APPENDIX F7

PACE Fluvial Study

Appendix VI
Vista Canyon Ranch VTTM # 69164

Vista Canyon Ranch Santa Clara River Bank Protection
Santa Clara River Fluvial Study

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Executive Summary

This technical study provides an evaluation of the existing and proposed fluvial characteristics and long-term stability of Santa Clara River between Sand Canyon Road Bridge and State Highway 14 Bridge. **It is the purpose of this analysis to determine if proposed project flood protection (primarily buried bank stabilization) along the River corridor within the Vista Canyon Ranch project will potentially modify the fluvial mechanics of the River, and to establish LACDPW required bank protection top and toe elevation.** The buried bank stabilization is intended to provide long-term erosion protection from lateral migration of the bank and flood protection for the adjacent development areas. This analysis, which is required to ensure consistency with the conclusions of the Vista Canyon Ranch EIR, analyzes whether there would be any substantial changes from build-out of Vista Canyon Ranch to 1) the fluvial modifications of the Riverbed from single hypothetical storm events and 2) changes in the floodplain fluvial operation over the long term. Finally, this analysis will establish the final top and toe of the Vista Canyon Ranch bank protection.

Three previous studies have been conducted by Simons, Li & Associates (SLA) within the study reach between Sand Canyon Road and State Highway 14. Two additional studies of interest are available for the study area. The first was conducted by R. T. Frankian & Associates (RTF), which assessed the stability of the north bank of Santa Clara River adjacent to the project site. The final study performed internally by Los Angeles County Department of Public Works (LACDPW) examined several sediment grain size analyses to determine the gradation of Santa Clara River adjacent to the Sand Canyon tributary.

For the PACE analysis, sediment collection for Santa Clara River along the study reach was conducted by LACDPW. Two samples were utilized from either end of the study reach, SCR-1 and SCR-6. The D_{50} values for all samples ranged from 8.5 to 10.1 mm.

Modifications to the riverbed are measured as bed adjustment in feet. Positive adjustment indicates aggradation and negative adjustment indicates degradation. Several types of adjustment are considered in this study including general adjustment, long-term adjustment, and other scour. General adjustment is bed change that occurs in an individual discharge event and is calculated as the difference between sediment inflow and outflow of a given River reach. Long-term adjustment consists of fluvial processes that occur over decades. Other scour is made up of local scour, bend scour, low-flow incisement, and bed form formation.

General adjustment was estimated in this study using the US Army Corps of Engineers (ACOE) SAM steady-state zero-dimensional numerical model. SAM is utilized to provide a first approximation of sediment transport potential for subreaches within Santa Clara River. The SAM numerical model is built upon hydraulic and fluvial representations of the study bed. The hydraulic component includes representations of bed characteristics and discharge. The fluvial component includes representation of bed gradation and sediment transport functions. SAM's hydraulic component utilized average cross-section data imported from HEC-2 numerical models of the river down-converted from HEC-RAS numerical models. Both the existing and proposed conditions HEC-RAS models were prepared by PACE. River subreaches that make up the SAM model are determined by examining the hydraulic parameters of the individual HEC-RAS cross-sections and identifying correlations between those hydraulic parameters and the longitudinal position in the channel.

Representation of sediment grain size distribution in SAM is percent finer data obtained from sieve analysis of channel sediment samples. At each sample location, multiple samples are collected and the average data is input into the model. Sediment transport equations used in all SAM modeling were chosen with the assistance of the Army Corps' SAM.AID subroutine. The SAM.AID subroutine determines the most representative transport function based on the hydraulic parameters and percent finer data by comparing model data with peer-reviewed sediment transport studies. The study found that

MPM was the representative transport function for all subreaches for both existing and proposed conditions because it produced adjustment values within physical reason.

SAM was run for the river reach and bed stability was estimated based on the change in potential transport between adjacent channel subreaches for the Q_{CAP} discharge using the LACDPW sediment data. General adjustment based on SAM modeling is presented in Chapter 4. No pattern of aggradation or degradation is apparent in the model results. General adjustment was calculated using the equation specified in the Los Angeles County Hydrology and Sedimentation Manual (LACSM). The LACSM general adjustment calculation is based only on flow mean velocity. **SAM modeling indicates that general adjustment ranges from -3.3 to +0.5 for the proposed condition. Table 4.3 and Figure 1 compare the change in general adjustment between the existing and proposed condition based on SAM method. The change in general adjustment ranges from -2.0 to +1.2 feet.** Finally, a general trend in general adjustment for the study reach as indicated by SAM modeling is not apparent for either the existing condition or proposed condition. In summary, there is no apparent change in trend between the pre- and post- project condition.

Table 4.3: Santa Clara River SAM Existing vs Proposed Conditions Bed Stability

Subreach	US Sta	Existing Conditions Grade Change (ft)	Proposed Conditions Grade Change (ft)	Delta (ft)	Result
6	18000	-0.5	-0.5	0.0	NO CHANGE
5	16800	-2.0	-2.0	0.0	NO CHANGE
4	15600	0.1	-1.5	-1.6	INCREASE DEG
3	14400	-1.3	-3.3	-2.0	INCREASE DEG
2	13400	-1.2	0.0	1.2	INCREASE AGG
1	11600	1.5	0.5	-0.9	DECREASE AGG

Long-term adjustment was calculated from historical records in the form of topographic data. Historic topographic data from 1929, 1964, 1977, 1981 and 2005 was digitized. Cross-sections were cut at the locations of select HEC-RAS sections for each historical topography. At least one cross-section was chosen for each location of significant engineering interest such as bridges, contractions and expansions. Areas of sections are calculated for all years and these areas are used to calculate the average change in bed elevation over time. Several events within the available historical record (1929 to present) have had an impact on the riverbed and fluvial mechanics. These events include construction of bridges spanning the River, development infill along the riverbanks, and periodic burning of surrounding vegetation during forest fires. **The sectional analysis finds that most historical sections show cyclical patterns of change (± 1.5 feet) over the period of record suggesting an approximate equilibrium state for these subreaches. This analysis is presented in Table 5.1B.**

Table 5.1B: Vista Canyon Ranch Historical Cross-Section Average Depth & Average Depth Change
Aggradation/Degradation Change 1929-2005

SUBREACH	SECTION	1929	1964	1977	1981	2005	29-05	CHANGE
1	10800 [1]	6.8	5.7	8.0	7.1	9.6	-1.5	DEGRADE
2	12600 [2]	4.6	5.5	6.4	4.4	6.6	-1.1	DEGRADE
3	14200	5.3	6.5	0.5	4.4	7.0	-1.7	DEGRADE
4	15400	4.1	4.6	3.8	5.4	7.2	-3.1	DEGRADE
5	16600 [2]	5.0	6.1	4.6	6.2	9.5	-3.4	DEGRADE
6	17200	5.1	3.9	3.6	5.3	6.1	-1.0	DEGRADE

Other scour considered in this study is comprised of four sub-categories: local scour, bend scour, low-flow incisement, and bed form height. Local scour occurs in the vicinity of flow obstructions including piers and abutments. Bend scour occurs because velocity gradients around curves in fluvial systems. Three distinct bends are located in the study reach. Low flow incisement is included to represent thalweg or low flow channel depth. On-site inspection and review of historic data of this feature suggest a thalweg depth of approximately two feet. Finally, bed form height represents the dunes and anti-dunes that develop in active soft-bottomed channels during flow events. Local scour ranges from -2.9 to -20.1 feet for the existing condition and -3.5 to -20.1 for the proposed condition (Appendix Chapter 6). Results of calculations of bend scour vary from 0.0 to –3.7 feet for the existing condition and 0.0 to -3.7 feet for the proposed condition. In this study, bed form height has been limited after Kennedy (1963). For the existing condition the bed form height ranges from -0.9 to -3.7 feet, and for the proposed condition the bed form height ranges from -0.9 to -3.7 feet.

General adjustment, long-term adjustment and other scour are summed to determine total potential bed adjustment following LACSM methodology. For cross-sections where SAM modeling predicts aggradation, the general adjustment contribution to total bed adjustment is not included. **Calculations of the existing condition predict that the combined bed adjustment ranges from approximately -5.3 to -22.6 feet while approximately -5.0 to -22.6 feet of adjustment occurs in the proposed condition for curved reaches. The individual components of total adjustment are shown in Table 7.1B for proposed conditions outside of curved reaches.**

Table 7.1B: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Summary of Degradation Components (ft)

Subreach	**US Section**	Z_{DEG}**	Z_{GS} (SAM)*	Z_{OTHER}	Z_{TOTAL}
6	18000	-2.0	-0.5	-3.5	**-6.0**
5	16800	-3.4	-2.0	-7.0	**-12.3**
4	15600	-3.1	-1.5	-5.9	**-10.5**
3	14400	-2.0	-3.3	-4.4	**-9.7**
2	13400	-2.0	0.0	-4.0	**-6.0**
1	11600	-2.0	0.5	-5.7	**-7.7**

*Positive values in Z_{GS} represent aggradation and are not included in the total

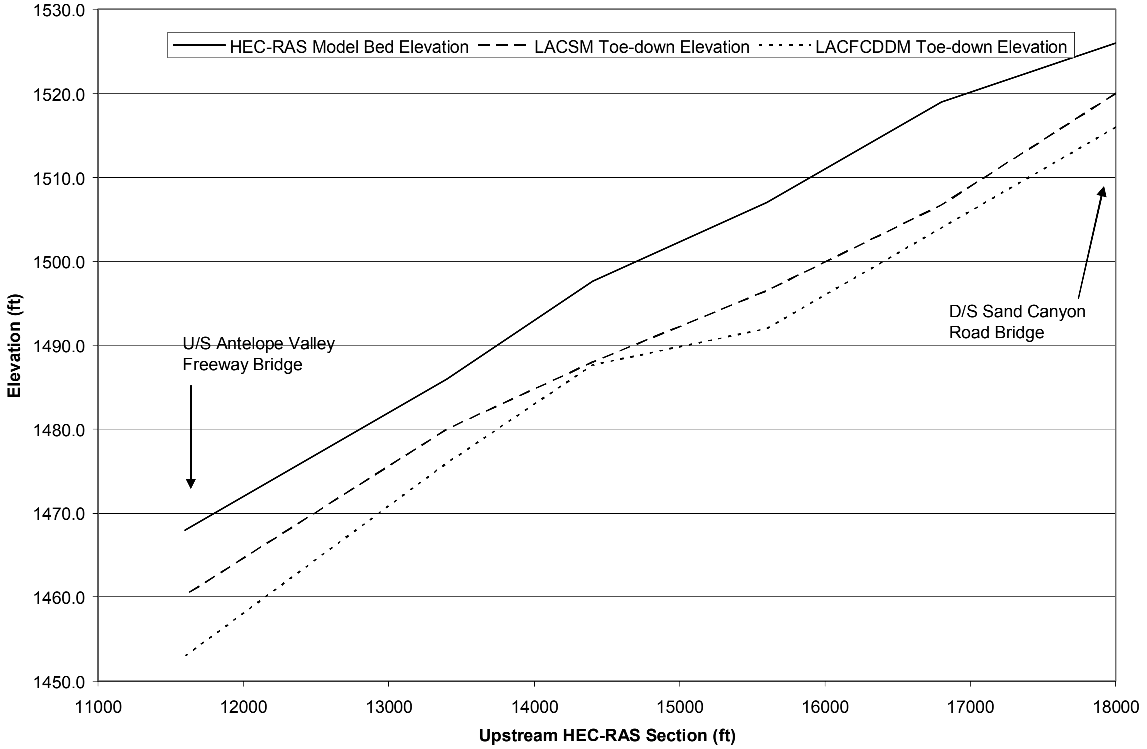
**Long-term degradation uses a minimum of 2 feet

A comparison of total bed adjustment estimated by both the summed methodology and the LACFCDDM methodology shows that the more intensive LACSM methodology predicts a shallower toedown in both the existing and proposed conditions than does the LACFCDDM. LACSM methodology utilizing SAM calculations predicts a shallower toedown than does the LACFCDDM methodology because the LACFCDDM does not account for the effects of long-term or general degradation as effectively. **A comparison of the LACFCDDM and LACSM calculations for the proposed conditions outside of a curved reach are shown in Table 7.2B and Figure 7.2B.**

Table 7.2B: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Toedown Summary by Methodology (ft)

Subreach	**US Section**	**HEC-RAS Model Bed Elevation**	**LACSM (SAM)**	**LACSM Toe-down Elevation**	**LACFCDDM**	**LACFCDDM Toe-down Elevation**
6	18000	1526.0	-6.0	1520.0	-10.0	1516.0
5	16800	1519.0	-12.3	1506.7	-15.0	1504.0
4	15600	1507.0	-10.5	1496.5	-15.0	1492.0
3	14400	1497.7	-9.7	1488.0	-10.0	1487.7
2	13400	1486.0	-6.0	1480.0	-10.0	1476.0
1	11600	1468.0	-7.7	1460.3	-15.0	1453.0

Figure 7.2B: Vista Canyon Ranch
Proposed Conditions Outside Curved Reach Toe-down Depths by Methodology



For the purposes of this report, freeboard is considered to be the additional height required to the top of the bank protection above the design water surface to prevent overtopping. Freeboard elevation is calculated in this study based on LACSM Section 5A-3, and includes LACFCDDM calculations. The maximum freeboard for the study each of the River is +2.5 feet. The individual components of total freeboard are shown in Table 7.3A for proposed conditions outside for curved reaches.

Table 7.3A: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Freeboard Summary (ft)

Subreach	HEC-RAS Section	Y_{AGG}+	Y_{GA}+	Y_{SE}+	H/2	$Y_{H\&SM}$	Y_{DM}	Y_{MAX}
1	18000	1.0	0.0	0.0	0.3	1.3	2.5	**2.5**
2	16800	1.0	0.0	0.4	0.9	2.3	2.5	**2.5**
3	15600	1.0	0.0	0.3	0.9	2.2	2.5	**2.5**
4	14400	1.0	0.0	0.0	0.9	1.9	2.5	**2.5**
5	13400	1.0	0.0	0.0	0.5	1.5	2.5	**2.5**
6	11600	1.0	0.6	0.2	0.6	2.4	2.5	**2.5**

Table 8 provides a summary of the toedown and top of levee values predicted by the present study.

A proposed gravity sewer line is to be placed in the River downstream of the proposed project Bridge approximately between Sections 13000 and 12800. The depth of the sewer line will be designed to LACSD standards, however, based on the present study the line should be at a depth of at least -10.0 feet and after Appendix 6.2. This minimum design depth assumes that the pipeline is placed outside the region of influence of the bridge pier scour. A preliminary HEC-18 calculation of the downstream distance of the gravity sewer line should be placed approximately 40 feet downstream of the bridge piers. A comprehensive HEC-18 study will be conducted on the bridge final design to determine final bridge abutment and pier toedown depths. If any design changes occur with final project layout the analysis provided herein will need to be evaluated for consistency and updated analysis provided if required.

The extent of proposed soil cement bank protection along the Santa Clara River north bank extends from approximately Section 14600 to Section 11800. The limited extent of the north bank protection results from the presence of exposed bedrock from approximately Section 14600 to Section 15800. The RTF study of this site indicates that the erodibility index of the bedrock material exceeds the stream power of Q_{CAP} event by several orders of magnitude. Moreover, the erodibility index of the material is comparable to that of soil cement in the project vicinity. Therefore, bank protection is not required along this subreach of the River.

Table 8: Santa Clara River Summary of Maximum Proposed Toe-down & Freeboard (ft)

Subreach	HEC-RAS Section	Z_{05} [1]	Outside Curved Reach		Straight-Inside Curved Reach		WSE	Outside Curved Reach		Straight-Inside Curved Reach	
			Maximum Total Degradation [2]	Proposed Toe-down Elevation [3]	Maximum Total Degradation [2]	Proposed Toe-down Elevation [3]		Maximum Total Freeboard [2]	Proposed Top of Levee Elevation [2]	Maximum Total Freeboard [2]	Proposed Top of Levee Elevation [2]
6	18000	1526.0	10.0	1516.0	10.0	1516.0	1546.7	2.5	1549.2	2.5	1549.2
	17800	1525.0	22.6	1502.4	22.6	1502.4	1539.5	2.5	1542.0	2.5	1542.0
	17600	1524.0	10.0	1514.0	10.0	1514.0	1538.7	2.5	1541.2	2.5	1541.2
	17400	1523.0	10.0	1513.0	10.0	1513.0	1537.7	2.5	1540.2	2.5	1540.2
	17200	1521.0	10.0	1511.0	10.0	1511.0	1535.1	2.5	1537.6	2.5	1537.6
	17000	1520.0	10.0	1510.0	10.0	1510.0	1532.5	2.5	1535.0	2.5	1535.0
5	16800	1519.0	15.0	1504.0	10.0	1509.0	1529.8	2.5	1532.3	2.5	1532.3
	16600	1517.0	15.0	1502.0	10.0	1507.0	1528.1	2.5	1530.6	2.5	1530.6
	16400	1515.0	15.0	1500.0	10.0	1505.0	1527.0	2.5	1529.5	2.5	1529.5
	16200	1512.2	15.0	1497.2	10.0	1502.2	1526.2	2.5	1528.7	2.5	1528.7
	16000	1510.4	12.2	1498.2	8.5	1501.8	1525.3	2.5	1527.8	2.5	1527.8
	15800	1508.6	12.0	1496.6	8.3	1500.4	1524.7	2.5	1527.2	2.5	1527.2
4	15600	1507.0	15.0	1492.0	10.0	1497.0	1523.1	2.5	1525.6	2.5	1525.6
	15400	1505.1	18.0	1487.1	12.5	1492.6	1520.1	3.2	1523.3	2.7	1522.8
	15200	1504.0	18.0	1486.0	12.5	1491.5	1517.3	2.9	1520.2	2.5	1519.8
	15000	1502.0	10.0	1492.0	10.0	1492.0	1515.3	2.5	1517.8	2.5	1517.8
	14800	1501.0	10.0	1491.0	10.0	1491.0	1513.0	2.5	1515.5	2.5	1515.5
	14600	1499.0	10.0	1489.0	10.0	1489.0	1510.4	2.5	1512.9	2.5	1512.9
3	14400	1497.7	10.0	1487.7	10.0	1487.7	1507.9	2.5	1510.4	2.5	1510.4
	14200	1495.0	10.0	1485.0	10.0	1485.0	1505.6	2.5	1508.1	2.5	1508.1
	14000	1493.0	10.0	1483.0	10.0	1483.0	1503.7	2.5	1506.2	2.5	1506.2
	13800	1491.0	10.0	1481.0	10.0	1481.0	1501.8	2.5	1504.3	2.5	1504.3
	13600	1488.5	10.0	1478.5	10.0	1478.5	1500.2	2.5	1502.7	2.5	1502.7
2	13400	1486.0	10.0	1476.0	10.0	1476.0	1498.7	2.5	1501.2	2.5	1501.2
	13200	1484.0	10.0	1474.0	10.0	1474.0	1497.3	2.5	1499.8	2.5	1499.8
	13050	1482.0	10.0	1472.0	10.0	1472.0	1494.7	2.5	1497.2	2.5	1497.2
	12920	1482.0	20.9	1461.1	20.9	1461.1	1493.2	2.5	1495.7	2.5	1495.7
	12600	1478.0	10.0	1468.0	10.0	1468.0	1490.3	2.5	1492.8	2.5	1492.8
	12400	1476.0	10.0	1466.0	10.0	1466.0	1488.2	2.5	1490.7	2.5	1490.7
	12200	1474.6	10.0	1464.6	10.0	1464.6	1485.9	2.5	1488.4	2.5	1488.4
	12000	1472.0	10.0	1462.0	10.0	1462.0	1483.8	2.5	1486.3	2.5	1486.3
	11800	1470.1	10.0	1460.1	10.0	1460.1	1482.0	2.5	1484.5	2.5	1484.5
1	11600	1468.0	15.0	1453.0	10.0	1458.0	1480.2	2.5	1482.7	2.5	1482.7
	11400	1466.0	15.0	1451.0	10.0	1456.0	1478.5	2.5	1481.0	2.5	1481.0
	11200	1465.0	15.0	1450.0	10.0	1455.0	1476.6	2.5	1479.1	2.5	1479.1
	11000	1463.0	15.0	1448.0	10.0	1453.0	1474.8	2.5	1477.3	2.5	1477.3
	10800	1461.1	15.0	1446.1	10.0	1451.1	1473.2	2.5	1475.7	2.5	1475.7
	10600	1458.0	15.0	1443.0	10.0	1448.0	1471.7	2.5	1474.2	2.5	1474.2
	10400	1456.0	15.0	1441.0	10.0	1446.0	1470.1	2.5	1472.6	2.5	1472.6
	10200	1451.0	15.0	1436.0	10.0	1441.0	1468.2	2.5	1470.7	2.5	1470.7
	10000	1448.0	22.1	1425.9	20.3	1427.7	1467.0	2.5	1469.5	2.5	1469.5

1 - Minimum 2005 Bed Elevation

2 - Toe-down and Freeboard based on max of LA County Hydrology & Sedimentation Manual (with SAM general aggradation) and LA County Design Manual, as per Hydrology & Sedimentation Manual

3 - Values at bridges are approxmiate. Final design of levee at bridge locations will include detailed bridge analysis

1 Introduction

The following technical investigation provides a detailed and focused evaluation of the fluvial characteristics and long-term stability of Santa Clara River in the vicinity of the proposed Vista Canyon Ranch. The River study reach is located adjacent to City of Santa Clarita in northern Los Angeles County, California (Figure 1.1). The study reach is bounded on the west by State Highway 14 and to the east by Sand Canyon Road (Figure 1.1). The Vista Canyon Ranch drainage area is approximately 191 acres of the 1634 square-mile Santa Clara River Basin watershed. Adjacent development along the River within the project site has the potential to modify the fluvial response of the watershed through changes in the runoff and reduction in the sediment supply from the developed areas. The proposed buried soil cement bank protection on the banks of the River is intended to provide long-term erosion protection from lateral migration of the bank and flood protection for the adjacent proposed development areas. These modifications to the river system have the potential to result in adjustment to the fluvial operation of the floodplain and changes to the stream mechanics, which is evaluated herein.

1.1 Types of Adjustment

Modifications to the river system are measured as bed adjustment in feet. Positive adjustment indicates bed aggradation while negative adjustment indicates bed degradation. Several types of adjustment are considered in this study including general adjustment, long-term adjustment, and other scour. General adjustment consists of scour that occurs in an individual discharge event, and may be considered as the difference between sediment inflow and outflow. That is, if sediment inflow into a given reach is higher than sediment outflow for the same reach, aggradation will occur. In contrast, if sediment outflow exceeds inflow for a given reach, degradation in the form of scour will occur in the reach. Long-term adjustment consists of fluvial processes that occur over many rainy seasons and contribute fluctuation of bed elevation of a river or creek. Other scour is comprised of local scour, bend scour, low-flow incisement, and bed form formation. These are discussed in detail, below.

1.1.1 Study Objectives

The primary objective of this report is to develop the technical engineering analysis to assess riverbed changes from potential modifications of fluvial operation from the approved Vista Canyon Ranch project and to ensure consistency with the conclusions of the Vista Canyon Ranch River Drainage Concept Report and the project EIR. The intent is to provide a comprehensive assessment of short- and long-term bed adjustment. This report provides technical analysis for (1) general adjustment, (2) long-term adjustment, (3) other scour, (4) study reach gradation, (5) SAM modeling and analysis, and (6) total soil cement bank protection toedown design. The objectives of the fluvial assessment for the proposed development project include the following:

1. Quantify the fluvial parameters that are representative of the riverbed characteristics.
2. Model the existing and proposed conditions riverbed and fluvial processes.
3. Provide preliminary assessment of the streambed stability through determination of the sediment transport capacities within different reaches of the floodplain.
4. Provide toedown depth assessment throughout the study reach.
5. Provide freeboard height assessment throughout the study reach.

VISTA CANYON

PROPOSED AND EXISTING CONDITION FLOODPLAIN LINES

FIGURE 1.1

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1/23/09

A variety of engineering analysis and tasks were associated with both the different aspects of the watershed hydrology and floodplain hydraulics. A technical framework was developed to guide the analysis of the system. These major task areas of study reflected the various objectives of the study and included the following:

1. Floodplain field investigations – Perform field reconnaissance of the existing watershed conditions as well as ground photo survey along the entire existing creek system within the fluvial study boundary.
2. Baseline digital floodplain cross-section geometry – Layout appropriate spacing and location of cross-sections to establish the representative channel geometry. Digitally develop extremely accurate cross-section coordinate points using topographic digital terrain models (DTM) and CAD subroutines suitable for hydraulic model format. Adjust cross-section data to include horizontal variation of roughness and other attributes.
3. Baseline HEC-RAS hydraulic model – Prepare floodplain model in HEC-RAS based on the digital geometry and existing condition flowrates. Evaluation based on single storm event and steady flow conditions.
4. HEC-2 model creation – Conversion of HEC model formats for use in SAM modeling.
5. Floodplain reach characterization and parameter estimation – Prepare an assessment of the hydraulic parameters and evaluate the statistics. Determine hydraulic subreaches based on hydraulic statistics. The analysis involves determining the average hydraulic properties for each reach and then applying the appropriate sediment transport relationship to each grain size fraction.
6. Determine the sediment inflow parameters associated with different storm return periods.
7. Sediment transport capacity analysis – Prepare steady state sediment transport capacity analysis through dividing the channel system into different reaches and comparing the capacity within each reach.
8. Analyze historic trends in riverbed adjustment – Consider available historic data to gain insight into changes in bed characteristics throughout the period of record.
9. Analysis of local bed adjustment components – Study of the individual components of local bed adjustment
10. Calculate toedown depth – Calculate the total toedown depth of proposed soil cement bank protection based on the analysis of individual bed adjustment components.

2 Previous Fluvial Analyses for Study Reach

2.1 Introduction

Three studies have been conducted by Simons, Li & Associates (SLA) within the study reach between Sand Canyon Road and State Highway 14. The first study by SLA, submitted June 1987, for the County of Los Angeles. The report aimed to develop methodology, criteria, and modeling approaches in order to comprehensively assess flood- and sediment-control needs in Santa Clara River through a three-level system.

The second study produced by SLA in May 1988 again for the County, reported the results obtained from the second quantitative analysis and third mathematical modeling levels of SLA's three-level approach. This includes hydrologic and hydraulic analyses and various methodologies for assessing sediment yield.

The third summary report prepared by SLA in November 1990 again for the County sought to provide information for flood and fluvial process management in the Santa Clara River from Soledad Canyon to Interstate 5, including many of the tributaries in between. The study included multiple tasks including data collection, quantitative and analysis and mathematical modeling, alternatives evaluation and other assignments.

Two additional studies of interest are available for the study area. The first was conducted by R. T. Frankian & Associates (RTF) which assessed the stability of the north bank of Santa Clara River adjacent to the project site. The final study performed internally by Los Angeles County Department of Public Works (LACDPW) examined several sediment grain size analyses to determine the gradation of Santa Clara River adjacent to the Sand Canyon tributary. The study included multiple tasks including data collection and quantitative analysis.

2.2 Simons, Li & Associates, 1987

The 1987 SLA interim report utilized the first of a three-level methodology, which is a qualitative geomorphic analysis whose purpose is to characterize existing fluvial systems, identify governing physical processes, interpret past historic behavior, and predict potential future response in the Santa Clara River basin. The study reach included 18 miles of Santa Clara River as well as 1 to 8 miles of seven of the River's tributaries. SLA cited a Capital Flood clear and bulked discharge of 45,400 cfs downstream of Sand Canyon (p.5.17). A brief description of the 1959 and 1981 bed characteristics are presented on page 6.6-7.

2.3 Simons, Li & Associates, 1988

The 1988 SLA interim report further assessed sediment yield using a number of techniques in addition to the LA County method, including the Modified Universal Soil Loss Equation (MUSLE) method, Tatum Method, and Adopted Method. Although no discharge was specified at the area of interest, SLA reported a capital flood clear flow discharge of 7,640 cfs for Santa Clara River at Sand Canyon (Table 2.5, p.2.15). Based on 19 samples collected along Santa Clara River, D_{50} was 2.0 mm downstream of Sand Canyon confluence (Table 5.1, p.5.6).

A comparison of the sediment yield methods showed a minimum of 33,600 cu. yd./ sq. mi. by LA County method and a maximum of 102,355 cu. yd./sq. mi. by the Limiting Concentration Method at a 13.3 sq. mi. drainage area at Sand Canyon (Table 4.17, p.4.54). A sediment-continuity analysis resulted in a net unbulked adjustment depth of +1.2 feet and net bulked adjustment depth of +1.7 feet for a 100-year flood event (Table 5.5, p.5.41). Based on the QUASED analysis for the capital flood under existing conditions, bulked adjustment was +0.94 feet (Table 6.10, p.6.16). There was no recommended toedown depth provided.

2.4 Simons, Li & Associates, 1990

The 1990 SLA study was broad in reach and included use of the proprietary QUASED numerical model for fluvial analysis. At present, it is not clear if this model is still available or how it compares to other fluvial modeling software such as HEC-6. The study included a large volume of data analysis including flood flow frequency analysis, HEC-2 numerical modeling, historic photograph analysis, and sediment yield calculation. Supplemental design criteria are provided for subsequent studies. Sediment gradation data was presented in an interim version of the study, which is not available at the time of this writing.

The study suggested a Capital Flood peak discharge of 44,700 cfs in the area of interest, adjacent to the Antelope Valley Freeway (p.3.11). A reach-by-reach analysis performed for each watershed in Santa Clara River found D_{50} to be 0.7 mm for the soil from Antelope Valley Freeway to Sand Canyon Road (Table 3.10, p.3.22). In this study reach, the bed was found to be aggrading 0 to 1 feet following a Capital Flood (Fig. 3.4, p.3.12). At Sand Canyon with a peak discharge of 9,050 cfs over a 13.3 $mi.^2$ drainage area, sediment yield is 30,444 $yd^3./mi.^2$ (Table 3.5, p.3.9).

SLA evaluated pier scour to be 11.7 and 10.5 feet for the existing Antelope Freeway Bridge and Sand Canyon Road Bridge, respectively (Table 3.17, p.3.42). General scour varied from 0.0 to 0.6 feet, bed form height from 3.6 to 3.7 feet, and low flow incisement at 2 feet (Table 3.17, p.3.42). Calculations of freeboard for a capital flood at the two existing bridges resulted in a 14.6 to 0.9 feet (Table 3.17, p.3.42).

2.5 R. T. Frankian & Associates, 2007

This study presented an erodibility index analysis for the Vista Canyon Ranch north bank parcel. The purpose of the study was to determine the engineering characteristics of bedrock and complete an erodibility index analysis to determine if these materials would be subject to erosion during a design flow event in the Santa Clara River. The analysis procedures followed Annandale (1995). The study found that bed material underlying the Vista Canyon Ranch north bank parcel is not subject to erosion during a Q_{cap} storm event, and that the peak stream power during the Q_{cap} event is about three orders of magnitude lower than the peak stream power required to initiate erosion.

2.6 Los Angeles County Department of Public Works, unknown date

LACDPW performed soil gradation analyses adjacent to Sand Canyon Road and Antelope Valley Freeway bridges. Both sieve analyses and Wolman pebble count analyses were employed at both locations from single samples at each respective site. The resulting data was compared to previous SLA study data. At both sampling locations the combined County data has a larger D50 than the SLA data. This difference appears to be primarily a result of the combination of the sieve data and the Wolman data. It is not clear if a Wolman count was incorporated with the SLA data.

3 Sediment Characterization and Analysis

3.1 Sediment Data Collection

To characterize the sediment of the riverbed and by extension the possible bed load of sediment during discharge events, a sediment grain size analysis was conducted. The goal of the analysis is to gain a statistical representation of the size distribution of soil components of the riverbed. Grain size distribution analysis is a powerful tool because the results can represent both a qualitative description of soil make up as well as quantitative input for further predictive measures, such as fluvial modeling.

Sediment collection for the Santa Clara River at Vista Canyon Ranch and its tributaries along the study reach was conducted by LACDPW. Within the River samples were collected at two different locations positioned along the river. These sampling locations are compiled in Table 3.1. Two ASTM samples were collected at the upstream and downstream edge of the study area (SCR-9 and SCR-10 respectively), which are compiled in Table 3.1.

Table 3.1 Location and Average D_{50} of Sediment Samples - Vista Canyon Ranch

PACE Subreach	US Section	LAC Sample Number	Subreach Average D_{50}
6	18000	SCR-9	8.5
1	10000	SCR-10	10.1

3.2 Sediment Gradation Analysis

Generally, grain size distribution analysis is broken down into three distinct steps. The first step is to dry the samples, and is accomplished in a desiccator or similar apparatus. The second step is to sieve or otherwise separate the sediment by particle size. Finally, fine material (smaller than standard mesh 200) is analyzed using hydrometric techniques. The sediment distributions are plotted on semi-log plots by percent finer for a given sample size. For this study, no fine material is included in analysis because fine material is generally transported as wash load, which is not of concern here. Distribution data has been averaged on a station-by-station basis. Averaging is accomplished by taking the mean of the samples from each station. Averaging provides a single representative sediment grain size distribution for a given station that can be used for numerical modeling or other analysis. A plot of the individual and average grain size distributions used in this study are presented in Figure 3.1A-B.

3.3 Sediment Characterization

A review of the raw gradation curves for the samples indicates that most samples are comprised of poorly graded sands and gravels with cobbles. The D_{50} values of the two samples ranged from 8.5 to 10.1 mm. A comparison of Figure 3.1A with Figure 3.1B indicates that averaging retains the essential character of the sampled soil.

Figure 3.1A: Santa Clara River Streambed Grain Size Gradation Curves (LAC SCR9 & SCR10)

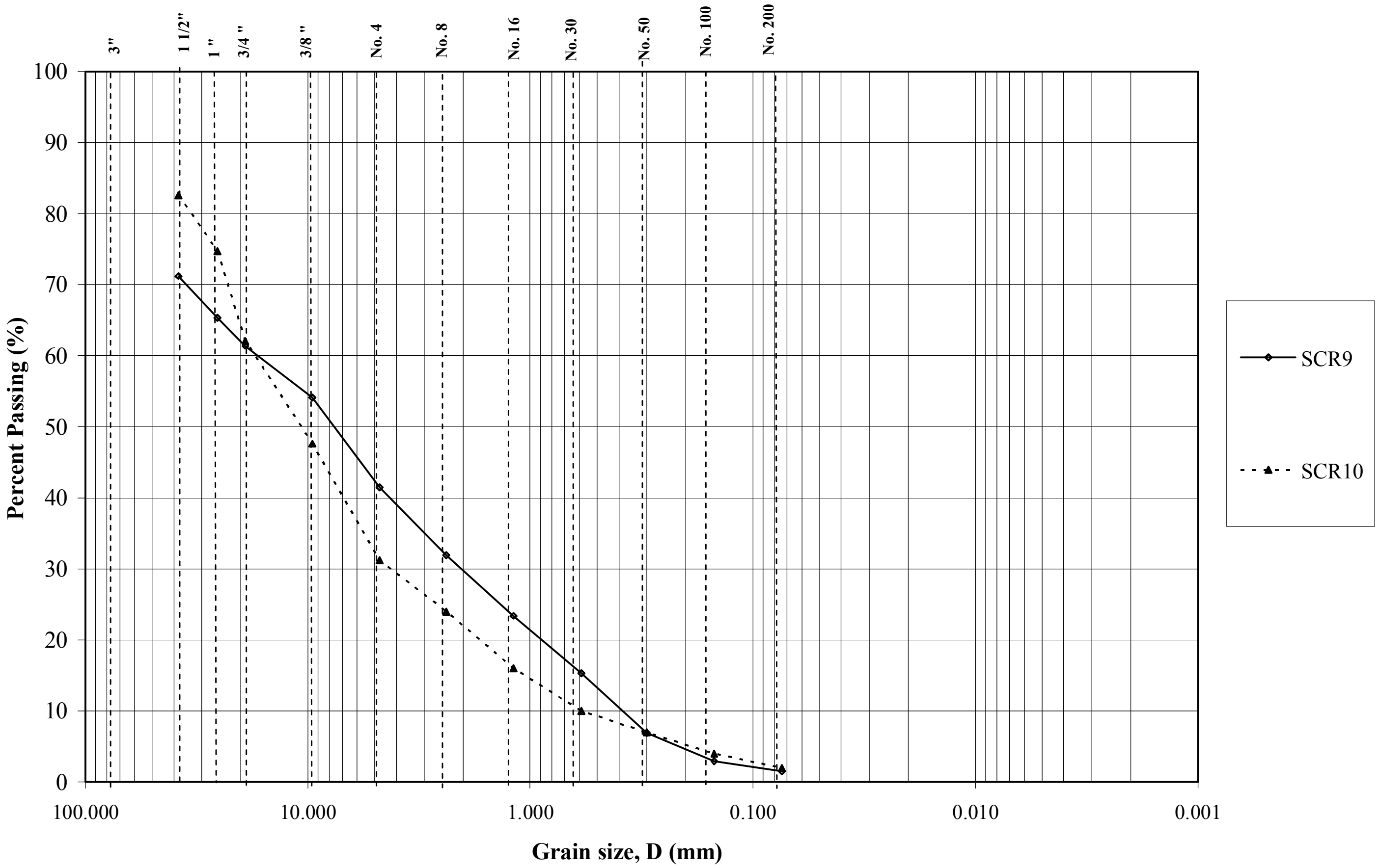


Figure 3.1 A - Santa Clara River Streambed Grain Size Gradation Curve (LAC SCR9 & SCR10)

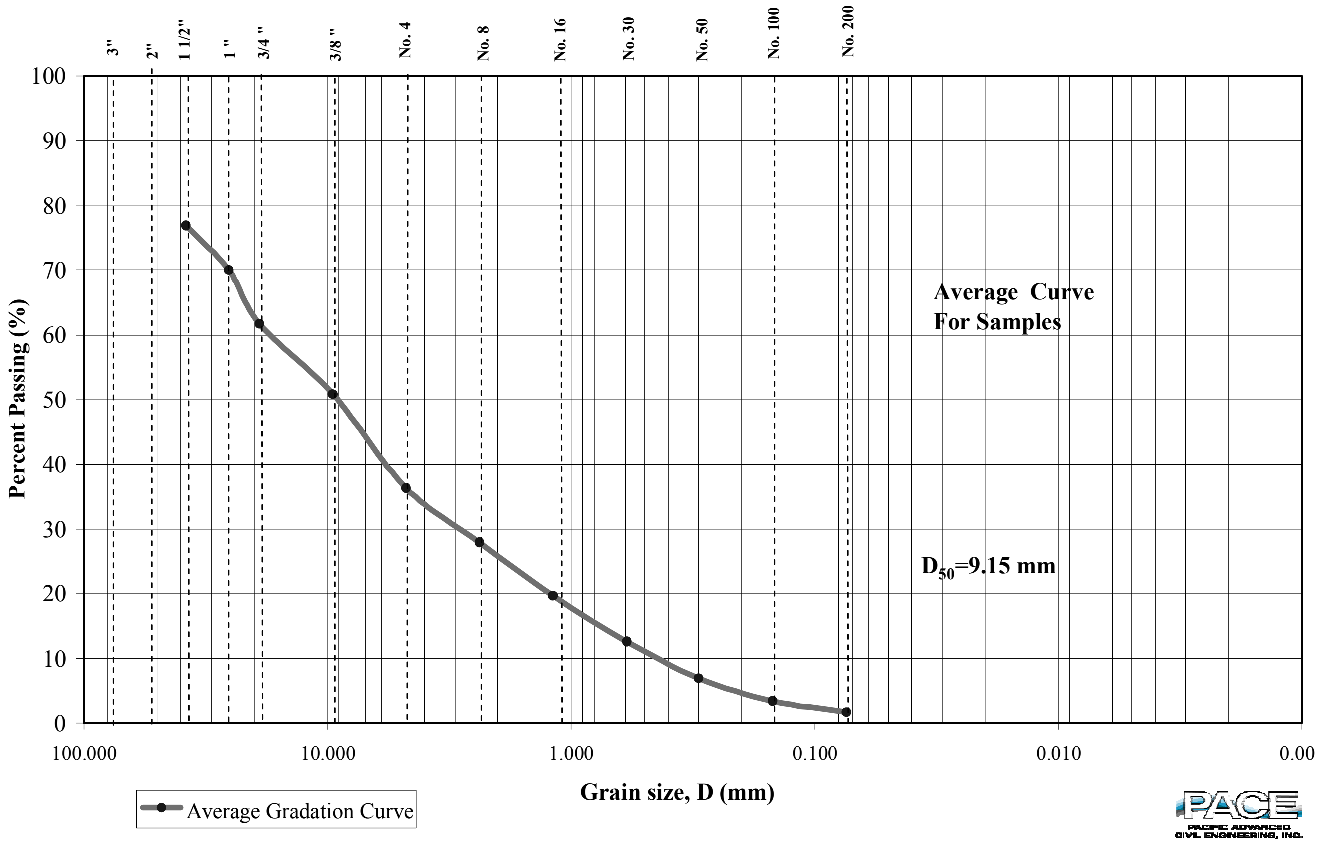


Figure 3.1B: Santa Clara River at Vista Canyon Ranch Average Sediment Gradation Curve

Figure 3.1 B – Santa Clara River at Vista Canyon Ranch Average Sediment Gradation Curve

4 General Adjustment

4.1 SAM Model

General adjustment was estimated in this study using the US Army Corps of Engineers (ACOE) SAM steady state numerical model. Here, SAM was employed to provide a first approximation of sediment transport potential for multiple subreaches within Santa Clara River through the Vista Canyon Ranch project. The SAM Sediment Hydraulic Package is an integrated system of programs developed through the Flood Damage Reduction and Stream Restoration Research Program to aid in the analyses associated with designing, operating and maintaining flood control channels and stream restoration projects. SAM combines the hydraulic information and the bed material gradation information to compute the sediment transport capacity for a given channel or floodplain hydraulic cross-section for a given discharge at a single point in time. A number of sediment transport functions are available for this analysis and SAM has the ability to assist in selecting the most appropriate sediment transport equation.
The three primary fluvial components of SAM are SAM.HYD, SAM.SED and SAM.AID. SAM.HYD provides a steady state, normal-depth, one-dimensional representation of channel hydraulics. The SAM.SED module combines the hydraulic parameters with the bed material gradation curve to compute bed material discharge rating curves by size classification. The SAM.AID module provides the user with recommended sediment transport equations based on the best matches between hydraulic parameters and grain size distribution of the study reach with parameters from widely accepted and published research.

4.1.1 SAM Model Theory and Limitations

The SAM numerical model is built upon hydraulic and fluvial components. The hydraulic components include representations of riverbed characteristics that are input into an analytical procedure. The fluvial component includes representation of bed gradation as percent finer statistics and a selection of up to twenty sediment transport equations. SAM's hydraulic component will accept either average reach parameters or cross-section data imported from HEC-2 models. Hydraulic modeling is based on a uniform flow equation where discharge is the dependent variable such that:

$$Q = f\ (D, n, W, z, S)$$

where Q is discharge in cfs, D is flow depth in feet, n is the Manning's number, W is bottom width in feet, z is the channel side slope, and S is the energy slope. The bottom width is representative of the total moveable bed width of the channel and Manning's number is a composite value. Normal depth is calculated using Manning's equation, and effective values of width and depth are calculated following normal depth calculations. In cases where HEC-2 cross-sections are used for modeling, as in this study, the effective depth and width are calculated from the cross-section data based on the channel hydraulics.

The fluvial component is based on sediment transport functions to calculate the bed material portion of the sediment discharge rating curve. The sediment transport equations are of the form:

$$GS_i=f(V, D, S_e, B_e, d_e, \rho_s, G_{sf}, d_s, i_b, \rho_f, T)$$

where GS_i is the transport rate for sediment size class i; the hydraulic terms V, D, S_e, and B_e, are the average velocity, effective flow depth, energy slope, and effective flow width, respectively; the sediment particle parameters d_e, ρ_s, and G_{sf} are the effective particle size, particle density, and grain size shape factor, respectively; the sediment mixture properties, d_s and i_b are the geometric mean particle size of sediment class i and fraction of class i in the bed, respectively; and the fluid properties ρ_f, and T, the water density and temperature, respectively. Twenty well known, published, peer-reviewed transport equations are available including Ackers-White, Colby, Laursen-Copeland, Laursen-Madden, MPM, Toffaleti, Yang, Van Rijn and others. Once the data assembly is complete, the SAM.SED module can be used to create a sediment discharge-rating curve based on grain size distribution. The reader is referred to the SAM user's documentation for further reference.

It is important to note that the SAM model is a zero-dimensional computational package that is only based on a single averaged cross-section at a particular point in time. As such, SAM simulations can only represent a reach average during a steady state discharge. Because SAM applies sediment transport to a point, no variability in size distribution in either space or time is calculated. With these limitations in mind, in this study SAM is intended to provide a first calculation of sediment transport to which other calculations can be compared.

4.1.2 SAM Model Assembly

In this study, hydraulic representation of the creek bed is accomplished in several distinct steps. First, the HEC-RAS numerical model is thinned to no more than 100 stations per cross-section, converted to HEC-2 format and run to produce the Army Corps' T95 binary hydraulic simulation output file. The HEC-RAS model is a variable Manning's number with mixed flow modified, as described below. Next, the T95 file is then read directly into SAM using the SAM model's M95 subroutine. This methodology is powerful because it ensures that data created for and analyzed using HEC-RAS and HEC-2 hydraulic software is fully compatible with, and implemented in, SAM fluvial analyses. A copy of the HEC-RAS (thinned for HEC-2) and HEC-2 models is included in Appendix 4.3. Appendix 4.4 compares velocities and water surface elevations by cross section between the models.

The HEC-RAS model of the Santa Clara River was developed by PACE using 1-foot contour data derived from aerial photogrammetric survey, collected by Hovell and Pilarski Engineering Inc. and C. and C. aerial mapping Corp. in December 2005. Subreaches within the SAM model are specified and average hydraulic parameters are calculated for those subreaches. Subreaches are determined by examining the hydraulic parameters of the individual HEC-RAS cross-sections and identifying correlations between those hydraulic parameters and the longitudinal position in the channel of the individual cross-section. This process is described in detail below.

4.1.3 Reach-by-Reach Channel Hydraulic Characterization

SAM modeling is based on channel subreaches determined by correlating hydraulic characteristics with longitudinal cross-section location to preserve the along-stream character of the flow. The hydraulic parameters examined are discharge (which only changes once within the study reach), energy slope, bed slope, Froude number, top width, hydraulic velocity and flow area based on the Q_{CAP} discharge. First, correlation coefficients are calculated for each section against the hydraulic parameters. The hydraulic parameter that produces the greatest correlation is plotted against cross-section location. Subreaches are then selected in a manner that preserves the trend of the hydraulic parameter as well as produces approximately equal subreach lengths, which are generally around 1000 feet long. This methodology seeks to maintain continuity of analysis by producing similar length subreaches while analyzing the hydraulic parameters that largely control sediment transport.

In the case of the Santa Clara River, all subreaches have been defined based on locations of trend changes within the River. Subreaches are defined in Table 4.1 shown in Figure 1.1. Statistical analysis of the reaches for both the existing and proposed conditions is shown in Appendix Chapter 4.5.

Table 4.1: Vista Canyon Ranch Existing & Proposed Conditions Sub-Reach Stationing

Subreach	US Section	DS Section	Transport Equation
6	18000	17000	MPM
5	16800	15800	MPM
4	15600	14600	MPM
3	14400	13600	MPM
2	13400	11800	MPM
1	11600	10000	MPM

4.1.4 Input Data and Selection of Transport Functions

Representation of sediment grain size distribution in SAM takes the form of percent finer data obtained from sieve analysis of channel sediment grab samples. At each sample location, multiple samples are collected and analyzed, and the average data is input into the model. All sampling and sieve analysis was conducted by LACDPW. Although the LACDPW data does include a Wolman pebble count, the pebble count data is not utilized in this study based on the findings of Kondolf (1997) that indicate the mixed methodologies of grain size analysis give skewed results. In these cases the most representative and obtainable data is used as described in Section 3, previously.

4.1.4.1 SAM.AID Application and Theory

Sediment transport equations used in all SAM modeling were chosen with the assistance of the Army Corps' SAM.AID subroutine. The SAM.AID subroutine determines the most representative transport function based on the hydraulic parameters and percent finer data for each subreach by comparing model data with the results of 20 peer-reviewed and widely acknowledged sediment transport studies. This case-by-case transport equation selection is more likely to provide a robust representation of channel sediment transport than choosing an individual transport equation for all reaches.

Application of different transport functions to an individual channel reach may provide significantly differing model output. This is because the parameters of a given study from which the function is derived vary greatly. To accomplish the task of guiding the user in selecting an appropriate transport function, SAM.AID assumes that the function that best represents sediment transport in a gauged stream would also best represent transport in an un-gauged stream with similar sediment and hydraulic characteristics. SAM.AID begins by comparing study parameters (V, D, S_e, B_e, D_{50}) with parameters in the transport function database. Comparison begins by determining if D_{50} falls within one of the ranges identified in the database. Once the database initial matches have been made, the three best matched sediment transport functions for the study reach are listed along with the parameters that matched the data set.

Once the best transport equation matches have been determined by SAM.AID, the most representative equations are run in SAM.SED for each subreach. For all reaches, the following five equations (in this order) were selected by SAM.AID: Ackers-White, Yang, Laursen (Madden), Ackers-White (D50) and Yang (D50). Additionally, the Meyer-Peter-Muller equation was added to all simulations despite not explicitly matched by SAM.AID. MPM was chosen because it has been noted by Alonso (1980) that it compares favorably with bed load calculations. Both bed load and gravel estimates are important to the specific aims of this study. Following SAM.SED computations sediment transport potential for each subreach can then be estimated by reviewing the calculations from each equation and analyzing the results. Any SAM.SED calculation outliers are excluded and calculations of bed adjustment are made using the median estimate of transport potential.

The Meyer-Peter and Muller (MPM) equation was found to be the representative transport equation for all subreaches because it was the only equation that produced results consistent with physical viability. The data show that existing and proposed conditions best matched with MPM estimates of transport, and that the other equations estimate unphysical volumes of discharge. Since the D_{50} for a given reach is the same for both the existing and proposed conditions models, the differences in transport function applicability is related to hydraulic differences between the two conditions.

4.1.5 SAM Bed Stability

Bed stability can be examined based on the change in potential transport between channel subreaches. Subreaches are readily determined from changes in hydraulic parameters, and frequently the most significant hydraulic parameter in terms of impact on stream stability is discharge (volume per unit time). If a channel subreach has equal potential transport both entering and exiting the reach then the subreach is said to be in, "equilibrium." Frequently, however, channel subreaches are either in an aggrading or degrading condition. For the purposes of this study, aggrading reaches are those whereby the potential transport entering the subreach (the potential transport of the subreach upstream of that under immediate consideration) is higher than the potential transport leaving the subreach (the potential transport of the subreach under immediate consideration). In degrading subreaches the opposite is true, and potential transport entering the subreach is lower than that leaving the subreach. While it would appear that downstream subreaches would be degrading constantly because discharge generally increases in downstream subreaches and in turn increases the transport potential as one moves downstream, other factors such as hydraulic depth, mean subreach velocity, hydraulic top width, and bed slope contribute significantly to potential transport.

Bed stability was determined by calculating the difference between subreach upstream and downstream sediment potential transport for the Q_{CAP} discharge. Transport potential for each subreach is shown in Table 4.2A-B. The table shows no clear trend in transport potential as a function of subreach. The difference in transport potential, ΔTP (ton/day), was converted to bed adjustment, *GA* (feet), as:

$$GA = \frac{\Delta TP}{\rho b R L} day$$

where ρ is density in tons per cubic feet, *b* is channel width in feet, *day* denotes one day's time, and *RL* is reach length in feet. Density has been taken as 165.36 lb/ft^3 (0.083 ton/ft^3). The upstream most subreach in a reach was analyzed for transport potential using SAM numerical modeling because changes in discharge between reaches preclude direct analysis of adjacent subreaches. To alleviate the issue, the location of change of discharge was moved upstream one subreach only to analyze potential transport at the upstream subreach below a discharge change. A summary of the adjustment for each reach is shown in Table 4.3.

General adjustment is based on SAM modeling presented in Figure 4.1A-B. It is important to note that no apparent pattern of aggradation/degradation is apparent between cross-sections in the figure. General adjustment calculated using the equation presented in the Los Angeles County Sedimentation Manual (LACSM) is also shown in the figures. This latter calculation methodology is only based on flow mean velocity at a given channel section as computed by the HEC-RAS model of the system. Scour predicted by the LACSM is less variable than that predicted by SAM.

The tables and figures indicate the general adjustment in the proposed condition ranges from -3.3 to +0.5 feet. There is a -1.0 feet of decreased aggradation in SRA1. There is more than 1 foot of change between subreaches 2, 3 and 4, with the greatest change of -2.0 feet of increased degradation occurring in subreach 3. The general trend in general adjustment for the study reach as indicated by SAM modeling is not apparent for either the existing or proposed condition.

Table 4.2A: Vista Canyon Ranch Existing Conditions Bed Stability

Subreach	US Section	DS Section	Trans Eq	Transport (Ton	Top Width (ft)	Depth (ft)	A/D	Grade Change (ft)
6	18000	17000	MPM	163617.9	495.3	0.5	DEGRADE	-0.5
5	16800	15800	MPM	280311.2	723.7	2.0	DEGRADE	-2.0
4	15600	14600	MPM	275748.6	561.0	0.1	AGGRADE	0.1
3	14400	13600	MPM	363031.4	1004.5	1.3	DEGRADE	-1.3
2	13400	11800	MPM	573075.8	1345.1	1.2	DEGRADE	-1.2
1	11600	10000	MPM	451899.6	627.4	1.5	AGGRADE	1.5

Table 4.2B: Vista Canyon Ranch Proposed Conditions Bed Stability

Subreach	US Section	DS Section	Trans Eq	Transport (Ton	Top Width (ft)	Depth (ft)	A/D	Grade Change (ft)
6	18000	17000	MPM	163617.9	495.3	0.5	DEGRADE	-0.5
5	16800	15800	MPM	280272.4	723.6	2.0	DEGRADE	-2.0
4	15600	14600	MPM	337557.6	464.5	1.5	DEGRADE	-1.5
3	14400	13600	MPM	498617.3	746.5	3.3	DEGRADE	-3.3
2	13400	11800	MPM	498331.3	748.1	0.0	AGGRADE	0.0
1	11600	10000	MPM	453724.7	625.6	0.5	AGGRADE	0.5

Table 4.3: Santa Clara River SAM Existing vs Proposed Conditions Bed Stability

Subreach	US Sta	Existing Conditions Grade Change (ft)	Proposed Conditions Grade Change (ft)	Delta (ft)	Result
6	18000	-0.5	-0.5	0.0	NO CHANGE
5	16800	-2.0	-2.0	0.0	NO CHANGE
4	15600	0.1	-1.5	-1.6	INCREASE DEG
3	14400	-1.3	-3.3	-2.0	INCREASE DEG
2	13400	-1.2	0.0	1.2	INCREASE AGG
1	11600	1.5	0.5	-0.9	DECREASE AGG

Table 4.4 compares the general adjustment predicted by SAM and LACSM methodologies. LACSM estimates general adjustment from -1.9 to -3.2 feet for the existing and from -2.3 to -3.2 feet for the proposed conditions. It is important to note that LACSM calculations are not able to predict aggradation components of general adjustment. Table 4.4 shows that LACSM estimates of general adjustment exceeds that predicted by SAM numerical modeling by as much as 3.5 feet. It is important to note that SAM modeling is conducted for an entire subreach while the LAC method is conducted on a section-by-section, and some consideration of this must occur when comparing values.

Table 4.4: Vista Canyon Ranch SAM & LACH&SM General Adjustment Comparison (ft)

Subreach	US Section	Existing Conditions		Proposed Conditions	
		SAM	LACH&SM	SAM	LACH&SM
6	18000	-0.5	-2.3	-0.5	-2.3
5	16800	-2.0	-3.2	-2.0	-3.2
4	15800	0.1	-2.4	-1.5	-2.5
3	15000	-1.3	-2.3	-3.3	-3.2
2	13400	-1.2	-1.9	0.0	-2.8
1	11600	1.5	-2.9	0.5	-3.0

Figure 4.1A: Santa Clara River Existing Conditions General Adjustment

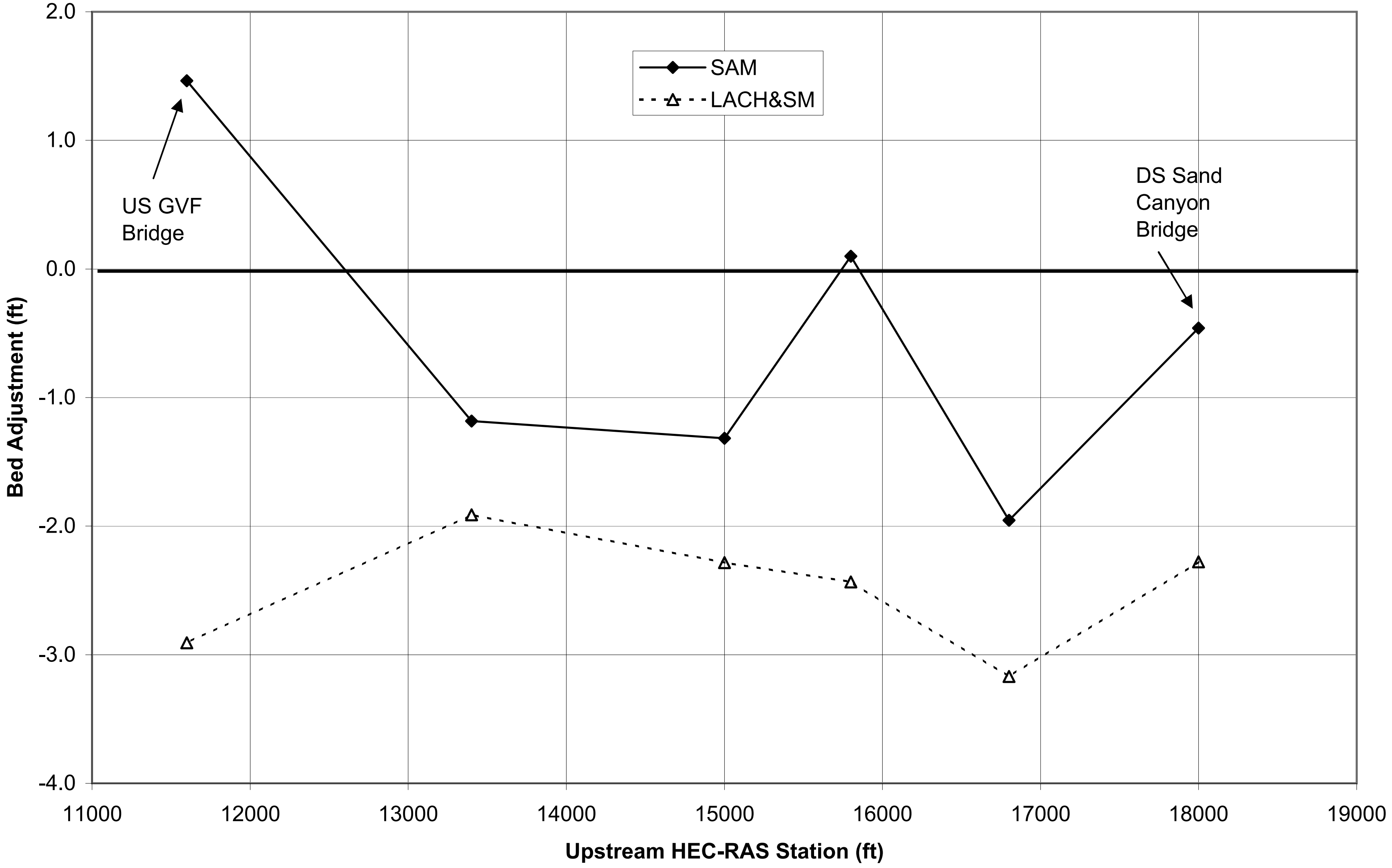
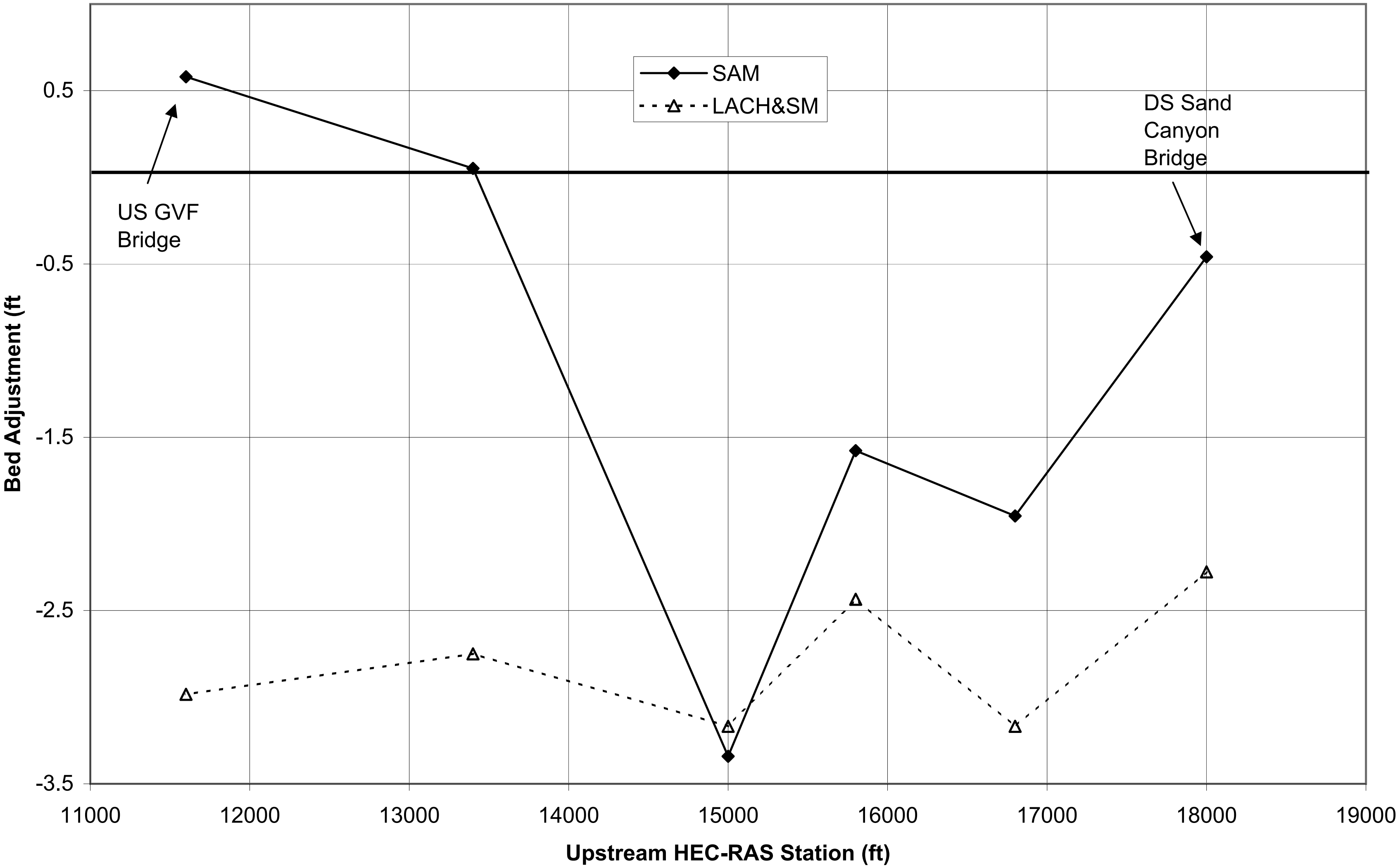


Figure 4.1B: Santa Clara River Proposed Conditions General Adjustment



5 Long-Term Adjustment

Long-term adjustment was calculated based on historical records in the form of topographic data. First, topographic data, provided by Allan E. Seward Engineering Geology dating from 1929, 1964, 1977, 1981 and 2005, was digitized (See Appendix Chapter 5.1). This was accomplished by determining a common coordinate system and creating lines of equal ground surface elevation within the study area. Topographic data was available in several formats including digital elevation maps (2005) and quad maps (1929, 1964, 1977 and 1981). Digital elevation maps were only adjusted for horizontal location. Cross-sections were next cut at the locations of select HEC-RAS sections (shown in Figure 5.1) for each historical topography. There are no changes in discharge so cross-sections were chosen at areas of engineering significance (areas of expansion, contraction, bridge locations, etc.). The HEC-RAS sections chosen are 10800, 12600, 14200, 15400, 16400, and 17200. Areas of the sections are calculated and these areas are used to calculate the average change in bed elevation over time. To calculate the area of a given cross-section the lowest historical point on the section is determined and the area of each vertical foot of the section in one foot intervals is calculated, as shown in Figure 5.2A-F, for each historical topography. The area of a section is the sum of the one foot area intervals, also shown in the figure. All areas for a given section have a common toe and top from which the area is calculated. The relative average change in depth for a given section and topography is calculated as the area divided by the top width, where the top width is taken as the width of the upper most one foot area. The top width in this sense is not a hydraulic characteristic but a physical one, which along with the sectional area determines the maximum capacity of the section. Moreover, the calculated depth is a relative physical value based on the section area and represents an average physical characteristic of the section as a whole.

Several events within the available historical record (1929 to present) have had an impact on the Riverbed and fluvial mechanics. These events include grading fill and other overbank development. Placement of the bridges does not appear to have had a measurable impact on long-term bed characteristics, except for local characteristics. Moreover, despite narrowing of the bed locally, bridge placement does not appear to have led to general bed degradation on the River as a whole. Periodic fires have burned the flora of the watershed historically, and as recently as Summer 2004. Fires are important to changes of the Riverbed because these fires deplete vegetation stalks and root systems that hold soil in upland areas, in turn leading to increased erosion on slopes and increased sediment delivery to creeks and rivers. Grading fills are important to the historic River fluvial mechanics because the fills limit the extent to which the River may migrate, in turn possibly causing vertical erosion of the creek bed. LACDPW has indicated that the constraining of the lateral erosion at the infill locations may exacerbate background erosion downstream.

Table 5.1A shows the long-term historical cross-sections area from 1929 to 2005. The table lists the area for each historical section in a given subreach. The table also lists the difference between historical sections (e.g. 1929 section 15400 area – 2005 section 15400 area). Table 5.1B shows the historical cross-section average depth and average depth change by section and year. As noted above, the average depth is the area of a given section by year divided by the section geometric top width for that year. The difference between historical areas is also shown. It is important to note that the vertical elevation for each section is the same. A minimum of 2 feet for degradation and 1 foot for aggradation was applied in later calculations where change was less than these values in order to be conservative.

Xrefs: RW LINE 5-9-07.dwg; 8587E-TOPO-NEW.dwg; 8587-SHADE HATCH NORTH SOUTH SC BP.dwg; 8587-STA-ALIGNMENT NORTH SOUTH SC BP.dwg; 8587-PROPOSED BRIDGE NORTH SOUTH SC BP.dwg; 8587-VistaCanyon-AirPhotoAerialImagery (GROUND).dwg; 8587-PROJECT BOUNDARY.dwg; 8587-TRAIL NORTH SOUTH SC BP.dwg; 8587-HEC-SECS FOR 5.1.dwg
Dimscale = 1; LTscale = 0.5 ; PSltscale = 1; Acad Ver. = 17.1s (LMS Tech) ; Visretain = 1

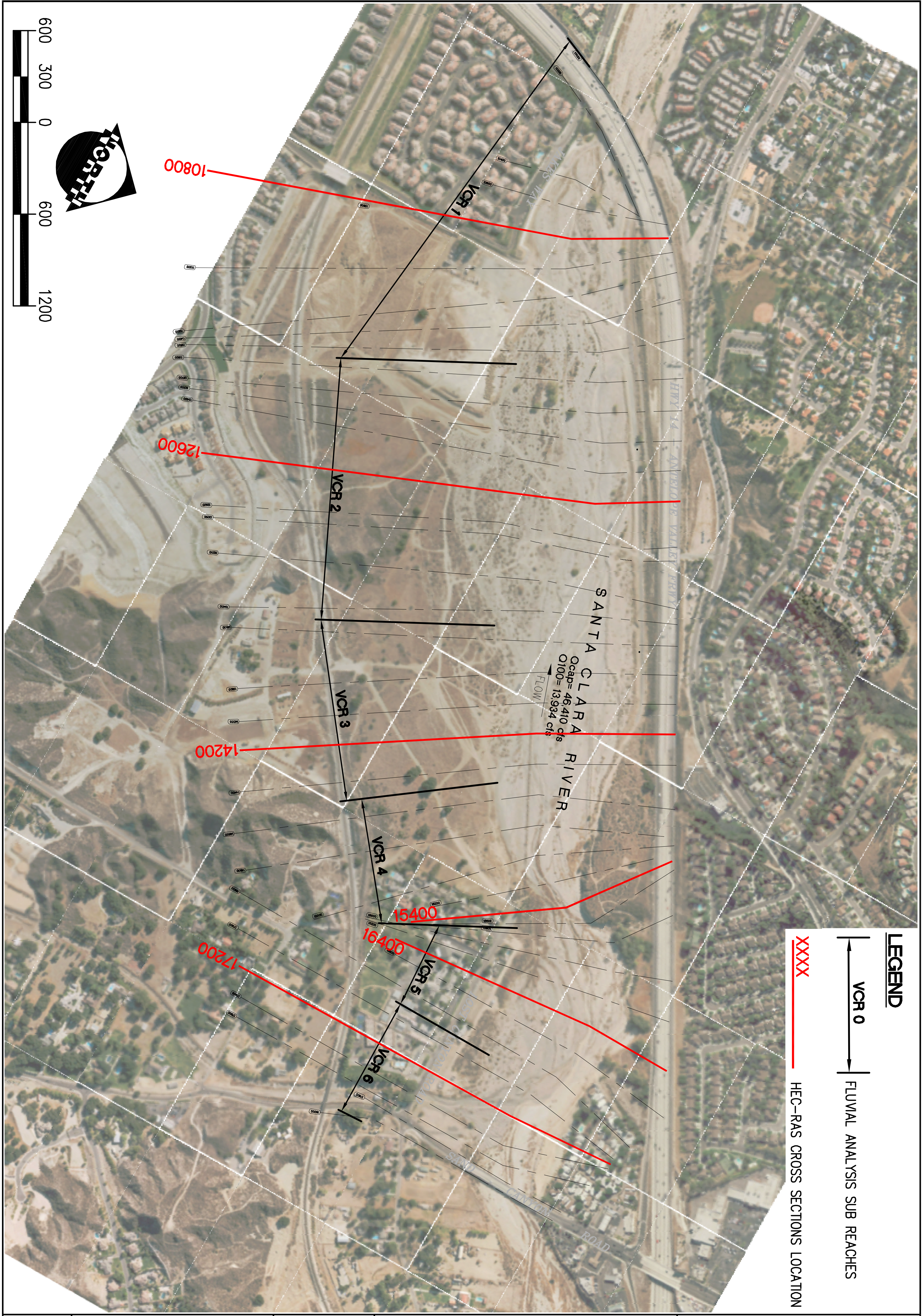


FIGURE
5.1

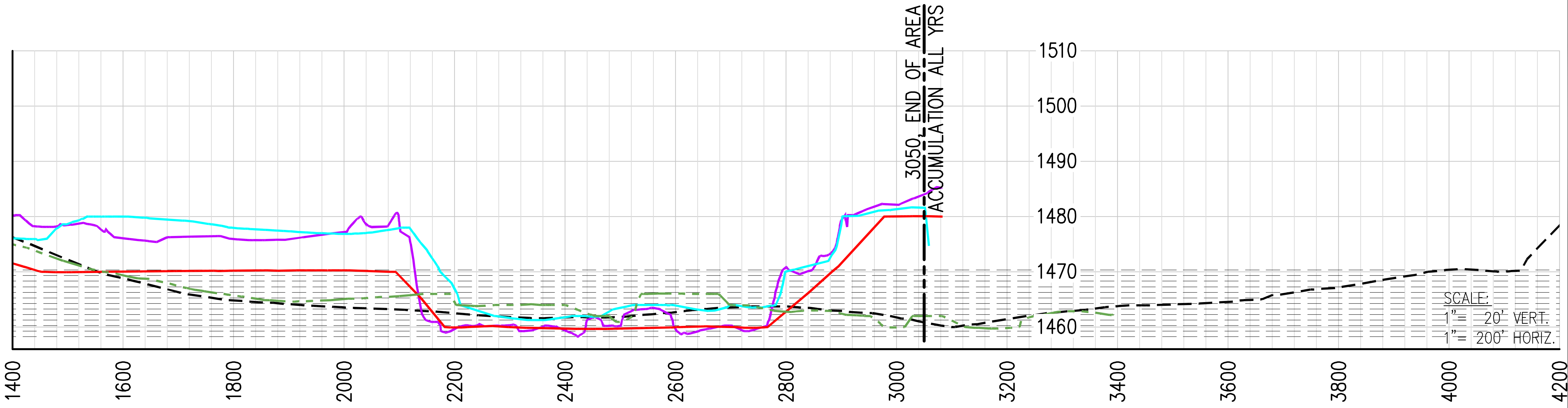
PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

SCALE	1" = 600
DESIGNED	J.P.
DRAWN	T.M.C.
CHECKED	J.P.
DATE	10/22/08
JOB NO.	8587E

JOB
VISTA CANYON
FLUVIAL STUDY
LOS ANGELES COUNTY CA

TITLE
VISTA CANYON RANCH
HISTORIC SECTIONS
ANALYSIS LOCATION MAP

P:\8587E\Engineering\GlobalExhibits\HISTORICAL TOPO-FLUVIAL STUDY EXHIBITS\8587E-Fig-5.1-VISTA CANYON-HISTORIC SECTIONS.dwg - Tab: 100 SCALE-STUDY - by jpreston on 10/22/08 at 2:06:34 PM



SUBREACH ---- SECTION 10800

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 10800 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1459.3	0.0	0.0	0.0	0.0	33.9
1460.3	7.7	13.4	232.5	0.0	220.8
1461.3	5.2	57.5	600.4	0.0	442.6
1462.3	199.4	131.5	620.4	125.8	531.3
1463.3	583.6	297.6	640.5	244.3	573.0
1464.3	1029.4	506.7	660.5	449.8	634.4
1465.3	1239.3	778.3	680.5	576.0	641.0
1466.3	1321.4	1082.9	701.3	583.7	644.9
1467.3	1367.9	1320.4	722.6	591.0	649.1
1468.3	1407.7	1363.7	743.5	598.8	653.1
1469.3	1449.0	1415.6	764.3	609.9	657.6
1470.3	1488.9	1471.4	904.0	623.1	662.8
Area	**10099.5**	**8438.9**	**7270.5**	**4402.4**	**6344.5**

LEGEND:

━━━━	2005 TERRAIN
━━━━	1981 TERRAIN
━━━━	1977 TERRAIN
— · — · —	1964 TERRAIN
- - - - - - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

JOB
VISTA CANYON RANCH FLUVIAL STUDY

LOS ANGELES COUNTY **CA**

SCALE	AS NOTED
DESIGNED	DAJ
DRAWN	DAD
CHECKED	MEK
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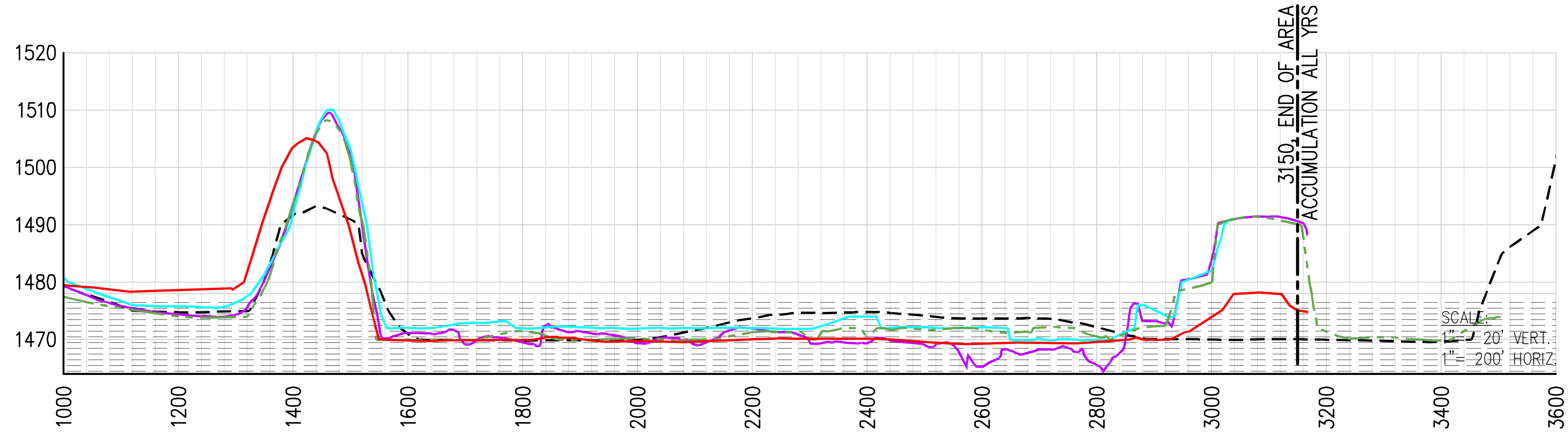
FIGURE
5.2A



SUBREACH ---- SECTION 12600

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 12600 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1475.5	0.0	0.0	0.0	0.0	9.3
1476.5	0.0	0.0	0.0	0.0	62.5
1477.5	0.0	0.0	0.0	0.0	113.4
1478.5	0.0	0.0	0.0	0.0	192.4
1479.5	0.0	0.0	21.4	0.0	339.3
1480.5	343.7	231.8	866.4	87.7	703.1
1481.5	769.0	691.1	1400.3	195.0	992.1
1482.5	869.6	1181.5	1424.7	585.9	1251.0
1483.5	967.0	1379.8	1442.7	1176.1	1326.9
1484.5	1233.4	1384.6	1460.7	1292.2	1366.6
1485.5	1538.0	1388.3	1478.3	1351.2	1374.7
1486.5	1587.6	1391.9	1489.9	1380.4	1386.8
Area	**7308.2**	**7648.8**	**9584.4**	**6068.5**	**9118.1**

LEGEND:

———	2005 TERRAIN
———	1981 TERRAIN
———	1977 TERRAIN
—·—·—	1964 TERRAIN
- - - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

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FIGURE
5.2B

Dimscale = 200; LTscale = 0.5; PSltscale = 1; Acad Ver. = 17.1s (LMS Tech); Visretain = 1

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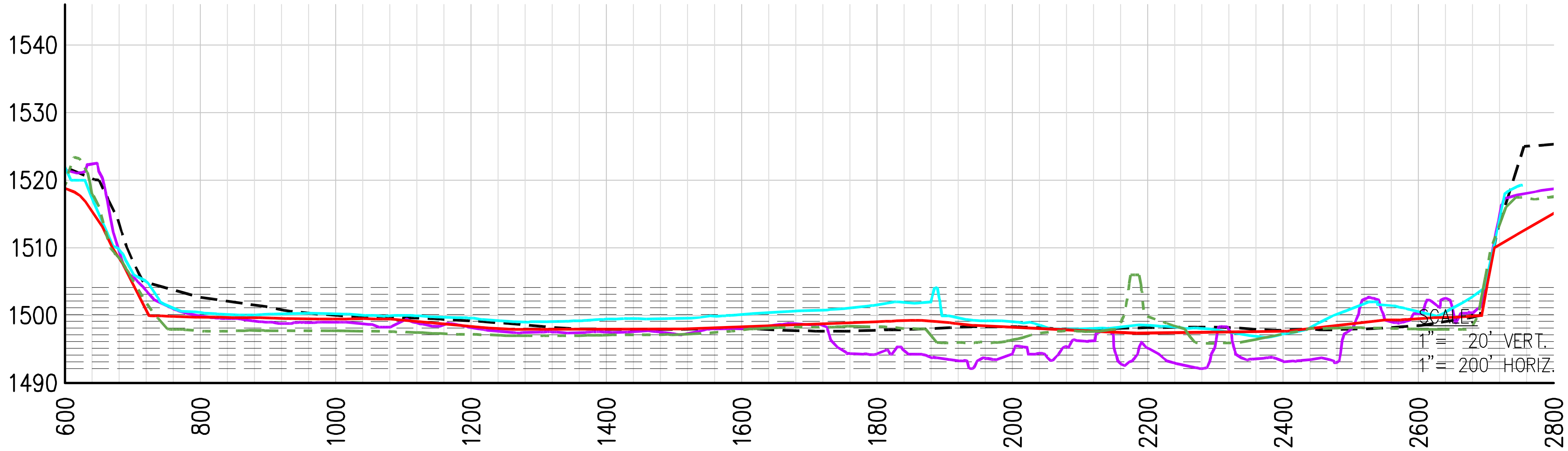

SUBREACH ---- SECTION 14200

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 14200 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1493.1	0.0	0.0	0.0	0.0	47.3
1494.1	0.0	0.0	0.0	0.0	264.5
1495.1	0.0	0.0	0.0	0.0	526.6
1496.1	0.0	25.3	0.0	0.0	641.5
1497.1	0.0	229.4	0.0	9.5	702.7
1498.1	0.0	976.4	238.9	113.0	934.0
1499.1	1284.4	1820.0	1047.2	387.9	1361.0
1500.1	1567.2	1905.6	1699.2	856.3	1716.9
1501.1	1752.8	1932.2	1973.1	1517.3	1827.4
1502.1	1818.9	1944.0	1980.0	1798.4	1886.4
1503.1	1887.9	1954.8	1987.0	1928.9	1951.2
1504.1	1932.3	1965.2	1994.0	1954.4	1976.2
Area	**10243.6**	**12752.9**	**10919.5**	**8565.7**	**13835.8**

LEGEND:

🟪	2005 TERRAIN
🟦	1981 TERRAIN
🟥	1977 TERRAIN
🟩	1964 TERRAIN
- - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

JOB
VISTA CANYON RANCH FLUVIAL STUDY

LOS ANGELES COUNTY **CA**

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FIGURE
5.2C

Dimscale = 200; LTscale = 0.5; PSltscale = 1; Acad Ver. = 17.1s (LMS Tech); Visretain = 1

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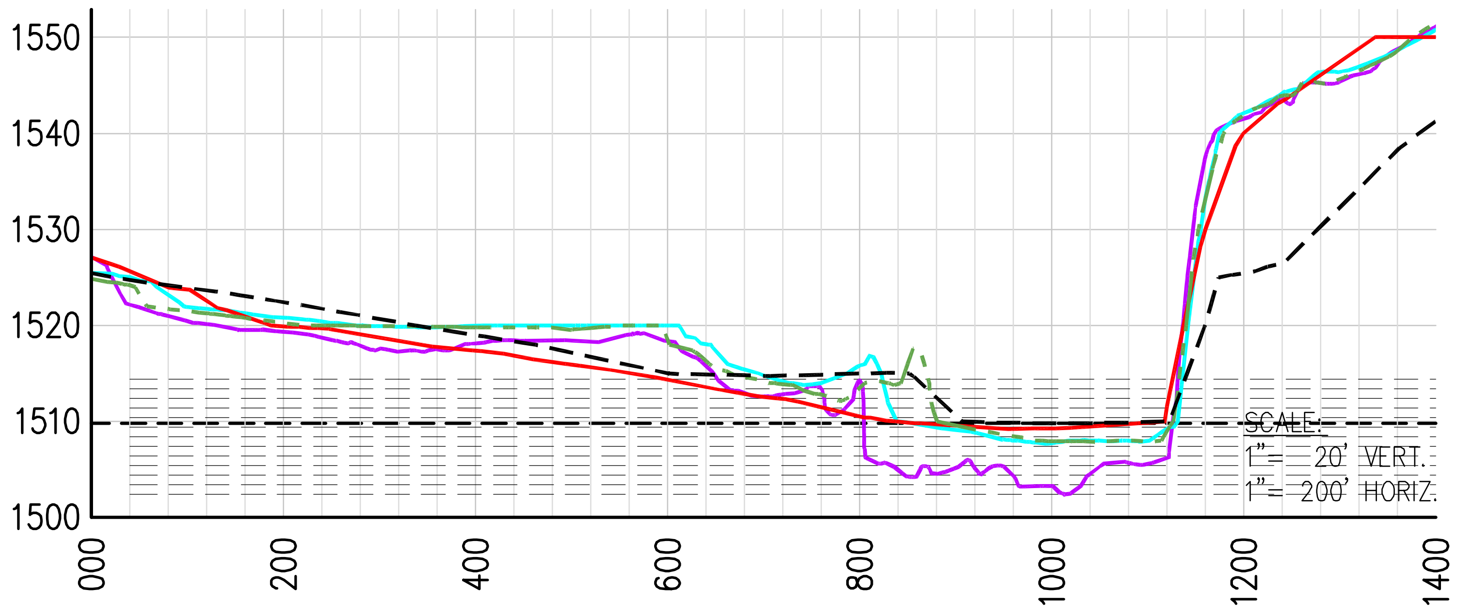

SUBREACH ---- SECTION 15400

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 15400 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1503.4	0.0	0.0	0.0	0.0	24.1
1504.4	0.0	0.0	0.0	0.0	73.3
1505.4	0.0	0.0	0.0	0.0	140.5
1506.4	0.0	0.0	0.0	0.0	277.3
1507.4	0.0	0.0	0.0	0.0	317.0
1508.4	0.0	61.3	0.0	73.6	318.7
1509.4	0.0	183.6	10.8	201.6	320.1
1510.4	113.6	236.4	233.4	277.7	321.5
1511.4	228.5	250.2	333.7	297.6	333.0
1512.4	243.0	256.3	378.1	303.1	351.0
1513.4	257.5	296.0	442.4	306.8	399.4
1514.4	272.0	359.0	501.0	331.4	465.2
Area	**1114.6**	**1642.8**	**1899.4**	**1791.9**	**3341.3**

LEGEND:

━━━━	2005 TERRAIN
━━━━	1981 TERRAIN
━━━━	1977 TERRAIN
— · — ·	1964 TERRAIN
- - - - - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

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FIGURE
5.2D

Dimscale = 200; LTscale = 1; PSltscale = 0.5; Acad Ver. = 17.1s (LMS Tech); Visretain = 1

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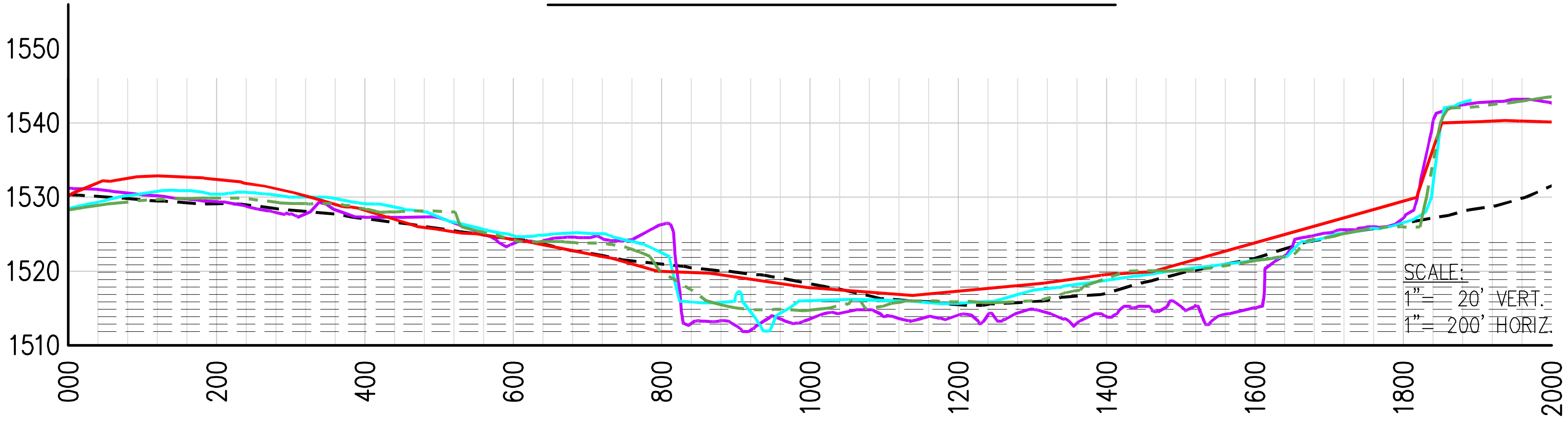
SUBREACH --- SECTION 16600



SUBREACH ---- SECTION 16400

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 16400 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1512.9	0.0	0.0	0.0	12.4	22.2
1513.9	0.0	0.0	0.0	23.9	189.8
1514.9	0.0	2.1	0.0	39.9	519.1
1515.9	32.6	182.1	0.0	68.4	745.6
1516.9	237.5	453.2	1.4	396.9	785.5
1517.9	362.4	514.6	148.5	481.1	788.1
1518.9	449.3	555.0	352.5	553.1	789.6
1519.9	546.7	600.8	505.6	624.7	791.3
1520.9	679.9	723.8	694.9	700.1	795.1
1521.9	815.8	809.1	767.2	781.5	808.9
1522.9	915.7	877.1	847.8	844.0	824.7
1523.9	999.0	921.3	933.5	874.6	832.9
Area	**5038.9**	**5639.2**	**4251.3**	**5400.7**	**7892.8**

LEGEND:

───	2005 TERRAIN
───	1981 TERRAIN
───	1977 TERRAIN
─ · ─	1964 TERRAIN
- - - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

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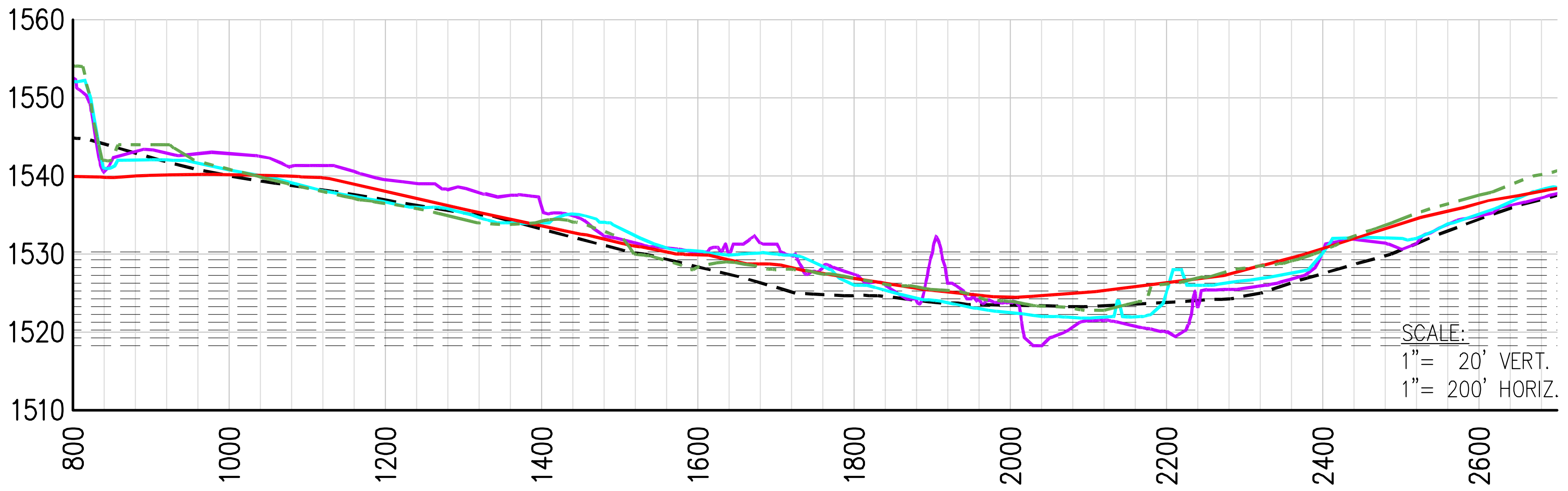
FIGURE
5.2E



SUBREACH ---- SECTION 17200

LOOKING DOWNSTREAM

CROSS SECTIONAL AREAS AT STA 17200 (sf)					
ELEV	**1929**	**1964**	**1977**	**1981**	**2005**
1519.3	0.0	0.0	0.0	0.0	21.4
1520.3	0.0	0.0	0.0	0.0	60.1
1521.3	0.0	0.0	0.0	0.0	133.4
1522.3	0.0	0.0	0.0	45.6	207.8
1523.3	0.0	23.2	0.0	200.9	219.8
1524.3	258.0	151.9	0.0	274.8	252.6
1525.3	524.9	227.0	91.6	336.6	327.4
1526.3	645.0	307.7	281.8	392.9	419.0
1527.3	710.8	428.5	426.0	508.6	521.2
1528.3	784.6	543.5	546.6	587.2	587.0
1529.3	860.4	734.3	653.7	636.4	641.0
1530.3	939.9	847.4	764.7	698.7	664.5
Area	**4723.8**	**3263.4**	**2764.4**	**3681.8**	**4055.3**

LEGEND:

—	2005 TERRAIN
—	1981 TERRAIN
—	1977 TERRAIN
—·—	1964 TERRAIN
- - - -	1929 TERRAIN

TITLE
HISTORICAL CROSS SECTIONS BY STATION

JOB
VISTA CANYON RANCH FLUVIAL STUDY

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FIGURE
5.2F

Dimscale = 200; LTscale = 0.5; PSltscale = 1; Acad Ver. = 17.1s (LMS Tech); Visretain = 1

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Table 5.1A: Vista Canyon Ranch Historical Cross-Section Area & Area Change 1929-2005

SUBREACH	SECTION	1929	1964	1977	1981	2005	29-05	CHANGE
1	10800[1]	10100	8439	7271	4402	6345	926	AGGRADE
2	12600[2]	7308	7649	9584	6069	9118	-1469	DEGRADE
3	14200	10244	12753	10920	8566	13836	-3592	DEGRADE
4	15400	1115	1643	1899	1792	3341	-2227	DEGRADE
5	16600[2]	5039	5639	4251	5401	7893	-2254	DEGRADE
6	17200	4724	3263	2764	3682	4055	669	AGGRADE

1: Utilizes 1977 data for computation since 1929 and 1964 data is of low resolution at this location.

2: Utilizes 1964 data for computation since 1929 data is of low resolution at this location.

Table 5.1B: Vista Canyon Ranch Historical Cross-Section Average Depth & Average Depth Change
Aggradation/Degradation Change 1929-2005

SUBREACH	SECTION	1929	1964	1977	1981	2005	29-05	CHANGE
1	10800[1]	6.8	5.7	8.0	7.1	9.6	-1.5	DEGRADE
2	12600[2]	4.6	5.5	6.4	4.4	6.6	-1.1	DEGRADE
3	14200	5.3	6.5	0.5	4.4	7.0	-1.7	DEGRADE
4	15400	4.1	4.6	3.8	5.4	7.2	-3.1	DEGRADE
5	16600[2]	5.0	6.1	4.6	6.2	9.5	-3.4	DEGRADE
6	17200	5.1	3.9	3.6	5.3	6.1	-1.0	DEGRADE

1: Utilizes 1977 data for computation since 1929 and 1964 data is of low resolution at this location.

2: Utilizes 1964 data for computation since 1929 data is of low resolution at this location.

Section 10800 (Subreach 6) is an area of contraction as the River begins to narrow. This section is upstream of the Antelope Valley Freeway Bridge and both overbanks are occupied by recent development. Figure 5.2A shows that the bed fluctuates over historical period. The data prior to the 1977 topography does not appear to have sufficient data in this section and is not used to determine long-term trends. The 1929 and 1964 data sets show that the river prior to the development of the overbanks was wider and flatter across the section. The features in the section approximately between stations 2200 and 2800 result from the braiding in the riverbed. Table 5.1B reports -1.5 feet of degradation from 1977 to 2005.

Section 12600 (Subreach 5) is downstream of the proposed project bridge and in the middle of the project site. Figure 5.2B shows that the channel is approximately widest here. There is development on the right overbank up to station 3000. The feature centered on station 1400 is a hill in the overbank. The 1964 topography is used for long-term analysis since the 1929 topography has insufficient resolution in this section. The 1977 data is also poor in this section. Generally, the bed greatly fluctuates over the period of record. Table 5.1B shows -1.1 feet of degradation from 1964 to 2005, and -2.2 feet of degradation since 1981.

Section 14200 (Subreach 4) contains development on the right overbank. Figure 5.2C shows a wide channel that with the river flowing primarily flowing between stations 1750 and 2500. A feature at station 2200 in the 1964 topography appears to be a groin to direct flow away from the left bank. This feature does not appear in either the 1929 or the 1977 topographies. It does appear at station 1900 in 1981 suggestion that the previous iteration of the structure was either removed or destroyed. The structure is not present today. Long-term calculations from 1929 to 2005 estimate -1.7 feet of degradation (Table 5.1B).

Section 15400 (Subreach 3) has approximately the narrowest section in the study area. This section has development on the left bank and exposed non-erodible material on the right bank. Figure 5.2D shows the retaining or groin type structure at station 850 in the 1964 data. By the 1981 topography, this feature appears to be incorporated into the bank as part of the development. Figure 5.1B indicates a trend of degradation of 3.1 feet between 1929 and 2005. It is not clear if this degradation is the result of the build-out of the left bank or of other processes within the River.

Section 16600 (Subreach 2) is located between the contraction downstream at Section 15400 and the Sand Canyon Bridge and confluence upstream. The backwater cause by the contraction and the potential for significant sediment delivery are both expected to impact this section. Section 16600 has development on both banks, and the development on the left bank appears to have increased into the river between 1964 and 2005. The resolution of the braids in the River is highest in the 2005 topography. It is unclear if these braids are related to a discharge event in the River or in the Sand Canyon tributary. Table 5.1B shows -3.4 feet of degradation from 1929 to 2005, the maximum within the study area. This may be a function of the increased resolution of the topography or a function of the encroachment from the development on the left bank.

Section 17200 (Subreach 1) is immediately downstream of the Sand Canyon Road Bridge at the confluence with Sand Canyon Creek. The majority of the flow appears to be confined between stations 1900 and 2200. At station 1900 in the 2005 topography a 6-foot berm appears to be present. It is unclear the origin of the berm, however, it may be from grading in the River associated with flows originating in the Creek. It also appears that the channel is down-cut at this location by flows from the Creek. In the 1981 topography, similar down-cutting is apparent between station 2150 and 2250. The 1981 down-cutting appears to be the function of flow in from the River, however. Older topography does not have sufficiently high resolution to illustrate the presence of similar features historically. The 1929 to 2005 topography shows degradation of -1.0 feet (Table 5.1B) in the long term.

6 Other Scour

The calculation of scour depth for design of toedown for structures is given in Chapter 5 of LACSM. The manual defines the toedown depth as the sum of long-term adjustment, general adjustment and five local effects that fall into the category of other scour. Other scour falls into four sub-categories: local scour, bend scour, low-flow incisement, and bed form height. Local scour occurs near flow obstructions including piers and abutments. Bend scour occurs because differential velocity gradients around curves in open channel flow. Three distinct bends are located in the River for this study reach. These bends have radii of 2090, 37,350 and 3,605 feet. The bends can be seen in Figure 1.1. Low flow incisement is included to represent thalweg or low flow channel depth. On-site inspection and analysis of historic topographic data of this feature estimates the thalweg at approximately two feet. Finally, bed form height represents the dunes and anti-dunes that develop in active soft bottomed channels during flow events. Because no observations are available, bed form height has been limited after Kennedy (1963).

Bend scour and bed form height have been calculated based on LACSM design curves in Section 5 and Appendix Q. Bend scour is based on equation Q-6A of the manual, given as (Zeller, 1981):

$$Z_{bs} = \frac{0.0685 Y V^{0.8}}{Y_h^{0.4} S_e^{0.3}} \left[1.59 \left(\frac{w}{r} \right)^{0.2} - 1 \right]$$

where Z_{bs} is the bend scour depth, V is mean velocity, Y is maximum depth of flow, Y_h is hydraulic depth of flow, S_e is energy slope, w is channel top width, and r is radius of curvature to the centerline of the channel. Bed form height is given by equation Q-8 of the manual, given as:

$$h = 0.027 V^2$$

where h is bed form height.

Results of calculations of other scour components are summarized in LACSM calculations tables in Appendix Chapter 6.1 as well as Table 6. The tables show that pier scour is 0.0 to -15.3 feet. Bend scour ranges from 0.0 to -3.7 feet. Bed form height ranges from -0.9 to -3.7 feet.

Table 6: Vista Canyon Ranch Summary of Other Scour (Feet)

Subreach	Section	Existing Condition		Proposed Condition		Δ Curved	Δ Straight
		Outside Curved Reach	Straight-Inside Curved Reach	Outside Curved Reach	Straight-Inside Curved Reach		
6	18000	3.5	3.5	3.5	3.5	0.0	0.0
	17800 *	20.1	20.1	20.1	20.1	0.0	0.0
	17600	4.6	4.6	4.6	4.6	0.0	0.0
	17400	4.4	4.4	4.4	4.4	0.0	0.0
	17200	4.7	4.7	4.7	4.7	0.0	0.0
	17000	4.2	4.2	4.2	4.2	0.0	0.0
5	16800	7.0	4.3	7.0	4.3	0.0	0.0
	16600	6.7	4.1	6.7	4.1	0.0	0.0
	16400	6.7	4.1	6.7	4.1	0.0	0.0
	16200	6.5	3.5	6.5	3.5	0.0	0.0
	16000	6.8	3.1	6.8	3.1	0.0	0.0
	15800	7.8	2.9	6.5	2.9	-0.1	0.0
4	15600	7.4	3.7	5.9	3.7	-1.4	0.1
	15400	8.4	5.7	7.2	5.7	-1.2	0.0
	15200	7.1	5.3	7.1	5.3	0.0	0.0
	15000	4.7	4.7	4.8	4.8	0.1	0.1
	14800	3.9	3.9	4.5	4.5	0.7	0.7
	14600	3.9	3.9	4.4	4.4	0.5	0.5
3	14400	3.5	3.5	4.4	4.4	0.9	0.9
	14200	3.5	3.5	4.2	4.2	0.8	0.8
	14000	3.4	3.4	4.1	4.1	0.7	0.7
	13800	3.4	3.4	4.1	4.1	0.7	0.7
	13600	3.3	3.3	4.0	4.0	0.8	0.8
	13400	3.2	3.2	4.0	4.0	0.8	0.8
2	13200	3.3	3.3	4.0	4.0	0.7	0.7
	13050	3.4	3.4	3.5	3.5	0.2	0.2
	12920 **	3.4	3.4	18.9	18.9	15.5	15.5
	12600	3.5	3.5	4.1	4.1	0.6	0.6
	12400	3.4	3.4	4.1	4.1	0.7	0.7
	12200	3.5	3.5	4.2	4.2	0.7	0.7
	12000	3.8	3.8	4.2	4.2	0.4	0.4
	11800	4.0	4.0	4.2	4.2	0.3	0.3
	11600	5.9	4.1	5.9	4.2	0.0	0.1
1	11400	5.7	4.3	5.7	4.3	0.0	0.0
	11200	5.6	4.5	5.6	4.5	0.0	0.0
	11000	6.1	4.4	5.7	4.3	-0.5	0.0
	10800	5.7	4.4	5.7	4.4	0.0	0.0
	10600	5.7	4.5	5.7	4.5	0.0	0.0
	10400	5.7	4.7	5.7	4.7	0.0	0.0
	10200	5.8	3.5	5.8	3.5	0.0	0.0
	10000 *	20.1	18.3	20.1	18.3	0.0	0.0

*: Existing bridge location

**: Proposed bridge location

7 Total Scour and Freeboard

7.1 Total Scour

To be conservative, general adjustment, long-term adjustment and other scour are summed to determine total potential bed adjustment following LACSM methodology, as presented in Section 5 of the LACSM manual. SAM values are used for general adjustment, and the long-term analysis presented in Chapter 5 represents long term trends. Individual and combined scour components are shown in Figure 7.1A-D and Table 7.1A-D, for the existing and proposed conditions, respectively. For cross-sections where SAM modeling predicts aggradation, the general adjustment contribution to total bed adjustment is not included. This conservative approach ensures that major trends are captured by the study but local or minor bed adjustments do not decrease total potential degradation. Long-term degradation values are taken as the larger of long-term degradation or two feet. The tables show that total bed degradation on the outside bank of curved reaches ranges from approximately -5.0 to -12.3 feet in the existing condition at sections 18000 and 16800, respectively. In the proposed condition, total bed degradation outside of curved reaches range from approximately -5.0 to -12.3 feet at sections 18000 and 16800, respectively. For the inside bank of curved reaches and in straight reaches in the existing condition, total degradation ranges from -5.0 to -9.6 feet at sections 18000 and 16800, respectively. For the inside bank of curved reaches and in straight reaches in the proposed condition, total degradation ranges from -5.0 to -9.6 feet at sections 18000 and 16800, respectively.

Table 7.1A: Vista Canyon Ranch Existing Conditions Outside Curved Reach Summary of Degradation Components (ft)

Subreach	US Section	Z_{DEG}**	Z_{GS} (SAM)*	Z_{OTHER}	Z_{TOTAL}
6	18000	-2.0	-0.5	-3.5	**-6.0**
5	16800	-3.4	-2.0	-7.0	**-12.3**
4	15600	-3.1	0.1	-7.4	**-10.4**
3	14400	-2.0	-1.3	-3.5	**-6.8**
2	13400	-2.0	-1.2	-3.3	**-6.5**
1	11600	-2.0	1.5	-5.7	**-7.7**

*Positive values in Z_{GS} represent aggradation and are not included in the total

**Long-term degradation uses a minimum of 2 feet

Table 7.1B: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Summary of Degradation Components (ft)

Subreach	**US Section**	**Z_{DEG}****	**Z_{GS} (SAM)***	**Z_{OTHER}**	**Z_{TOTAL}**
6	18000	-2.0	-0.5	-3.5	**-6.0**
5	16800	-3.4	-2.0	-7.0	**-12.3**
4	15600	-3.1	-1.5	-5.9	**-10.5**
3	14400	-2.0	-3.3	-4.4	**-9.7**
2	13400	-2.0	0.0	-4.0	**-6.0**
1	11600	-2.0	0.5	-5.7	**-7.7**

*Positive values in Z_{GS} represent aggradation and are not included in the total

**Long-term degradation uses a minimum of 2 feet

Figure 7.1A: Vista Canyon Ranch
Existing Conditions Outside Curved Reach Summary of Degradation Components

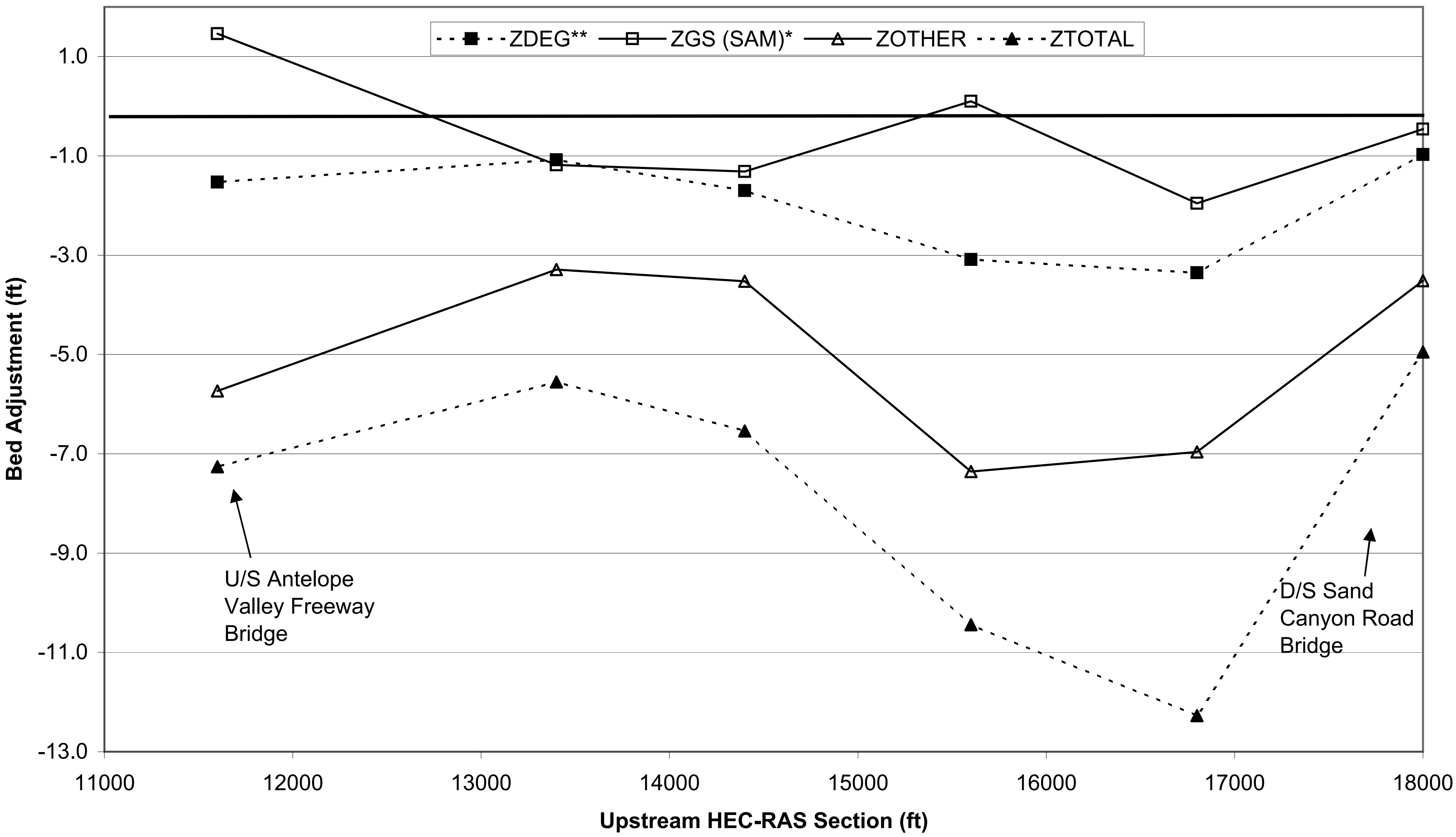


Figure 7.1B: Vista Canyon Ranch
Proposed Conditions Outside Curved Reach Summary of Degradation Components

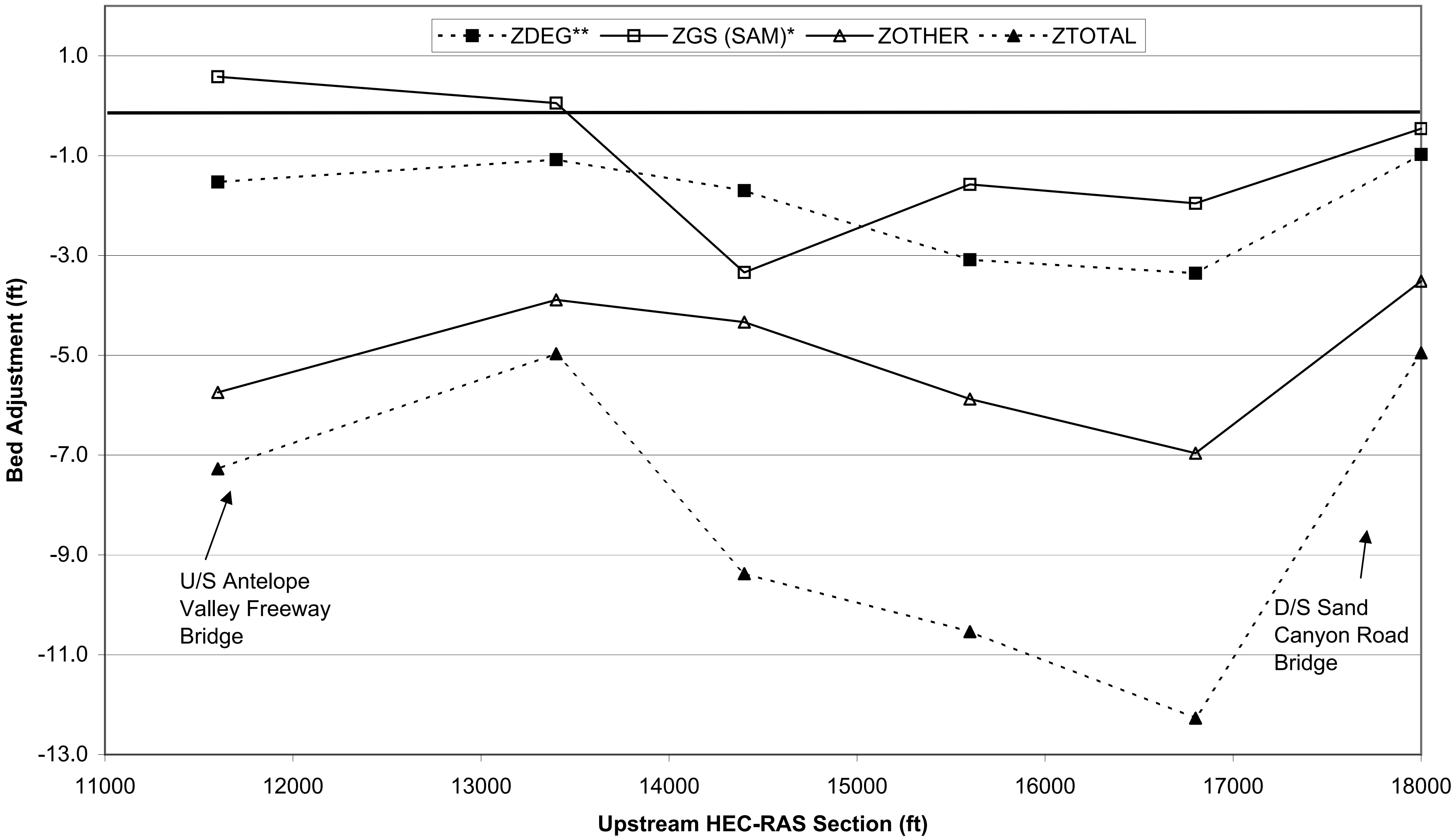


Table 7.1C: Vista Canyon Ranch Existing Conditions Straight-Inside Curved Reach Summary of Degradation Components (ft)

Subreach	US Section	Z_{DEG}**	Z_{GS} (SAM)*	Z_{OTHER}	Z_{TOTAL}
6	18000	-2.0	-0.5	-3.5	**-6.0**
5	16800	-3.4	-2.0	-4.3	**-9.6**
4	15600	-3.1	0.1	-3.7	**-6.7**
3	14400	-2.0	-1.3	-3.5	**-6.8**
2	13400	-2.0	-1.2	-3.3	**-6.5**
1	11600	-2.0	1.5	-4.3	**-6.3**

*Positive values in Z_{GS} represent aggradation and are not included in the total

**Long-term degradation uses a minimum of 2 feet

Table 7.1D: Vista Canyon Ranch Proposed Conditions Straight-Inside Curved Reach Summary of Degradation Components (ft)

Subreach	**US Section**	**Z_{DEG}****	**Z_{GS} (SAM)***	**Z_{OTHER}**	**Z_{TOTAL}**
6	18000	-2.0	-0.5	-3.5	**-6.0**
5	16800	-3.4	-2.0	-4.3	**-9.6**
4	15600	-3.1	-1.5	-3.7	**-8.3**
3	14400	-2.0	-3.3	-4.4	**-9.7**
2	13400	-2.0	0.0	-4.0	**-6.0**
1	11600	-2.0	0.5	-4.3	**-6.3**

*Positive values in Z_{GS} represent aggradation and are not included in the total

**Long-term degradation uses a minimum of 2 feet

Figure 7.2A-D presents a comparison of total bed adjustment for the summed methodology, previously presented, and the methodology based on the Los Angeles County Flood Control District's Design Manual (LACFCDDM), Table F-31. Calculations are shown in Table 7.2A-D. The LACFCDDM methodology is based only on velocity and does not account for any other river parameters. Generally, the LACFCDDM is the most conservative among all total scour methodologies. Figure 7.2A-D shows that the more intensive LACSM methodology predicts a shallower toedown in both the existing and proposed conditions than does the LACFCDDM methodology for most sections. The LACFCDDM does not effectively account for the local degradation; therefore, the LACSM methodology utilizing SAM calculations predicts a deeper toedown at some locations than does the LACFCDDM methodology. Figure 7.2A-D shows the HEC-RAS model bed elevation and a comparison of the toedown elevation based on the LACSM with SAM components and the LACFCDDM methodologies. The figures show that the LACSM methodology predicts a shallower toedown depth than does LACFCDDM.

Table 7.2A: Vista Canyon Ranch Existing Conditions Outside Curved Reach Toedown Summary by Methodology (ft)

Subreach	US Section	HEC-RAS Model Bed Elevation	LACSM (SAM)	LACSM Toe-down Elevation	LACFCDDM	LACFCDDM Toe-down Elevation
6	18000	1526.0	-6.0	1520.0	-10.0	1516.0
5	16800	1519.0	-12.3	1506.7	-15.0	1504.0
4	15600	1507.0	-10.4	1496.6	-15.0	1492.0
3	14400	1497.7	-6.8	1490.8	-10.0	1487.7
2	13400	1486.0	-6.5	1479.5	-8.0	1478.0
1	11600	1468.0	-7.7	1460.3	-15.0	1453.0

Figure 7.2A: Vista Canyon Ranch
Existing Conditions Outside Curved Reach Toe-down Depths by Methodology

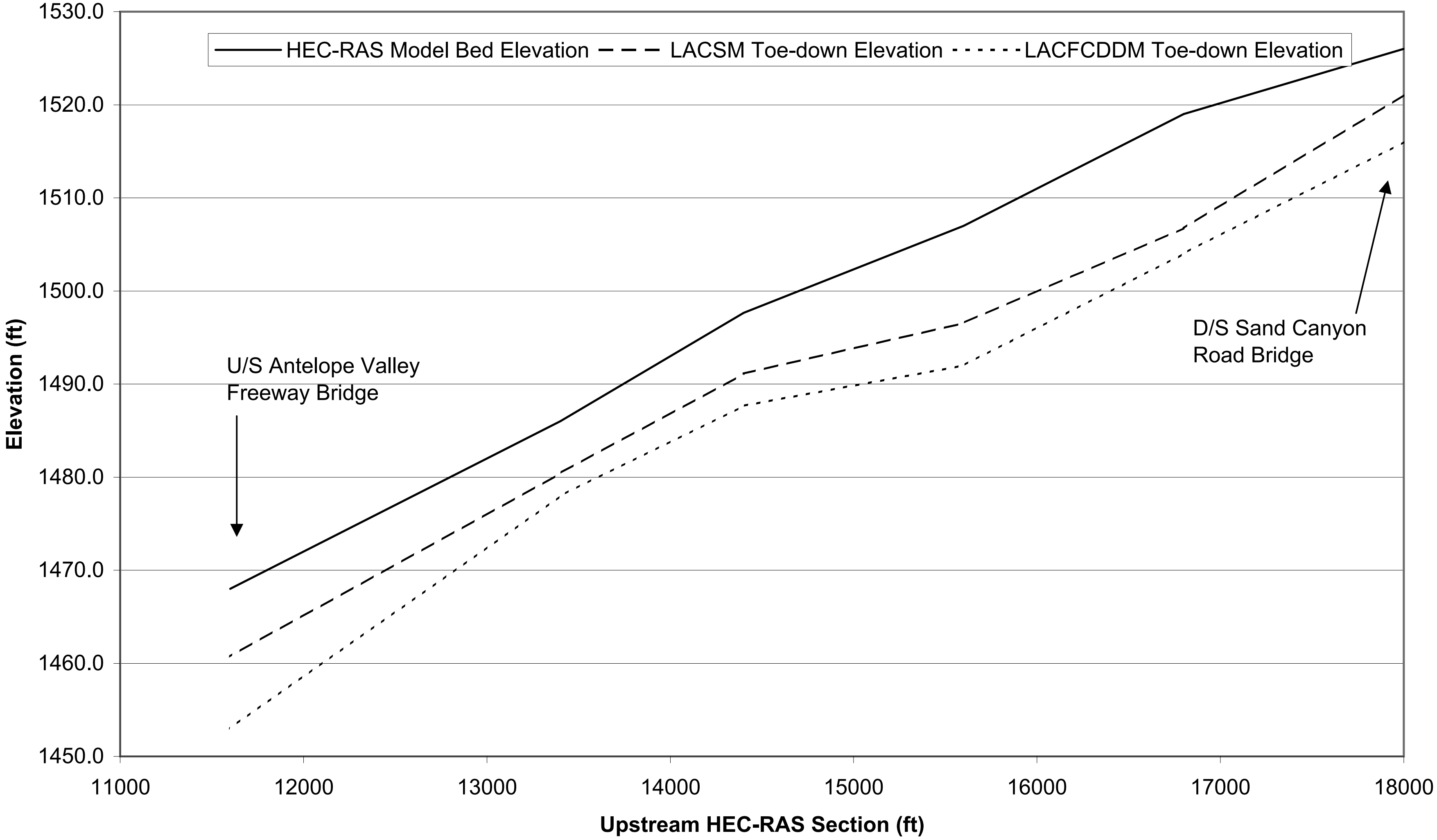


Figure 7.2B: Vista Canyon Ranch
Proposed Conditions Outside Curved Reach Toe-down Depths by Methodology

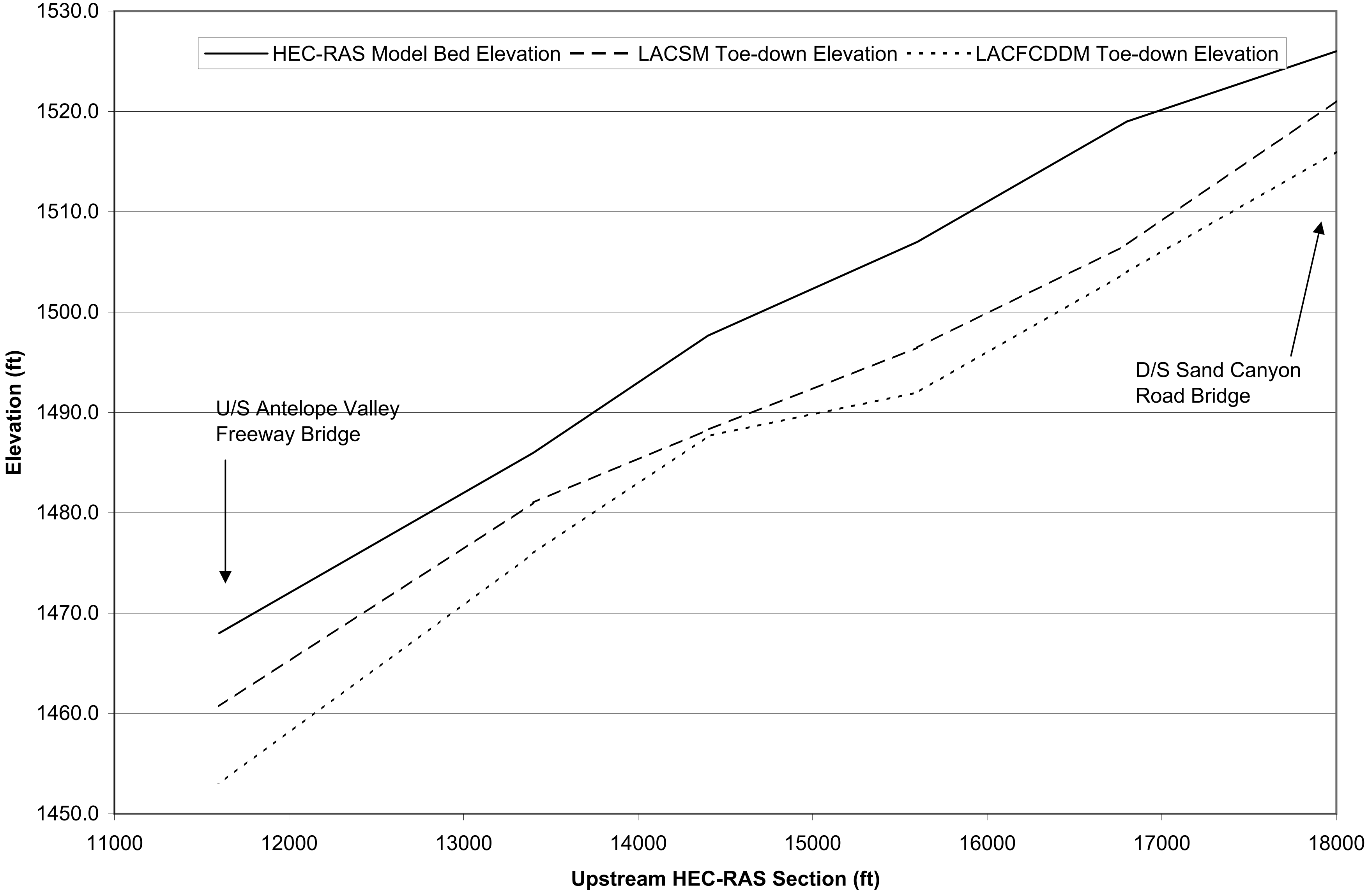


Figure 7.2C: Vista Canyon Ranch
Existing Conditions Straight-Inside Curved Reach Toe-down Depths by Methodology

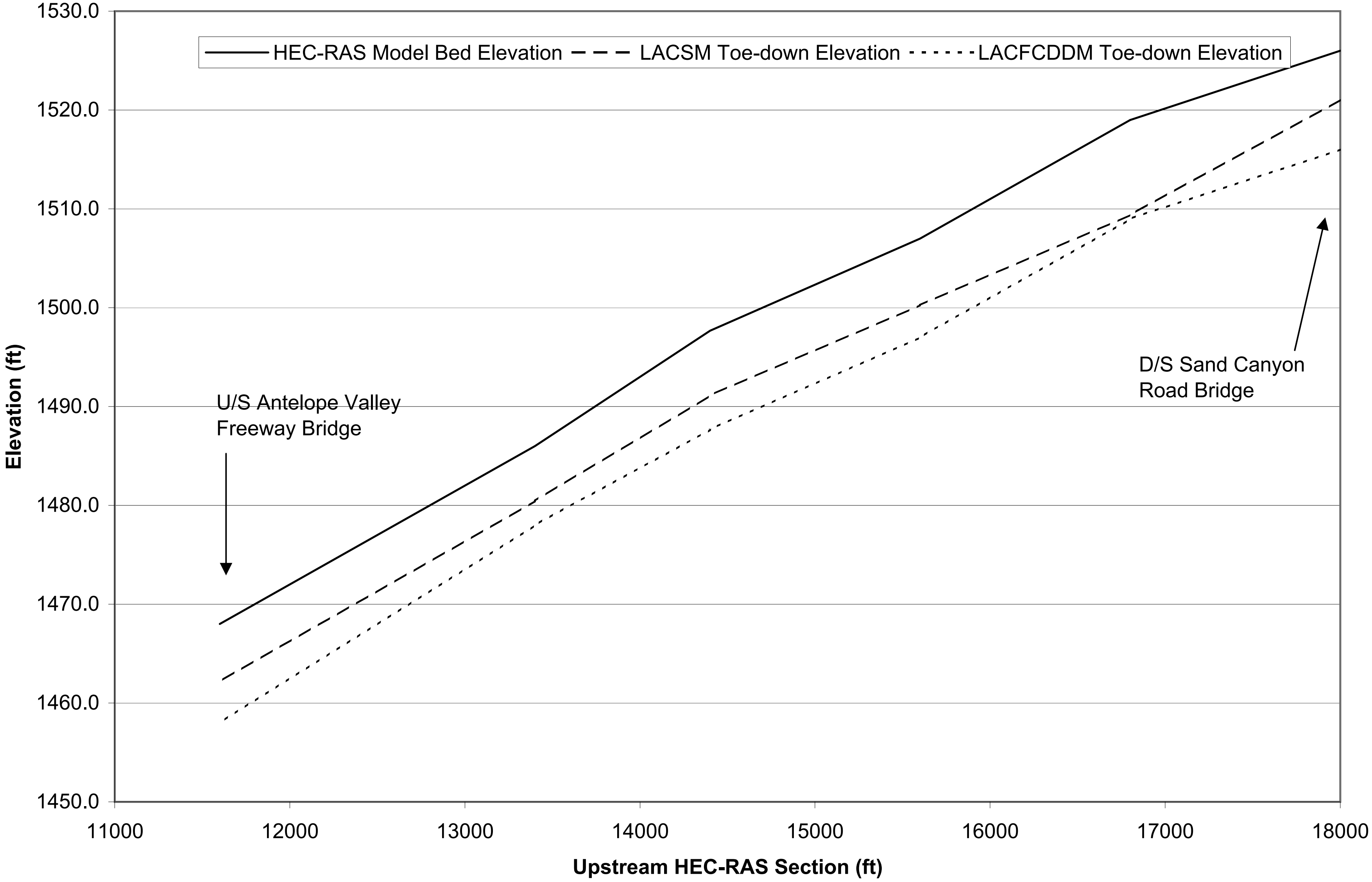


Figure 7.2D: Vista Canyon Ranch
Proposed Conditions Straight-Inside Curved Reach Toe-down Depths by Methodology

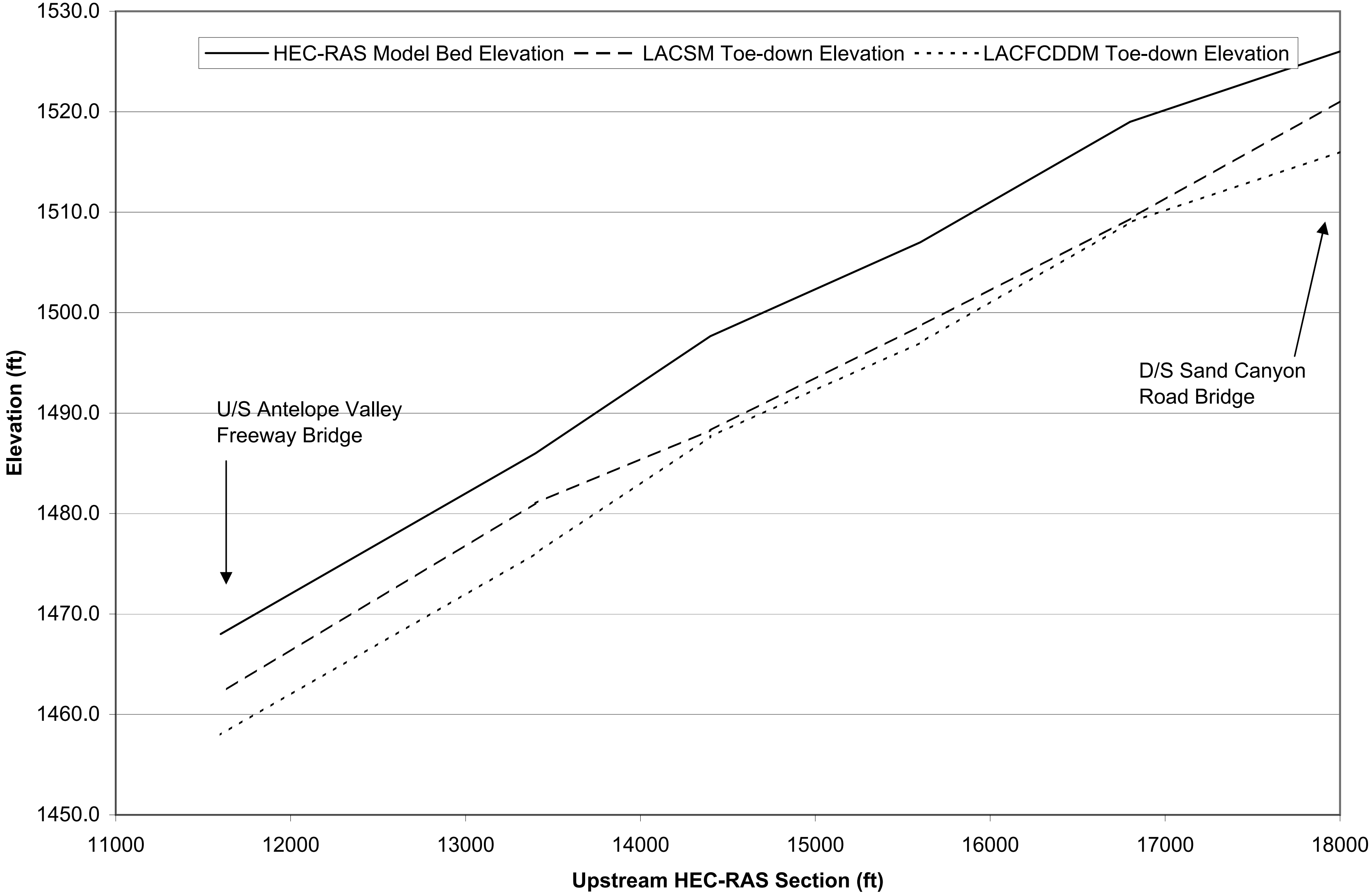


Table 7.2B: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Toedown Summary by Methodology (ft)

Subreach	**US Section**	**HEC-RAS Model Bed Elevation**	**LACSM (SAM)**	**LACSM Toe-down Elevation**	**LACFCDDM**	**LACFCDDM Toe-down Elevation**
6	18000	1526.0	-6.0	1520.0	-10.0	1516.0
5	16800	1519.0	-12.3	1506.7	-15.0	1504.0
4	15600	1507.0	-10.5	1496.5	-15.0	1492.0
3	14400	1497.7	-9.7	1488.0	-10.0	1487.7
2	13400	1486.0	-6.0	1480.0	-10.0	1476.0
1	11600	1468.0	-7.7	1460.3	-15.0	1453.0

Table 7.2C: Vista Canyon Ranch Existing Conditions Straight-Inside Curved Reach Toedown Summary by Methodology (ft)

Subreach	US Section	HEC-RAS Model Bed Elevation	LACSM (SAM)	LACSM Toe-down Elevation	LACFCDDM	LACFCDDM Toe-down Elevation
6	18000	1526.0	-6.0	1520.0	-10.0	1516.0
5	16800	1519.0	-9.6	1509.4	-10.0	1509.0
4	15600	1507.0	-6.7	1500.3	-10.0	1497.0
3	14400	1497.7	-6.8	1490.8	-10.0	1487.7
2	13400	1486.0	-6.5	1479.5	-8.0	1478.0
1	11600	1468.0	-6.3	1461.7	-10.0	1458.0

Table 7.2D: Vista Canyon Ranch Proposed Conditions Straight-Inside Curved Reach Toedown Summary by Methodology (ft)

Subreach	**US Section**	**HEC-RAS Model Bed Elevation**	**LACSM (SAM)**	**LACSM Toe-down Elevation**	**LACFCDDM**	**LACFCDDM Toe-down Elevation**
6	18000	1526.0	-6.0	1520.0	-10.0	1516.0
5	16800	1519.0	-9.6	1509.4	-10.0	1509.0
4	15600	1507.0	-8.3	1498.7	-10.0	1497.0
3	14400	1497.7	-9.7	1488.0	-10.0	1487.7
2	13400	1486.0	-6.0	1480.0	-10.0	1476.0
1	11600	1468.0	-6.3	1461.7	-10.0	1458.0

Previous studies presented in Chapter 2 provided no toedown recommended value for adequate protection of structures within the reach of the riverbed. The results of this study, however, suggest that a variable toedown from approximately -6 to -22 feet based on SAM modeling, or -10 to -18 feet based on LACFCDDM is appropriate. A large portion of this difference can be attributed to the difference in bridge scour, which in this study was as much as 15.3 feet.

7.2 Freeboard Elevation

Freeboard is considered for the purposes of this report to be the additional height required above the top of a levee or other bank protection to prevent overtopping. The factors considered in the calculation of freeboard are long-term adjustment as aggradation, general adjustment as aggradation, super elevation and bed form height. Freeboard elevation is calculated in this study based on LACSM Section 5A-3, and includes LACFCDDM calculations. Freeboard calculations are presented in Appendix Chapter 6.2. Long-term adjustment was calculated based on historical records in the form of topographic data, and taken as the greater of positive long-term area change values as presented in Table 5.1B, or one foot. General adjustment is taken from SAM aggradation values (Table 4.2B). Table 7.3A-B summarizes the freeboard calculations for both the outside bank of curved reaches (A) and inside bank of curved or in straight reaches (B). The table shows that long-term aggradation is set to one foot. General aggradation ranges is 0.6 feet with the maximum general aggradation occurring in Subreach 6. The table also compares the freeboard based on LACSM and LACFCDDM methodologies. At all locations the LACFCDDM values are more conservative and the maximum calculated freeboard of either methodology is between 2.5 and 3.3 feet.

Table 7.3A: Vista Canyon Ranch Proposed Conditions Outside Curved Reach Freeboard Summary (ft)

Subreach	**HEC-RAS Section**	Y_{AGG}+	Y_{GA}+	Y_{SE}+	**H/2**	$Y_{H\&SM}$	Y_{DM}	Y_{MAX}
1	18000	1.0	0.0	0.0	0.3	1.3	2.5	**2.5**
2	16800	1.0	0.0	0.4	0.9	2.3	2.5	**2.5**
3	15600	1.0	0.0	0.3	0.9	2.2	2.5	**2.5**
4	14400	1.0	0.0	0.0	0.9	1.9	2.5	**2.5**
5	13400	1.0	0.0	0.0	0.5	1.5	2.5	**2.5**
6	11600	1.0	0.6	0.2	0.6	2.4	2.5	**2.5**

Table 7.3B: Vista Canyon Ranch Proposed Conditions Straight-Inside Curved Reach Freeboard Summary (ft)

Subreach	**HEC-RAS Section**	Y_{AGG}+	Y_{GA}+	Y_{SE}+	**H/2**	$Y_{H\&SM}$	Y_{DM}	Y_{MAX}
1	18000	1.0	0.0	0.0	0.3	1.3	2.5	**2.5**
2	16800	1.0	0.0	0.0	0.9	1.9	2.5	**2.5**
3	15600	1.0	0.0	0.0	0.9	1.9	2.5	**2.5**
4	14400	1.0	0.0	0.0	0.9	1.9	2.5	**2.5**
5	13400	1.0	0.0	0.0	0.5	1.5	2.5	**2.5**
6	11600	1.0	0.6	0.0	0.6	2.2	2.5	**2.5**

YAGG: LONG-TERM AGGRADATION; YGA: GENERAL AGGRADATION; YSE: SUPER ELEVATION ADJUSTMENT; H: BEDFORM HEIGHT;

YH&SM: TOTAL FREEBOARD BASED ON LACDPW H&SM METHODOLOGY; YDM: TOTAL FREEBOARD BASED ON LACFCDDM METHODOLOGY;

YMAX: LARGER OF YSM AND YDM. YAGG IS CALCULATED AS THE GREATER OF LONG TERM AGGRADATION FROM TABLE 5.1 OR 1 FOOT.

7.3 Gravity Sewer Line Scour Protection

A proposed gravity sewer line is to be placed in the River downstream of the proposed project Bridge approximately between Sections 12920 and 12600. The proposed abutment soil cement bank protection is shown in Figure 1.1. The depth of the sewer line will be designed to LACSD standards, however, based on the present study the line should be at a depth of at least -10.0 feet and after Appendix 6.2. This minimum design depth assumes that the pipeline is placed outside the region of influence of the bridge pier scour. FHWA's HEC-18 generally advises that the top width of a scour hole is roughly two times the depth of the scour hole. Preliminary estimates of pier scour depth presented in Chapter 6 of this study suggest that a scour hole of 14.6 feet will occur during the Q_{CAP} discharge. Including a factor of safety of 33%, the downstream distance of the gravity sewer line should be placed approximately 40 feet downstream of the bridge piers. While a comprehensive HEC-18 study will be conducted on the bridge final design to determine final bridge abutment and pier toedown depths, it is expected that the additional factor of safety will sufficiently place the sewer line downstream of the bridge.

7.4 Extent of Bank Protection Along River's North Bank

The extent of proposed soil cement bank protection along the Santa Clara River north bank extends from approximately Section 14600 to Section 11800, while bank protection of the south bank extends until approximately Section 15800. The limited extent of the north bank protection results from the presence of exposed bedrock from approximately Section 14600 to Section 15800. As noted in Chapter 2, above, as well as Appendix Chapter 3, the RTF study of this site indicates that the erodibility index of the bedrock material exceeds the stream power of Q_{CAP} event by several orders of magnitude. Moreover, the erodibility index of the material is comparable to that of soil cement in the project vicinity. Therefore, bank protection is not required along this subreach of the River.

8 Summary

The total toedown is the sum of the individual degradation components as described in Chapter 7: general adjustment, or single-event degradation, calculated using the SAM zero-dimensional numerical modeling and LAC sediment data (Chapter 4 & 7); long-term adjustment, or long-term degradation, calculated from long-term historical topographic analysis (Chapter 5); and other adjustments calculated using LACSM (Chapter 6). Likewise, total freeboard is calculated as the sum of aggradation components: general aggradation from SAM calculations; long-term aggradation from long-term topographic analysis; and other aggradation from LACSM calculations, which includes superelevation changes to water surface elevations. This data is summarized in Table 8 and Figure 8 for the outside curved reaches and inside curved or straight reaches. The table, based on Appendix 6.1 & 6.2, shows the total calculated toedown below the model minimum channel bed elevation and the total freeboard above the HEC-RAS water surface elevation by subreach and section. A summary of the significant components and influences of each subreach follows.

The portion of the channel in Subreach 1 is narrower than the immediate upstream subreach, has development on both banks and contains the Antelope Valley Freeway Bridge. There is a bend in the subreach with a radius of 3,605 feet. Long-term adjustment is from -1.5 (Table 5.1B). SAM accounts for +0.6 feet of adjustment (Table 7.1A-D). Other adjustment ranges from -3.5 to -20.1 feet, which accounts for most of the total toedown at the Bridge(Table 6). Again, LACSM calculations of toedown range from -5.6 to -20.1 feet and are shallower than that of LACFCDDM at -15 feet for outside of curved reaches (Appendix Chapter 6) except for the bridge location. While LACFCDDM freeboard values are 2.5 feet for all four subreaches, LACSM freeboard values range from +2.0 to +2.5 feet (Appendix Chapter 6).

The channel between Subreaches 2 through 4 are wide and braided with a large, wide overbank on the south side of the River. Subreaches 2 through 4 have a fair amount of vegetation and are braided. Long-term analysis shows a range of -1.1, -1.7 and -3.1 feet of degradation (Table 5.1B) for Subreaches 2 through 4, respectively. SAM modeling results show 0.0, -3.3 and -1.5 feet of general adjustment (Table 7.1A-D) for Subreaches 2 through 4, respectively. Other components range from -3.6 to -19.0 feet for straight-inside curved reaches and -3.7 to -18.9 feet for curved reaches (Table 6). LACSM methodology calculates -6.1 to -20.9 feet of toedown for straight or inside-curved reaches, and -5.5 to -20.9 feet for outside-curved reaches. LACFCDDM methodology produces deeper calculated toedown still with -10.0 to -12.5 feet for straight-inside curved reaches and -10.0 to -18.0 feet for outside curved reaches (Appendix Chapter 6). Freeboard calculations predict +1.5 to+3.3 feet for outside curved reaches and +1.5 to+2.7 feet for straight-inside curved reaches by LACSM, whereas LACFCDDM predicts +2.5 feet (Appendix Chapter 6). The second and part of the third of the three curves in the study reach exists in these subreaches also. The second curve is so large relative to the width of the channel that no super-elevation or bend scour is present.

The channel in Subreaches 5 and 6 are narrower than the downstream subreaches, particularly Subreach 5, which contains a bedrock protrusion into the channel. The third bend continues in this subreach. Long-term degradation for the two subreaches is -3.4 and -1.0 ft, respectively (Table 5.1B). SAM modeling expects -2.0 and -0.5 feet of general adjustment to occur (Table 7.1B), while other components add -3.5 to -20.1 feet of degradation for outside curved reaches and straight-inside curved reaches (Table 6). LACSM toedown is from -6.0 to -22.0 feet, shallower than LACFCDDM at -10.0 to -15.0 feet for outside curved reaches (Appendix Chapter 6). Freeboard is +1.3 to +2.3 feet by LACSM methodology for outside curved and straight-inside curved reaches, and +2.5 feet by LACFCDDM methodology (Appendix Chapter 6). The recommended toedown depths, toedown elevations, freeboard heights and freeboard elevations are given in Table 8 for both inside and outside of curves.

Finally, the Santa Clara River watershed above the Vista Canyon Ranch project has an area of approximately 191 square miles. Since the Vista Canyon Ranch project impacts less than 11.7% of the total Santa Clara River watershed, no hydro-modification as a result of the project is expected.

Table 8: Santa Clara River Summary of Maximum Proposed Toe-down & Freeboard (ft)

Subreach	HEC-RAS Section	Z_{05} [1]	Outside Curved Reach		Straight-Inside Curved Reach		WSE	Outside Curved Reach		Straight-Inside Curved Reach	
			Maximum Total Degradation [2]	Proposed Toe-down Elevation [3]	Maximum Total Degradation [2]	Proposed Toe-down Elevation [3]		Maximum Total Freeboard [2]	Proposed Top of Levee Elevation [2]	Maximum Total Freeboard [2]	Proposed Top of Levee Elevation [2]
6	18000	1526.0	10.0	1516.0	10.0	1516.0	1546.7	2.5	1549.2	2.5	1549.2
	17800	1525.0	22.6	1502.4	22.6	1502.4	1539.5	2.5	1542.0	2.5	1542.0
	17600	1524.0	10.0	1514.0	10.0	1514.0	1538.7	2.5	1541.2	2.5	1541.2
	17400	1523.0	10.0	1513.0	10.0	1513.0	1537.7	2.5	1540.2	2.5	1540.2
	17200	1521.0	10.0	1511.0	10.0	1511.0	1535.1	2.5	1537.6	2.5	1537.6
	17000	1520.0	10.0	1510.0	10.0	1510.0	1532.5	2.5	1535.0	2.5	1535.0
5	16800	1519.0	15.0	1504.0	10.0	1509.0	1529.8	2.5	1532.3	2.5	1532.3
	16600	1517.0	15.0	1502.0	10.0	1507.0	1528.1	2.5	1530.6	2.5	1530.6
	16400	1515.0	15.0	1500.0	10.0	1505.0	1527.0	2.5	1529.5	2.5	1529.5
	16200	1512.2	15.0	1497.2	10.0	1502.2	1526.2	2.5	1528.7	2.5	1528.7
	16000	1510.4	12.2	1498.2	8.5	1501.8	1525.3	2.5	1527.8	2.5	1527.8
	15800	1508.6	12.0	1496.6	8.3	1500.4	1524.7	2.5	1527.2	2.5	1527.2
4	15600	1507.0	15.0	1492.0	10.0	1497.0	1523.1	2.5	1525.6	2.5	1525.6
	15400	1505.1	18.0	1487.1	12.5	1492.6	1520.1	3.2	1523.3	2.7	1522.8
	15200	1504.0	18.0	1486.0	12.5	1491.5	1517.3	2.9	1520.2	2.5	1519.8
	15000	1502.0	10.0	1492.0	10.0	1492.0	1515.3	2.5	1517.8	2.5	1517.8
	14800	1501.0	10.0	1491.0	10.0	1491.0	1513.0	2.5	1515.5	2.5	1515.5
	14600	1499.0	10.0	1489.0	10.0	1489.0	1510.4	2.5	1512.9	2.5	1512.9
3	14400	1497.7	10.0	1487.7	10.0	1487.7	1507.9	2.5	1510.4	2.5	1510.4
	14200	1495.0	10.0	1485.0	10.0	1485.0	1505.6	2.5	1508.1	2.5	1508.1
	14000	1493.0	10.0	1483.0	10.0	1483.0	1503.7	2.5	1506.2	2.5	1506.2
	13800	1491.0	10.0	1481.0	10.0	1481.0	1501.8	2.5	1504.3	2.5	1504.3
	13600	1488.5	10.0	1478.5	10.0	1478.5	1500.2	2.5	1502.7	2.5	1502.7
2	13400	1486.0	10.0	1476.0	10.0	1476.0	1498.7	2.5	1501.2	2.5	1501.2
	13200	1484.0	10.0	1474.0	10.0	1474.0	1497.3	2.5	1499.8	2.5	1499.8
	13050	1482.0	10.0	1472.0	10.0	1472.0	1494.7	2.5	1497.2	2.5	1497.2
	12920	1482.0	20.9	1461.1	20.9	1461.1	1493.2	2.5	1495.7	2.5	1495.7
	12600	1478.0	10.0	1468.0	10.0	1468.0	1490.3	2.5	1492.8	2.5	1492.8
	12400	1476.0	10.0	1466.0	10.0	1466.0	1488.2	2.5	1490.7	2.5	1490.7
	12200	1474.6	10.0	1464.6	10.0	1464.6	1485.9	2.5	1488.4	2.5	1488.4
	12000	1472.0	10.0	1462.0	10.0	1462.0	1483.8	2.5	1486.3	2.5	1486.3
	11800	1470.1	10.0	1460.1	10.0	1460.1	1482.0	2.5	1484.5	2.5	1484.5
1	11600	1468.0	15.0	1453.0	10.0	1458.0	1480.2	2.5	1482.7	2.5	1482.7
	11400	1466.0	15.0	1451.0	10.0	1456.0	1478.5	2.5	1481.0	2.5	1481.0
	11200	1465.0	15.0	1450.0	10.0	1455.0	1476.6	2.5	1479.1	2.5	1479.1
	11000	1463.0	15.0	1448.0	10.0	1453.0	1474.8	2.5	1477.3	2.5	1477.3
	10800	1461.1	15.0	1446.1	10.0	1451.1	1473.2	2.5	1475.7	2.5	1475.7
	10600	1458.0	15.0	1443.0	10.0	1448.0	1471.7	2.5	1474.2	2.5	1474.2
	10400	1456.0	15.0	1441.0	10.0	1446.0	1470.1	2.5	1472.6	2.5	1472.6
	10200	1451.0	15.0	1436.0	10.0	1441.0	1468.2	2.5	1470.7	2.5	1470.7
	10000	1448.0	22.1	1425.9	20.3	1427.7	1467.0	2.5	1469.5	2.5	1469.5

1 - Minimum 2005 Bed Elevation

2 - Toe-down and Freeboard based on max of LA County Hydrology & Sedimentation Manual (with SAM general aggradation) and LA County Design Manual, as per Hydrology & Sedimentation Manual

3 - Values at bridges are approxmiate. Final design of levee at bridge locations will include detailed bridge analysis

9 References

Kennedy, J.F. (1963) The mechanics of dunes and antidunes in erodible bed channels. J. Fluid Mechanics, 16, 521-544.

Kondolf, G.M. (1997). Application of the pebble count: notes on purpose, method, and variants. JAWRA, v. 33, n. 1, pp. 79-87.

Los Angeles County Department of Public Works Hydrology and Sedimentation Manuals (LACSM) (January 2006)

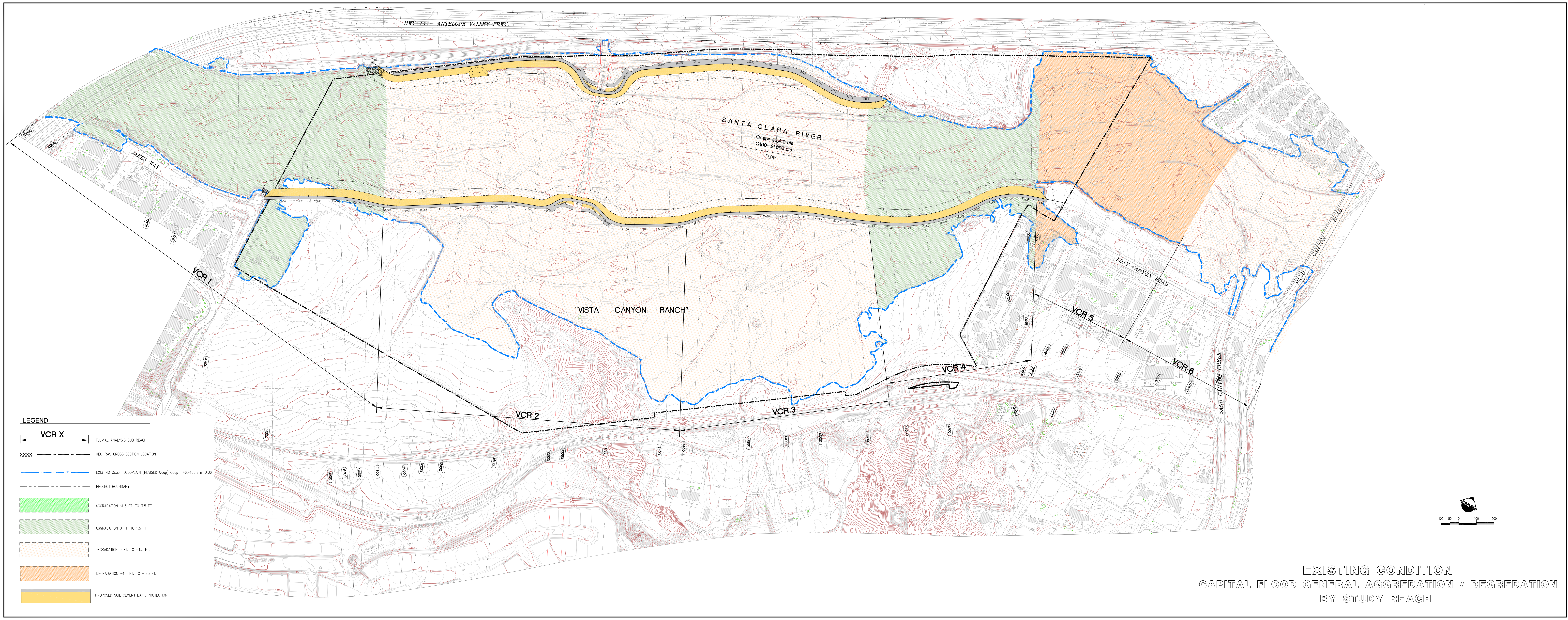
Los Angeles County Flood Control District Design Manual (LACFCDDM) (October 1979)

Simons, Li & Associates (June 1987) Fluvial Study of Santa Clara River and Its Tributaries.

Simons, Li & Associates (May 1988) Fluvial Study of Santa Clara River and Its Tributaries.

Simons, Li & Associates (November 1990) Fluvial Study of Santa Clara River and the Tributaries.

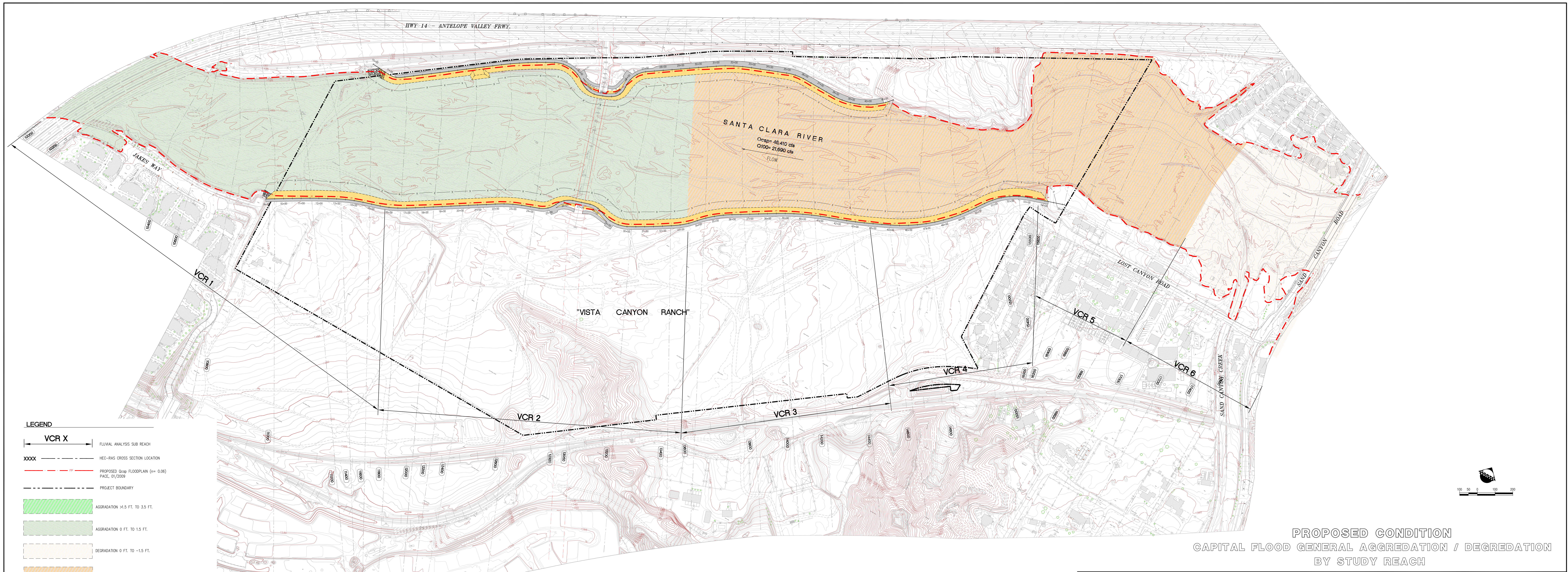
US Army Corps of Engineers (ACOE) (September 2002) SAM Hydraulic Design Package for Channels.



LEGEND

VCR X	FLUVIAL ANALYSIS SUB REACH
XXXX — - — - —	HEC–RAS CROSS SECTION LOCATION
— · — · — FP —	EXISTING Qcap FLOODPLAIN (REVISED Qcap) Qcap= 46,410cfs n=0.06
— - - — - - —	PROJECT BOUNDARY
🟩	AGGRADATION >1.5 FT. TO 3.5 FT.
🟩	AGGRADATION 0 FT. TO 1.5 FT.
⬜	DEGRADATION 0 FT. TO –1.5 FT.
🟧	DEGRADATION –1.5 FT. TO –3.5 FT.
🟨	PROPOSED SOIL CEMENT BANK PROTECTION

EXISTING CONDITION
CAPITAL FLOOD GENERAL AGGREDATION / DEGREDATION
BY STUDY REACH



LEGEND

VCR X	FLUVIAL ANALYSIS SUB REACH
XXXX — - — - —	HEC–RAS CROSS SECTION LOCATION
— · — · — FP —	PROPOSED Qcap FLOODPLAIN (n= 0.06) PACE, 01/2009
— - - — - - —	PROJECT BOUNDARY
🟩	AGGRADATION >1.5 FT. TO 3.5 FT.
🟩	AGGRADATION 0 FT. TO 1.5 FT.
⬜	DEGRADATION 0 FT. TO –1.5 FT.
🟧	DEGRADATION –1.5 FT. TO –3.5 FT.
🟨	PROPOSED SOIL CEMENT BANK PROTECTION

PROPOSED CONDITION
CAPITAL FLOOD GENERAL AGGREDATION / DEGREDATION
BY STUDY REACH

CAPITAL FLOOD SAM RESULTS
GENERAL AGGREDATION / DEGREDATION
FOR EXISTING & PROPOSED CONDITION

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

SCALE AS SHOWN
DESIGNED D.J.
DRAWN JEP
CHECKED MEK
DATE JANUARY 2009
JOB NO. 8587E

VISTA CANYON RANCH
FLUVIAL STUDY

EXHIBIT
01
JOB NO. 8587E

PACE
Advanced Water Engineering

Appendix 3.0

RTF&A
GEOTECHNICAL ENGINEERING & ENGINEERING GEOLOGY

December 21, 2007

Vista Canyon Ranch, LLC
27441 Tourney Road, Suite 260
Valencia, CA 91355

Job No. 2005-052-01

Attention: Mr. Stephen F. Valenziano

Subject: Erodibility Index Analysis
Vista Canyon Ranch
North Parcel
Santa Clarita, Los Angeles County, California

INTRODUCTION

This presents our erodibility index analysis at the Vista Canyon Ranch North Parcel in Santa Clarita, California. The purpose of this work was to determine the engineering characteristics of bedrock and complete an erodibility index analysis to determine if these materials would be subject to erosion during a design flow event in the Santa Clara River. This work was performed in accordance with our proposal (P120-2006-01), dated December 8, 2006 and your written authorization to proceed.

SCOPE OF WORK

The scope of work for this investigation included:

- research and review of information related to the erodibility index including professional papers completed by G.W. Annandale. References are at the end of this report;

- field exploration including geologic mapping and excavation of three exploratory borings;
- geotechnical laboratory testing on select samples of bedrock collected from the exploratory borings;
- compilation of the field and laboratory data for bedrock and preparation of an erodibility index analysis; and
- preparation of this report and accompanying illustrations.

SITE CONDITIONS AND BACKGROUND

The north parcel of the Vista Canyon Ranch Development is located on the north bank of the Santa Clara River at the washed-out eastern terminus of Lost Canyon Road. Portions of the site are located in two parcels identified by L.A. County Assessor's ID No.'s 2840-006-007 and 2840-006-009. The site is bounded to the north by the Antelope Valley Freeway, on the west and east by undeveloped river bank, and on the south by the active channel of the river. The portions of the parcels currently of interest occupy an uplifted and dissected river terrace that rises about 40 feet above the adjacent channel. The south edge of the terrace is a modified natural slope with a maximum height of about 35 feet and variable surface ratios of 0.5:1 (horizontal to vertical) to 2:1. The slope is about 450 feet long. The entire length is exposed to erosion and scour from the river.

We understand it is proposed to develop the property as a multi-unit commercial facility with six office/warehouse buildings and associated parking, streets, utilities, etc. Earthwork for the proposed development would likely involve a cut to lower site grade on the eastern portion of the site and fill on the western portion of the site. Development plans are conceptual at this time.

FIELD EXPLORATION

Field exploration included geologic mapping of the site on a 40-scale topographic base. Bedrock is exposed in the south and east facing natural slopes and the north facing cut slope that abuts the freeway. The entire stratigraphic section that underlies the site is exposed. We completed detailed mapping of the slopes to identify lithology, physical, and structural features of the rock mass. Geologic conditions are shown on Geotechnical Map - Figure 1.

Field exploration included excavation of three exploratory borings. Two borings were excavated with a truck-mounted hollow-stem auger drill rig and one boring was excavated with a bucket-auger drill rig. The borings extended to maximum depths between 36 to 61 feet below ground surface. Both hollow-stem borings encountered drilling refusal. Relatively undisturbed samples were collected at regular intervals in the borings. Earth materials were logged in the field by an engineering geologist. Borings were backfilled with the excavated spoils and tamped with the drill steel. Settlement of the backfill should be anticipated. Borings logs are in Appendix A.

LABORATORY TESTING

Samples collected from the exploratory borings were transported to our laboratory for geotechnical testing. The following laboratory tests were performed:

- in-situ moisture and density;

- direct shear tests;
- grain size distribution;
- Atterberg's limits; and
- corrosion tests.

Test results are summarized on the boring logs and test sheets are in Appendix B.

SOIL CORROSIVITY

Schiff Associates (Schiff) performed soil corrosivity testing on samples of the on-site soils that we provided to them during our investigations. One sample of on-site soils was tested. A copy of the corrosion test results is attached in Appendix B. The tests indicate that the on-site soils are severely corrosive to ferrous metals. Sulfate attack on portland cement concrete is negligible.

GEOLOGIC CONDITIONS

Earth materials that underlie the site include terrace deposits and bedrock. Bedrock is assigned to the Miocene aged Mint Canyon Formation, Deltaic Facies. River alluvium is located in the Santa Clara River Channel. Slopewash is encountered locally. The areal distribution of earth materials is shown on Figure 1, which also includes interpreted subsurface conditions on three geologic cross sections. Following is a brief description of the earth materials with emphasis on their engineering characteristics.

MINT CANYON FORMATION, DELTAIC FACIES

Mint Canyon Formation underlies the entire site and is exposed at ground surface on the surrounding slopes. This unit consists of fine to coarse grained arkosic sandstone interbedded with conglomerate and siltstone. The rock is hard when struck with a rock pick and difficult to excavate with standard drill rigs. Beds are several inches to several feet thick and have diffuse planar contacts. The color is light gray to brown. The rock mass shows few widely spaced joints. Joint spacing is in excess of 20 feet. Joints are tight with no separation and continuous over several feet to ten feet. Joint surfaces are rough and irregular and may show no coating or a coating of disseminated carbonate or oxide. Joint attitudes measured in outcrop show one primary joint set with scatter. The primary joint set has a north strike with a west dip around 80 degrees.

Two mudstone beds are located on the east portion of the site where they are exposed in the south facing slope. The beds are 12 to 18 inches thick with sharp contacts. The beds are weathered and oxidized in outcrop. No evidence was observed of shear surfaces or large lateral deformation. The beds are separated stratigraphically by 12 to 15 feet. The lower bed was encountered in Boring B-8. The upper bed is eroded and no longer present at the location of the boring. The beds are identified on Figure 1.

Bedding has north strikes with west dips around 40°. This orientation is potentially unfavorable for west and northwest facing slopes.

TERRACE DEPOSITS

Bedrock is locally mantled by a thin veneer of terrace deposits that reach a maximum thickness of about seven feet. Terrace deposits consist of loose and unconsolidated sand and silt with gravel and cobbles. The material is dry to the touch. The color is brown.

SLOPEWASH

Slopewash is located to the northeast of the site outside the current area of investigation. Slopewash generally consists of loose and unconsolidated sand, silt, and gravel. The color is tan to brown. The depth of this material is generally less than ten feet.

ALLUVIUM

Alluvium of the Santa River channel is located to the south and east of the project outside the area of investigation. Alluvium consists of loose and unconsolidated mixtures of silt, sand, gravel, cobbles, and boulders. The color is tan to brown. The material was deposited by the Santa Clara River.

ENGINEERING CHARACTERISTICS OF EARTH MATERIALS FOR ERODIBILTY INDEX ANALYSIS

BEDROCK

Miocene aged sandstone underlies the site and is exposed at ground surface in the surrounding slopes. Sandstone is interbedded with matrix supported gravel/cobble conglomerate and sandy siltstone. Two mudstone beds were also identified. The rock is bedded. Bed thickness ranges from inches to feet. Beds have diffuse planar contacts. There was no evidence of shear surfaces or other features indicative of large lateral displacement in any of the rock mass. The rock mass shows few widely spaced joints. Joint spacing is greater than twenty feet. Joints are continuous over a few feet to ten feet. Joint surfaces are rough and irregular. Joints are tight with no separation and may show no infilling or a disseminated coating of alkaline earth salts or iron or manganese oxide. The rock mass is dense to very dense and difficult to excavate with conventional drill rigs. The density and hardness of the rock mass caused drilling refusal in two hollow stem auger borings. In outcrop, the rock is non-friable. A blow from a rock pick leaves almost no mark except in heavily weathered areas. Sampling blow counts using a Standard Penetration Test hammer and a California type ring sampler were 50 or more in every case with sampler penetration less than six inches. Laboratory test results show an average moisture content of 7.8% and an average dry density of 110 pounds per cubic foot (pcf). Unit weights may be lower than in-situ values because of sample disturbance. Direct shear tests on bedrock materials are summarized in the following table.

Summary of Direct Shear Test Results.

Boring	Depth	Rock Type	Peak Strength		Residual Strength*	
			ϕ°	c (psf)	ϕ°	c (psf)
3	15’	Sandy Siltstone	35.3	1,170	29.4	1,000
3	25’	Mudstone	40.6	1,880	30.1	1,000
3	55’	Sandstone	17.6	7,140	27.6	2,600

*Single shear residual. Strength value chosen at maximum displacement on the first shear cycle.

ERODIBILITY INDEX

The erodibility index, K_h, was developed from earth spillway performance data collected by several U.S. government agencies between 1983 and 1993 (USDA, 1997). The heart of the erodibility index is an earth material classification system that closely resembles the *Q*-system developed in 1974 (Barton, et al, 1974). The classification system allows a quantitative estimation of the in-situ characteristics of rock masses or soil masses. The *Q*-system has been used in a variety of field applications. One such application is to determine earth material resistance to ripping excavation. The erodibility index is based on an analogy between bulldozer drawbar power required for ripping earth materials and the hydraulic power associated with turbulent energy dissipation at a spillway headcut. The erodibility index is a measure of the resistance of the earth material to erosion.

The erodibility index is the scalar product of the indices for its constituent parameters and takes the form:

$$K_h = M_s \cdot K_b \cdot K_d \cdot J_s$$

Where:
K_h = erodibility index
M_s = material strength number
K_b = block or particle size number
K_d = discontinuity or interparticle bond shear strength number
J_s = relative ground structure number

The material strength number, M_s, is expressed as the unconfined compressive strength of an intact (unjointed and unweathered) sample of the rock or soil mass without consideration of geologic discontinuities. The intact strength is then downgraded based on structural and lithologic features of the rock mass. For cohesionless granular materials M_s may be related to Standard Penetration Test (SPT) N-value or in-situ modulus of deformation. Standard charts showing these relationships are presented in the National Engineering Handbook Chapter 52 (USDA, 1997). The block or particle size number, K_b, is expressed as the cube root of the volume of the mean block size of jointed rock material and is determined by the number, orientation and spacing of joint sets. For ease of calculation Annandale suggests the following equation K_b = RQD/J_n, where RQD equals Rock Quality Designation (Annandale, 1995, Page 483). The discontinuity or interparticle bond shear strength number, K_d, represents the shear strength of a discontinuity in a rock mass or the shear strength of interparticle bonds in cohesionless granular materials and is taken as Tan ϕ'_r where ϕ'_r is equal to the residual friction angle. The relative ground structure number, J_s, is a measure of the structure of the ground with respect to streamflow. It considers the orientation and shape of individual joint-bound blocks as determined by spacing, dip angles, and dip directions of joint sets in comparison to the direction of streamflow.

Bedrock materials on site have similar engineering characteristics with respect to application of the erodibility index. We chose representative values from the various rock types for each of the following parameters and use them to characterize the entire rock mass. The following analysis is in general accordance with Chapter 52 and Appendix 52C of the National Engineering Handbook (USDA, 1997). References to tables in the following discussion refer to this document.

ERODIBILITY INDEX FOR BEDROCK

Material Strength Number, M_s: Based on the physical characteristics of the rock mass as measured in the field and laboratory we estimate the rock mass may be classified as moderately hard rock in accordance with Table 5. We selected an average unconfined compressive strength of 20 MPa (417,709 psf) for design. This yields an average M_s value of 20.

Block or Particle Size Number, K_b: Block size for bedrock materials may be calculated by dividing RQD by the joint set number J_n. We conservatively estimated J_n using Table 8 and assuming two joint sets. This yields a J_n = 1.83. We conservatively estimated RQD by using the joint count number, J_c, and mean block diameter. We calculated a J_n = 4 and a RQD value of 100. We chose to lower the RQD value to 94. The block size number was then calculated as K_b = 51.4.

Interparticle Bond Shear Strength Number, K_d: We calculated the interparticle bond shear strength number by dividing the joint roughness number, J_n, by the joint alteration number, J_a. The joint roughness number was estimated using Table 9 and a value of 1.5 was chosen for joint surfaces that are rough, irregular, and planar. The joint alteration number was estimated using Table 10 and a value of 1.0 for joint walls with no separation and hard non-softening mineral infilling. This is consistent with a residual friction angle greater than or equal to 30°. We calculated $K_d = 1.5$.

Relative Ground Structure Number, J_s: The ground structure number is a complex calculation that relates the orientation of critical bedrock structure to the azimuth of flow and gradient in the flow channel. We calculated this value in accordance with curve matching formulas from Table 52-12. The strike and dip of bedrock is the critical structural feature of the rock mass and the average strike azimuth is 0 degrees. The average dip azimuth is 270 degrees and the average dip is 40 degrees. This orientation is with the direction of flow for the local stretch of the Santa Clara River. We estimate $J_s = 0.54$.

Erodibility index for moderately hard bedrock with the jointing characteristics previously described is sensitive to variations in river flow azimuth. The Santa Clara River has several potential flow azimuths in the local reach of the river. The flow azimuth could vary from about 174 degrees to 270 degrees. We evaluated a variety of flow azimuths within this arc. Results are shown on Erodibility Index, Figure 2. Figure 2 is modified from Annandale, 1995 and includes two empirical data sets from which we interpreted an erodibility threshold line. Data points that plot above the erodibility threshold are subject to erosion, those that plot below the threshold are not subject to erosion. By plotting the erodibility index along the x axis and extending the line up to the erodibility threshold, the peak stream power at which erosion will be initiated may be determined. Results are summarized in Table 1.

Table 1. Summary of results of erodibility index analyses.

Material	Erodibility Index			Peak Stream Power at Erodibility Threshold (kW/m)		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Bedrock	826	992	1180	100	150	300

PEAK STREAM POWER

Figure 2 shows a plot of erodibility index against rate of energy dissipation. Rate of energy dissipation is equivalent to hydraulic energy expressed as peak stream power. By plotting the erodibility index as described in previous paragraphs an estimate may be made of the peak stream power at which erosion will be initiated. To evaluate whether or not earth materials are subject to erosion, an estimate of peak stream power adjacent to the south bank of the Santa Clara River during the design flow event is required. To make this estimate, we used the Bernoulli and Continuity equations as presented in Appendix 52B of the National Engineering Handbook (USDA, 1997). The energy head is calculated using the Bernoulli equation as follows:

$$H_L = V^2/2g + d - 1.5[V^2d^2/g]^{0.33} + H_o$$

where:
H_L = energy head (ft)
V = velocity of flow in the exit channel at peak discharge (ft/sec)
g = acceleration of gravity (ft/sec^2)
d = depth of flow corresponding to V in exit channel (ft)
$H_o = (z_1 - z_2)$

where:
z_1 = elevation at end of exit channel (ft)
z_2 = elevation of flood plain (ft)

The term H_o drops out because of site conditions. Lacking hydraulic data, we estimated maximum depth of flow during a Q_{cap} event of eight feet. We assumed a Q_{cap} flow rate of fifteen feet per second. The depth of flow and flow rate are based on data provided by Pacific Advanced Civil Engineering. Using the equation above, we calculate an energy head of 0.025 feet.

Hydraulic energy as peak stream power is calculated with the continuity equation as follows:

$$E = [62.4(0.746/550)]VdH_L$$

where:
E = hydraulic energy as peak stream power (kW/m)
V = velocity of flow in the exit channel at peak discharge (ft/sec)
d = depth of flow corresponding to V in exit channel (ft)
H_L = energy head (ft)

Using the equation above and the assumptions regarding velocity and depth of flow for the Q_{cap} event, we calculate a peak stream power of about 0.26 kW/m. Analysis of Figure 2 shows that at a peak stream power of 0.26 kW/m, bedrock materials are not subject to erosion.

CONCLUSIONS

Bedrock underlying the Vista Canyon Ranch North Parcel is not subject to erosion during a Q_{cap} storm event. Peak stream power during the Q_{cap} event is about three orders of magnitude lower than the peak stream power required to initiate erosion. Erodibility index values calculated for bedrock materials are within the range of erodibility index values calculated for soil cement mixtures at other sites in the Santa Clarita area. Soil cement buttresses/levees are often used as bank protection in local stretches of the river. Bank protection will not be required at the subject site from a geotechnical standpoint.

CLOSURE

This work was performed in accordance with generally accepted professional engineering geology and geotechnical engineering principles and practice in southern California at this time. We make no other warranty either express or implied. This work is based on review of reports prepared by others and by subsurface exploration, laboratory testing and geologic mapping completed on site.

-oOo-

We appreciate the opportunity to be of continued service. Please call if you have questions or would like to discuss this report in more detail. The following are attached and complete this report.

- Geotechnical Map - Figure 1
- Erodibility Index - Figure 2
- Appendix A - Exploration,
    - Boring Logs, B-8, HS-1 and HS-2
- Appendix B - Laboratory Tests,
    - Summary of Shear Test Data (one page)
    - Grain Size Distribution (three pages)
    - Corrosion Test Results (one page)

Professional Geologist No. 5917
Certified Engineering Geologist No. 1866
Exp. 9/08

Respectfully submitted,

R. T. FRANKIAN & ASSOCIATES

by: Douglas S. Santo
Principal Engineering Geologist

Dharmesh Amin

and: Dharmesh P. Amin
Principal Geotechnical Engineer

No. 2553
Exp: 12-31-08

DSS/DPA/sjc

Distribution: (2) Vista Canyon Ranch, LLC
Attn: Mr. Stephen F. Valenziano
(1) Pacific Advanced Civil Engineering
Attn. Mr. Mark Krebs

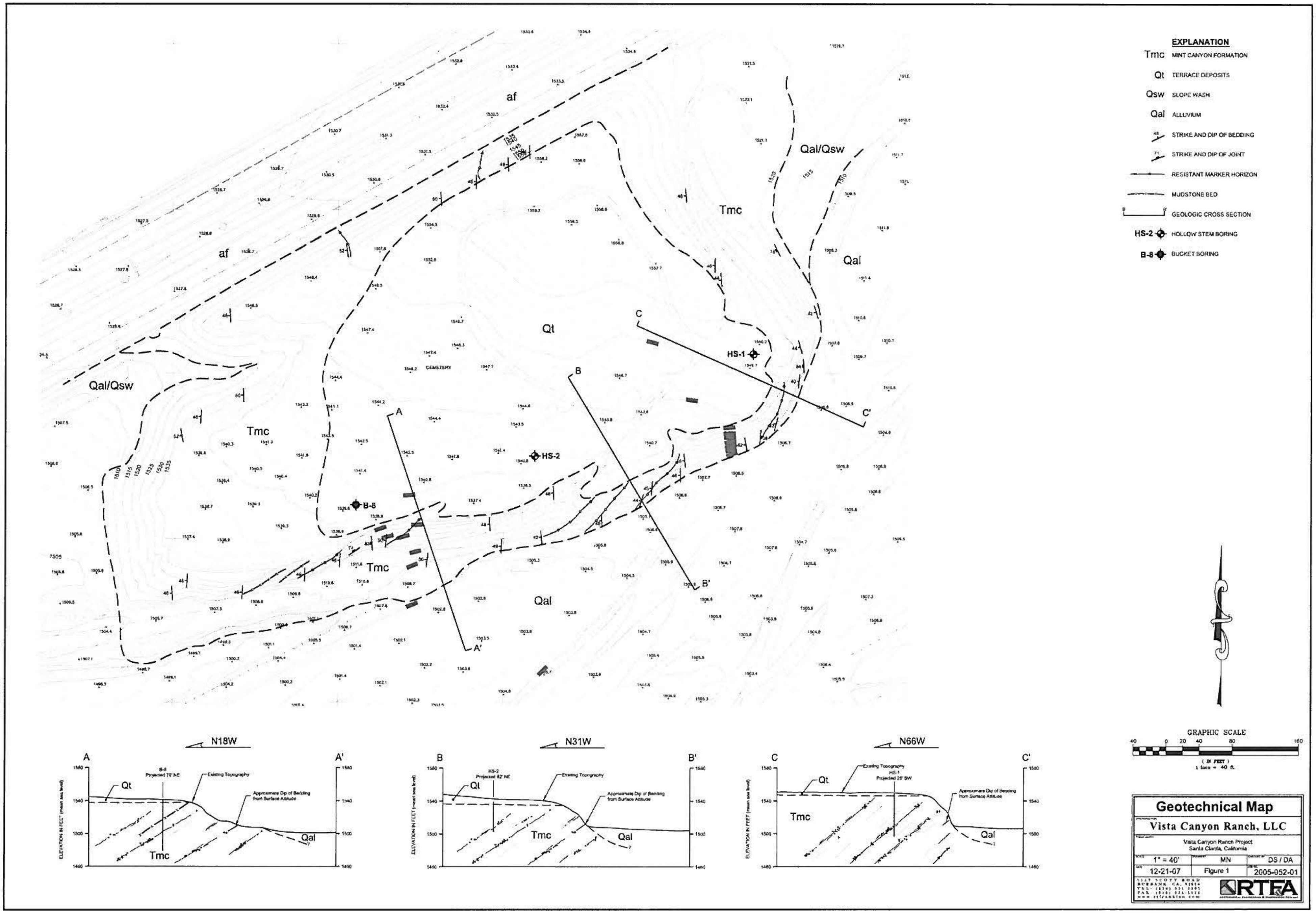
REFERENCES

Annandale, G.W., 1995, Erodibility, Journal of Hydraulic Research, Vol. 33, No. 4.

Barton, N., Lien, R., and Lunde, J., 1974, Engineering Classification of Rock Masses for the Design of Tunnel Support, Rock Mechanics, Vol. 6, p. 189-236.

Frankian, R. T. & Associates, 2003, Results of Soil-Cement Mix Design and Final Report of Observation and Testing Soil-Cement Channel Liner Along San Francisquito Creek at West Creek Development, PD/MTD No. 2509, Valencia, California, Project No. 99-302-12.

U.S. Department of Agriculture, 1997 (Rev. 2001), National Engineering Handbook, Part 628 Dams, Chapter 52 Field Procedures Guide for the Headcut Erodibility Index, Appendix 52B Headcut Erodibility Index Flow Chart..



Geotechnical Map

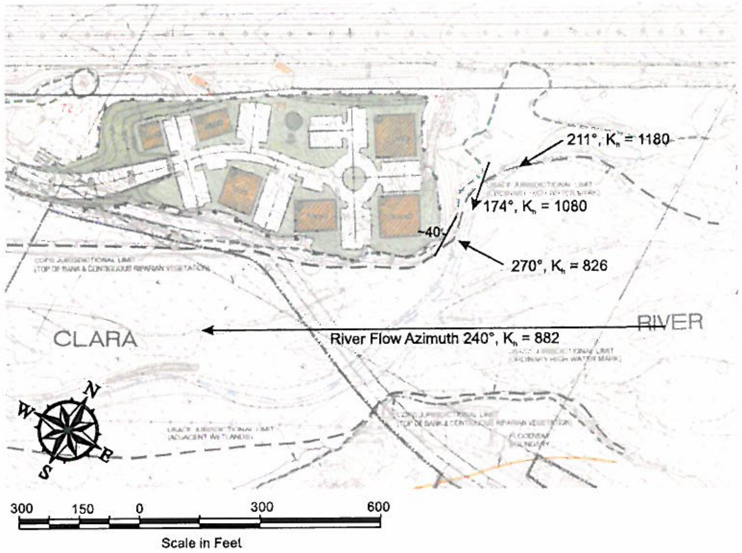
Vista Canyon Ranch, LLC

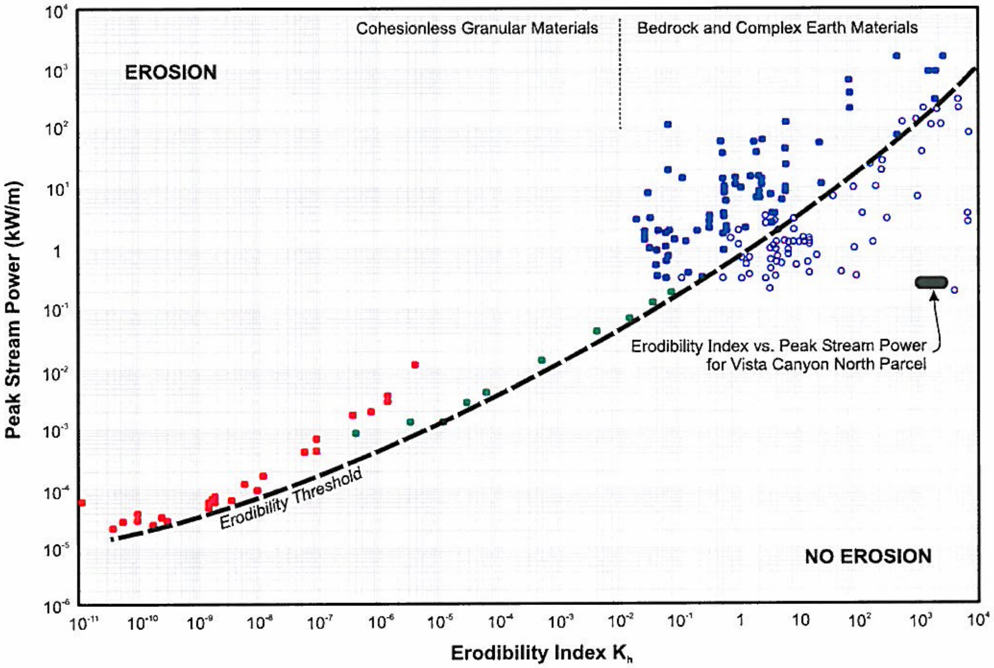
Vista Canyon Ranch Project
Santa Clarita, California

1" = 40'
MN
DS / DA
12-21-07
Figure 1
2005-052-01

1125 SCOTT ROAD
BURBANK, CA. 91504
RTF&A

C:\Documents and Settings\[illegible]\My Documents\DRAFTING\Jobs\2005\2005-052\12-21-07\Geotechnical Map.dwg, 12/21/2007 10:44:42 AM, PostScript Custom Page Size, 1:1





Bedrock and Complex Earth Materials (Annandale, 1995; Fig. 9)

- ■ Erosion
- ○ No Erosion

Cohesionless Granular Materials (Annandale, 1995)

- 🟩 Incipient Motion (Table 11)
- 🟥 Incipient Motion (Table 10)

ERODIBILITY INDEX

Material Type Sandstone (Mint Canyon Fm.)

River Gradient	0.70	degrees
River Flow Direction	270	azimuth degrees
Bedrock Strike	0	azimuth degrees
Bedrock Dip	40	degrees
Bedrock Dip Direction	270	azimuth degrees
Apparent Dip	40	degrees
Effective Dip	39	degrees
Dip direction	with	flow
RQD	94	(estimated)
Residual friction angle	30	degrees (laboratory)
Unconfined compressive strength	20	MPa (estimated)
Joint Set Number, J_n	1.83	
Joint Roughness Number, J_r	1.5	
Joint Alteration Number, J_a	1.00	
Joint Count Number, J_c	4	
Material Strength Number, M_s	20	
Block Size Number, K_b	51	
Discontinuity strength number, K_d	1.5	
Ground Structure Number, J_s	0.54	

Erodibility Index, K_h = $M_s \cdot K_b \cdot K_d \cdot J_s$ = 826

HYDRAULIC ENERGY

Peak Velocity	15	fps
Maximum Depth of Flow	8	ft
Energy Head	0.025	ft
Peak Stream Power	0.26	kW/m

REFERENCES

Annandale, G.W., 1995, Erodibility, Journal of Hydraulic Research, Vol. 33, No. 4.

U. S. Department of Agriculture, 1997 (Rev. 2001), National Engineering Handbook, Part 628 Dams, Chapter 52 Field Procedures Guide for the Headcut Erodibility Index, Appendix 52B Headcut Erodibility Index Flow Chart.

Pacific Advanced Civil Engineering, 10/17/07, verbal communication on peak velocity and maximum depth of flow.

R.T. FRANKIAN & ASSOCIATES

ERODIBILITY INDEX

Vista Canyon Ranch Project
Santa Clarita, California

SCALE as shown	DRAWN BY MN	CHECKED BY DS/DA
DATE 12/21/07	Figure 2	Job No. 2005-052-01

APPENDIX A

EXPLORATION

APPENDIX A

EXPLORATION

The soil and bedrock conditions within the site were explored by drilling two hollow-stem auger and one bucket auger boring at the location shown on the Geotechnical Map (Figure 1). The borings were drilled to a maximum depth of 61 feet below the existing grade. Results of the borings are presented in this Appendix.

Our field geologist obtained undisturbed and bulk samples for laboratory inspection and testing. The undisturbed samples were collected with a 3¼-inch outside diameter lined-barrel sampler containing an 8-inch long, 2.625-inch inside diameter sampling sleeve. The number of blows of the kelly or hammer needed to drive the sampler 12 inches was recorded as an indication of the density or consistency of the earth materials. The kelly and hammer weights for various depths and drilling equipment are summarized in the following tables. Except as indicated, a drop of 12 inches was used. The depths at which undisturbed samples were obtained and the number of blows required to drive the lined-barrel sampler 12 inches are indicated to the left of the boring logs.

KELLY WEIGHTS
(Boring B-8)

Depth in Feet	Weight in pounds
0 to 25	4,900
25 to 50	3,400
50 to 75	2,200
75 to 100	1,200

HAMMER WEIGHTS
(Borings HS-1 and HS-2)

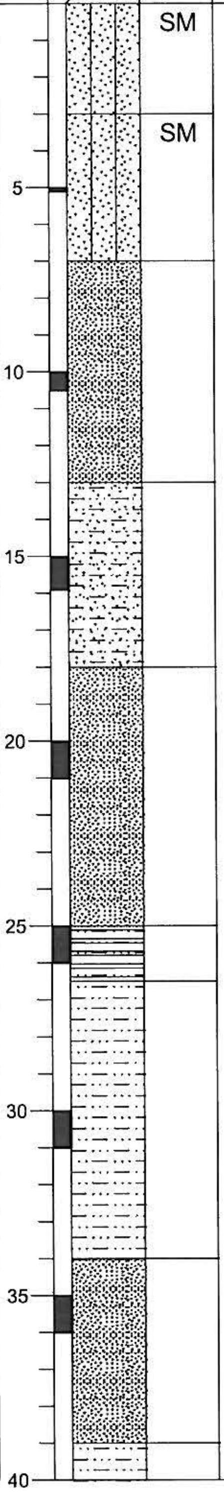
Borings HS-1 and HS-2	
Depth in Feet	Weight in pounds
Undisturbed (30-inch drop)	140
SPT (30-inch drop)	140

In addition to obtaining undisturbed samples, Standard Penetration Tests (SPT) were performed in hollow stem borings. The results of the tests are indicated on the boring logs. The standard penetration tests were performed in accordance with the ASTM D1586 Test Method.

BORING B-8

JOB NUMBER: 2005-052-01
DATE DRILLED: 11/12/07
EQUIPMENT USED: 24" Bucket Auger with Frankian Sampler using driving weights of 4900 lbs. to 25', 3400 lbs. to 50', and 2200 lbs. to 61'.
ELEVATION: 1540'
LOGGED BY: AMB
BORING DEPTH: 0-61'
SURFACE CONDITIONS: Level pad cleared with sagebrush

BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (LBS. PER CU. FT.)	N-VALUE	DEPTH (FEET)
5/2"	2.8	125	-	5
10/6"	3.5	114	-	10
12/10"	4.9	121	-	15
13	5.8	120	-	20
10	15.7	115	-	25
5	12.5	113	-	30
20	7.8	124	-	35
				40



SOIL TYPE / DESCRIPTION:

SM SILTY SAND: fine to coarse, minor cobbles, dry, brown (10YR 5/3)

SM **TERRACE DEPOSITS (Qt)**
SILTY SAND: fine to coarse, cobbly, dry, pale brown (10YR 6/3)

BEDROCK: MINT CANYON FORMATION (Tmc)
SANDSTONE: fine to coarse, trace gravel, dry, light gray (2/5Y 7/2)

SANDY SILTSTONE: fine, dry, light gray (2.5Y 7/2)

SANDSTONE: fine to medium, dry, light gray (2.5Y 7/2)

MUDSTONE: dry, pale olive (5Y 6/3), (LL=62%, PL=27%, PI=35) (84% passing no. 200 sieve)

SILTSTONE: dry, gray (5Y 6/1)

fine to medium, dry, light gray (2/5Y 7/2)

dry, gray (5Y 6/1)

Note: The log of subsurface conditions shown hereon is approximate and applies only at the specific location and date indicated. It is not warranted to be representative of subsurface conditions at other locations or times.

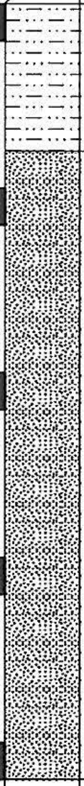
(CONTINUED ON THE FOLLOWING FIGURE)

LOG OF BORING

BORING B-8 (CONTINUED)

JOB NUMBER: 2005-052-01
DATE DRILLED: 11/12/07
EQUIPMENT USED: 24" Bucket Auger with Frankian Sampler using driving weights of 4900 lbs. to 25', 3400 lbs. to 50', and 2200 lbs. to 61'.
ELEVATION: 1540'
LOGGED BY: AMB
BORING DEPTH: 0-61'
SURFACE CONDITIONS: Level pad cleared with sagebrush

BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (LBS. PER CU. FT.)	N-VALUE	DEPTH (FEET)	SAMPLE LOCATION	GRAPHIC LOG	SOIL TYPE
20			-		■		
12	8.2	108	-	45	■		
20	7.7	116	-	50	■		
20	8.9	115	-	55	■		
16	10.5	117	-	60	■		
				65			
				70			
				75			
				80			



(inner tube got bent, could not retrieve out of sampling tube)

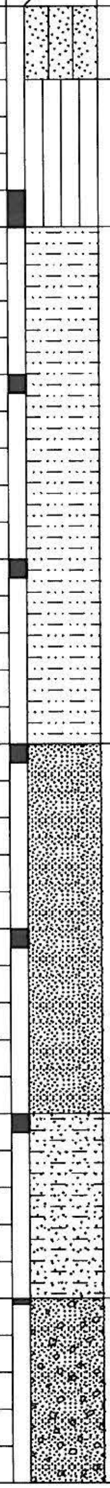
SANDSTONE: fine to coarse, trace gravel, dry, light gray (2/5Y 7/2)

Bottom of Boring at 61 feet.
No groundwater. No caving. Boring backfilled with cuttings after drilling.

Note: The log of subsurface conditions shown hereon is approximate and applies only at the specific location and date indicated.
It is not warranted to be representative of subsurface conditions at other locations or times.

BORING HS-1

JOB NUMBER: 2005-052-01
DATE DRILLED: 11/8/07
EQUIPMENT USED: 6" Hollow Stem Auger with Frankian Sampler
ELEVATION: 1550'
LOGGED BY: AMB
BORING DEPTH: 0-53'
SURFACE CONDITIONS: Level Terrace with moderate sage brush vegetation and light grass



BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (LBS. PER CU. FT.)	N-VALUE	DEPTH (FEET)	SOIL TYPE	
					SM	SILTY SAND: loose, dry
					ML	**TERRACE DEPOSITS (Qt)** GRAVELLY SANDY SILT: medium to fine, few cobbles, dry, light gray
55	1.7	108	-	5		
						BEDROCK: MINT CANYON FORMATION (Tmc) SILTSTONE: dry, light gray (2.5Y 7/2)
50/5"	4.7	116	-	10		
50/5"	9.8	99	-	15		
50/6"	7.7	108	-	20		SANDSTONE: medium to fine, dry, light gray (2.5Y 7/2)
50/5"			-	25		coarse to fine
50/4"			-	30		SANDY SILTSTONE: medium to fine, dry
50/2"			-	35		(Chatter of drill stem. Added H20 to cool) GRAVELLY SANDSTONE: coarse to fine, with clay balls, dry, pale brown (10YR 6/3)
				40		

Note: The log of subsurface conditions shown hereon is approximate and applies only at the specific location and date indicated. It is not warranted to be representative of subsurface conditions at other locations or times.

(CONTINUED ON THE FOLLOWING FIGURE)

BOREHOLE LOG 2005-052-01.GPJ FRANKIAN.GDT 12/11/07

LOG OF BORING

R.T. FRANKIAN & ASSOCIATES

BORING HS-1 (CONTINUED)

JOB NUMBER: 2005-052-01
DATE DRILLED: 11/8/07
EQUIPMENT USED: 6" Hollow Stem Auger with Frankian Sampler
ELEVATION: 1550'
LOGGED BY: AMB
BORING DEPTH: 0-53'
SURFACE CONDITIONS: Level Terrace with moderate sage brush vegetation and light grass

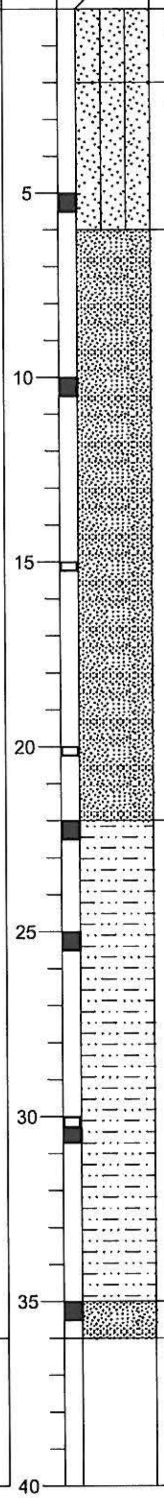
BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (LBS. PER CU. FT.)	N-VALUE	DEPTH (FEET)	SAMPLE LOCATION	GRAPHIC LOG	SOIL TYPE	
65/7"	7.8	113	-		■	▨		SANDSTONE: medium to fine, light gray (2.5Y 7/2), with interbedded light olive brown (2.5Y 5/3) siltstone
50/5"	9.6	100	-	45	■	▨		with interbedded very dark brown (10YR 2/2) siltstone
50/5"			-	50	■	▨		coarse to fine, trace gravels, light gray (2.5Y 7/2)
						▨		(chatter of drill stem)
								Bottom of Boring at 53 feet. No groundwater. No caving. Boring backfilled with cuttings after drilling.
				55				
				60				
				65				
				70				
				75				
				80				

Note: The log of subsurface conditions shown hereon is approximate and applies only at the specific location and date indicated. It is not warranted to be representative of subsurface conditions at other locations or times.

LOG OF BORING

BORING HS-2

JOB NUMBER: 2005-052-01
DATE DRILLED: 11/8/07
EQUIPMENT USED: 6" Hollow Stem Auger with Frankian Sampler
ELEVATION: 1540'
LOGGED BY: AMB
BORING DEPTH: 0-36'
SURFACE CONDITIONS: Level pad with sagebrush and minor grasses



BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (LBS. PER CU. FT.)	N-VALUE	DEPTH (FEET)	SOIL TYPE	
					SM	SILTY SAND: loose, dry
					SM	**TERRACE DEPOSITS (Qt)** GRAVELLY SILTY SAND: fine to coarse, clay, light yellowish brown (10Y 6/4)
50/5"	5.1	102	-	5		
						BEDROCK: MINT CANYON FORMATION (Tmc) SANDSTONE: fine to coarse, trace gravel, dry, light gray (2.5Y 7/2)
50/5"	3.2	108	-	10		
50/3"			-	15		
			-	20		
50/6"	6.1	117	-			SILTSTONE: light olive brown (2/5Y 5/3) to light gray (2/5Y 7/2) with interbedded medium to fine light gray (2/5Y 7/2) sandstone
50/6"			-	25		
50/4" 200/5"	6.6	103	- -	30		(LL=37%, PL=22%, PI=15.1%)
50/4"	11.2	100	-	35		SANDSTONE: fine to coarse, light gray (2.5Y 7/2)
				40		Bottom of Boring at 36 feet. No groundwater. No caving. Boring backfilled after drilling. Drill Rig broke down.

Note: The log of subsurface conditions shown hereon is approximate and applies only at the specific location and date indicated. It is not warranted to be representative of subsurface conditions at other locations or times.

LOG OF BORING

APPENDIX B

LABORATORY TESTS

APPENDIX B

LABORATORY TESTS

Laboratory tests were performed on selected samples obtained from the test borings to aid in the classification of the soils, and to determine their engineering properties.

Moisture and Density Tests: Moisture content and unit dry density tests were performed on samples of undisturbed soil obtained in the borings. Dry density and field moisture information is useful in correlating field and laboratory data, and in providing a gross picture of the variations of soil characteristics. The results of the tests are presented on the boring logs in Appendix A.

Direct Shear Tests: Direct shear tests were performed on selected undisturbed samples to determine the strength and supporting capacities of the soils. The method of performing these tests is to contain the sample in testing rings, to apply a normal load, and to then allow sufficient time to elapse to dissipate any excess hydrostatic pressure which may have developed in applying the normal pressure.

The sample is then subjected to strain-controlled, double-plane shear tests. The method of applying the normal and shearing load is such as to allow the sample to change in volume during shear without producing an associated change in the normal stress. The shearing stress is measured at a constant rate of strain of approximately 0.02 inch per minute.

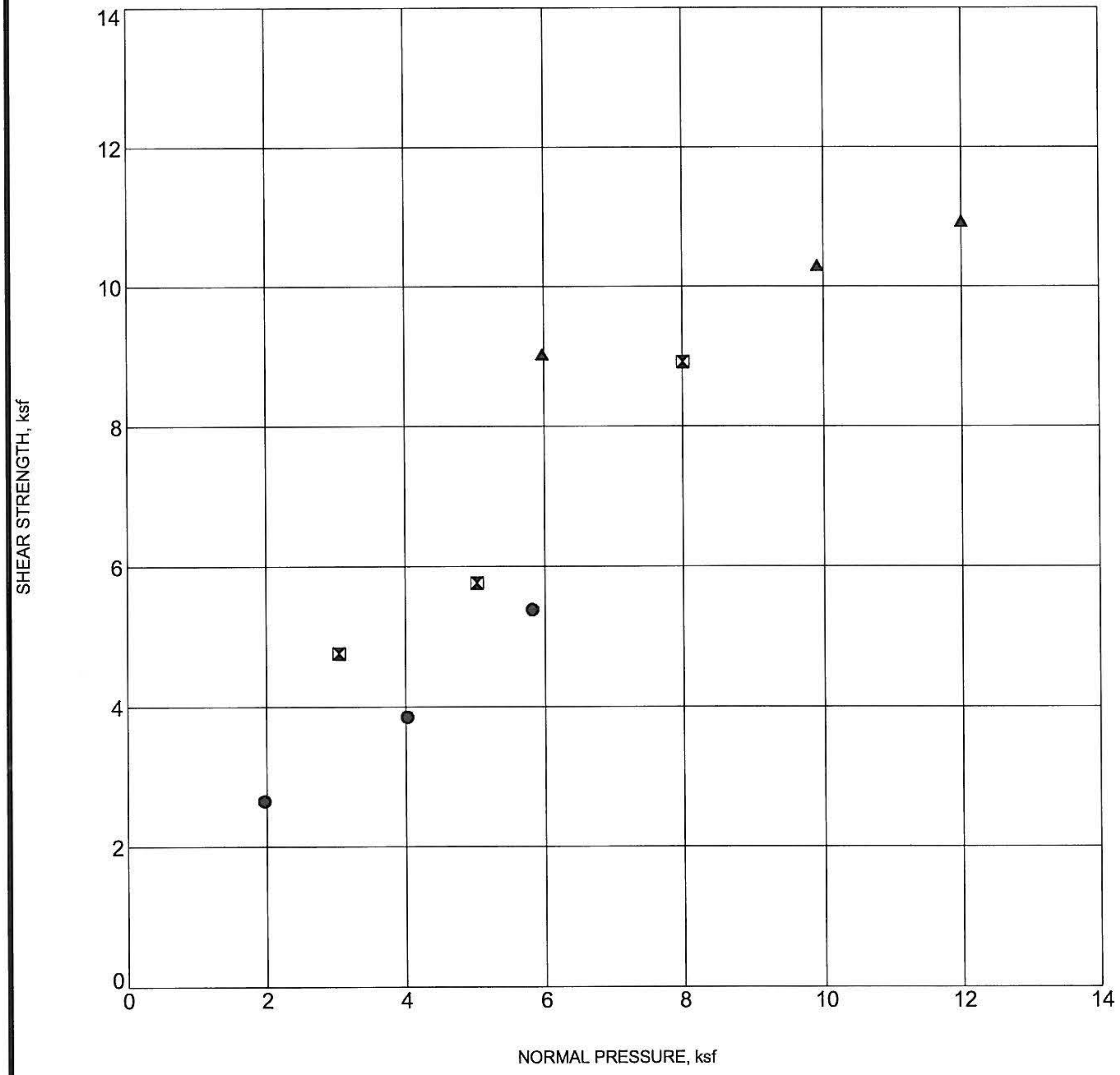
Selected samples of the soil were tested at confining pressures similar to those of the materials in-situ. Additional specimens, from the same sample, were also tested at increased normal pressures in order to determine the increase in shear strengths associated with increased intergranular pressures. Specimens were soaked for testing.

To evaluate the effect of sustaining a shearing stress on a soil for a long period of time, where such might be the case in the field, the direct shear tests are run until the ultimate portion of the stress-strain curve is reached and then held until the soil has "relaxed" to an equilibrium shearing resistance. The ultimate portion of the stress-strain curve represents the shearing resistance available under large deflections, usually greater than 0.1 inch for direct shear tests, or four percent axial strain for unconfined compression tests. Allowing the soil to "relax" removed the majority of the shearing resistance due to the viscous component of the shear strength, such as would be involved in creep or plastic flow. Unless otherwise stated, these are the values which are shown on the graphic "Summary of Shear Test Data."

Atterberg limits: Atterberg limits (liquid and plastic limit) tests were conducted on selected samples to aid in classifying the soils in accordance with USCS (by evaluating soil plasticity). Test results are presented on the boring log in Appendix A.

Grain Size Analyses: To estimate the particle size distribution of the soils and to aid in classifying the soils, grain size analyses were performed on samples obtained from the borings. The percentage of "fines" (percent passing the No. 200 sieve) of various samples is presented on the boring logs in Appendix A; the complete results of the grain size analyses (i.e., sieve and hydrometer tests) are presented in this appendix.

Corrosivity Studies: Soil chemical testing was performed for us on a sample of the on-site soils by M. J. Schiff and Associates. Test results are presented in this Appendix.



Specimen Identification			Classification				
●	**B-8**	**15.0'**	**SANDY SILTSTONE (Tmc)**				
☒	**B-8**	**25.0'**	**MUDSTONE (Tmc)**				
▲	**B-8**	**55.0'**	**SANDSTONE (Tmc)**				

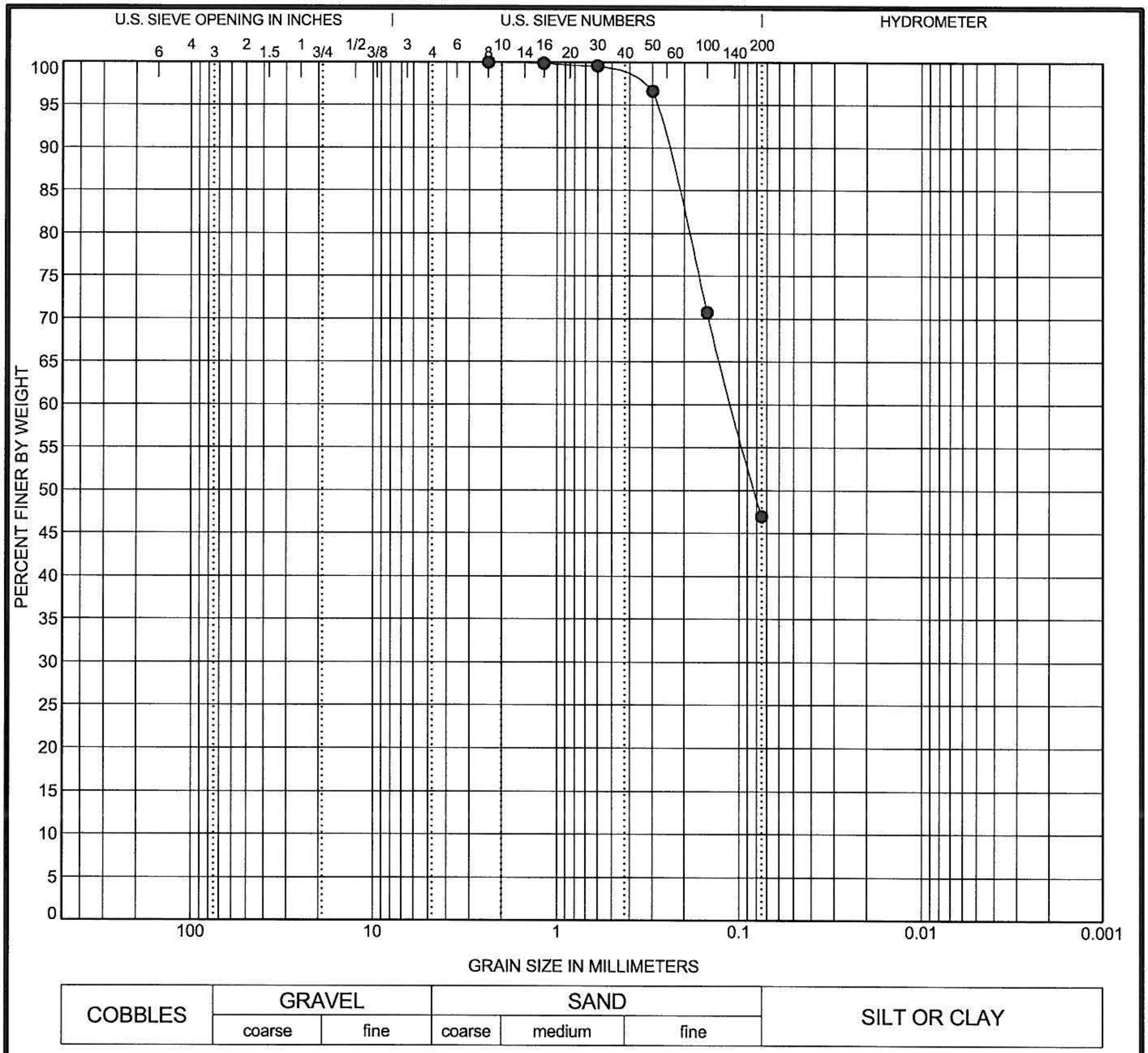
R. T. Frankian & Associates
1329 Scott Road
Burbank, Ca 91504
Telephone: (818) 531-1501
Fax: (818) 531-1511

DIRECT SHEAR TEST

JOB NUMBER: 2005-052-01

REPORT DATED: 12-21-2007

US DIRECT SHEAR 2005-052-01.GPJ FRANKIAN.GDT 12/11/07



Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● B-8	15.0	SANDY SILTSTONE (Tmc)					

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-8	15.0	2.36	0.11				53.0	47.0	

US GRAIN SIZE 2005-052-01.GPJ FRANKIAN.GDT 12/11/07

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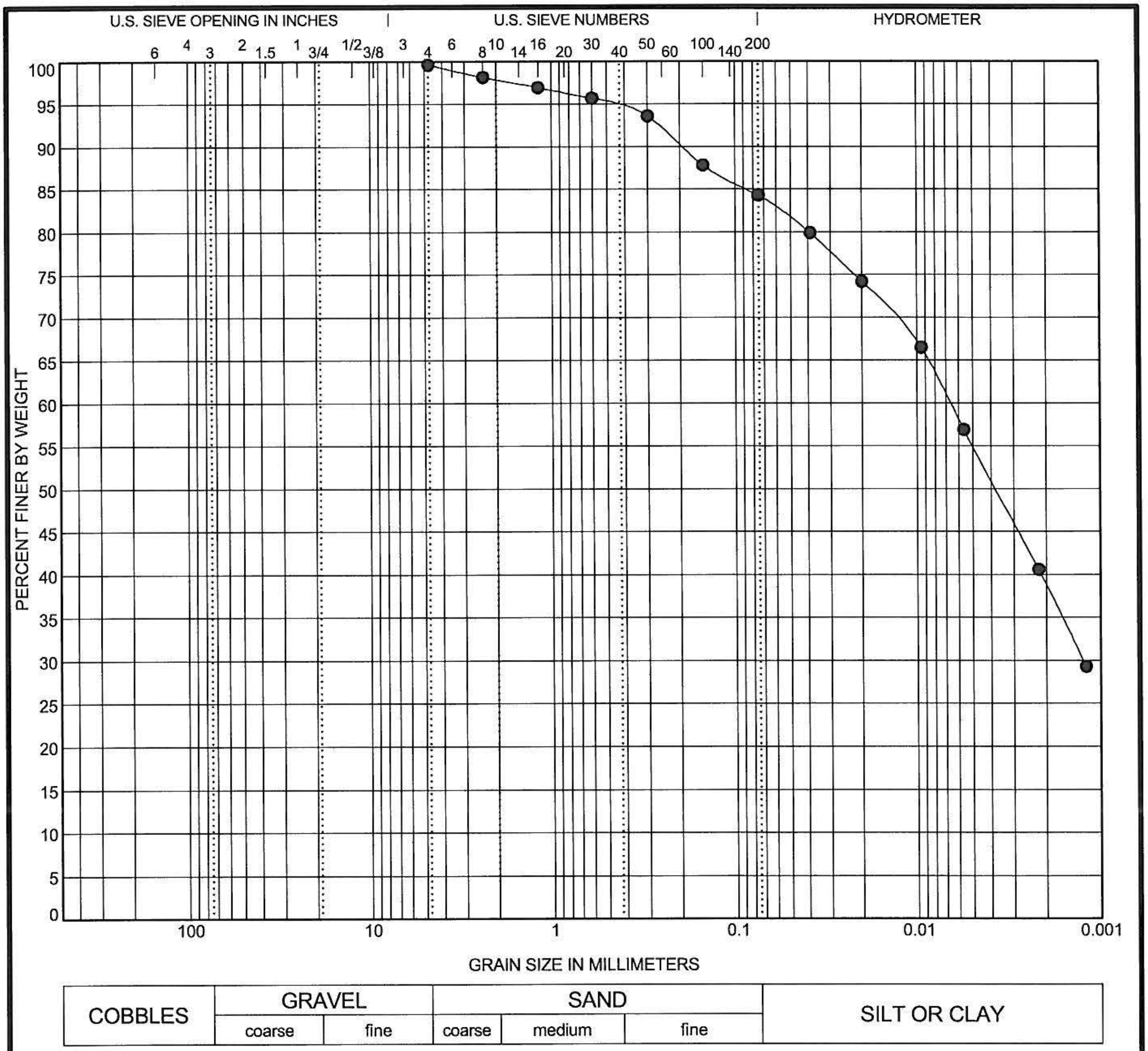
1329 Scott Road
Burbank, Ca 91504
Telephone: (818) 531-1501
Fax: (818) 531-1511

GRAIN SIZE DISTRIBUTION

JOB NUMBER: 2005-052-01

REPORT DATED: 12-21-2007



Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **B-8**	**25.0**	**MUDSTONE (Tmc)**	**62**	**27**	**35**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-8**	**25.0**	**4.75**	**0.007**	**0.001**			**15.3**	**29.4**	**54.9**

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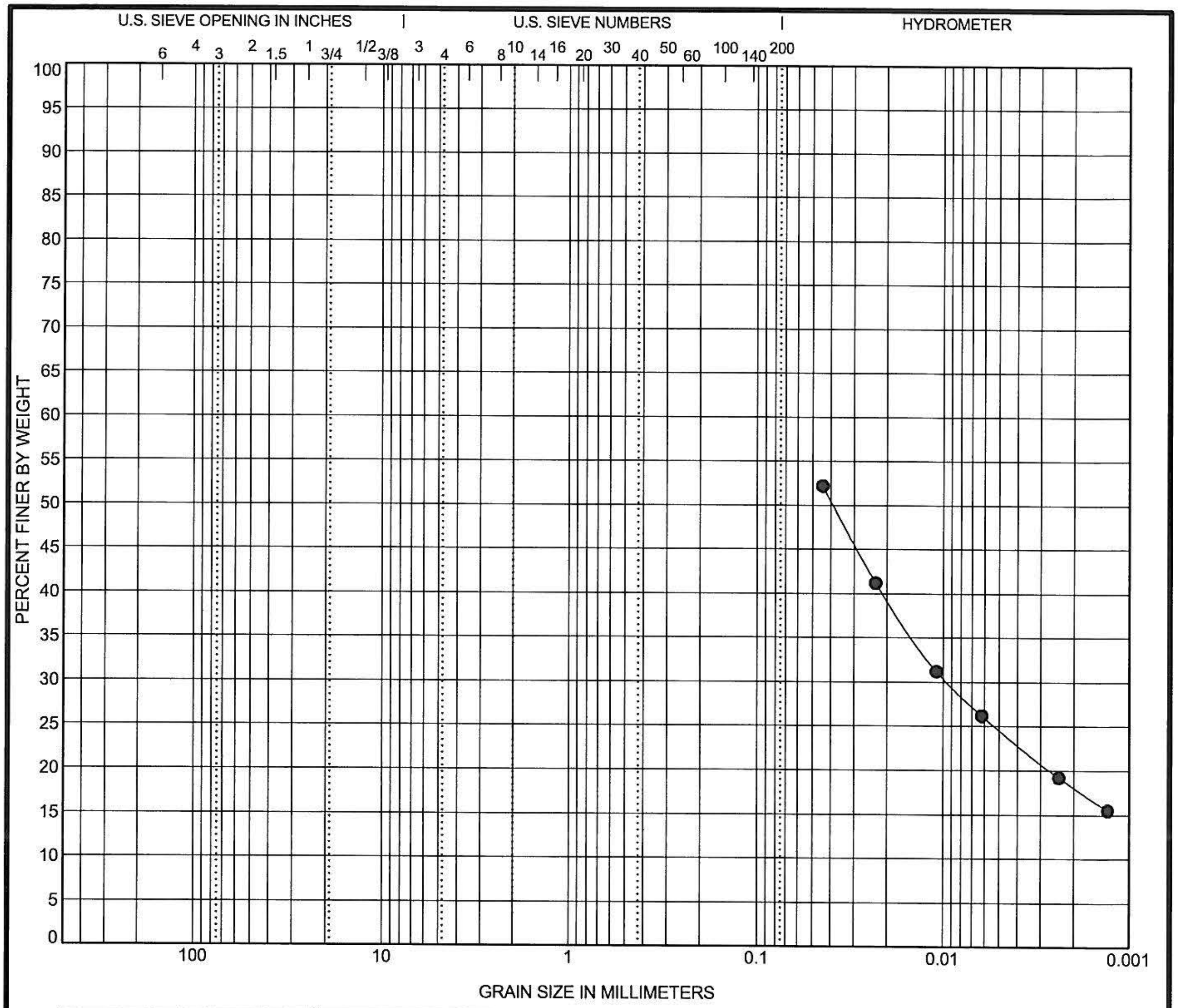
Fax: (818) 531-1511

GRAIN SIZE DISTRIBUTION

JOB NUMBER: 2005-052-01

REPORT DATED: 12-21-2007

US GRAIN SIZE 2005-052-01.GPJ FRANKIAN.GDT 12/20/07



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**HS-2**	**30.0**	**SILTSTONE (Tmc)**	**37**	**22**	**15**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**HS-2**	**30.0**			**0.01**					**24.6**

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Burbank, Ca 91504
Telephone: (818) 531-1501
Fax: (818) 531-1511

GRAIN SIZE DISTRIBUTION

JOB NUMBER: 2005-052-01

REPORT DATED: 12-21-2007

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Table 1 - Laboratory Tests on Soil Samples

R.T. Frankian & Assoc.
J.S.B.
Your #2007-037-01, SA #07-1537LAB
16-Nov-07

Sample ID			B3 @ 10' SP / SM
Resistivity		**Units**	
as-received		ohm-cm	80,000
minimum		ohm-cm	11,600
pH			8.0
Electrical Conductivity		mS/cm	0.04
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	11
magnesium	Mg^{2+}	mg/kg	3.0
sodium	Na^{1+}	mg/kg	46
potassium	K^{1+}	mg/kg	1.0
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	95
flouride	F^{1-}	mg/kg	2.0
chloride	Cl^{1-}	mg/kg	1.0
sulfate	SO_4^{2-}	mg/kg	3.0
phosphate	PO_4^{3-}	mg/kg	3.0
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	0.6
sulfide	S^{2-}	qual	na
Redox		mV	na

Minimum resistivity per CTM 643

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

PACE
Advanced Water Engineering

Appendix 4.1

APPENDIX CHAPTER 4.1

Existing Condition HEC-RAS Output

HEC-RAS Plan: ex 085 thin   River: SCR   Reach: 1   Profile: Qcap

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	18000	Qcap	46410.00	1526.00	1546.73	1534.40	1547.10	0.001587	4.85	9591.47	1547.66	0.20
1	17900		Bridge									
1	17800	Qcap	46410.00	1525.00	1539.45	1533.98	1540.42	0.007702	7.90	5872.83	791.27	0.40
1	17600	Qcap	46410.00	1524.00	1538.65	1533.46	1539.56	0.007146	7.86	6205.47	1036.92	0.39
1	17400	Qcap	46410.00	1523.00	1537.67	1533.25	1538.53	0.008701	7.49	6286.58	1113.03	0.42
1	17200	Qcap	46410.00	1521.00	1535.14	1532.55	1536.36	0.013457	9.58	5430.41	1051.37	0.52
1	17000	Qcap	46410.00	1520.00	1532.46	1529.69	1533.53	0.014516	8.33	5595.84	763.73	0.52
1	16800	Qcap	46410.00	1519.00	1529.75		1530.75	0.013148	8.04	5770.48	711.84	0.50
1	16600	Qcap	46410.00	1517.00	1528.00		1528.67	0.007744	6.55	7084.20	797.77	0.39
1	16400	Qcap	46410.00	1515.00	1526.84		1527.35	0.005316	5.74	8102.13	902.50	0.33
1	16200	Qcap	46410.00	1512.21	1525.91	1519.54	1526.36	0.004431	5.38	8622.09	1132.77	0.30
1	16000	Qcap	46410.00	1510.37	1525.03	1518.22	1525.50	0.004124	5.52	8412.63	1155.45	0.29
1	15800	Qcap	46410.00	1508.63	1524.26	1516.70	1524.74	0.003583	5.54	8389.59	1427.24	0.29
1	15600	Qcap	46410.00	1507.00	1522.55	1516.30	1523.66	0.007569	8.47	5486.40	968.03	0.40
1	15400	Qcap	46410.00	1505.11	1520.03	1516.25	1521.66	0.013532	10.55	4774.64	540.73	0.53
1	15200	Qcap	46410.00	1504.00	1516.74	1513.56	1518.59	0.017373	10.89	4262.25	584.16	0.59
1	15000	Qcap	46410.00	1502.00	1514.28		1515.42	0.012730	8.59	5491.79	768.64	0.50
1	14800	Qcap	46410.00	1501.00	1511.94		1512.72	0.013181	7.12	6521.60	973.58	0.48
1	14600	Qcap	46410.00	1499.00	1509.11		1509.92	0.014934	7.27	6590.80	1269.34	0.51
1	14400	Qcap	46410.00	1497.66	1506.45	1504.17	1507.04	0.013239	6.24	7658.56	1835.87	0.47
1	14200	Qcap	46410.00	1495.00	1504.14	1502.20	1504.68	0.010475	6.40	8428.00	1870.88	0.43
1	14000	Qcap	46410.00	1493.00	1502.18	1500.14	1502.67	0.009531	6.05	8857.52	1950.53	0.41
1	13800	Qcap	46410.00	1491.00	1500.12	1498.26	1500.65	0.010573	6.28	8467.80	1869.75	0.43
1	13600	Qcap	46410.00	1488.46	1498.34	1495.69	1498.69	0.008626	4.77	9738.40	2009.60	0.37
1	13400	Qcap	46410.00	1486.00	1496.49	1494.09	1496.87	0.009611	4.95	9380.65	1988.02	0.39
1	13200	Qcap	46410.00	1484.00	1494.45	1492.00	1494.90	0.010050	5.36	8660.06	1680.06	0.41
1	13050	Qcap	46430.00	1482.00	1491.89	1489.33	1492.38	0.010104	5.59	8306.46	1518.23	0.41
1	12920	Qcap	46430.00	1482.00	1491.07	1488.30	1491.53	0.009082	5.48	8505.44	1508.80	0.39
1	12600	Qcap	46430.00	1478.00	1488.25	1485.84	1488.83	0.011742	6.09	7622.94	1576.30	0.45
1	12400	Qcap	46430.00	1476.00	1486.38	1483.50	1486.82	0.008382	5.34	8887.33	1684.74	0.38
1	12200	Qcap	46430.00	1474.59	1484.98		1485.35	0.006341	4.86	9655.61	1591.50	0.33
1	12000	Qcap	46430.00	1472.00	1483.25	1479.68	1483.86	0.008559	6.26	7416.78	1163.73	0.40
1	11800	Qcap	46430.00	1470.05	1481.68		1482.28	0.007298	6.17	7539.30	928.93	0.37
1	11600	Qcap	46430.00	1468.00	1480.12		1480.76	0.007886	6.40	7321.68	967.66	0.39
1	11400	Qcap	46430.00	1466.00	1478.47		1479.20	0.007586	6.86	6956.32	946.91	0.39
1	11200	Qcap	46430.00	1465.00	1476.56		1477.48	0.009592	7.74	6284.71	1093.71	0.44
1	11000	Qcap	46430.00	1463.00	1474.81	1470.49	1475.64	0.008587	7.31	6385.78	1270.49	0.41
1	10800	Qcap	46430.00	1461.11	1473.15		1473.95	0.008242	7.18	6468.19	719.80	0.41
1	10600	Qcap	46430.00	1458.00	1471.68	1466.35	1472.44	0.006844	6.97	6663.05	674.09	0.38
1	10400	Qcap	46430.00	1456.00	1470.05	1464.96	1470.95	0.007916	7.63	6095.89	601.61	0.41
1	10200	Qcap	46430.00	1451.00	1468.20	1461.40	1468.66	0.003760	5.52	8645.06	817.61	0.28
1	10100		Bridge									
1	10000	Qcap	46430.00	1448.00	1467.01	1458.82	1467.45	0.003002	5.43	8844.53	741.83	0.26

HEC-RAS Plan: vcr ex 025 thin   River: SCR   Reach: 1   Profile: Qcap

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	18000	Qcap	46410.00	1526.00	1536.68	1534.40	1538.42	0.001808	10.60	4384.12	774.01	0.64
1	17900		Bridge									
1	17800	Qcap	46410.00	1525.00	1534.08	1533.98	1537.26	0.004620	14.32	3240.41	482.55	0.97
1	17600	Qcap	46410.00	1524.00	1533.79	1533.46	1536.72	0.003714	13.80	3443.35	581.78	0.89
1	17400	Qcap	46410.00	1523.00	1533.35	1533.25	1536.12	0.004909	13.38	3469.15	599.52	0.98
1	17200	Qcap	46410.00	1521.00	1532.55	1532.55	1535.28	0.003585	14.17	3739.50	659.24	0.88
1	17000	Qcap	46410.00	1520.00	1529.69	1529.69	1532.25	0.005174	12.86	3618.67	712.87	0.99
1	16800	Qcap	46410.00	1519.00	1526.46	1526.46	1529.14	0.005367	13.15	3527.97	667.68	1.01
1	16600	Qcap	46410.00	1517.00	1523.67	1523.67	1526.10	0.005466	12.53	3705.32	763.15	1.00
1	16400	Qcap	46410.00	1515.00	1521.48	1521.48	1523.88	0.005545	12.42	3736.99	790.35	1.01
1	16200	Qcap	46410.00	1512.21	1520.77	1519.54	1522.46	0.002629	10.44	4447.52	694.84	0.73
1	16000	Qcap	46410.00	1510.37	1520.61	1518.22	1521.91	0.001819	9.14	5079.89	736.80	0.61
1	15800	Qcap	46410.00	1508.63	1520.58	1516.70	1521.56	0.000930	7.96	5831.29	908.88	0.46
1	15600	Qcap	46410.00	1507.00	1519.33	1516.30	1521.23	0.001573	11.08	4189.48	593.68	0.60
1	15400	Qcap	46410.00	1505.11	1516.25	1516.25	1520.50	0.004594	16.55	2804.93	462.81	1.00
1	15200	Qcap	46410.00	1504.00	1513.56	1513.56	1517.32	0.004719	15.56	2982.34	395.00	1.00
1	15000	Qcap	46410.00	1502.00	1510.56	1510.56	1513.67	0.005025	14.15	3278.94	527.19	1.00
1	14800	Qcap	46410.00	1501.00	1509.16	1509.16	1511.34	0.005668	11.84	3920.72	908.38	1.00
1	14600	Qcap	46410.00	1499.00	1506.60	1506.60	1508.79	0.005624	11.88	3907.46	891.24	1.00
1	14400	Qcap	46410.00	1497.66	1504.17	1504.17	1505.92	0.005954	10.62	4371.09	1297.86	1.00
1	14200	Qcap	46410.00	1495.00	1502.20	1502.20	1503.76	0.003704	10.42	5088.68	1712.03	0.83
1	14000	Qcap	46410.00	1493.00	1500.14	1500.14	1501.65	0.003673	10.20	5147.46	1763.50	0.82
1	13800	Qcap	46410.00	1491.00	1498.26	1498.26	1499.76	0.003696	10.17	5163.84	1776.12	0.82
1	13600	Qcap	46410.00	1488.46	1495.69	1495.69	1497.14	0.006386	9.65	4808.80	1657.27	1.00
1	13400	Qcap	46410.00	1486.00	1494.09	1494.09	1495.47	0.006534	9.43	4920.07	1784.80	1.00
1	13200	Qcap	46410.00	1484.00	1492.00	1492.00	1493.49	0.006310	9.78	4743.54	1586.43	1.00
1	13050	Qcap	46430.00	1482.00	1489.33	1489.33	1490.91	0.006160	10.10	4594.86	1437.41	1.00
1	12920	Qcap	46430.00	1482.00	1488.30	1488.30	1489.91	0.006183	10.21	4559.02	1415.47	1.00
1	12600	Qcap	46430.00	1478.00	1485.84	1485.84	1487.52	0.006006	10.42	4457.66	1318.29	0.99
1	12400	Qcap	46430.00	1476.00	1483.50	1483.50	1485.13	0.006170	10.25	4529.38	1403.79	1.00
1	12200	Qcap	46430.00	1474.59	1481.47	1481.47	1483.14	0.006135	10.38	4474.86	1341.59	1.00
1	12000	Qcap	46430.00	1472.00	1479.68	1479.68	1481.78	0.005659	11.61	3999.11	950.45	1.00
1	11800	Qcap	46430.00	1470.05	1477.53	1477.53	1479.77	0.005624	12.02	3861.73	868.12	1.00
1	11600	Qcap	46430.00	1468.00	1475.90	1475.90	1478.30	0.005587	12.44	3732.30	788.78	1.01
1	11400	Qcap	46430.00	1466.00	1473.90	1473.90	1476.55	0.005284	13.06	3554.91	672.88	1.00
1	11200	Qcap	46430.00	1465.00	1472.41	1472.41	1475.29	0.005216	13.63	3406.87	598.89	1.01
1	11000	Qcap	46430.00	1463.00	1470.49	1470.49	1473.21	0.005205	13.23	3518.92	799.50	1.00
1	10800	Qcap	46430.00	1461.11	1468.60	1468.60	1471.35	0.005316	13.31	3487.94	644.16	1.01
1	10600	Qcap	46430.00	1458.00	1466.35	1466.35	1469.23	0.005090	13.62	3408.16	588.15	1.00
1	10400	Qcap	46430.00	1456.00	1464.96	1464.96	1468.03	0.005012	14.05	3304.31	537.33	1.00
1	10200	Qcap	46430.00	1451.00	1462.81	1461.40	1464.49	0.002459	10.43	4504.96	725.57	0.71
1	10100		Bridge									
1	10000	Qcap	46430.00	1448.00	1459.86	1458.82	1461.94	0.003003	11.60	4011.52	607.54	0.79

Appendix 4.2

Appendix 4.2

APPENDIX CHAPTER 4.2

Proposed Condition HEC-RAS Output

HEC-RAS Plan: pro sam mod   River: SCR   Reach: 1   Profile: Qcap

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	18000	Qcap	46410.00	1526.00	1536.68	1534.40	1538.42	0.001808	10.60	4384.12	774.01	0.64
1	17900		Bridge									
1	17800	Qcap	46410.00	1525.00	1534.08	1533.98	1537.26	0.004620	14.32	3240.41	482.55	0.97
1	17600	Qcap	46410.00	1524.00	1533.79	1533.46	1536.72	0.003714	13.80	3443.35	581.78	0.89
1	17400	Qcap	46410.00	1523.00	1533.35	1533.25	1536.12	0.004909	13.38	3469.15	599.52	0.98
1	17200	Qcap	46410.00	1521.00	1532.55	1532.55	1535.28	0.003585	14.17	3739.50	659.24	0.88
1	17000	Qcap	46410.00	1520.00	1529.69	1529.69	1532.25	0.005174	12.86	3618.67	712.87	0.99
1	16800	Qcap	46410.00	1519.00	1526.46	1526.46	1529.14	0.005366	13.15	3528.21	667.68	1.01
1	16600	Qcap	46410.00	1517.00	1523.67	1523.67	1526.10	0.005464	12.52	3705.79	763.15	1.00
1	16400	Qcap	46410.00	1515.00	1521.48	1521.48	1523.88	0.005543	12.42	3737.38	790.35	1.01
1	16200	Qcap	46410.00	1512.21	1520.76	1519.54	1522.46	0.002640	10.45	4441.83	694.80	0.73
1	16000	Qcap	46410.00	1510.37	1520.61	1518.22	1521.90	0.001826	9.15	5072.88	736.60	0.61
1	15800	Qcap	46410.00	1508.42	1520.57	1516.69	1521.56	0.000933	7.97	5823.40	627.87	0.46
1	15600	Qcap	46410.00	1507.00	1519.29	1516.32	1521.22	0.001599	11.15	4164.04	400.11	0.61
1	15400	Qcap	46410.00	1505.11	1516.25	1516.25	1520.49	0.004568	16.52	2809.53	328.79	1.00
1	15200	Qcap	46410.00	1504.00	1513.52	1513.52	1517.32	0.004809	15.65	2965.26	395.03	1.01
1	15000	Qcap	46410.00	1502.00	1510.72	1510.72	1513.95	0.004962	14.43	3216.75	499.48	1.00
1	14800	Qcap	46410.00	1501.00	1509.50	1509.50	1512.44	0.005114	13.74	3377.66	578.65	1.00
1	14600	Qcap	46410.00	1499.00	1506.95	1506.95	1509.67	0.005211	13.23	3507.93	640.32	1.00
1	14400	Qcap	46410.00	1497.66	1504.84	1504.84	1507.59	0.005314	13.33	3482.40	640.21	1.01
1	14200	Qcap	46410.00	1495.00	1502.25	1502.25	1504.82	0.005345	12.87	3604.93	700.63	1.00
1	14000	Qcap	46410.00	1493.00	1499.93	1499.93	1502.38	0.005475	12.55	3697.01	761.59	1.00
1	13800	Qcap	46410.00	1491.00	1498.12	1498.12	1500.48	0.005464	12.34	3759.88	795.01	1.00
1	13600	Qcap	46410.00	1488.46	1496.06	1496.06	1498.39	0.005497	12.24	3792.22	816.52	1.00
1	13400	Qcap	46410.00	1486.00	1494.72	1494.72	1497.00	0.005630	12.13	3827.09	850.02	1.01
1	13200	Qcap	46410.00	1484.00	1493.06	1493.06	1495.34	0.005646	12.11	3831.47	854.46	1.01
1	13050	Qcap	46430.00	1482.00	1492.46	1491.23	1494.23	0.002695	10.69	4345.25	669.18	0.74
1	12985		Bridge									
1	12920	Qcap	46430.00	1482.00	1490.18	1490.18	1492.87	0.005302	13.16	3529.14	661.52	1.00
1	12600	Qcap	46430.00	1478.00	1486.73	1486.73	1489.15	0.005378	12.47	3722.92	765.33	1.00
1	12400	Qcap	46430.00	1476.00	1484.64	1484.64	1487.11	0.005480	12.61	3682.03	754.37	1.01
1	12200	Qcap	46430.00	1474.59	1482.73	1482.73	1485.20	0.005399	12.63	3676.45	744.54	1.00
1	12000	Qcap	46430.00	1472.00	1480.56	1480.56	1483.07	0.005319	12.71	3651.72	723.01	1.00
1	11800	Qcap	46430.00	1470.93	1478.55	1478.55	1481.12	0.005328	12.86	3610.42	703.81	1.00
1	11600	Qcap	46430.00	1468.00	1476.21	1476.21	1478.68	0.005435	12.62	3680.21	746.15	1.00
1	11400	Qcap	46430.00	1466.00	1473.90	1473.90	1476.55	0.005285	13.06	3554.67	672.88	1.00
1	11200	Qcap	46430.00	1465.00	1472.40	1472.40	1475.29	0.005219	13.64	3403.48	597.40	1.01
1	11000	Qcap	46430.00	1463.00	1470.49	1470.49	1473.18	0.005280	13.16	3529.26	660.62	1.00
1	10800	Qcap	46430.00	1461.11	1468.60	1468.60	1471.35	0.005320	13.31	3487.23	644.16	1.01
1	10600	Qcap	46430.00	1458.00	1466.35	1466.35	1469.23	0.005090	13.62	3408.16	588.15	1.00
1	10400	Qcap	46430.00	1456.00	1464.96	1464.96	1468.03	0.005012	14.05	3304.31	537.33	1.00
1	10200	Qcap	46430.00	1451.00	1462.82	1461.45	1464.49	0.002448	10.41	4511.60	725.68	0.71
1	10100		Bridge									
1	10000	Qcap	46430.00	1448.00	1459.86	1458.82	1461.94	0.003003	11.60	4011.52	607.54	0.79

HEC-RAS Plan: Pr.085   River: SCR   Reach: 1   Profile: Qcap

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	18000	Qcap	46410.00	1526.00	1546.73	1534.40	1547.10	0.001588	4.85	9590.49	1548.43	0.20
1	17900		Bridge									
1	17800	Qcap	46410.00	1525.00	1539.44	1533.97	1540.41	0.007707	7.90	5871.62	791.37	0.40
1	17600	Qcap	46410.00	1524.00	1538.65	1533.45	1539.56	0.007127	7.85	6214.47	1040.00	0.39
1	17400	Qcap	46410.00	1523.00	1537.67	1533.25	1538.53	0.008614	7.47	6306.09	1111.41	0.42
1	17200	Qcap	46410.00	1521.00	1535.14	1532.59	1536.37	0.013549	9.58	5425.05	1051.13	0.52
1	17000	Qcap	46410.00	1520.00	1532.48	1529.67	1533.54	0.014354	8.30	5615.93	763.25	0.52
1	16800	Qcap	46410.00	1519.00	1529.79		1530.79	0.013006	8.01	5795.28	713.38	0.50
1	16600	Qcap	46410.00	1517.00	1528.11		1528.76	0.007420	6.46	7182.02	828.79	0.38
1	16400	Qcap	46410.00	1515.00	1527.01		1527.50	0.005030	5.64	8257.44	956.49	0.32
1	16200	Qcap	46410.00	1512.21	1526.15	1519.52	1526.58	0.004106	5.26	8826.25	1142.73	0.29
1	16000	Qcap	46410.00	1510.37	1525.34	1518.23	1525.79	0.003772	5.37	8647.04	1174.79	0.28
1	15800	Qcap	46410.00	1508.39	1524.63	1516.67	1525.09	0.003247	5.45	8667.53	1437.06	0.27
1	15600	Qcap	46410.00	1507.00	1523.10	1516.32	1524.13	0.006628	8.15	5702.66	1056.93	0.38
1	15400	Qcap	46410.00	1505.11	1520.08	1516.25	1522.10	0.015647	11.38	4078.46	454.90	0.57
1	15200	Qcap	46410.00	1504.00	1517.27		1518.94	0.014879	10.37	4473.96	409.22	0.55
1	15000	Qcap	46410.00	1502.00	1515.28		1516.37	0.009911	8.37	5542.75	518.73	0.45
1	14800	Qcap	46410.00	1501.00	1512.95		1514.07	0.013428	8.50	5462.98	632.56	0.51
1	14600	Qcap	46410.00	1499.00	1510.64	1506.90	1511.57	0.011116	7.74	5995.11	686.90	0.46
1	14400	Qcap	46410.00	1497.66	1508.05		1509.13	0.013371	8.33	5574.59	660.14	0.50
1	14200	Qcap	46410.00	1495.00	1505.68		1506.60	0.011516	7.67	6048.78	722.97	0.47
1	14000	Qcap	46410.00	1493.00	1503.71		1504.47	0.009438	7.01	6624.69	784.16	0.42
1	13800	Qcap	46410.00	1491.00	1501.89		1502.61	0.009102	6.82	6802.89	817.51	0.42
1	13600	Qcap	46410.00	1488.46	1500.32		1500.94	0.007415	6.34	7319.76	842.11	0.38
1	13400	Qcap	46410.00	1486.00	1498.81		1499.43	0.007677	6.31	7355.59	874.36	0.38
1	13200	Qcap	46410.00	1484.00	1497.36		1497.94	0.007084	6.14	7556.98	879.88	0.37
1	13050	Qcap	46430.00	1482.00	1494.66	1491.23	1495.64	0.011921	7.96	5832.97	677.75	0.48
1	12985		Bridge									
1	12920	Qcap	46430.00	1482.00	1493.18		1494.28	0.014045	8.40	5529.74	671.03	0.52
1	12600	Qcap	46430.00	1478.00	1490.33	1486.70	1491.11	0.009931	7.10	6539.46	806.65	0.43
1	12400	Qcap	46430.00	1476.00	1488.35		1489.13	0.009877	7.09	6548.48	787.51	0.43
1	12200	Qcap	46430.00	1474.59	1486.28		1487.10	0.010368	7.28	6375.90	765.76	0.44
1	12000	Qcap	46430.00	1472.00	1484.24	1480.53	1485.06	0.010031	7.29	6371.71	744.49	0.44
1	11800	Qcap	46430.00	1470.93	1482.07		1482.96	0.010972	7.57	6135.90	725.33	0.46
1	11600	Qcap	46430.00	1468.00	1480.21		1480.95	0.008855	6.92	6712.83	770.18	0.41
1	11400	Qcap	46430.00	1466.00	1478.55		1479.29	0.007790	6.89	6747.70	737.45	0.39
1	11200	Qcap	46430.00	1465.00	1476.57		1477.51	0.009995	7.78	6025.89	737.63	0.45
1	11000	Qcap	46430.00	1463.00	1474.82		1475.62	0.008587	7.19	6478.76	729.92	0.41
1	10800	Qcap	46430.00	1461.11	1473.15		1473.94	0.008183	7.16	6491.43	719.91	0.40
1	10600	Qcap	46430.00	1458.00	1471.68	1466.35	1472.44	0.006841	6.97	6664.13	674.09	0.38
1	10400	Qcap	46430.00	1456.00	1470.05	1464.96	1470.96	0.007916	7.63	6096.10	601.62	0.41
1	10200	Qcap	46430.00	1451.00	1468.20	1461.45	1468.66	0.003763	5.52	8622.20	791.94	0.28
1	10100		Bridge									
1	10000	Qcap	46430.00	1448.00	1467.01	1458.82	1467.45	0.003002	5.43	8844.54	741.83	0.26

Appendix 4.3

Appendix 4.4

Appendix 4.4

Table A4.4: Vista Canyon Ranch Existing and Proposed Conditions HEC-RAS Velocity & WSE, n=0.025

Subreach	Section	Existing (Qcap)		Proposed (Qcap)	
		Velocity (fps)	WSE (ft)	Velocity (fps)	WSE (ft)
6	18000	10.6	1536.7	10.6	1536.7
	17800	14.3	1534.1	14.3	1534.1
	17600	13.8	1533.8	13.8	1533.8
	17400	13.4	1533.4	13.4	1533.4
	17200	14.2	1532.6	14.2	1532.6
	17000	12.9	1529.7	12.9	1529.7
5	16800	13.2	1526.5	13.2	1526.5
	16600	12.5	1523.7	12.5	1523.7
	16400	12.4	1521.5	12.4	1521.5
	16200	10.4	1520.8	10.5	1520.8
	16000	9.1	1520.6	9.2	1520.6
	15800	8.0	1520.6	8.0	1520.6
4	15600	11.1	1519.3	11.2	1519.3
	15400	16.6	1516.3	16.5	1516.3
	15200	15.6	1513.6	15.7	1513.5
	15000	14.2	1510.6	14.4	1510.7
	14800	11.8	1509.2	13.7	1509.5
	14600	11.9	1506.6	13.2	1507.0
3	14400	10.6	1504.2	13.3	1504.8
	14200	10.4	1502.2	12.9	1502.3
	14000	10.2	1500.1	12.6	1499.9
	13800	10.2	1498.3	12.3	1498.1
	13600	9.7	1495.7	12.2	1496.1
2	13400	9.4	1494.1	12.1	1494.7
	13200	9.8	1492.0	12.1	1493.1
	13050	10.1	1489.3	10.7	1492.5
	12920	10.2	1488.3	13.2	1490.2
	12600	10.4	1485.8	12.5	1486.7
	12400	10.3	1483.5	12.6	1484.6
	12200	10.4	1481.5	12.6	1482.7
	12000	11.6	1479.7	12.7	1480.6
	11800	12.0	1477.5	12.9	1478.6
1	11600	12.4	1475.9	12.6	1476.2
	11400	13.1	1473.9	13.1	1473.9
	11200	13.6	1472.4	13.6	1472.4
	11000	13.2	1470.5	13.2	1470.5
	10800	13.3	1468.6	13.3	1468.6
	10600	13.6	1466.4	13.6	1466.4
	10400	14.1	1465.0	14.1	1465.0
	10200	10.4	1462.8	10.4	1462.8
	10000	11.6	1459.9	11.6	1459.9

PACE
Advanced Water Engineering

Appendix 5.0

FIGURE
B1

2005 Base Map Shown for Reference
Original Scale 1:24,000, Contour Interval 25 ft

ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

1929 6-Minute Humphreys Quadrangle
Surveyed 1929; Published 1932

Date: 4/21/08		Job No.: 08-2267	
Scale: 1" = 500'		CAD File: 1929 Topo	
PLATE T29	Geology by: N/A	Revised:	
	Drawn by: N/A		

DATUM – USC & GS 1955 ADJ.
COORDINATES LAMBERT TOPOGRAPHY AERIAL
CONTOUR INTERVAL 2 FT
C.I. 62 CALC. BOOK S 244 – 21
FIELD BOOK F C. 2031

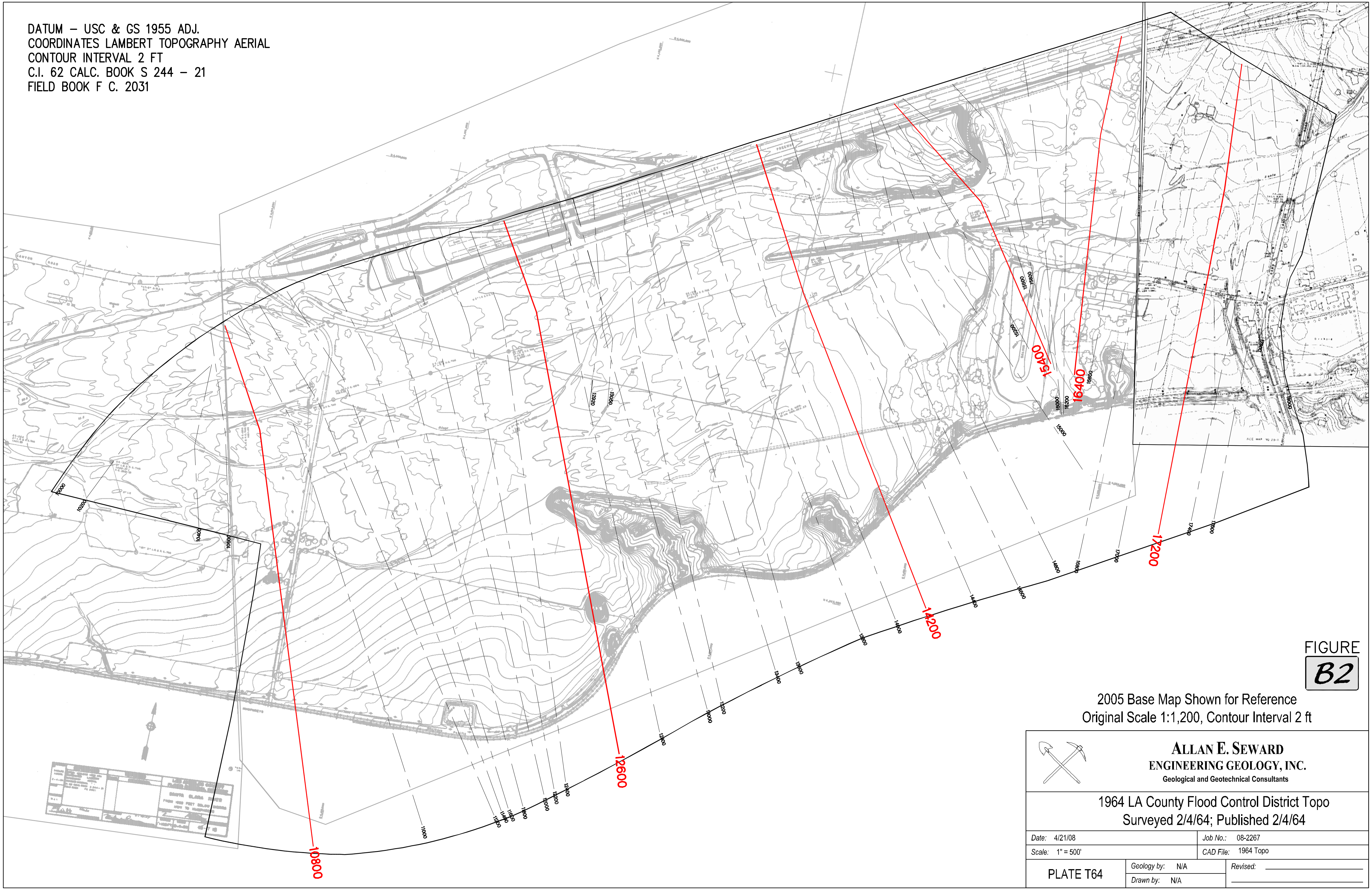


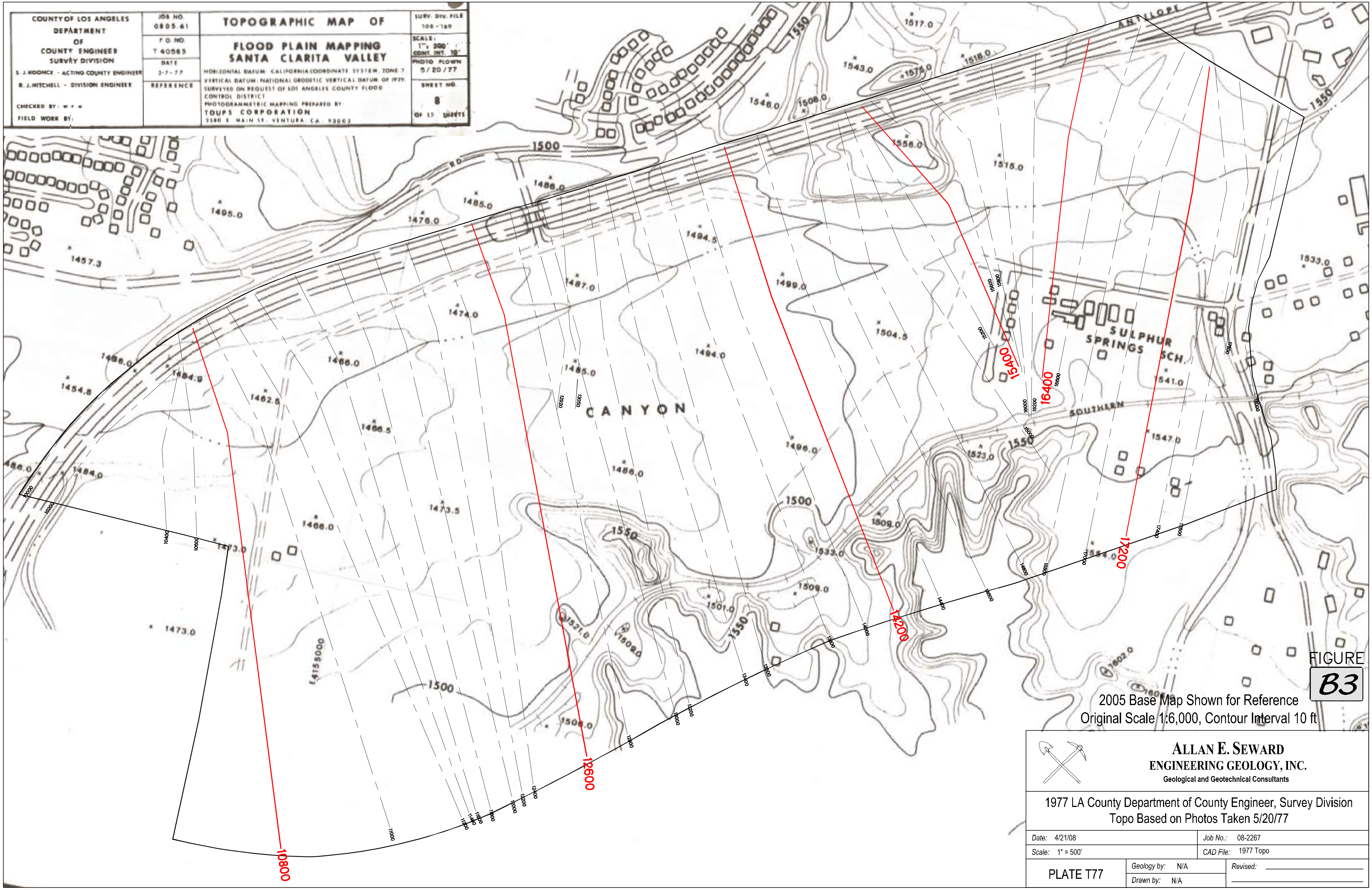
FIGURE
B2

2005 Base Map Shown for Reference
Original Scale 1:1,200, Contour Interval 2 ft

ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

1964 LA County Flood Control District Topo
Surveyed 2/4/64; Published 2/4/64

Date: 4/21/08		Job No.: 08-2267	
Scale: 1" = 500'		CAD File: 1964 Topo	
PLATE T64	Geology by: N/A Drawn by: N/A	Revised:	



COUNTY OF LOS ANGELES DEPARTMENT OF COUNTY ENGINEER SURVEY DIVISION	JOB NO. 0805.61	TOPOGRAPHIC MAP OF	SURV. DIV. FILE 108-189
S. J. KOONCE - ACTING COUNTY ENGINEER	P. O. NO. T 40563	FLOOD PLAIN MAPPING SANTA CLARITA VALLEY	SCALE: 1" = 500' CONT. INT. 10'
R. J. MITCHELL - DIVISION ENGINEER	DATE 3-7-77	HORIZONTAL DATUM: CALIFORNIA COORDINATE SYSTEM, ZONE 7. VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929. SURVEYED ON REQUEST OF LOS ANGELES COUNTY FLOOD CONTROL DISTRICT	PHOTO FLOWN 5/20/77
CHECKED BY: W F M FIELD WORK BY:	REFERENCE	PHOTOGRAMMETRIC MAPPING PREPARED BY TOUPS CORPORATION 2580 E. MAIN ST. VENTURA, CA. 93003	SHEET NO. 8 OF 15 SHEETS

FIGURE
B3

2005 Base Map Shown for Reference
Original Scale 1:6,000, Contour Interval 10 ft

ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

1977 LA County Department of County Engineer, Survey Division
Topo Based on Photos Taken 5/20/77

Date: 4/21/08		Job No.: 08-2267	
Scale: 1" = 500'		CAD File: 1977 Topo	
PLATE T77	Geology by: N/A Drawn by: N/A	Revised:	

SURVEY INFORMATION:
BOUNDARY NOTE:
NO BOUNDARY SURVEY WAS PERFORMED
BOUNDARY POSITIONED GRAPHICALLY
BENCHMARK:
DATUM..1995
ELEV. 1586.011
DESCRIPTION....CS MON IN WELL 250MM DN @ PI 600MM EAST OF CENTERLINE SAND CANYON ROAD AND 161M NORTH OF LIVE OAK SPRINGS CANYON ROAD 8.2M NORTHEAST OF POWER POLE #1155006E MKD (PI 24)

TOPOGRAPHY:
CONTOURS ARE BASED ON AN AERIAL PHOTOGRAMETRIC SURVEY PERFORMED BY HOVELL AND PILARSKI ENGINEERING, INC. AND C AND C AERIAL MAPPING CORP. ON
DECEMBER 2005

ASSESSOR'S PARCEL NUMBERS:
2840-005-057, 2840-005-058, 2840-004-017, 2840-004-036

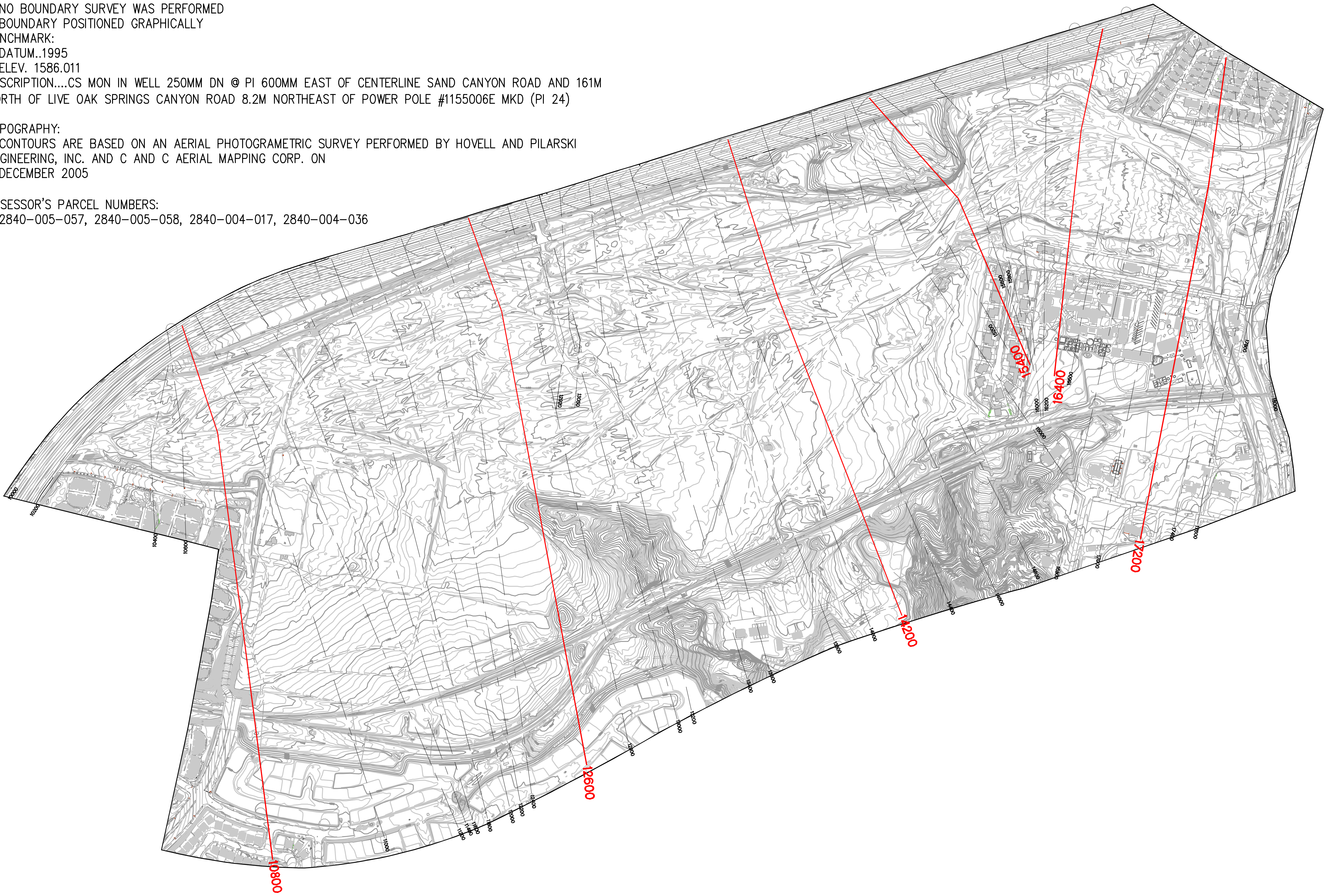


FIGURE
B5

REFERENCES

VERTICAL DATUM
L.A. CO. RD. DEPT. 1978 ADJ.

HORIZONTAL DATUM
LAMBERT - ZONE 7

CALC. BOOK
S-244-33

FIELD BOOK
F.C. 3217

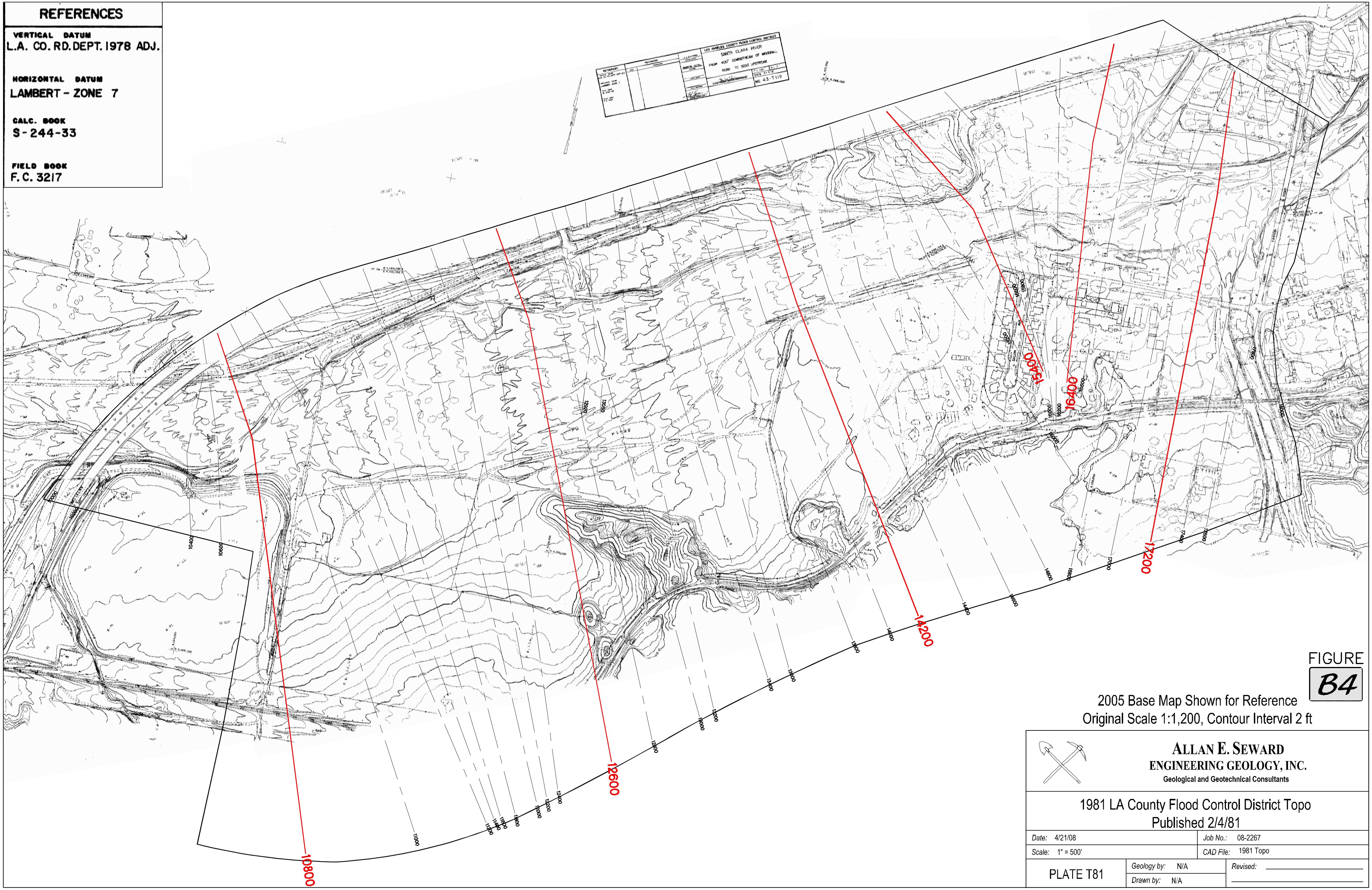


FIGURE
B4

2005 Base Map Shown for Reference
Original Scale 1:1,200, Contour Interval 2 ft

ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

1981 LA County Flood Control District Topo
Published 2/4/81

Date: 4/21/08	Job No.: 08-2267
Scale: 1" = 500'	CAD File: 1981 Topo
PLATE T81	Geology by: N/A Drawn by: N/A
	Revised:

PACE
Advanced Water Engineering

Appendix 6.1

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM n=0.025, STRAIGHT PROPOSED CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}=
18000	**10.0**	7.8	10.6	10.7	2.0	2.3	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**25.7**	25.7	14.3	9.1	2.0	3.6	0.9	4.0	1	0.0	0	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	10.0	13.8	9.8	2.0	3.4	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	9.7	13.4	10.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.3**	10.3	14.2	11.6	2.0	3.6	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	9.3	12.9	9.7	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**10.9**	10.9	13.2	7.5	3.4	3.2	0	0.0	1	0.0	0	0.0	0	5.3	0.005	667.7	0	0.0	2.0	2.3	10
16600	**10.5**	10.5	12.5	6.7	3.4	2.9	0	0.0	1	0.0	0	0.0	0	4.9	0.005	763.2	0	0.0	2.0	2.1	10
16400	**10.4**	10.4	12.4	6.5	3.4	2.9	0	0.0	1	0.0	0	0.0	0	4.7	0.006	790.4	0	0.0	2.0	2.1	10
16200	**10.0**	9.1	10.5	8.5	3.4	2.2	0	0.0	1	0.0	0	0.0	0	6.4	0.003	694.8	0	0.0	2.0	1.5	10
16000	**8.4**	8.4	9.2	10.2	3.4	1.8	0	0.0	1	0.0	0	0.0	0	6.9	0.002	736.6	0	0.0	2.0	1.1	8
15800	**8.0**	7.8	8.0	12.1	3.4	1.5	0	0.0	1	0.0	0	0.0	0	9.3	0.001	627.9	0	0.0	2.0	0.9	8
15600	**10.0**	9.2	11.2	12.3	3.1	2.5	0	0.0	1	0.0	0	0.0	0	10.4	0.002	400.1	0	0.0	2.0	1.7	10
15400	**13.3**	13.3	16.5	11.1	3.1	4.5	0	0.0	1	0.0	0	0.0	0	8.5	0.005	328.8	0	0.0	2.0	3.7	13
15200	**12.6**	12.6	15.7	9.5	3.1	4.2	0	0.0	1	0.0	0	0.0	0	7.5	0.005	395.0	0	0.0	2.0	3.3	13
15000	**11.6**	11.6	14.4	8.7	3.1	3.7	0	0.0	1	0.0	0	0.0	0	6.4	0.005	499.5	0	0.0	2.0	2.8	10
14800	**11.0**	11.0	13.7	8.5	3.1	3.4	0	0.0	1	0.0	0	0.0	0	5.8	0.005	578.7	0	0.0	2.0	2.5	10
14600	**10.7**	10.7	13.2	8.0	3.1	3.2	0	0.0	1	0.0	0	0.0	0	5.5	0.005	640.3	0	0.0	2.0	2.4	10
14400	**10.0**	9.6	13.3	7.2	2.0	3.2	0	0.0	1	0.0	0	0.0	0	5.4	0.005	640.2	0	0.0	2.0	2.4	10
14200	**10.0**	9.3	12.9	7.3	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.2	0.005	700.6	0	0.0	2.0	2.2	10
14000	**10.0**	9.1	12.6	6.9	2.0	2.9	0	0.0	1	0.0	0	0.0	0	4.9	0.005	761.6	0	0.0	2.0	2.1	10
13800	**10.0**	8.9	12.3	7.1	2.0	2.9	0	0.0	1	0.0	0	0.0	0	4.7	0.005	795.0	0	0.0	2.0	2.1	10
13600	**10.0**	8.9	12.2	7.6	2.0	2.8	0	0.0	1	0.0	0	0.0	0	4.6	0.005	816.5	0	0.0	2.0	2.0	10
13400	**10.0**	8.8	12.1	8.7	2.0	2.8	0	0.0	1	0.0	0	0.0	0	4.5	0.006	850.0	0	0.0	2.0	2.0	10
13200	**10.0**	8.8	12.1	9.1	2.0	2.8	0	0.0	1	0.0	0	0.0	0	4.5	0.006	854.5	0	0.0	2.0	2.0	10
13050	**10.0**	7.8	10.7	10.5	2.0	2.3	0	0.0	1	0.0	0	0.0	0	6.5	0.003	669.2	0	0.0	2.0	1.5	10
12920	**24.1**	24.1	13.2	8.2	2.0	3.2	0.9	4.0	1	0.0	0	14.5	0	5.3	0.005	661.5	0	0.0	2.0	2.3	10
12600	**10.0**	9.0	12.5	8.7	2.0	2.9	0	0.0	1	0.0	0	0.0	0	4.9	0.005	765.3	0	0.0	2.0	2.1	10
12400	**10.0**	9.1	12.6	8.6	2.0	3.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	754.4	0	0.0	2.0	2.1	10
12200	**10.0**	9.1	12.6	8.1	2.0	3.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	744.5	0	0.0	2.0	2.2	10
12000	**10.0**	9.2	12.7	8.6	2.0	3.0	0	0.0	1	0.0	0	0.0	0	5.1	0.005	723.0	0	0.0	2.0	2.2	10
11800	**10.0**	9.3	12.9	7.6	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.1	0.005	703.8	0	0.0	2.0	2.2	10
11600	**10.0**	9.1	12.6	8.2	2.0	3.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	746.2	0	0.0	2.0	2.2	10
11400	**10.0**	9.4	13.1	7.9	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.3	0.005	672.9	0	0.0	2.0	2.3	10
11200	**10.0**	9.9	13.6	7.4	2.0	3.4	0	0.0	1	0.0	0	0.0	0	5.7	0.005	597.4	0	0.0	2.0	2.5	10
11000	**10.0**	9.5	13.2	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	0	5.3	0.005	660.6	0	0.0	2.0	2.3	10
10800	**10.0**	9.6	13.3	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	0	5.4	0.005	644.2	0	0.0	2.0	2.4	10
10600	**10.0**	9.9	13.6	8.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	588.2	0	0.0	2.0	2.5	10
10400	**10.2**	10.2	14.1	9.0	2.0	3.5	0	0.0	1	0.0	0	0.0	0	6.2	0.005	537.3	0	0.0	2.0	2.7	10
10200	**10.0**	7.7	10.4	11.8	2.0	2.2	0	0.0	1	0.0	0	0.0	0	6.2	0.002	725.7	0	0.0	2.0	1.5	10
10000	**22.9**	22.9	11.6	11.9	2.0	2.6	0.9	4.0	1	0.0	0	14.5	0	6.6	0.003	607.5	0	0.0	2.0	1.8	10
MAXIMUM=		25.7			3.4	4.5						15.3						0.0		3.7	13
MINIMUM=		7.7			2.0	1.5						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_{I}=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM n=0.025, STRAIGHT/INSIDE CURVE EXISTING CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}=
18000	**10.0**	7.8	10.6	10.7	2.0	2.3	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**25.7**	25.7	14.3	9.1	2.0	3.6	0.9	4.0	1	0.0	1	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	10.0	13.8	9.8	2.0	3.4	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	9.7	13.4	10.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.3**	10.3	14.2	11.6	2.0	3.6	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	9.3	12.9	9.7	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**10.9**	10.9	13.2	7.5	3.4	3.2	0	0.0	1	0.0	0	0.0	0	5.3	0.005	667.7	0	0.0	2.0	2.3	10
16600	**10.5**	10.5	12.5	6.7	3.4	2.9	0	0.0	1	0.0	0	0.0	0	4.9	0.005	763.2	0	0.0	2.0	2.1	10
16400	**10.4**	10.4	12.4	6.5	3.4	2.9	0	0.0	1	0.0	0	0.0	0	4.7	0.006	790.4	0	0.0	2.0	2.1	10
16200	**10.0**	9.1	10.4	8.6	3.4	2.2	0	0.0	1	0.0	0	0.0	0	6.4	0.003	694.8	0	0.0	2.0	1.5	10
16000	**8.4**	8.4	9.1	10.2	3.4	1.8	0	0.0	1	0.0	0	0.0	0	6.9	0.002	736.8	0	0.0	2.0	1.1	8
15800	**8.0**	7.7	8.0	11.9	3.4	1.5	0	0.0	1	0.0	0	0.0	0	9.3	0.001	908.9	0	0.0	2.0	0.9	8
15600	**10.0**	9.2	11.1	12.3	3.1	2.4	0	0.0	1	0.0	0	0.0	0	10.5	0.002	593.7	0	0.0	2.0	1.7	10
15400	**13.4**	13.4	16.6	11.1	3.1	4.6	0	0.0	1	0.0	0	0.0	0	8.5	0.005	462.8	0	0.0	2.0	3.7	13
15200	**12.5**	12.5	15.6	9.6	3.1	4.1	0	0.0	1	0.0	0	0.0	0	7.6	0.005	395.0	0	0.0	2.0	3.3	13
15000	**11.4**	11.4	14.2	8.6	3.1	3.6	0	0.0	1	0.0	0	0.0	0	6.2	0.005	527.2	0	0.0	2.0	2.7	10
14800	**10.0**	9.7	11.8	8.2	3.1	2.7	0	0.0	1	0.0	0	0.0	0	4.3	0.006	908.4	0	0.0	2.0	1.9	10
14600	**10.0**	9.7	11.9	7.6	3.1	2.7	0	0.0	1	0.0	0	0.0	0	4.4	0.006	891.2	0	0.0	2.0	1.9	10
14400	**10.0**	7.8	10.6	6.5	2.0	2.3	0	0.0	1	0.0	0	0.0	0	3.5	0.006	1297.9	0	0.0	2.0	1.5	10
14200	**10.0**	7.7	10.4	7.2	2.0	2.2	0	0.0	1	0.0	0	0.0	0	3.1	0.004	1712.0	0	0.0	2.0	1.5	10
14000	**10.0**	7.6	10.2	7.1	2.0	2.1	0	0.0	1	0.0	0	0.0	0	2.9	0.004	1763.5	0	0.0	2.0	1.4	10
13800	**10.0**	7.5	10.2	7.3	2.0	2.1	0	0.0	1	0.0	0	0.0	0	2.9	0.004	1776.1	0	0.0	2.0	1.4	10
13600	**8.0**	7.2	9.7	7.2	2.0	2.0	0	0.0	1	0.0	0	0.0	0	2.9	0.006	1657.3	0	0.0	2.0	1.3	8
13400	**8.0**	7.1	9.4	8.1	2.0	1.9	0	0.0	1	0.0	0	0.0	0	2.8	0.007	1784.8	0	0.0	2.0	1.2	8
13200	**8.0**	7.3	9.8	8.0	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.0	0.006	1586.4	0	0.0	2.0	1.3	8
13050	**10.0**	7.5	10.1	7.3	2.0	2.1	0	0.0	1	0.0	0	0.0	0	3.2	0.006	1437.4	0	0.0	2.0	1.4	10
12920	**10.0**	7.6	10.2	6.3	2.0	2.2	0	0.0	1	0.0	0	0.0	0	3.2	0.006	1415.5	0	0.0	2.0	1.4	10
12600	**10.0**	7.7	10.4	7.8	2.0	2.2	0	0.0	1	0.0	0	0.0	0	3.4	0.006	1318.3	0	0.0	2.0	1.5	10
12400	**10.0**	7.6	10.3	7.5	2.0	2.2	0	0.0	1	0.0	0	0.0	0	3.3	0.006	1403.8	0	0.0	2.0	1.4	10
12200	**10.0**	7.7	10.4	6.9	2.0	2.2	0	0.0	1	0.0	0	0.0	0	3.3	0.006	1341.6	0	0.0	2.0	1.5	10
12000	**10.0**	8.4	11.6	7.7	2.0	2.6	0	0.0	1	0.0	0	0.0	0	4.2	0.006	950.5	0	0.0	2.0	1.8	10
11800	**10.0**	8.7	12.0	7.5	2.0	2.8	0	0.0	1	0.0	0	0.0	0	4.5	0.006	868.1	0	0.0	2.0	2.0	10
11600	**10.0**	9.0	12.4	7.9	2.0	2.9	0	0.0	1	0.0	0	0.0	0	4.7	0.006	788.8	0	0.0	2.0	2.1	10
11400	**10.0**	9.4	13.1	7.9	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.3	0.005	672.9	0	0.0	2.0	2.3	10
11200	**10.0**	9.9	13.6	7.4	2.0	3.4	0	0.0	1	0.0	0	0.0	0	5.7	0.005	598.9	0	0.0	2.0	2.5	10
11000	**10.0**	9.6	13.2	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	0	5.4	0.005	799.5	0	0.0	2.0	2.4	10
10800	**10.0**	9.6	13.3	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	0	5.4	0.005	644.2	0	0.0	2.0	2.4	10
10600	**10.0**	9.9	13.6	8.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	588.2	0	0.0	2.0	2.5	10
10400	**10.2**	10.2	14.1	9.0	2.0	3.5	0	0.0	1	0.0	0	0.0	0	6.2	0.005	537.3	0	0.0	2.0	2.7	10
10200	**10.0**	7.7	10.4	11.8	2.0	2.2	0	0.0	1	0.0	0	0.0	0	6.2	0.002	725.6	0	0.0	2.0	1.5	10
10000	**22.9**	22.9	11.6	11.9	2.0	2.6	0.9	4.0	1	0.0	1	14.5	0	6.6	0.003	607.5	0	0.0	2.0	1.8	10
MAXIMUM=	25.7	25.7			3.4	4.6						15.3						0.0		3.7	13
MINIMUM=	8.0	7.1			2.0	1.5						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_I=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM n=0.025, CURVED PROPOSED CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}=
18000	**10.0**	7.8	10.6	10.7	2.0	2.3	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**25.7**	25.7	14.3	9.1	2.0	3.6	0.9	4.0	1	0.0	0	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	10.0	13.8	9.8	2.0	3.4	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	9.7	13.4	10.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.3**	10.3	14.2	11.6	2.0	3.6	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	9.3	12.9	9.7	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**15.0**	13.5	13.2	7.5	3.4	3.2	0	0.0	1	0.0	0	0.0	1	5.3	0.005	667.7	2090	2.6	2.0	2.3	15
16600	**15.0**	13.1	12.5	6.7	3.4	2.9	0	0.0	1	0.0	0	0.0	1	4.9	0.005	763.2	2090	2.6	2.0	2.1	15
16400	**15.0**	13.0	12.4	6.5	3.4	2.9	0	0.0	1	0.0	0	0.0	1	4.7	0.006	790.4	2090	2.6	2.0	2.1	15
16200	**15.0**	12.1	10.5	8.5	3.4	2.2	0	0.0	1	0.0	0	0.0	1	6.4	0.003	694.8	2090	3.0	2.0	1.5	15
16000	**12.0**	12.0	9.2	10.2	3.4	1.8	0	0.0	1	0.0	0	0.0	1	6.9	0.002	736.6	2090	3.7	2.0	1.1	12
15800	**12.0**	11.4	8.0	12.1	3.4	1.5	0	0.0	1	0.0	0	0.0	1	9.3	0.001	627.9	2090	3.6	2.0	0.9	12
15600	**15.0**	11.5	11.2	12.3	3.1	2.5	0	0.0	1	0.0	0	0.0	1	10.4	0.002	400.1	2090	2.2	2.0	1.7	15
15400	**18.0**	14.8	16.5	11.1	3.1	4.5	0	0.0	1	0.0	0	0.0	1	8.5	0.005	328.8	2090	1.5	2.0	3.7	18
15200	**18.0**	14.4	15.7	9.5	3.1	4.2	0	0.0	1	0.0	0	0.0	1	7.5	0.005	395.0	2090	1.8	2.0	3.3	18
15000	**11.6**	11.6	14.4	8.7	3.1	3.7	0	0.0	1	0.0	0	0.0	1	6.4	0.005	499.5	37350	0.0	2.0	2.8	10
14800	**11.0**	11.0	13.7	8.5	3.1	3.4	0	0.0	1	0.0	0	0.0	1	5.8	0.005	578.7	37350	0.0	2.0	2.5	10
14600	**10.7**	10.7	13.2	8.0	3.1	3.2	0	0.0	1	0.0	0	0.0	1	5.5	0.005	640.3	37350	0.0	2.0	2.4	10
14400	**10.0**	9.6	13.3	7.2	2.0	3.2	0	0.0	1	0.0	0	0.0	1	5.4	0.005	640.2	37350	0.0	2.0	2.4	10
14200	**10.0**	9.3	12.9	7.3	2.0	3.1	0	0.0	1	0.0	0	0.0	1	5.2	0.005	700.6	37350	0.0	2.0	2.2	10
14000	**10.0**	9.1	12.6	6.9	2.0	2.9	0	0.0	1	0.0	0	0.0	1	4.9	0.005	761.6	37350	0.0	2.0	2.1	10
13800	**10.0**	8.9	12.3	7.1	2.0	2.9	0	0.0	1	0.0	0	0.0	1	4.7	0.005	795.0	37350	0.0	2.0	2.1	10
13600	**10.0**	8.9	12.2	7.6	2.0	2.8	0	0.0	1	0.0	0	0.0	1	4.6	0.005	816.5	37350	0.0	2.0	2.0	10
13400	**10.0**	8.8	12.1	8.7	2.0	2.8	0	0.0	1	0.0	0	0.0	1	4.5	0.006	850.0	37350	0.0	2.0	2.0	10
13200	**10.0**	8.8	12.1	9.1	2.0	2.8	0	0.0	1	0.0	0	0.0	1	4.5	0.006	854.5	37350	0.0	2.0	2.0	10
13050	**10.0**	7.8	10.7	10.5	2.0	2.3	0	0.0	1	0.0	0	0.0	1	6.5	0.003	669.2	37350	0.0	2.0	1.5	10
12920	**24.1**	24.1	13.2	8.2	2.0	3.2	0.9	4.0	1	0.0	0	14.5	1	5.3	0.005	661.5	37350	0.0	2.0	2.3	10
12600	**10.0**	9.0	12.5	8.7	2.0	2.9	0	0.0	1	0.0	0	0.0	1	4.9	0.005	765.3	37350	0.0	2.0	2.1	10
12400	**10.0**	9.1	12.6	8.6	2.0	3.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	754.4	37350	0.0	2.0	2.1	10
12200	**10.0**	9.1	12.6	8.1	2.0	3.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	744.5	37350	0.0	2.0	2.2	10
12000	**10.0**	9.2	12.7	8.6	2.0	3.0	0	0.0	1	0.0	0	0.0	1	5.1	0.005	723.0	37350	0.0	2.0	2.2	10
11800	**10.0**	9.3	12.9	7.6	2.0	3.1	0	0.0	1	0.0	0	0.0	1	5.1	0.005	703.8	37350	0.0	2.0	2.2	10
11600	**15.0**	10.9	12.6	8.2	2.0	3.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	746.2	3605	1.7	2.0	2.2	15
11400	**15.0**	10.9	13.1	7.9	2.0	3.1	0	0.0	1	0.0	0	0.0	1	5.3	0.005	672.9	3605	1.4	2.0	2.3	15
11200	**15.0**	11.0	13.6	7.4	2.0	3.4	0	0.0	1	0.0	0	0.0	1	5.7	0.005	597.4	3605	1.1	2.0	2.5	15
11000	**15.0**	10.8	13.2	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	1	5.3	0.005	660.6	3605	1.3	2.0	2.3	15
10800	**15.0**	10.9	13.3	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	1	5.4	0.005	644.2	3605	1.3	2.0	2.4	15
10600	**15.0**	11.0	13.6	8.3	2.0	3.3	0	0.0	1	0.0	0	0.0	1	5.8	0.005	588.2	3605	1.2	2.0	2.5	15
10400	**15.0**	11.2	14.1	9.0	2.0	3.5	0	0.0	1	0.0	0	0.0	1	6.2	0.005	537.3	3605	1.0	2.0	2.7	15
10200	**15.0**	10.1	10.4	11.8	2.0	2.2	0	0.0	1	0.0	0	0.0	1	6.2	0.002	725.7	3605	2.4	2.0	1.5	15
10000	**24.7**	24.7	11.6	11.9	2.0	2.6	0.9	4.0	1	0.0	0	14.5	1	6.6	0.003	607.5	3605	1.8	2.0	1.8	15
MAXIMUM=		25.7			3.4	4.5						15.3						3.7		3.7	18
MINIMUM=		7.8			2.0	1.5						0.0						0.0		0.9	10

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
  1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
  0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
  0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_{I}=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM n=0.025, CURVED EXISTING CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}=
18000	**10.0**	7.8	10.6	10.7	2.0	2.3	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**25.7**	25.7	14.3	9.1	2.0	3.6	0.9	4.0	1	0.0	1	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	10.0	13.8	9.8	2.0	3.4	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	9.7	13.4	10.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.3**	10.3	14.2	11.6	2.0	3.6	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	9.3	12.9	9.7	2.0	3.1	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**15.0**	13.5	13.2	7.5	3.4	3.2	0	0.0	1	0.0	0	0.0	1	5.3	0.005	667.7	2090	2.6	2.0	2.3	15
16600	**15.0**	13.1	12.5	6.7	3.4	2.9	0	0.0	1	0.0	0	0.0	1	4.9	0.005	763.2	2090	2.6	2.0	2.1	15
16400	**15.0**	13.0	12.4	6.5	3.4	2.9	0	0.0	1	0.0	0	0.0	1	4.7	0.006	790.4	2090	2.6	2.0	2.1	15
16200	**15.0**	12.1	10.4	8.6	3.4	2.2	0	0.0	1	0.0	0	0.0	1	6.4	0.003	694.8	2090	3.0	2.0	1.5	15
16000	**12.0**	12.0	9.1	10.2	3.4	1.8	0	0.0	1	0.0	0	0.0	1	6.9	0.002	736.8	2090	3.7	2.0	1.1	12
15800	**12.7**	12.7	8.0	11.9	3.4	1.5	0	0.0	1	0.0	0	0.0	1	9.3	0.001	908.9	2090	5.0	2.0	0.9	12
15600	**15.0**	12.9	11.1	12.3	3.1	2.4	0	0.0	1	0.0	0	0.0	1	10.5	0.002	593.7	2090	3.7	2.0	1.7	15
15400	**18.0**	16.1	16.6	11.1	3.1	4.6	0	0.0	1	0.0	0	0.0	1	8.5	0.005	462.8	2090	2.7	2.0	3.7	18
15200	**18.0**	14.3	15.6	9.6	3.1	4.1	0	0.0	1	0.0	0	0.0	1	7.6	0.005	395.0	2090	1.8	2.0	3.3	18
15000	**11.4**	11.4	14.2	8.6	3.1	3.6	0	0.0	1	0.0	0	0.0	1	6.2	0.005	527.2	37350	0.0	2.0	2.7	10
14800	**10.0**	9.7	11.8	8.2	3.1	2.7	0	0.0	1	0.0	0	0.0	1	4.3	0.006	908.4	37350	0.0	2.0	1.9	10
14600	**10.0**	9.7	11.9	7.6	3.1	2.7	0	0.0	1	0.0	0	0.0	1	4.4	0.006	891.2	37350	0.0	2.0	1.9	10
14400	**10.0**	7.8	10.6	6.5	2.0	2.3	0	0.0	1	0.0	0	0.0	1	3.5	0.006	1297.9	37350	0.0	2.0	1.5	10
14200	**10.0**	7.7	10.4	7.2	2.0	2.2	0	0.0	1	0.0	0	0.0	1	3.1	0.004	1712.0	37350	0.0	2.0	1.5	10
14000	**10.0**	7.6	10.2	7.1	2.0	2.1	0	0.0	1	0.0	0	0.0	1	2.9	0.004	1763.5	37350	0.0	2.0	1.4	10
13800	**10.0**	7.5	10.2	7.3	2.0	2.1	0	0.0	1	0.0	0	0.0	1	2.9	0.004	1776.1	37350	0.0	2.0	1.4	10
13600	**8.0**	7.2	9.7	7.2	2.0	2.0	0	0.0	1	0.0	0	0.0	1	2.9	0.006	1657.3	37350	0.0	2.0	1.3	8
13400	**8.0**	7.1	9.4	8.1	2.0	1.9	0	0.0	1	0.0	0	0.0	1	2.8	0.007	1784.8	37350	0.0	2.0	1.2	8
13200	**8.0**	7.3	9.8	8.0	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.0	0.006	1586.4	37350	0.0	2.0	1.3	8
13050	**10.0**	7.5	10.1	7.3	2.0	2.1	0	0.0	1	0.0	0	0.0	1	3.2	0.006	1437.4	37350	0.0	2.0	1.4	10
12920	**10.0**	7.6	10.2	6.3	2.0	2.2	0	0.0	1	0.0	0	0.0	1	3.2	0.006	1415.5	37350	0.0	2.0	1.4	10
12600	**10.0**	7.7	10.4	7.8	2.0	2.2	0	0.0	1	0.0	0	0.0	1	3.4	0.006	1318.3	37350	0.0	2.0	1.5	10
12400	**10.0**	7.6	10.3	7.5	2.0	2.2	0	0.0	1	0.0	0	0.0	1	3.3	0.006	1403.8	37350	0.0	2.0	1.4	10
12200	**10.0**	7.7	10.4	6.9	2.0	2.2	0	0.0	1	0.0	0	0.0	1	3.3	0.006	1341.6	37350	0.0	2.0	1.5	10
12000	**10.0**	8.4	11.6	7.7	2.0	2.6	0	0.0	1	0.0	0	0.0	1	4.2	0.006	950.5	37350	0.0	2.0	1.8	10
11800	**10.0**	8.7	12.0	7.5	2.0	2.8	0	0.0	1	0.0	0	0.0	1	4.5	0.006	868.1	37350	0.0	2.0	2.0	10
11600	**15.0**	10.8	12.4	7.9	2.0	2.9	0	0.0	1	0.0	0	0.0	1	4.7	0.006	788.8	3605	1.8	2.0	2.1	15
11400	**15.0**	10.9	13.1	7.9	2.0	3.1	0	0.0	1	0.0	0	0.0	1	5.3	0.005	672.9	3605	1.4	2.0	2.3	15
11200	**15.0**	11.0	13.6	7.4	2.0	3.4	0	0.0	1	0.0	0	0.0	1	5.7	0.005	598.9	3605	1.1	2.0	2.5	15
11000	**15.0**	11.3	13.2	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	1	5.4	0.005	799.5	3605	1.8	2.0	2.4	15
10800	**15.0**	10.9	13.3	7.5	2.0	3.2	0	0.0	1	0.0	0	0.0	1	5.4	0.005	644.2	3605	1.3	2.0	2.4	15
10600	**15.0**	11.0	13.6	8.3	2.0	3.3	0	0.0	1	0.0	0	0.0	1	5.8	0.005	588.2	3605	1.2	2.0	2.5	15
10400	**15.0**	11.2	14.1	9.0	2.0	3.5	0	0.0	1	0.0	0	0.0	1	6.2	0.005	537.3	3605	1.0	2.0	2.7	15
10200	**15.0**	10.1	10.4	11.8	2.0	2.2	0	0.0	1	0.0	0	0.0	1	6.2	0.002	725.6	3605	2.4	2.0	1.5	15
10000	**24.7**	24.7	11.6	11.9	2.0	2.6	0.9	4.0	1	0.0	1	14.5	1	6.6	0.003	607.5	3605	1.8	2.0	1.8	15
MAXIMUM=	25.7	25.7			3.4	4.6						15.3						5.0		3.7	18
MINIMUM=	8.0	7.1			2.0	1.5						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_I=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS. THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

Appendix 6.2

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM WITH SAM FOR STRAIGHT/INSIDE CURVED REACHES PROPOSED CONDITIONS

SECTION	Z_{MAX} =	Z_{TOT} =	V (FPS)	FLOW DEPTH (FT)	Z_{DEG} +	Z_{GS} +	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS} +	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS} +	Z_{I} +	H/2	Z_{DM} =
18000	**10.0**	6.0	10.6	10.7	2.0	0.5	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**22.6**	22.6	14.3	9.1	2.0	0.5	0.9	4.0	1	0.0	1	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	7.1	13.8	9.8	2.0	0.5	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	6.9	13.4	10.3	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.0**	7.2	14.2	11.6	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	6.7	12.9	9.7	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**10.0**	9.7	13.2	7.5	3.4	2.0	0	0.0	1	0.0	0	0.0	0	5.3	0.005	667.7	0	0.0	2.0	2.3	10
16600	**10.0**	9.5	12.5	6.7	3.4	2.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	763.2	0	0.0	2.0	2.1	10
16400	**10.0**	9.5	12.4	6.5	3.4	2.0	0	0.0	1	0.0	0	0.0	0	4.7	0.006	790.4	0	0.0	2.0	2.1	10
16200	**10.0**	8.9	10.5	8.5	3.4	2.0	0	0.0	1	0.0	0	0.0	0	6.4	0.003	694.8	0	0.0	2.0	1.5	10
16000	**8.5**	8.5	9.2	10.2	3.4	2.0	0	0.0	1	0.0	0	0.0	0	6.9	0.002	736.6	0	0.0	2.0	1.1	8
15800	**8.3**	8.3	8.0	12.1	3.4	2.0	0	0.0	1	0.0	0	0.0	0	9.3	0.001	627.9	0	0.0	2.0	0.9	8
15600	**10.0**	8.3	11.2	12.3	3.1	1.5	0	0.0	1	0.0	0	0.0	0	10.4	0.002	400.1	0	0.0	2.0	1.7	10
15400	**12.5**	10.3	16.5	11.1	3.1	1.5	0	0.0	1	0.0	0	0.0	0	8.5	0.005	328.8	0	0.0	2.0	3.7	12.5
15200	**12.5**	9.9	15.7	9.5	3.1	1.5	0	0.0	1	0.0	0	0.0	0	7.5	0.005	395.0	0	0.0	2.0	3.3	12.5
15000	**10.0**	9.4	14.4	8.7	3.1	1.5	0	0.0	1	0.0	0	0.0	0	6.4	0.005	499.5	0	0.0	2.0	2.8	10
14800	**10.0**	9.1	13.7	8.5	3.1	1.5	0	0.0	1	0.0	0	0.0	0	5.8	0.005	578.7	0	0.0	2.0	2.5	10
14600	**10.0**	9.0	13.2	8.0	3.1	1.5	0	0.0	1	0.0	0	0.0	0	5.5	0.005	640.3	0	0.0	2.0	2.4	10
14400	**10.0**	9.7	13.3	7.2	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.4	0.005	640.2	0	0.0	2.0	2.4	10
14200	**10.0**	9.5	12.9	7.3	2.0	3.3	0	0.0	1	0.0	0	0.0	0	5.2	0.005	700.6	0	0.0	2.0	2.2	10
14000	**10.0**	9.4	12.6	6.9	2.0	3.3	0	0.0	1	0.0	0	0.0	0	4.9	0.005	761.6	0	0.0	2.0	2.1	10
13800	**10.0**	9.4	12.3	7.1	2.0	3.3	0	0.0	1	0.0	0	0.0	0	4.7	0.005	795.0	0	0.0	2.0	2.1	10
13600	**10.0**	9.3	12.2	7.6	2.0	3.3	0	0.0	1	0.0	0	0.0	0	4.6	0.005	816.5	0	0.0	2.0	2.0	10
13400	**10.0**	6.0	12.1	8.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.5	0.006	850.0	0	0.0	2.0	2.0	10
13200	**10.0**	6.0	12.1	9.1	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.5	0.006	854.5	0	0.0	2.0	2.0	10
13050	**10.0**	5.5	10.7	10.5	2.0	0.0	0	0.0	1	0.0	0	0.0	0	6.5	0.003	669.2	0	0.0	2.0	1.5	10
12920	**20.9**	20.9	13.2	8.2	2.0	0.0	0.9	4.0	1	0.0	1	14.5	0	5.3	0.005	661.5	0	0.0	2.0	2.3	10
12600	**10.0**	6.1	12.5	8.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	765.3	0	0.0	2.0	2.1	10
12400	**10.0**	6.1	12.6	8.6	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	754.4	0	0.0	2.0	2.1	10
12200	**10.0**	6.2	12.6	8.1	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	744.5	0	0.0	2.0	2.2	10
12000	**10.0**	6.2	12.7	8.6	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.1	0.005	723.0	0	0.0	2.0	2.2	10
11800	**10.0**	6.2	12.9	7.6	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.1	0.005	703.8	0	0.0	2.0	2.2	10
11600	**10.0**	6.2	12.6	8.2	2.0	0.0	0	0.0	1	0.0	0	0.0	0	4.9	0.005	746.2	0	0.0	2.0	2.2	10
11400	**10.0**	6.3	13.1	7.9	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.3	0.005	672.9	0	0.0	2.0	2.3	10
11200	**10.0**	6.5	13.6	7.4	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.7	0.005	597.4	0	0.0	2.0	2.5	10
11000	**10.0**	6.3	13.2	7.5	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.3	0.005	660.6	0	0.0	2.0	2.3	10
10800	**10.0**	6.4	13.3	7.5	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.4	0.005	644.2	0	0.0	2.0	2.4	10
10600	**10.0**	6.5	13.6	8.3	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.8	0.005	588.2	0	0.0	2.0	2.5	10
10400	**10.0**	6.7	14.1	9.0	2.0	0.0	0	0.0	1	0.0	0	0.0	0	6.2	0.005	537.3	0	0.0	2.0	2.7	10
10200	**10.0**	5.5	10.4	11.8	2.0	0.0	0	0.0	1	0.0	0	0.0	0	6.2	0.002	725.7	0	0.0	2.0	1.5	10
10000	**20.3**	20.3	11.6	11.9	2.0	0.0	0.9	4.0	1	0.0	1	14.5	0	6.6	0.003	607.5	0	0.0	2.0	1.8	10
MAXIMUM=	22.6	22.6			3.4	3.3						15.3						0.0		3.7	13
MINIMUM=	8.3	5.5			2.0	0.0						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND
Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}
Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG}=LONG TERM DEGRADATION IN FEET
Z_{GS}=GENERAL SCOUR IN FEET
Z_{LS}=LOCAL SCOUR IN FEET
PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS
FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET
B=WIDTH OF PIERS IN FEET; NO PIER=0
ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**
A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM
Z_{BS}=BEND SCOUR IN FEET
BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1
HYD DEPTH=HYDRAULIC DEPTH IN FEET
E SLOPE=ENERGY SLOPE, UNITLESS
TOP WIDTH=CHANNEL TOP WIDTH IN FEET
RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_{I}=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)
Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED, OR USER SUPPLIED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM WITH SAM FOR STRAIGHT/INSIDE CURVED REACHES EXISTING CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}=
18000	**10.0**	5.5	10.6	10.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**22.1**	22.1	14.3	9.1	2.0	0.0	0.9	4.0	1	0.0	1	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	6.6	13.8	9.8	2.0	0.0	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	6.4	13.4	10.3	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.0**	6.7	14.2	11.6	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	6.2	12.9	9.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**10.0**	8.9	13.2	7.5	3.4	1.2	0	0.0	1	0.0	0	0.0	0	5.3	0.005	667.7	0	0.0	2.0	2.3	10
16600	**10.0**	8.7	12.5	6.7	3.4	1.2	0	0.0	1	0.0	0	0.0	0	4.9	0.005	763.2	0	0.0	2.0	2.1	10
16400	**10.0**	8.7	12.4	6.5	3.4	1.2	0	0.0	1	0.0	0	0.0	0	4.7	0.006	790.4	0	0.0	2.0	2.1	10
16200	**10.0**	8.1	10.4	8.6	3.4	1.2	0	0.0	1	0.0	0	0.0	0	6.4	0.003	694.8	0	0.0	2.0	1.5	10
16000	**8.0**	7.7	9.1	10.2	3.4	1.2	0	0.0	1	0.0	0	0.0	0	6.9	0.002	736.8	0	0.0	2.0	1.1	8
15800	**8.0**	7.5	8.0	11.9	3.4	1.2	0	0.0	1	0.0	0	0.0	0	9.3	0.001	908.9	0	0.0	2.0	0.9	8
15600	**10.0**	8.1	11.1	12.3	3.1	1.3	0	0.0	1	0.0	0	0.0	0	10.5	0.002	593.7	0	0.0	2.0	1.7	10
15400	**12.5**	10.1	16.6	11.1	3.1	1.3	0	0.0	1	0.0	0	0.0	0	8.5	0.005	462.8	0	0.0	2.0	3.7	13
15200	**12.5**	9.7	15.6	9.6	3.1	1.3	0	0.0	1	0.0	0	0.0	0	7.6	0.005	395.0	0	0.0	2.0	3.3	13
15000	**10.0**	9.1	14.2	8.6	3.1	1.3	0	0.0	1	0.0	0	0.0	0	6.2	0.005	527.2	0	0.0	2.0	2.7	10
14800	**10.0**	8.3	11.8	8.2	3.1	1.3	0	0.0	1	0.0	0	0.0	0	4.3	0.006	908.4	0	0.0	2.0	1.9	10
14600	**10.0**	8.3	11.9	7.6	3.1	1.3	0	0.0	1	0.0	0	0.0	0	4.4	0.006	891.2	0	0.0	2.0	1.9	10
14400	**10.0**	5.5	10.6	6.5	2.0	0.0	0	0.0	1	0.0	0	0.0	0	3.5	0.006	1297.9	0	0.0	2.0	1.5	10
14200	**10.0**	5.5	10.4	7.2	2.0	0.0	0	0.0	1	0.0	0	0.0	0	3.1	0.004	1712.0	0	0.0	2.0	1.5	10
14000	**10.0**	5.4	10.2	7.1	2.0	0.0	0	0.0	1	0.0	0	0.0	0	2.9	0.004	1763.5	0	0.0	2.0	1.4	10
13800	**10.0**	5.4	10.2	7.3	2.0	0.0	0	0.0	1	0.0	0	0.0	0	2.9	0.004	1776.1	0	0.0	2.0	1.4	10
13600	**8.0**	5.3	9.7	7.2	2.0	0.0	0	0.0	1	0.0	0	0.0	0	2.9	0.006	1657.3	0	0.0	2.0	1.3	8
13400	**8.0**	7.2	9.4	8.1	2.0	2.0	0	0.0	1	0.0	0	0.0	0	2.8	0.007	1784.8	0	0.0	2.0	1.2	8
13200	**8.0**	7.3	9.8	8.0	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.0	0.006	1586.4	0	0.0	2.0	1.3	8
13050	**10.0**	7.4	10.1	7.3	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.2	0.006	1437.4	0	0.0	2.0	1.4	10
12920	**10.0**	7.4	10.2	6.3	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.2	0.006	1415.5	0	0.0	2.0	1.4	10
12600	**10.0**	7.5	10.4	7.8	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.4	0.006	1318.3	0	0.0	2.0	1.5	10
12400	**10.0**	7.4	10.3	7.5	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.3	0.006	1403.8	0	0.0	2.0	1.4	10
12200	**10.0**	7.5	10.4	6.9	2.0	2.0	0	0.0	1	0.0	0	0.0	0	3.3	0.006	1341.6	0	0.0	2.0	1.5	10
12000	**10.0**	7.8	11.6	7.7	2.0	2.0	0	0.0	1	0.0	0	0.0	0	4.2	0.006	950.5	0	0.0	2.0	1.8	10
11800	**10.0**	8.0	12.0	7.5	2.0	2.0	0	0.0	1	0.0	0	0.0	0	4.5	0.006	868.1	0	0.0	2.0	2.0	10
11600	**10.0**	6.6	12.4	7.9	2.0	0.5	0	0.0	1	0.0	0	0.0	0	4.7	0.006	788.8	0	0.0	2.0	2.1	10
11400	**10.0**	6.8	13.1	7.9	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.3	0.005	672.9	0	0.0	2.0	2.3	10
11200	**10.0**	7.0	13.6	7.4	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.7	0.005	598.9	0	0.0	2.0	2.5	10
11000	**10.0**	6.9	13.2	7.5	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.4	0.005	799.5	0	0.0	2.0	2.4	10
10800	**10.0**	6.9	13.3	7.5	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.4	0.005	644.2	0	0.0	2.0	2.4	10
10600	**10.0**	7.0	13.6	8.3	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.8	0.005	588.2	0	0.0	2.0	2.5	10
10400	**10.0**	7.2	14.1	9.0	2.0	0.5	0	0.0	1	0.0	0	0.0	0	6.2	0.005	537.3	0	0.0	2.0	2.7	10
10200	**10.0**	6.0	10.4	11.8	2.0	0.5	0	0.0	1	0.0	0	0.0	0	6.2	0.002	725.6	0	0.0	2.0	1.5	10
10000	**20.8**	20.8	11.6	11.9	2.0	0.5	0.9	4.0	1	0.0	1	14.5	0	6.6	0.003	607.5	0	0.0	2.0	1.8	10
MAXIMUM=		22.1			3.4	2.0						15.3						0.0		3.7	13
MINIMUM=		5.3			2.0	0.0						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND
Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}
Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG}=LONG TERM DEGRADATION IN FEET
Z_{GS}=GENERAL SCOUR IN FEET
Z_{LS}=LOCAL SCOUR IN FEET
PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS
FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET
B=WIDTH OF PIERS IN FEET; NO PIER=0
ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**
A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM
Z_{BS}=BEND SCOUR IN FEET
BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1
HYD DEPTH=HYDRAULIC DEPTH IN FEET
E SLOPE=ENERGY SLOPE, UNITLESS
TOP WIDTH=CHANNEL TOP WIDTH IN FEET
RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)
Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS
THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED, OR USER SUPPLIED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06
THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM WITH SAM FOR CURVED REACHES PROPOSED CONDITIONS

SECTION	Z_{MAX}=	Z_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS}+	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2	Z_{DM}=
18000	**10.0**	6.0	10.6	10.7	2.0	0.5	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**22.6**	22.6	14.3	9.1	2.0	0.5	0.9	4.0	1	0.0	0	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	7.1	13.8	9.8	2.0	0.5	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	6.9	13.4	10.3	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.0**	7.2	14.2	11.6	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	6.7	12.9	9.7	2.0	0.5	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**15.0**	12.4	13.2	7.5	3.4	2.0	0	0.0	1	0.0	0	0.0	1	5.3	0.005	667.7	2090	2.6	2.0	2.3	15
16600	**15.0**	12.1	12.5	6.7	3.4	2.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	763.2	2090	2.6	2.0	2.1	15
16400	**15.0**	12.1	12.4	6.5	3.4	2.0	0	0.0	1	0.0	0	0.0	1	4.7	0.006	790.4	2090	2.6	2.0	2.1	15
16200	**15.0**	11.9	10.5	8.5	3.4	2.0	0	0.0	1	0.0	0	0.0	1	6.4	0.003	694.8	2090	3.0	2.0	1.5	15
16000	**12.2**	12.2	9.2	10.2	3.4	2.0	0	0.0	1	0.0	0	0.0	1	6.9	0.002	736.6	2090	3.7	2.0	1.1	12
15800	**12.0**	11.9	8.0	12.1	3.4	2.0	0	0.0	1	0.0	0	0.0	1	9.3	0.001	627.9	2090	3.6	2.0	0.9	12
15600	**15.0**	10.5	11.2	12.3	3.1	1.5	0	0.0	1	0.0	0	0.0	1	10.4	0.002	400.1	2090	2.2	2.0	1.7	15
15400	**18.0**	11.8	16.5	11.1	3.1	1.5	0	0.0	1	0.0	0	0.0	1	8.5	0.005	328.8	2090	1.5	2.0	3.7	18
15200	**18.0**	11.7	15.7	9.5	3.1	1.5	0	0.0	1	0.0	0	0.0	1	7.5	0.005	395.0	2090	1.8	2.0	3.3	18
15000	**10.0**	9.4	14.4	8.7	3.1	1.5	0	0.0	1	0.0	0	0.0	1	6.4	0.005	499.5	37350	0.0	2.0	2.8	10
14800	**10.0**	9.1	13.7	8.5	3.1	1.5	0	0.0	1	0.0	0	0.0	1	5.8	0.005	578.7	37350	0.0	2.0	2.5	10
14600	**10.0**	9.0	13.2	8.0	3.1	1.5	0	0.0	1	0.0	0	0.0	1	5.5	0.005	640.3	37350	0.0	2.0	2.4	10
14400	**10.0**	9.7	13.3	7.2	2.0	3.3	0	0.0	1	0.0	0	0.0	1	5.4	0.005	640.2	37350	0.0	2.0	2.4	10
14200	**10.0**	9.5	12.9	7.3	2.0	3.3	0	0.0	1	0.0	0	0.0	1	5.2	0.005	700.6	37350	0.0	2.0	2.2	10
14000	**10.0**	9.4	12.6	6.9	2.0	3.3	0	0.0	1	0.0	0	0.0	1	4.9	0.005	761.6	37350	0.0	2.0	2.1	10
13800	**10.0**	9.4	12.3	7.1	2.0	3.3	0	0.0	1	0.0	0	0.0	1	4.7	0.005	795.0	37350	0.0	2.0	2.1	10
13600	**10.0**	9.3	12.2	7.6	2.0	3.3	0	0.0	1	0.0	0	0.0	1	4.6	0.005	816.5	37350	0.0	2.0	2.0	10
13400	**10.0**	6.0	12.1	8.7	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.5	0.006	850.0	37350	0.0	2.0	2.0	10
13200	**10.0**	6.0	12.1	9.1	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.5	0.006	854.5	37350	0.0	2.0	2.0	10
13050	**10.0**	5.5	10.7	10.5	2.0	0.0	0	0.0	1	0.0	0	0.0	1	6.5	0.003	669.2	37350	0.0	2.0	1.5	10
12920	**20.9**	20.9	13.2	8.2	2.0	0.0	0.9	4.0	1	0.0	0	14.5	1	5.3	0.005	661.5	37350	0.0	2.0	2.3	10
12600	**10.0**	6.1	12.5	8.7	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	765.3	37350	0.0	2.0	2.1	10
12400	**10.0**	6.1	12.6	8.6	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	754.4	37350	0.0	2.0	2.1	10
12200	**10.0**	6.2	12.6	8.1	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	744.5	37350	0.0	2.0	2.2	10
12000	**10.0**	6.2	12.7	8.6	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.1	0.005	723.0	37350	0.0	2.0	2.2	10
11800	**10.0**	6.2	12.9	7.6	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.1	0.005	703.8	37350	0.0	2.0	2.2	10
11600	**15.0**	7.9	12.6	8.2	2.0	0.0	0	0.0	1	0.0	0	0.0	1	4.9	0.005	746.2	3605	1.7	2.0	2.2	15
11400	**15.0**	7.7	13.1	7.9	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.3	0.005	672.9	3605	1.4	2.0	2.3	15
11200	**15.0**	7.6	13.6	7.4	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.7	0.005	597.4	3605	1.1	2.0	2.5	15
11000	**15.0**	7.7	13.2	7.5	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.3	0.005	660.6	3605	1.3	2.0	2.3	15
10800	**15.0**	7.7	13.3	7.5	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.4	0.005	644.2	3605	1.3	2.0	2.4	15
10600	**15.0**	7.7	13.6	8.3	2.0	0.0	0	0.0	1	0.0	0	0.0	1	5.8	0.005	588.2	3605	1.2	2.0	2.5	15
10400	**15.0**	7.7	14.1	9.0	2.0	0.0	0	0.0	1	0.0	0	0.0	1	6.2	0.005	537.3	3605	1.0	2.0	2.7	15
10200	**15.0**	7.8	10.4	11.8	2.0	0.0	0	0.0	1	0.0	0	0.0	1	6.2	0.002	725.7	3605	2.4	2.0	1.5	15
10000	**22.1**	22.1	11.6	11.9	2.0	0.0	0.9	4.0	1	0.0	0	14.5	1	6.6	0.003	607.5	3605	1.8	2.0	1.8	15
MAXIMUM=	22.6	22.6			3.4	3.3						15.3						3.7		3.7	18
MINIMUM=	10.0	5.5			2.0	0.0						0.0						0.0		0.9	10

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_I=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED, OR USER SUPPLIED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE

CALCULATIONS FOR SANTA CLARA RIVER TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACSM AND LACFCDDM WITH SAM n=0.025, CURVED EXISTING CONDITIONS

SECTION	Z_{MAX} =	Z_{TOT} =	V (FPS)	FLOW DEPTH (FT)	Z_{DEG} +	Z_{GS} +	PIER TYPE	B	ABUT TYPE	A	SOFT	Z_{LS} +	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS} +	Z_{I} +	H/2	Z_{DM} =
18000	**10.0**	5.5	10.6	10.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	8.6	0.002	774.0	0	0.0	2.0	1.5	10
17800	**22.1**	22.1	14.3	9.1	2.0	0.0	0.9	4.0	1	0.0	1	15.3	0	6.7	0.005	482.6	0	0.0	2.0	2.8	10
17600	**10.0**	6.6	13.8	9.8	2.0	0.0	0	0.0	1	0.0	0	0.0	0	6.3	0.004	581.8	0	0.0	2.0	2.6	10
17400	**10.0**	6.4	13.4	10.3	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.8	0.005	599.5	0	0.0	2.0	2.4	10
17200	**10.0**	6.7	14.2	11.6	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.8	0.004	659.2	0	0.0	2.0	2.7	10
17000	**10.0**	6.2	12.9	9.7	2.0	0.0	0	0.0	1	0.0	0	0.0	0	5.2	0.005	712.9	0	0.0	2.0	2.2	10
16800	**15.0**	11.6	13.2	7.5	3.4	1.2	0	0.0	1	0.0	0	0.0	1	5.3	0.005	667.7	2090	2.6	2.0	2.3	15
16600	**15.0**	11.3	12.5	6.7	3.4	1.2	0	0.0	1	0.0	0	0.0	1	4.9	0.005	763.2	2090	2.6	2.0	2.1	15
16400	**15.0**	11.3	12.4	6.5	3.4	1.2	0	0.0	1	0.0	0	0.0	1	4.7	0.006	790.4	2090	2.6	2.0	2.1	15
16200	**15.0**	11.1	10.4	8.6	3.4	1.2	0	0.0	1	0.0	0	0.0	1	6.4	0.003	694.8	2090	3.0	2.0	1.5	15
16000	**12.0**	11.4	9.1	10.2	3.4	1.2	0	0.0	1	0.0	0	0.0	1	6.9	0.002	736.8	2090	3.7	2.0	1.1	12
15800	**12.4**	12.4	8.0	11.9	3.4	1.2	0	0.0	1	0.0	0	0.0	1	9.3	0.001	908.9	2090	5.0	2.0	0.9	12
15600	**15.0**	11.8	11.1	12.3	3.1	1.3	0	0.0	1	0.0	0	0.0	1	10.5	0.002	593.7	2090	3.7	2.0	1.7	15
15400	**18.0**	12.8	16.6	11.1	3.1	1.3	0	0.0	1	0.0	0	0.0	1	8.5	0.005	462.8	2090	2.7	2.0	3.7	18
15200	**18.0**	11.5	15.6	9.6	3.1	1.3	0	0.0	1	0.0	0	0.0	1	7.6	0.005	395.0	2090	1.8	2.0	3.3	18
15000	**10.0**	9.1	14.2	8.6	3.1	1.3	0	0.0	1	0.0	0	0.0	1	6.2	0.005	527.2	37350	0.0	2.0	2.7	10
14800	**10.0**	8.3	11.8	8.2	3.1	1.3	0	0.0	1	0.0	0	0.0	1	4.3	0.006	908.4	37350	0.0	2.0	1.9	10
14600	**10.0**	8.3	11.9	7.6	3.1	1.3	0	0.0	1	0.0	0	0.0	1	4.4	0.006	891.2	37350	0.0	2.0	1.9	10
14400	**10.0**	5.5	10.6	6.5	2.0	0.0	0	0.0	1	0.0	0	0.0	1	3.5	0.006	1297.9	37350	0.0	2.0	1.5	10
14200	**10.0**	5.5	10.4	7.2	2.0	0.0	0	0.0	1	0.0	0	0.0	1	3.1	0.004	1712.0	37350	0.0	2.0	1.5	10
14000	**10.0**	5.4	10.2	7.1	2.0	0.0	0	0.0	1	0.0	0	0.0	1	2.9	0.004	1763.5	37350	0.0	2.0	1.4	10
13800	**10.0**	5.4	10.2	7.3	2.0	0.0	0	0.0	1	0.0	0	0.0	1	2.9	0.004	1776.1	37350	0.0	2.0	1.4	10
13600	**8.0**	5.3	9.7	7.2	2.0	0.0	0	0.0	1	0.0	0	0.0	1	2.9	0.006	1657.3	37350	0.0	2.0	1.3	8
13400	**8.0**	7.2	9.4	8.1	2.0	2.0	0	0.0	1	0.0	0	0.0	1	2.8	0.007	1784.8	37350	0.0	2.0	1.2	8
13200	**8.0**	7.3	9.8	8.0	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.0	0.006	1586.4	37350	0.0	2.0	1.3	8
13050	**10.0**	7.4	10.1	7.3	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.2	0.006	1437.4	37350	0.0	2.0	1.4	10
12920	**10.0**	7.4	10.2	6.3	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.2	0.006	1415.5	37350	0.0	2.0	1.4	10
12600	**10.0**	7.5	10.4	7.8	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.4	0.006	1318.3	37350	0.0	2.0	1.5	10
12400	**10.0**	7.4	10.3	7.5	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.3	0.006	1403.8	37350	0.0	2.0	1.4	10
12200	**10.0**	7.5	10.4	6.9	2.0	2.0	0	0.0	1	0.0	0	0.0	1	3.3	0.006	1341.6	37350	0.0	2.0	1.5	10
12000	**10.0**	7.8	11.6	7.7	2.0	2.0	0	0.0	1	0.0	0	0.0	1	4.2	0.006	950.5	37350	0.0	2.0	1.8	10
11800	**10.0**	8.0	12.0	7.5	2.0	2.0	0	0.0	1	0.0	0	0.0	1	4.5	0.006	868.1	37350	0.0	2.0	2.0	10
11600	**15.0**	8.4	12.4	7.9	2.0	0.5	0	0.0	1	0.0	0	0.0	1	4.7	0.006	788.8	3605	1.8	2.0	2.1	15
11400	**15.0**	8.2	13.1	7.9	2.0	0.5	0	0.0	1	0.0	0	0.0	1	5.3	0.005	672.9	3605	1.4	2.0	2.3	15
11200	**15.0**	8.1	13.6	7.4	2.0	0.5	0	0.0	1	0.0	0	0.0	1	5.7	0.005	598.9	3605	1.1	2.0	2.5	15
11000	**15.0**	8.6	13.2	7.5	2.0	0.5	0	0.0	1	0.0	0	0.0	1	5.4	0.005	799.5	3605	1.8	2.0	2.4	15
10800	**15.0**	8.2	13.3	7.5	2.0	0.5	0	0.0	1	0.0	0	0.0	1	5.4	0.005	644.2	3605	1.3	2.0	2.4	15
10600	**15.0**	8.2	13.6	8.3	2.0	0.5	0	0.0	1	0.0	0	0.0	1	5.8	0.005	588.2	3605	1.2	2.0	2.5	15
10400	**15.0**	8.2	14.1	9.0	2.0	0.5	0	0.0	1	0.0	0	0.0	1	6.2	0.005	537.3	3605	1.0	2.0	2.7	15
10200	**15.0**	8.3	10.4	11.8	2.0	0.5	0	0.0	1	0.0	0	0.0	1	6.2	0.002	725.6	3605	2.4	2.0	1.5	15
10000	**22.6**	22.6	11.6	11.9	2.0	0.5	0.9	4.0	1	0.0	1	14.5	1	6.6	0.003	607.5	3605	1.8	2.0	1.8	15
MAXIMUM=	22.6	22.6			3.4	2.0						15.3						5.0		3.7	18
MINIMUM=	8.0	5.3			2.0	0.0						0.0						0.0		0.9	8

DEFINITIONS

V(FPS) =VELOCITY IN FEET PER SECOND

Z_{MAX}=GREATER OF Z_{TOT} AND Z_{DM}

Z_{TOT}=TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET

Z_{DEG}=LONG TERM DEGRADATION IN FEET

Z_{GS}=GENERAL SCOUR IN FEET

Z_{LS}=LOCAL SCOUR IN FEET

PIER TYPE=PIER SHAPE FACTOR; IF NO PIERS=**0**
  1.0=SQUARE NOSE; **0.9** ROUND NOSE; **0.9** CYLINDER;
  0.8 SHARP NOSE; **0.9** GROUP OF CYLINDERS

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

B=WIDTH OF PIERS IN FEET; NO PIER=0

ABUT TYPE=VERT WALL FACTOR; IF VERT=**2**; NON VERT=**1**

A=ABUTMENT PROTRUSION INTO FLOW PATH IN FEET

SOFT = SOFT BOTTOM AT A BRIDGE OR AN ABUTMENT
  0 = HARD BOTTOM; **1** = SOFT BOTTOM

Z_{BS}=BEND SCOUR IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

HYD DEPTH=HYDRAULIC DEPTH IN FEET

E SLOPE=ENERGY SLOPE, UNITLESS

TOP WIDTH=CHANNEL TOP WIDTH IN FEET

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

Z_{I}=LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**

H=BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

Z_{DM}=CUT OFF DEPTH REQUIRED BY LACFCDDM

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-60 AND ASSOCIATED APPENDICES (APPENDIX C). ALL VELOCITIES ARE IN FPS THE PRESENT VERSION (05/08) WILL CALCULATE UP TO 100 SCOUR DEPTHS AT ONE TIME. LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR IS TAKEN FROM APPENDIX C-3, INTERPOLATED, OR USER SUPPLIED. LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON LADWP EQUATIONS FOUND IN APP C-6-C-8. BEND SCOUR IS BASED ON EQUATIONS IN APPENDIX C-7-C-8. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON EQUATIONS IN APPENDIX C-9. JULY 2005 REVISION INCLUDES CALCULATION FOR CUT OFF DEPTH BASED ON LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL. THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT OFF DEPTH BASED ON TABLE F-06 THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY, REVISION INCLUDES THE ZMAX CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED

PACE
Advanced Water Engineering

Appendix 6.3

CALCULATIONS FOR SANTA CLARA RIVER FREEBOARD BASED ON LACDPWH&SM AND LACFCDDM WITH SAM n=0.085 CURVED REACHES PROPOSED CONDITIONS

SECTION	Y_{MAX}	Y_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
18000	**2.5**	1.3	4.9	20.7	1.0	0.0	2	443.2	1548.4	0.0	0	3.0	0	0.3	2.5
17800	**2.5**	1.8	7.9	14.4	1.0	0.0	2	421.2	791.4	0.0	0	3.0	0	0.8	2.5
17600	**2.5**	1.8	7.9	14.7	1.0	0.0	2	415.5	1040.0	0.0	0	3.0	0	0.8	2.5
17400	**2.5**	1.8	7.5	14.7	1.0	0.0	2	267.1	1111.4	0.0	0	3.0	0	0.8	2.5
17200	**2.5**	2.2	9.6	14.1	1.0	0.0	2	220.4	1051.1	0.0	0	3.0	0	1.2	2.5
17000	**2.5**	1.9	8.3	12.5	1.0	0.0	2	302.0	763.3	0.0	0	3.0	0	0.9	2.5
16800	**2.5**	2.3	8.0	10.8	1.0	0.0	2	649.7	713.4	0.4	1	3.0	2090	0.9	2.5
16600	**2.5**	1.8	6.5	11.1	1.0	0.0	2	676.0	828.8	0.3	1	3.0	2090	0.6	2.5
16400	**2.5**	1.6	5.6	12.0	1.0	0.0	2	665.9	956.5	0.2	1	3.0	2090	0.4	2.5
16200	**2.5**	1.5	5.3	13.9	1.0	0.0	2	629.8	1142.7	0.2	1	3.0	2090	0.4	2.5
16000	**2.5**	1.5	5.4	15.0	1.0	0.0	2	453.6	1174.8	0.1	1	3.0	2090	0.4	2.5
15800	**2.5**	1.6	5.5	16.2	1.0	0.0	2	536.3	1437.1	0.2	1	3.0	2090	0.4	2.5
15600	**2.5**	2.2	8.2	16.1	1.0	0.0	2	386.6	1056.9	0.3	1	3.0	2090	0.9	2.5
15400	**3.2**	3.2	11.4	15.0	1.0	0.0	2	317.3	454.9	0.5	1	3.0	2090	1.7	2.5
15200	**2.9**	2.9	10.4	13.3	1.0	0.0	2	366.0	409.2	0.4	1	3.0	2090	1.5	2.5
15000	**2.5**	1.9	8.4	13.3	1.0	0.0	2	481.9	518.7	0.0	1	3.0	37350	0.9	2.5
14800	**2.5**	2.0	8.5	12.0	1.0	0.0	2	509.1	632.6	0.0	1	3.0	37350	1.0	2.5
14600	**2.5**	1.8	7.7	11.6	1.0	0.0	2	565.7	686.9	0.0	1	3.0	37350	0.8	2.5
14400	**2.5**	1.9	8.3	10.4	1.0	0.0	2	613.7	660.1	0.0	1	3.0	37350	0.9	2.5
14200	**2.5**	1.8	7.7	10.7	1.0	0.0	2	552.5	723.0	0.0	1	3.0	37350	0.8	2.5
14000	**2.5**	1.7	7.0	10.7	1.0	0.0	2	673.3	784.2	0.0	1	3.0	37350	0.7	2.5
13800	**2.5**	1.6	6.8	10.9	1.0	0.0	2	615.4	817.5	0.0	1	3.0	37350	0.6	2.5
13600	**2.5**	1.5	6.3	11.9	1.0	0.0	2	610.9	842.1	0.0	1	3.0	37350	0.5	2.5
13400	**2.5**	1.5	6.3	12.8	1.0	0.0	2	472.0	874.4	0.0	1	3.0	37350	0.5	2.5
13200	**2.5**	1.5	6.1	13.4	1.0	0.0	2	421.4	879.9	0.0	1	3.0	37350	0.5	2.5
13050	**2.5**	1.9	8.0	12.7	1.0	0.0	2	355.7	677.8	0.0	1	3.0	37350	0.9	2.5
12920	**2.5**	2.0	8.4	11.2	1.0	0.0	2	374.2	671.0	0.0	1	3.0	37350	1.0	2.5
12600	**2.5**	1.7	7.1	12.3	1.0	0.0	2	460.4	806.7	0.0	1	3.0	37350	0.7	2.5
12400	**2.5**	1.7	7.1	12.3	1.0	0.0	2	527.6	787.5	0.0	1	3.0	37350	0.7	2.5
12200	**2.5**	1.7	7.3	11.7	1.0	0.0	2	536.2	765.8	0.0	1	3.0	37350	0.7	2.5
12000	**2.5**	1.7	7.3	12.2	1.0	0.0	2	531.8	744.5	0.0	1	3.0	37350	0.7	2.5
11800	**2.5**	1.8	7.6	11.1	1.0	0.0	2	480.5	725.3	0.0	1	3.0	37350	0.8	2.5
11600	**2.5**	2.3	6.9	12.2	1.0	0.5	2	560.2	770.2	0.2	1	3.0	3605	0.6	2.5
11400	**2.5**	2.3	6.9	12.6	1.0	0.5	2	591.6	737.5	0.2	1	3.0	3605	0.6	2.5
11200	**2.5**	2.5	7.8	11.6	1.0	0.5	2	541.3	737.6	0.2	1	3.0	3605	0.8	2.5
11000	**2.5**	2.3	7.2	11.8	1.0	0.5	2	491.5	729.9	0.1	1	3.0	3605	0.7	2.5
10800	**2.5**	2.3	7.2	12.0	1.0	0.5	2	502.1	719.9	0.1	1	3.0	3605	0.7	2.5
10600	**2.5**	2.3	7.0	13.7	1.0	0.5	2	539.1	674.1	0.1	1	3.0	3605	0.7	2.5
10400	**2.5**	2.4	7.6	14.1	1.0	0.5	2	360.2	601.6	0.1	1	3.0	3605	0.8	2.5
10200	**2.5**	2.0	5.5	17.2	1.0	0.5	2	257.5	791.9	0.1	1	3.0	3605	0.4	2.5
10000	**2.5**	2.0	5.4	19.0	1.0	0.5	2	352.0	741.8	0.1	1	3.0	3605	0.4	2.5
MAX=	3.2	3.2								0.5				1.7	2.5
MIN=	2.5	1.3								0.0				0.3	2.5

DEFINITIONS

Y_{MAX} = GREATER OF THE DM AND H&S HEIGHTS

Y_{TOT}=TOTAL EMBANKMENT PROTECTION IN FEET BASED ON THE H&S

V(FPS) =VELOCITY IN FEET PER SECOND

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

Y_{AGG}=LONG TERM AGGRADATION IN FEET

Y_{GA}=GENERAL AGGRADATION IN FEET

CHANNEL TYPE=CHANNEL SHAPE/FLOW FACTOR:
  IF Fr<1, RECTANGULAR = 0; IF Fr>1, RECTANGULAR = 1;
  IF Fr<1, TRAPEZOIDAL = 2; IF Fr>1, TRAPEZOIDAL = 3.

Y_{SE}=SUPER ELEVATION IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

SIDE SLOPE=CHANNEL SIDE SLOPE (H:V), UNITLESS

BOTTOM WIDTH=CHANNEL BOTTOM WIDTH IN FEET, 2-YEAR WATER SURFACE

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

H/2=HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH,
  AFTER KENNEDY (1963)

Y_{DM} = EMBANKMENT PROTECTION REQUIRED BY THE LACFCDDM IN FEET

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE TOP PROTECTION (FREE BOARD) BASED ON LACDPW COUNTY HYDROLOGY MANUAL (1991) PAGES 5.8-5.9 AND ASSOCIATED APPENDICES (SEDIMENTATION MANUAL). ALL VELOCITIES ARE IN FPS, WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM OF APPROXIMATELY 20-30 FPS. THE PRESENT VERSION (8/05) WILL CALCULATE UP TO 100 VELOCITIES AT ONE TIME. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON LACFCDDM EQUATIONS FOUND IN C-3.1. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX Q13. IF FLOW IS SUPERCRITICAL SPREADSHEET REPORTS LACFCDDM TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL (LACFCDDM) VALUES ARE PRESENTED AS A PART OF LACH&SM CALCULATIONS. THE SPREADSHEET CALCULATES THE GREATER OF THE TWO METHODOLOGIES. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE AFTER ACOE PROCEDURES.

COLOR CODES

OUTPUT

DATA FROM HEC-RAS

USER SUPPLIED DATA

INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005

PACE

CALCULATIONS FOR SANTA CLARA RIVER FREEBOARD BASED ON LACDPWH&SM AND LACFCDDM WITH SAM n=0.085 STRAIGHT/INSIDE CURVES EXISTING CONDITIONS

SECTION	Y_{MAX}	Y_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
18000	2.5	1.3	4.9	20.7	1.0	0.0	2	443.2	1547.7	0.0	0	3.0	0	0.3	2.5
17800	2.5	1.8	7.9	14.5	1.0	0.0	2	421.2	791.3	0.0	0	3.0	0	0.8	2.5
17600	2.5	1.8	7.9	14.7	1.0	0.0	2	415.5	1036.9	0.0	0	3.0	0	0.8	2.5
17400	2.5	1.8	7.5	14.7	1.0	0.0	2	267.1	1113.0	0.0	0	3.0	0	0.8	2.5
17200	2.5	2.2	9.6	14.1	1.0	0.0	2	220.4	1051.4	0.0	0	3.0	0	1.2	2.5
17000	2.5	1.9	8.3	12.5	1.0	0.0	2	302.0	763.7	0.0	0	3.0	0	0.9	2.5
16800	2.5	1.9	8.0	10.8	1.0	0.0	2	649.7	711.8	0.0	0	3.0	2090	0.9	2.5
16600	2.5	1.6	6.6	11.0	1.0	0.0	2	676.0	797.8	0.0	0	3.0	2090	0.6	2.5
16400	2.5	1.4	5.7	11.8	1.0	0.0	2	665.9	902.5	0.0	0	3.0	2090	0.4	2.5
16200	2.5	1.4	5.4	13.7	1.0	0.0	2	629.8	1132.8	0.0	0	3.0	2090	0.4	2.5
16000	2.5	1.4	5.5	14.7	1.0	0.0	2	453.6	1155.5	0.0	0	3.0	2090	0.4	2.5
15800	2.5	1.4	5.5	15.6	1.0	0.0	2	536.3	1427.2	0.0	0	3.0	2090	0.4	2.5
15600	2.5	2.1	8.5	15.6	1.0	0.1	2	386.6	968.0	0.0	0	3.0	2090	1.0	2.5
15400	2.6	2.6	10.6	14.9	1.0	0.1	2	317.3	540.7	0.0	0	3.0	2090	1.5	2.5
15200	2.7	2.7	10.9	12.7	1.0	0.1	2	365.8	584.2	0.0	0	3.0	2090	1.6	2.5
15000	2.5	2.1	8.6	12.3	1.0	0.1	2	499.8	768.6	0.0	0	3.0	37350	1.0	2.5
14800	2.5	1.8	7.1	10.9	1.0	0.1	2	542.6	973.6	0.0	0	3.0	37350	0.7	2.5
14600	2.5	1.8	7.3	10.1	1.0	0.1	2	638.5	1269.3	0.0	0	3.0	37350	0.7	2.5
14400	2.5	1.5	6.2	8.8	1.0	0.0	2	660.9	1835.9	0.0	0	3.0	37350	0.5	2.5
14200	2.5	1.6	6.4	9.1	1.0	0.0	2	595.0	1870.9	0.0	0	3.0	37350	0.6	2.5
14000	2.5	1.5	6.1	9.2	1.0	0.0	2	727.2	1950.5	0.0	0	3.0	37350	0.5	2.5
13800	2.5	1.5	6.3	9.1	1.0	0.0	2	675.9	1869.8	0.0	0	3.0	37350	0.5	2.5
13600	2.5	1.3	4.8	9.9	1.0	0.0	2	643.4	2009.6	0.0	0	3.0	37350	0.3	2.5
13400	2.5	1.3	5.0	10.5	1.0	0.0	2	520.8	1988.0	0.0	0	3.0	37350	0.3	2.5
13200	2.5	1.4	5.4	10.5	1.0	0.0	2	495.7	1680.1	0.0	0	3.0	37350	0.4	2.5
13050	2.5	1.4	5.6	9.9	1.0	0.0	2	746.6	1518.2	0.0	0	3.0	37350	0.4	2.5
12920	2.5	1.4	5.5	9.1	1.0	0.0	2	814.3	1508.8	0.0	0	3.0	37350	0.4	2.5
12600	2.5	1.5	6.1	10.3	1.0	0.0	2	538.4	1576.3	0.0	0	3.0	37350	0.5	2.5
12400	2.5	1.4	5.3	10.4	1.0	0.0	2	726.7	1684.7	0.0	0	3.0	37350	0.4	2.5
12200	2.5	1.3	4.9	10.4	1.0	0.0	2	679.6	1591.5	0.0	0	3.0	37350	0.3	2.5
12000	2.5	1.5	6.3	11.3	1.0	0.0	2	456.7	1163.7	0.0	0	3.0	37350	0.5	2.5
11800	2.5	1.5	6.2	11.6	1.0	0.0	2	564.7	928.9	0.0	0	3.0	37350	0.5	2.5
11600	3.1	3.1	6.4	12.1	1.0	1.5	2	611.8	967.7	0.0	0	3.0	3605	0.6	2.5
11400	3.1	3.1	6.9	12.5	1.0	1.5	2	591.6	946.9	0.0	0	3.0	3605	0.6	2.5
11200	3.3	3.3	7.7	11.6	1.0	1.5	2	541.3	1093.7	0.0	0	3.0	3605	0.8	2.5
11000	3.2	3.2	7.3	11.8	1.0	1.5	2	491.5	1270.5	0.0	0	3.0	3605	0.7	2.5
10800	3.2	3.2	7.2	12.0	1.0	1.5	2	502.1	719.8	0.0	0	3.0	3605	0.7	2.5
10600	3.2	3.2	7.0	13.7	1.0	1.5	2	539.1	674.1	0.0	0	3.0	3605	0.7	2.5
10400	3.3	3.3	7.6	14.1	1.0	1.5	2	360.2	601.6	0.0	0	3.0	3605	0.8	2.5
10200	2.9	2.9	5.5	17.2	1.0	1.5	2	257.5	817.6	0.0	0	3.0	3605	0.4	2.5
10000	2.9	2.9	5.4	19.0	1.0	1.5	2	352.0	741.8	0.0	0	3.0	3605	0.4	2.5
MAX=	3.3	3.3								0.0				1.6	2.5
MIN=	2.5	1.3								0.0				0.3	2.5

DEFINITIONS

Y_{MAX} = GREATER OF THE DM AND H&S HEIGHTS

Y_{TOT}=TOTAL EMBANKMENT PROTECTION IN FEET BASED ON THE H&S

V(FPS) =VELOCITY IN FEET PER SECOND

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

Y_{AGG}=LONG TERM AGGRADATION IN FEET

Y_{GA}=GENERAL AGGRADATION IN FEET

CHANNEL TYPE=CHANNEL SHAPE/FLOW FACTOR:
IF Fr<1, RECTANGULAR = 0; IF Fr>1, RECTANGULAR = 1;
IF Fr<1, TRAPEZOIDAL = 2; IF Fr>1, TRAPEZOIDAL = 3.

Y_{SE}=SUPER ELEVATION IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

SIDE SLOPE=CHANNEL SIDE SLOPE (H:V), UNITLESS

BOTTOM WIDTH=CHANNEL BOTTOM WIDTH IN FEET, 2-YEAR WATER SURFACE

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

H/2=HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH,
AFTER KENNEDY (1963)

Y_{DM} = EMBANKMENT PROTECTION REQUIRED BY THE LACFCDDM IN FEET

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE TOP PROTECTION (FREE BOARD) BASED ON LACDPW COUNTY HYDROLOGY MANUAL (1991) PAGES 5.8-5.9 AND ASSOCIATED APPENDICES (SEDIMENTATION MANUAL). ALL VELOCITIES ARE IN FPS, WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM OF APPROXIMATELY 20-30 FPS. THE PRESENT VERSION (8/05) WILL CALCULATE UP TO 100 VELOCITIES AT ONE TIME. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON LACFCDDM EQUATIONS FOUND IN C-3.1. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX Q13. IF FLOW IS SUPERCRITICAL SPREADSHEET REPORTS LACFCDDM TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL (LACFCDDM) VALUES ARE PRESENTED AS A PART OF LACH&SM CALCULATIONS. THE SPREADSHEET CALCULATES THE GREATER OF THE TWO METHODOLOGIES. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE AFTER ACOE PROCEDURES.

COLOR CODES

OUTPUT

DATA FROM HEC-RAS

USER SUPPLIED DATA

INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005

PACE

CALCULATIONS FOR SANTA CLARA RIVER FREEBOARD BASED ON LACDPWH&SM AND LACFCDDM WITH SAM n=0.085 CURVED REACHES EXISTING CONDITIONS

SECTION	Y_{MAX}	Y_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
18000	**2.5**	1.3	4.9	20.7	1.0	0.0	2	443.2	1547.7	0.0	0	3.0	0	0.3	2.5
17800	**2.5**	1.8	7.9	14.5	1.0	0.0	2	421.2	791.3	0.0	0	3.0	0	0.8	2.5
17600	**2.5**	1.8	7.9	14.7	1.0	0.0	2	415.5	1036.9	0.0	0	3.0	0	0.8	2.5
17400	**2.5**	1.8	7.5	14.7	1.0	0.0	2	267.1	1113.0	0.0	0	3.0	0	0.8	2.5
17200	**2.5**	2.2	9.6	14.1	1.0	0.0	2	220.4	1051.4	0.0	0	3.0	0	1.2	2.5
17000	**2.5**	1.9	8.3	12.5	1.0	0.0	2	302.0	763.7	0.0	0	3.0	0	0.9	2.5
16800	**2.5**	2.3	8.0	10.8	1.0	0.0	2	649.7	711.8	0.4	1	3.0	2090	0.9	2.5
16600	**2.5**	1.9	6.6	11.0	1.0	0.0	2	676.0	797.8	0.3	1	3.0	2090	0.6	2.5
16400	**2.5**	1.7	5.7	11.8	1.0	0.0	2	665.9	902.5	0.2	1	3.0	2090	0.4	2.5
16200	**2.5**	1.6	5.4	13.7	1.0	0.0	2	629.8	1132.8	0.2	1	3.0	2090	0.4	2.5
16000	**2.5**	1.6	5.5	14.7	1.0	0.0	2	453.6	1155.5	0.1	1	3.0	2090	0.4	2.5
15800	**2.5**	1.6	5.5	15.6	1.0	0.0	2	536.3	1427.2	0.2	1	3.0	2090	0.4	2.5
15600	**2.5**	2.4	8.5	15.6	1.0	0.1	2	386.6	968.0	0.3	1	3.0	2090	1.0	2.5
15400	**3.0**	3.0	10.6	14.9	1.0	0.1	2	317.3	540.7	0.4	1	3.0	2090	1.5	2.5
15200	**3.1**	3.1	10.9	12.7	1.0	0.1	2	365.8	584.2	0.4	1	3.0	2090	1.6	2.5
15000	**2.5**	2.1	8.6	12.3	1.0	0.1	2	499.8	768.6	0.0	1	3.0	37350	1.0	2.5
14800	**2.5**	1.8	7.1	10.9	1.0	0.1	2	542.6	973.6	0.0	1	3.0	37350	0.7	2.5
14600	**2.5**	1.8	7.3	10.1	1.0	0.1	2	638.5	1269.3	0.0	1	3.0	37350	0.7	2.5
14400	**2.5**	1.5	6.2	8.8	1.0	0.0	2	660.9	1835.9	0.0	1	3.0	37350	0.5	2.5
14200	**2.5**	1.6	6.4	9.1	1.0	0.0	2	595.0	1870.9	0.0	1	3.0	37350	0.6	2.5
14000	**2.5**	1.5	6.1	9.2	1.0	0.0	2	727.2	1950.5	0.0	1	3.0	37350	0.5	2.5
13800	**2.5**	1.5	6.3	9.1	1.0	0.0	2	675.9	1869.8	0.0	1	3.0	37350	0.5	2.5
13600	**2.5**	1.3	4.8	9.9	1.0	0.0	2	643.4	2009.6	0.0	1	3.0	37350	0.3	2.5
13400	**2.5**	1.3	5.0	10.5	1.0	0.0	2	520.8	1988.0	0.0	1	3.0	37350	0.3	2.5
13200	**2.5**	1.4	5.4	10.5	1.0	0.0	2	495.7	1680.1	0.0	1	3.0	37350	0.4	2.5
13050	**2.5**	1.4	5.6	9.9	1.0	0.0	2	746.6	1518.2	0.0	1	3.0	37350	0.4	2.5
12920	**2.5**	1.4	5.5	9.1	1.0	0.0	2	814.3	1508.8	0.0	1	3.0	37350	0.4	2.5
12600	**2.5**	1.5	6.1	10.3	1.0	0.0	2	538.4	1576.3	0.0	1	3.0	37350	0.5	2.5
12400	**2.5**	1.4	5.3	10.4	1.0	0.0	2	726.7	1684.7	0.0	1	3.0	37350	0.4	2.5
12200	**2.5**	1.3	4.9	10.4	1.0	0.0	2	679.6	1591.5	0.0	1	3.0	37350	0.3	2.5
12000	**2.5**	1.5	6.3	11.3	1.0	0.0	2	456.7	1163.7	0.0	1	3.0	37350	0.5	2.5
11800	**2.5**	1.5	6.2	11.6	1.0	0.0	2	564.7	928.9	0.0	1	3.0	37350	0.5	2.5
11600	**3.2**	3.2	6.4	12.1	1.0	1.5	2	611.8	967.7	0.1	1	3.0	3605	0.6	2.5
11400	**3.3**	3.3	6.9	12.5	1.0	1.5	2	591.6	946.9	0.2	1	3.0	3605	0.6	2.5
11200	**3.5**	3.5	7.7	11.6	1.0	1.5	2	541.3	1093.7	0.2	1	3.0	3605	0.8	2.5
11000	**3.4**	3.4	7.3	11.8	1.0	1.5	2	491.5	1270.5	0.1	1	3.0	3605	0.7	2.5
10800	**3.3**	3.3	7.2	12.0	1.0	1.5	2	502.1	719.8	0.1	1	3.0	3605	0.7	2.5
10600	**3.3**	3.3	7.0	13.7	1.0	1.5	2	539.1	674.1	0.1	1	3.0	3605	0.7	2.5
10400	**3.4**	3.4	7.6	14.1	1.0	1.5	2	360.2	601.6	0.1	1	3.0	3605	0.8	2.5
10200	**3.0**	3.0	5.5	17.2	1.0	1.5	2	257.5	817.6	0.1	1	3.0	3605	0.4	2.5
10000	**3.0**	3.0	5.4	19.0	1.0	1.5	2	352.0	741.8	0.1	1	3.0	3605	0.4	2.5
MAX=	3.5	3.5								0.4				1.6	2.5
MIN=	2.5	1.3								0.0				0.3	2.5

DEFINITIONS

Y_{MAX} = GREATER OF THE DM AND H&S HEIGHTS

Y_{TOT}=TOTAL EMBANKMENT PROTECTION IN FEET BASED ON THE H&S

V(FPS) =VELOCITY IN FEET PER SECOND

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

Y_{AGG}=LONG TERM AGGRADATION IN FEET

Y_{GA}=GENERAL AGGRADATION IN FEET

CHANNEL TYPE=CHANNEL SHAPE/FLOW FACTOR:
IF Fr<1, RECTANGULAR = 0; IF Fr>1, RECTANGULAR = 1;
IF Fr<1, TRAPEZOIDAL = 2; IF Fr>1, TRAPEZOIDAL = 3.

Y_{SE}=SUPER ELEVATION IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

SIDE SLOPE=CHANNEL SIDE SLOPE (H:V), UNITLESS

BOTTOM WIDTH=CHANNEL BOTTOM WIDTH IN FEET, 2-YEAR WATER SURFACE

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

H/2=HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH,
AFTER KENNEDY (1963)

Y_{DM} = EMBANKMENT PROTECTION REQUIRED BY THE LACFCDDM IN FEET

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE TOP PROTECTION (FREE BOARD) BASED ON LACDPW COUNTY HYDROLOGY MANUAL (1991) PAGES 5.8-5.9 AND ASSOCIATED APPENDICES (SEDIMENTATION MANUAL). ALL VELOCITIES ARE IN FPS, WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM OF APPROXIMATELY 20-30 FPS. THE PRESENT VERSION (8/05) WILL CALCULATE UP TO 100 VELOCITIES AT ONE TIME. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON LACFCDDM EQUATIONS FOUND IN C-3.1. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX Q13. IF FLOW IS SUPERCRITICAL SPREADSHEET REPORTS LACFCDDM TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. LOS ANGELES COUNTY FLOOD CONTROL DISTRICT DESIGN MANUAL (LACFCDDM) VALUES ARE PRESENTED AS A PART OF LACH&SM CALCULATIONS. THE SPREADSHEET CALCULATES THE GREATER OF THE TWO METHODOLOGIES. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE AFTER ACOE PROCEDURES.

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005

PACE

CALCULATIONS FOR SANTA CLARA RIVER FREEBOARD BASED ON LACDPWH&SM AND LACFCDDM WITH SAM n=0.085 STRAIGHT/INSIDE CURVES PROPOSED CONDITIONS

SECTION	Y_{MAX}	Y_{TOT}=	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
18000	**2.5**	1.3	4.9	20.7	1.0	0.0	2	443.2	1548.4	0.0	0	3.0	0	0.3	2.5
17800	**2.5**	1.8	7.9	14.4	1.0	0.0	2	421.2	791.4	0.0	0	3.0	0	0.8	2.5
17600	**2.5**	1.8	7.9	14.7	1.0	0.0	2	415.5	1040.0	0.0	0	3.0	0	0.8	2.5
17400	**2.5**	1.8	7.5	14.7	1.0	0.0	2	267.1	1111.4	0.0	0	3.0	0	0.8	2.5
17200	**2.5**	2.2	9.6	14.1	1.0	0.0	2	220.4	1051.1	0.0	0	3.0	0	1.2	2.5
17000	**2.5**	1.9	8.3	12.5	1.0	0.0	2	302.0	763.3	0.0	0	3.0	0	0.9	2.5
16800	**2.5**	1.9	8.0	10.8	1.0	0.0	2	649.7	713.4	0.0	0	3.0	2090	0.9	2.5
16600	**2.5**	1.6	6.5	11.1	1.0	0.0	2	676.0	828.8	0.0	0	3.0	2090	0.6	2.5
16400	**2.5**	1.4	5.6	12.0	1.0	0.0	2	665.9	956.5	0.0	0	3.0	2090	0.4	2.5
16200	**2.5**	1.4	5.3	13.9	1.0	0.0	2	629.8	1142.7	0.0	0	3.0	2090	0.4	2.5
16000	**2.5**	1.4	5.4	15.0	1.0	0.0	2	453.6	1174.8	0.0	0	3.0	2090	0.4	2.5
15800	**2.5**	1.4	5.5	16.2	1.0	0.0	2	536.3	1437.1	0.0	0	3.0	2090	0.4	2.5
15600	**2.5**	1.9	8.2	16.1	1.0	0.0	2	386.6	1056.9	0.0	0	3.0	2090	0.9	2.5
15400	**2.7**	2.7	11.4	15.0	1.0	0.0	2	317.3	454.9	0.0	0	3.0	2090	1.7	2.5
15200	**2.5**	2.5	10.4	13.3	1.0	0.0	2	366.0	409.2	0.0	0	3.0	2090	1.5	2.5
15000	**2.5**	1.9	8.4	13.3	1.0	0.0	2	481.9	518.7	0.0	0	3.0	37350	0.9	2.5
14800	**2.5**	2.0	8.5	12.0	1.0	0.0	2	509.1	632.6	0.0	0	3.0	37350	1.0	2.5
14600	**2.5**	1.8	7.7	11.6	1.0	0.0	2	565.7	686.9	0.0	0	3.0	37350	0.8	2.5
14400	**2.5**	1.9	8.3	10.4	1.0	0.0	2	613.7	660.1	0.0	0	3.0	37350	0.9	2.5
14200	**2.5**	1.8	7.7	10.7	1.0	0.0	2	552.5	723.0	0.0	0	3.0	37350	0.8	2.5
14000	**2.5**	1.7	7.0	10.7	1.0	0.0	2	673.3	784.2	0.0	0	3.0	37350	0.7	2.5
13800	**2.5**	1.6	6.8	10.9	1.0	0.0	2	615.4	817.5	0.0	0	3.0	37350	0.6	2.5
13600	**2.5**	1.5	6.3	11.9	1.0	0.0	2	610.9	842.1	0.0	0	3.0	37350	0.5	2.5
13400	**2.5**	1.5	6.3	12.8	1.0	0.0	2	472.0	874.4	0.0	0	3.0	37350	0.5	2.5
13200	**2.5**	1.5	6.1	13.4	1.0	0.0	2	421.4	879.9	0.0	0	3.0	37350	0.5	2.5
13050	**2.5**	1.9	8.0	12.7	1.0	0.0	2	355.7	677.8	0.0	0	3.0	37350	0.9	2.5
12920	**2.5**	2.0	8.4	11.2	1.0	0.0	2	374.2	671.0	0.0	0	3.0	37350	1.0	2.5
12600	**2.5**	1.7	7.1	12.3	1.0	0.0	2	460.4	806.7	0.0	0	3.0	37350	0.7	2.5
12400	**2.5**	1.7	7.1	12.3	1.0	0.0	2	527.6	787.5	0.0	0	3.0	37350	0.7	2.5
12200	**2.5**	1.7	7.3	11.7	1.0	0.0	2	536.2	765.8	0.0	0	3.0	37350	0.7	2.5
12000	**2.5**	1.7	7.3	12.2	1.0	0.0	2	531.8	744.5	0.0	0	3.0	37350	0.7	2.5
11800	**2.5**	1.8	7.6	11.1	1.0	0.0	2	480.5	725.3	0.0	0	3.0	37350	0.8	2.5
11600	**2.5**	2.1	6.9	12.2	1.0	0.5	2	560.2	770.2	0.0	0	3.0	3605	0.6	2.5
11400	**2.5**	2.1	6.9	12.6	1.0	0.5	2	591.6	737.5	0.0	0	3.0	3605	0.6	2.5
11200	**2.5**	2.3	7.8	11.6	1.0	0.5	2	541.3	737.6	0.0	0	3.0	3605	0.8	2.5
11000	**2.5**	2.2	7.2	11.8	1.0	0.5	2	491.5	729.9	0.0	0	3.0	3605	0.7	2.5
10800	**2.5**	2.2	7.2	12.0	1.0	0.5	2	502.1	719.9	0.0	0	3.0	3605	0.7	2.5
10600	**2.5**	2.2	7.0	13.7	1.0	0.5	2	539.1	674.1	0.0	0	3.0	3605	0.7	2.5
10400	**2.5**	2.3	7.6	14.1	1.0	0.5	2	360.2	601.6	0.0	0	3.0	3605	0.8	2.5
10200	**2.5**	1.9	5.5	17.2	1.0	0.5	2	257.5	791.9	0.0	0	3.0	3605	0.4	2.5
10000	**2.5**	1.9	5.4	19.0	1.0	0.5	2	352.0	741.8	0.0	0	3.0	3605	0.4	2.5
MAX=	2.7	2.7								0.0				1.7	2.5
MIN=	2.5	1.3								0.0				0.3	2.5

DEFINITIONS

Y_{MAX} = GREATER OF THE DM AND H&S HEIGHTS

Y_{TOT}=TOTAL EMBANKMENT PROTECTION IN FEET BASED ON THE H&S

V(FPS) =VELOCITY IN FEET PER SECOND

FLOW DEPTH=WATER DEPTH IN CHANNEL IN FEET

Y_{AGG}=LONG TERM AGGRADATION IN FEET

Y_{GA}=GENERAL AGGRADATION IN FEET

CHANNEL TYPE=CHANNEL SHAPE/FLOW FACTOR:
IF Fr<1, RECTANGULAR = 0; IF Fr>1, RECTANGULAR = 1;
IF Fr<1, TRAPEZOIDAL = 2; IF Fr>1, TRAPEZOIDAL = 3.

Y_{SE}=SUPER ELEVATION IN FEET

BEND COEFF=BEND COEFFICIENT; IF NO BEND=0, BEND=1

SIDE SLOPE=CHANNEL SIDE SLOPE (H:V), UNITLESS

BOTTOM WIDTH=CHANNEL BOTTOM WIDTH IN FEET, 2-YEAR WATER SURFACE

RADIUS=RADIUS OF CURVATURE TO CENTERLINE IN FEET

H/2=HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH, AFTER KENNEDY (1963)

Y_{DM} = EMBANKMENT PROTECTION REQUIRED BY THE LACFCDDM IN FEET

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