	00.00	-00.01	0000.00	01.75
00.70	00.00	00.95	00.00	00.00	-00.01	0000.00	01.79
00.75	00.00	00.85	00.00	00.00	00.01	0000.00	01.84
00.80	00.00	00.75	00.00	00.00	00.02	0000.00	01.88
00.85	00.00	00.60	00.00	00.00	-00.02	0000.00	01.91
00.90	00.00	00.50	00.00	00.00	00.00	0000.00	01.95
00.95	00.00	00.40	00.00	00.00	00.03	0000.00	01.99
01.00	00.00	00.35	00.00	00.00	00.10	0000.00	02.02
01.05	00.00	00.35	00.00	00.00	00.23	0000.00	02.05
01.10	00.00	00.35	00.00	00.00	00.38	0000.00	02.09
01.15	00.00	00.35	00.00	00.00	00.52	0000.00	02.12

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 Shoulders
Traffic Index (TI) = 08.5
R.Value of Subgrade (Native Soil) = 40
Required GE = 0001.63 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.60 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.94	00.19	00.15	01.94	00.29
00.20	01.94	00.39	00.25	01.94	00.49
00.30	01.94	00.58	00.35	01.94	00.68
00.40	01.94	00.78	00.45	01.94	00.87
00.50	01.94	00.97	00.55	01.97	01.08
00.60	02.03	01.22	00.65	02.08	01.35
00.70	02.13	01.49	00.75	02.18	01.64
00.80	02.23	01.78	00.85	02.27	01.93
00.90	02.32	02.09	00.95	02.36	02.24
01.00	02.40	02.40	01.05	02.44	02.56
01.10	02.48	02.73	01.15	02.52	02.90

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.15 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

CalFP SR-163 Shoulders.txt

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.40	00.00	00.80	00.00	00.00	00.02	0000.00	01.94
00.45	00.00	00.70	00.00	00.00	00.01	0000.00	01.94
00.50	00.00	00.60	00.00	00.00	-00.00	0000.00	01.94
00.55	00.00	00.50	00.00	00.00	00.00	0000.00	01.97
00.60	00.00	00.40	00.00	00.00	00.03	0000.00	02.03
00.65	00.00	00.35	00.00	00.00	00.11	0000.00	02.08
00.70	00.00	00.35	00.00	00.00	00.24	0000.00	02.13
00.75	00.00	00.35	00.00	00.00	00.39	0000.00	02.18
00.80	00.00	00.35	00.00	00.00	00.54	0000.00	02.23

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 (Friars Flyover/Undercrossing)
Traffic Index (TI) = 11.0
R.Value of Subgrade (Native Soil) = 40
Required GE = 0002.11 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.77 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.71	00.17	00.15	01.71	00.26
00.20	01.71	00.34	00.25	01.71	00.43
00.30	01.71	00.51	00.35	01.71	00.60
00.40	01.71	00.68	00.45	01.71	00.77
00.50	01.71	00.86	00.55	01.73	00.95
00.60	01.78	01.07	00.65	01.83	01.19
00.70	01.87	01.31	00.75	01.92	01.44
00.80	01.96	01.57	00.85	02.00	01.70
00.90	02.04	01.84	00.95	02.07	01.97
01.00	02.11	02.11	01.05	02.15	02.26
01.10	02.18	02.40	01.15	02.21	02.54
01.20	02.24	02.69	01.25	02.27	02.84
01.30	02.30	02.99	01.35	02.33	03.15
01.40	02.36	03.30	01.45	02.39	03.47
01.50	02.42	03.63	01.55	02.44	03.78

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.50 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.55	00.00	01.05	00.00	00.00	-00.01	0000.00	01.73
00.60	00.00	00.95	00.00	00.00	00.00	0000.00	01.78
00.65	00.00	00.85	00.00	00.00	00.01	0000.00	01.83
00.70	00.00	00.75	00.00	00.00	00.02	0000.00	01.87
00.75	00.00	00.60	00.00	00.00	-00.01	0000.00	01.92
00.80	00.00	00.50	00.00	00.00	00.01	0000.00	01.96
00.85	00.00	00.35	00.00	00.00	-00.03	0000.00	02.00
00.90	00.00	00.35	00.00	00.00	00.11	0000.00	02.04
00.95	00.00	00.35	00.00	00.00	00.24	0000.00	02.07
01.00	00.00	00.35	00.00	00.00	00.38	0000.00	02.11
01.05	00.00	00.35	00.00	00.00	00.53	0000.00	02.15

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: SR-163 (Friars Flyover/Undercrossing) Shoulders
Traffic Index (TI) = 08.5
R.Value of Subgrade (Native Soil) = 40
Required GE = 0001.63 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.60 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.94	00.19	00.15	01.94	00.29
00.20	01.94	00.39	00.25	01.94	00.49
00.30	01.94	00.58	00.35	01.94	00.68
00.40	01.94	00.78	00.45	01.94	00.87
00.50	01.94	00.97	00.55	01.97	01.08
00.60	02.03	01.22	00.65	02.08	01.35
00.70	02.13	01.49	00.75	02.18	01.64
00.80	02.23	01.78	00.85	02.27	01.93
00.90	02.32	02.09	00.95	02.36	02.24
01.00	02.40	02.40	01.05	02.44	02.56
01.10	02.48	02.73	01.15	02.52	02.90

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.15 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

CalFP SR-163 (Friars Flyover-Undercrossing) Shoulders.txt

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.40	00.00	00.80	00.00	00.00	00.02	0000.00	01.94
00.45	00.00	00.70	00.00	00.00	00.01	0000.00	01.94
00.50	00.00	00.60	00.00	00.00	-00.00	0000.00	01.94
00.55	00.00	00.50	00.00	00.00	00.00	0000.00	01.97
00.60	00.00	00.40	00.00	00.00	00.03	0000.00	02.03
00.65	00.00	00.35	00.00	00.00	00.11	0000.00	02.08
00.70	00.00	00.35	00.00	00.00	00.24	0000.00	02.13
00.75	00.00	00.35	00.00	00.00	00.39	0000.00	02.18
00.80	00.00	00.35	00.00	00.00	00.54	0000.00	02.23

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: Ramps
Traffic Index (TI) = 10.0
R.Value of Subgrade (Native Soil) = 40
Required GE = 0001.92 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.70 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.79	00.18	00.15	01.79	00.27
00.20	01.79	00.36	00.25	01.79	00.45
00.30	01.79	00.54	00.35	01.79	00.63
00.40	01.79	00.72	00.45	01.79	00.81
00.50	01.79	00.90	00.55	01.81	01.00
00.60	01.87	01.12	00.65	01.92	01.25
00.70	01.97	01.38	00.75	02.01	01.51
00.80	02.05	01.64	00.85	02.10	01.79
00.90	02.14	01.93	00.95	02.18	02.07
01.00	02.21	02.21	01.05	02.25	02.36
01.10	02.29	02.52	01.15	02.32	02.67
01.20	02.35	02.82	01.25	02.38	02.98
01.30	02.42	03.15	01.35	02.45	03.31

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.35 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.50	00.00	00.95	00.00	00.00	00.02	0000.00	01.79
00.55	00.00	00.85	00.00	00.00	00.01	0000.00	01.81
00.60	00.00	00.75	00.00	00.00	00.03	0000.00	01.87
00.65	00.00	00.60	00.00	00.00	-00.01	0000.00	01.92
00.70	00.00	00.50	00.00	00.00	00.01	0000.00	01.97
00.75	00.00	00.35	00.00	00.00	-00.03	0000.00	02.01
00.80	00.00	00.35	00.00	00.00	00.11	0000.00	02.05
00.85	00.00	00.35	00.00	00.00	00.25	0000.00	02.10
00.90	00.00	00.35	00.00	00.00	00.39	0000.00	02.14
00.95	00.00	00.35	00.00	00.00	00.54	0000.00	02.18

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: Ramps Shoulders
Traffic Index (TI) = 08.0
R.Value of Subgrade (Native Soil) = 40
Required GE = 0001.54 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.56 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	02.00	00.20	00.15	02.00	00.30
00.20	02.00	00.40	00.25	02.00	00.50
00.30	02.00	00.60	00.35	02.00	00.70
00.40	02.00	00.80	00.45	02.00	00.90
00.50	02.00	01.00	00.55	02.03	01.12
00.60	02.09	01.25	00.65	02.14	01.39
00.70	02.20	01.54	00.75	02.25	01.69
00.80	02.30	01.84	00.85	02.34	01.99
00.90	02.39	02.15	00.95	02.43	02.31
01.00	02.47	02.47	01.05	02.52	02.65
01.10	02.55	02.81	01.15	02.59	02.98

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.10 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

CalFP Ramps Shoulders.txt

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.40	00.00	00.65	00.00	00.00	-00.02	0000.00	02.00
00.45	00.00	00.60	00.00	00.00	00.02	0000.00	02.00
00.50	00.00	00.50	00.00	00.00	00.01	0000.00	02.00
00.55	00.00	00.40	00.00	00.00	00.02	0000.00	02.03
00.60	00.00	00.35	00.00	00.00	00.10	0000.00	02.09
00.65	00.00	00.35	00.00	00.00	00.24	0000.00	02.14
00.70	00.00	00.35	00.00	00.00	00.39	0000.00	02.20
00.75	00.00	00.35	00.00	00.00	00.54	0000.00	02.25

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: Collector-Distributor
Traffic Index (TI) = 11.0
R.Value of Subgrade (Native Soil) = 30
Required GE = 0002.46 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.77 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	01.71	00.17	00.15	01.71	00.26
00.20	01.71	00.34	00.25	01.71	00.43
00.30	01.71	00.51	00.35	01.71	00.60
00.40	01.71	00.68	00.45	01.71	00.77
00.50	01.71	00.86	00.55	01.73	00.95
00.60	01.78	01.07	00.65	01.83	01.19
00.70	01.87	01.31	00.75	01.92	01.44
00.80	01.96	01.57	00.85	02.00	01.70
00.90	02.04	01.84	00.95	02.07	01.97
01.00	02.11	02.11	01.05	02.15	02.26
01.10	02.18	02.40	01.15	02.21	02.54
01.20	02.24	02.69	01.25	02.27	02.84
01.30	02.30	02.99	01.35	02.33	03.15
01.40	02.36	03.30	01.45	02.39	03.47
01.50	02.42	03.63	01.55	02.44	03.78

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.50 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.55	00.00	01.35	00.00	00.00	-00.03	0000.00	01.73
00.60	00.00	01.25	00.00	00.00	-00.02	0000.00	01.78
00.65	00.00	01.15	00.00	00.00	-00.01	0000.00	01.83
00.70	00.00	01.05	00.00	00.00	00.00	0000.00	01.87
00.75	00.00	00.95	00.00	00.00	00.02	0000.00	01.92
00.80	00.00	00.80	00.00	00.00	-00.02	0000.00	01.96
00.85	00.00	00.70	00.00	00.00	00.01	0000.00	02.00
00.90	00.00	00.55	00.00	00.00	-00.02	0000.00	02.04
00.95	00.00	00.45	00.00	00.00	-00.00	0000.00	02.07
01.00	00.00	00.35	00.00	00.00	00.03	0000.00	02.11
01.05	00.00	00.35	00.00	00.00	00.18	0000.00	02.15
01.10	00.00	00.35	00.00	00.00	00.32	0000.00	02.18
01.15	00.00	00.35	00.00	00.00	00.46	0000.00	02.21

***** FINISH *****

CALFP Ver. 1.1

Unit System = E

Title: Collector-Distributor Shoulders
Traffic Index (TI) = 08.0
R.Value of Subgrade (Native Soil) = 30
Required GE = 0001.79 ft

Base Type = AB-Class 2

Base Gravel Factor = 0001.10
Base R.Value = 0078.00
0.0032*TI*(100-R.VALUE) = 0000.56 ft
Base MAX. depth = 0002.00 ft
Base MIN. depth = 0000.35 ft

Depth (ft)	GF	GE (ft)	Depth (ft)	GF	GE (ft)
00.10	02.00	00.20	00.15	02.00	00.30
00.20	02.00	00.40	00.25	02.00	00.50
00.30	02.00	00.60	00.35	02.00	00.70
00.40	02.00	00.80	00.45	02.00	00.90
00.50	02.00	01.00	00.55	02.03	01.12
00.60	02.09	01.25	00.65	02.14	01.39
00.70	02.20	01.54	00.75	02.25	01.69
00.80	02.30	01.84	00.85	02.34	01.99
00.90	02.39	02.15	00.95	02.43	02.31
01.00	02.47	02.47	01.05	02.52	02.65
01.10	02.55	02.81	01.15	02.59	02.98

HMA Safety Factor (GE) = 0000.20 ft
HMA Ultimate Depth = 0001.10 ft
(HMA MAX. Depth shown in Table)

HMA MIN. Depth (from Base) = 0000.20 ft

HMA MIN. Depth (selected) = 0000.20 ft

Note: Mandatory enhancements should be incorporated for design life greater than twenty years:

Note: Positive Residual GE indicates over-design.
Note: Negative Safety Factor in Base

CalFP Collector-Distributor Shoulders.txt

HMA ft	TPB ft	T-Base ft	B-Base ft	Subbase ft	Res-GE ft	Cost $/y^2	HMA-GF
00.40	00.00	00.90	00.00	00.00	-00.00	0000.00	02.00
00.45	00.00	00.80	00.00	00.00	-00.01	0000.00	02.00
00.50	00.00	00.70	00.00	00.00	-00.02	0000.00	02.00
00.55	00.00	00.60	00.00	00.00	-00.02	0000.00	02.03
00.60	00.00	00.50	00.00	00.00	00.01	0000.00	02.09
00.65	00.00	00.35	00.00	00.00	-00.02	0000.00	02.14
00.70	00.00	00.35	00.00	00.00	00.13	0000.00	02.20
00.75	00.00	00.35	00.00	00.00	00.28	0000.00	02.25
00.80	00.00	00.35	00.00	00.00	00.43	0000.00	02.30
00.85	00.00	00.35	00.00	00.00	00.58	0000.00	02.34

***** FINISH *****

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Input Parameters:			**A-03-008**																												
Peak ground accel (g)=			0.440	Based on Caltrans ARS online tool																											
Earthquake magnitude, M=			7.5																												
Water table depth (m)=			4.9																												
Ave. γ above water table (kN/m^3)=				15.6																											
Ave. γ below water table (kN/m^3)=				15.2																											
Borehole diameter (mm)=			100																												
Requires correction for sampler liners (YES/NO)					NO																										
Rod lengths assumed equal to the depth plus 1.5 m (for the above ground extension).																															

SPT sample number	Depth (m)	Measured N	Soil type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	Fines content (%)	Energy ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPa)	σ_{VC}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress reduct. Coeff, r_d	CSR	MSF for sand	K_σ for sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety	Limiting shear strain γ_{lim}	Para-meter F_α	Maximum shear strain γ_{max}	ΔH_i (m)	ΔLD_i (m)	Vertical reconsol. Strain ε_v	ΔS_i (m)
1	1.2	42	SM	Unsaturated	22	75	1.25	1	0.75	1.00	39.4	19	19	1.54	60.7	4.8	65.46	1.00	0.285	1.00	1.10	2.000	n.a.	**n.a.**	0.000	-2.895	0.000	2.100	0.000	0.000	0.00
2	2.1	23	SM	Unsaturated	19	75	1.25	1	0.8	1.00	23.0	33	33	1.42	32.6	4.2	36.79	0.99	0.283	1.00	1.10	1.663	n.a.	**n.a.**	0.016	-0.566	0.000	0.914	0.000	0.000	0.00
3	3.0	21	SP	Unsaturated	5	75	1.25	1	0.85	1.00	22.3	48	48	1.32	29.4	0.0	29.35	0.98	0.281	1.00	1.10	0.447	n.a.	**n.a.**	0.051	-0.046	0.000	0.914	0.000	0.000	0.00
4	3.8	18	SP	Unsaturated	5	75	1.25	1	0.85	1.00	19.1	59	59	1.24	23.7	0.0	23.72	0.97	0.278	1.00	1.08	0.263	n.a.	**n.a.**	0.104	0.309	0.000	0.762	0.000	0.000	0.00
5	4.6	24	SP		5	75	1.25	1	0.95	1.00	28.5	71	71	1.13	32.1	0.0	32.13	0.97	0.276	1.00	1.08	0.658	0.709	**2.000**	0.034	-0.234	0.000	0.762	0.000	0.000	0.00
6	5.0	10	SM		21	75	1.25	1	0.95	1.00	11.9	78	77	1.13	13.4	4.6	18.07	0.96	0.278	1.00	1.03	0.184	0.191	**0.685**	0.197	0.616	0.197	0.428	0.084	0.025	0.01
7	6.0	28	SM		21	75	1.25	1	0.95	1.00	33.3	94	83	1.06	35.3	4.6	39.91	0.95	0.308	1.00	1.06	2.000	2.000	**2.000**	0.009	-0.797	0.000	1.046	0.000	0.000	0.00
8	7.6	38	SM		21	75	1.25	1	0.95	1.00	45.1	117	91	1.03	46.4	4.6	50.99	0.93	0.343	1.00	1.03	2.000	2.000	**2.000**	0.000	-1.670	0.000	1.554	0.000	0.000	0.00
9	9.1	14	CL	Clay	75	75	1.25	1	1	1.00	17.5	140	99	1.00	n.a.	n.a.	n.a.	0.91	0.368	1.00	1.01	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.500	0.000	0.000	0.00
10	10.7	29	ML	Clay	58	75	1.25	1	1	1.00	36.3	165	108	0.98	n.a.	n.a.	n.a.	0.89	0.387	1.00	0.98	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.600	0.000	0.000	0.00
11	12.2	11	CL	Clay	85	75	1.25	1	1	1.00	13.8	187	116	0.97	n.a.	n.a.	n.a.	0.86	0.400	1.00	0.96	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.500	0.000	0.000	0.00
																												LDI=	**0.08**		
																												Total Settlement (Meters)			0.01
LDI: LATERAL DISPLACEMENT INDEX																												**Total Settlement (Inches)**			0.4
						Lateral Displacement = (Gound Slope* + 0.2)*LDI							Total Lateral Displacement=				0.02	meters													
									*Ground Slope assumed to be 3%								0.8	inches													

Note - Analysis based on procedure presented in Earthquake Engineering Research Institute "Soil Liquefaction During Earthquakes" I.M. Idriss, R.W. Boulanger, April 2008.

"Estimating Liquefaction-Induced Lateral Displacements Using the Standard Penetration Test or Cone Penetration Test", G.Zahng, P.K. Robertson, M.ASCE, and R.W.I. Brachman. Journal of Geotechnical and Geoenvironmental Engineering, ASCE / August 2004.

SC & ST **SOUTHERN CALIFORNIA SOIL & TESTING**

FRIARS ROAD AT STATE ROUTE 163

BY: SHV DATE: 6/28/2012

JOB NUMBER: 1111191-1 APPENDIX VI

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Input Parameters:			**R-12-034**																												
Peak ground accel (g)=			0.440	Based on a Caltran ARS online tool																											
Earthquake magnitude, M=			7.5																												
Water table depth (m)=			1.8																												
Ave. γ above water table (kN/m^3)=				17.2																											
Ave. γ below water table (kN/m^3)=				18.8																											
Borehole diameter (mm)=			100																												
Requires correction for sampler liners (YES/NO)					NO																										
Rod lengths assumed equal to the depth plus 1.5 m (for the above ground extension).																															

SPT sample number	Depth (m)	Measured N	Soil type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	Fines content (%)	Energy ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPa)	σ_{VC}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress reduct. Coeff, r_d	CSR	MSF for sand	K_σ for sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety	Limiting shear strain γ_{lim}	Para-meter F_α	Maximum shear strain γ_{max}	ΔH_i (m)	ΔLD_i (m)	Vertical reconsol. Strain ε_v	ΔS_i (m)
1	3.0	3	SM		13	75	1.25	1	0.85	1.00	3.2	54	42	1.64	5.2	2.5	7.77	0.98	0.362	1.00	1.07	0.103	0.111	**0.306**	0.500	0.945	0.500	2.100	1.050	0.043	0.09
2	4.6	7	SM		13	75	1.25	1	0.95	1.00	8.3	83	56	1.34	11.1	2.5	13.70	0.97	0.411	1.00	1.06	0.145	0.155	**0.377**	0.317	0.805	0.317	1.524	0.483	0.031	0.05
3	6.1	4	SM		13	75	1.25	1	0.95	1.00	4.8	112	70	1.23	5.8	2.5	8.40	0.95	0.435	1.00	1.03	0.107	0.111	**0.254**	0.500	0.940	0.500	1.524	0.762	0.041	0.06
4	7.6	13	SM		13	75	1.25	1	0.95	1.00	15.4	140	83	1.09	16.8	2.5	19.36	0.93	0.448	1.00	1.03	0.198	0.203	**0.454**	0.171	0.551	0.171	1.524	0.260	0.024	0.04
5	9.1	15	SP-SM		7	75	1.25	1	1	1.00	18.8	169	97	1.02	19.1	0.2	19.24	0.91	0.453	1.00	1.01	0.197	0.198	**0.438**	0.173	0.557	0.173	1.524	0.264	0.024	0.04
6	10.7	17	SP-SM		7	75	1.25	1	1	1.00	21.3	198	111	0.96	20.4	0.2	20.58	0.89	0.453	1.00	0.99	0.213	0.210	**0.465**	0.149	0.487	0.149	1.524	0.227	0.023	0.03
7	12.2	24	SP-SM		7	75	1.25	1	1	1.00	30.0	226	124	0.93	27.8	0.2	27.90	0.86	0.450	1.00	0.96	0.380	0.365	**0.812**	0.062	0.049	0.052	1.524	0.079	0.011	0.02
8	13.7	17	SM		31	75	1.25	1	1	1.00	21.3	255	138	0.88	18.7	5.4	24.13	0.84	0.444	1.00	0.95	0.271	0.258	**0.580**	0.099	0.284	0.099	1.524	0.150	0.020	0.03
9	15.2	26	SP-SM		6	75	1.25	1	1	1.00	32.5	284	152	0.86	27.9	0.0	27.93	0.82	0.438	1.00	0.92	0.381	0.352	**0.805**	0.061	0.047	0.053	1.524	0.080	0.011	0.02
10	18.3	44	GP-GM		6	75	1.25	1	1	1.00	55.0	341	179	0.86	47.4	0.0	47.44	0.77	0.421	1.00	0.83	2.000	1.662	**2.000**	0.001	-1.382	0.000	3.048	0.000	0.000	0.00
11	21.3	56	SW-SM		6	75	1.25	1	1	1.00	70.0	398	207	0.83	58.2	0.0	58.18	0.73	0.404	1.00	0.79	2.000	1.578	**2.000**	0.000	-2.268	0.000	3.048	0.000	0.000	0.00
12	24.1	56	SW-SM		6	75	1.25	1	1	1.00	70.0	450	231	0.81	56.5	0.0	56.51	0.70	0.388	1.00	0.76	2.000	1.511	**2.000**	0.000	-2.127	0.000	2.743	0.000	0.000	0.00
																												LDI=	**3.36**		
LDI: LATERAL DISPLACEMENT INDEX																												**Total Settlement (Meters)**			0.37
						Lateral Displacement = (Gound Slope* + 0.2)*LDI							Total Lateral Displacement=				0.77	meters										**Total Settlement (Inches)**			14.6
						*Ground Slope assumed to be 3%											30.4	inches													

Note - Analysis based on procedure presented in Earthquake Engineering Research Institute "Soil Liquefaction During Earthquakes" I.M. Idriss, R.W. Boulanger, April 2008.

"Estimating Liquefaction-Induced Lateral Displacements Using the Standard Penetration Test or Cone Penetration Test", G.Zahng, P.K. Robertson, M.ASCE, and R.W.I. Brachman. Journal of Geotechnical and Geoenvironmental Engineering, ASCE / August 2004.

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY: SHV | DATE: 6/28/2012

JOB NUMBER: 1111191-1 | APPENDIX VI

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Input Parameters:			**R-12-038**																												
Peak ground accel (g)=			0.440	Based on a Caltran ARS online tool																											
Earthquake magnitude, M=			7.5																												
Water table depth (m)=			3																												
Ave. γ above water table (kN/m^3)=				18.5																											
Ave. γ below water table (kN/m^3)=				19.6																											
Borehole diameter (mm)=			100																												
Requires correction for sampler liners (YES/NO)					NO																										
Rod lengths assumed equal to the depth plus 1.5 m (for the above ground extension).																															

SPT sample number	Depth (m)	Measured N	Soil type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	Fines content (%)	Energy ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPa)	σ_{VC}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress reduct. Coeff, r_d	CSR	MSF for sand	K_σ for sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety	Limiting shear strain γ_{lim}	Para-meter F_α	Maximum shear strain γ_{max}	ΔH_i (m)	ΔLD_i (m)	Vertical reconsol. Strain ε_v	ΔS_i (m)
1	1.5	17	SP	Unsaturated	3	75	1.25	1	0.8	1.00	17.0	28	28	1.62	27.5	0.0	27.51	1.00	0.285	1.00	1.10	0.364	n.a.	**n.a.**	0.065	0.075	0.000	2.100	0.000	0.000	0.00
2	3.0	12	SP		3	75	1.25	1	0.85	1.00	12.8	56	56	1.32	16.8	0.0	16.78	0.98	0.283	1.00	1.07	0.172	0.184	**0.650**	0.227	0.677	0.227	1.524	0.346	0.026	0.04
3	6.1	17	SP		3	75	1.25	1	0.95	1.00	20.2	116	86	1.07	21.6	0.0	21.63	0.95	0.367	1.00	1.02	0.227	0.233	**0.634**	0.132	0.429	0.132	3.048	0.403	0.022	0.07
4	7.6	7	SP		3	75	1.25	1	0.95	1.00	8.3	146	101	1.00	8.3	0.0	8.32	0.93	0.385	1.00	1.00	0.107	0.107	**0.277**	0.500	0.941	0.500	1.524	0.762	0.041	0.06
5	9.1	7	SM		32	75	1.25	1	1	1.00	8.8	176	116	0.93	8.2	5.4	13.62	0.91	0.395	1.00	0.99	0.145	0.143	**0.362**	0.319	0.808	0.319	1.524	0.487	0.031	0.05
6	10.7	14	SM		32	75	1.25	1	1	1.00	17.5	206	131	0.90	15.7	5.4	21.12	0.89	0.400	1.00	0.96	0.220	0.212	**0.532**	0.140	0.457	0.140	1.524	0.214	0.022	0.03
7	12.2	10	SM		42	75	1.25	1	1	1.00	12.5	236	145	0.84	10.5	5.6	16.11	0.86	0.400	1.00	0.96	0.166	0.159	**0.397**	0.244	0.707	0.244	1.524	0.372	0.027	0.04
8	13.7	25	SM		42	75	1.25	1	1	1.00	31.3	266	160	0.85	26.7	5.6	32.24	0.84	0.398	1.00	0.90	0.669	0.599	**1.504**	0.034	-0.242	0.012	1.524	0.019	0.002	0.00
9	15.2	12	SM	Unreliable	41	75	1.25	1	1	1.00	15.0	295	175	0.78	11.6	5.6	17.22	0.82	0.395	1.00	0.93	0.176	?	**?**	0.216	0.657	0.000	1.524	0.000	0.000	0.00
10	16.8	33	SP		5	75	1.25	1	1	1.00	41.3	325	190	0.81	33.3	0.0	33.33	0.80	0.389	1.00	0.85	0.805	0.683	**1.753**	0.029	-0.318	0.005	1.524	0.008	0.001	0.00
11	19.8	59	GM		15	75	1.25	1	1	1.00	73.8	385	220	0.82	60.3	3.3	63.53	0.75	0.377	1.00	0.77	2.000	1.541	**2.000**	0.000	-2.727	0.000	3.048	0.000	0.000	0.00
12	23.2	59	GM		15	75	1.25	1	1	1.00	73.8	451	253	0.79	58.1	3.3	61.40	0.71	0.361	1.00	0.73	2.000	1.459	**2.000**	0.000	-2.543	0.000	3.353	0.000	0.000	0.00
																												LDI=	**2.61**		
																												Total Settlement (Meters)			0.30
LDI: LATERAL DISPLACEMENT INDEX																												**Total Settlement (Inches)**			11.7
						Lateral Displacement = (Gound Slope* + 0.2)*LDI							Total Lateral Displacement=				0.60	meters													
						*Ground Slope assumed to be 3%											23.6	inches														

Note - Analysis based on procedure presented in Earthquake Engineering Research Institute "Soil Liquefaction During Earthquakes" I.M. Idriss, R.W. Boulanger, April 2008.

"Estimating Liquefaction-Induced Lateral Displacements Using the Standard Penetration Test or Cone Penetration Test", G.Zahng, P.K. Robertson, M.ASCE, and R.W.I. Brachman. Journal of Geotechnical and Geoenvironmental Engineering, ASCE / August 2004.

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY: SHV DATE: 6/28/2012

JOB NUMBER: 1111191-1 APPENDIX VI

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Input Parameters:			**R-12-040**																												
Peak ground accel (g)=			0.440	Based on Caltran ARS online tool																											
Earthquake magnitude, M=			7.5																												
Water table depth (m)=			4.2																												
Ave. γ above water table (kN/m^3)=				17.2																											
Ave. γ below water table (kN/m^3)=				18.8																											
Borehole diameter (mm)=			100																												
Requires correction for sampler liners (YES/NO)					NO																										
Rod lengths assumed equal to the depth plus 1.5 m (for the above ground extension).																															

SPT sample number	Depth (m)	Measured N	Soil type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	Fines content (%)	Energy ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPa)	σ_{VC}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress reduct. Coeff, r_d	CSR	MSF for sand	K_σ for sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety	Limiting shear strain γ_{lim}	Para-meter F_α	Maximum shear strain γ_{max}	ΔH_i (m)	ΔLD_i (m)	Vertical reconsol. Strain ε_v	ΔS_i (m)
1	1.5	17	SP-SM	Unsaturated	6	75	1.25	1	0.8	1.00	17.0	26	26	1.65	28.1	0.0	28.12	1.00	0.285	1.00	1.10	0.388	n.a.	**n.a.**	0.060	0.036	0.000	2.100	0.000	0.000	0.00
2	3.0	13	SP-SM	Unsaturated	6	75	1.25	1	0.85	1.00	13.8	52	52	1.34	18.5	0.0	18.55	0.98	0.281	1.00	1.08	0.189	n.a.	**n.a.**	0.187	0.592	0.000	1.524	0.000	0.000	0.00
3	4.6	16	SP-SM		6	75	1.25	1	0.95	1.00	19.0	79	76	1.13	21.5	0.0	21.49	0.97	0.290	1.00	1.04	0.226	0.235	**0.811**	0.134	0.437	0.063	1.524	0.095	0.017	0.03
4	6.0	5	SM		6	75	1.25	1	0.95	1.00	5.9	107	89	1.08	6.4	0.0	6.41	0.95	0.327	1.00	1.01	0.095	0.096	**0.292**	0.500	0.948	0.500	1.474	0.737	0.047	0.07
5	7.6	12	SP-SM		6	75	1.25	1	0.95	1.00	14.3	137	103	0.99	14.1	0.0	14.15	0.93	0.352	1.00	1.00	0.149	0.149	**0.423**	0.302	0.788	0.302	1.574	0.475	0.030	0.05
6	9.1	15	SP		6	75	1.25	1	1	1.00	18.8	165	117	0.94	17.6	0.0	17.58	0.91	0.368	1.00	0.98	0.180	0.176	**0.480**	0.208	0.639	0.208	1.524	0.317	0.026	0.04
7	10.7	14	SM		15	75	1.25	1	1	1.00	17.5	194	130	0.89	15.6	3.3	18.88	0.89	0.377	1.00	0.97	0.193	0.187	**0.495**	0.180	0.576	0.180	1.524	0.275	0.024	0.04
8	12.2	17	SM		15	75	1.25	1	1	1.00	21.3	222	144	0.86	18.3	3.3	21.54	0.86	0.382	1.00	0.95	0.226	0.215	**0.563**	0.134	0.434	0.134	1.524	0.203	0.022	0.03
9	13.7	4	MH	Clay	83	75	1.25	1	1	1.00	5.0	251	158	0.89	n.a.	n.a.	n.a.	0.84	0.383	1.00	0.87	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.524	0.000	0.000	0.00
10	15.2	4	MH	Clay	83	75	1.25	1	1	1.00	5.0	280	171	0.87	n.a.	n.a.	n.a.	0.82	0.382	1.00	0.84	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.524	0.000	0.000	0.00
11	18.3	9	ML	Clay	52	75	1.25	1	1	1.00	11.3	337	199	0.84	n.a.	n.a.	n.a.	0.77	0.375	1.00	0.80	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	3.048	0.000	0.000	0.00
12	21.3	3	SC	Clay	44	75	1.25	1	1	1.00	3.8	394	226	0.81	n.a.	n.a.	n.a.	0.73	0.365	1.00	0.76	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	3.048	0.000	0.000	0.00
13	24.4	40	GM		15	75	1.25	1	1	1.00	50.0	452	254	0.77	38.5	3.3	41.77	0.69	0.354	1.00	0.73	2.000	1.457	**2.000**	0.006	-0.938	0.000	3.048	0.000	0.000	0.00
																												LDI=	**2.10**		

LDI: LATERAL DISPLACEMENT INDEX		**Total Settlement (Meters)**	0.25
		Total Settlement (Inches)	9.9

Lateral Displacement = (Gound Slope* + 0.2)*LDI — Total Lateral Displacement= 0.48 meters (19.0 inches)

*Ground Slope assumed to be 3%

Note - Analysis based on procedure presented in Earthquake Engineering Research Institute "Soil Liquefaction During Earthquakes" I.M. Idriss, R.W. Boulanger, April 2008.

"Estimating Liquefaction-Induced Lateral Displacements Using the Standard Penetration Test or Cone Penetration Test", G.Zahng, P.K. Robertson, M.ASCE, and R.W.I. Brachman. Journal of Geotechnical and Geoenvironmental Engineering, ASCE / August 2004.

SOUTHERN CALIFORNIA SOIL & TESTING

FRIARS ROAD AT STATE ROUTE 163

BY: SHV | DATE: 6/28/2012

JOB NUMBER: 1111191-1 | APPENDIX VI

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Input Parameters:			**R-12-041**																												
Peak ground accel (g)=			0.440	Based on Caltrans ARS online tool																											
Earthquake magnitude, M=			7.5																												
Water table depth (m)=			4.2672																												
Ave. γ above water table (kN/m^3)=				17.2																											
Ave. γ below water table (kN/m^3)=				18.8																											
Borehole diameter (mm)=			100																												
Requires correction for sampler liners (YES/NO)					NO																										
Rod lengths assumed equal to the depth plus 1.5 m (for the above ground extension).																															
SPT sample number	Depth (m)	Measured N	Soil type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	Fines content (%)	Energy ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPa)	σ_{VC}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress reduct. Coeff, r_d	CSR	MSF for sand	K_σ for sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety	Limiting shear strain γ_{lim}	Para-meter F_α	Maximum shear strain γ_{max}	ΔH_i (m)	ΔLD_i (m)	Vertical reconsol. Strain ε_v	ΔS_i (m)
1	1.5	9	SM	Unsaturated	25	75	1.25	1	0.8	1.00	9.0	26	26	1.70	15.3	5.1	20.37	1.00	0.285	1.00	1.10	0.210	n.a.	**n.a.**	0.153	0.498	0.000	2.100	0.000	0.000	0.00
2	3.0	8	SP-SM	Unsaturated	10	75	1.25	1	0.85	1.00	8.5	52	52	1.39	11.8	1.1	12.97	0.98	0.281	1.00	1.07	0.140	n.a.	**n.a.**	0.342	0.831	0.000	1.524	0.000	0.000	0.00
3	4.6	5	SP-SM		10	75	1.25	1	0.95	1.00	5.9	79	76	1.17	7.0	1.1	8.11	0.97	0.287	1.00	1.02	0.105	0.108	**0.376**	0.500	0.943	0.500	1.524	0.762	0.042	0.06
4	6.0	6	SP-SM		10	75	1.25	1	0.95	1.00	7.1	107	89	1.07	7.6	1.1	8.77	0.95	0.324	1.00	1.01	0.110	0.111	**0.342**	0.500	0.935	0.500	1.474	0.737	0.040	0.06
5	7.6	15	SM		22	75	1.25	1	0.95	1.00	17.8	136	104	0.99	17.6	4.7	22.35	0.93	0.350	1.00	1.00	0.238	0.238	**0.679**	0.122	0.389	0.097	1.574	0.153	0.021	0.03
6	9.1	11	SP-SM		10	75	1.25	1	1	1.00	13.8	165	117	0.93	12.8	1.1	13.92	0.91	0.366	1.00	0.98	0.147	0.145	**0.396**	0.309	0.797	0.309	1.524	0.471	0.030	0.05
7	10.7	7	SM		25	75	1.25	1	1	1.00	8.8	194	131	0.88	7.7	5.1	12.75	0.89	0.375	1.00	0.97	0.138	0.134	**0.358**	0.351	0.838	0.351	1.524	0.535	0.032	0.05
8	12.2	10	SM		25	75	1.25	1	1	1.00	12.5	222	145	0.84	10.5	5.1	15.61	0.86	0.380	1.00	0.96	0.161	0.155	**0.407**	0.258	0.729	0.258	1.524	0.393	0.028	0.04
9	13.7	2	CL	Clay	75	75	1.25	1	1	1.00	2.5	251	158	0.89	n.a.	n.a.	n.a.	0.84	0.382	1.00	0.87	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.524	0.000	0.000	0.00
10	15.2	6	SC	Clay	25	75	1.25	1	1	1.00	7.5	280	172	0.87	n.a.	n.a.	n.a.	0.82	0.381	1.00	0.84	n.a.	n.a.	**n.a.**	0.000	0.000	0.000	1.524	0.000	0.000	0.00
11	18.3	2	SM	Unreliable	39	75	1.25	1	1	1.00	2.5	337	199	0.68	1.7	5.6	7.26	0.77	0.374	1.00	0.94	0.100	?	**?**	0.500	0.947	0.000	3.048	0.000	0.000	0.00
12	21.3	48	GM		10	75	1.25	1	1	1.00	60.0	394	227	0.81	48.7	1.1	49.80	0.73	0.364	1.00	0.76	2.000	1.523	**2.000**	0.000	-1.573	0.000	3.048	0.000	0.000	0.00
13	24.4	48	GM		10	75	1.25	1	1	1.00	60.0	452	254	0.79	47.2	1.1	48.38	0.69	0.353	1.00	0.73	2.000	1.455	**2.000**	0.001	-1.458	0.000	3.048	0.000	0.000	0.00
																												LDI=	**3.05**		
																												Total Settlement (Meters)			0.29
LDI: LATERAL DISPLACEMENT INDEX																												**Total Settlement (Inches)**			11.6
						Lateral Displacement = (Gound Slope* + 0.2)*LDI							Total Lateral Displacement=				0.70	meters													
									*Ground Slope assumed to be 3%								27.6	inches													

Note - Analysis based on procedure presented in Earthquake Engineering Research Institute "Soil Liquefaction During Earthquakes" I.M. Idriss, R.W. Boulanger, April 2008.

"Estimating Liquefaction-Induced Lateral Displacements Using the Standard Penetration Test or Cone Penetration Test", G.Zahng, P.K. Robertson, M.ASCE, and R.W.I. Brachman. Journal of Geotechnical and Geoenvironmental Engineering, ASCE / August 2004.

SC & ST **SOUTHERN CALIFORNIA SOIL & TESTING**

FRIARS ROAD AT STATE ROUTE 163

BY: SHV DATE: 6/28/2012

JOB NUMBER: 1111191-1 APPENDIX VI

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Southern California Soil and Testing
San Diego, California

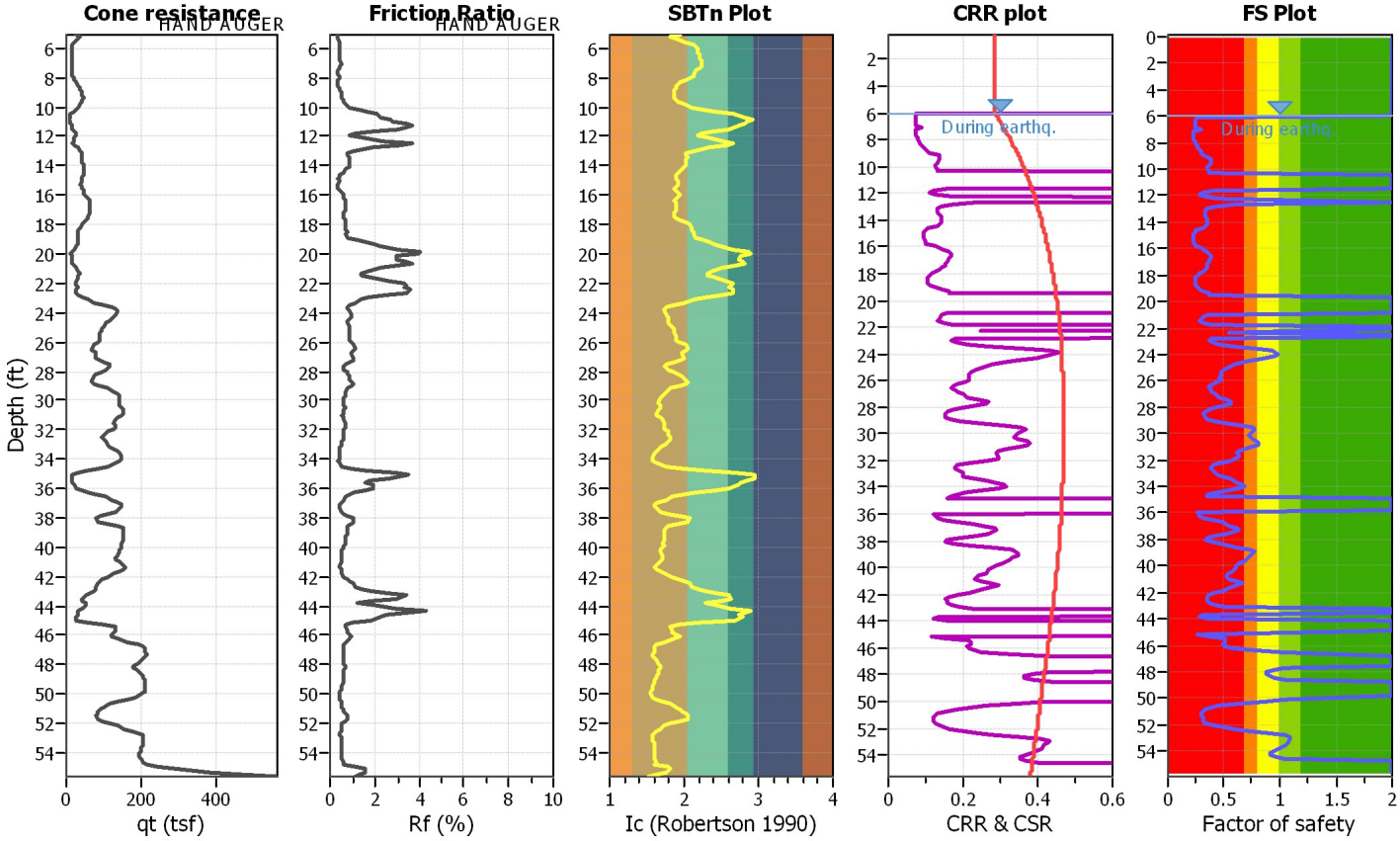
LIQUEFACTION ANALYSIS REPORT

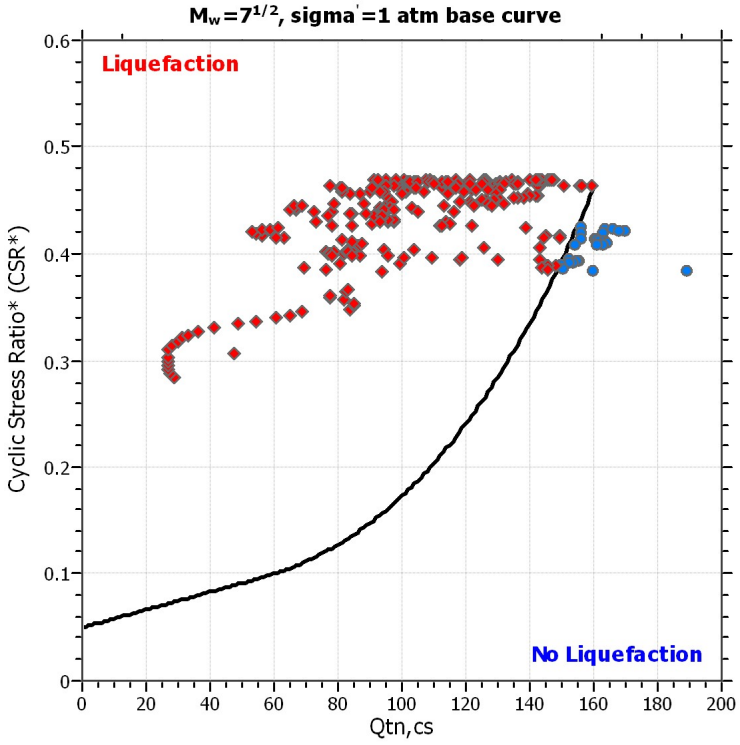
Project title : Friars Road, **Location : Bridge over San DIego River**

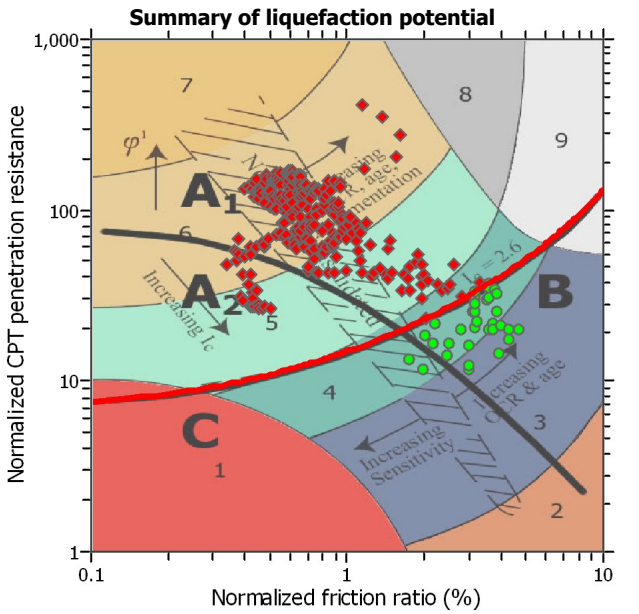
CPT file : CPT-12-001

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	No		

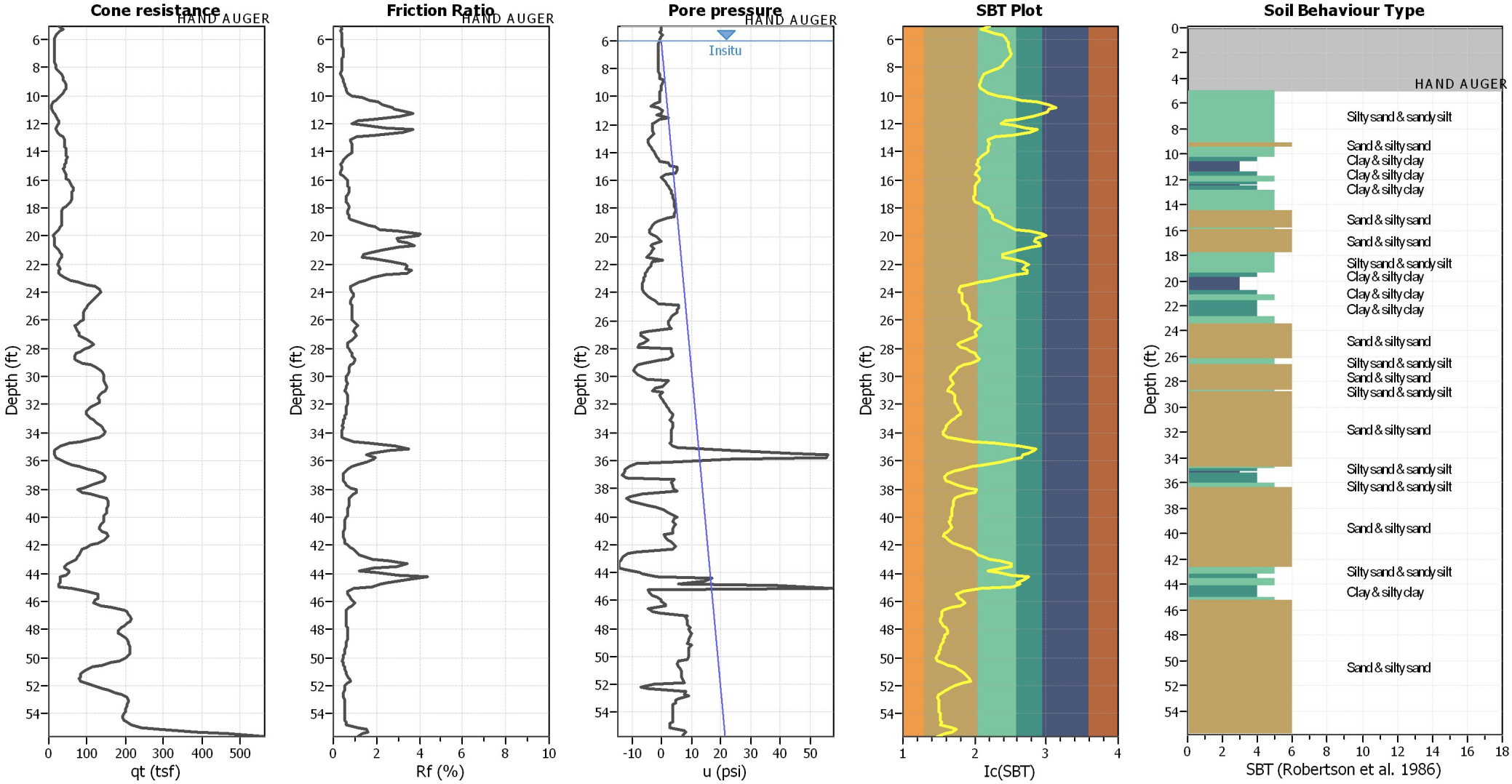






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



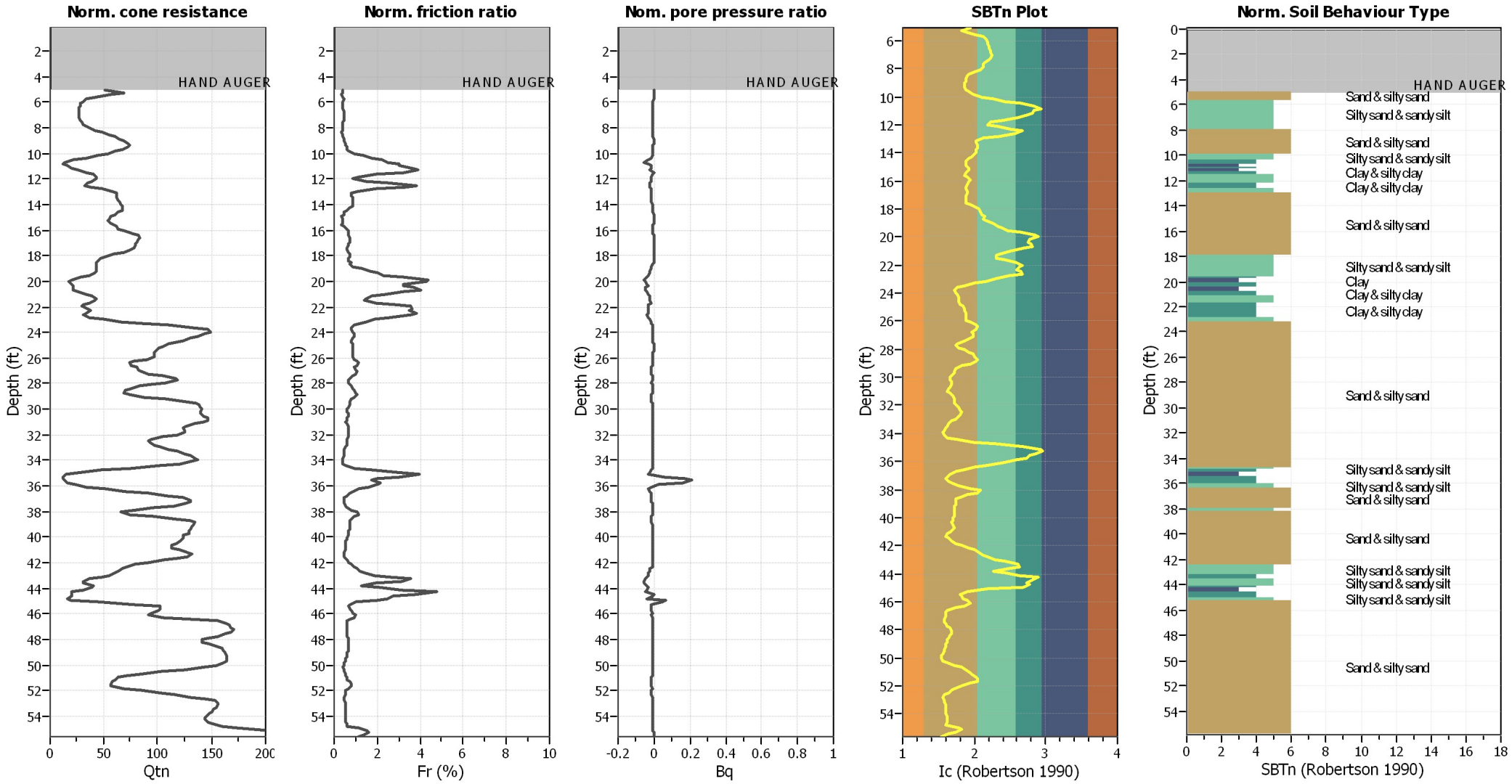
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



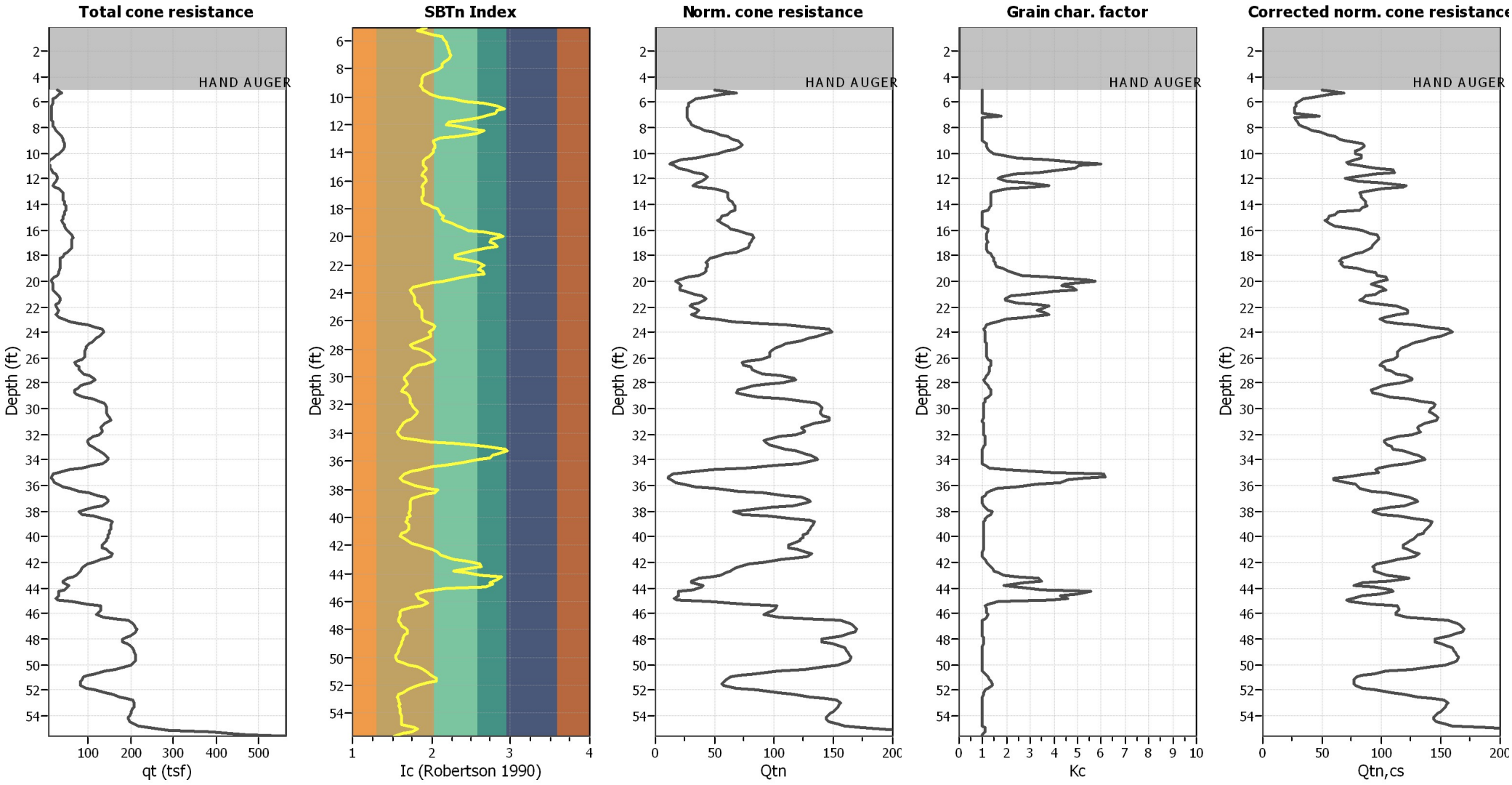
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

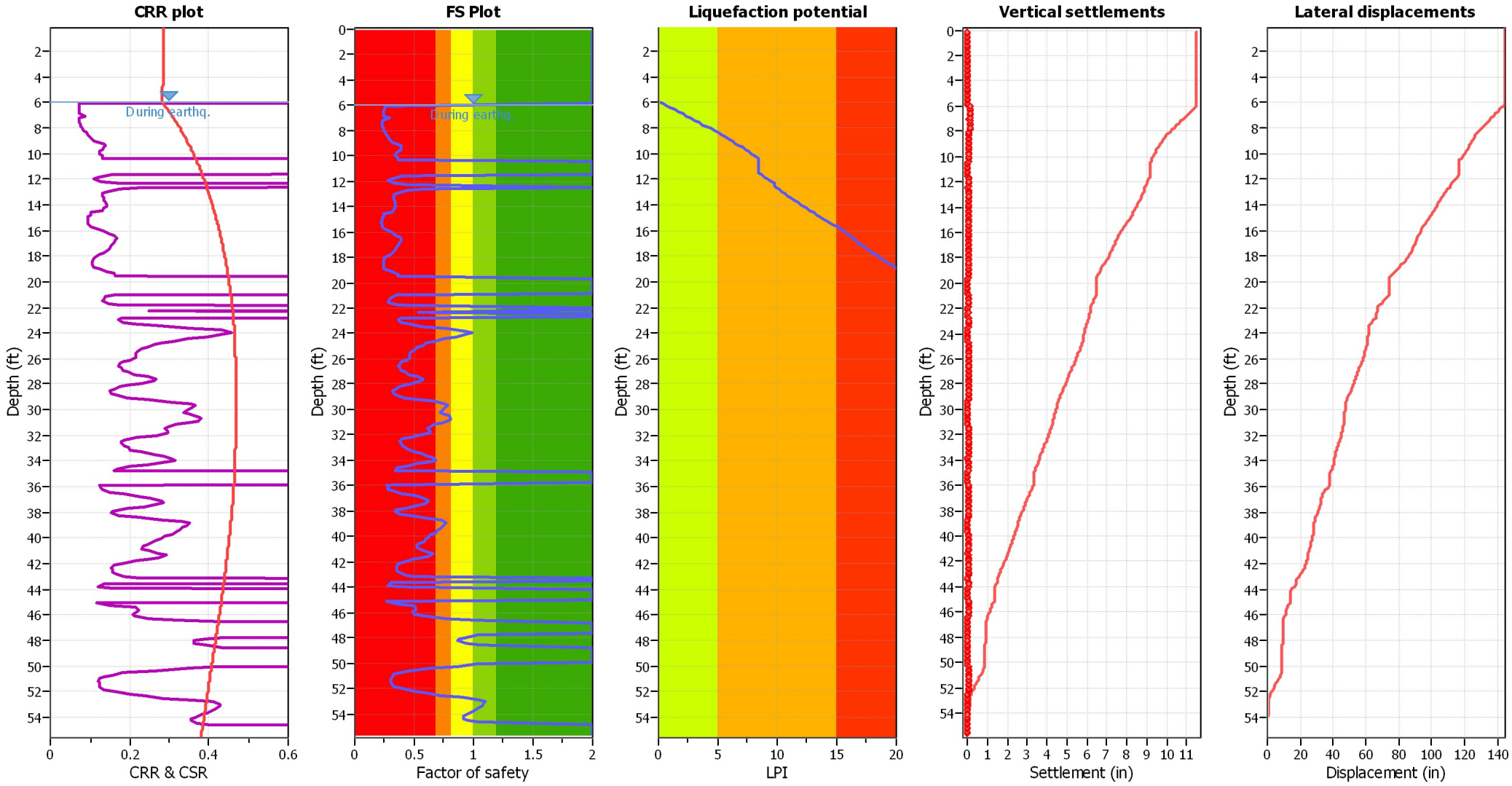
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

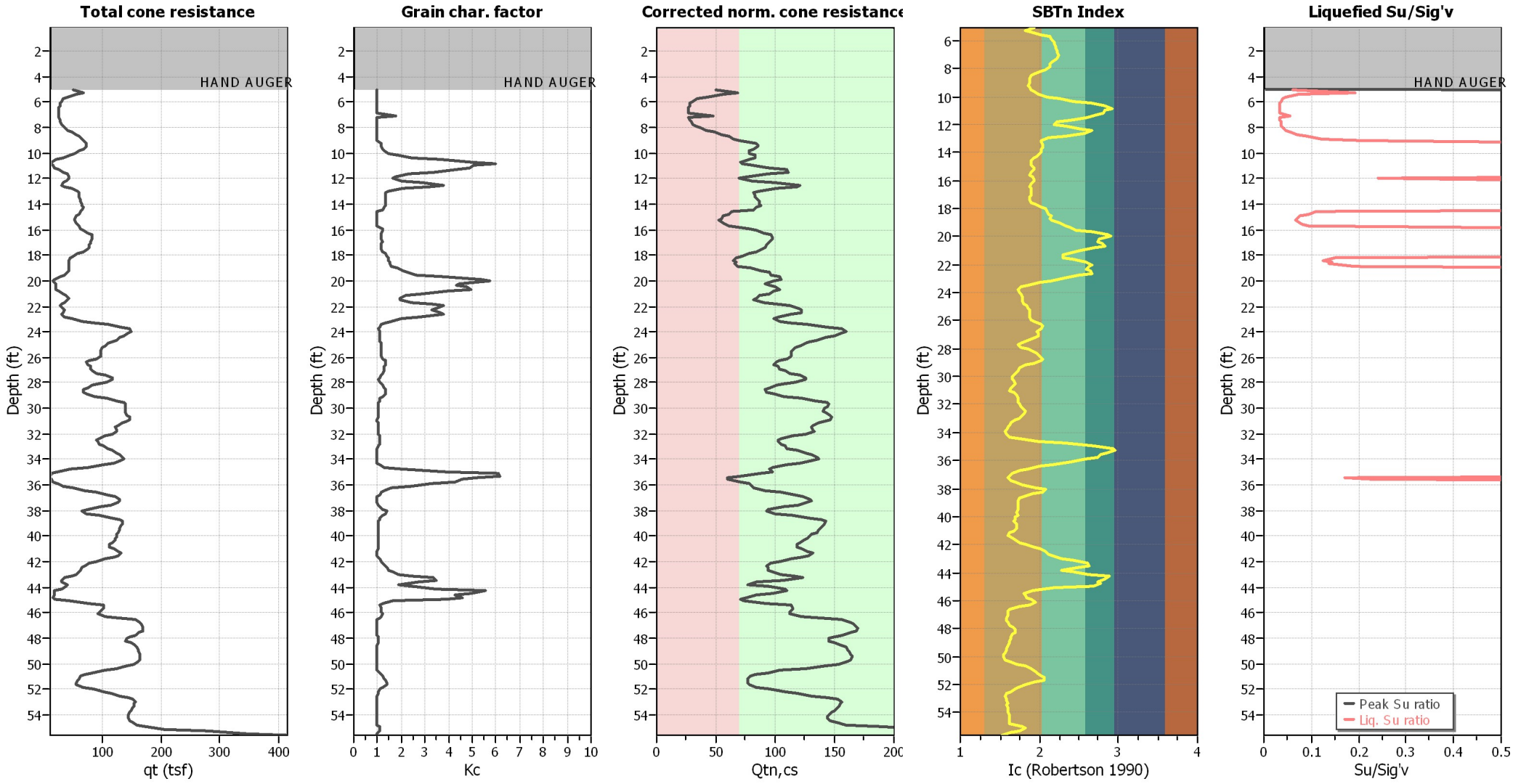
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

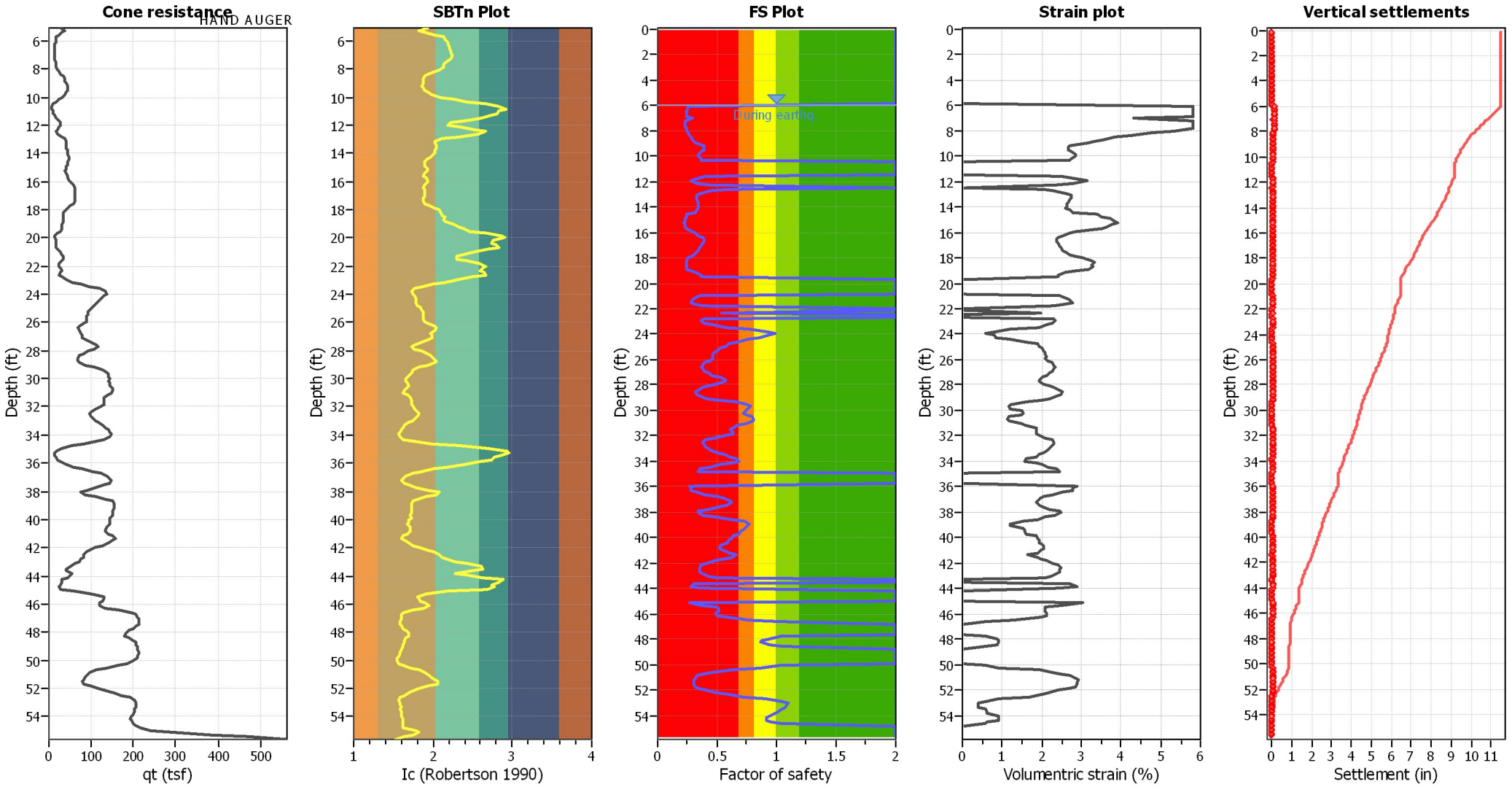
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements

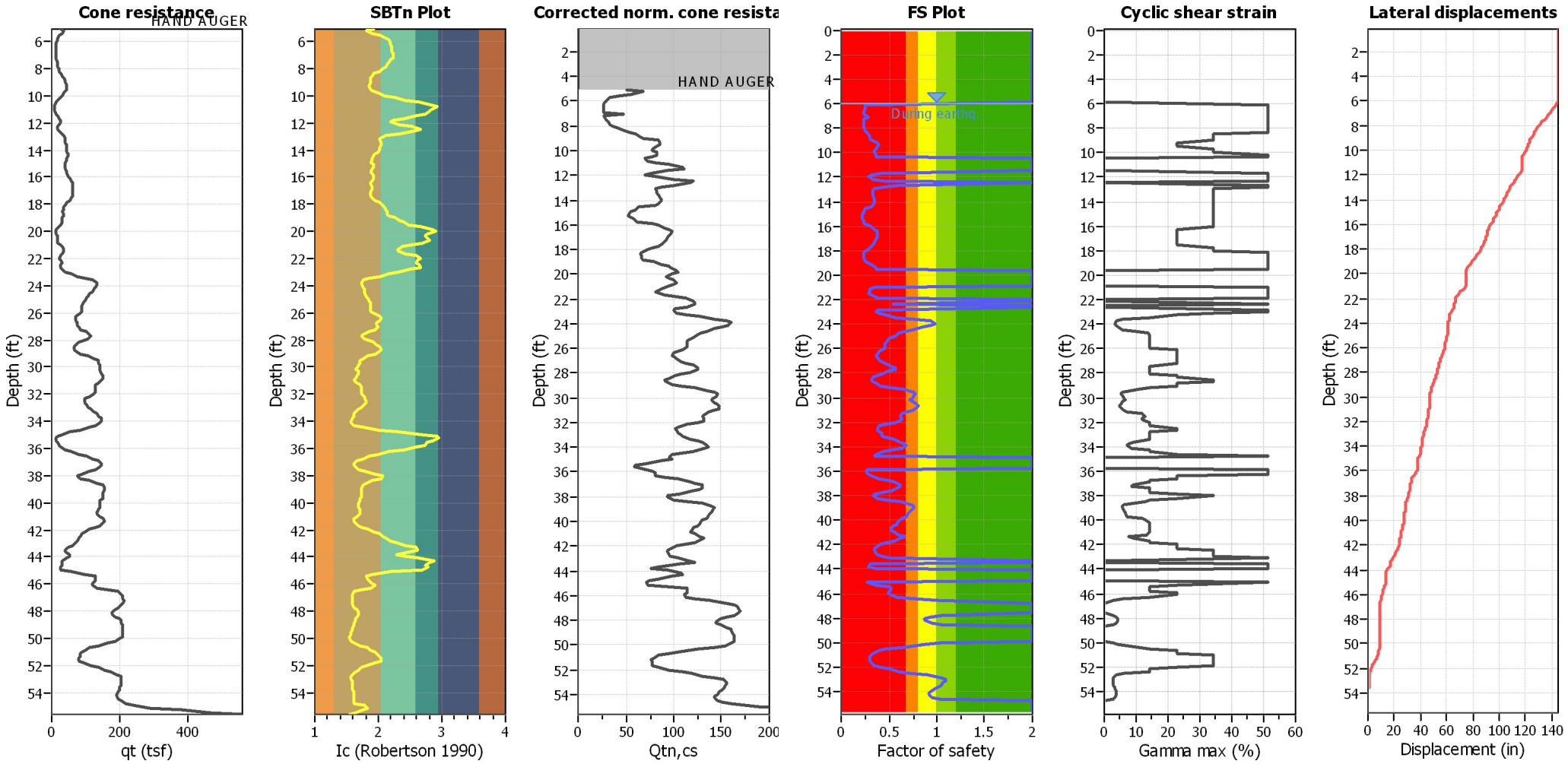


Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements

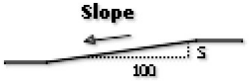
Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



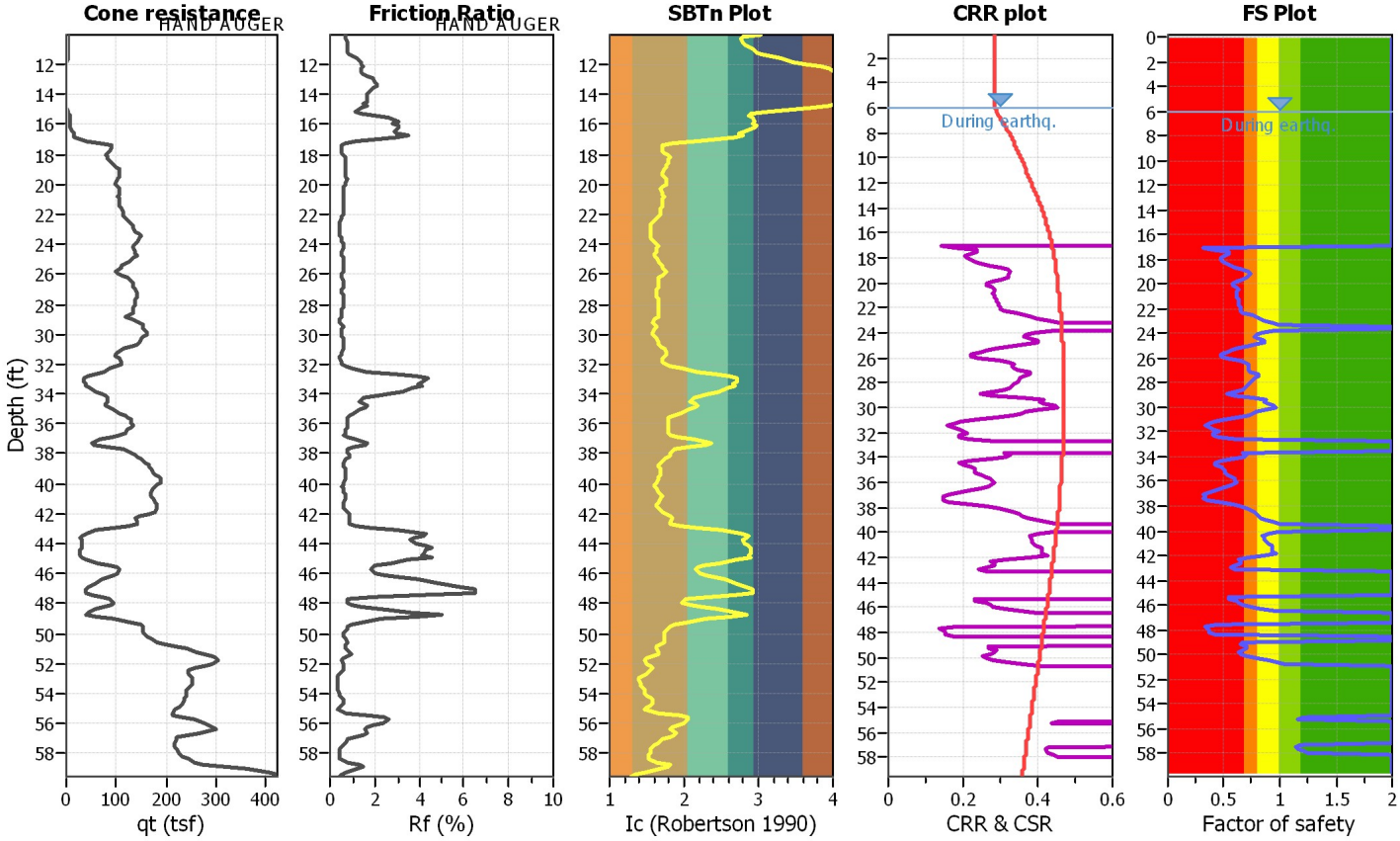
LIQUEFACTION ANALYSIS REPORT

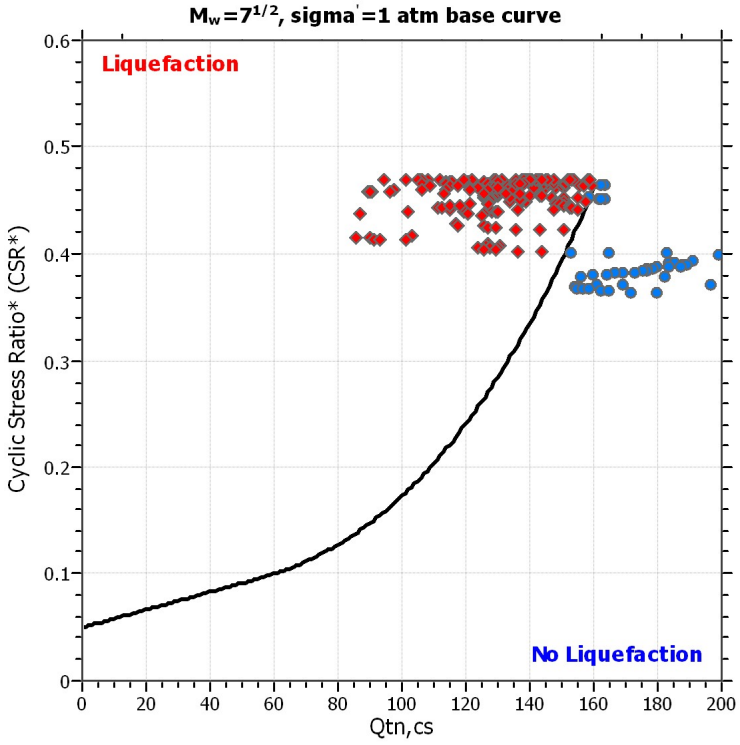
Project title : Friars Road, **Location : Bridge over San DIego River**

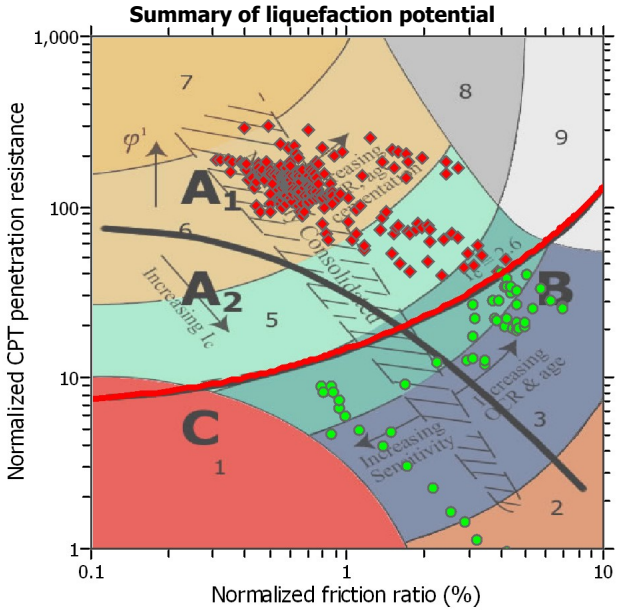
CPT file : CPT-12-002

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	No		

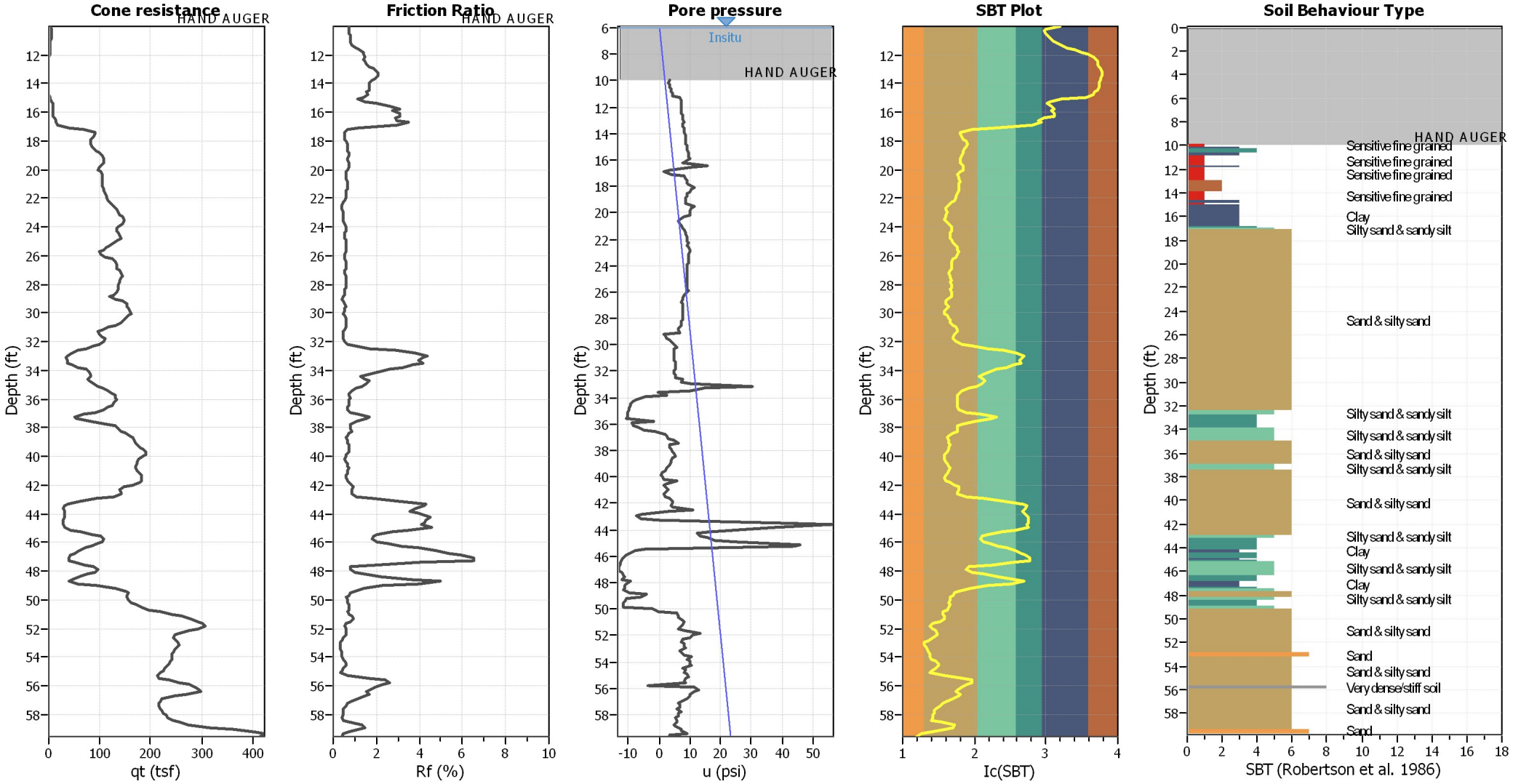






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



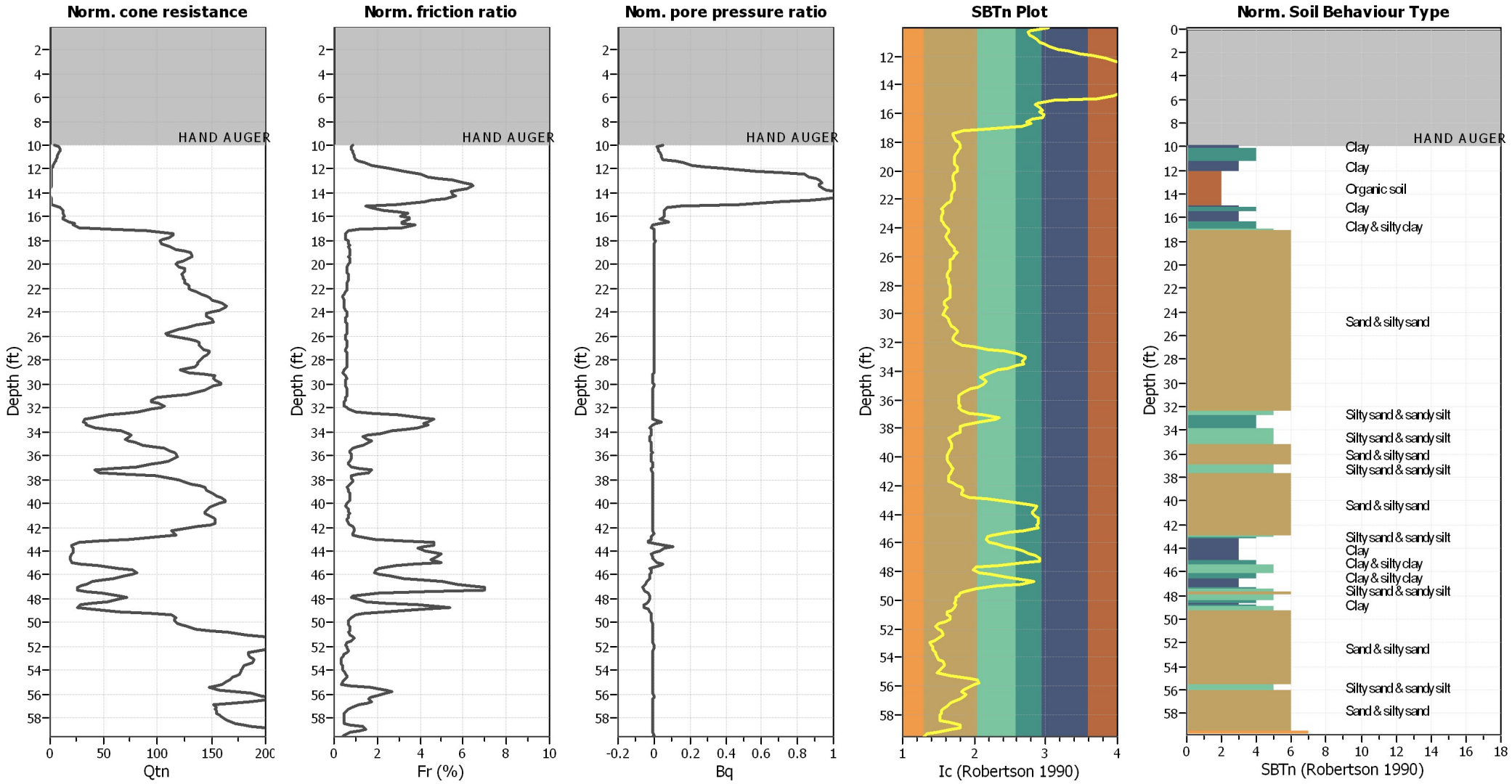
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



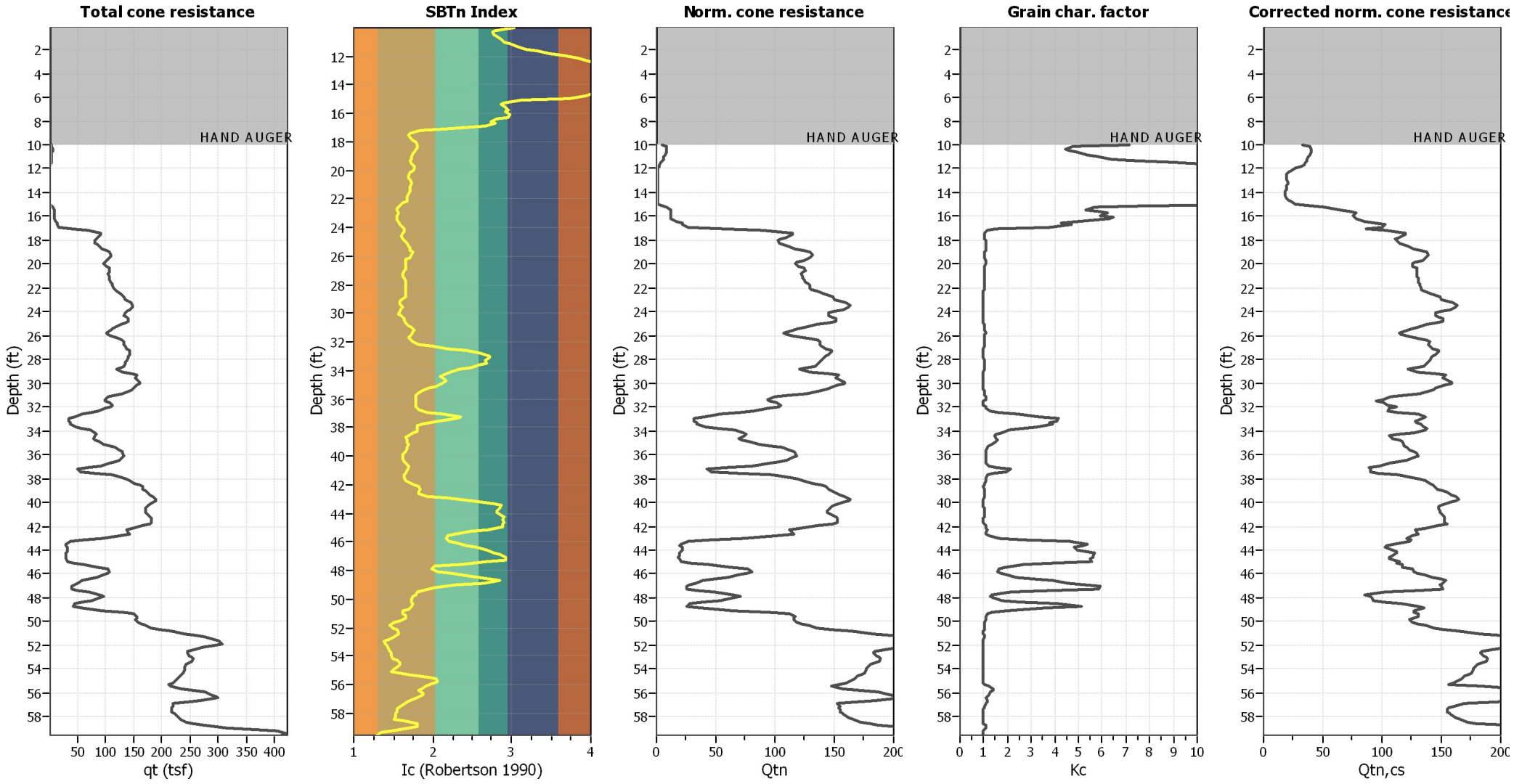
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

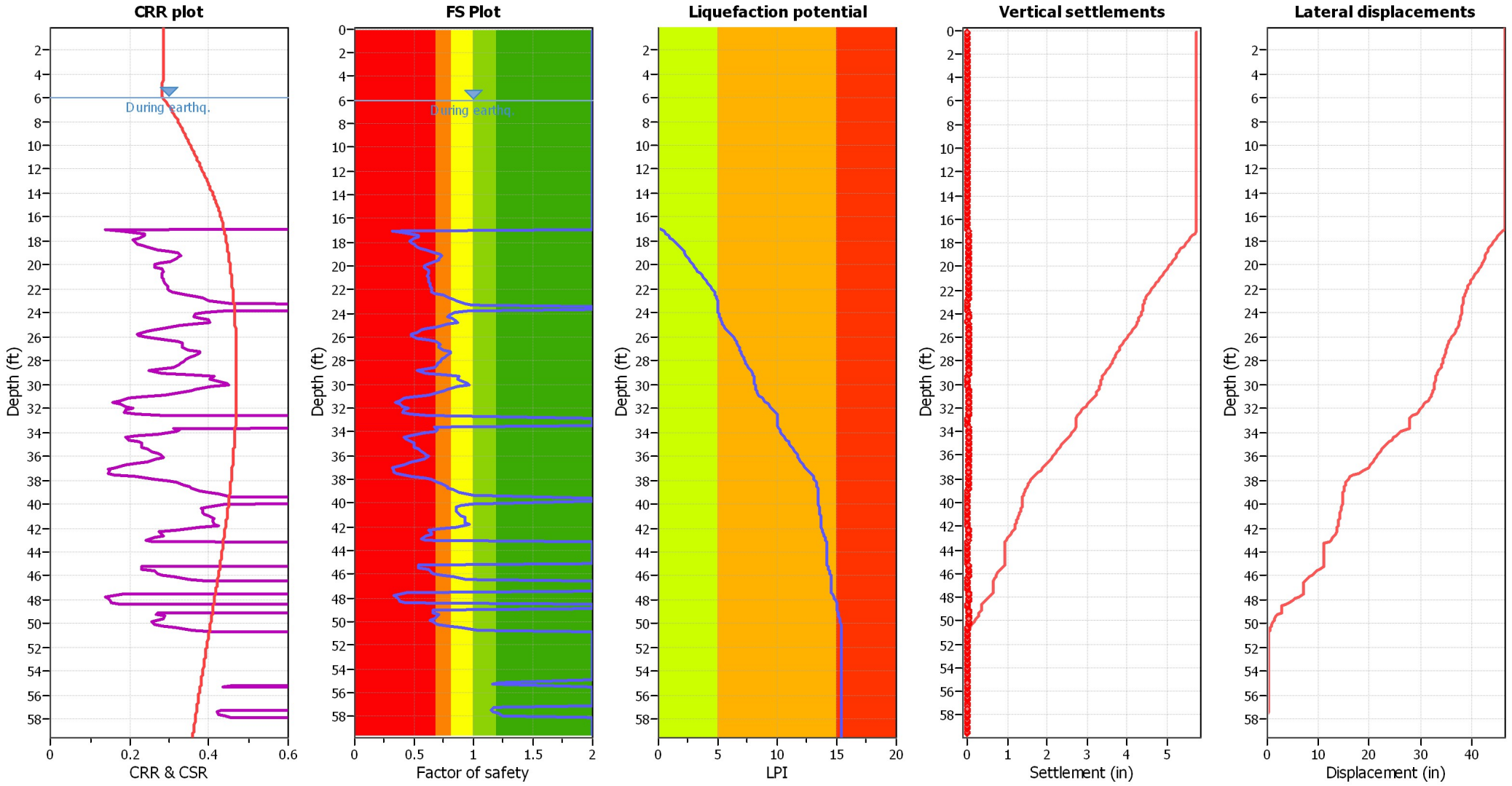
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

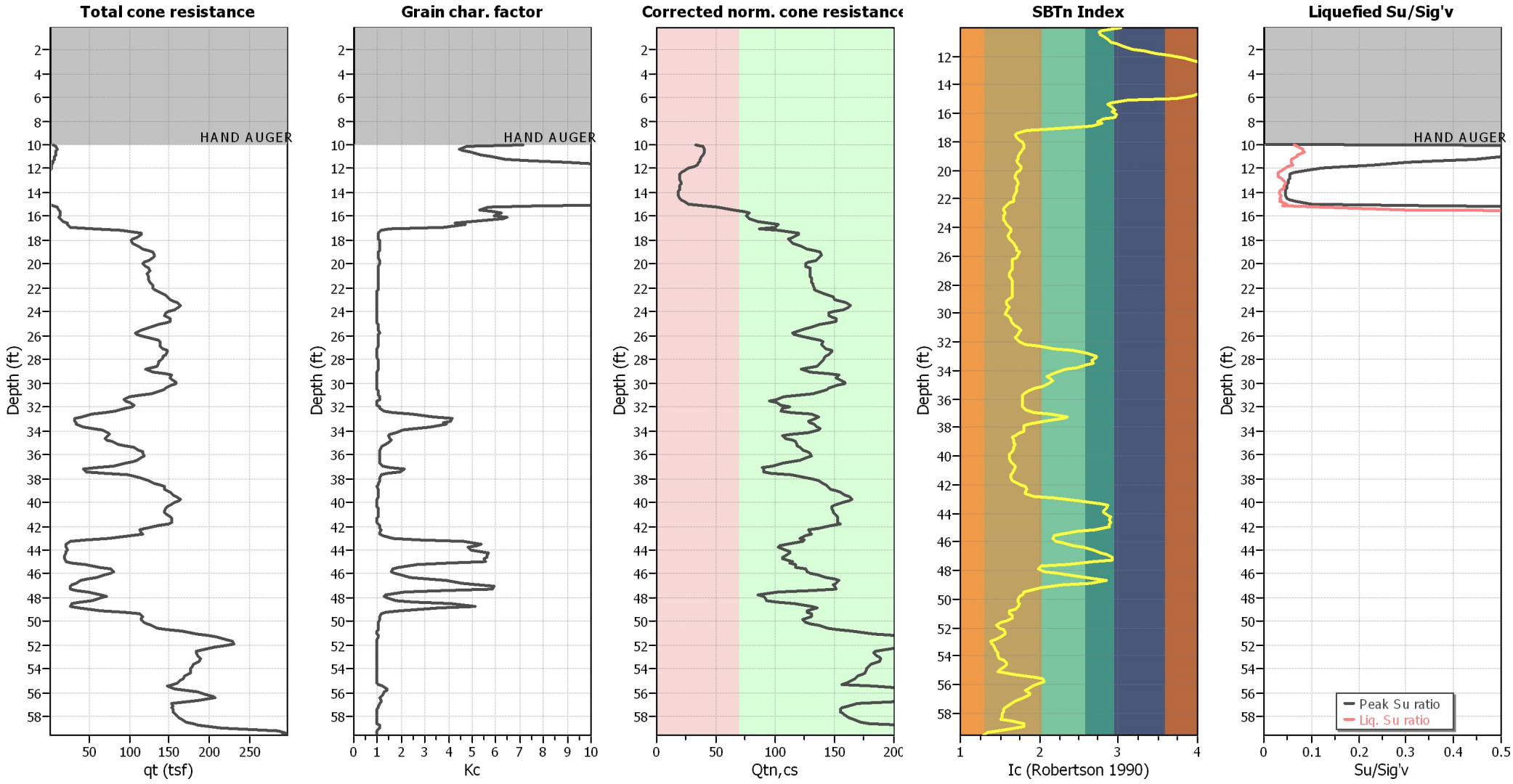
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

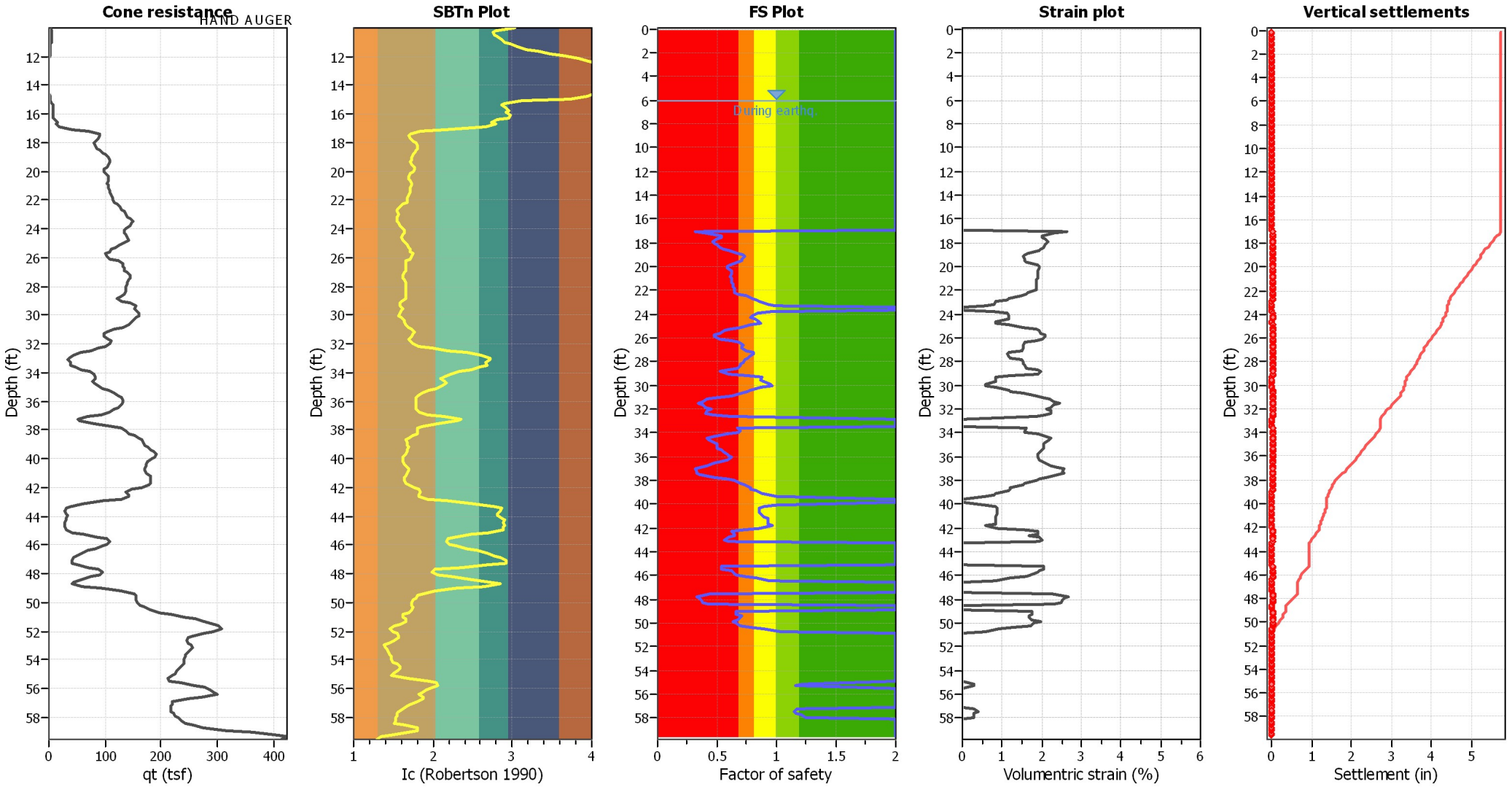
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements

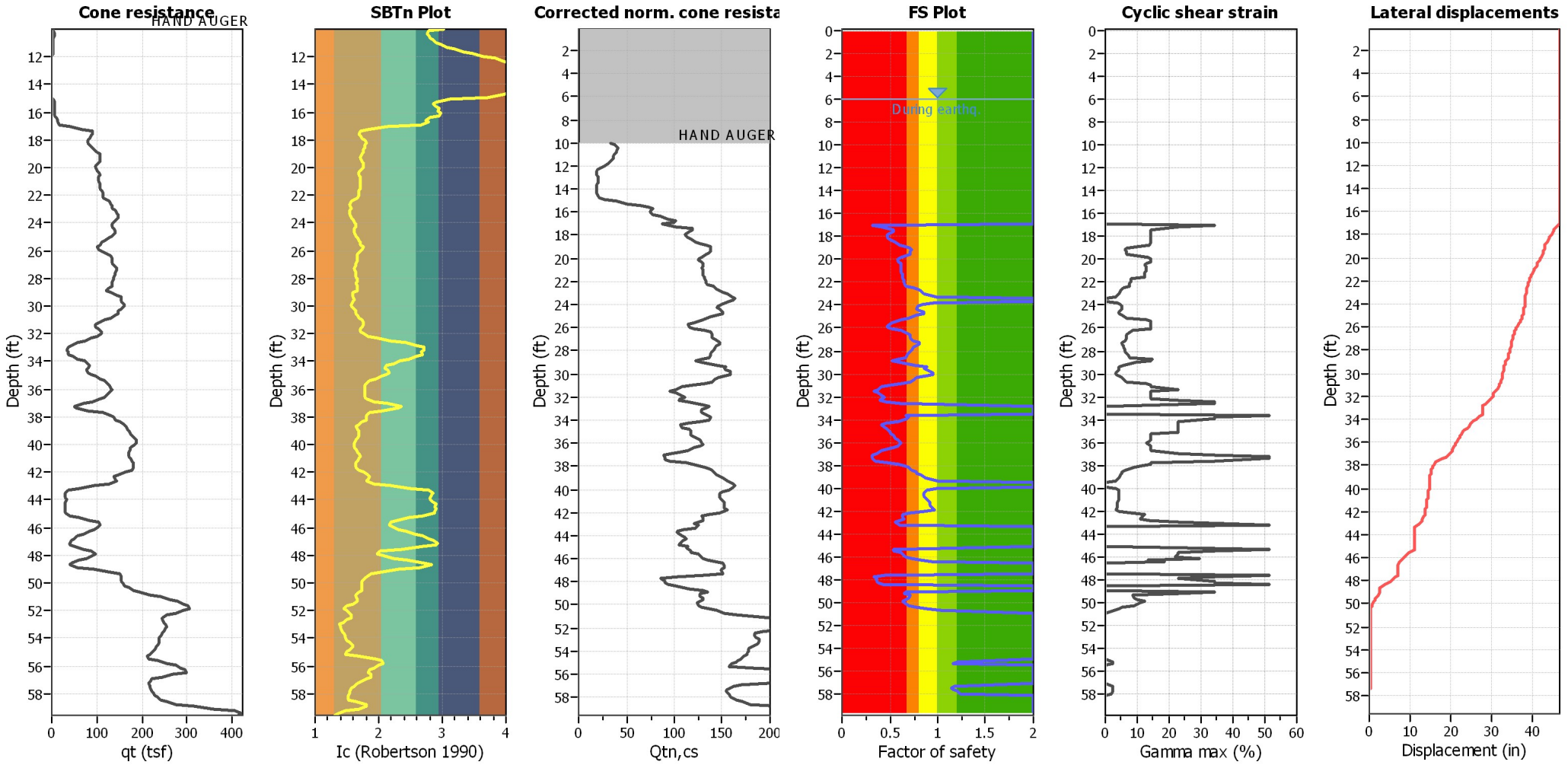


Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements

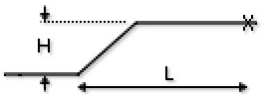
Geometric parameters: Level ground (or gently sloping) with free face (L: 49.00 ft - H: 5.00 ft)



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



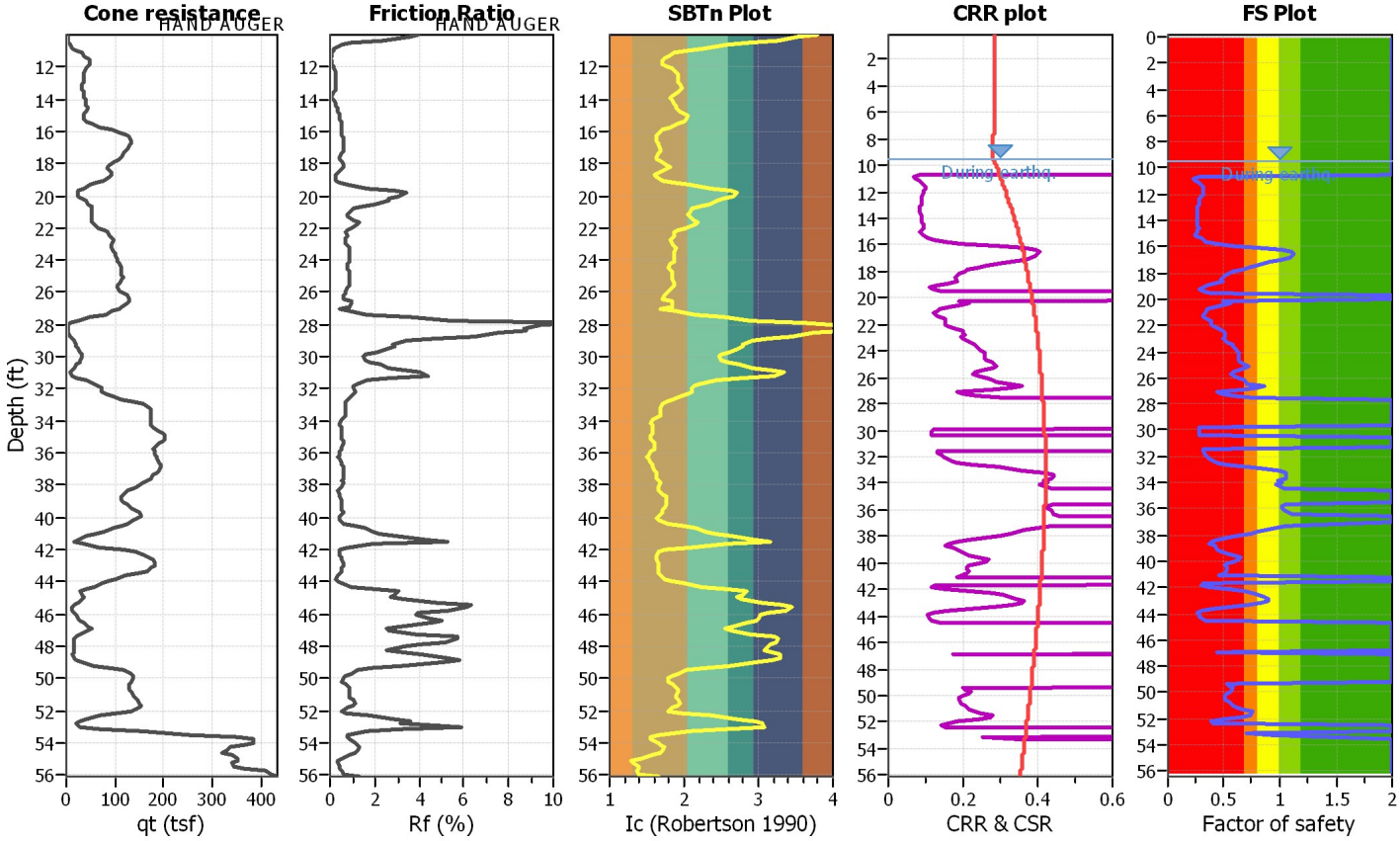
LIQUEFACTION ANALYSIS REPORT

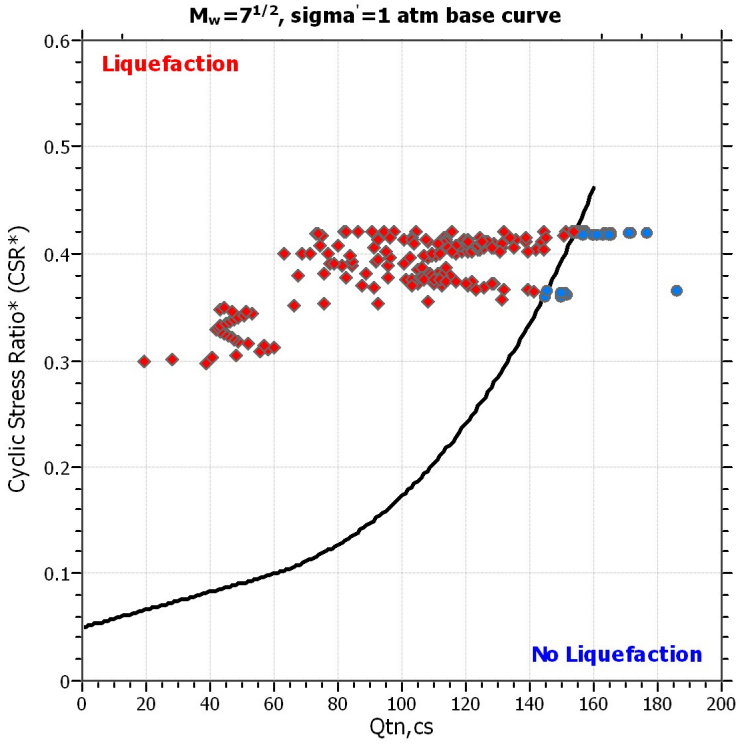
Project title : Friars Road, **Location : Bridge over San DIego River**

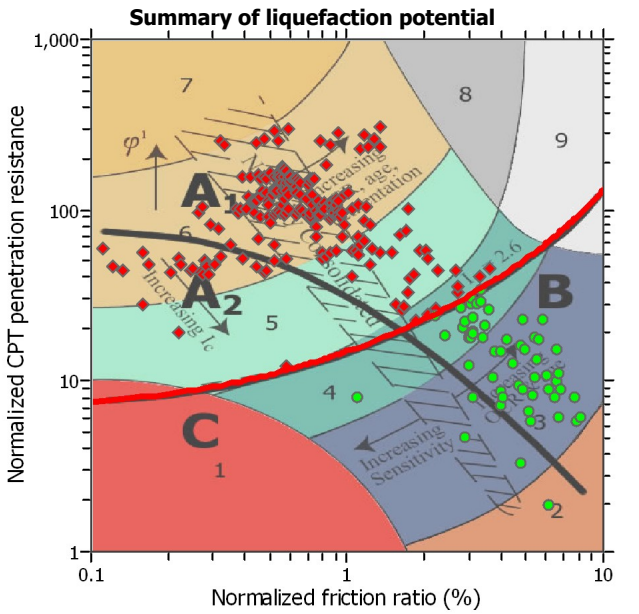
CPT file : CPT-12-003

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	9.50 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	No		

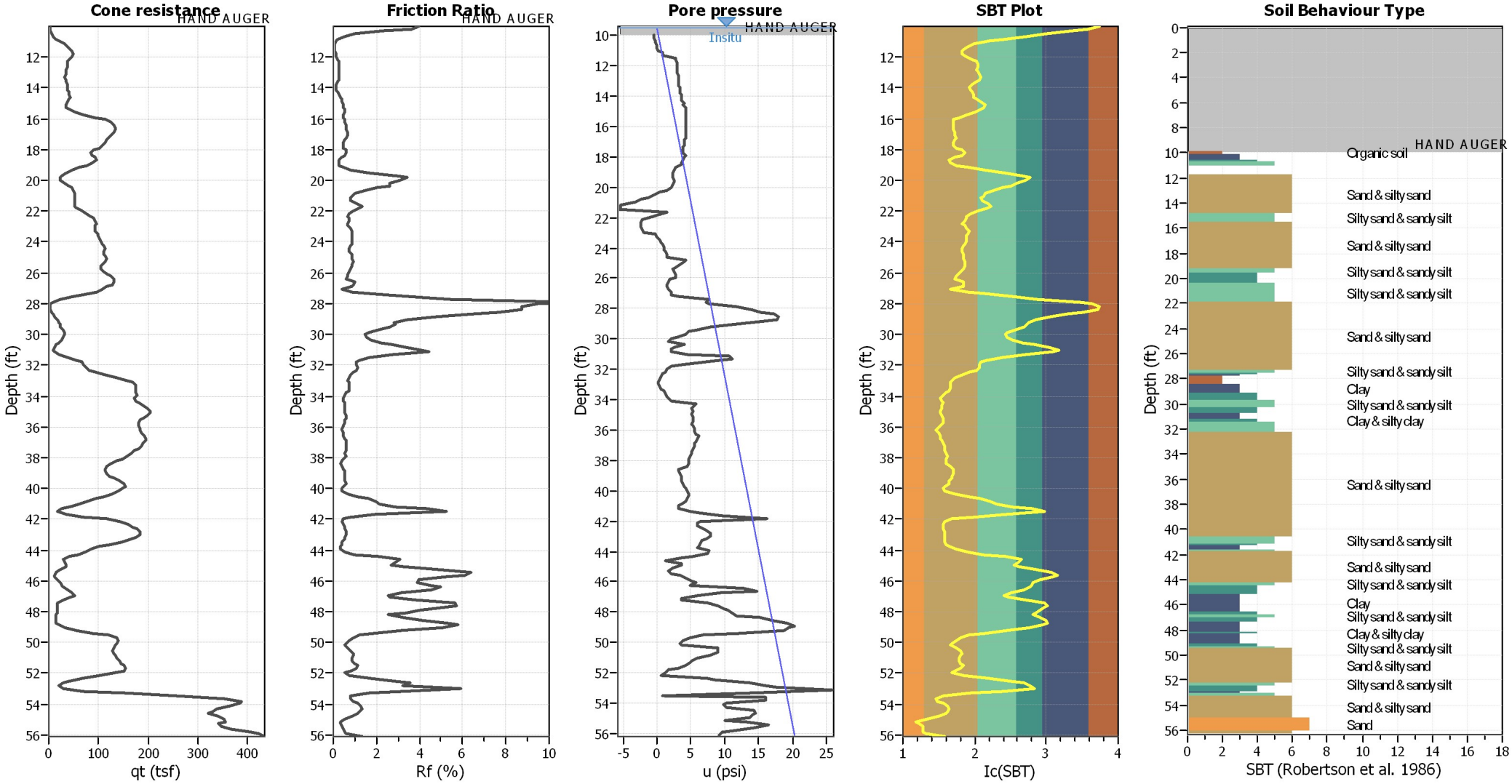






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



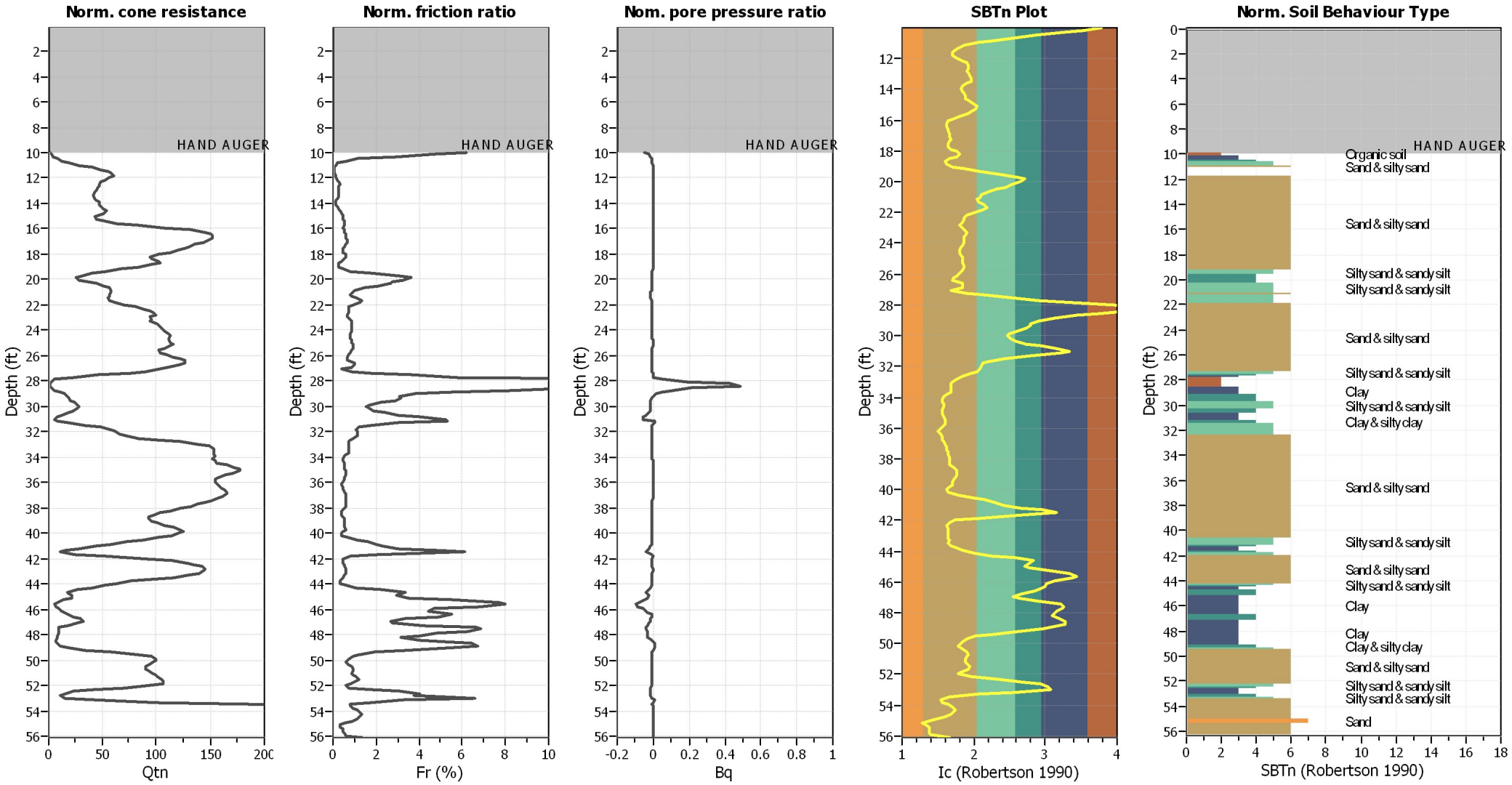
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



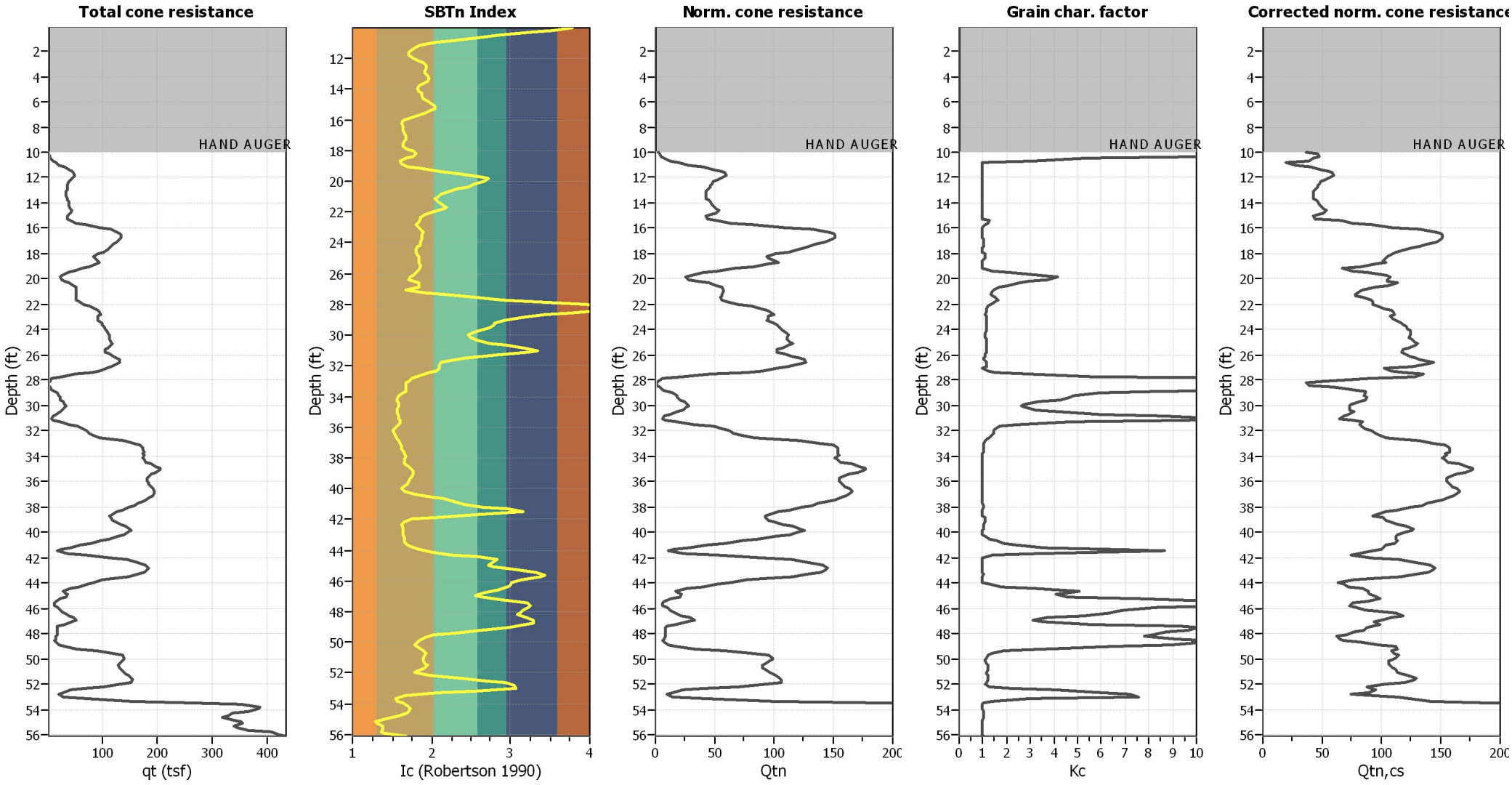
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

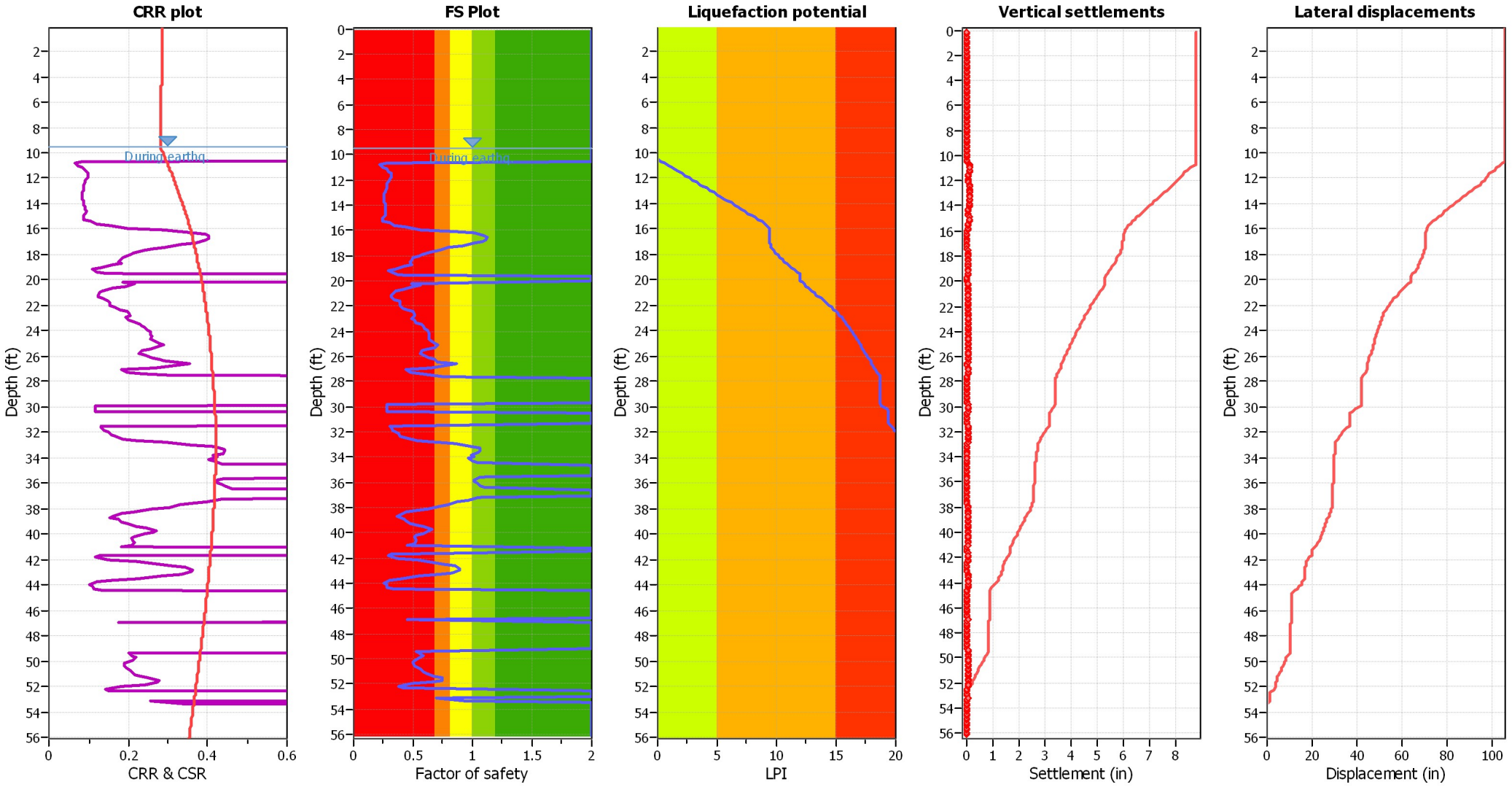
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

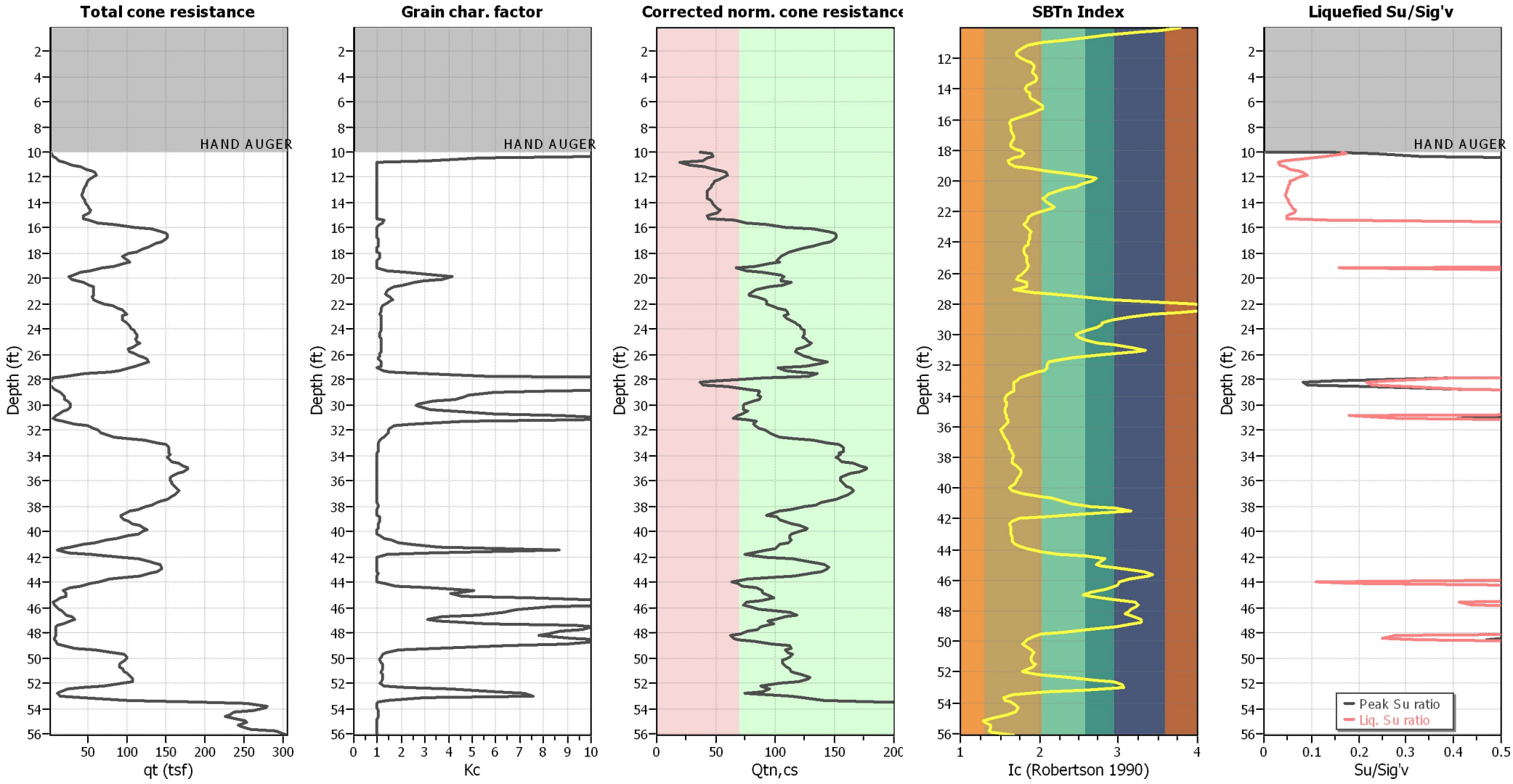
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

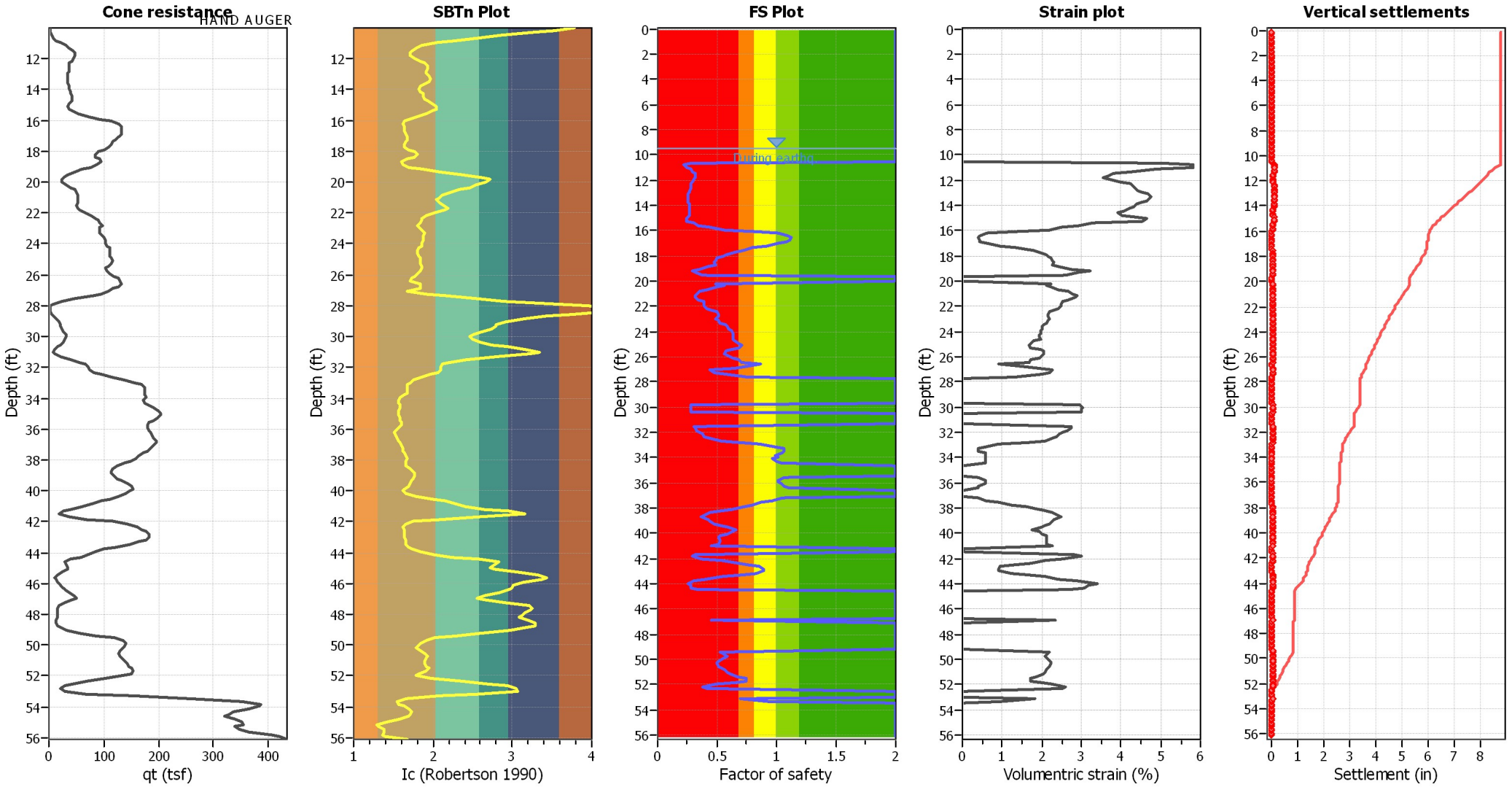
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements

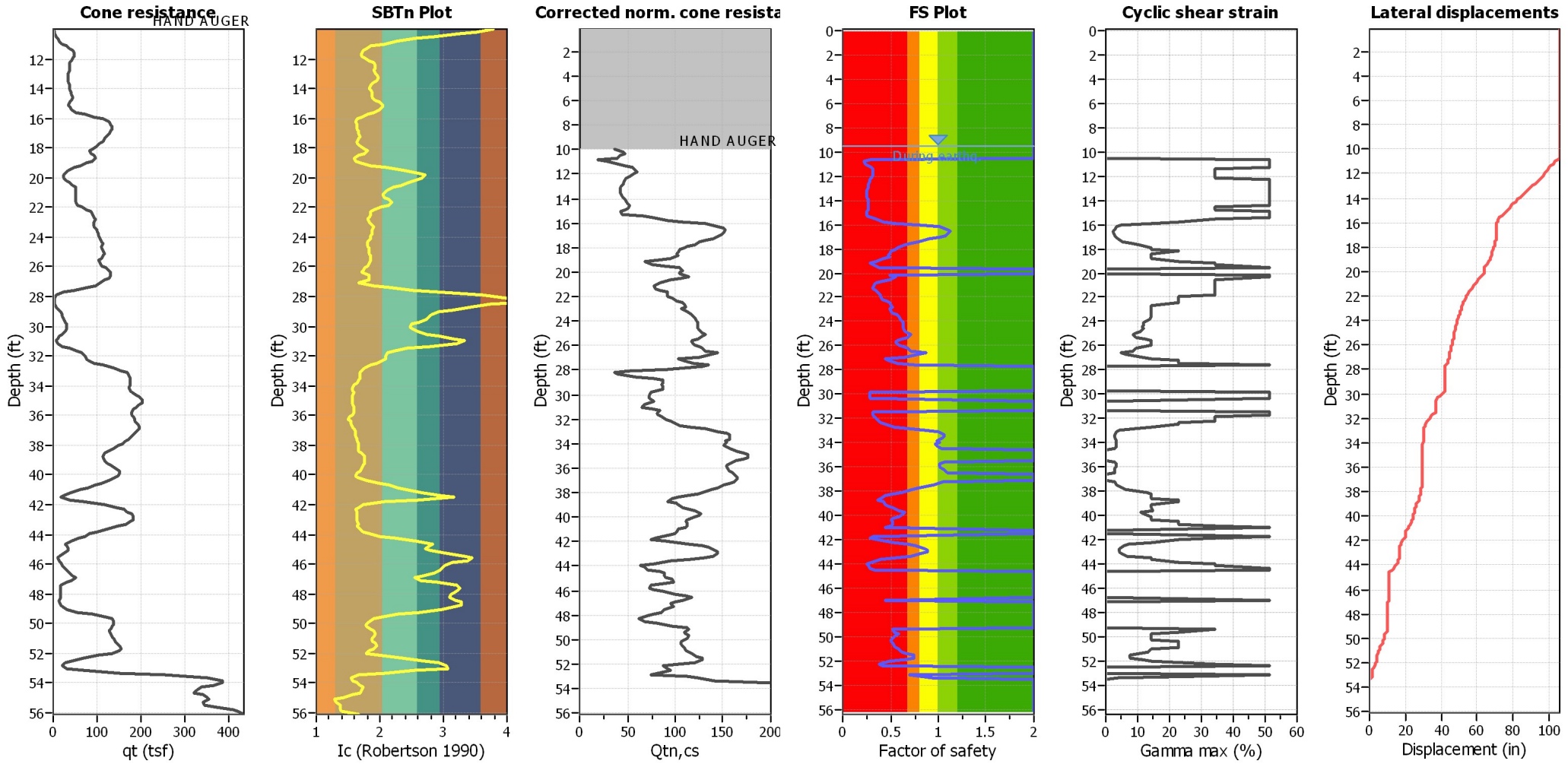


Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements

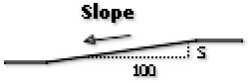
Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



Southern California Soil and Testing
San Diego, California

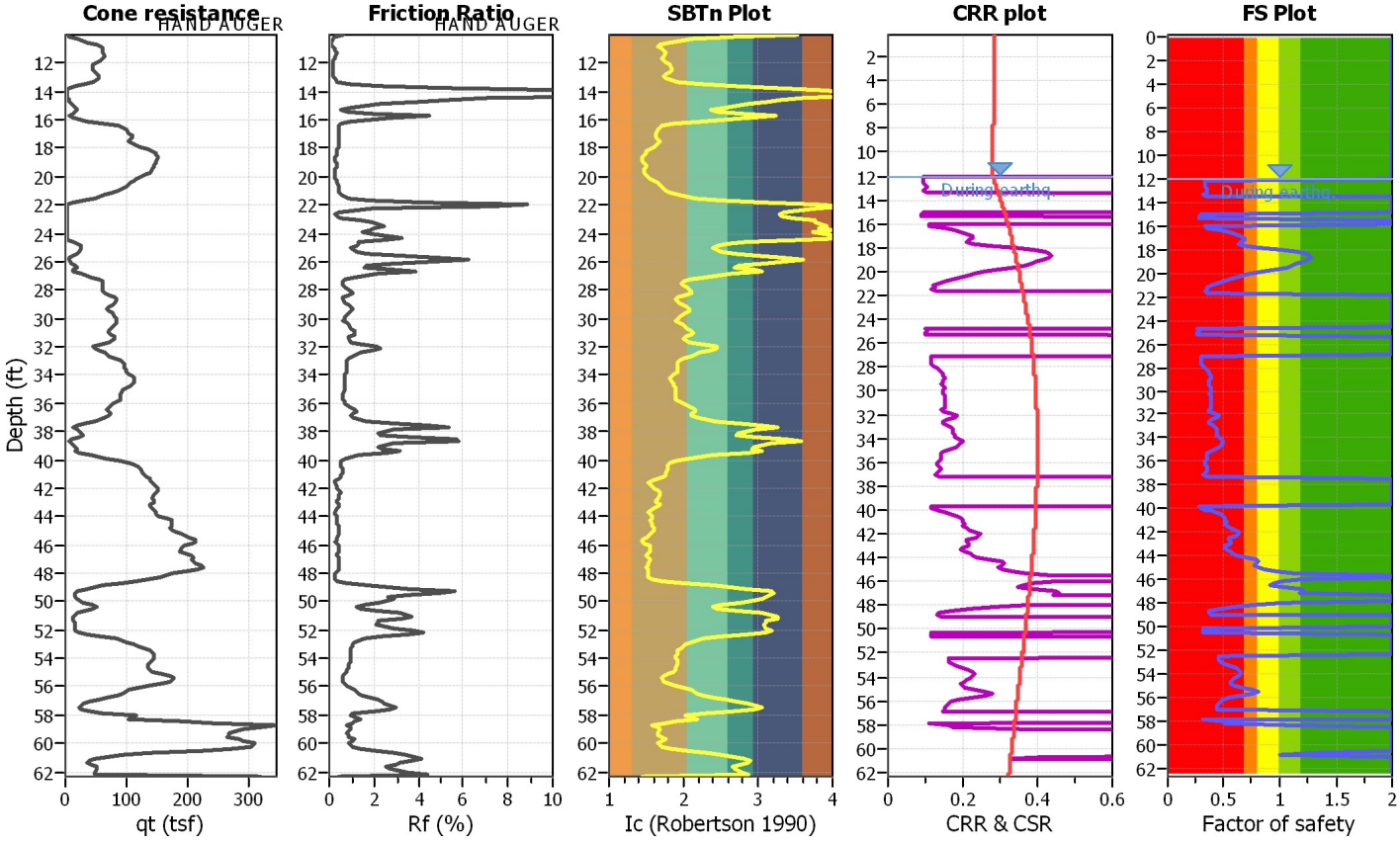
LIQUEFACTION ANALYSIS REPORT

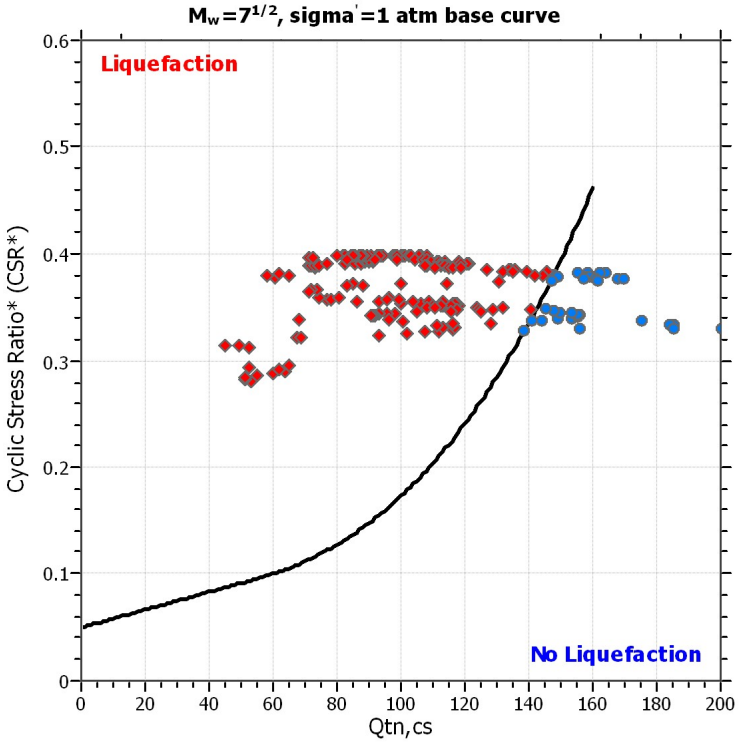
Project title : Friars Road, **Location : Bridge over San DIego River**

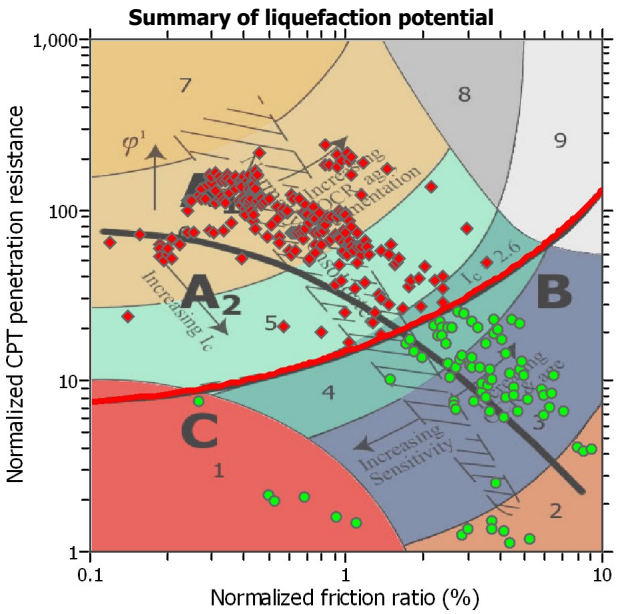
CPT file : CPT-12-004

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	No		

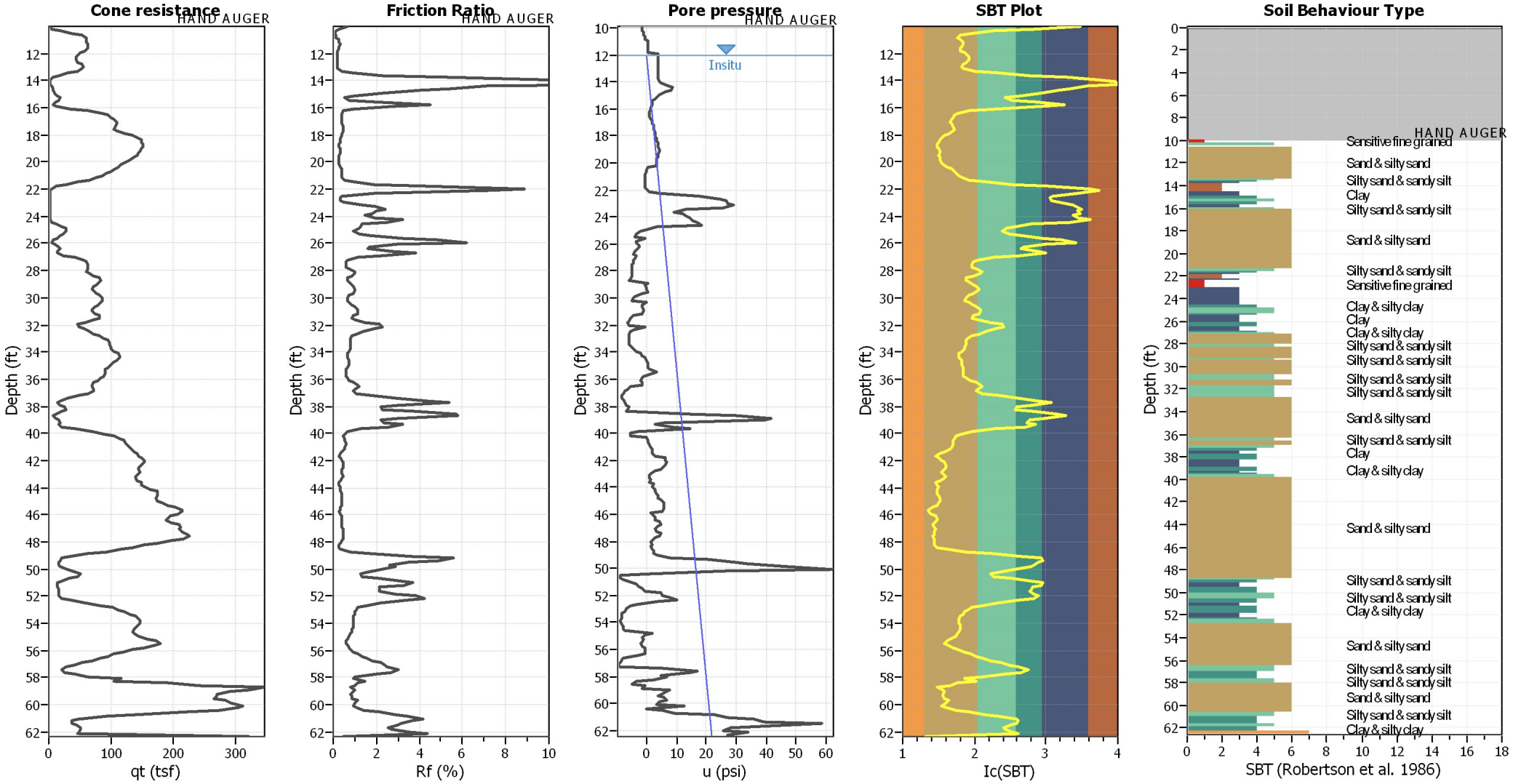






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



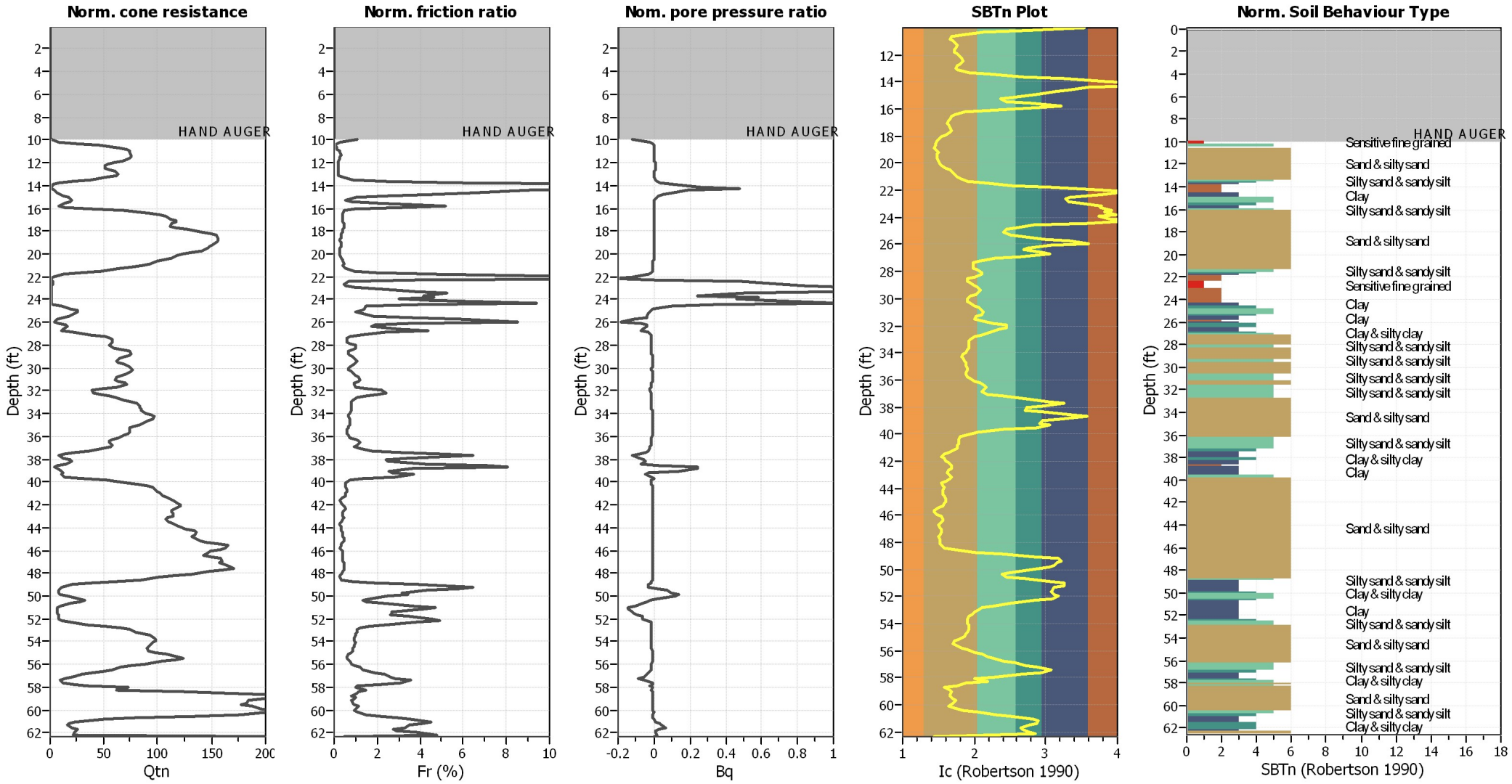
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



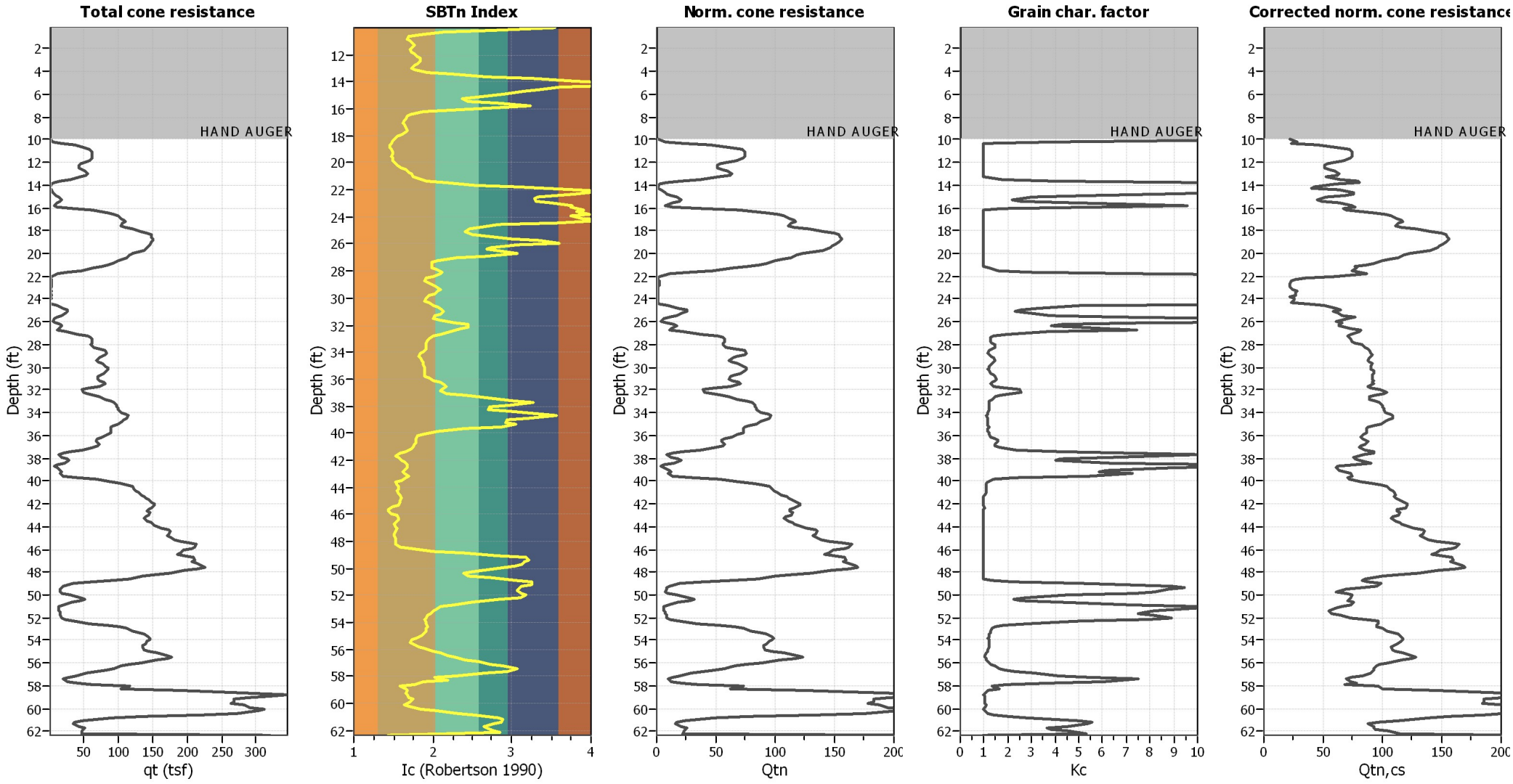
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

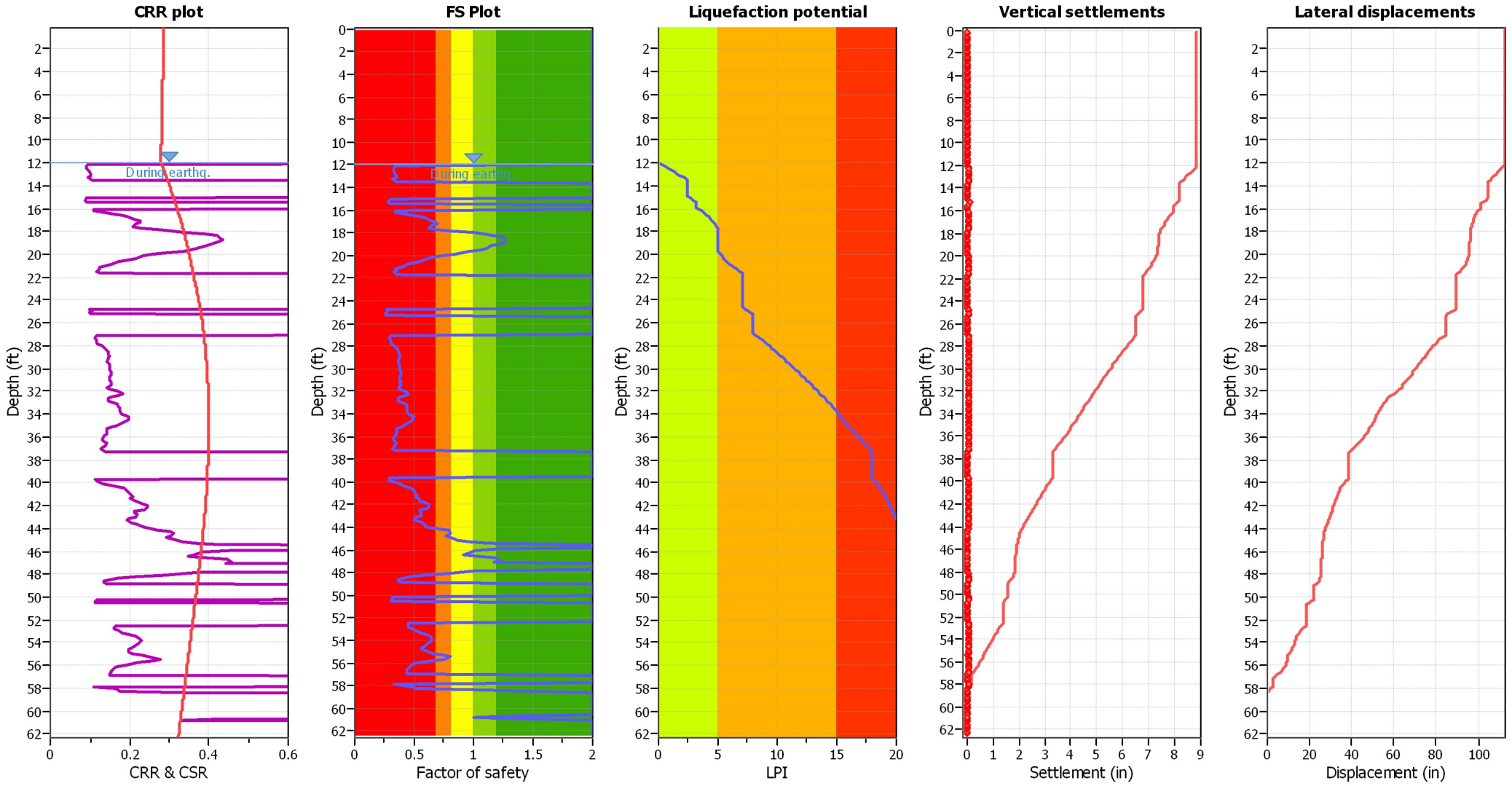
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

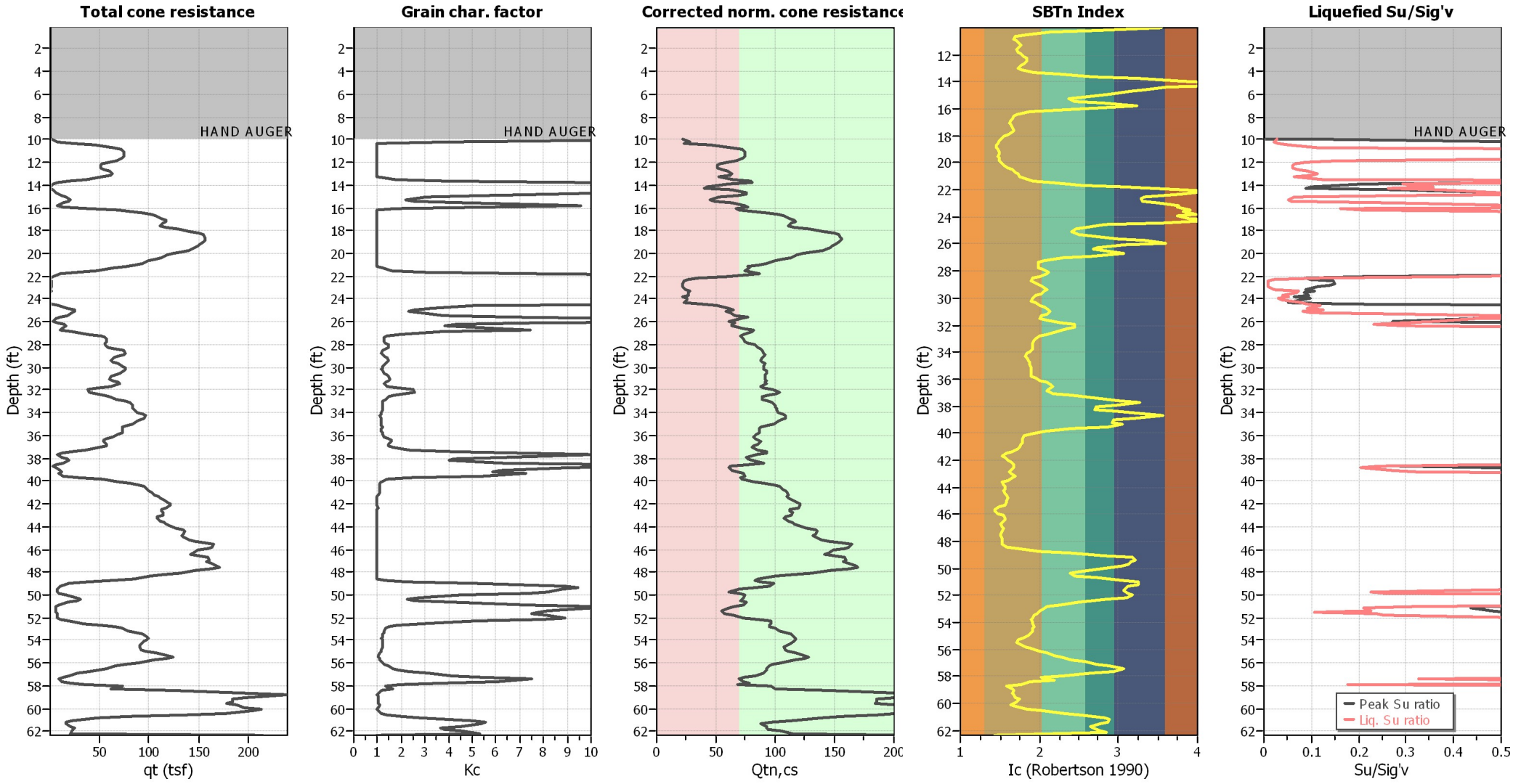
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

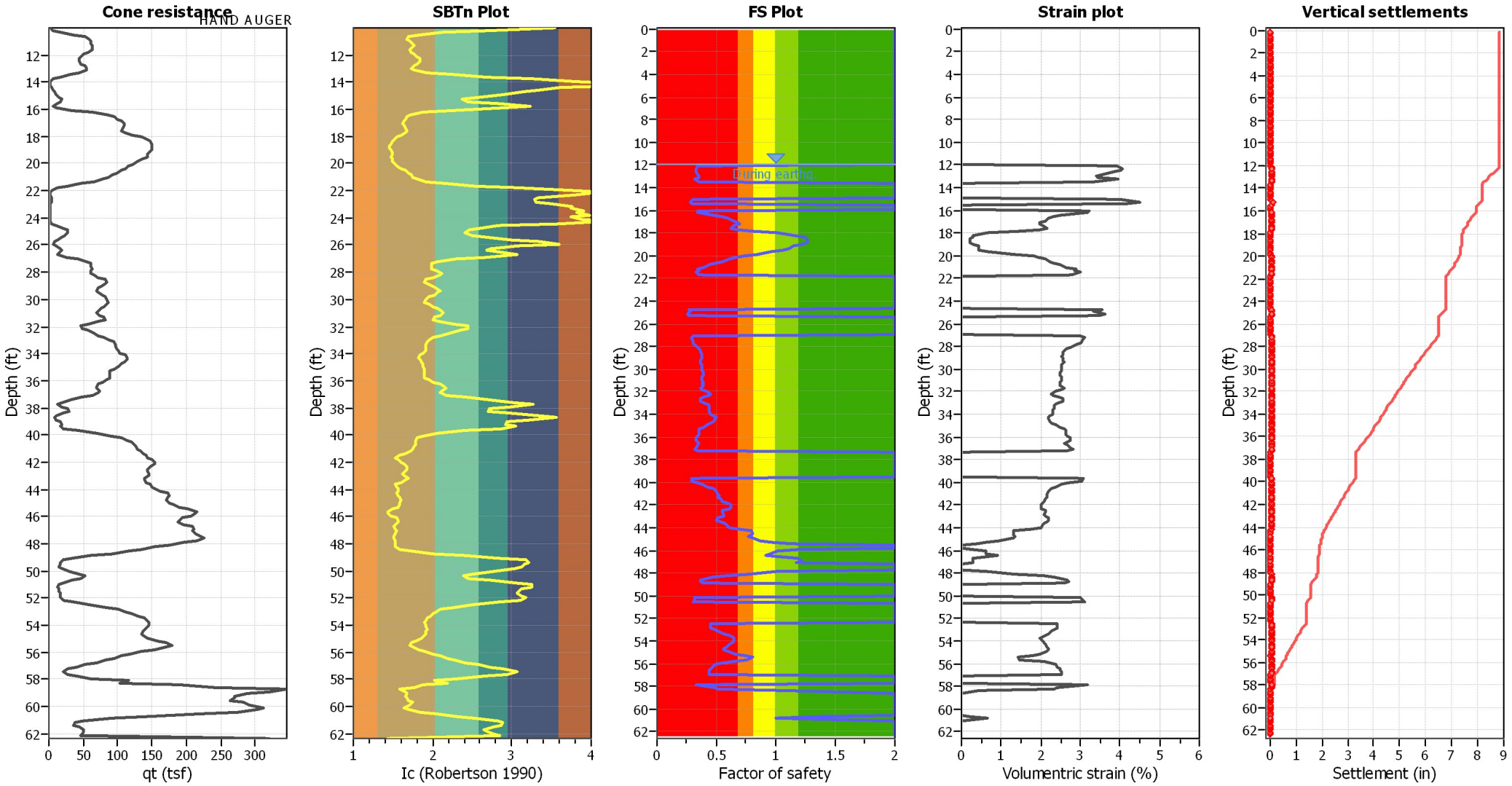
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements

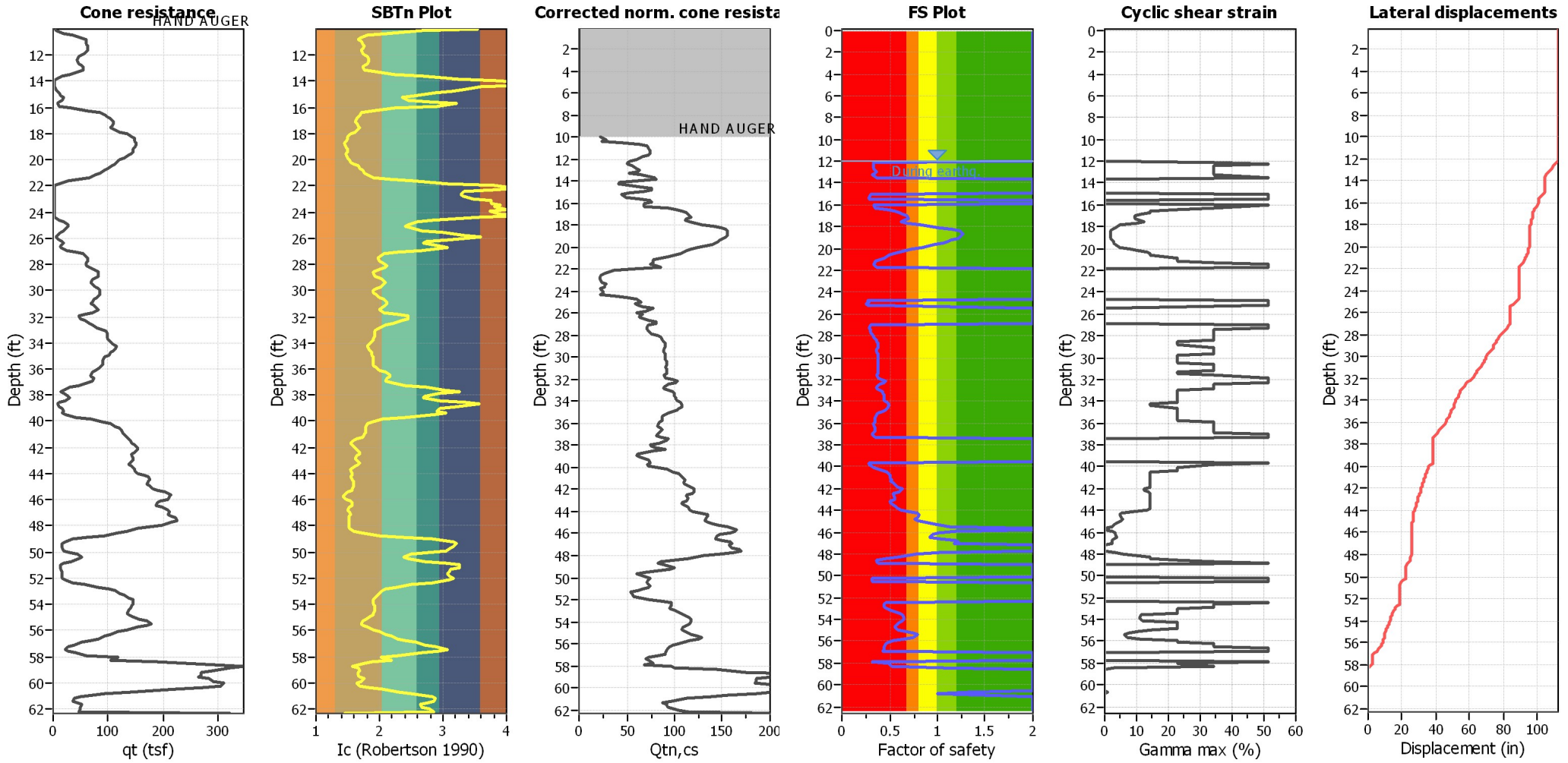


Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements

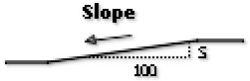
Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



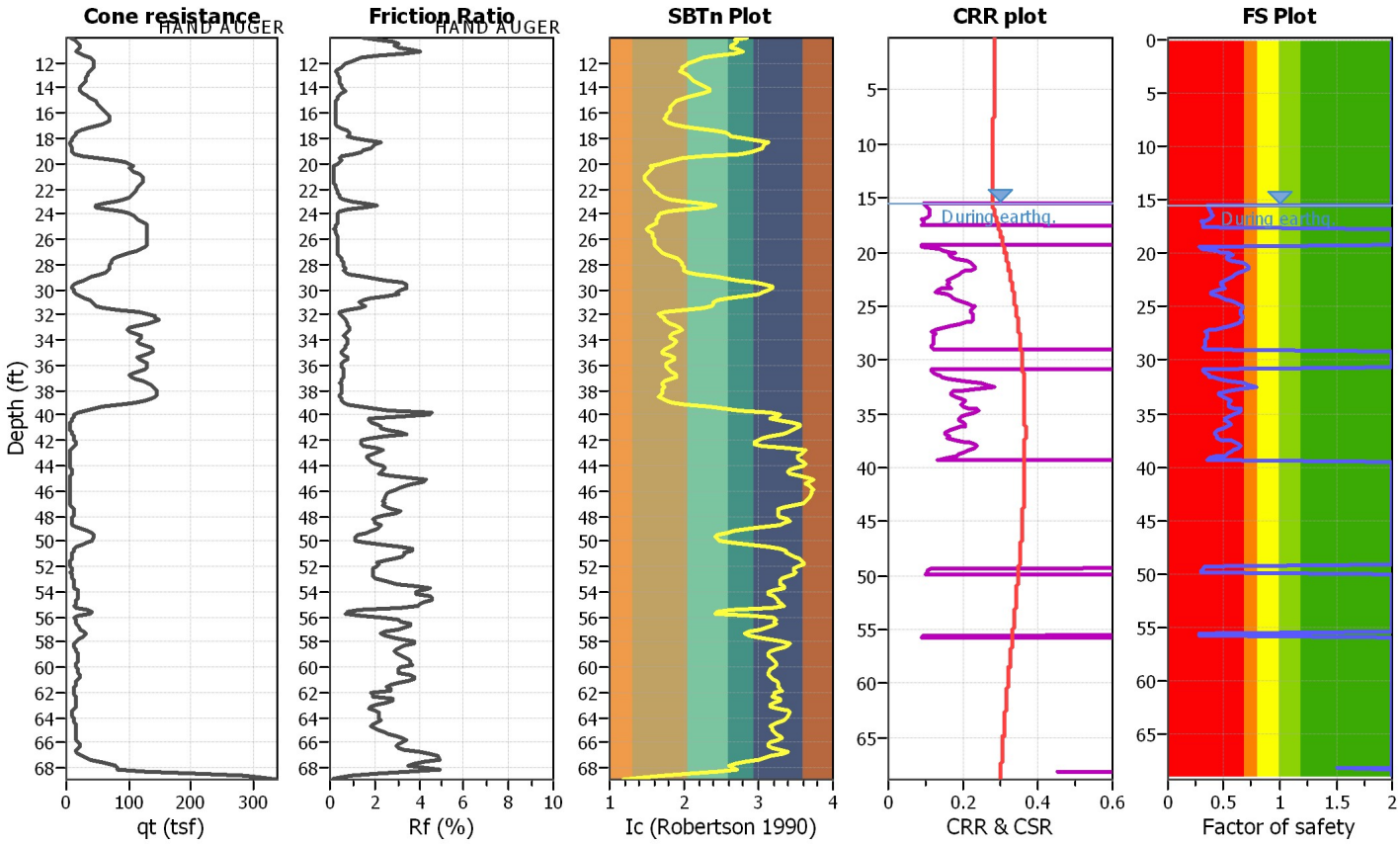
LIQUEFACTION ANALYSIS REPORT

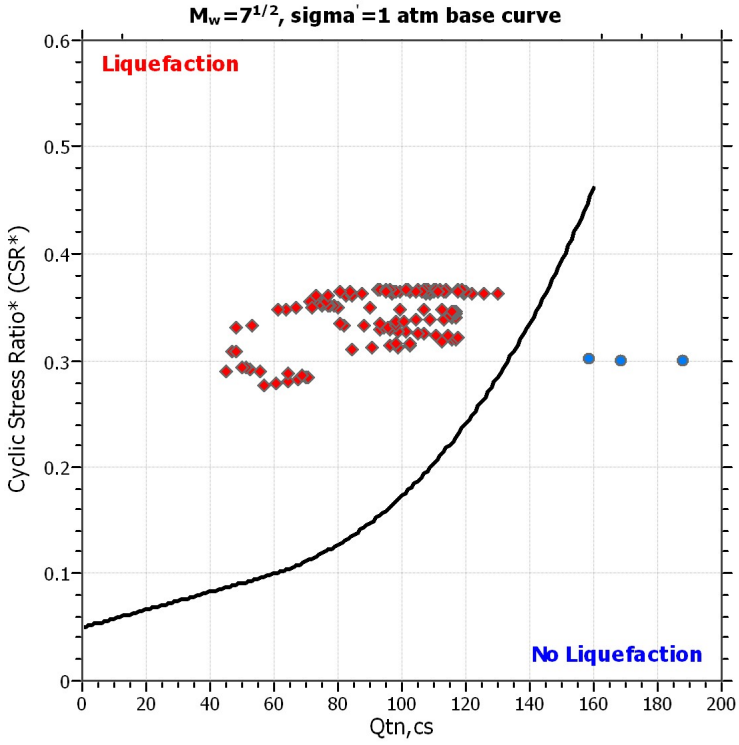
Project title : Friars Road, **Location : Bridge over San DIego River**

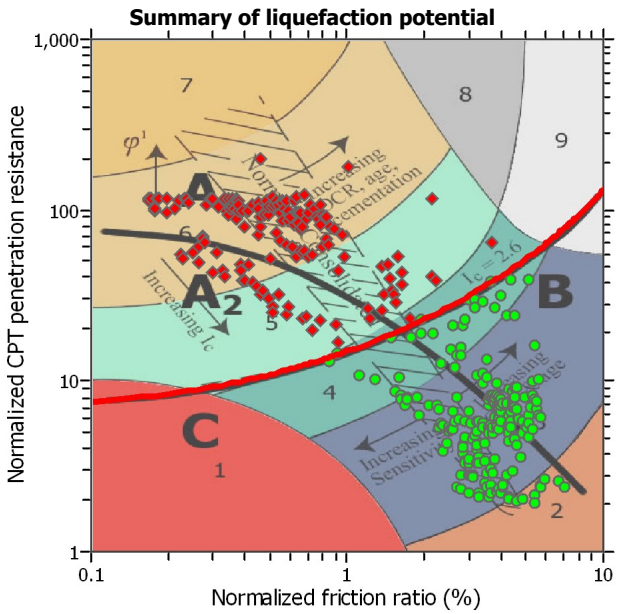
CPT file : CPT-12-005

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	15.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	15.50 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	No		

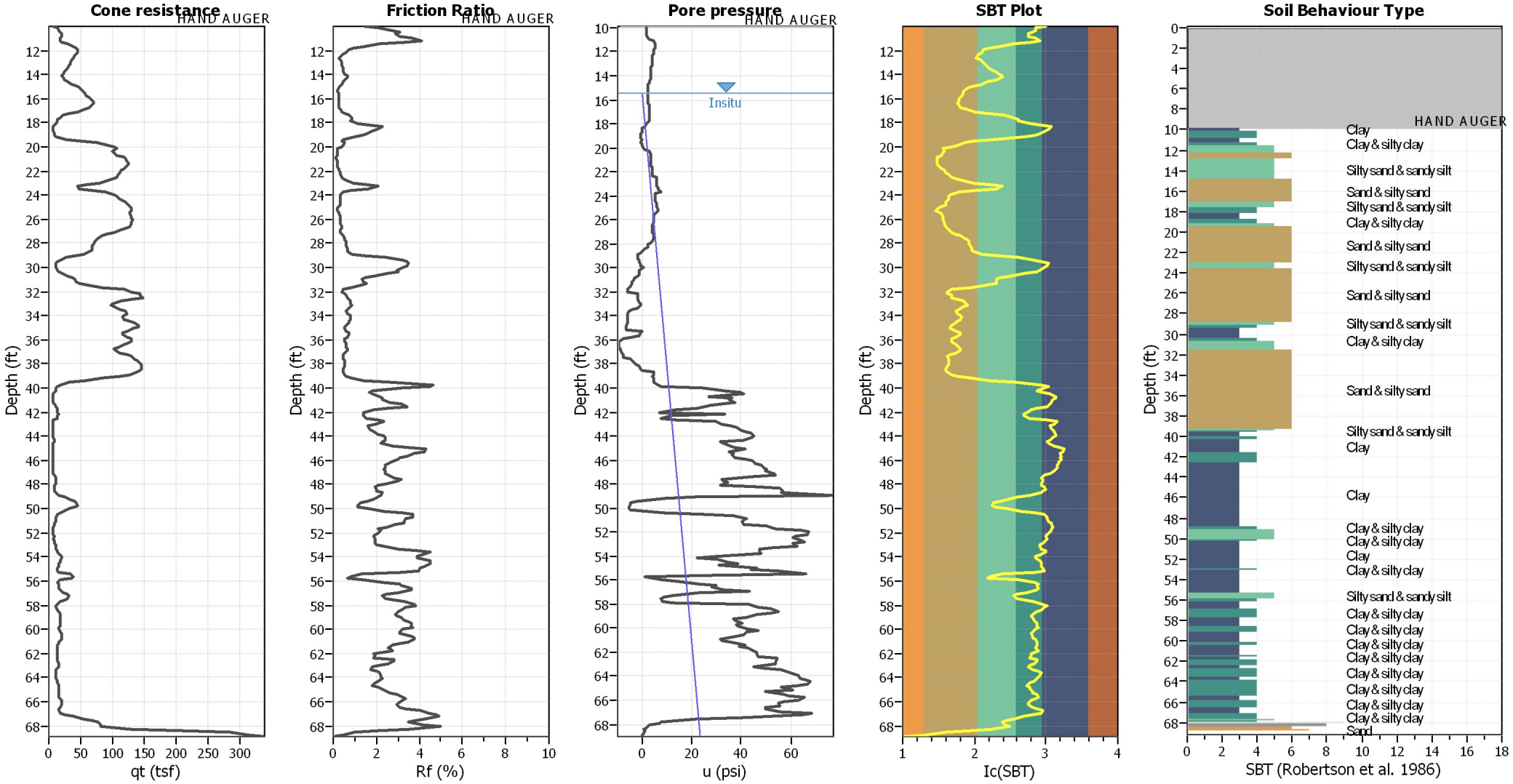






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



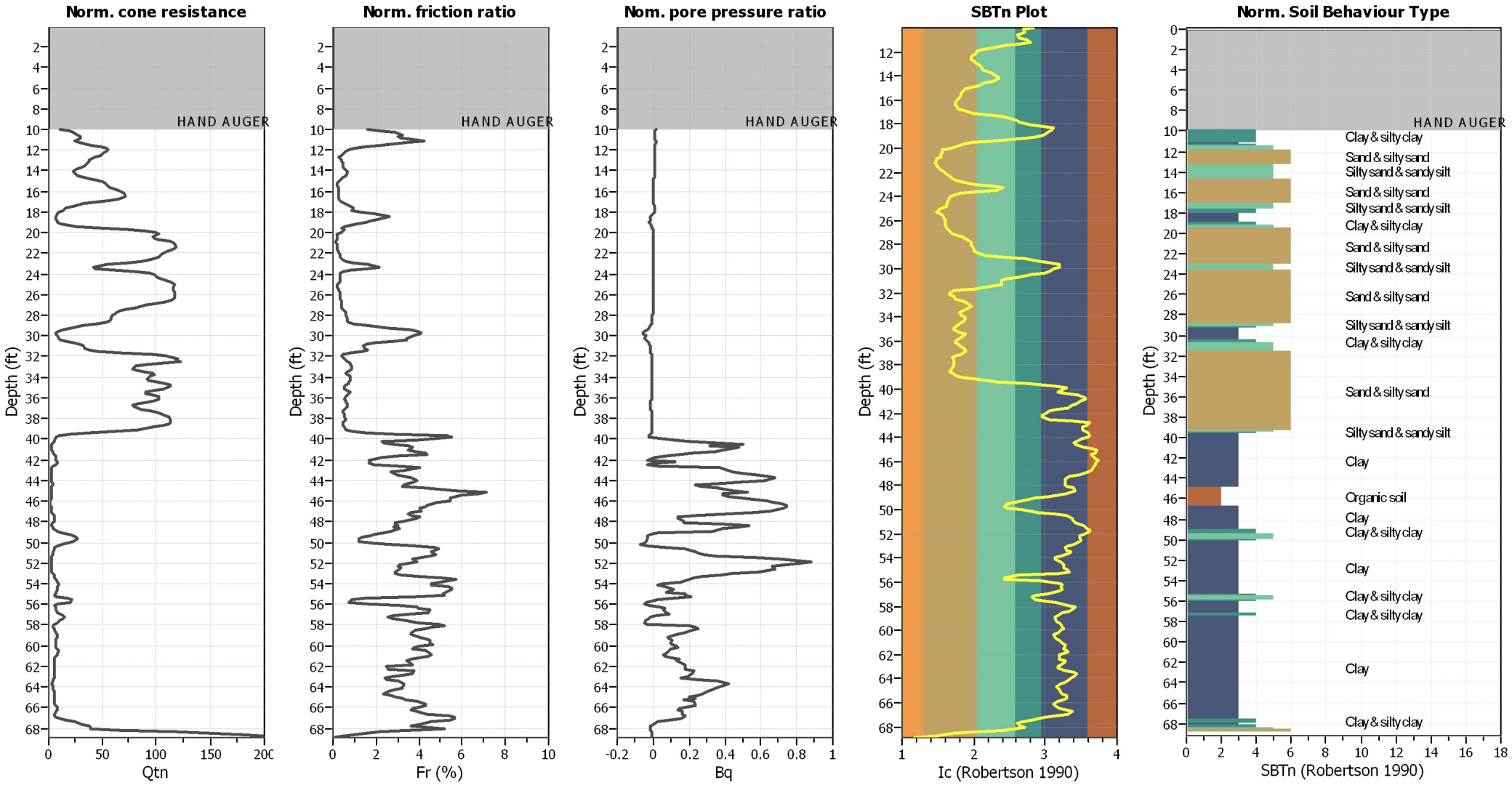
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



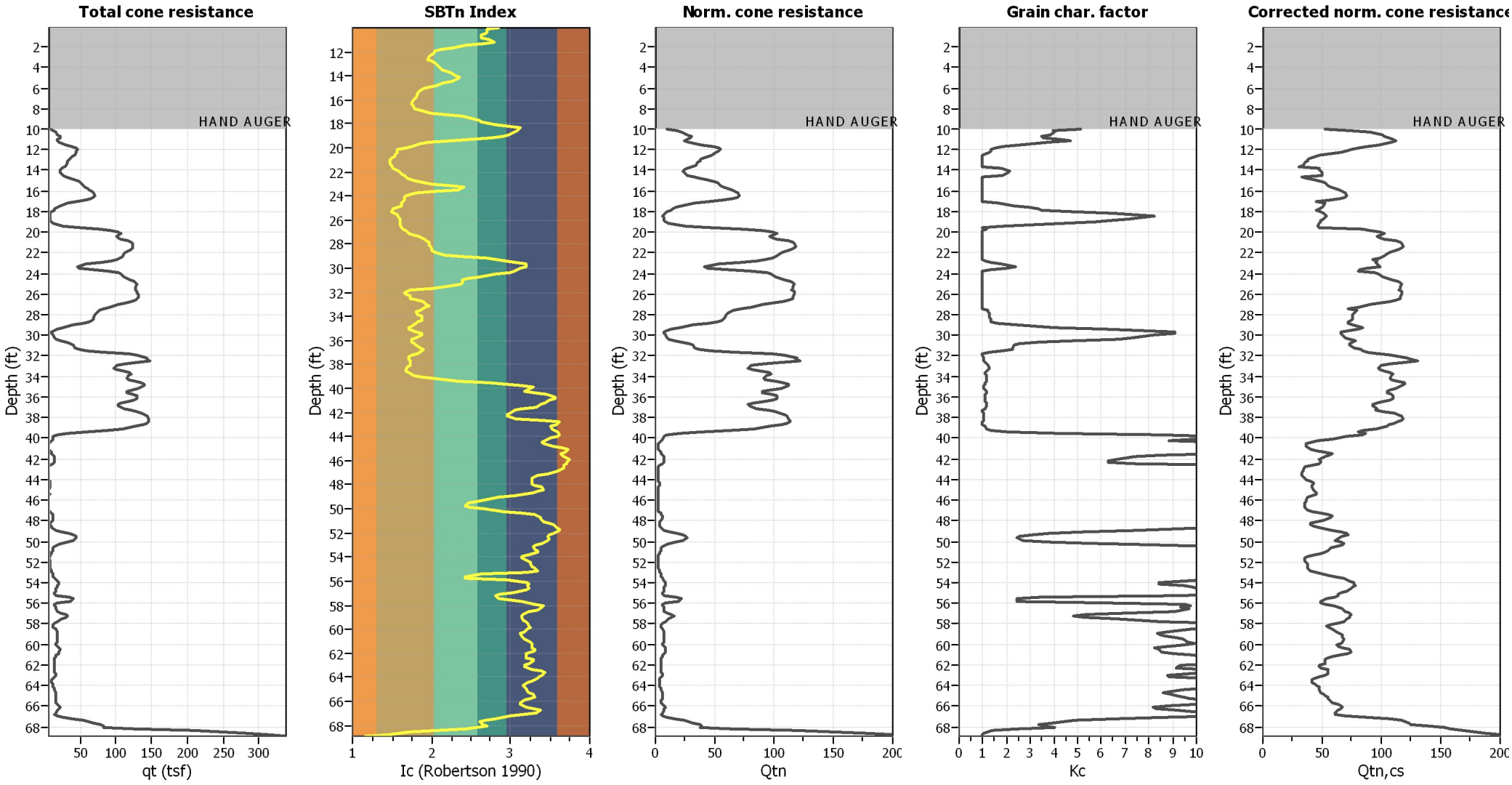
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

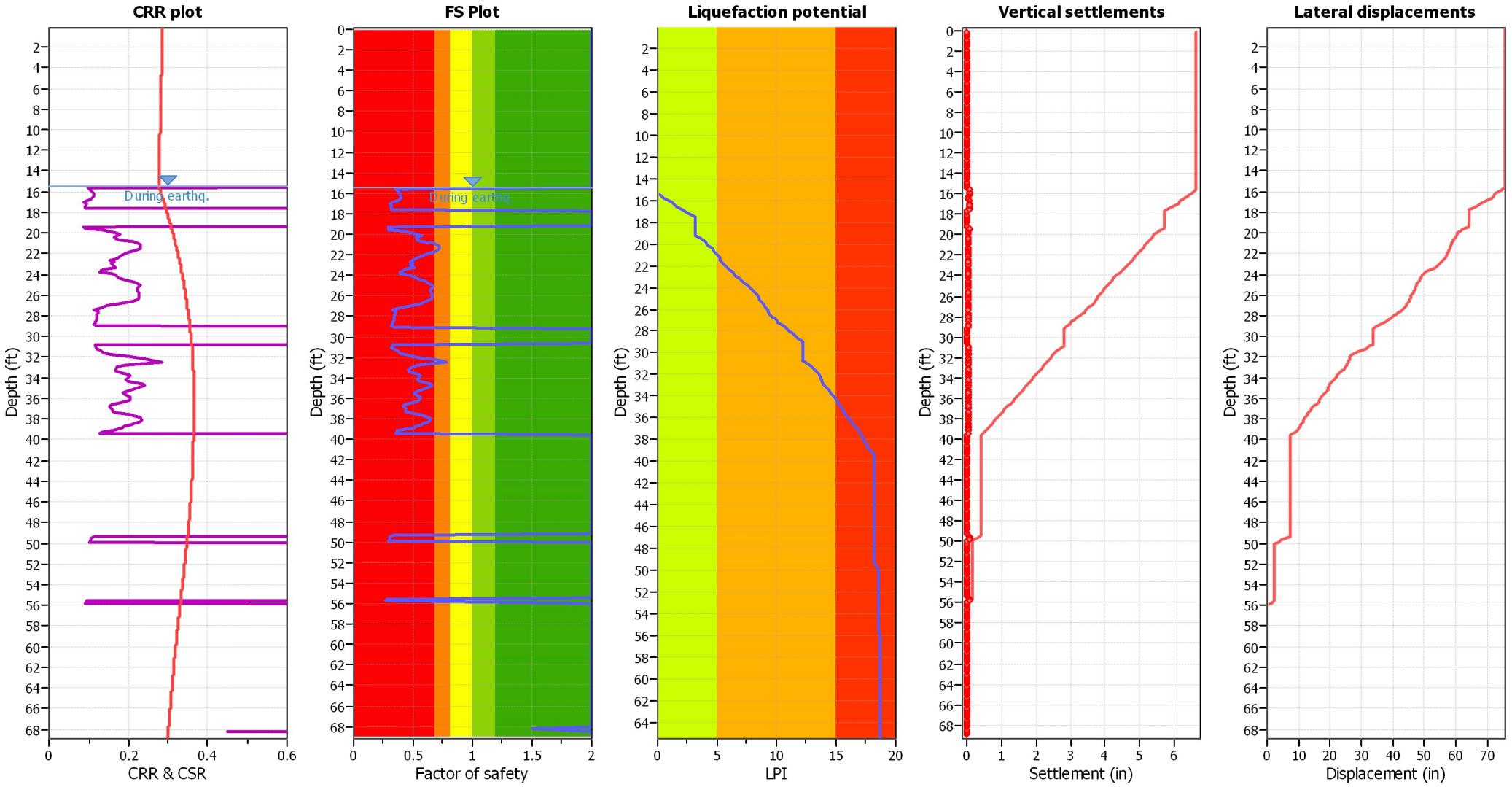
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.50 ft	Fill height:	N/A	Limit depth:	N/A

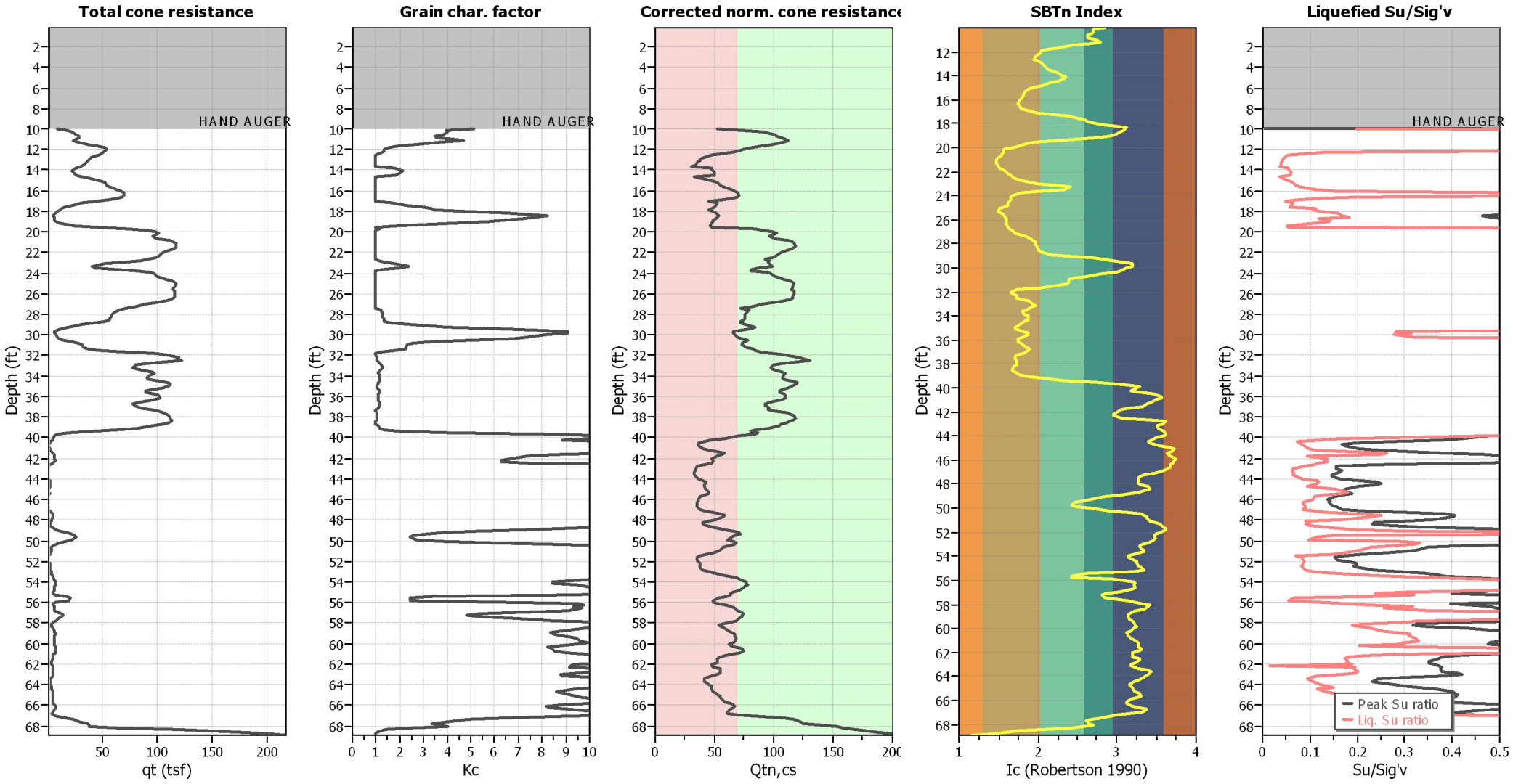
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

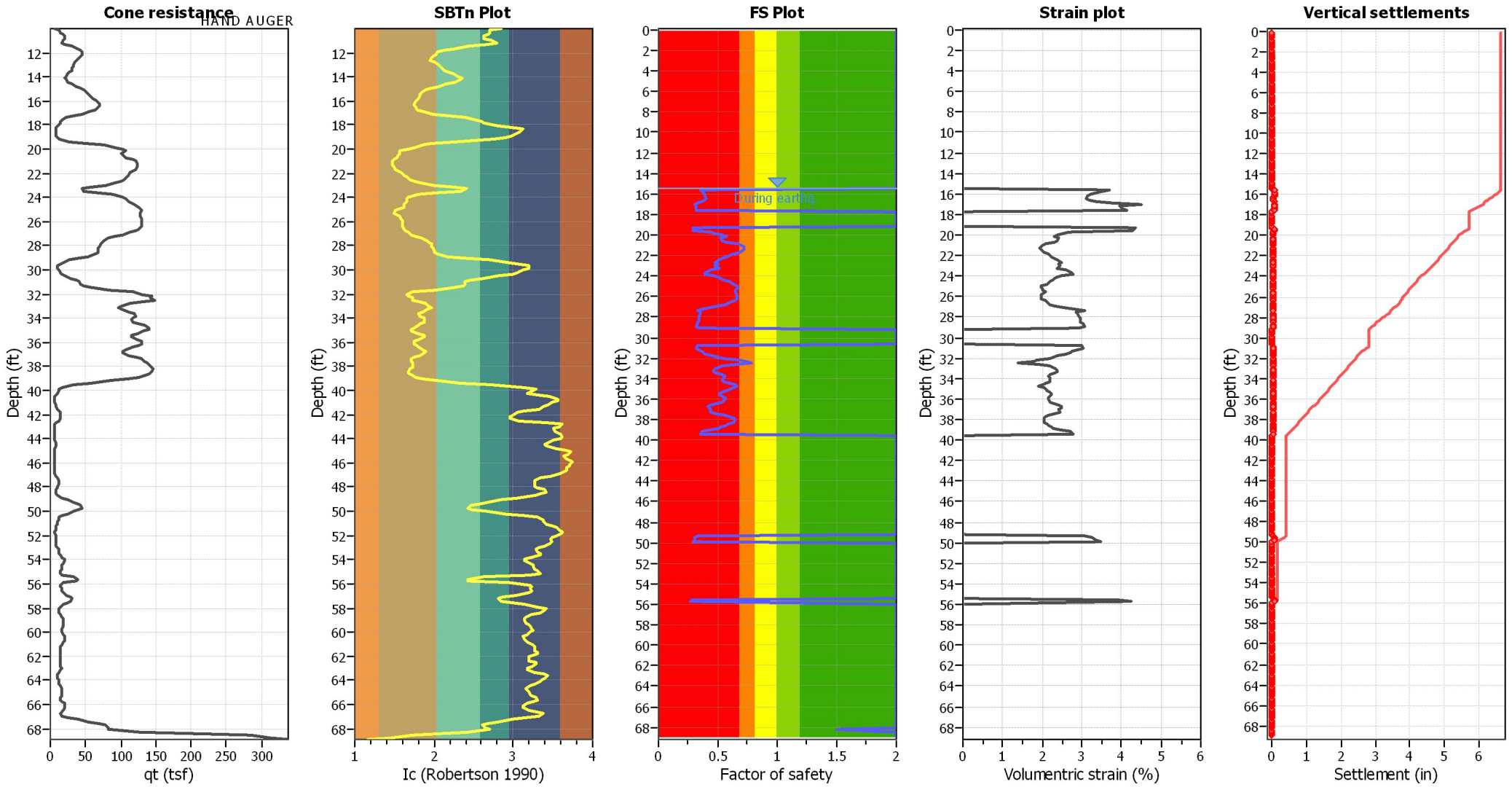
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.50 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements

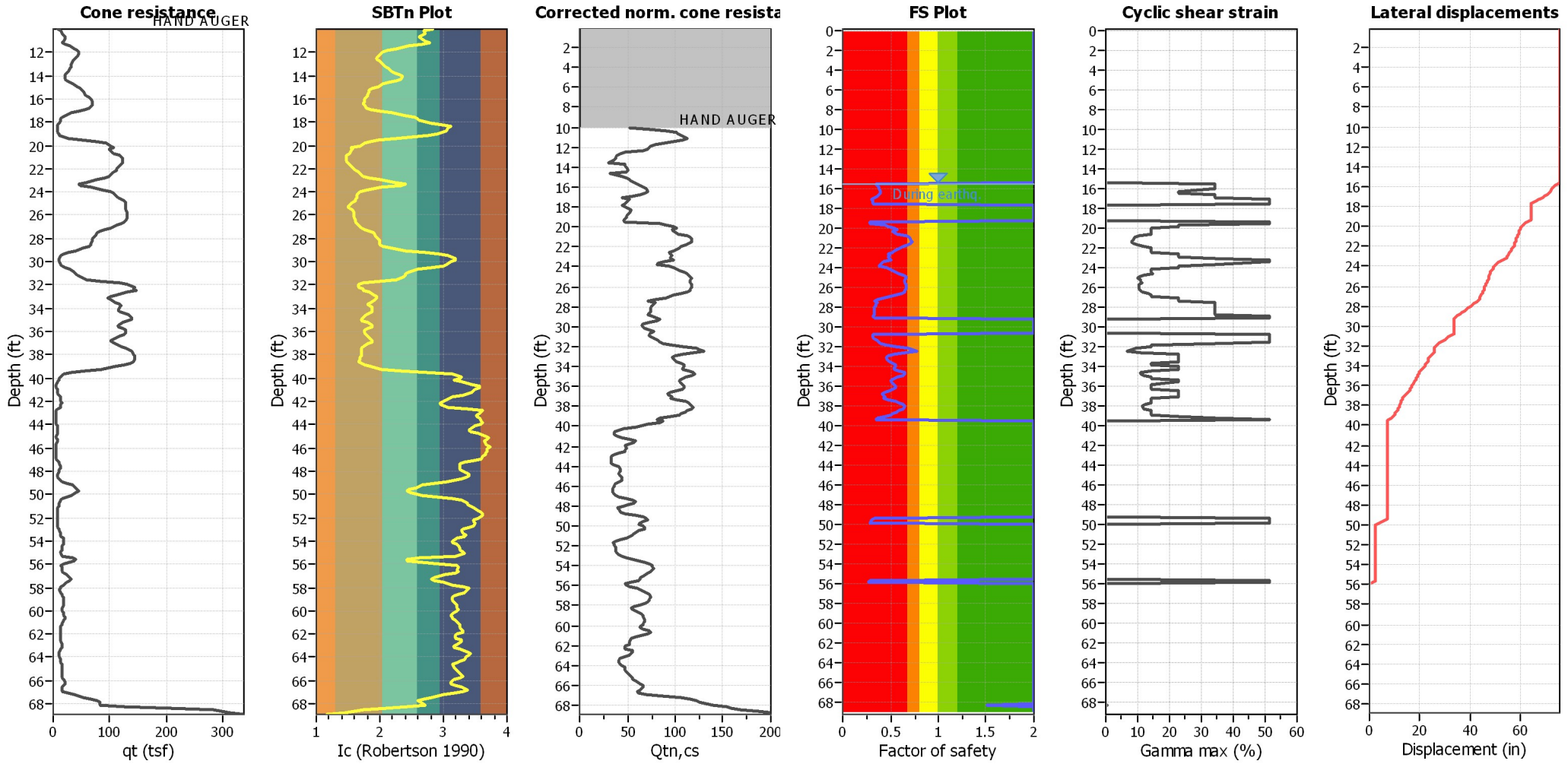


Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements

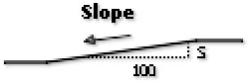
Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

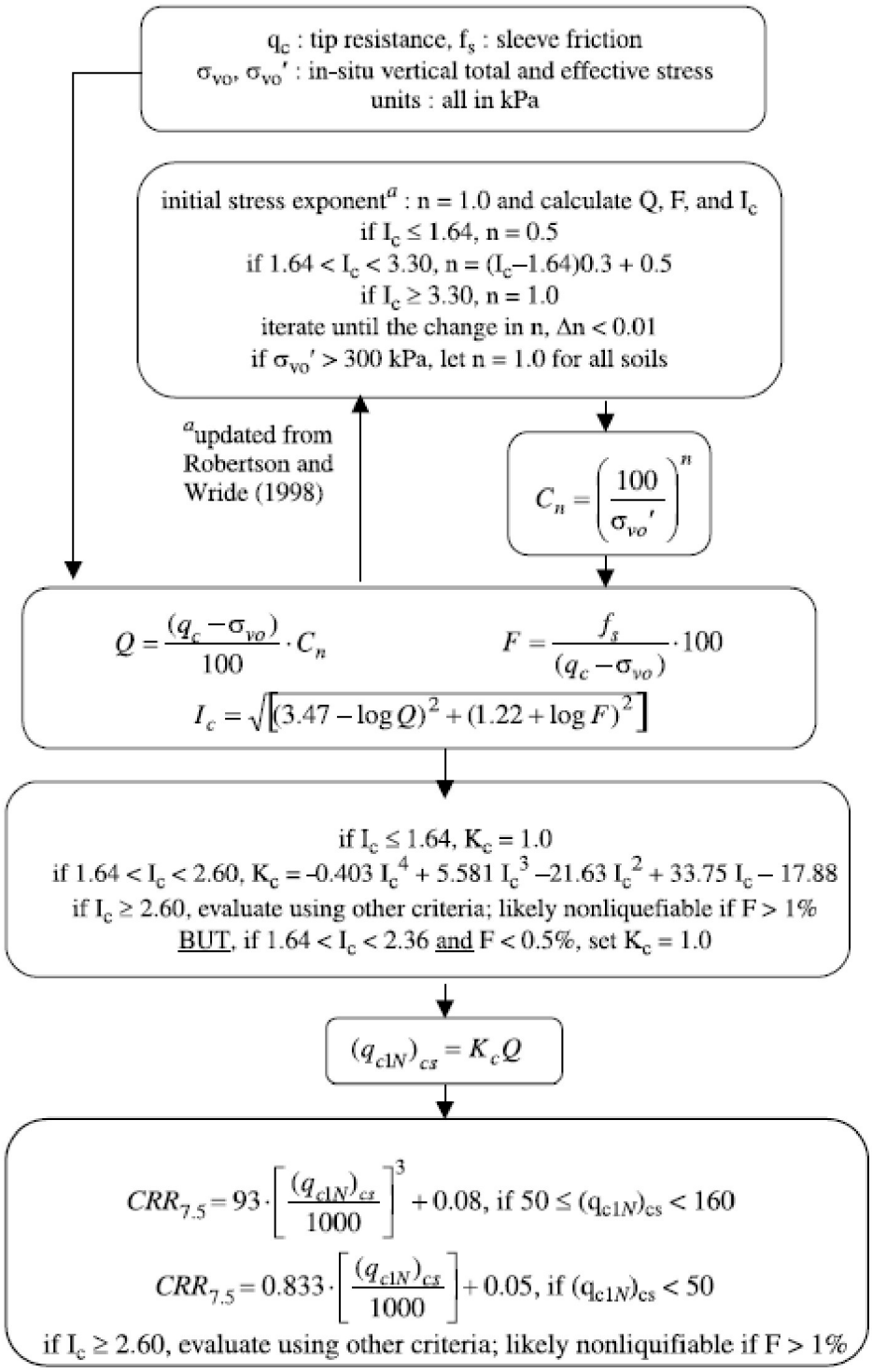
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

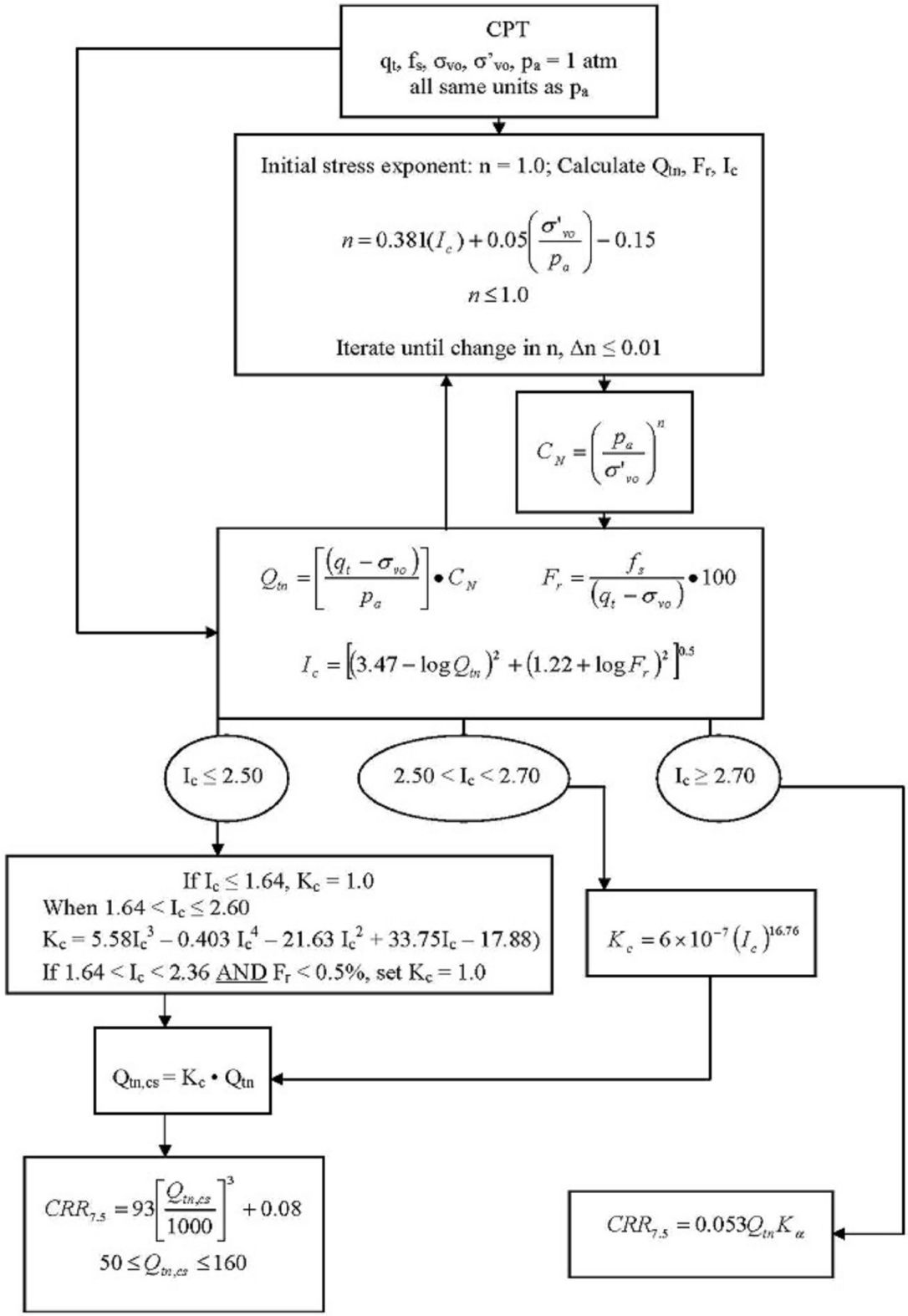
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

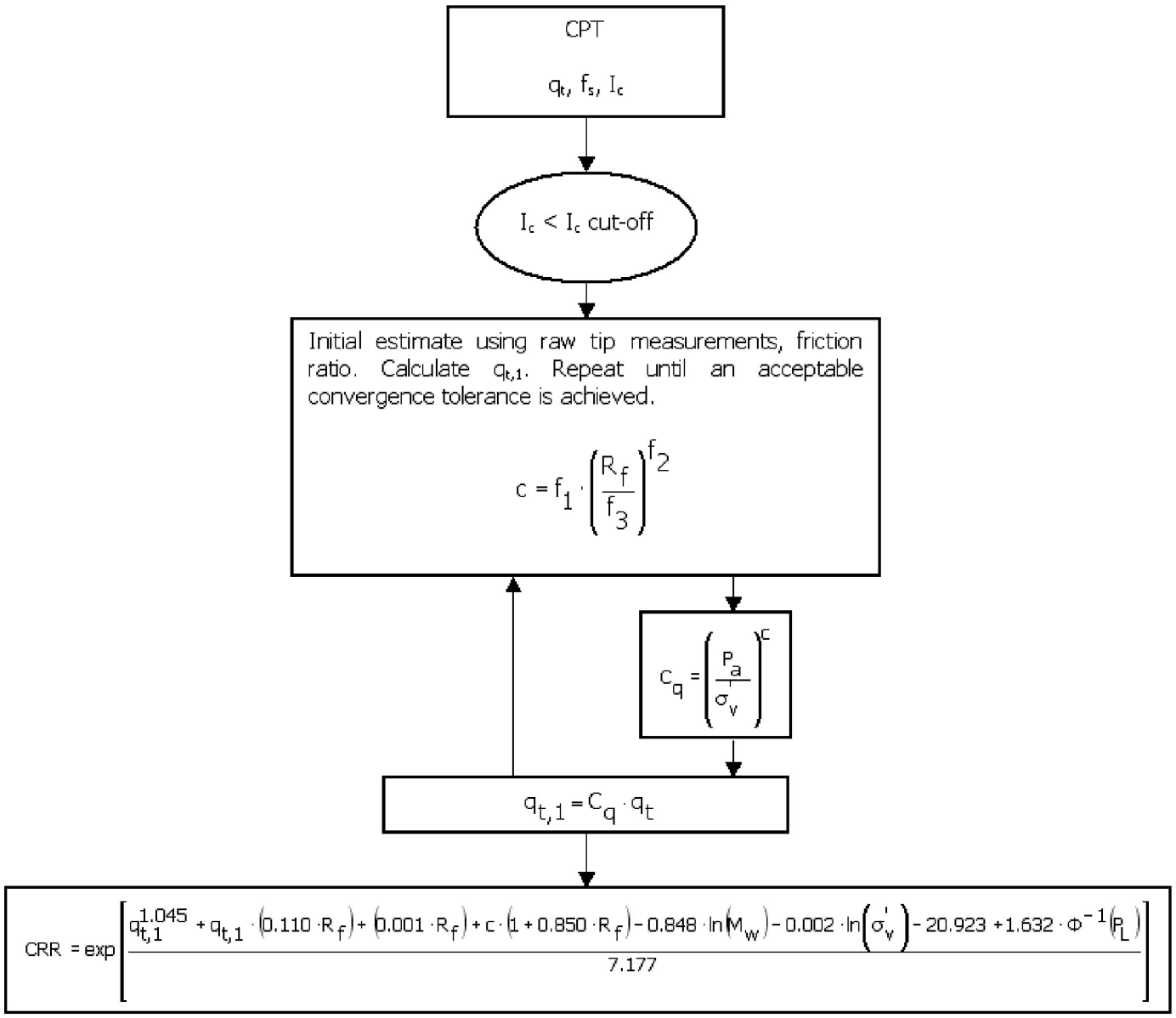
Procedure for the evaluation of soil liquefaction resistance (all soils) - Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

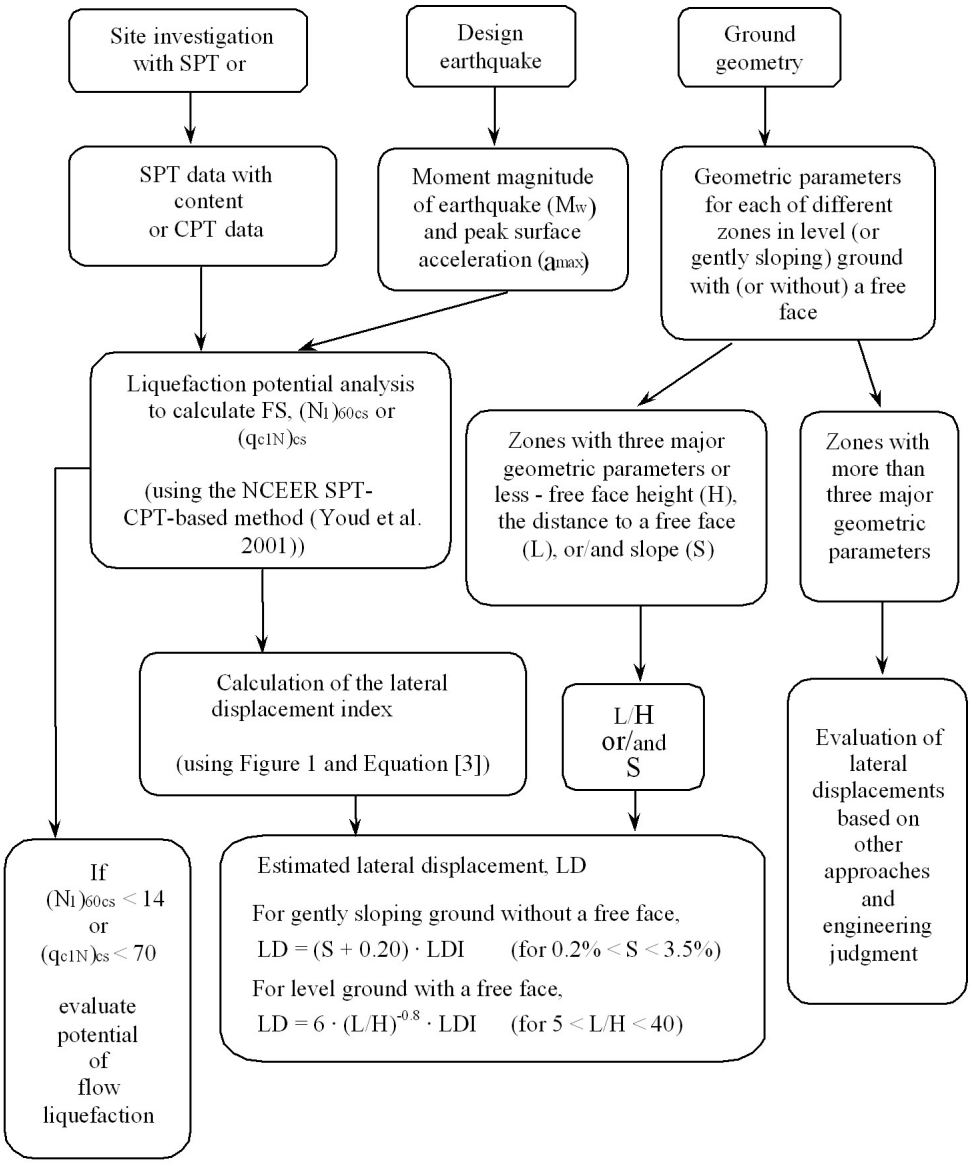


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

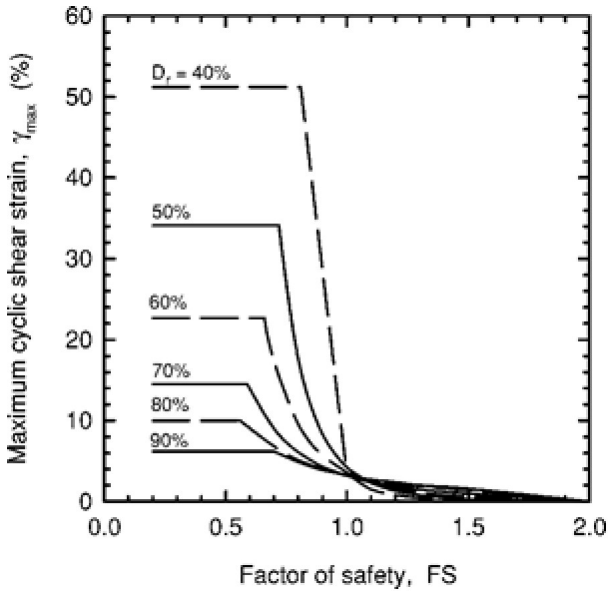
Procedure for the evaluation of soil liquefaction resistance (sandy soils) - Moss et al. (2006)



Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



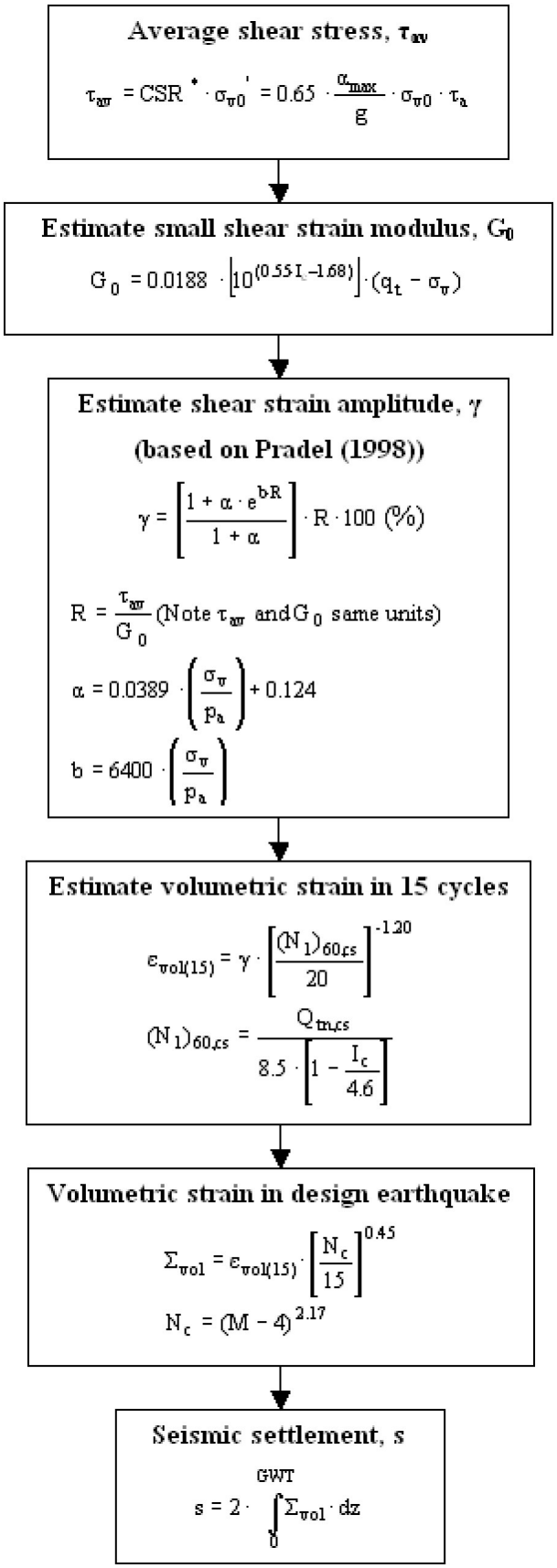
[1] Figure 1

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] Equation [3]

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

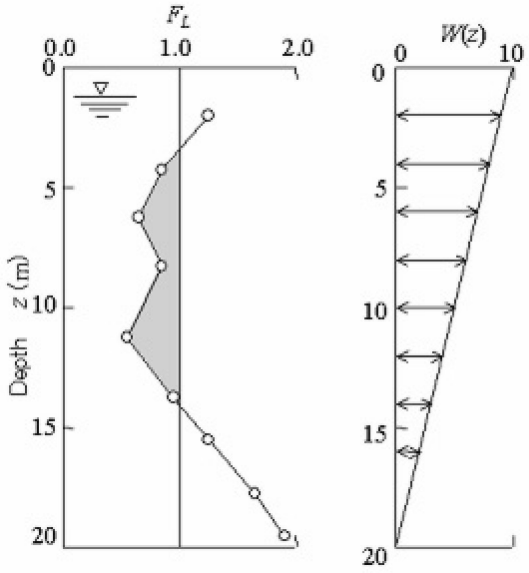
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.

- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652

- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.

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- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871

- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70

- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355

- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009

- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA

- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132,

APPENDIX VII

Date: 09/04/2012
Reports: GDR SR-163/Friars Road Interchange Modification
PI:
Response s By: Brian Hinman
Page: 1 of 1

Page	Section	Comments By		Comment	Response
	General Comment	BH		This GDR should follow the format for a Caltrans GDR with all pertinent sections. Dokken staff are familiar with producing geotechnical products according to Caltrans guidelines. All Recommendations, Design Advisories, and Construction Considerations should be stated in separate sections with those titles.	
	General Comment	BH		Within these review comments the use of italics represent suggested wording.	
	General Comment	BH		Should this be a District Preliminary Geotechnical Report? Where are the project plans that show the project features that this report addresses? This report appears to be primarily a geotechnical exploration. Many specific design and construction considerations have not been addressed and have been inappropriately put off as items to be determined during the construction phase of the project.	
	Executive Summary	BH		The summary contains no information useful to busy executives, project designers, or contractors. Briefly discuss the significant conditions encountered that are likely to impact project design, cost, schedule, or construction and the implications of those conditions No critical information is provided in the executive summary by describing the exploration program or the ordinary materials encountered.	
				The first paragraph should state that the modifications are planned to be designed and constructed in three phases. We don't know that they will be.	
1	Project Description			Whose project is this?	
1			Par 1	…investigation *by* Southern California…modifications *are planned to* be designed…	
1			Par 2	…construction of soil nail wall and *standard* retaining walls.	

Date: 09/04/2012
Reports: GDR SR-163/Friars Road Interchange Modification
PI:
Response s By: Brian Hinman
Page: 2 of 1

Page	Section	Comments By		Comment	Response
1			Par 3	The first sentence is awkward. Consider splitting into two sentences and removing casual language like "as well as."	
1			Par 3	Hmmm… no Caltrans documents were reviewed!	
2	Existing Facilities and Proposed Improvements			Where is the discussion of the proposed improvements?	
2			Par 2	…crosses Mission Valley, *a floodplain landform of the San Diego River.*	
2			Par 2	…located along the *roadway* alignments.	
2	Existing Pavement Sections		Par 1	The margins above and below table seem misaligned.	
3	Pertinent Reports and Investigations		Par 1	…and reports is *presented* below.	
3	Scope of Work			This section, along with the Executive Summary, contains yet another description of the field exploration and laboratory testing program. This program description should be presented only once in the section titled "Field Exploration and Laboratory testing."	
4			Par 2	Replace "other" recommendations with more precise wording like design and construction recommendations.	
4			Par 2	The paragraph is one sentence with three sets of parenthesis. Perhaps more than one sentence should be utilized.	

Date: 09/04/2012
Reports: GDR SR-163/Friars Road Interchange Modification
PI:
Response s By: Brian Hinman
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4	Climate		Par 1	The first sentence is unnecessary. The assessments contained in this report should be geotechnically related. Climate does affect such things as drainage design. Early sections of a GDR should only describe conditions – all assessments and recommendations should be presented in later sections dealing with assessments and recommendations.	
5	Regional Geology and Seismicity			This report section seems to discuss site geology and does not discuss regional geology as the section title would imply.	
5			Par 1	Replace "subject" site with project site.	
5			Par 2 & 4	The thickness of fills and alluvium are "estimated" and "anticipated." What do your exploratory borings and the as-built bridge borings indicate?	
6	Faulting		Par 2	Remove metric units and replace with U.S. customary units.	
6	Geologic hazard Categories		Par 1	What is the "site interchange geologic hazard categories"?	
6			Par 1	Remove the wording "in our opinion" from the entire report except for the disclaimer section. This entire report reflects your opinion so there is no need to state it numerous times in the body of the report.	
7	Landsliding		Par 1	The last sentence of paragraph 2 should be placed just behind the first sentence of paragraph 1.	
7			Par 2	Remove "it is our opinion."	
7	Liquefaction		Par 1	Remove "in our opinion." This is more than your opinion. This is the opinion of the entire soils engineering profession.	
8			Par 1	The alignment of what that crosses the San Diego River plain?	

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8			Par 1	"Appendix V presents our analysis." Appendix V is titled Laboratory Testing not Liquefaction Analysis. Analyses conducted for the report should be contained in a separate appendix with the appropriate title. This section should describe what liquefaction analyses where performed and what programs where utilized in the analyses.	
8			Par 1	Do not comment on the adequacy of bridge foundations or provide design opinions on bridge foundations in a GDR!	
8	Field Exploration		Par 2	What year Caltrans Soil and Rock Logging Manual?	
8				A brief check reveals LOTB do not have QA/QC compliance with CT standards and logging manual.	
9	Natural Slope Stability		Par 1	Cut slopes are not natural slopes. Cut slopes should be addressed in a section on cut slopes. How do you know that "The slopes have an adequate factor-of-safety in respect to global stability." Did you perform an analysis? Just report your observations about the slope condition and performance.	
9	Soil and Rock Conditions		All Par	These units are described in the Executive Summaray, Section 2.4.1, and again here. This is unnecessarily repetitive.	
9&10			Various Par	There is no value in describing what formation was encountered in various borings. The reader can just review the LOTB to find what was encountered in any boring. If some particularly significant geotechnical condition or trend was discovered this section would be a good place to describe that condition or trend.	
10	Groundwater			The elevation of groundwater in any boring can probably be obtained by reviewing the LOTB so this table appears to be superfluous. What is this data telling us about the groundwater? Is the groundwater perched, regional, pervasive, primarily within the river alluvium, what?	

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10	Surface Water		Par 1	Expand on description of river and flooding. Is the river a permanent surface water body? How often does flooding occur? What portions of the project are in the floodplain?	
10	Scour		Par 1	It is okay to describe the alluvium as being susceptible to scour; however, within a GDR do not comment on what should be done for bridge foundation design! Again, do not repeat that this is your opinion.	
11	Erosion		Par 1	To what locations does the first sentence refer? The rest of the paragraph contains recommendation that belong in an appropriate section. This section should only contain discussion of observations and erosion potential.	
11	Project Site Seismicity		Par 1	This section describes the alluvium as "potentially liquefiable." Section 2.4.5 states that the alluvium "can be considered liquefiable." Resolve the potentially conflicting interpretation. Also, change "subject" site to project site.	
11	Ground Rupture		Par 1	Same comment concerning "It is out opinion…"	
11	Earthwork General		Par 1	The first sentence is superfluous, there is no need to state that State highway work should be performed in accordance with Caltrans Standard Specifications. It is only necessary to state such work that should be performed differently to what is stated in the Standard Specifications.	
11			Par 2	The language in parenthesis in the first sentence does not clarify the preceding language. Simplify the meaning.	
11			Par 2	Did you do tests for expansion index? Are there places on the project where the expansion index of the subgrade soil is 50 or greater? If so where? How much? What is the estimated volume of this remedial grading? This is an important recommendation that can affect project cost and construction.	

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12	Cut Slopes		Par 1	What is the "barrier fence" that is referred to in this section? What should the designer utilize? Is it a rockfall barrier? If so provide the appropriate design and Special Provisions.	
12	Excavation Characteristics		Par 1	Were well cemented zones and hard rock observed in relation to this project? If so where? How much? What volume estimate? This report is a "contract document." This report should state what equipment may be utilized to facilitate construction.	
12	Grading Factors		Par 1	The existence of gravel and cobbles and the equipment required to compact such materials does not benefit the discussion of grading factor. Requirements for compaction are already stated in the Standard Specifications and do not need to be stated here. The total volume and place of origin of boulder sized material should be estimated. Do not state how or where boulder size material should be disposed. Standard Specifications allow for the burying of boulder size material within fills. State that boulder size material may be stockpiled for use in landscaping or appropriately handled in accordance with the Standard Specifications.	
13	Foundations		Par 1	Shallow spread footings *founded* in compacted fill…	
13			Par 1	*It is expected that loose fill will need to be excavated and replaced as compacted fill beneath portions of the wall foundations.*	
13			Par 1	With regard to the remedial grading required beneath wall foundations: Where? What volume? To what depth and lateral extent? Is there a detail? This is the exact information we look for in a GDR. You must make a reasonable attempt to define this work if it is indeed necessary.	
13			Table	Are any Standard Plan retaining walls suitable or not for these retaining walls?	
14	Active Pressure		Par 1	Instead of surcharge loads from traffic we often refer to transient loads that may include traffic loads or temporary conditions. Remove "upon approval of the City of San Diego."	

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14	At-Rest Pressure		Par 1	Same comments as above.	
15			Par 1	Soundwalls impart very little vertical load. It is very unusual that a fill needs to be removed and replaced in order to support a soundwall, particularly if the wall is on a pile cap foundation. Again, where? What volume? What detail?	
15			Par 1	What modification to the standard plans? Why? Is a detail provided?	
15			Par 1	Regardless of what the Caltrans Geotechnical Manual states, what do you consider to be the most cost effective or appropriate foundation design for each soundwall location? Your table seems to indicate you have considered additional factors.	
16	Settlement		Par 1	How much settlement is anticipated? Did you perform analyses? If not, why not?	
16	Corrosion		Par 2	Where are the test results presented? What are the exceptions to the non corrosive materials found? Was there a pattern of significance or particular formation associated with the various corrosive environments? Do not tell the design engineer exactly how to design for the corrosive environment, simply provide the data and notify the engineer that for reason ___ all project soil should be considered corrosive and designed accordingly.	
16	Pavement Structural Section			This section should be reviewed by the District Materials Engineer.	
17	Closure			This is a good example of Section titles that do not follow Caltrans GDR format.	

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17	Geotechnical Review		Par 1	Where are the project plans that detail the features discussed in this GDR? This GDR and the recommendations it contains should be tied to the features shown as on an attached plan set. This paragraph undermines the authority of Caltrans functional units who will likely provide project support. Much of what this paragraph states belongs in your disclaimer section that you have titled "Limitations."	
17			Par 2	This paragraph undermines the authority of the Resident Engineer. The RE bears responsibility for the entire construction project and it is up to him to decide who should perform reviews and what testing is appropriate to support the project.	
18	Limitations		Par 2	A GDR will be used by many people besides Dokken and it should be sufficient for all users including the RE and the Contractor. This is a project on the State highway system therefore this report should be prepared to Caltrans standards and not to generally accepted geotechnical practices in San Diego County.	
	General			Any recommendations for temporary slopes? Any issues that might impact right-of-way requirements?	

THE CITY OF SAN DIEGO

July 28, 2015

Mr. Fred Yazdan, PE
Caltrans District 11
4050 Taylor Street
San Diego, California 92110

Subject: Friars Road/SR-163 Interchange Project – Water Source Letter

Dear Mr. Fred Yazdan:

Sufficient quantity of potable water is available within the project limits for construction of the Friars Road/SR-163 Interchange Project.

The Contractor shall be responsible for obtaining and renting a water meter(s) for a fee from the Meter Shop Supervisor at Chollas Operations, 2797 Caminito Chollas. A meter shall be installed whenever water is required by the Contractor. The Contractor shall pay the regular monthly fee for water and a fee for quantity of water used.

Any use of water not purchased by the Contractor during construction is subject to a fine of $500 or six (6) months imprisonment, or both, under State Penal Code Section 499. Additionally, the Contractor would be subject to a civil liability to the City for such misappropriation.

Please feel free to contact me at (619) 533-4661 or by email at jmanchester@sandiego.gov should you have any questions.

Best Regards,

Jeff Manchester

Jeffrey R Manchester, PE, QSD/P
Project Manager

cc: Hanh Nguyen, PE, Caltrans District 11
Luis Schaar, PE, City of San Diego
Mary Elizabeth Northeimer, PE, Dokken Engineering

CITY OF SAN DIEGO PUBLIC WORKS DEPARTMENT

Public Works Department – Right of Way Design
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