LOCATION HYDRAULIC STUDY

MARCH 2007

DE ANZA TRAIL SITE
Saratoga, California

For:

LSA Associates, Inc.
&
Shute, Mihaly & Weinberger

Y6259-01.00684

5900 Hollis Street, Suite D • Emeryville, CA 94608 • (510) 420-8686

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BASELINE Environmental Consulting
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REPORT PREPARER

Prepared by: _____

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(510) 420-8686

Date: 3/8/07

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LOCATION HYDRAULIC STUDY
De Anza Trail Bridges at Rodeo and Saratoga Creeks

BACKGROUND

The City of Saratoga is proposing to construct a 1.6-mile bicycle and pedestrian trail. The trail would consist of a 12-foot wide route including two creek crossings: Rodeo Creek and Saratoga Creek. The construction of the trail would be funded by the Federal Highway Administration (FHWA) and the California Department of Transportation (Caltrans). Therefore, an assessment of environmental impacts must be performed in accordance with the National Environmental Policy Act (NEPA) requirements. This Location Hydraulic Study (LHS) was prepared to determine if the construction of the project would result in flood plain encroachment. This LHS is for the bridges at both Rodeo and Saratoga Creeks.

This LHS evaluates whether the proposed development is consistent with existing watershed and flood plain management program; would result in an increase in base flood elevation; or would result in significant impact on the natural or beneficial flood plain values. The LHS is a study administered by Caltrans under agreement with the FHWA. This LHS is performed in accordance with Title 23, Code of Federal Regulations (CFR), Part 650.111, entitled *Location Hydraulic Studies*.

LOCATION HYDRAULIC STUDY

Location

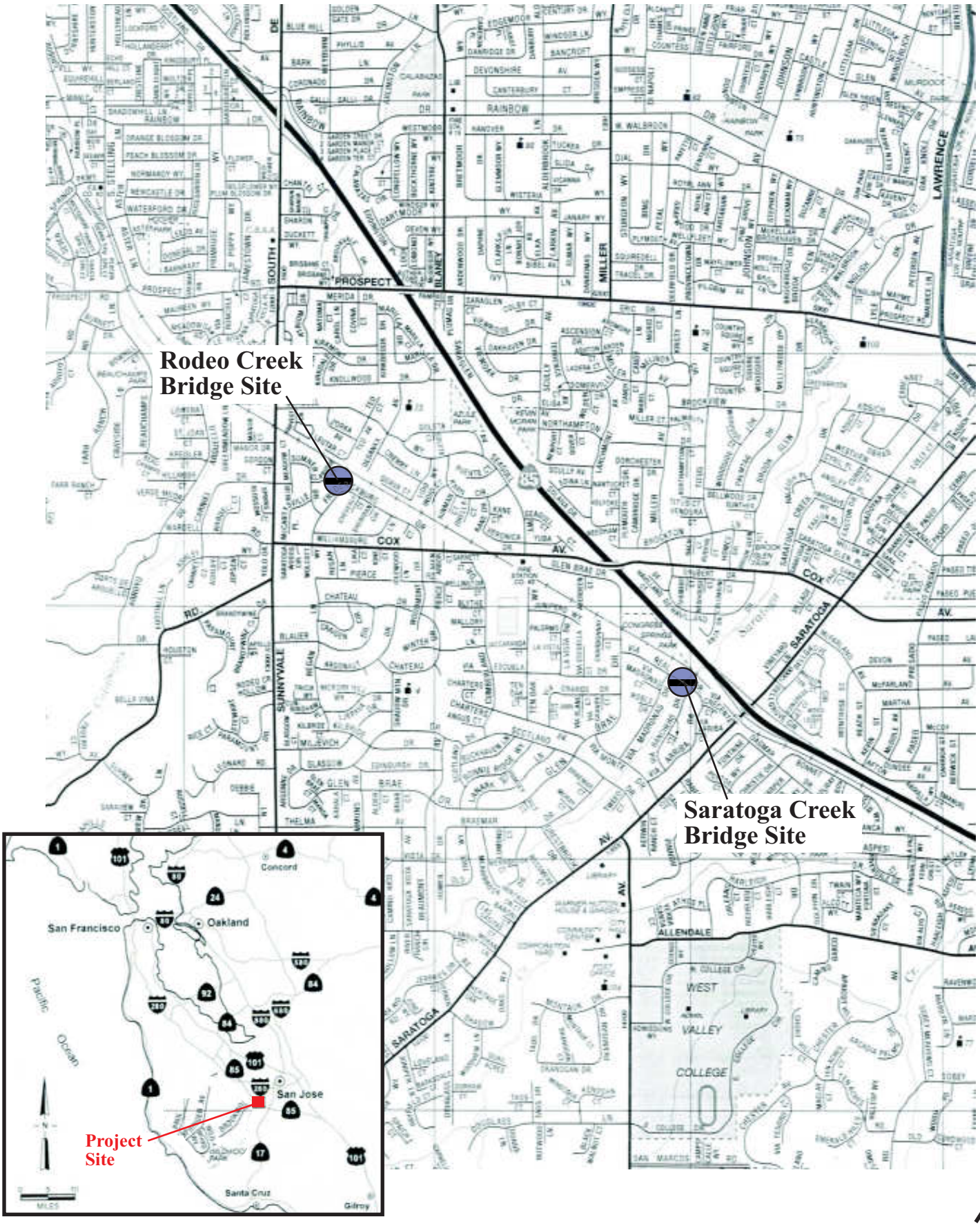
The proposed project is located between Sunnyvale Road and Saratoga Avenue in Saratoga, California (Figure 1). The proposed trail would entail construction of two bridges that cross Rodeo and Saratoga creeks. Each bridge crossing will consist of a pre-fabricated steel truss structure supported on concrete abutments. Cotton, Shires & Associates (CSA) performed a geotechnical investigation on the proposed bridge crossings and recommended that concrete abutments be constructed a minimum of six feet from the creek banks (CSA, 2006). A copy of CSA's report is provided in Appendix A.

Rodeo Creek

Schaaf & Wheeler Consulting Civil Engineers (Schaaf & Wheeler) prepared a technical memorandum to evaluate the 100-year surface elevation of Rodeo Creek. A copy of Schaaf & Wheeler's technical memorandum for Rodeo Creek is provided in Appendix B. Rodeo Creek is an ephemeral creek influenced by precipitation run-off. The rainfall run-off includes storm water collected and conveyed by the local storm water system. A six-foot diameter culvert is located underneath railroad tracks that run along the alignment of the proposed trail (Schaaf & Wheeler, 2006). The incised channel of the creek at the proposed bridge site is approximately 40 to 45 feet wide and seven feet deep (CSA, 2006).

REGIONAL LOCATION

Figure 1



Saratoga De Anza Trail
Saratoga, California

0 2000 Feet

BASELINE

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Saratoga Creek

Schaaf & Wheeler also prepared a technical memorandum to evaluate the 100-year surface elevation of Saratoga Creek. A copy of Schaaf & Wheeler's technical memorandum for Saratoga Creek is provided in Appendix C. Saratoga Creek is located on the southeastern portion of Congress Springs Parks. The banks of creek contain large mature trees and other vegetation. The incised channel of the creek at the proposed bridge site is approximately 70 to 75 feet wide and 14 to 15 feet deep (CSA, 2006).

Bridge Number

The bridge numbers for the proposed Rodeo Creek Bridge and Saratoga Creek Bridge are unknown at the time of preparing this study.

Geographical Reference

The proposed Rodeo Creek and Saratoga Creek bridges are both located within the Cupertino Quadrangle, United States Geological Survey (USGS) topographic quadrangle (7.5 minute series), dated 1980 (photo revised). Rodeo Creek Bridge is in Township 7 South (T7S), Range 2 West (R2W), Section 36; Saratoga Creek Bridge is in T7S, R1W, Section 31; both in the City of Saratoga.

Description of Proposed Action

The City of Saratoga proposes to develop a multi-use trail to create a functional recreational amenity. The proposed bridge crossings will be constructed from pre-fabricated steel bridges supported on concrete piers. The concrete piers will be located a minimum of six feet from the creek banks.

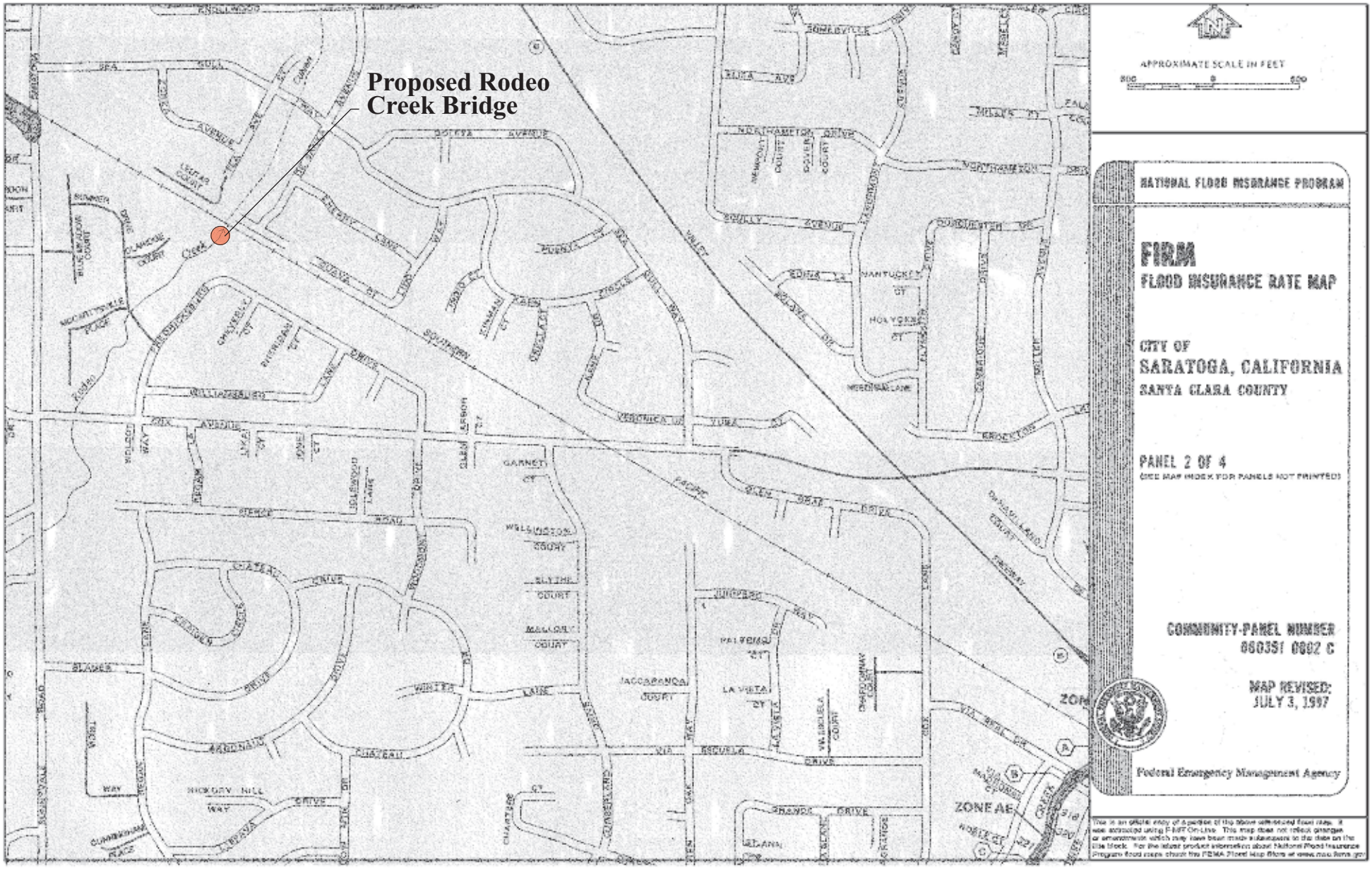
Hydraulic Data – Base Flood (Q_{100}) and Corresponding Water Surface Elevation

Schaaf & Wheeler estimated the flow at the proposed Rodeo Creek Bridge site during a 100-year 24-hour storm to be 262 cubic feet per second (cfs) (Schaaf & Wheeler, 2006b). This value considers features of a developed environment, such as paved surfaces and a storm drain system. However, for undeveloped surroundings, the estimated flow at the proposed Rodeo Creek Bridge site during a 100-year 24-hour storm is 400 cfs. To be conservative, Schaaf & Wheeler used the undeveloped flow value of 400 cfs to calculate the water surface elevation associated with a 100-year storm. The resulting water surface elevation is 320.2 feet NAVD.[1] These findings agree with the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) dated 3 July 1997 (Figure 2), which does not indicate the presence of a flood zone beyond the creek channel banks.

[1] North American Vertical Datum.

FLOOD INSURANCE RATE MAP, RODEO CREEK AREA

Figure 2



Saratoga De Anza Trail
Saratoga, California

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect charges or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov. See Figure 3 for Legend.

0 800 Feet

BASELINE

Y6259-01.00684.Fig2.cdr 3/8/07

Schaaf & Wheeler determined the water surface elevation at the proposed Saratoga Creek Bridge site for a 100-year storm using the FEMA FIRM dated 3 July 1997 (Schaaf & Wheeler, 2006a) (Figure 3). The FIRM indicates water surface elevations associated with the flood plain at various locations along the waterway. The water surface elevation of an area immediately upstream of the proposed bridge site is 312 feet NGVD.[2] A conversion factor of +2.74, based on geographic coordinates, was applied to the water surface elevation to transform the reference datum from NGVD to NAVD. The resulting water surface elevation is 315.3 feet NAVD. This equates to a flow of 3,950 cfs. The estimated water surface elevation indicates that the water surface elevation during a 100-year storm at or near the proposed bridge site will be less than or equal to 315 feet NAVD and will be contained within the creek channel banks.

Flood Plain Map

The FIRM, dated 3 July 1997, indicates the 100-year flood zone at Rodeo Creek Bridge would not exceed the banks of the creek (Figure 2). The hydraulic analysis of the creek performed by Schaaf & Wheeler confirms that the flood plain during a 100-year storm is contained within the banks of the channel (Schaaf & Wheeler, 2006b).

At Saratoga Creek, a flood zone hazard was identified in the FIRM (Figure 3). The proposed bridge site is located in Zone A, where no base flood elevation is determined (Figure 2). Based on the FIRM, the water surface elevation during a 100-year storm would be approximately 315 feet NGVD and the width of the flood plain at or near the proposed bridge site is approximately 70 feet. The 70-foot wide flood plain zone at the proposed bridge site would be contained within the banks of the channel.

Base Flood (Q_{100}) Backwater Potential Impacts

The existing land use surrounding both proposed bridge sites includes residential, industrial, and open space. In addition to residential and industrial land uses, the proposed Saratoga Bridge will be located within a recreational park, Congress Spring Park.

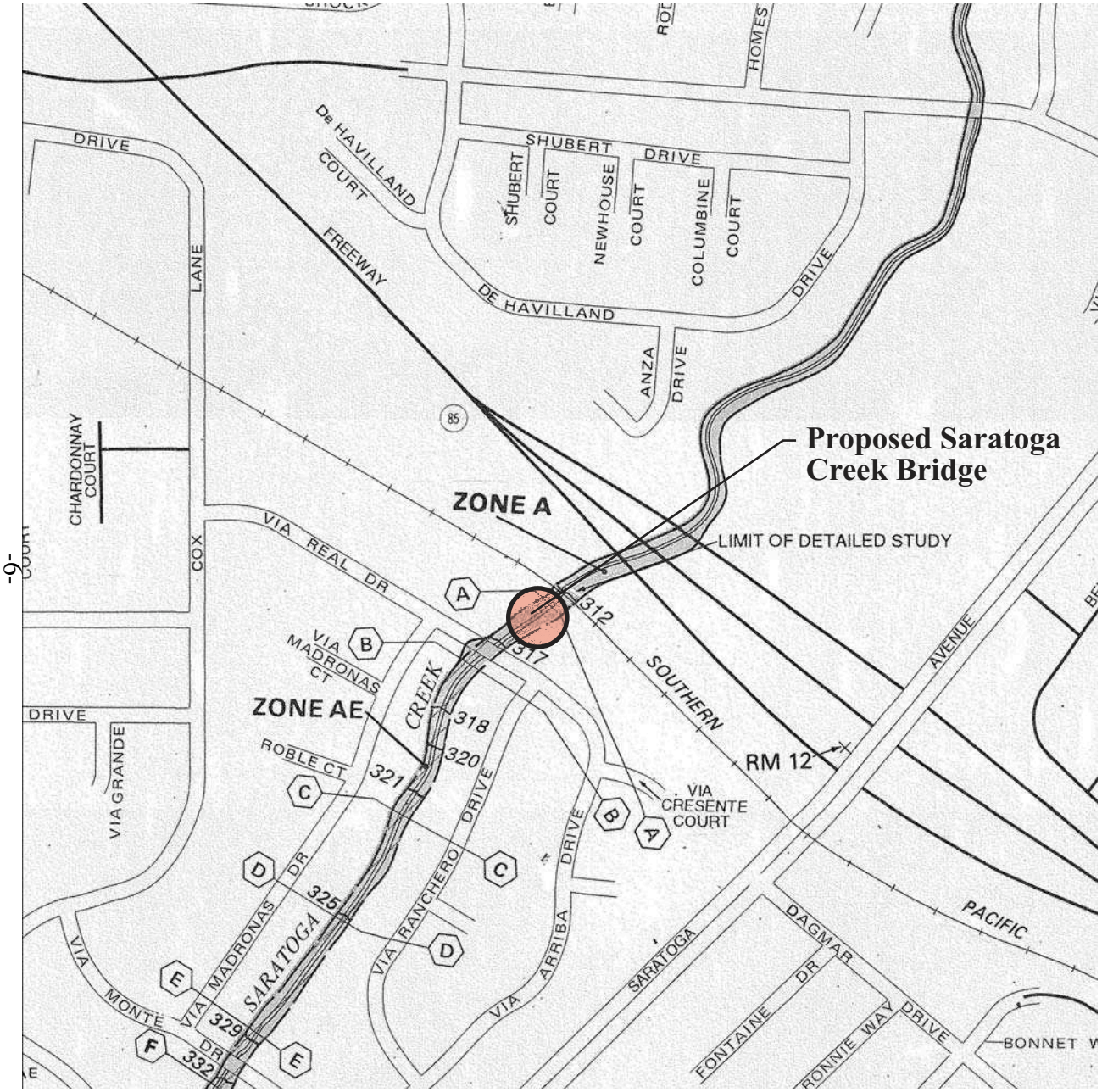
The proposed bridge crossings are not expected to result in flood plain encroachment because the expected flood plain during a 100-year storm is within the banks of the creek and the bridge-supporting piers will be located a minimum of six feet from the banks of the creek (CSA, 2006).

The clearance between the bottom of the proposed bridges and the water surface elevation of the corresponding creeks was not evaluated because engineering design drawings were not available at the time of this study. However, the water surface elevation is not expected to exceed the elevation of the bottom of the respective bridges if the bridge supports are located not less than six feet from the creek banks.

[2] National Geodetic Vertical Datum.

FLOOD INSURANCE RATE MAP, SARATOGA CREEK AREA

Figure 3



Legend

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.

ZONE V Coastal flood with velocity hazard (wave actions); base flood elevations determined.

ZONE VE FLOOD AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 3 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to special flood harzard areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet where Uniform within Zone*

RM 7x — Elevation Reference Mark

Source: Community-Panel No. 060351 0002 C

Saratoga De Anza Trail
Saratoga, California

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect charges or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

0 500 Feet

BASELINE

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Traffic

Approximate Traffic Volume

The existing condition at or near the proposed bridge sites does not contain any roadways. The trail and the connecting bridges would only be used for pedestrian and bike traffic.

Emergency Supply/ Evacuation Route and Emergency Vehicle Access

The proposed bridges would be designed for pedestrian and bicycle traffic and therefore, not expected to serve as emergency route and emergency vehicle access points.

Available Practicable Detour

The proposed trail and associated bridges would be used for recreational activities and therefore are not considered as essential transportation corridors. Therefore, an available, practicable detour is not necessary.

School Bus or Mail Route

The proposed bridge crossings are part of a 1.6-mile mixed-use trail. It is not expected that the proposed bridges would be used as a route for mail delivery or school bus use.

Approximate Duration of Traffic Interruption for 100-year Base Flood (Q_{100})

The proposed bridge crossings would not be used for transportation routes other than a pedestrian walkway and bicycle route and the project is not expected to result in an increase in base flood elevation or flood plain encroachment. Therefore, traffic interruptions associated with a 100-year base flood are not expected to occur.

Other – Impacts and Corresponding Measures to Restore and Preserve Natural and Beneficial Flood Plain Values[3]

The City of Saratoga's goal is to develop the proposed trail while preserving the natural beauty of the creek (Saratoga, 2004a). Natural landscaping has been incorporated in the design to promote a natural habitat for wildlife and fisheries. Irrigated landscaping and disturbance to vegetation will be minimized to the greatest extent possible. Once built, the 1.6-mile bike and pedestrian trail will provide additional Open Space and outdoor recreation for the residents of Saratoga. Based on the goals and objectives of the project, it appears that the bridge improvements would not result in incompatible flood plain development.

[3] According to 23 CFR Part 650A, natural and beneficial flood plain values include, but not limited to, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, forestry, natural moderation of floods, water quality maintenance, and groundwater discharge.

REFERENCES

Cotton, Shires & Associates (CSA), 2006, *Geotechnical Investigation Saratoga Bridges Rodeo Creek and Saratoga Creek*, November.

Saratoga, City of, 2004a, Fact Sheet: *Goals and Objectives*, 12 August.

Schaaf & Wheeler Civil Engineers (Schaaf & Wheeler), 2006a, Technical Memorandum, *100-Year Water Surface Elevation of Saratoga Creek at Proposed Bridge Crossing,* November.

Schaaf & Wheeler Civil Engineers, 2006b, Technical Memorandum, *100-Year Water Surface Elevation of Rodeo Creek at Proposed Bridge Crossing*, December.

APPENDIX A

Cotton, Shires & Associates
Geotechnical Investigation, Saratoga Bridges
Rodeo Creek and Saratoga Creek

November 28, 2006
E0476

Ms. Iveta Harvancik
Associate Civil Engineer
CITY OF SARATOGA
13777 Fruitvale Avenue
Saratoga, California 95070

SUBJECT: **Geotechnical Investigation**
RE: Saratoga Bridges, Rodeo Creek and Saratoga Creek
Saratoga, California

Dear Ms. Harvancik:

With this letter, we are pleased to submit the following report describing the findings, conclusions, and recommendations of our geotechnical investigation for the proposed pedestrian/bicycle bridges over Rodeo Creek and Saratoga Creek in Saratoga, California. This investigation was performed in accordance with our Proposal for Geotechnical Services dated August 15, 2006.

Included in this report is our engineering geologic characterization and assessment of the geologic and subsurface conditions at the bridge sites, as well as our conclusions and recommendations, based on our geotechnical investigation of the surface and subsurface conditions in the vicinity of the proposed bridge abutments.

We appreciate the opportunity to have been of service to you on this project. If you have any questions regarding this report, please contact our office.

Very truly yours,
COTTON, SHIRES AND ASSOCIATES, INC.

David T. Schrier
Supervising Geotechnical Engineer
GE 2334

Ted Sayre
Supervising Engineering Geologist
CEG 1795

DTS:TS:POS:st

GEOTECHNICAL INVESTIGATION

SARATOGA BRIDGES
RODEO CREEK AND SARATOGA CREEK
SARATOGA, CALIFORNIA

Prepared for:
Ms. Iveta Harvancik
Associate Engineer
CITY OF SARATOGA
13777 Fruitvale Avenue
Saratoga, California 95070

NOVEMBER 2006

COTTON, SHIRES & ASSOCIATES, INC.
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GEOTECHNICAL INVESTIGATION
SARATOGA BRIDGES
RODEO CREEK AND SARATOGA CREEK
Saratoga, California

for

The City of Saratoga
13777 Fruitvale Avenue
Saratoga, California 95070

by

COTTON, SHIRES AND ASSOCIATES, INC.
330 Village Lane
Los Gatos, California 95030

November 2006

GEOTECHNICAL INVESTIGATION
SARATOGA BRIDGES
RODEO CREEK AND SARATOGA CREEK
Saratoga, California

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GEOTECHNICAL INVESTIGATION
SARATOGA BRIDGES
RODEO CREEK AND SARATOGA CREEK
Saratoga, California

1.0 INTRODUCTION

In this report we present the results of our geotechnical investigation for the proposed pedestrian/bicycle bridges to be located across Rodeo Creek and Saratoga Creek in Saratoga, California. The proposed bridge site at Rodeo Creek is to be located between Saratoga-Sunnyvale Road and Cox Avenue, and adjacent to the southwestern side of the railroad tracks (Figure 1). The proposed bridge site at Saratoga Creek is to be located between Glen Brae Drive and Saratoga Avenue, near the southeastern end of Congress Springs Park, and adjacent to the southwestern side of the railroad tracks (Figure 1).

We understand that both bridges will consist of prefabricated steel truss structures supported by concrete abutments. We also understand that the planned pedestrian/bicycle bridges will be part of the Saratoga de Anza Trail, and that the bridges will be designed for relatively light loads associated with pedestrians and bicycles.

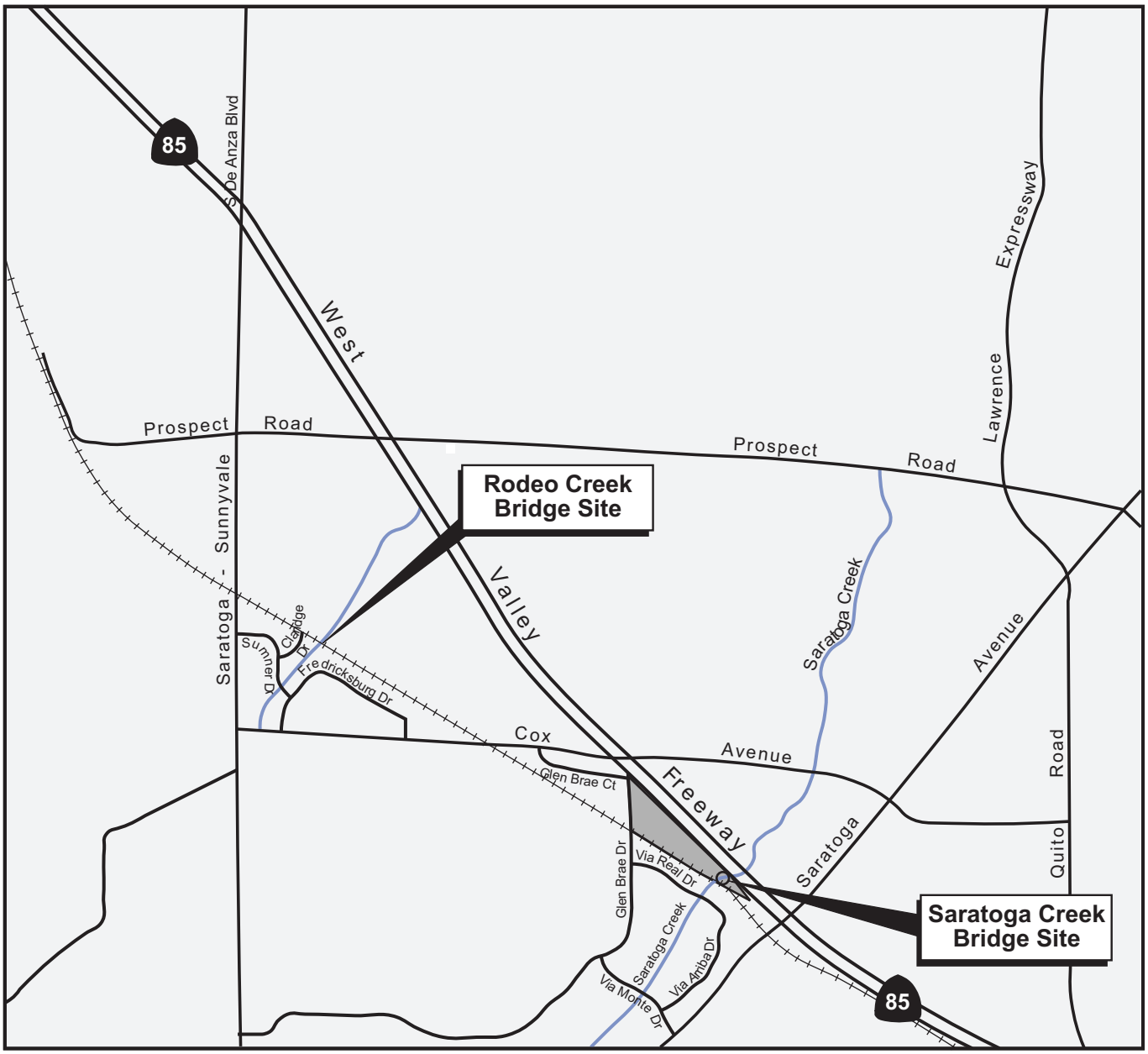
We performed this supplemental investigation between October 19, 2006 and November 21, 2006, for the City of Saratoga in accordance with our proposal dated August 15, 2005.

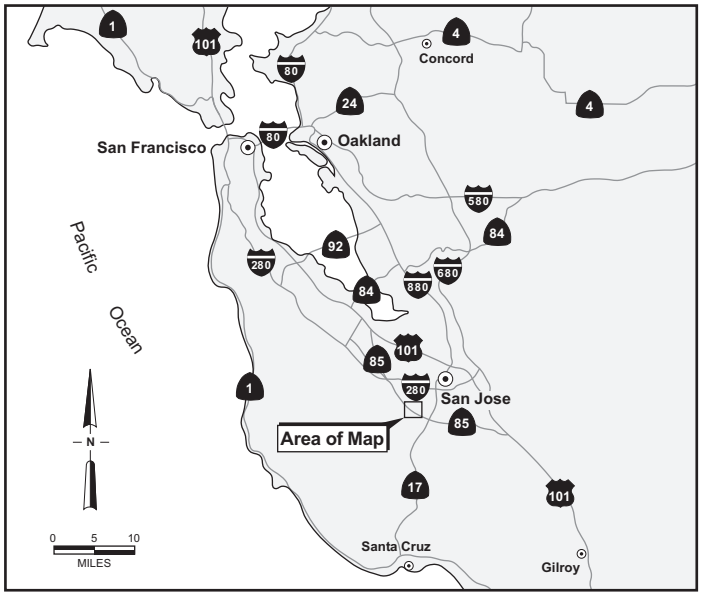
1.1 Purpose and Scope of Work

The purpose of our investigation was to develop geotechnical data for the project design. Our objectives were to: 1) evaluate and characterize surface and subsurface conditions; and 2) develop conclusions and recommendations regarding: geotechnical hazards; site grading; and foundation type and design criteria.

The specific scope of work performed for our investigation included the following tasks:

1) Review of in-house geologic data;
2) Subsurface exploration;
3) Laboratory testing;





N

0 0.25 0.5
MILES

Reference: Thomas Guide, 2001

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

SITE LOCATION MAP

SARATOGA BRIDGES
SARATOGA, CALIFORNIA

GEO/ENG. BY	SCALE	PROJECT NO.
DTS	As shown	E0476
APPROVED BY	DATE	FIGURE NO.
TS	NOVEMBER 2006	1

4) Engineering analysis; and
5) Preparation of this report.

2.0 GEOLOGIC SETTING

2.1 Terrain

Both bridge sites are located in a relatively level area of Saratoga, just west of Highway 85. According to the topographic cross section provided to us, the existing ground surface elevation at the Rodeo Creek bridge site is roughly 322 feet, and the elevation at the Saratoga Creek bridge site is approximately 321 feet.

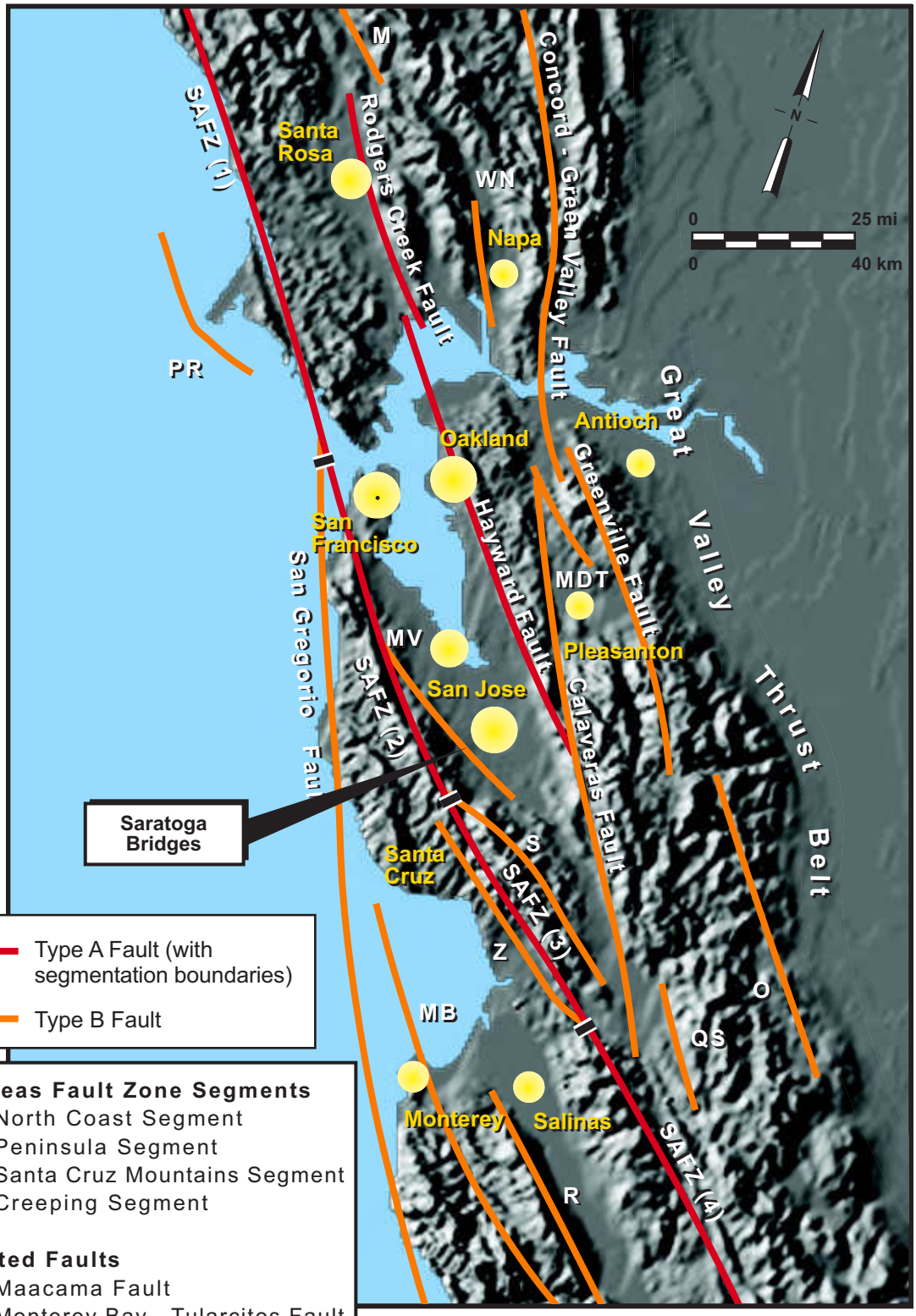
2.2 Geologic Setting

Both sites are located in the Santa Clara Valley, east of the Santa Cruz Mountains. The Rodeo Creek site is mapped as being underlain, at depth, by older alluvial fan deposits while the Saratoga Creek site is mapped as being underlain by younger alluvial terrace materials (Lettis, 1994).

Locally the Santa Cruz Mountains consist of Franciscan Complex sedimentary and metamorphic bedrock materials that have been uplifted and thrust over younger bedrock and alluvial soil materials of the Santa Clara Valley. The Santa Clara Valley is an elongated, northwest-trending extension of the San Francisco Bay structural trough, bounded on the west by the Santa Cruz Mountains and on the east by the Diablo Range.

2.3 Seismic Setting

Based on our review of regional geologic maps of the area, a trace of the potentially active Monta Vista (locally known as the Shannon fault) is located approximately 1,000 feet (0.2 miles/0.3 kilometers), and 2,000 feet (0.4 miles/0.6 kilometers) southwest, respectively, of the Rodeo Creek and Saratoga Creek Bridge sites (Figure 2). The Lettis (1994) map depicts several topographic lineaments, identified as traces of the Monta Vista fault, that pass very close to, or through, the proposed Rodeo Creek bridge site and just south of the Saratoga Creek site. The other significant active fault located close to



Type A Fault (with segmentation boundaries)

Type B Fault

San Andreas Fault Zone Segments

SAFZ-1	North Coast Segment
SAFZ-2	Peninsula Segment
SAFZ-3	Santa Cruz Mountains Segment
SAFZ-4	Creeping Segment

Abbreviated Faults

M	Maacama Fault
MB	Monterey Bay - Tularcitos Fault
MDT	Mount Diablo Thrust Fault
MV	Monte Vista - Shannon Fault
O	Ortigalita Fault
PR	Point Reyes Fault
QS	Quien Sabe Fault
R	Rinconada Fault
S	Sargent - Berrocal Fault
WN	West Napa Fault
Z	Zayante - Vergeles Fault

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

SAN FRANCISCO BAY AREA FAULT MAP

SARATOGA BRIDGES
SARATOGA, CALIFORNIA

GEO/ENG. BY	SCALE	PROJECT NO.
DTS	1"=25 miles	E0476
APPROVED BY	DATE	FIGURE NO.
TS	NOVEMBER 2006	2

the bridge sites is the San Andreas fault (4 to 4.5 miles/6.5 to 7.2 kilometers toward the southwest).

2.3.1 **Deterministic Analysis** - The following table summarizes pertinent fault information for the three closest active faults to the Rodeo Creek and Saratoga Creek Sites, including lists of the major earthquake sources, the distance from the sources to the site, the faulting style, the Maximum Credible Earthquake (MCE) Moment Magnitudes and the results of our deterministic Peak Horizontal Ground Accelerations analysis that are anticipated at the two sites (the Rodeo Creek site is listed first followed by the Saratoga Creek Site).

Fault Source	Fault-to-Site Distance (mi/km)[1]	Faulting Style	MCE Moment Magnitude[2]	Peak Horizontal Accelerations (g)[3]
Monta Vista (Shannon)	0.2/0.3 and 0.6/0.6	Reverse-oblique	6.5	**0.66** and **0.65**
San Andreas	4/6.5 and 4.5/7.2	Strike-slip	7.9	0.48 and 0.47
Zayante-Vergeles	14.1/22.7 and 13.4/21.5	Strike-slip	7.0	0.17 and 0.18

[1]Based on UBCSEIS Computer Program Vesion 1.03 by T.F. Blake, updated 2004;

[2] Based on "Probabilistic Seismic Hazard Assessment for the State of California" by CDMG, DMG Open-File Report 96-08;

[3] Based on attenuation relationships developed by Bozorgnia, Campbell & Niazi 1999, (horizontal component, Pleistocene, corrected); as determined using the computer program EQFAULT Version 3.00b by T.F. Blake, 1989, and updated 2004.

2.3.2 **Probabilistic Analysis** - We also performed a probabilistic analysis employing the computer program FRISKSP (by T.F. Blake, 1988 and updated 2004) and incorporated moment magnitudes from the California Division of Mines and Geology (CDMG) publication "Probabilistic Seismic Hazard Assessment For The State of California" (DMG Open-File Report 96-08), and attenuation relationships by Bozorgnia, Campbell, and Niazi 1999 (horizontal – Pleistocene soil, corrected). The results of our

probabilistic analysis indicate an appropriate Design Basis Earthquake (10 percent probability of exceedance in 50 years or a 475-year return interval, which is generally used for residential and commercial buildings) peak horizontal ground acceleration is **0.56g** for the Rodeo Creek site and **0.55g** for the Saratoga Creek site.

Taking into account the above earthquake Moment Magnitudes, the 1997 Uniform Building Code (UBC) coefficients presented in Section 5.6, and the results of the deterministic and probabilistic approaches, it is our opinion that the Rodeo Creek and Saratoga Creek project areas could experience peak horizontal ground acceleration (PGA) as high as **0.66g** to **0.65g** (equal to the deterministic acceleration calculated for an earthquake on the Monta Vista fault for the sites), respectively.

3.0 SITE CONDITIONS

In the following section we summarize the results of our interpretation of the surface and subsurface conditions observed and encountered at the Rodeo Creek and Saratoga Creek Bridge Sites.

3.1 Surface Conditions

The Rodeo Creek bridge site is a located in a residential area situated toward the northern side of the Town of Saratoga. Vegetation in the area includes several large, mature trees adjacent to the creek bank. The bridge would be located adjacent to the southern side of the railroad tracks between Saratoga Sunnyvale Road and Cox Avenue. The existing improvements in the immediate area consist of an existing culvert (with trash rack) that conveys the creek under the tracks, adjacent high power utility lines and a tower, and various vaults and manholes for underground utilities. The incised creek channel at the proposed bridge location is approximately 40 to 45 feet wide and roughly 7 feet deep.

The Saratoga Creek bridge site is located just beyond the southeastern end of Congress Springs Park, adjacent to the Highway 85 and Saratoga Avenue intersection. We observed several large, mature trees adjacent to the creek bank. The bridge would be located adjacent to the southern side of the railroad tracks between Glen Brae Drive and

Saratoga Avenue. The existing improvements in the immediate area consist of a railroad track bridge over the creek, adjacent high power utility lines and a tower, and various vaults and manholes for underground utilities. The incised creek channel at this proposed bridge location is approximately 70 to 75 feet wide and roughly 14 to 15 feet deep.

We did not observe any indications of landsliding or significant grading at the two proposed bridge sites.

3.2 Subsurface Conditions

We explored subsurface conditions at the two bridge sites by means of four (4) exploratory borings (one boring located on each bridge abutment) drilled to depths of 35.5 to 36 feet at the locations shown on Figures 3 and 4. In the two borings (CSA/SD-3 and CSA/SD-4) located at the Rodeo Creek bridge site, we generally encountered loose (in CSA/SD-3 at 10 feet) to very dense silty, sandy alluvial soil materials (with gravels and several interbedded clay lenses) to the depths explored (Figure 5). In the two borings (CSA/SD-1 and CSA/SD-2) located at the Saratoga Creek bridge site, we generally encountered very loose (in CSA/SD-2 at 4 feet) to very dense silty, sandy fill and alluvial soil materials (with gravels and one interbedded clay lense) to the depths explored (Figure 6). In Borings CSA/SD-1 and CSA/SD-2, we encountered 8.5 feet and 5.5 feet of fill material, respectively, overlying the alluvial soil material. The fill material generally consisted of silty sand; however, in CSA/SD-2, we encountered two feet thickness of clean sand. We interpreted the clean sand material as trench backfill, possibly for one of the nearby underground utilities.

Based on the results of our laboratory testing, it appears that the native, sandy material has high shear strengths and has low plasticity, at both bridge sites.

A detailed description of the exploration program, logs of the borings, and the results of laboratory tests performed on representative samples are presented on the boring logs in Appendix A and in Appendix B.

3.3 Groundwater Conditions

Explanation

Map Symbols

B' B — Engineering Geologic Cross Section

CSA-SD-4 — Small Diameter Exploratory Boring

NOTE: The location and alignment of the cross section are generalized

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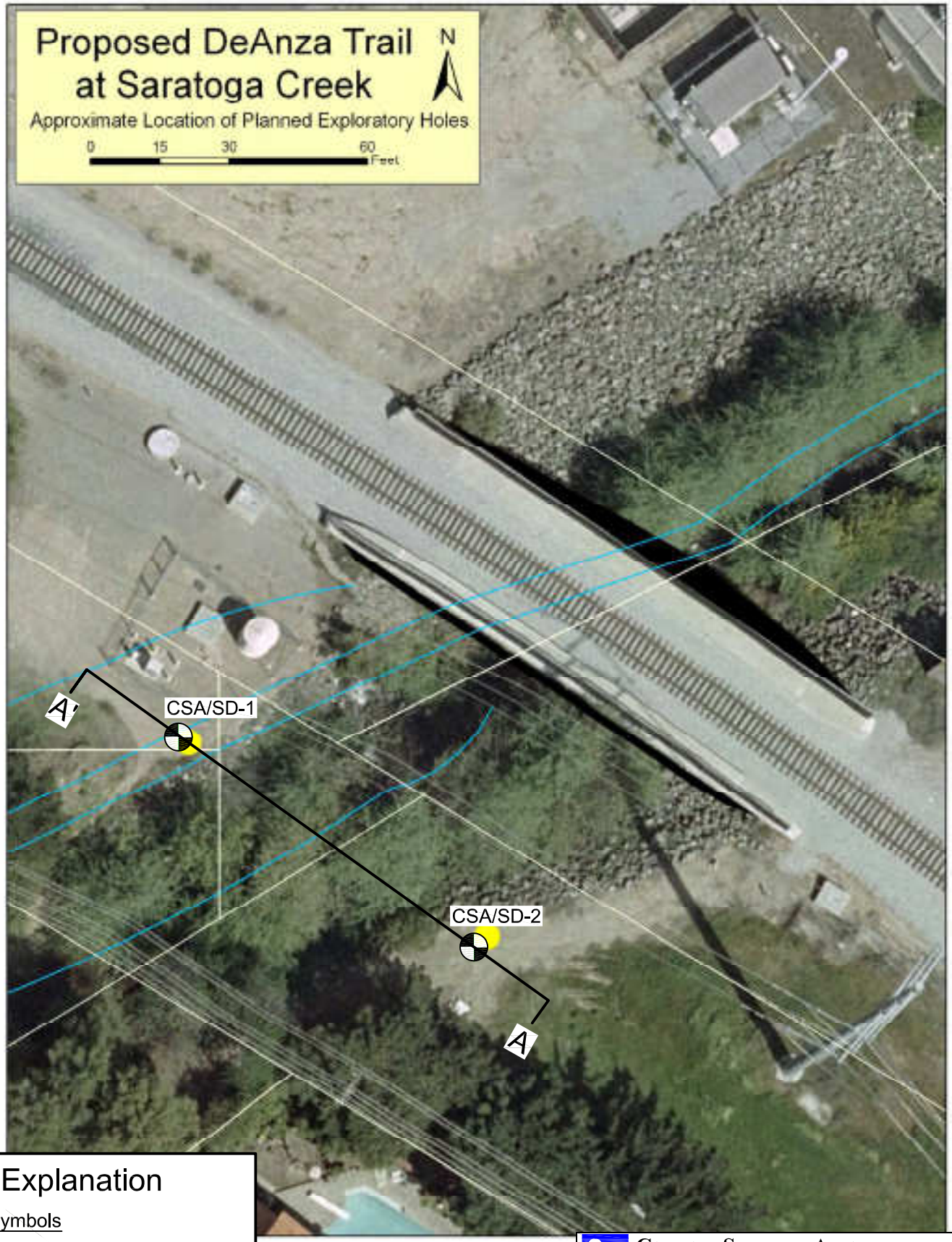
Rodeo Creek Site Plan and Boring Location Map
Saratoga Bridges
Saratoga, California

GEO/ENG BY	SCALE	PROJECT NO.
TS/DTS	1"=30'	E0476
APPROVED BY	DATE	FIGURE NO.
POS	NOVEMBER 2006	3



Explanation

Map Symbols

A' — A: Engineering Geologic Cross Section

CSA-SD-2: Small Diameter Exploratory Boring

NOTE: The location and alignment of the cross section are generalized

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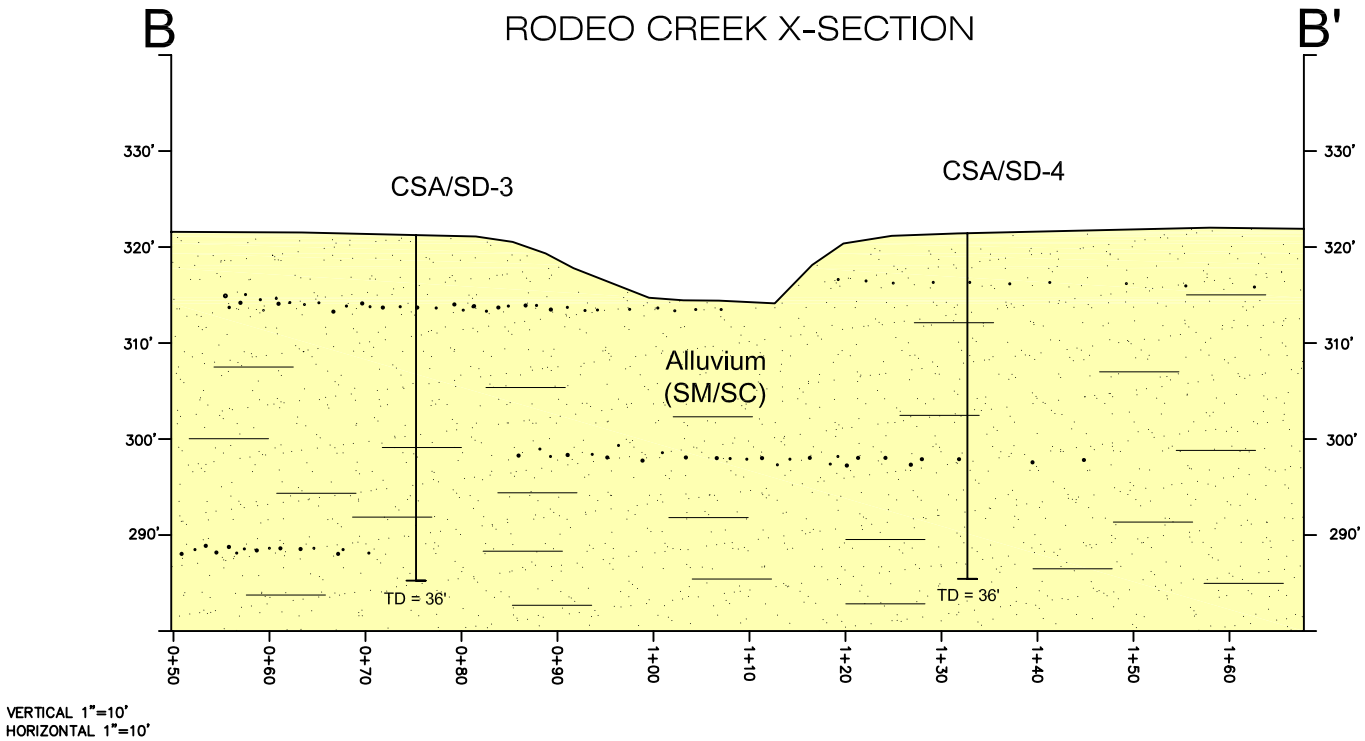
Saratoga Creek Site Plan and Boring Location Map
Saratoga Bridges
Saratoga, California

GEO/ENG BY	SCALE	PROJECT NO.
TS/DTS	1"=30'	E0476
APPROVED BY	DATE	FIGURE NO.
POS	NOVEMBER 2006	4



NOTE:
ALL ELEVATIONS ARE BASED ON SCHAAF & WHEELER DECEMBER 7, 2006 TECHNICAL MEMORANDUM.
CREEK X-SECTION ARE FROM PROPOSED CENTER LINE OF TRAIL LOOKING UPSTREAM.

Explanation

Earth Materials

Surficial Deposits

SM/SC — Alluvium; Silty Sand/Clayey Sand

Symbols

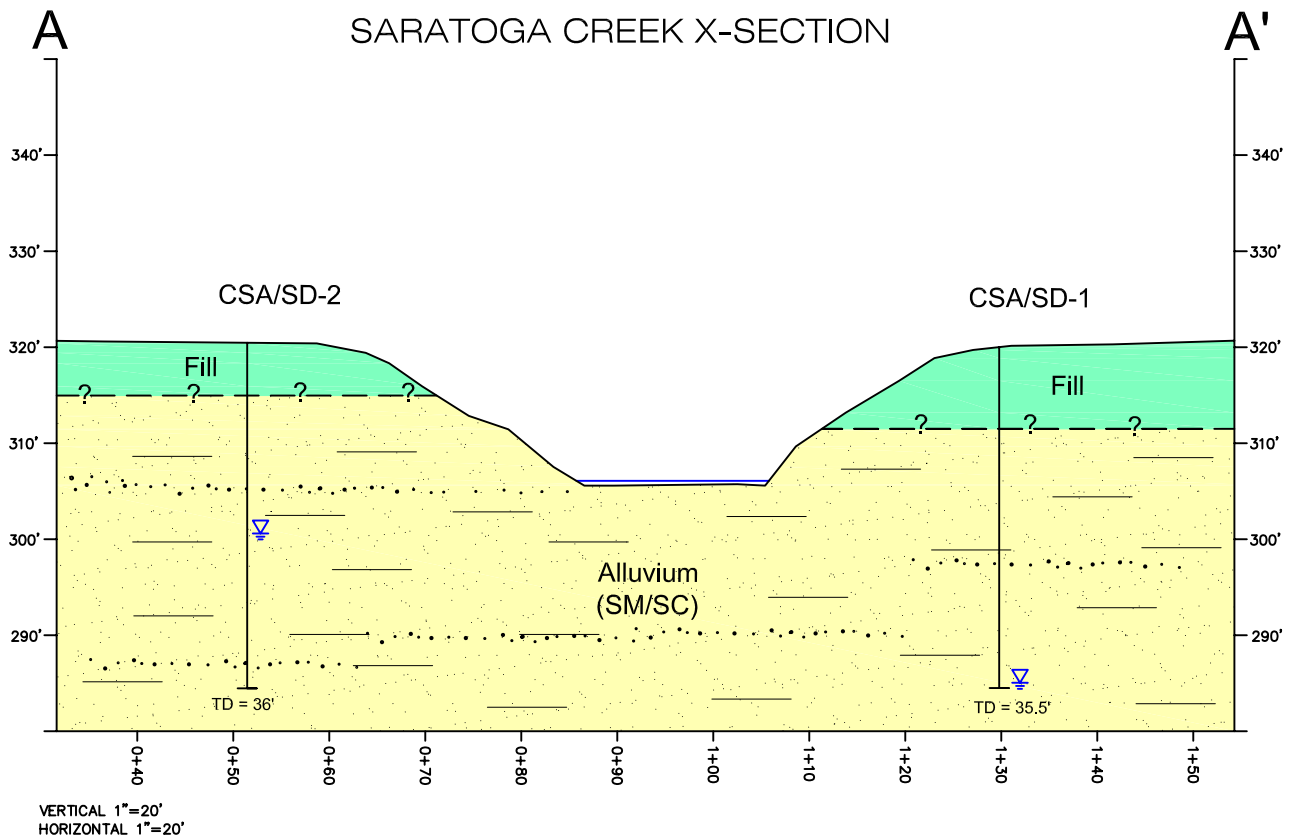
CSA/SD-4
TD = 36'
Exploratory Boring

Profile prepared by
PAUL JENSEN
PROFESSIONAL LAND SURVEYOR #4627
BOULDER CREEK, CALIFORNIA
AUGUST, 2006

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

Engineering Geologic Section B-B'
Rodeo Creek - Saratoga Bridges
Saratoga, California

GEO/ENG BY	SCALE	PROJECT NO.
TS/DTS	1"=20'	E0476
APPROVED BY	DATE	FIGURE NO.
POS	NOVEMBER 2006	5



Explanation

Earth Materials

Surficial Deposits

Artificial Fill

Alluvium; Silty Sand/Clayey Sand

Symbols

CSA/SD-2
TD = 36'
Exploratory Boring

Water Level Measured in Boring at Time of Drilling

Geologic Contact, Dashed where Approximate

NOTE:
ALL ELEVATIONS ARE BASED ON NAVD 88.
CREEK X-SECTION ARE FROM PROPOSED CENTER LINE OF TRAIL LOOKING UPSTREAM.

Profile prepared by
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BOULDER CREEK, CALIFORNIA
AUGUST, 2006

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

Engineering Geologic Section A-A'
Saratoga Creek - Saratoga Bridges
Saratoga, California

GEO/ENG BY	SCALE	PROJECT NO.
TS/DTS	1"=20'	E0476
APPROVED BY	DATE	FIGURE NO.
POS	NOVEMBER 2006	6

Groundwater was encountered during drilling of the borings adjacent to Saratoga Creek at the following depths: in CSA-1 at a depth of 20 feet; and in CSA-2 at a depth of 35 feet. Fluctuations in the groundwater level could occur from variations in rainfall, flooding and other factors, and groundwater levels may be different at different times and locations.

4.0 POTENTIAL GEOTECHNICAL HAZARDS

In the following section, we list identified potential geotechnical hazards at the proposed bridge sites, along with the corresponding degrees of determined potential risk, and recommendations for possible mitigation measures.

4.1 Creek Bank Erosion and Scour

Based on our field reconnaissance and mapping, we judge that the potential for undermining of the bridge foundations and abutments from creek bank erosion and scour to be **moderate to high**. In order to reduce the potential adverse effects of creek scour undermining the proposed bridge foundations, we have provided recommendations for a cast-in-place drilled pier foundation where the piers extend well below the current creek channel bottom. We have also recommended that the drilled piers be located at least 6 feet from the top of the creek bank, and this is consistent with the City's request.

We recommend that the project hydrologist determine the following: peak creek flows and corresponding return intervals to ensure that the proposed pedestrian/bicycle bridges will be able to convey the design flows; the capacity of the adjacent culvert and bridge; and potential adverse upstream and downstream effects due to the proposed new structures.

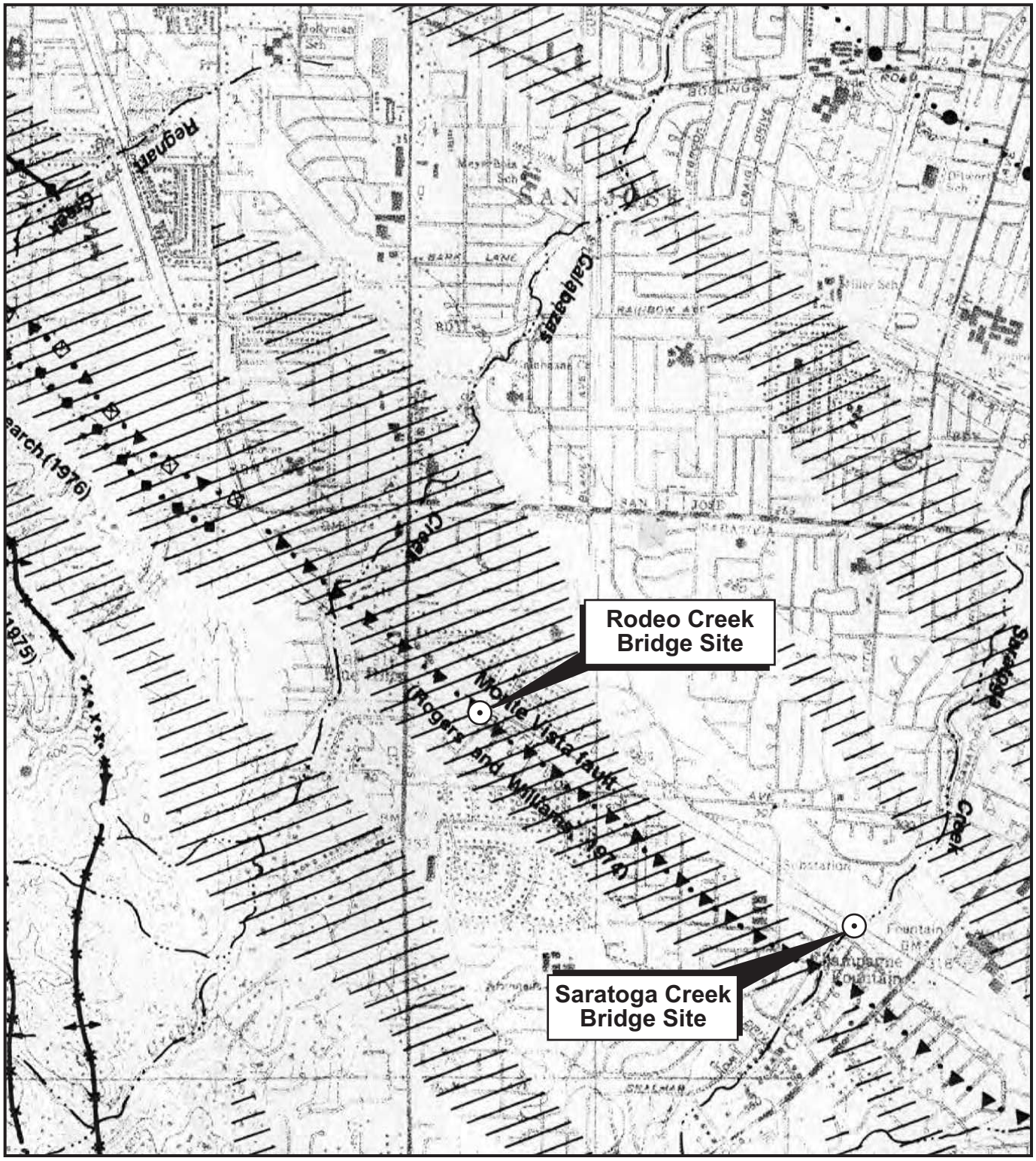
4.2 Seismic Hazards

Seismic ground shaking associated with a large earthquake on either the San Andreas or Monta Vista/Shannon faults is considered to be a hazard in the project area. Peak ground accelerations between 0.55 g and 0.66 g should be anticipated at the bridge sites (see report Section 2.3).

Seismically-induced ground failure mechanisms include fault rupture, differential compaction, liquefaction, and landsliding. Our review of several geologic maps of the area indicates that one map (Lettis, 1994) projects a trace or a "photolineament" of the Monta Vista/Shannon fault approximately through the proposed Rodeo Creek bridge site area (Figure 7). Consequently, the potential for fault rupture at the proposed Rodeo Creek bridge site is considered to be **moderate to high** if the local trace is presumed to be active, while the potential for fault rupture at the proposed Saratoga Creek bridge site is considered to be **low**. The geological activity of this fault trace is not well defined. If the City determines that additional investigation for identifying the location of fault traces in the area is warranted, then a fault investigation could be considered; however, due to the relatively low slip rates associated with the Monta Vista/Shannon fault system, and that the structure is uninhabitable and not a "life line", it is possible that such an investigation would not significantly modify the bridge design or location.

The potential for lurching and differential compaction due to earthquake shaking is considered to be **moderate to high,** and could result in differential settlements, while the potential for seismically induced landsliding of the creek banks is also considered **moderate** to **high**. The potential for deep landsliding, which could impact deep foundations, is considered to be **low**. The recommended foundation systems should mitigate the potential adverse effects of earthquake-induced creek bank failures, as well as seismically induced differential settlement and/or lurching.

Soil liquefaction is a phenomenon in which a saturated, cohesionless, near-surface soil layer loses strength during cyclic loading, such as is caused by earthquakes. During the loss of strength, the soil acquires a "mobility" sufficient to permit both horizontal and vertical movements. Soils that are most susceptible to liquefaction are clean, loose saturated, uniformly graded, fine-grained sands. We note that the Saratoga Creek site **is** located in the liquefaction hazard zone as mapped by the California Geological Survey, while the Rodeo Creek site is not (Figure 8).



N

0 1000 2000

FEET

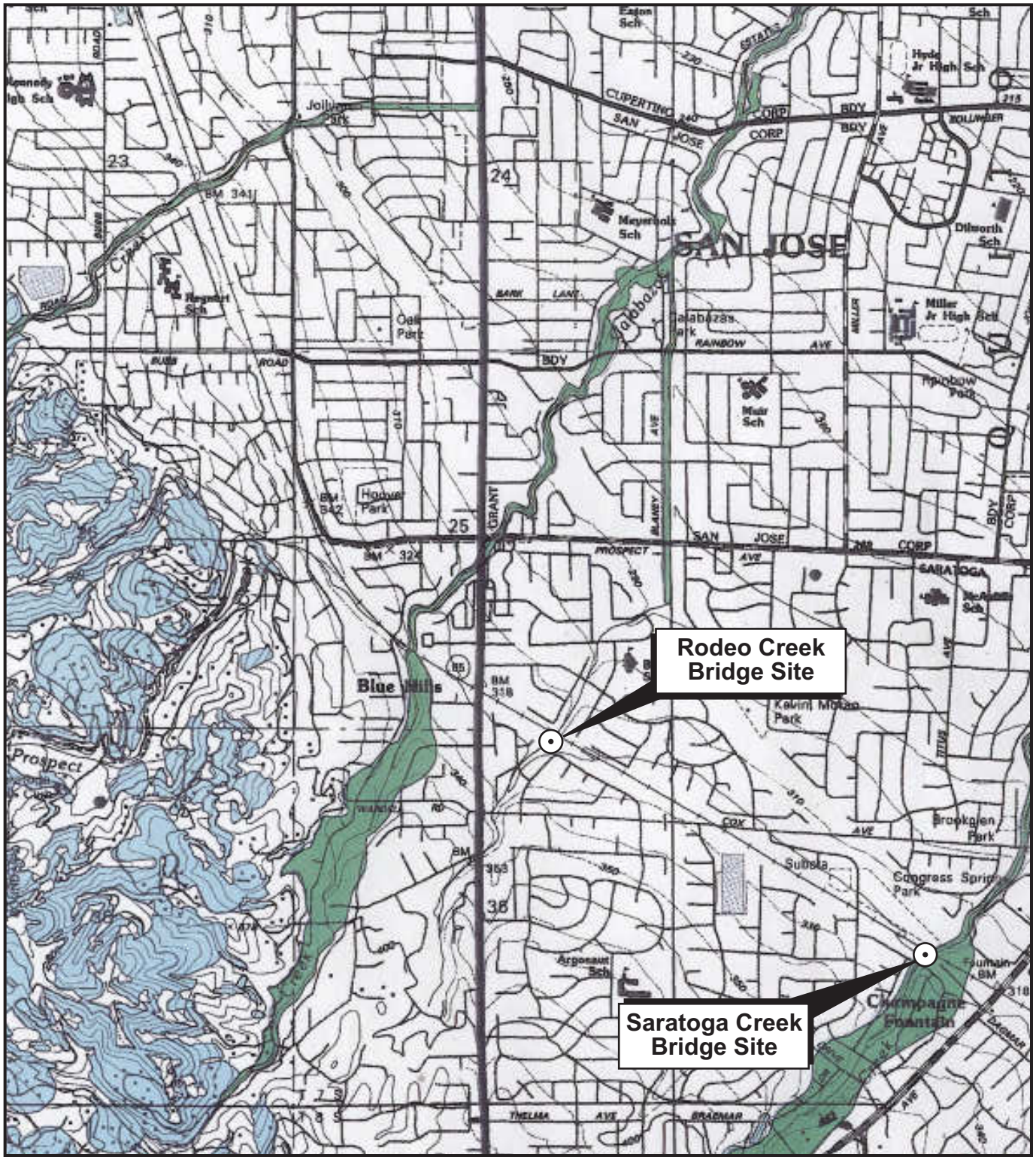
Source: William Lettis and Associates, 1994

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LINEATION AND FAULT ZONE MAP

SARATOGA BRIDGES
SARATOGA, CALIFORNIA

GEO/ENG. BY	SCALE	PROJECT NO.
DTS	As shown	E0476
APPROVED BY	DATE	FIGURE NO.
TS	NOVEMBER 2006	7



N

0 1000 2000

FEET

Source: California Geological Survey, 2002

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CALIFORNIA GEOLOGICAL SURVEY SEISMIC HAZARD ZONES MAP

SARATOGA BRIDGES

SARATOGA, CALIFORNIA

GEO/ENG. BY	SCALE	PROJECT NO.
DTS	As shown	E0476
APPROVED BY	DATE	FIGURE NO.
TS	NOVEMBER 2006	8

Based on an assumed conservative high groundwater level of 4 feet below the ground surface, we encountered potentially liquefiable sandy soil materials at both the Saratoga Creek Bridge and the Rodeo Creek Bridge sites.

We determined the factors of safety against triggering liquefaction (FS_l) by calculating the ratio of (1) the horizontal cyclic shear stress necessary to trigger liquefaction to (2) the average horizontal cyclic shear stress induced by the design earthquake. When this ratio is 1.3 or less (i.e., F.S.≤1.3), liquefaction is predicted to occur or could potentially be a problem.

We calculated **high** liquefaction potentials (i.e., low factor of safety), at the Saratoga Creek Bridge site in Boring CSA/SD-1, between 4 and 6.5 feet and in Boring CSA/SD-2, between 4 and 18.5 feet. We also calculated **high** liquefaction potentials at the Rodeo Creek Bridge site in Boring CSA/SD-3, between depths of 9 and 13 feet. The potential consequences of liquefaction include dynamic settlement, sand boils, ground fissures, and lateral deformations that could damage structures and other improvements.

We calculated that total or differential settlement of the ground surface due to liquefaction could be up to 2-1/4 inches (Tokimatsu and Seed, 1987) at the Saratoga Creek site and 1-1/2 inches at the Rodeo Creek site.

Due to the near-surface potentially liquefiable materials, we judge that liquefaction at both sites could result in surficial expressions such as sand boils (Ishihara, 1995). We also judge that the potential for lateral spreading is **high** because liquefiable soils are located at or above the Saratoga Creek channel bottom; however, the proposed foundation systems should help to reduce the potential adverse affects to the bridge abutments from lateral spreading and sand boils.

In order to reduce the adverse effects of liquefaction, we have provided recommendations for a cast-in-place drilled pier foundation system to support the bridge abutments below the zone of liquefiable material. While the recommended foundation system should resist ground distress from liquefaction to the extent necessary to prevent foundation failure, the level of damage that occurs from earthquake shaking will depend upon a number of factors, including the strength and

duration of shaking, variations in soil conditions between borings, the design of the lateral force-resisting system, and the care taken during construction.

We estimate that differential settlements due to static loading (excluding liquefaction) will be less than 1 inch across the bridge, at either site.

4.3 Surficial Erosion

Based on our experience, the underlying alluvial soil and terrace deposits are **moderately** susceptible to surficial erosion. We have provided recommendations for erosion control and surface drainage.

5.0 RECOMMENDATIONS

Based on the results of our investigation of the proposed bridge sites, we have developed the following recommendations and design criteria.

5.1 Foundation Design Criteria

5.1.1 Cast-in-Place Drilled Piers/Bridge Abutment - The proposed new bridge abutments should be supported by drilled, cast-in-place reinforced concrete piers that derive vertical support from adhesion (skin friction) in firm alluvium material beginning at a depth of 13 feet for both sites. The piers should also be located no closer than 6 feet from the top of the creek bank. The piers should be sized according to the following criteria:

Vertical Capacity – minimum three (3) pier diameter spacing
Minimum pier diameter ..... 18 inches
Minimum pier penetration below a depth of 13 feet ..... 10 feet

Allowable adhesion (skin friction), for reinforced concrete dead plus live loads:
0 to 13 feet into alluvium and fill material ..... 0 psf

Below a depth of 13 feet.....550 psf

Lateral Passive Resistance - piers [equivalent fluid pressure applied over an effective width of two (2) pier diameters]
0 to 13 feet into alluvium and fill material.....0 pcf
Below a depth of 13 feet.....450 pcf

The above adhesion value (skin friction) can be increased by 1/3 for seismic loading and should be decreased by 1/2 for uplift. The upper portion of the piers should be formed to create vertical surfaces, and "mushrooming" of pier tops and overpours around grade beams should be prevented. Drilled pier holes should be machine cleaned of all loose material prior to the placement of steel and concrete. Piers should be steel reinforced with a minimum of 4, No. 5 bars vertical (or with greater reinforcement as required by the project Structural Engineer).

If water is present in the pier holes prior to placing concrete (and we anticipate that this will be the case), the water should be pumped out until the pier holes are dry, or the concrete should be poured by tremie methods to displace the water. Casing will likely be necessary to prevent the cohesionless materials encountered in our borings from caving.

5.2 Site Grading

Based on our field investigation, grading excavations should be within the capabilities of moderate to heavy conventional excavation equipment (i.e., excavators, drill rigs and dozers).

5.2.1 Site Preparation - All loose material, vegetation, debris, and other deleterious material should be stripped and removed from the areas to be developed. This material should be disposed of in a suitable location off-site.

Excavation should proceed as necessary for planned grades, and soft and/or yielding materials in the location of the planned structures should be over excavated and replaced with engineered fill. Areas to be filled, should be scarified to at least an 8-inch depth, moisture conditioned to at least optimum moisture content and compacted to at

least 90 percent relative compaction based on ASTM D-1557-00. If fill is to be placed at the Saratoga Creek site, then the existing 5.5 to 8.5 feet of fill material should be removed and replaced with engineered fill.

5.2.2. **Compacted Fill** - Excavated on-site material is suitable for re-use as compacted fill provided it is free of organic material and other debris and rocks greater than 4 inches in maximum dimension. Imported fill should be free of organic material, should contain no material larger than 4 inches and should have a plasticity index of less than 16. Fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness, moisture conditioned to at least optimum moisture content, and compacted in lifts to at least 95 percent relative compaction beneath all structures, and within 18 inches of the aggregate base rock for pavements, and 90 percent relative compaction elsewhere.

5.2.3 **Cut Slope Design** - Any new permanent cut slopes in alluvium should not exceed an inclination of 2 horizontal to 1 vertical (2:1).

During the dry season, temporary cut slopes of 1.5 horizontal to 1 vertical (1.5:1) in alluvium, should be satisfactory for construction purposes, provided that they are inspected and approved by our field representative at the time of construction and monitored daily during construction. Excavation methods and safety are ultimately the responsibility of the contractor. All excavations should comply with applicable Local, State and Federal safety regulations.

5.2.4 **Fill Slope Design** - All permanent fill slopes should have a maximum inclination of 2 horizontal to 1 vertical (2:1).

5.2.5 **Keyway Design** - Fill materials placed on slopes steeper than 6:1 should be continuously keyed and benched at least 1 foot into firm in-place material. The resulting subgrade should be inspected for firmness prior to placement of any new fill materials.

5.2.6 **Pipelines, Utility Trench and Retaining Wall Backfill** – Planned pipelines should be placed at least 3 feet below final ground surface. Bedding materials for pipes should be in accordance with the pipe manufacturer's recommendations.

Trenches should be backfilled with either on site or approved import fill material compacted to a minimum of 90% of maximum dry density in non-structural areas and a minimum of 95% of maximum dry density beneath structures and the upper 18 inches of pavement subgrades. Equipment and methods should be used that are suitable for work in confined areas without damaging the walls or conduits.

Where a pipeline crosses a bridge abutment, it should be equipped with a flexible connection capable of withstanding up to 6 inches of deflection in all directions (including elongation).

Retaining walls should be backfilled with material that meets the requirements for compacted fill. Compaction equipment and methods should be used that are suitable for work in confined areas and that will not damage the backdrain pipe and filter fabric.

5.2.7 **Trail Subgrade Preparation** - After general compaction and compaction of the utility trench backfills, trail subgrade surfaces should be checked for yielding areas by proof-rolling with a loaded water truck or equivalent. Any yielding areas should be excavated and replaced with compacted fill. Then the upper 8 inches should be moisture conditioned to at least optimum moisture content and compacted to at least 95 percent relative compaction.

5.3 Retaining Wall Design

The following section provides our recommendations for the bridge abutments, wing walls, and site retaining walls.

5.3.1 **Retaining Walls** – The bridge abutments, wing walls, and site retaining walls should be supported on drilled piers designed according to the Foundation Design Criteria provided above. Retaining walls and abutments free to rotate should be designed to resist an active lateral fluid pressure of 50 pounds per cubic foot (pcf) for horizontal backfill, 60 pcf for 3:1 sloping backfill, and 75 pcf for 2:1 sloping backfill. The above active lateral fluid pressures should be increased by 50% for walls that are restrained from rotation. The lateral loads on the retaining wall can be resisted by passive pressure against the side of the piers using the Lateral Passive Resistance provided in Foundation Design Criteria, above. For seismic loading, a dynamic

resultant force should be applied to the wall acting at 0.6H up from the bottom of the wall, and equal to $20H^2$ (where H is the height of the wall).

For walls which will support vehicle loads (bridge abutments), a traffic surcharge of 250 psf should be included and applied against the top 10 feet of the retaining wall.

5.3.2 **Backdrain** - Backdrains should be constructed behind all retaining walls. The backdrain should be a minimum 12-inch wide continuous blanket of either Caltrans Class 2 Permeable Material or 3/4-inch x 1/2-inch clean crush drainrock enclosed in Mirafi 140N (or approved equivalent) filter fabric, and extended to within 1 to 1-1/2 feet of the ground surface where an impervious fill and/or asphaltic concrete cap should be placed. A minimum 4-inch diameter PVC Schedule 40 perforated drain pipe should be placed near the bottom of the drainrock (perforations down), surrounded by a minimum of 4 inches of drainrock with at least 2 inches of drainrock underlying the pipe. All backdrain pipes should be sloped to drain at a minimum of 1/2 percent and collected in 4-inch diameter non-perforated Schedule 40 PVC pipes which are sloped a minimum of 1 percent and discharged either into the City storm drainage system, the creek, or to a suitable location away from structures, or onto an impermeable surface.

5.4 Drainage

Because of the detrimental influence of water as it interacts with soil, bedrock, foundations, pavements, and cut and fill slopes, it is important that surface water be controlled. Retaining walls supporting cutslopes should be equipped with concrete lined ditches which discharge into area drains. Grades should be sloped to drain at a minimum of 2% for a distance of at least 10 feet out from structures with runoff directed into an appropriate catch basin/storm drain system.

5.5 Seismic Design

Peak ground accelerations of 0.66g and 0.65g for the Rodeo Creek and Saratoga Creek sites should be anticipated for design purposes. For the 1997 Uniform Building Code (UBC), assume that the site is located within Seismic Zone No. 4, and use the following values for design at both sites: Seismic Coefficients Ca and Cv of 0.57 and 1.02, respectively; and Na and Nv values of 1.3 and 1.6, respectively.

5.6 Erosion Control

All graded slopes higher than eight (8) feet, and steeper than 20 percent (5:1) should be covered with a securely staked erosion control blanket consisting of straw and coconut fiber and treated with hydroseed prior to exposure to rain. All other grounds disturbed by construction activities should be treated with hydroseed prior to exposure to rain.

An approved Storm Water Pollution Prevention Plan (SWPPP) should be implemented in accordance with Caltrans Standard Specifications. If freshly graded slopes are exposed to rain, this plan should include properly keyed and staked straw bale barriers at the base of the slopes higher than eight feet and steeper than 20 percent.

5.7 Technical Review

Supplemental geotechnical design recommendations should be provided by our firm based on specific design needs developed by the other project design professionals. This report, and any supplemental recommendations, should be reviewed by the contractor as part of the bid process. It is strongly recommended that no construction be started nor grading undertaken until the final drawings, specifications, and calculations have been reviewed and approved in writing by a representative of **our firm.**

5.8 Earthwork Construction Inspection and Testing

All excavations including foundations and keyways should be inspected by a representative of **our firm** prior to placing rebar, backfilling, and/or pouring concrete foundations. Any grading should also be inspected and tested as appropriate to confirm adequate stripping, subgrade preparation, and compaction. Our office should be contacted with a minimum of 48 hours advance notice of construction activities requiring inspection and/or testing services.

6.0 INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted engineering geology and geotechnical engineering principles

and practices. No warranty, expressed or implied, or merchantability of fitness, is made or intended in connection with our work, by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings.

Any recommendations and/or design criteria presented in this report are contingent upon our firm being retained to review the final drawings and specifications, to be consulted when any questions arise with regard to the recommendations contained herein, and to provide testing and inspection services for earthwork and construction operations. Unanticipated soil and geologic conditions are commonly encountered during construction which cannot be fully determined from existing exposures or by limited subsurface investigation. Such conditions may require additional expenditures during construction to obtain a properly constructed project. Some contingency fund is recommended to accommodate these possible extra costs.

This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are called the attention of the project engineer and incorporated into the plans. Furthermore, it is also the responsibility of the owner, or of his representative, to ensure that the contractor and subcontractors carry out such recommendations in the field.

7.0 REFERENCES

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the Northeastern Margin of the Santa Cruz Mountains Report to U.S. Geological Survey, 1994.

APPENDIX A

Field Investigation
Logs of Exploratory Borings

APPENDIX A
FIELD INVESTIGATION

The subsurface conditions of the subject sites were investigated using truck-mounted equipment provided by Cenozoic Exploration, Felton, California to drill a total of 4, small-diameter borings, one at each abutment. The engineering geologist logged the borings and visually classified the soils in accordance with ASTM D-2487. We obtained relatively undisturbed samples of the materials encountered at selected depths. These samples were obtained in brass liners that were 2.5 inches in outside diameter and 6 inches long; the liners were inside a 3-inch diameter modified split-barrel California Sampler. The sampler was driven with a 140-pound hammer that was raised by rope and cathead and allowed to freely fall about 30 inches. We also performed Standard Penetration Tests at selected depths. The depths of the sampling (and penetration testing) are shown on the boring logs. The bold number at the conclusion of the sampling interval represents the corrected blow count from a modified California sampler to Standard Penetration Test value accomplished by multiplying the blow count by 0.68.

Descriptive logs of the borings are presented in this appendix (see Logs for CSA/SD-1 through CSA/SD-4, A-1 through A-8). These logs depict our interpretation of the subsurface conditions at the dates and locations indicated based on representative samples collected at roughly a two-and-half to five-foot sampling intervals. It is not warranted that they are representative of subsurface conditions at other times and locations. The contacts on the logs represent the approximate boundaries between earth materials, and the transitions between these materials may be gradual. Representative samples were collected for subsequent laboratory testing and identification (see Appendix B).

COTTON, SHIRES, AND ASSOCIATES, INC.
LOG OF EXPLORATORY DRILLING

Project SARATOGA CREEK BRIDGES
Boring No. CSA/SD-3
Location East side of Rodeo Creek
Project No. E0476
Drilling Contractor/Rig CENOZOIC
Date of Drilling 10/20/06
Ground Surface Elev. _____ **Logged By** AM
Hole Diameter 3 1/4″
Surface Conditions _____
Weather Clear / Warm

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov.	Remarks
		SM	**ALLUVIUM 0′-BOH**							Start at 8:55 am
			0′-25′ Silty sand with gravels; moderate yellow brown to orange brown, loose to medium dense, moist to wet, gravels up to 2″				21	MC		
2				T-1	108	6.3	32			
				T-2			50/5″			
							50/5″			
4							10	MC		
				T-3			11			
				T-4	111	6.1	15			9:07 am
6							**18**			
							7	MC		
8				T-5			20			
				T-6			50/5″			**11% Passing #200 sieve**
							50/5″			
10							4	MC		
				T-7			3			
				T-8	103	10.8	7			**TX/UU 10,029 (7000)**
12							**7**			
14										9:30 am
							27	MC		
16			- Samples become wet at 15.5′	T-9			42			
				T-10	130	9.4	50/5″			
							50/5″			
18										
20							26	MC		
				T-11			50/3″			
							50/3″			
22										
24										
		SC	25′-36′ Clayey sand with gravels; moderate brown, dense, moist to wet							10:09 am
							12	MC		
26				T-12	127	12.1	31			**TX/UU 12,786 (10,000)**
				T-13			37			
							46			
28										

Project SARATOGA CREEK BRIDGES / E0476 Date 10/20/06 Boring No. CSA/SD-3

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov. (%)	Remarks
							23	MC		
				T-14			42			
				T-15			50/3″			
32							**50/5″**			
34										
							25	MC		
				T-16			50/4″			end at 10:55 am
36			**Total Depth = 36′** **No Water Encountered**				**50/4″**			
38										
40										
42										
44										
46										
48										
50										
52										
54										
56										
58										
60										
62										

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

COTTON, SHIRES, AND ASSOCIATES, INC.
LOG OF EXPLORATORY DRILLING

Project SARATOGA CREEK BRIDGES — **Boring No.** CSA/SD-2

Location East side of Saratoga Creek — **Project No.** E0476

Drilling Contractor/Rig CENOZOIC — **Date of Drilling** 10/19/06

Ground Surface Elev. _____ **Logged By** AM — **Hole Diameter** 3 1/4"

Surface Conditions Gravel Fill Pad — **Weather** Clear / Warm

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov.	Remarks
		SM	**FILL 0'-5.5'**							Start at 1:07 pm
			0'-4' Silty sand with gravels; moderate yellowish brown, medium dense, dry to moist, gravels up to 2" diameter				25	MC		
2				T-1			20			
				T-2	114	6.4	15			
							24			
4		SP	4'-5.5' Clean Sand trench backfill				1	MC		
							2			
				T-3			4			
6		SM	**ALLUVIUM 5.5'-BOH**				4			
			5.5'-20' Silty sand with gravels; moderate brown to orange brown, loose to medium dense, moist to wet, gravels up to 2"				6	MC		
8				B-1			12			
							12			
							16			
10							1	MC		
				T-4			2			
				T-5	116	2.3	6			TX/UU 4055 (2000)
12							5			
14										
							15	MC		
16				T-6			20			
				T-7	127	4.8	13			
							22			
18										
20		SC	20'-35.5' Clayey sand with gravels; moderate brown, dense, moist to wet				13	MC		
				T-8			21			
				T-9	131	10.4	32			TX/UU 7300 (3000)
22							36			
24										
							13	MC		
26				T-10			37			
				T-11	122	6.8	34			
							48			
28										
										2:55 pm

Project SARATOGA CREEK BRIDGES / E0476 Date 10/19/06 Boring No. CSA/SD-2

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov. (%)	Remarks
							20	MC		
				T-12			38			
				T-13			50/3″			
32							**50/5″**			
34										
				T-14			50/4″	MC		
36			**Total Depth = 35.5′** **Free Water on tip of sampler @ 35′** **Creek at 15′**				**50/4″**			end at 12:00 pm
38										
40										
42										
44										
46										
48										
50										
52										
54										
56										
58										
60										
62										

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

COTTON, SHIRES, AND ASSOCIATES, INC.
LOG OF EXPLORATORY DRILLING

Project SARATOGA CREEK BRIDGES
Boring No. CSA/SD-4
Location West Side of Rodeo Creek
Project No. E0476
Drilling Contractor/Rig CENOZOIC
Date of Drilling 10/20/06
Ground Surface Elev. _____ **Logged By** AM
Hole Diameter 3 1/4″
Surface Conditions _____
Weather Clear / Warm

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov.	Remarks
		SM	**ALLUVIUM 0′-BOH**							Start at 12:00 pm
			0′-36′ Silty sand with gravels; moderate yellow brown to orange brown, loose to medium dense, moist to wet, gravels up to 2″				27	MC		
2				T-1			27			
				T-2			25			**LL = 21, PI = 4**
							35			
4							8	MC		
				T-3			32			
				T-4	**127**	**5.8**	51			
6							**56**			
							19	MC		
				T-5			32			
8				T-6	**127**	**6.7**	51			**TX/CU C=0 Ø = 42°**
							56			
10							20	MC		12:27 pm
				T-7			50/5″			
12							**50/5″**			
14										
							34	MC		
				T-8			43			
16				T-9	**123**	**11.6**	50/5″			
							50/5″			
18										
20							23	MC		12:55 pm
				T-10	**124**	**9.8**	26			
				T-11			34			
22							**41**			
24										
							9	MC		
				T-12			15			
26				T-13			22			
							25			
28										

Project SARATOGA CREEK BRIDGES / E0476 Date 10/20/06 Boring No. CSA/SD-4

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov. (%)	Remarks
				T-14			50/3″	MC		
							50/5″			
32										
34										
							25	MC		
36				T-15			45			end at 2:07 pm
				T-16			50/5″			
			Total Depth = 36′ **No Water Encountered**				**50/5″**			
38										
40										
42										
44										
46										
48										
50										
52										
54										
56										
58										
60										
62										

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

COTTON, SHIRES, AND ASSOCIATES, INC.
LOG OF EXPLORATORY DRILLING

Project SARATOGA CREEK BRIDGES
Boring No. CSA/SD-1
Location West side of Saratoga Creek
Project No. E0476
Drilling Contractor/Rig CENOZOIC
Date of Drilling 10/19/06
Ground Surface Elev. 320.14′ **Logged By** AM
Hole Diameter 3 1/4″
Surface Conditions Gravel Fill Pad
Weather Clear / Warm

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov.	Remarks
		SM	**FILL 0′-8.5′**							Start at 10:06 am
			0′-8.5′ Silty sand with gravels; moderate yellowish brown, medium dense, dry to moist, gravels up to 2″ diameter				7	MC		
2				T-1			14			
				T-2	107	7.1	13			
							18			
4							12	MC		
				T-3			12			
				T-4	114	7.9	13			
6							17			
							14	MC		
8				T-5			7			
				T-6	110	7.1	32			
		SM	**ALLUVIUM 8.5′-BOH**				27			
10			8.5′-16′ Silty sand with gravels; moderate brown to orange brown, dense, moist to wet				23	MC		
				T-7	118	7.1	30			
				T-8			32			10:33 am
12							42			
14										
							15	MC		
				T-9			41			
16		SC	16′-36′ Clayey sand with gravels; moderate brown, dense, moist to wet	T-10	126	12.5	50			**TX/UU 8320 (3000)** 10:46 am
							62			
18										
20			- below 20′ material becomes gray, less fines				40	MC		
				T-11			29			
				T-12			39			
22							46			
24										
							28	MC		
26				T-13			50/5″			11:27 am
							50/5″			
28										

Project SARATOGA CREEK BRIDGES / E0476 Date 10/19/06 Boring No. CSA/SD-1

Depth (feet)	Graphic Log	USCS Class.	Geotechnical Description	Sample Desig.	Dry Density (pcf)	Moisture Content (%)	SPT Bl./ft.	Sample Type	Recov. (%)	Remarks
							27	MC		
				T-14			50/5″			
32							**50/5″**			
34										
							42	MC		
36				T-15			53/6″			end at 12:00 pm
			Total Depth = 36′ **Water encountered at 20′** **Creek at 15′**				**53/6″**			
38										
40										
42										
44										
46										
48										
50										
52										
54										
56										
58										
60										
62										

COTTON, SHIRES & ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

APPENDIX B

Laboratory Testing
Summary of Triaxial Compression Shear Strength Testing

APPENDIX B
LABORATORY TESTING

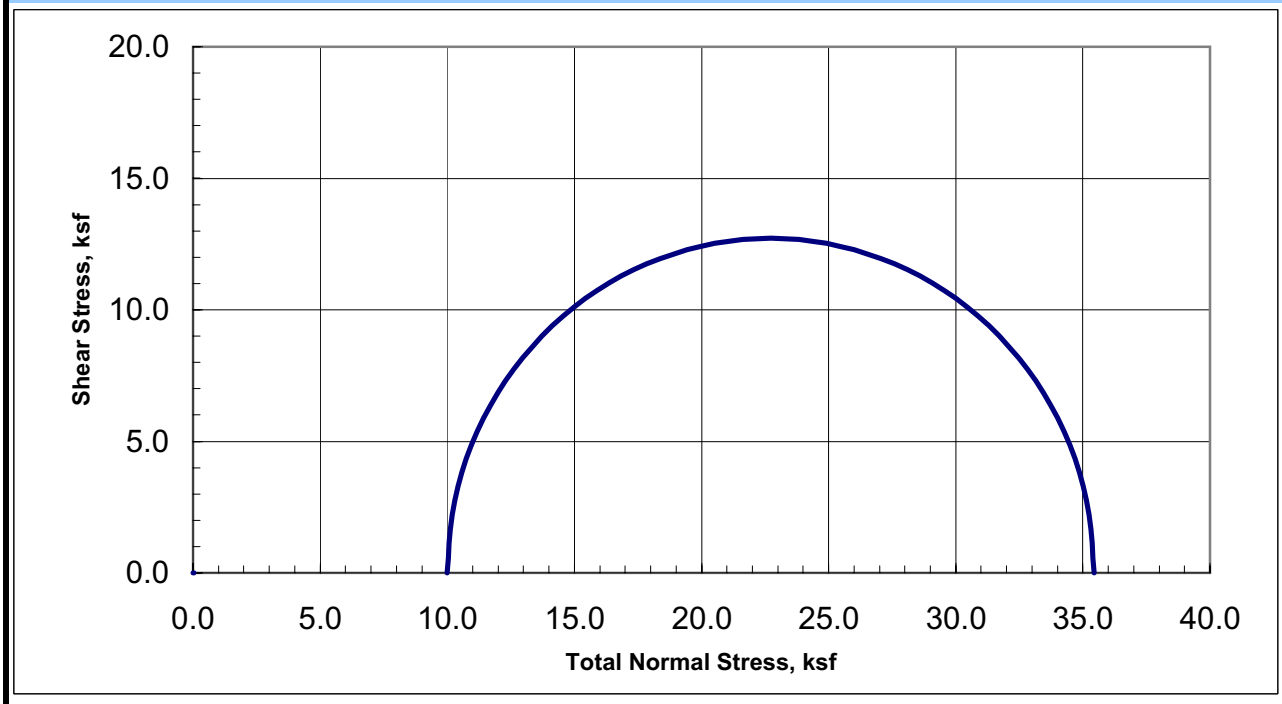
The laboratory analysis performed consisted of limited testing of the principal soil types sampled during the field investigation to evaluate index properties and strength parameters of subsurface materials. The soil descriptions and the field and laboratory test results were used to assign parameters to the various materials at the site. The results of the laboratory testing program are presented in this appendix and on the boring logs (Figures B-1 through B-3).

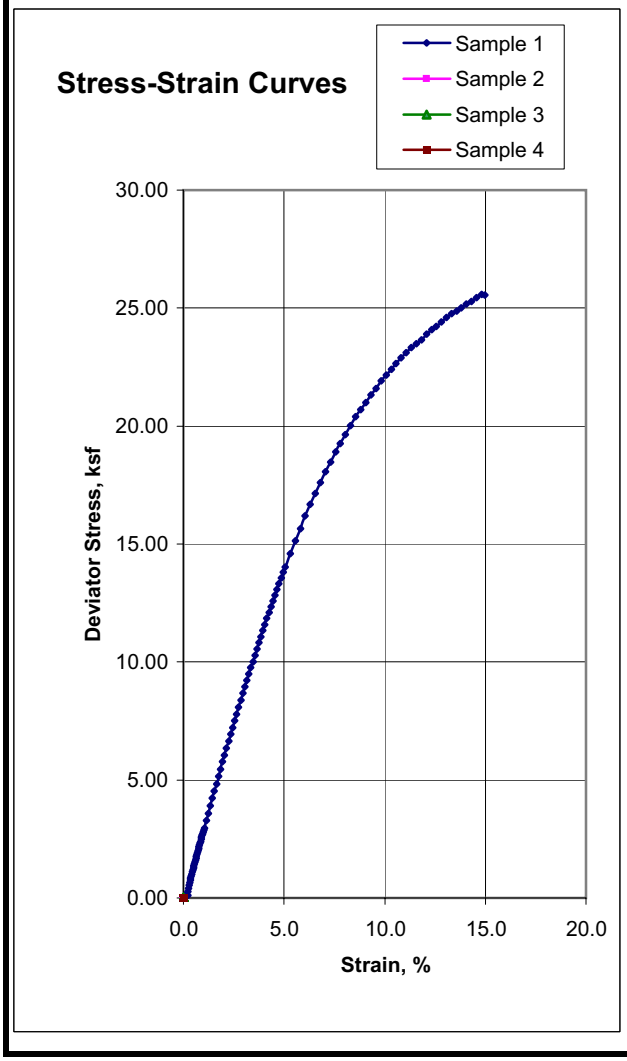
The following laboratory tests were performed as part of this investigation:

1. Detailed soil description: ASTM D 2487;
2. Natural moisture content of the soil: ASTM D 2216;
3. In-situ unit weight of the soil (wet and dry);
4. Triaxial compression shear strength (unconsolidated, undained) ASTM D 2850;
5. Triaxial compression shear strength (consolidated, undrained) ASTM D 4767;
6. Percent minus the No. 200 sieve, ASTM D 1140; and
7. Atterberg limits determination: ASTM D 4318.

Unconsolidated-Undrained Triaxial Test

ASTM D-2850



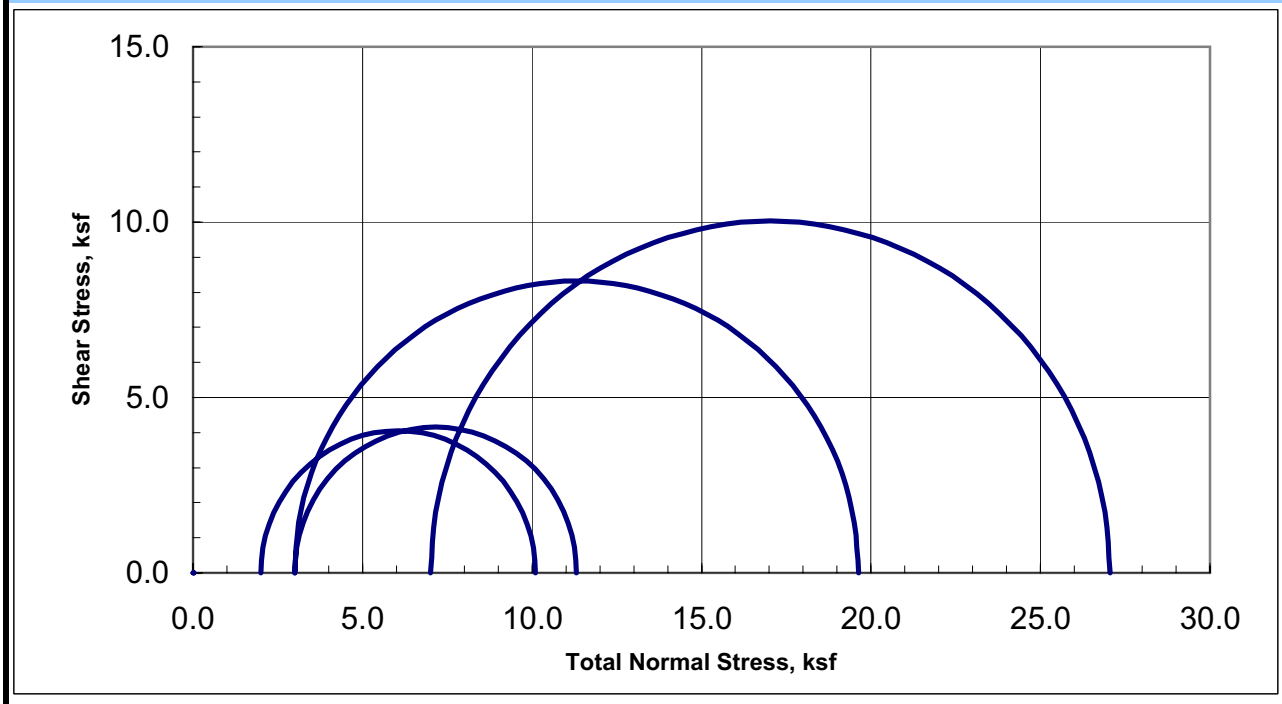


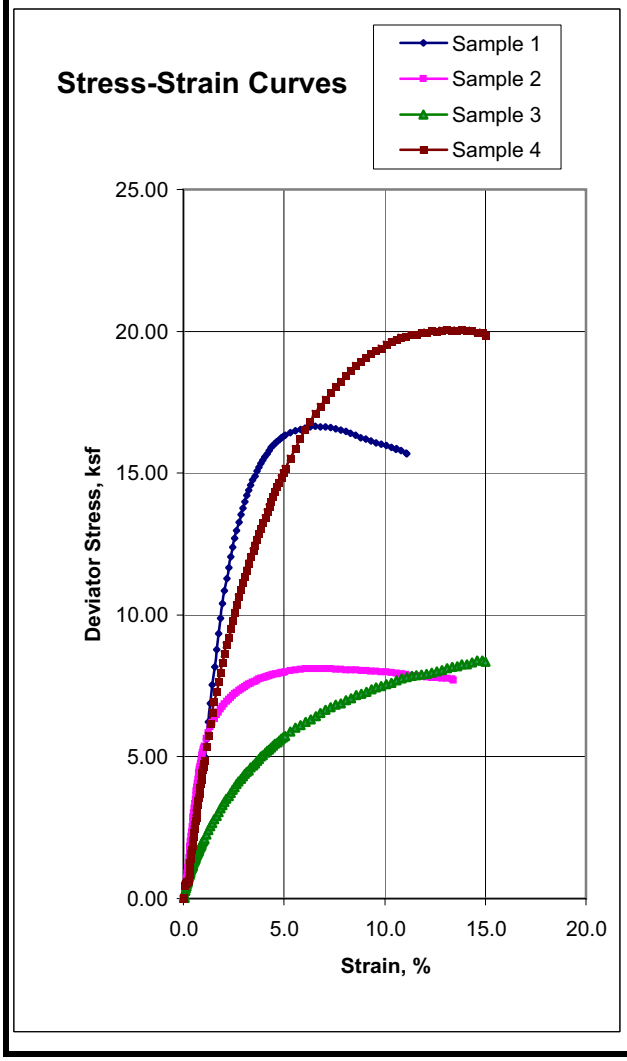
Sample Data				
	1	2	3	4
Moisture %	12.1			
Dry Den,pcf	127.0			
Void Ratio	0.327			
Saturation %	99.8			
Height in	5.01			
Diameter in	2.41			
Cell psi	69.4			
Strain %	14.80			
Deviator, ksf	25.572			
Rate %/min	1.00			
in/min	0.050			
Job No.:	026-350b			
Client:	Cotton, Shires & Associates			
Project:	Saratoga Bridges - E0476			
Boring:	SD-3			
Sample:	T-12			
Depth ft:	26			

Visual Soil Description	
Sample #	
1	Brown Clayey SAND w/ Gravel
2	
3	
4	
Remarks:	

Unconsolidated-Undrained Triaxial Test

ASTM D-2850





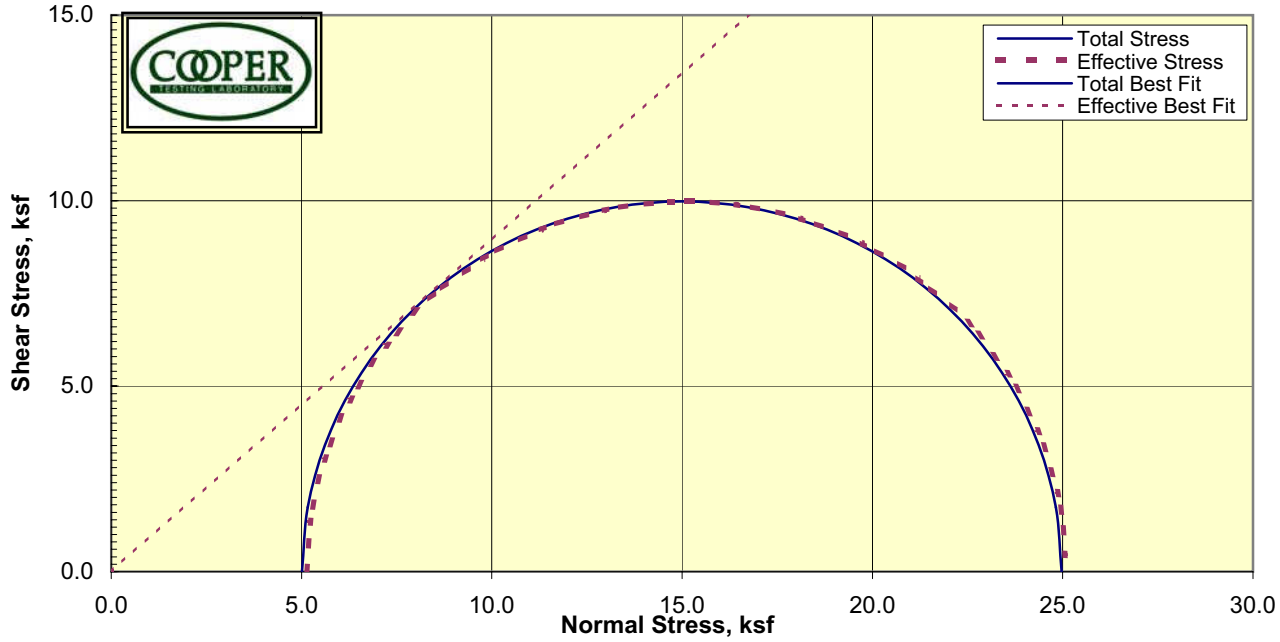
Sample Data				
	1	2	3	4
Moisture %	12.5	2.3	10.4	10.8
Dry Den,pcf	125.7	116.2	131.1	103.1
Void Ratio	0.341	0.451	0.286	0.635
Saturation %	98.9	13.6	98.4	46.0
Height in	5.00	4.99	4.98	5.00
Diameter in	2.43	2.43	2.42	2.42
Cell psi	20.8	13.9	20.8	48.6
Strain %	6.60	6.80	14.60	13.10
Deviator, ksf	16.641	8.109	8.384	20.058
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.050	0.050	0.050	0.050
Job No.:	026-350a			
Client:	Cotton, Shires & Associates			
Project:	Saratoga Bridges - E0476			
Boring:	SD-1	SD-2	SD-2	SD-3
Sample:	T-10	T-5	T-9	T-8
Depth ft:	16	11	21	11

Visual Soil Description	
Sample #	
1	Brown Clayey SAND w/ Gravel
2	Brown Clayey SAND w/ Gravel
3	Brown Clayey SAND w/ Gravel
4	Brown Clayey SAND w/ Gravel

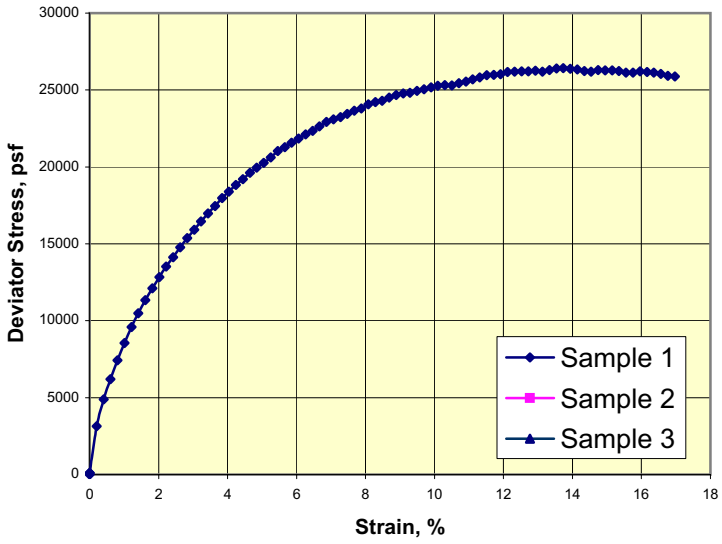
Remarks:

Triaxial Consolidated Undrained

(ASTM D4767)



Stress-Strain Response



Sample:	1	2	3	4
MC, %	6.7			
Dry Dens, pcf	127.4			
Sat. %	56.1			
Void Ratio	0.323			
Diameter in	2.42			
Height, in	5.00			
	Final			
MC, %	11.6			
Dry Dens, pcf	128.2			
Sat. %	100.0			
Void Ratio	0.314			
Diameter, in	2.42			
Height, in	4.95			
Cell, psi	73.2			
BP, psi	38.4			
	Effective Stresses At:			
Strain, %	5.0			
Deviator ksf	19.958			
Excess PP	-0.130			
Sigma 1	25.098			
Sigma 3	5.141			
P, ksf	15.120			
Q, ksf	9.979			
Stress Ratio	4.882			
Rate in/min	0.002			
Total C	N/A	ksf		
Total Phi	N/A	Degrees		
Eff. C	0.0	ksf		
Eff. Phi	41.9	Degrees		

Job No.: 026-350 **Date:** 11/27/2006

Client: Cotton-Shires BY:MD/DC

Project: E0476

Sample 1) SD-4, T-6 @ 8.0' Brown Silty GRAVEL w/Sand

Sample 2)

Sample 3)

Sample 4)

REMARKS: Strengths picked at 5% strain.

APPENDIX B

Schaaf & Wheeler Civil Engineers
Technical Memorandum
100-Year Water Surface Elevation of Rodeo Creek at Proposed Bridge Crossing

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

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s&w@swsv.com

TECHNICAL MEMORANDUM

TO: Iveta Harvancik DATE: December 7, 2006

FROM: Jim Schaaf, P.E., Ph.D. JOB #: SARA.01.06

SUBJECT: 100-Year Water Surface Elevation of Rodeo Creek at Proposed Bridge Crossing

---

Schaaf & Wheeler has determined the water surface elevation of Rodeo Creek at the proposed De Anza Trail bridge crossing. This memo will discuss the existing condition during the 100-year storm event.

SITE DETAILS

Rodeo Creek is an ephemeral creek that collects drainage from a 0.93 square mile watershed at the location of the proposed bridge crossing. There currently exists a 6 foot diameter culvert to carry flows across the railroad. The watershed is completely developed, mostly residential.

MODELING OVERVIEW

The Santa Clara County method was used to calculate the resulting flow of watershed which utilizes the Army Corps of Engineers HEC1 model. The 100-yr 24-hr storm results in a total precipitation depth of 6.66 inches, based upon an average mean annual precipitation of 24 inches. The watershed was split into two separate basins, one pervious and one impervious. The pervious basin was modeled with a curve number of 73, urban grass weighted by the varying soil types. The impervious basin had a curve number of 98. It was assumed the antecedent moisture condition would be II and that the impervious area was 65% of the total, which is typical for residential areas. The time of concentration was calculated at 0.191 hours for the pervious basin and 0.098hours for the impervious basin. These times corresponded to storage coefficients of 0.244 and 0.065, respectively. The flow was routed according to the Santa Clara County Water Districts storm drain routing for hillside areas greater than 400 acres without stream barriers. With these parameters, the resulting flow at the proposed bridge crossing is 262 cubic feet per second.

For the naturally existing condition (no development and no storm drain system), 400 cfs is typical for a basin of this size. In case the existing storm drain is unable to throttle the flows as much as District predicts, we will use the higher flow value of 400 cfs to determine the water surface elevation to be conservative.

Creek cross sections were taken from survey information provided by the City of Saratoga and well as a separate survey performed by Schaaf & Wheeler. The 400 cfs of flow was run through these cross sections using a HEC-RAS model. A Manning's n value of 0.035 was assumed as well as inlet control at the culvert and normal depth upstream.

RESULTS

This results in a water surface elevation of 319.2 feet NAVD at the mouth of the culvert and 320.2 feet at the proposed bridge crossing. Figure 1 shows the water surface elevation with the cross section geometry at the proposed bridge crossing.

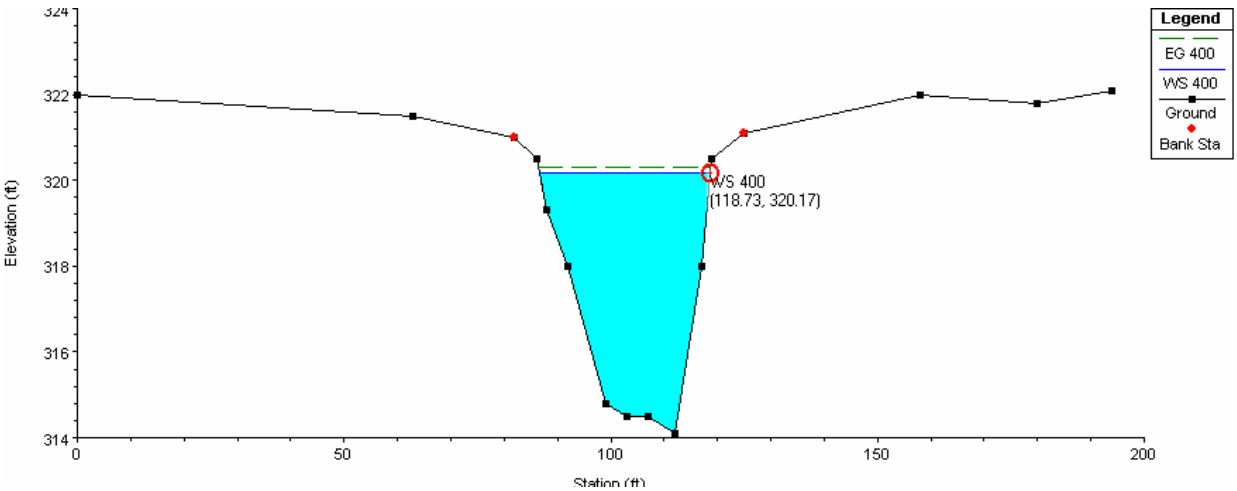

Figure 1: 100-year Water Surface Elevation with Cross Section Geometry at Proposed Rodeo Creek Bridge Crossing

With the bridge abutments at the top of the banks, the bridge will be above the water surface elevation during the 100-year storm.

APPENDIX C

Schaaf & Wheeler Civil Engineers
Technical Memorandum
100-Year Water Surface Elevation of Saratoga Creek at Proposed Bridge Crossing

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

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s&w@swsv.com

TECHNICAL MEMORANDUM

TO: Iveta Harvancik DATE: November 27, 2006

FROM: Jim Schaaf, P.E., Ph.D. JOB #: SARA.01.06

SUBJECT: 100-Year Water Surface Elevation of Saratoga Creek at Proposed Bridge Crossing

---

Schaaf & Wheeler has determined the water surface elevation of Saratoga Creek at the proposed De Anza Trail bridge crossing. This memo will discuss the existing condition during the 100-year storm event based upon the effective FEMA Flood Insurance Study (FIS) for the City of Saratoga, Santa Clara County, effective date July 3, 1997.

The location of the proposed bridge almost matches the FIS cross section A (Flood Insurance Rate Map 060351 0002 C). At this cross section, the water surface elevation is 312.6 feet NGVD (FIS, Table 2). To convert this number to NAVD to correspond to the survey data of the cross section, a conversion factor of +2.74 was found based upon geographic coordinates. This puts the water surface elevation at 315.3 feet NAVD. This WSE is shown with the cross section geometry in Figure 1.

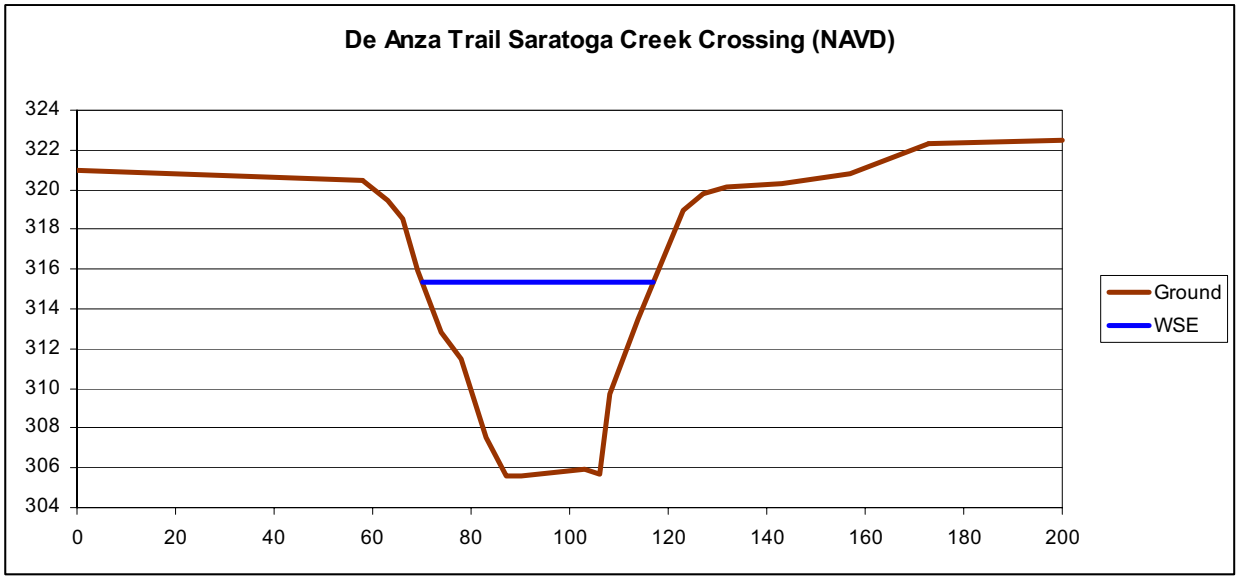

Figure 1: 100-year Water Surface Elevation with Cross Section Geometry at Proposed Saratoga Creek Bridge Crossing

At this cross section, the mean flow velocity is 8.6 feet per second (FIS, Table 2), transporting 3,950 cfs (FIS, page 14). With this high velocity, care should be taken to guard against erosion at the bridge abutments.