Drainage Report

Santa Cruz Route 1 HOV

Tier I Corridor Analysis of

High Occupancy Vehicle (HOV) Lanes and Transportation System Management (TSM) Alternatives

(05 SCR-1-PM R7.24-16.13)

and

Tier II Build Project Analysis

41st Avenue to Soquel Avenue/Drive

Auxiliary Lanes and Chanticleer Avenue Pedestrian Overcrossing

(05 SCR-1-PM 13.5-14.9)

EA 0C7300

Prepared by the

State of California Department of Transportation

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U.S. Department of Transportation

Drainage Report

TIER I - CORRIDOR ANALYSIS OF
HIGH OCCUPANCY VEHICLE (HOV) LANES
AND TRANSPORTATION SYSTEM MANAGEMENT (TSM) ALTERNATIVES
AND
TIER II - BUILD PROJECT ANALYSIS OF
41ST AVENUE TO SOQUEL AVENUE/DRIVE AUXILIARY LANES AND
CHANTICLEER AVENUE PEDESTRIAN OVERCROSSING

San Andreas-Larkin Valley Road Interchange to Morrissey Boulevard Interchange in Santa Cruz County

05-SCR-1- PM R7.24/16.13 (KP R11.64/25.96)
EA 05-0C7300

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Han-Bin Liang, Ph.D., P.E.
(925) 941-0017
WRECO

State Route 1 HOV Lane Widening Project (From Morrissey Boulevard to San Andreas Road) DRAINAGE REPORT

Errata

June 10, 2015

This Errata sheet revises the Drainage Report as described below.

1. **Purpose and Need.** The purpose and need text provided in Section 1.2 of the report is hereby changed to replace the existing text of Section 1.2 with the following text.

1.3 Purpose and Need

Purpose

The purpose of the proposed Tier I project on Route 1 within the project limits is to achieve the following:

- Reduce congestion.
- Promote the use of alternative transportation modes as means to increase transportation system capacity.
- Encourage carpooling and ridesharing.

The purpose of the Tier II project is to:

- Reduce congestion.
- Improve safety.
- Promote the use of alternative transportation modes as means to increase transportation system capacity.

The main distinction between the Tier I and Tier II project purposes is the Tier II project also addresses a congestion-related safety need within its limits but will not promote carpooling in the Route 1 corridor.

The Tier I and Tier II projects are intended to address specific deficiencies and needs on Route 1, as described in the following subsection.

Need

The Tier I and Tier II projects address the following needs resulting from deficiencies on Route 1 within the project limits:

- Several bottlenecks along Route 1 in the southbound and northbound directions cause recurrent congestion during peak hours.
- Travel time delays due to congestion are experienced by commuters, commerce, and emergency vehicles.
- “Cut-through” traffic, or traffic on local streets, occurs and is increasing because drivers seek to avoid congestion on the highway.

- Limited opportunities exist for pedestrians and bicyclists to safely get across Route 1 within the project corridor.

Within the Tier I project limits, in addition to the common needs identified above there is a need to address the following corridor-wide deficiencies:

- Insufficient incentives to increase transit service in the Route 1 corridor because congestion threatens reliability and cost-effective transit service delivery.
- Inadequate facilities to support carpool and rideshare vehicles over single-occupant vehicles, reducing travel time savings and reliability.

The Tier II project, in addition to the common needs identified above, also addresses the following need:

- Improve operational safety to address accident rates in excess of the statewide average.

2. Project Description. The project alternatives text provided in Section 1.2 of the report is hereby changed to replace the existing text of Section 1.2 with the following text.

1.2 Project Alternatives

This section describes the proposed project improvements and the project alternatives developed to meet the purpose and need, while avoiding or minimizing environmental impacts. The alternatives are the Tier I Corridor HOV Lane Alternative, the Tier I Corridor TSM Alternative, and the Tier II Auxiliary Lane Alternative.

The proposed Tier I and Tier II project locations are in Santa Cruz County, California, on Route 1.The Tier I eastern project limit is just south of the village of Aptos, approximately 0.4 mile south of the San Andreas-Larkin Valley Road interchange; the Tier I project then traverses the villages of Soquel, Live Oak and unincorporated Santa Cruz County. The western Tier I project limit is in the City of Santa Cruz, approximately 0.4 mile north of the Morrissey Boulevard interchange, for a total length of 8.9 miles. The Tier II project limits, which lie within the Tier I corridor, begin at 41st Avenue on the east and extend a distance of 1.4 miles westward to Soquel Avenue.

Within the Tier I and Tier II project limits, Route 1 is a four-lane divided freeway with 12-foot lanes. In the southbound direction the existing inside paved shoulder width varies from approximately 4 feet to 18 feet and in the northbound direction the existing inside paved shoulder width varies from 7 feet to 18 feet. In the southbound direction in the project corridor, the outside shoulder width varies from 8 feet to 12 feet. In the northbound direction in the project corridor, the outside shoulder width varies from 6 feet to 8 feet.

The purpose of the Tier I project is to reduce congestion, promote the use of alternative transportation modes as means to increase transportation system capacity, and encourage carpooling and ridesharing. The purpose of the Tier II project is to reduce congestion, improve safety, and promote the use of alternative transportation modes as means to increase transportation system capacity.

Alternatives

This section describes the Tier I Corridor Alternatives and the Tier II Auxiliary Lane Alternative that were analyzed in this document. The Project Development Team studied various design alternatives and options. In an effort to reduce and avoid impacts, the Project Development Team also considered preliminary environmental information to better understand the impacts of those alternatives. The views of stakeholders were elicited through public information meetings and meetings with local agency staff and elected officials. From this preliminary analysis and public outreach, a longer list of alternatives and options was narrowed to include the alternatives described below.

The Tier I Corridor HOV Lane and TSM Alternatives were originally conceived as construction-level study alternatives, under the assumption that funding would be available in the near future. The Project Development Team recognized that funding sources to construct either of those alternatives would be limited in the short term and that implementation of the Tier I project would occur over a multi-year period. To make a decision on the types of transportation improvements that would occur within the corridor in the future, Tier I project implementation alternatives were identified. The team decided to study the HOV Lane and TSM Alternatives in a Tier I or Master Plan environmental document. The Tier I/II DEIR/EA will allow for the identification of a preferred corridor alternative for the 8.9-mile-long project corridor and facilitate the programming of funds. At the same time, the team also recognized that there was sufficient funding to implement a construction-level Tier II project within the corridor that would have more immediate congestion-relief benefits. Accordingly, a Tier II Auxiliary Lane and Pedestrian/Bicycle Overcrossing Alternative is also defined and analyzed in the Tier I/II DEIR/EA.

The Tier I corridor analysis includes three alternatives: a Tier I Corridor HOV Lane Alternative, a Tier I Corridor TSM Alternative, and a Tier I No Build Alternative. As funding becomes available, the high-priority improvements in the corridor would become subsequent incremental (Tier II) construction-level projects and would be subject to separate environmental reviews.

The Tier II corridor analysis considers an Auxiliary Lane Alternative and Pedestrian/Bicycle Overcrossing, and a No Build Alternative. The Tier II project is located between 41st Avenue and Soquel Avenue/Drive. It is anticipated that construction of the Tier II project could begin in 2019.

Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives

The Tier I HOV Lane and TSM Alternatives share many features, such as: the addition of auxiliary lanes, new pedestrian/bicycle overcrossings over Route 1, and Transportation Operations System elements. These common design features are described below.

Auxiliary Lanes

Auxiliary lanes are designed to reduce conflicts between traffic entering and exiting the highway by connecting the on-ramp of one interchange to the off-ramp of the next; they are not designed to serve through traffic. Auxiliary lanes would be constructed to improve merging operations at the locations listed below:

- Freedom Boulevard and Rio Del Mar Boulevard – northbound and southbound
- Rio Del Mar Boulevard and State Park Drive – northbound and southbound
- State Park Drive and Park Avenue – both directions in the TSM Alternative; southbound only in the HOV Lane Alternative
- Park Avenue and Bay Avenue/Porter Street – northbound and southbound
- 41st Avenue and Soquel Avenue/Drive – northbound and southbound

New Pedestrian/Bicycle Overcrossings

Both Tier I alternatives would construct new pedestrian/bicycle overcrossings of Route 1 at the following locations:

- Mar Vista Drive – The crossing would start on the north side of Route 1 and parallel the highway eastward for approximately 600 feet, doubling back westward as it climbs before crossing the highway and McGregor Drive at a right angle and then descending by switchbacks to and along Mar Vista Drive for approximately 550 feet; the final design will be determined as part of the Tier II design/environmental analysis of this facility.
- Chanticleer Avenue – The crossing would start at the Chanticleer Avenue cul-de-sac on the north side of Route 1 and run parallel the highway for approximately 400 feet to the west and then cross Route 1 and Soquel Avenue (frontage road) on a curved alignment, terminating just west of Chanticleer Avenue on the south side of the highway and Soquel Avenue (frontage road).
- Trevethan Avenue – The crossing would start on the north side of Route 1 at Trevethan Avenue and parallel the highway approximately 600 feet before crossing on an angle and continuing along the banks of the western tributary to Arana Gulch to terminate close to Harbor High School; multiple configurations are possible, with the final design to be determined as part of the subsequent design/environmental analysis of this facility.

Other Common Features of the Tier I Corridor Alternatives

The Tier I Corridor Alternatives would include reconstruction of the Santa Cruz Branch Rail Line bridges over Route 1 and the State Park Drive, Capitola Avenue, 41st Avenue, and Soquel Avenue overcrossings. The Santa Cruz Branch Line railroad underpass structures are proposed to be modified or replaced to accommodate highway widening to match the ultimate six-through-lane concept, including shoulder and sidewalk facilities to accommodate pedestrians and bicycles. These modifications will lower the highway profile to provide standard clearances. In addition the Aptos Creek Bridge would be widened.

Both build alternatives would include Transportation Operations System elements such as changeable message signs, closed-circuit television, microwave detection systems, and vehicle detection systems. In addition, ramp metering and HOV on-ramp bypass lanes with highway patrol enforcement areas would be constructed on the Route 1 ramps within the Tier I project limits; however, only the HOV Lane Alternative would include HOV lanes on the mainline.

Table 1-4 summarizes the major features of the Tier I Corridor Alternatives.

Tier I Corridor HOV Lane Alternative

The Tier I Corridor HOV Lane Alternative includes the following main components, which are discussed in detail below and are shown in Figure 1-3 and in plan view in Appendix G of the EIR/EA:

- Highway mainline to include northbound and southbound HOV lanes throughout the project limits;
- Auxiliary lanes;
- Highway interchange reconfigurations and improvements such as ramp metering, on-ramp HOV bypass lanes and California Highway Patrol enforcement areas, and stormwater drainage/treatment facilities;
- Construction of three pedestrian/bicycle overcrossings;
- Reconstruction of two Santa Cruz Branch Rail Line overcrossings in Aptos;
- Widening of the Aptos Creek Bridge;
- Replacement of the Capitola Avenue overcrossing;
- Retaining walls;
- Soundwalls; and
- Traffic signal coordination and other transportation operation system improvements.

The Tier I Corridor HOV Lane Alternative would expand the existing four-lane highway to a six through-lane facility by adding HOV lanes in both the northbound and southbound directions. HOV lanes would be constructed entirely within the existing median where possible. In those areas where the median is not wide enough to accommodate additional

lanes, widening would occur outside of the existing freeway footprint. The southernmost 1.5 miles of the freeway can accommodate an HOV lane inside the existing median. From approximately Freedom Boulevard to Soquel Drive, the existing median is not wide enough to accommodate an HOV lane, so the space needed for the additional lanes would be achieved through a combination of median conversion within existing right-of-way and acquisition of property adjacent to the freeway. Plan drawings depicting the Tier I Corridor HOV Lane Alternative are presented in Appendix G of the EIR/EA, Figures HOV-1 through HOV-20.

Table 1-4: Major Project Features
Tier I Project Alternatives

Project Features	HOV Lane Alternative	TSM Alternative	No Build Alternative
Highway Mainline Changes			
HOV lanes	X		
Lower highway profile at Santa Cruz Branch Line bridge crossings[1]	X	X	
Auxiliary Lane Improvements			
Northbound and southbound between Freedom Boulevard and Rio Del Mar Boulevard	X	X	
Northbound and southbound between Rio Del Mar Boulevard and State Park Drive	X	X	
Northbound between State Park Drive and Park Avenue		X	
Southbound between State Park Drive and Park Avenue	X	X	
Northbound and southbound between Park Avenue and Bay Avenue/Porter Street	X	X	
Northbound and southbound from 41st Avenue to Soquel Avenue/Drive	X	X	
Highway Interchange Improvements			
Reconfigure all nine interchanges within project limits	X		
Reconstruct State Park Drive, 41st Avenue, and Soquel overcrossings		X	
Ramp metering	X	X	
On-ramp HOV bypass lanes	X	X	
On-ramp California Highway Patrol enforcement areas	X	X	
Stormwater drainage and treatment facilities	X	X	
New Pedestrian/Bicycle Overcrossings			
Mar Vista Drive Crossing	X	X	
Chanticleer Avenue Crossing	X	X	
Trevethan Avenue Crossing	X	X	
Santa Cruz Branch Line Bridges Replacement	X	X	
Aptos Creek Bridge Widening	X	X	
Capitola Avenue Overcrossing Replacement	X	X	
Retaining Walls	X	X	
Soundwalls	X	X	
Traffic Signal Coordination	X	X	X
Transportation Operations System	X	X	X
Transit-Supportive Improvements	X		
1 Existing highway profile does not meet vertical clearance standards for railroad bridge crossings.			

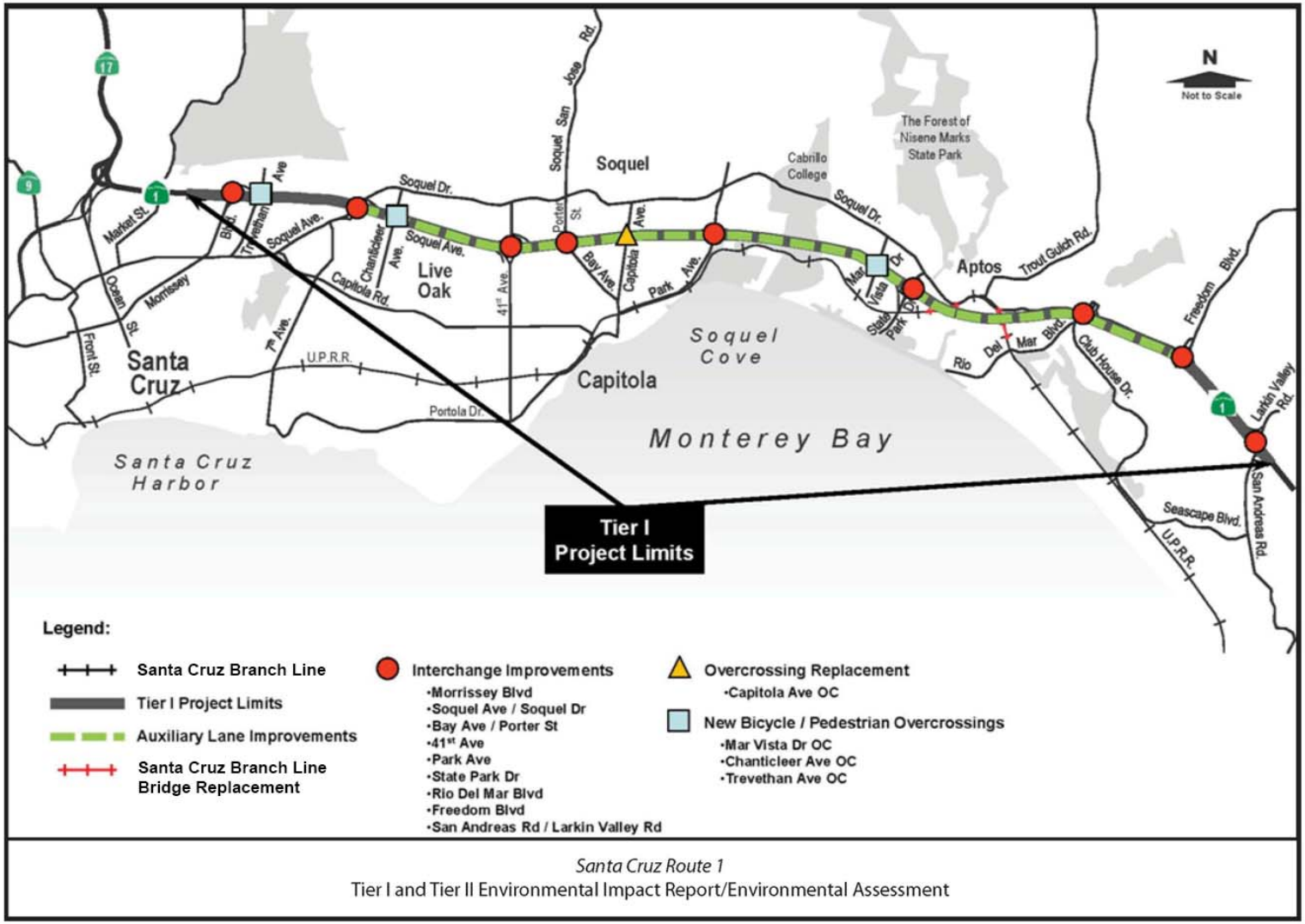


Figure 1-3: Tier I Corridor HOV Lane Alternative – Project Features

The Tier I Corridor HOV Lane Alternative would expand the existing four-lane highway to a six through-lane facility by adding HOV lanes in both the northbound and southbound directions. HOV lanes would be constructed entirely within the existing median where possible. In those areas where the median is not wide enough to accommodate additional lanes, widening would occur outside of the existing freeway footprint. The southernmost 1.5 miles of the freeway can accommodate an HOV lane inside the existing median. From approximately Freedom Boulevard to Soquel Drive, the existing median is not wide enough to accommodate an HOV lane, so the space needed for the additional lanes would be achieved through a combination of median conversion within existing right-of-way and acquisition of property adjacent to the freeway. Plan drawings depicting the Tier I Corridor HOV Lane Alternative are presented in Appendix G of the EIR/EA, Figures HOV-1 through HOV-20.

A mandatory standard median width (22 feet) set by Caltrans in its Highway Design Manual is proposed through most of the project corridor, north of Freedom Boulevard. The mandatory standard median width comprises two 10-foot-wide inside shoulders and a 2-foot-wide barrier. Where meeting the mandatory median width standard would result in acquiring property on the non-highway side of existing frontage roads, inside shoulder widths of 5 feet are proposed to reduce property requirements and impacts. Five feet is a nonstandard inside shoulder width for a Caltrans facility. This exception to shoulder-width design standards has received conceptual review in meetings between Caltrans and the project sponsor. All projects requiring design exceptions must ultimately be approved by Caltrans.

The Tier I Corridor HOV Lane Alternative would modify or reconstruct all nine interchanges within the project corridor to improve merging operations and ramp geometry by increasing the length of lanes for acceleration and deceleration, adding HOV bypass lanes and mixed-flow lanes to on-ramps, and improving sight distances. The Bay Avenue/Porter Street and 41st Avenue interchanges would be modified to operate as one interchange with frontage roads connecting the two interchanges. Where feasible, design deficiencies on existing ramps would be corrected to meet current design standards. Ramp metering and HOV bypass lanes would be provided on all Route 1 on-ramps. This alternative would include auxiliary lanes between all interchange ramps (with the exception of a northbound auxiliary lane between State Park Drive and Park Avenue) and Transportation Operations System elements, such as changeable message signs, microwave detection systems, and vehicle detection systems. Bridge structures and the Capitola Avenue overcrossing would be modified or replaced to accommodate the HOV lanes. New and widened highway crossing structures would include shoulder and sidewalk facilities to accommodate pedestrians and bicycles. The HOV Lane Alternative would include three new pedestrian/bicycle overcrossings of Route 1. The two existing Santa Cruz Branch Line structures over Route 1 in Aptos would be replaced with longer bridges at the same elevation, and the highway profile

would be lowered to achieve standard vertical clearance under the bridges to make room for the HOV and auxiliary lanes. In addition, this design configuration would reduce environmental impacts. The existing Route 1 bridge over Aptos Creek would be widened on the outside to accommodate the HOV lanes in each direction. The existing Capitola Avenue overcrossing would be replaced with a longer structure.

Retaining walls would be constructed to minimize property acquisitions and reduce environmental impacts. At locations where frontage roads are adjacent to Route 1, concrete barriers would be constructed to separate the highway and frontage road.

Changes to Highway Mainline with the Tier I Corridor HOV Lane Alternative

- Route 1 would be expanded to allow for two standard-width (12-foot) mixed-flow lanes, one standard-width (12-foot) HOV lane, and standard-width outside (10-foot) shoulders in each direction.
- The proposed lanes would be constructed within the existing 45-foot median. In locations where the existing median width is less than 45 feet, widening would occur both in the median and at the outside, generally within the existing Route 1 right-of-way.
- Where auxiliary lanes are proposed, widening by approximately 12 feet outside of the existing highway footprint would occur.
- A mandatory standard median width of 22 feet is proposed through most of the corridor.
- The highway centerline would be shifted northward in the vicinity of the Santa Cruz Branch Line crossings in Aptos to reduce impacts to wetlands. The bridge over Aptos Creek would be widened to allow for four new lanes: two HOV, two auxiliary, and pedestrian/bicycle facilities.
- Route 1 would be lowered to obtain vertical clearance at the Santa Cruz Branch Line crossings in Aptos (see Appendix G of the EIR/EA, Figures HOV-14 and HOV-15). A mandatory standard median width of 22 feet is proposed to minimize impact to the railroad bridge.
- At three locations, median and inside shoulder widths would be nonstandard to reduce impacts to adjacent streets. The three locations are: McGregor Drive, Cabrillo College Drive, and Kennedy Drive. At these three constrained locations, the inside shoulder in the constrained direction would be a nonstandard 5 feet, and the median would be a nonstandard 17 feet.

Auxiliary Lane Improvements with the Tier I Corridor HOV Lane Alternative

The auxiliary lane improvements are discussed above in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives.

Interchange Improvements with the Tier I Corridor HOV Lane Alternative

All nine interchanges within the project corridor would be modified under the Tier I Corridor HOV Lane Alternative, including overcrossing and undercrossing widening or replacement. These modifications would improve merging operations and ramp geometrics, and accessibility and safety for pedestrians and bicyclists. Major interchange improvements would include the following:

- Reconfiguration of intersections, including replacement or widening of highway overcrossings and undercrossings.
- Intersections of freeway ramps with local roads would be modified to shorten the pedestrian and bike crossing distances. Additionally, free right turns would be eliminated where feasible and traffic signals installed to improve traffic flow and slow vehicle traffic speeds through the bike and pedestrian crossing areas.
- Local roadways would be widened at the interchanges to accommodate the anticipated travel demand.
- Drainage and stormwater runoff treatment facilities would be provided.

Interchange improvements and design reconfigurations proposed for each interchange are listed in Table 1-5.

Table 1-5: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.[1]	Tier I Corridor HOV Lane Alternative Features
San Andreas/ Larkin Valley Roads Interchange	HOV-20	The existing northbound cloverleaf off-ramp free right-turn onto Larkin Valley Road would be eliminated in favor of a signalized 90-degree intersection.
		A signalized intersection would be provided at the San Andreas Road ramps and the free right-turns would be eliminated.
		The existing on-ramps would be widened to accommodate HOV bypass lanes.
		The southbound Route 1 bridge over San Andreas/Larkin Valley Road would be widened into the median to accommodate the HOV lanes.
		San Andreas/Larkin Valley Roads would be widened within the Tier I project limits to add turn lanes.
		New sidewalks would be added along San Andreas/Larkin Valley Roads within the Tier I project limits.
Freedom Boulevard Interchange	HOV-18	The existing ramp termini at Freedom Boulevard would be modified to provide less-skewed intersections with Freedom Boulevard. These intersections would be signalized, and free right-turns would be eliminated.
		The southbound off-ramp would be widened to two exit lanes.
		The existing on-ramps would be widened to accommodate HOV bypass lanes.
		Freedom Boulevard would be widened within the Tier I project limits to add turn lanes.
		The Freedom Boulevard/Bonita Drive intersection would be enlarged to add turn lanes and achieve acceptable level of service.

Table 1-5: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.[1]	Tier I Corridor HOV Lane Alternative Features
		The Freedom Boulevard bridge would be replaced with a wider structure that would accommodate a new turn lane on Freedom Boulevard and the new HOV lanes on Route 1.
		New sidewalks would be added along Freedom Boulevard within the Tier I project limits.
Rio Del Mar Boulevard Interchange	HOV-16	The northbound on-ramp would be realigned to form the north leg of a four-way intersection with Rio Del Mar Boulevard and the northbound off-ramp. This intersection would be signalized, and free right turns would be eliminated
		The northbound off-ramp would be widened to two exit lanes.
		The southbound ramps would be widened, the intersection with Rio Del Mar Boulevard signalized, and free right-turns eliminated.
		The existing on-ramps would be widened to accommodate HOV bypass lanes.
		Soquel Drive would be shifted northward to accommodate the roadway widening along the northbound off-ramp.
		Rio Del Mar Boulevard would be widened within the Tier I project limits to add turn lanes and a through lane in each direction.
		The Rio Del Mar Boulevard bridge over Route 1 would be replaced with a longer, wider bridge to accommodate a new turn lane and a through lane in each direction on Rio Del Mar Boulevard and the new HOV lanes on Route 1.
		Sidewalk would be added along eastbound Rio Del Mar Boulevard within the Tier I project limits; the sidewalk on westbound Rio Del Mar Boulevard would be retained.
State Park Drive Interchange	HOV-13	The existing northbound cloverleaf on-ramp free-right turn would be changed to a signalized right turn.
		The existing northbound off-ramp terminus would be modified to form, together with the realigned northbound on-ramp terminus, the south leg of a signalized intersection with State Park Drive.
		The northbound and southbound off-ramps would be widened to two exit lanes.
		The existing on-ramps would be widened to accommodate HOV bypass lanes.
		State Park Drive would be widened within the Tier I project limits to add turn lanes and a through lane in each direction.
		The State Park Drive bridge over Route 1 would be replaced with a longer, wider bridge to accommodate a new through-lane in each direction on State Park Drive and the new HOV lanes on Route 1.
		Sidewalk would be added along eastbound State Park Drive within the Tier I project limits; the sidewalk along westbound State Park Drive would be retained.
Park Avenue Interchange	HOV-10	The existing diamond interchange ramp design would be retained and ramps would be widened.
		The northbound and southbound off-ramps would be widened to two exit lanes.
		The existing on-ramps would be widened to accommodate HOV bypass lanes.
		Park Avenue would be widened within the Tier I project limits to add turn lanes.
		The two Route 1 bridges over Park Avenue would be replaced with one, wider structure to accommodate the new HOV lanes on Route 1.
		Sidewalk would be added within the Tier I project limits along westbound Park Avenue; the sidewalk along eastbound Park Avenue would be retained.

Table 1-5: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.[1]	Tier I Corridor HOV Lane Alternative Features
Bay Avenue/ Porter Street and 41st Avenue Interchanges	HOV-7	Improvements at the Bay Avenue/Porter Street and 41st Avenue interchanges would be designed so that these two interchanges would work as a single interchange connected by a collector/frontage road running between the interchanges.
		The freeway ramps would be reconstructed to form less-skewed intersections with Bay Avenue/Porter Street.
		The existing southbound Route 1 off-ramp to Bay Avenue/Porter Street would be eliminated. Southbound traffic bound for Bay Avenue/Porter Street would exit at the 41st Avenue two-lane off-ramp and continue on a new southbound collector/frontage road to Bay Avenue/Porter Street.
		The existing two-lane on-ramp from Porter Street to northbound Route 1 would be modified to become a northbound collector/frontage road serving traffic bound for 41st Avenue or northbound Route 1.
		Northbound traffic exiting Route 1 would either bear right to intersect with Porter Street and continue north, or stay left and continue on a new structure over Porter Street, join the northbound collector/frontage road, and end at a new signalized intersection at 41st Avenue.
		At 41st Avenue, southbound on- and off-ramps would be eliminated and replaced with a diagonal off-ramp and a collector/frontage road serving traffic bound for Bay Avenue/Porter Street or southbound Route 1. The new ramp and collector/frontage road would form a signalized intersection with 41st Avenue.
		At 41st Avenue, the northbound on-ramps would be realigned.
		New on-ramps would include HOV bypass lanes.
		41st Avenue would be widened within the Tier I project limits to add turn lanes and eastbound though lanes over Route 1.
		Bay Avenue/Porter Street would be widened to add right-turn lanes at the on-ramps.
		A new bridge over Soquel Creek and Soquel Wharf Road would be constructed for the new southbound collector/frontage road from 41st Avenue to Bay Avenue/Porter Street.
		The 41st Avenue bridge over Route 1 would be replaced with a longer, wider bridge to accommodate the new eastbound through lane and turn lanes on 41st Avenue, and the new HOV lanes on Route 1. Northbound and southbound Class I bike paths would be constructed between 41st Avenue and Bay Avenue/Porter Street on either side of the new collector/frontage roads, respectively.
Soquel Avenue/ Drive Interchange	HOV-3	The northbound off-ramp would be realigned to a signalized 90-degree intersection with Soquel Drive. The existing access to Commercial Way would be eliminated.
		The westbound Soquel Drive on-ramp to northbound Route 1 would be modified to eliminate the free right-turn access.
		The existing northbound loop on-ramp from eastbound Soquel Avenue would be realigned and its free-right terminus would become a signalized 90-degree intersection.
		A new, wider southbound diagonal off-ramp that adds turn lanes at its terminus and a new loop on-ramp would form the north leg of a signalized intersection at Soquel Avenue.

Table 1-5: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.[1]	Tier I Corridor HOV Lane Alternative Features
		The existing southbound hook on-ramp would be widened to add an HOV bypass lane and realigned to be made standard.
		The northbound and southbound off-ramps would be widened to two exit lanes.
		All new on-ramps would include HOV bypass lanes.
		Soquel Avenue within the Tier I project limits would be widened to add an eastbound through lane and turn lanes.
		Salisbury Lane would be shifted eastward to form an intersection with the realigned northbound off-ramp and loop on-ramp.
		The Soquel Drive bridge over Route 1 would be replaced with a longer, wider bridge to add an eastbound through lane and a turn lane to Soquel Drive and accommodate the new HOV lanes on Route 1.
		The culvert at Arana Gulch would be extended underneath the widened Route 1 and new southbound off-ramp.
		Sidewalk would be added along eastbound Soquel Drive within the Tier I (and Tier II) project limits; the sidewalk along westbound Soquel Drive would be retained.
Morrissey Boulevard Interchange	HOV-1	The southbound exit would be realigned to terminate at a new signalized intersection with Morrissey Boulevard.
		The existing southbound on-ramp would be eliminated and replaced with a new, wider diagonal ramp with a signalized terminus.
		The existing southbound off- and on-ramp at Elk Street would be eliminated.
		The existing northbound loop on-ramp would be eliminated, as would access to Rooney Street from this northbound loop.
		The northbound off-ramp would be widened to two exit lanes.
		New on-ramps would include HOV bypass lanes.
		Morrissey Boulevard is being replaced with a wider bridge to add an eastbound through lane and turn lanes, and realigned to form a straight line between its intersections with Fairmont Avenue and Rooney Street.
		The Morrissey Boulevard bridge is being replaced with a longer, wider bridge to accommodate a new eastbound through lane and turn lanes on Morrissey Boulevard and new HOV lanes on Route 1.
		Sidewalk would be added along eastbound Morrissey Boulevard within the Tier I project limits; the sidewalk along westbound Morrissey Boulevard would be retained.
Transit-Related Facilities	NA	Both on-ramps and both off-ramps at the reconfigured Park Avenue interchange include options for bus pads and bus shelters.
		Ramps and collectors at the Bay Avenue/Porter Street and 41st Avenue interchanges include options for bus pads and shelters.

[1] Project plan sheets are provided in Appendix G of the EIR/EA.

Transit Supportive Planning and Design

The Tier I Corridor HOV Lane Alternative would not preclude the development of the following features from being added in the future to facilitate freeway-oriented transit services and operations:

- The reconfigured Park Avenue and Bay Avenue/Porter Street/41st Avenue interchanges would allow for future bus pads and bus stop shelters to be constructed as part of a separate project.
- Future park-and-ride lots are under consideration by RTC at the Larkin Valley Road/San Andreas Road and 41st Avenue interchanges, to be coordinated with the bus facilities as part of a future project.

The aforementioned features are not part of the proposed project and would be subject to future environmental clearance. The proposed Tier I project is simply taking into consideration potential future transit projects as a collaborative planning effort.

New Pedestrian/Bicycle Overcrossings

The proposed pedestrian/bicycle overcrossings are discussed above in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives.

Tier I Corridor TSM Alternative

The Tier I Corridor TSM Alternative was formulated to provide Route 1 improvements that would partially address the purpose and need, and could be achieved at lower cost and with fewer impacts than the Tier I Corridor HOV Lane Alternative. TSM strategies typically consist of improvements that can benefit the operations of existing facilities without increasing the number of through lanes.

As discussed in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives, the Tier I Corridor TSM Alternative proposes to add auxiliary lanes, ramp metering and HOV on-ramp bypass lanes; improve existing nonstandard geometric elements at various ramps; and incorporate other TSM elements, such as changeable message signs, closed circuit television, microwave detection systems, and vehicle detection systems.). In short, the TSM Alternative shares many of the Tier I Corridor HOV Lane Alternative features, except HOV lanes would not be constructed along the mainline and the Soquel Drive interchange would be the only interchange reconfigured. Plan drawings depicting the TSM Alternative are presented in Appendix H of the EIR/EA, Figures TSM-1 through TSM-20. An overview of the major features of the TSM Alternative is provided in Figure 1-4 and in plan view in Appendix H of the EIR/EA.

Auxiliary Lanes

The majority of auxiliary lane improvements are discussed above in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives. In addition, the TSM

Alternative would have both a southbound and northbound auxiliary lane between State Park Drive and Park Avenue — improvements that are not included in the HOV Lane Alternative.

Interchange Improvements

Improvements to interchanges proposed under the Tier I Corridor TSM Alternative include the following:

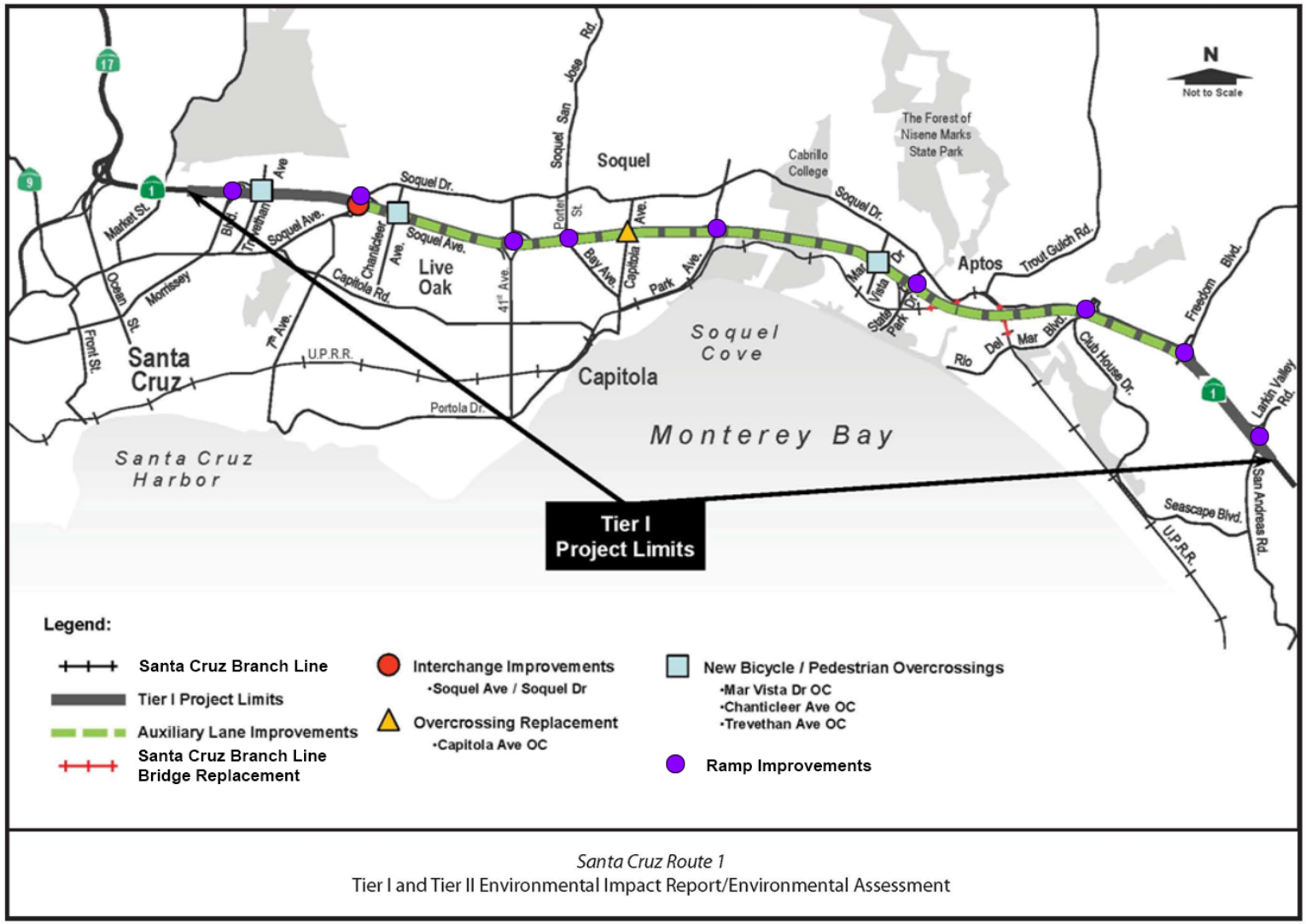
- The Soquel Avenue northbound off-ramp from Route 1 would be realigned and widened from one to two exit lanes for a distance of approximately 1,300 feet, widening to four lanes at its intersection with Soquel Drive. The northbound off-ramp/Commercial Way connection would be eliminated, and Commercial Way would become a cul-de-sac north of the realigned ramp. The intersection of the northbound off-ramp with Soquel Drive would be enlarged to achieve an acceptable level of service for the anticipated traffic volume.
- Improve existing nonstandard geometric elements at various ramps.
- Provide HOV bypass lanes on all except northbound Morrissey Boulevard on-ramps.
- Add California Highway Patrol enforcement areas at on-ramps with HOV bypass lanes.

New Pedestrian/Bicycle Overcrossings

The proposed pedestrian/bicycle overcrossings are discussed above in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives.

Other Improvements

The details of the other improvements are included above in Section 1.5 Common Design Features of the Tier I Corridor HOV Lane and TSM Alternatives.



Santa Cruz Route 1
Tier I and Tier II Environmental Impact Report/Environmental Assessment

Figure 1-4: Tier I Corridor TSM Alternative – Project Features

Tier II Auxiliary Lane Alternative

The Tier II Auxiliary Lane Alternative would construct northbound and southbound auxiliary lanes on Route 1 from 41st Avenue to Soquel Drive and make other improvements, as discussed below. Figure 1-5 shows features of the Auxiliary Lane Alternative, and Appendix I of the EIR/EA provides a plan view of the proposed Tier II project. To construct the Auxiliary Lane Alternative, right-of-way would be acquired along Soquel Avenue west of Chanticleer Avenue and at the Chanticleer Avenue cul-de-sac north of Route 1 to accommodate the bicycle/pedestrian overcrossing.

Auxiliary Lanes

The Tier II Auxiliary Lane Alternative proposes to widen Route 1 by adding an auxiliary lane in both the northbound and southbound directions between the 41st Avenue and Soquel Avenue/Drive interchanges. The total roadway widening would be approximately 1.4 miles in length. Southbound, the auxiliary lane would begin at the existing Soquel Avenue on-ramp and end at the existing off-ramp to 41st Avenue. Northbound, the auxiliary lane would begin just south of the 41st Avenue overcrossing, at the existing loop on-ramp from northbound 41st Avenue. North of the overcrossing, the on-ramp from 41st Avenue to northbound Route 1 would merge with the new auxiliary lane, approximately 1,000 feet downstream from the loop ramp.

The new auxiliary lanes would be 12 feet wide. In the southbound direction, the width needed for the new lane would be added in the median, and the median barrier would be shifted approximately 5 feet toward the northbound side of the freeway to make room for the new lane and a standard 10-foot-wide shoulder. Where the new southbound lane meets the existing ramps, outside shoulder widening would occur to achieve standard 10-foot-wide shoulders. In the northbound direction, the Tier II project proposes to pave a 10-foot-wide median shoulder and widen to the outside to add the 12-foot-wide auxiliary lane and a new 10–foot-wide shoulder.

As part of the widening in the northbound direction, the Tier II project proposes to repair an existing pavement failure in the outside lane and shoulder by improving the pavement section, installing a retaining wall and, if necessary, replacing the underlying County-owned sanitary sewer line crossing Route 1. A new concrete median battier would also be constructed.

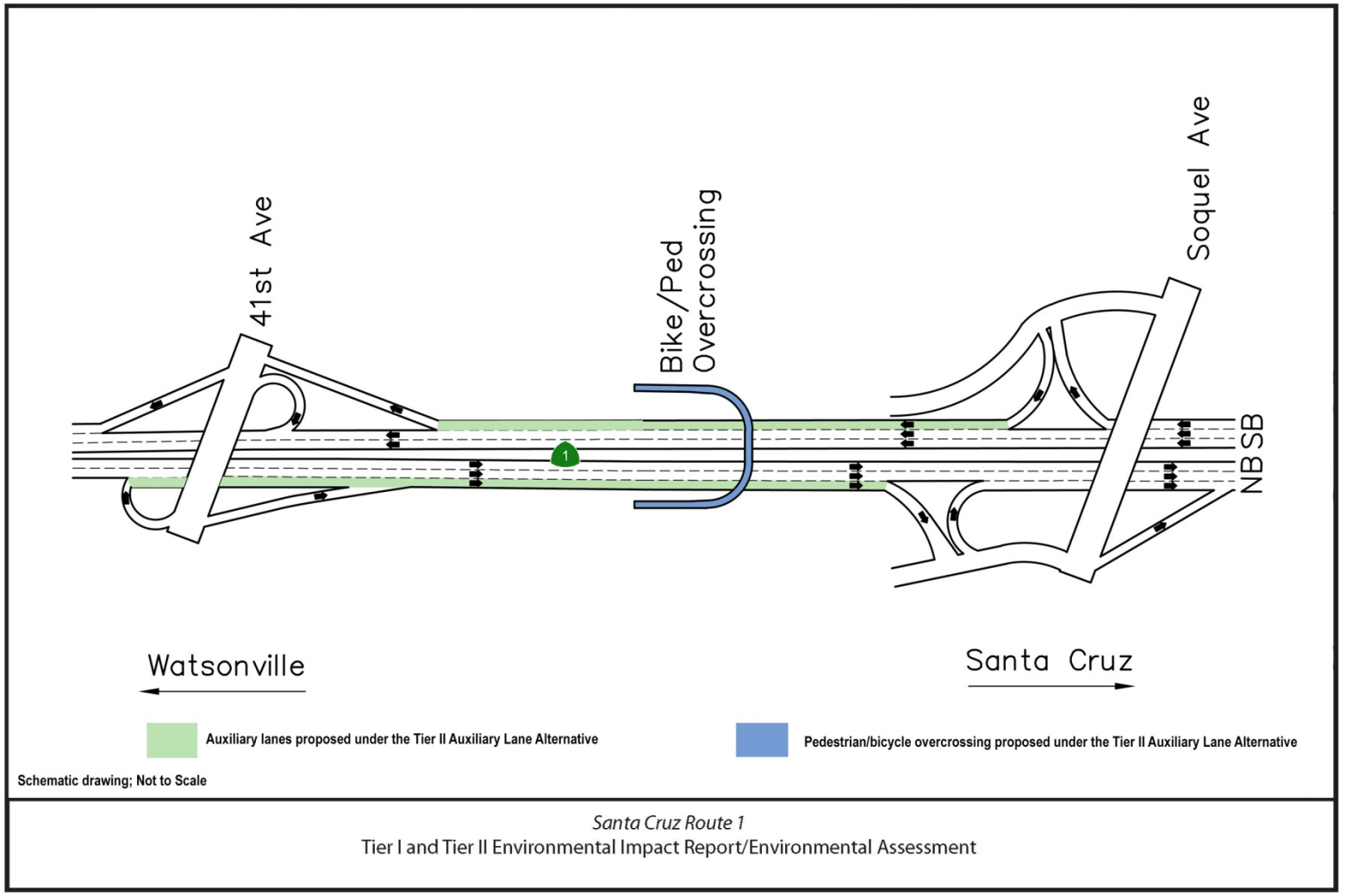


Figure 1-5: Tier II Auxiliary Lane Alternative – Project Features

Pedestrian/Bicycle Overcrossing

A new horseshoe-shaped pedestrian overcrossing is proposed over Route 1 at Chanticleer Avenue.[1] The overcrossing would vary in width from 14 feet along the ramps to 16 feet around the curves. Ramps from Chanticleer Avenue up to the overcrossing would be at approximately a 5 percent grade. Up to where the overcrossing exceeds approximately 10 feet in height, the ramp would be built on
retained fill; beyond that point, the bridge would rest on columns along the north right-of-way of Route 1, in the Route 1 median, behind the curb between Route 1 and Soquel Avenue, and along the south side of Soquel Avenue. The design of the ramps and bridge would include architectural texture or other aesthetic treatment. (See Section 2.16 for a visual simulation of the proposed Chanticleer Avenue pedestrian/bicycle overcrossing.)

In addition, a new 360-foot-long by 6-foot-wide sidewalk would be constructed along the south side of Soquel Avenue, starting at Chanticleer Avenue. The sidewalk would be separated from the street by a 4-foot-wide strip.

Retaining Walls

Retaining walls would be constructed as part of the roadway widening, with four separate walls: three on the north side of Route 1 and one on the south side. One of the retaining walls would start after the 41st Avenue on-ramp and extend approximately 150 feet; two other retaining walls on the northbound side would be 375 and 408 feet. On the southbound side, a 350-foot-long wall would be constructed along the highway mainline and Soquel Avenue, over the Rodeo Gulch culvert.

Three of the walls would be located to allow widening for an additional mainline lane on Route 1 in each direction in the future. The wall proposed along the northbound on-ramp at 41st Avenue would have to be demolished and replaced if the highway were to be widened in the future. Two of the walls would span Rodeo Creek Gulch, where there is an existing 9-foot arch concrete culvert, and one would be constructed within a narrow jurisdictional wetland area on the northbound side of Route 1, adjacent to a 39-inch culvert crossing.

No Build Alternative

The No Build Alternative offers a basis for comparing the effects of the Tier I Corridor Alternatives and the Tier II Auxiliary Lane Alternative with doing none of the proposed improvements. The No Build Alternative assumes there would be no major construction on Route 1 through the Tier I project limits other than currently planned and programmed improvements and continued routine maintenance. The following planned and programmed

[1] The overcrossing at Chanticleer is included in both the Tier I and Tier II Projects. The Tier I program of improvements encompasses the current Tier II Auxiliary Lane Project, which has been identified as the first phase of the overall program of improvements.

improvements included in the No Build Alternative are contained in the 2010 Regional Transportation Plan:

- Construction of auxiliary lanes between the Soquel Drive and Morrissey Boulevard interchanges for the Soquel to Morrissey Auxiliary Lanes Project; construction completed in December 2013.
- Replacement of the La Fonda Avenue overcrossing of Route 1, included as part of the Soquel to Morrissey Auxiliary Lanes project; construction completed in 2013.
- Reconstruction of bridges and addition of a merge lane in each direction between Highway 17 and the Morrissey/La Fonda area for the Highway 1/17 Merge Lanes Project; construction completed in 2008.
- Installation of median barrier on Route 1 from Freedom Boulevard to Rio Del Mar Boulevard.

Improvements of roadways and roadsides on Rio Del Mar Boulevard from Esplanade to Route 1, which includes the addition of bike lanes, transit turnouts, left-turn pockets, merge lanes, and intersection improvements. Roadwork includes major rehabilitation and ongoing maintenance. If the No Build Alternative is selected, it is highly likely that other improvements could be expected in the future.

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Executive Summary

The purpose of the State Route (Route) 1 High Occupancy Vehicle Lane Widening Project (Project) is to reduce congestion, encourage carpooling and the use of alternative transportation modes as the means to increase transportation system capacity, and improve safety. The Project is separated into Tier I and Tier II portions in the Environmental Document. For the Tier I Project, there are currently two build alternatives and a no-build alternative under consideration. The Tier II portion analyzes a build alternative and a no-build alternative for a construction level project on Route 1 between 41st Avenue and Soquel Drive.

This report identifies existing hydrologic and hydraulic conditions, highway drainage design elements, and hydrologic and hydraulic design standards for the Project. The design goal will be to maintain pre-construction storm water discharge flows. The proposed drainage systems within the Project limits will be designed to intercept storm water runoff from the roadway and the areas adjacent to the California Department of Transportation (Caltrans) right-of-way. Due to the increase in roadway area as a result of this Project, new longitudinal drainage systems may be proposed to accommodate the increase in flow. Detailed hydrologic and hydraulic calculations will be performed as the Project progresses into the final design phase.

For both portions of the Project, local agency requirements and regulatory requirements must be met for any proposed drainage improvements affecting local drainage systems and work in jurisdictional areas. To meet these regulatory requirements, the Project design goal will be to meter or detain storm water flows to pre-construction rates prior to discharge to a receiving water body or municipal separate storm sewer system. In addition, this Project would not significantly affect the existing drainage patterns and would try to address the increased roadway runoff from the proposed widening by implementing outlet protection, velocity dissipation devices, and possible peak flow attenuation basins, if required. The additional flows would not be significant in comparison to the overall watersheds of the receiving water bodies of the Project. In addition, the Project will consider best management practices, including water quality measures, to address potential temporary and permanent water quality impacts from the Project.

Tier I Project

The proposed Tier I Project limits begin on the southerly end of the Larkin Valley Road/San Andreas Road interchange and extend to the northerly end at the Morrissey Boulevard interchange, between Route 1 post miles R7.24 and 16.13 in Santa Cruz County. The two build alternatives are the Transportation System Management Alternative (TSM Alternative) and the High Occupancy Vehicle Lane Alternative (HOV Lane Alternative).

In the Tier I Project, the HOV Lane Alternative includes all elements of the Transportation System Management Alternative and, in addition, widens the existing

highway by adding new HOV lanes. Therefore, the HOV Lane Alternative would have more impacts to existing drainage systems.

Preliminary hydraulic calculations of the cross culverts were performed for the major creek crossings within the Tier I Project limits. These calculations showed that the 72'' (1800 mm) (height) concrete arch culvert for Arana Gulch at Station 171+03, the 48" (1200 mm) reinforced concrete pipe for the tributary to Tannery Gulch, and the 4' x 4' (1220 mm x 1220 mm) reinforced concrete box culvert for the tributary to Arana Gulch at Station 177+92 are undersized. Drainage design improvements will need to be proposed to accommodate the incoming flow. With the addition of concrete median barriers, sound walls, and retaining walls, new longitudinal systems as well as impacts to existing drainage systems will be considered. Flow diversion will be kept to the minimum extent practicable.

Tier II Project

The Tier II Project is located on Route 1 between 41st Avenue and Soquel Avenue, between Route 1 post miles 13.5 and 14.9 in Santa Cruz County. The Tier II portion of the environmental documentation examines a project-level build alternative and a no build alternative.

For the Tier II Project, the principal features that would impact existing drainage facilities are the widening of the roadway and the new retaining walls. The existing cross culverts along the Tier II Project would likely be extended due to the proposed roadway widening. The additional discharge that would be conveyed downstream should be metered such that pre-construction flows meet post-construction flows. In general, the Tier II Project would not significantly affect the existing drainage patterns.

For the Tier II Project, the drainage systems at Soquel Creek and Rodeo Creek Gulch were assessed to be sufficiently sized to pass the 100-year design discharge. Due to the negligible increase in impervious area resulting from the Tier II Project (less than for the Tier I Project), the drainage systems should still be sufficiently sized to pass the 100-year design discharge. The drainage system at Arana Gulch was assessed to be undersized to pass the 100-year design discharge and would need to be replaced with larger sizes (or parallel systems).

Acronyms

AC	Asphalt concrete
APC	Alternative pipe culvert
BMP	Best Management Practices
Caltrans	California Department of Transportation
CCC	California Coastal Commission
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFW	California Department of Fish and Wildlife
EPA	Environmental Protection Agency
ESA	Environmentally Sensitive Area
FHWA	Federal Highway Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HEC	*Hydraulic Engineering Circular*
HDM	Highway Design Manual
HOV	High Occupancy Vehicle
IDF	Intensity-duration-frequency
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
PM	Post mile
SCAS	Spatial Climate Analysis Service
SCCRTC	Santa Cruz County Regional Transportation Commission
UC	Undercrossing
USGS	United States Geological Survey
USACE	United States Army Corps of Engineers

1 GENERAL DESCRIPTION

This Drainage Report defines the hydrologic and hydraulic conditions of the existing highway drainage system within the Project limits and proposes the hydrologic and hydraulic design standards that would be used for the drainage design of the State Route (Route) 1 High Occupancy Vehicle (HOV) Lane Widening Project (Project). This report proposes the procedures, methodology, and criteria to be used in the design phase, and presents any unusual aspects of the design that may require special attention.

1.1 Project Description

The California Department of Transportation, in cooperation with the Federal Highway Administration and the Santa Cruz County Regional Transportation Commission, proposes to improve State Route 1 (Route 1) in Santa Cruz County for a distance of approximately 8.9 miles, from approximately 0.4 miles south of the San Andreas-Larkin Valley Road Interchange through the Morrissey Boulevard Interchange.

1.2 Project History

Route 1 is the primary route connecting communities in Santa Cruz County and is the only continuous commuter route linking Watsonville, Capitola, Aptos, Cabrillo College, Santa Cruz and the University of California at Santa Cruz. Approximately one quarter of commuters using Route 1 continue on Route 17 to jobs in Santa Clara County. Route 1 also is the southern terminus for Routes 9 and 17, which bring heavy tourist traffic to coastal destinations in Santa Cruz and Monterey Counties. Route 1 between San Andreas Road and the Route 1/Route 17 interchange is a four-lane divided freeway with a median varying in width from 8.2 to 62.6 feet. Within the project limits there are nine interchanges, two overcrossings, and two Santa Cruz Branch Rail Line overpass bridge structures.

The population of Santa Cruz County has doubled in the last 30 years to approximately 270,000. During this time, operational improvements have been made to the route within the Project limits, but no capacity enhancements, and this segment of Route 1 has become heavily congested during morning and evening commute times. Heavy congestion is now experienced on weekdays on Route 1 for three and a half hours in the morning from 6:30 a.m. to 10 a.m. and for four and a half hours in the evening from 2 p.m. to 6:30 p.m. Traffic projections for the No-Build scenario in design year 2035 show that from 6:00 a.m. to noon, the corridor would operate at Level of Service (LOS) F in the northbound direction. From 2:00 p.m. to 8:00 p.m., the corridor would operate at LOS F in both directions. The average northbound travel time in the AM peak hour would be as high as 59 minutes, up from 23 minutes under existing conditions. Travel time for the southbound direction during the PM peak hour would average 61 minutes, up from 27 minutes under existing conditions. In the peak commute direction in 2035 for the No-Build scenario, the average travel speed would drop from 44 mph to 18 mph in the AM and from 39 mph to 15 mph in the PM (*State Route 1 HOV Lane Project [From*

Morrissey Boulevard to San Andreas Road] Traffic Operations Report, April 2012, Wilbur Smith Associates).

This project uses a "tiered" approach to its environmental documentation. Tiering is a staged approach that addresses broad programs and issues related to the entire corridor in the Tier I analysis. As specific projects within the corridor are ready for implementation, impacts of that action are evaluated in subsequent Tier II studies. The tiered process supports decision making on issues that are ripe for decision and provides a means to preserve those decisions. The Tier I portion of the project documentation provides fact-based analyses that supports informed decision making on the 8.9-mile corridor and discloses issues associated with the selection of a Tier I Corridor alternative. Identification of a Tier I Corridor alternative will not result directly in construction; however, it will provide the basis for decision makers to select a program of transportation improvements within the corridor.

The Tier II portion of the environmental documentation examines a project-level Auxiliary Lane Alternative and a No-Build Alternative. The Tier II corridor segment is within the project limits of the Tier I corridor and would represent the first implementation phase of transportation improvements for the 8.9-mile corridor. As mentioned above, all Tier II corridor projects will be subject to separate environmental review.

1.3 Project Alternatives

Figure 1 provides a Project location map. It shows the Tier II Highway 1 41st Avenue to Soquel Avenue/Drive Auxiliary Lanes Project location in relation to the Tier I Project. The Tier II Highway 1 41st Avenue to Soquel Avenue/Drive Auxiliary Lanes Project is located between post miles 05-SCr-1 –PM 13.5/14.9. Figure 2 displays the Project limits.

1.3.1 Tier I Alternatives

The three Tier I alternatives currently under consideration are the High Occupancy Vehicle Lane Alternative, the Transportation System Management Alternative, and the No-Build Alternative.

Common Design Features of the Build Alternatives

The High Occupancy Vehicle Lane Alternative shares three primary sets of features with the Transportation System Management Alternative: new auxiliary lanes, new pedestrian/bicycle overcrossings of Route 1, and Transportation Operations System electronic equipment. These common design features are highlighted here, but the auxiliary lanes are discussed in detail within the separate description of each alternative, since specifics vary.

Auxiliary Lanes
Auxiliary lanes would be constructed in the following locations under either the High Occupancy Vehicle Lane or Transportation System Management Alternative:

- Freedom Boulevard and Rio Del Mar Boulevard – northbound and southbound.
- Rio Del Mar Boulevard and State Park Drive – northbound and southbound.
- State Park Drive and Park Avenue – both directions in the Transportation System Management Alternative; southbound only in the High Occupancy Vehicle Alternative.
- Park Avenue and Bay Avenue/Porter Street – northbound and southbound.
- 41st Avenue and Soquel Avenue/Soquel Drive – northbound and southbound.

New Bicycle/Pedestrian Overcrossings
Both build alternatives include construction of new bicycle/pedestrian overcrossings of Route 1 at Mar Vista Drive and Trevethan Avenue, as described under the High Occupancy Vehicle Lane Alternative.

Other Common Features of the Build Alternatives
Both the High Occupancy Vehicle Lane and Transportation System Management alternatives include installation of ramp metering and construction of High Occupancy Vehicle bypass lanes on the Route 1 on-ramps within the project limits. Under the Transportation System Management Alternative, however, no new High Occupancy Vehicle lanes would be incorporated into the freeway mainline. Highway Patrol enforcement areas would be included with the new High Occupancy Vehicle bypass lanes.

Both build alternatives would include reconstruction of the Santa Cruz Branch Rail Line bridges over Route 1 and the State Park Drive, Capitola Avenue, 41st Avenue and Soquel Avenue overcrossings. Also, under both alternatives, the Aptos Creek and Soquel Creek bridges would be widened.

Both the High Occupancy Vehicle Lane and Transportation System Management alternatives also would include Transportation Operations System equipment, described in detail within each alternative description.

1.3.1.1 High Occupancy Vehicle Lane Alternative

The High Occupancy Vehicle Lane Alternative would widen the existing four-lane highway to a six-lane facility by adding a High Occupancy Vehicle lane next to the median in both the northbound and southbound directions. Along the southern portion of the project, the existing median generally is wide enough to add the new High Occupancy Vehicle lanes within the existing right-of-way. A mandatory standard median width (22 feet) would be used through most of the corridor, north of Freedom Boulevard. Where existing frontage roads would be impacted, non-standard inside shoulder widths of 5 feet

are proposed to reduce right-of-way requirements and impacts. Such non-standard design features will require design exceptions when they are part of Tier II project. In some locations, widening would extend outside the existing state right-of-way.

The High Occupancy Vehicle Lane Alternative would modify or reconstruct all nine interchanges within the project limits to improve merging operations and ramp geometrics, lengthen acceleration and deceleration lanes, and improve sight distances. The Bay Avenue/Porter Street and 41st Avenue interchanges would be modified to operate as one interchange with a frontage road connecting the two interchanges. Where feasible, design deficiencies on existing ramps would be corrected to meet current design standards. Ramp metering and High Occupancy Vehicle bypass lanes would be provided on all Route 1 on-ramps. The High Occupancy Vehicle Lane Alternative would include auxiliary lanes between interchange ramps and Transportation Operations System electronic equipment, such as changeable message signs, closed-circuit television, microwave detection systems and vehicle detection systems as also described under the Transportation System Management Alternative – with the exception that an auxiliary lane would not be constructed northbound between State Park Drive and Park Avenue.

Bridge structures and the Capitola Avenue Overcrossing would be modified or replaced to accommodate the new High Occupancy Vehicle lanes. New and widened highway crossing structures would include shoulder and sidewalk facilities to accommodate pedestrians and bicycles. The High Occupancy Vehicle Lane Alternative would include two new pedestrian/bicycle overcrossings of Route 1. The existing Santa Cruz Branch Rail Line structures would be replaced, not relocated or raised, to minimize environmental impacts. The Route 1 bridge over Aptos Creek would be widened on the outside to accommodate the new High Occupancy Vehicle lanes.

Retaining walls would be constructed to minimize right-of-way acquisition and reduce or avoid environmental impacts. At locations where frontage roads are adjacent to Route 1, concrete barriers would be constructed to separate the two facilities and minimize right-of-way acquisition. The project also would include demolition and disposal, excavation, borrow and fill, sound walls, right-of-way acquisition, and temporary easements.

Mainline Improvements with the High Occupancy Vehicle Lane Alternative

- Route 1 would be widened to allow for two standard width (12 feet) mixed-flow lanes, one standard width (12 feet) High Occupancy Vehicle lane and standard outside (10 foot) shoulders.
- The proposed widening would be constructed into the median where the existing median width is over 45 feet. Where the existing median width is less than 45 feet, the required widening would be both into the median and at the outside shoulder, but generally within the existing Route 1 right-of-way.
- Where auxiliary lanes are proposed, widening to the outside would be increased by approximately 12 feet.

- A mandatory standard median width of 22 feet is proposed through most of the corridor.
- The highway centerline would be shifted northward in the vicinity of the Santa Cruz Branch Rail Line crossings to reduce impacts to wetlands. The bridge over Aptos Creek would be widened.
- Route 1 would be lowered to obtain vertical clearance at the Santa Cruz Branch Rail Line crossings in Aptos. A mandatory standard median width of 22 feet is proposed to minimize impacts to the Union Pacific Railroad.
- Median and inside shoulder width would be non-standard to reduce impacts to adjacent streets: McGregor Drive, Cabrillo College Drive, Kennedy Drive and Soquel Avenue. At these four constrained locations, the inside shoulder would be a non-standard 5 feet and the median a non-standard 17 feet.

Auxiliary Lane Improvements with the High Occupancy Vehicle Lane Alternative

Auxiliary lanes are designed to reduce conflicts between traffic entering and exiting the highway by connecting from the on-ramp of one interchange to the off-ramp of the next; they are not designed to serve through traffic. Auxiliary lanes would be added at the following locations:

- Northbound and southbound between Freedom Boulevard and Rio Del Mar Boulevard;
- Northbound and southbound between Rio Del Mar Boulevard and State Park Drive;
- Southbound between State Park Drive and Park Avenue;
- Northbound and southbound from Park Avenue to Bay Avenue/Porter Street; and
- Northbound and southbound from 41st Avenue to Soquel Drive/Soquel Avenue.

Interchange Improvements with the High Occupancy Vehicle Lane Alternative

All interchanges within the project limits would be modified to improve merging operations and ramp geometrics, and to improve accessibility and safety for pedestrians and bicyclists.

Interchange improvements would generally include the following:

- Ramp metering and High Occupancy Vehicle bypass lanes would be provided on all on-ramps.
- Ramps would be widened and their geometrics improved where feasible.
- California Highway Patrol enforcement areas would be provided at all on-ramps except Park Avenue, southbound.

- Intersections of freeway ramps with local roads would be modified to provide less-skewed intersections with crosswalks for pedestrians and bicycles; free right-turns would be eliminated where feasible and traffic signals installed.
- Local roadways would be widened at the interchanges to serve anticipated travel demand.
- Retaining walls would be constructed to minimize impacts to local roadways, development, wetlands, and waterways.
- Drainage facilities would be provided for adequate drainage and treatment of storm water runoff.
- Other specific improvements are identified by interchange area.

Changes at San Andreas/Larkin Valley Roads Interchange

- The existing northbound cloverleaf off-ramp free right-turn onto Larkin Valley Road would be eliminated in favor of a signalized 90 degree intersection.
- A signalized intersection would be provided at the San Andreas Road ramps and the free right-turns eliminated.
- The existing on-ramps would be widened to accommodate High Occupancy Vehicle bypass lanes.
- The southbound Route 1 bridge over San Andreas/Larkin Valley Road would be widened approximately 16.4 feet into the median to accommodate the High Occupancy Vehicle lanes.
- San Andreas/Larkin Valley Roads would be widened within the project limits to add turn lanes.
- New sidewalks would be added along San Andreas/Larkin Valley Roads within the project limits.

Changes at Freedom Boulevard Interchange

- The existing ramp termini at Freedom Boulevard would be modified to provide less-skewed intersections with Freedom Boulevard. These intersections would be signalized, and free right-turns eliminated.
- The southbound off-ramp would be widened to two exit lanes.
- The existing on-ramps would be widened to accommodate High Occupancy Vehicle bypass lanes.
- Freedom Boulevard would be widened within the project limits to add turn lanes.
- The Freedom Boulevard/Bonita Drive intersection would be enlarged to add turn lanes and achieve acceptable level of service.

- The Freedom Boulevard bridge would be replaced with a wider structure that would accommodate a new turn lane on Freedom Boulevard and the new High Occupancy Vehicle lane on Route 1.
- New sidewalks would be added along Freedom Boulevard within the project limits.

Changes at Rio Del Mar Boulevard Interchange

- The northbound on-ramp would be realigned to form the north leg of a four-way intersection with Rio Del Mar Boulevard and the northbound off-ramp. This intersection would be signalized, and free right turns eliminated.
- The northbound off-ramp would be widened to two exit lanes.
- The southbound ramps would be widened, the intersection with Rio Del Mar Boulevard signalized, and free right-turns eliminated.
- The existing on-ramps would be widened to accommodate High Occupancy Vehicle bypass lanes.
- Soquel Drive would be shifted northward to accommodate the roadway widening along the northbound off-ramp.
- Rio Del Mar Boulevard would be widened within the project limits to add turn lanes and a through lane in each direction.
- The Rio Del Mar Boulevard bridge over Route 1 would be replaced with a longer, wider bridge to accommodate a new turn lane and a through lane in each direction on Rio Del Mar and the new High Occupancy Vehicle lane on Route 1.
- Sidewalk would be added along eastbound Rio Del Mar Boulevard within the project limits; sidewalk on westbound Rio Del Mar Boulevard is existing.

Changes at State Park Drive Interchange

- The existing northbound cloverleaf on-ramp free-right would be changed to a signalized right turn.
- The existing northbound off-ramp terminus would be modified to form, together with the realigned northbound on-ramp terminus, the south leg of a signalized intersection with State Park Drive.
- The northbound and southbound off-ramps would be widened to two exit lanes.
- The existing on-ramps would be widened to accommodate High Occupancy Vehicle bypass lanes.
- State Park Drive would be widened within the project limits to add turn lanes and a through lane in each direction.

- The State Park Drive bridge over Route 1 would be replaced with a longer, wider bridge to accommodate a new through lane in each direction on State Park Drive, and the new High Occupancy Vehicle lane on Route 1.
- Sidewalk would be added along eastbound State Park Drive within the project limits; sidewalk along westbound State Park Drive is existing.

Changes at Park Avenue Interchange

- The existing diamond interchange ramp design would be retained and ramps would be widened.
- The northbound and southbound off-ramps would be widened to two exit lanes.
- The existing on-ramps would be widened to accommodate High Occupancy Vehicle bypass lanes.
- Park Avenue would be widened within the project limits to add turn lanes.
- The two Route 1 bridges over Park Avenue would be replaced with one, wider structure to accommodate the new High Occupancy Vehicle lanes on Route 1.
- Sidewalk would be added within the project limits along westbound Park Avenue; sidewalk along eastbound is existing.

Changes at Bay Avenue/Porter Street and 41st Avenue Interchanges

- Improvements at the Bay Avenue/Porter Street and 41st Avenue interchanges are designed so that these two interchanges would work as a single interchange connected by a collector/frontage road running between the interchanges.
- The ramps at Bay Avenue/Porter Street would be reconstructed to form less skewed intersections with Bay Avenue/Porter Street.
- The existing southbound Route 1 off-ramp to Bay Avenue/Porter Street would be eliminated. Southbound traffic bound for Bay Avenue/Porter Street would exit at 41st Avenue two-lane ramp and continue on a new southbound collector/frontage road to Bay Avenue/Porter Street.
- The existing on-ramp from Porter Street to northbound Route 1 on a two-lane ramp would be modified to become a northbound collector/frontage road serving traffic bound for 41st Avenue or northbound Route 1.
- Northbound traffic exiting Route 1 would bear right to access Bay Avenue/Porter Street, or stay left and continue on a new structure over Bay Avenue/Porter Street, join the northbound collector/frontage road, and end at a new signalized intersection at 41st Avenue.
- At 41st Avenue, southbound on- and off-ramps would be eliminated and replaced with a diagonal off-ramp and a collector/frontage road serving traffic bound for

Bay Avenue/Porter Street or southbound Route 1. The new ramp and collector/frontage road would form a signalized intersection with 41st Avenue.

- At 41st Avenue, the northbound on-ramps would include a realigned loop and realigned diagonal.
- New on-ramps would include High Occupancy Vehicle bypass lanes.
- 41st Avenue would be widened within the project limits to add turn lanes and eastbound though lanes over Route 1.
- Bay Avenue/Porter Street would be widened to add right-turn lanes at the on-ramps.
- A new bridge over Soquel Creek and Soquel Wharf Road would be constructed for the new southbound collector/frontage road from 41st Avenue to Bay Avenue/Porter Street.
- The 41st Avenue bridge over Route 1 would be replaced with a longer, wider bridge to accommodate the new eastbound through lane and turn lanes on 41st Avenue, and the new High Occupancy Vehicle lanes on Route 1.
- Class I bike paths would be constructed between 41st Avenue and Bay Avenue/Porter Street adjacent to the new collector/frontage roads.

Changes at Soquel Drive/Soquel Avenue Interchange

- The northbound off-ramp would be realigned to a signalized 90 degree intersection with Soquel Drive. The existing access to Commercial Way would be eliminated.
- The westbound Soquel Drive on-ramp to northbound Route 1 would be modified to eliminate the free right-turn access.
- The existing northbound loop on-ramp from eastbound Soquel Avenue would be realigned and its free-right terminus would become a signalized 90 degree intersection.
- A new, wider southbound diagonal off-ramp that adds turn lanes at its terminus and a new loop on-ramp would form the north leg of a signalized intersection at Soquel Avenue.
- The existing southbound hook on-ramp would be widened to add a High Occupancy Vehicle bypass lane and realigned to be made standard.
- The northbound and southbound off-ramps would be widened to two exit lanes.
- New on-ramps would include High Occupancy Vehicle bypass lanes.
- Soquel Avenue within the project limits would be widened to add an eastbound though lane and turn lanes.

- Salisbury Lane would be shifted eastward to form an intersection with the realigned northbound off-ramp and loop on-ramp.
- The Soquel Drive/Soquel Avenue bridge over Route 1 would be replaced with a longer, wider bridge to add an eastbound through lane and a turn lane to Soquel Drive and accommodate the new High Occupancy Vehicle lane on Route 1.
- The culvert at Arana Gulch would be extended underneath the widened Route 1 and new southbound off-ramp.
- Sidewalk would be added along eastbound Soquel Drive/Soquel Avenue within the project limits; sidewalk along westbound Soquel Drive/Soquel Avenue is existing.

Changes at Morrissey Boulevard Interchange

- The southbound exit would be realigned to terminate at a new signalized intersection with Morrissey Boulevard.
- The existing southbound on-ramp would be eliminated and replaced with a new, wider diagonal ramp with a signalized terminus.
- The existing southbound exit and on-ramp at Elk Street would be eliminated.
- The existing northbound loop on-ramp would be eliminated, as would access to Rooney Street from this northbound loop
- The northbound off-ramp would be widened to two exit lanes.
- New on-ramps would include High Occupancy Vehicle bypass lanes.
- Morrissey Boulevard within the project limits would be widened to add an eastbound through lane and turn lanes, and realigned to form a straight line between its intersections with Fairmont Avenue and Rooney Street.
- The Morrissey Boulevard bridge would be replaced with a longer, wider bridge to accommodate a new eastbound through lane and turn lanes on Morrissey Boulevard and new High Occupancy Vehicle lanes on Route 1.
- Sidewalk would be added along eastbound Morrissey Boulevard within the project limits; sidewalk along westbound Morrissey Boulevard is existing.

Transit-Related Facilities

In addition to the mainline High Occupancy Vehicle through-lanes on the highway and High Occupancy Vehicle bypass lanes on the ramps, the High Occupancy Vehicle Lane Alternative could include the following features to facilitate freeway-oriented transit services and operations:

- Both on-ramps and off-ramps at the reconfigured Park Avenue interchange include options for bus pads and bus shelters.
- Ramps and collectors at the Bay Avenue/Porter Street and 41st Avenue interchange include options for bus pads and shelters.
- A future Park and Ride lot is under consideration at the 41st Avenue interchange, to be coordinated with the bus facilities.
- Feasibility for a Park and Ride lot in the Bay Avenue/Porter Street interchange area would be investigated.

These improvements would be considered as part of the detailed Tier II design/ environmental analysis of those respective facilities in the future.

New Bicycle/Pedestrian Overcrossings

The High Occupancy Vehicle Lane Alternative would construct new bicycle/pedestrian overcrossings of Route 1 at the following locations:

- Mar Vista Drive – the crossing would start on the north side of Route 1 and parallel the highway eastward for about 600 feet, doubling back westward as it climbs before crossing the highway at a right angle and then descending by switchbacks to and along Mar Vista Drive for about 550 feet; multiple configurations are under consideration the final design will be determined as part of the Tier II design/environmental analysis of this facility.
- Chanticleer Avenue – the crossing would start at the Chanticleer cul-de-sac on the north side of Route 1 and parallel the highway for about 400 feet to the west before crossing it on a curved alignment, returning to terminate just west of Chanticleer on the south side of the highway.
- Trevethan Avenue – the crossing would start on the north side of Route 1 at Trevethan Avenue and parallel the highway about 600 feet before crossing on an angle and continuing along the banks of the western tributary to Arana Gulch to terminate close to Harbor High School; multiple configurations are possible with the final design to be determined as part of the Tier II design/environmental analysis of this facility.

1.3.1.2 Transportation System Management Alternative

The Transportation System Management Alternative proposes to add ramp metering and construct High Occupancy Vehicle bypass lanes on existing interchange on-ramps, improve existing nonstandard geometric elements at various ramps, and add auxiliary lanes along the mainline between major interchange pairs within the project limits, as

described below and summarized under Common Design Features of the Build Alternatives.

It would not construct High Occupancy Vehicle lanes or any additional through lanes on the mainline.

The common design features of the Build Alternatives section describes other features included in the Transportation System Management Alternative.

Auxiliary Lanes

Auxiliary lanes are designed to reduce conflicts between traffic entering and exiting the highway by connecting from the on-ramp of one interchange to the off-ramp of the next; they are not designed to serve through traffic. Auxiliary lanes to be constructed on Route 1 with the Transportation System Management Alternative consist of the following:

- Northbound and southbound between Freedom Boulevard and Rio Del Mar Boulevard.
- Northbound and southbound between Rio Del Mar Boulevard and State Park Drive.
- Northbound and southbound between State Park Drive and Park Avenue.
- Northbound and southbound between Park Avenue and Bay Avenue/Porter Street.
- Northbound and southbound from 41st Avenue to Soquel Drive/Soquel Avenue.

New Bicycle/Pedestrian Overcrossings

The Transportation System Management Alternative would construct new bicycle/pedestrian overcrossings of Route 1 at Mar Vista Drive, Chanticleer Avenue, and Trevethan Avenue as described under the High Occupancy Vehicle Lane Alternative.

Other Improvements

- At Freedom Boulevard, the southbound off-ramp would be widened to two exit lanes.
- At State Park Drive, the northbound and southbound off-ramps would be widened to two exit lanes.
- At Park Avenue, the northbound and southbound off-ramps would be widened to two exit lanes.

  Like the High Occupancy Vehicle Lane alternative, the Transportation System Management alternative would widen the Soquel Avenue northbound and southbound off-ramps to provide two exit lanes, but the southbound ramp would not be realigned and the northbound ramp realignment would not be as significant as in the High Occupancy Vehicle alternative. Also as in the High Occupancy

Vehicle alternative, the realigned northbound off-ramp would eliminate access to Commercial Way.

1.3.1.3 No-Build Alternative

The No-Build Alternative offers a basis of comparison with the Transportation System Management and High Occupancy Vehicle Lane Alternatives in the future analysis year of 2035. It would not address the project purpose and need. It assumes no major construction on Route 1 through the project limits other than currently planned and programmed improvements and continued routine maintenance. Planned and programmed improvements included in the No-Build Alternative are the following improvements contained in the 2010 Regional Transportation Plan:

- Installation of median barrier on Route 1 from Freedom Boulevard to Rio Del Mar Boulevard.
- Construction of auxiliary lanes between the Soquel Avenue-Soquel Drive and Morrissey Boulevard interchanges (EA 05-0F6500, completed May 2013).
- Replacement of the La Fonda Avenue overcrossing of Route 1, included as part of the Soquel-Morrissey Auxiliary Lanes project.

Also included in the No-Build Alternative are a number of locally-sponsored projects for improving the local arterial network and constructing or improving bicycle lanes.

1.3.2 Tier II Alternative

The Tier II project purpose matches that of the Santa Cruz County Route 1 High Occupancy Vehicle project, that is, reducing congestion and encouraging use of alternative transportation modes as a means to increase system capacity, except that encouraging carpooling is not a part of the Tier II project purpose.

Auxiliary Lanes

It is proposed to widen Route 1 by adding an auxiliary lane to both the northbound and southbound sides between the 41st Avenue and Soquel Drive interchanges. The total roadway widening would be approximately 1.2 miles in length. Southbound, the auxiliary lane would begin at the existing Soquel Drive on-ramp, and end at the existing off-ramp at 41st Avenue. Northbound, the auxiliary lane would begin just south of the 41st Avenue overcrossing, at the existing loop on-ramp to northbound 41st Avenue. West of the overcrossing, the on-ramp from southbound 41st Avenue to northbound Route 1 would merge with the new auxiliary lane, approximately 1,000 feet downstream from its beginning at the bottom of the loop ramp.

As part of the widening in the northbound direction, the project proposes to repair the pavement failure in the outside lane and shoulder by improving the pavement section, installing a retaining wall, and if necessary, replacing the underlying county-owned sanitary sewer.

Pedestrian Features

A new horseshoe-shaped pedestrian overcrossing at Chanticleer Avenue is proposed, and approximately 400 feet of sidewalk would be constructed along the south side of Soquel Avenue, starting at Chanticleer Avenue.

Retaining Walls

Retaining walls would be constructed as part of the roadway widening, with a total of four separate walls: three on the northbound side of the highway and one on the southbound side. Three of the walls would be located to allow widening for a future lane on the highway, in both directions. The wall proposed along the northbound on-ramp at 41st Avenue would require demolition in the event the highway was widened in the future. Two of the walls would span Rodeo Creek Gulch, where there is an existing 9 foot arch concrete culvert, and one would be constructed within a narrow jurisdictional area on the northbound side of Route 1, adjacent to a 39 inch culvert crossing.

Right-of-Way

Right-of-way would be acquired along Soquel Avenue west of Chanticleer Avenue and at the Chanticleer Avenue cul-de-sac north of the highway, along with temporary construction easements on both sides of Route 1 near the proposed overcrossing.

1.4 Need for Project

The need for the project is summarized by these deficiencies on Route 1 within the project limits:

- Several bottlenecks along Route 1 in the southbound and northbound directions cause recurrent congestion during peak hours;
- Travel time delays due to congestion and related accidents are experienced by commuters, commerce, and emergency vehicles;
- "Cut-through" traffic, or traffic on local streets, occurs and is increasing because drivers seek to avoid congestion on the highway;
- Limited opportunities for pedestrians and bicyclists to safely get across Route 1 within the project limits;
- Insufficient support facilities and incentives to increase transit service that operates in the Route 1 corridor because congestion threatens reliability and cost-effective transit service delivery; and
- Inadequate facilities to support carpooler and rideshare vehicles over single-occupancy vehicles; therefore, incentives, such as travel time savings, and reliability are difficult to achieve.

1.4.1 Tier I Project

The purpose of the proposed project is to achieve the following within the Tier I project limits:

- Reduce congestion; and
- Encourage carpooling and use of alternative transportation modes as a means to increase transportation system capacity.

1.4.2 Tier II Project

The Tier II project purpose matches that of the Tier I project, except that encouraging carpooling is not a part of the Tier II project purpose.

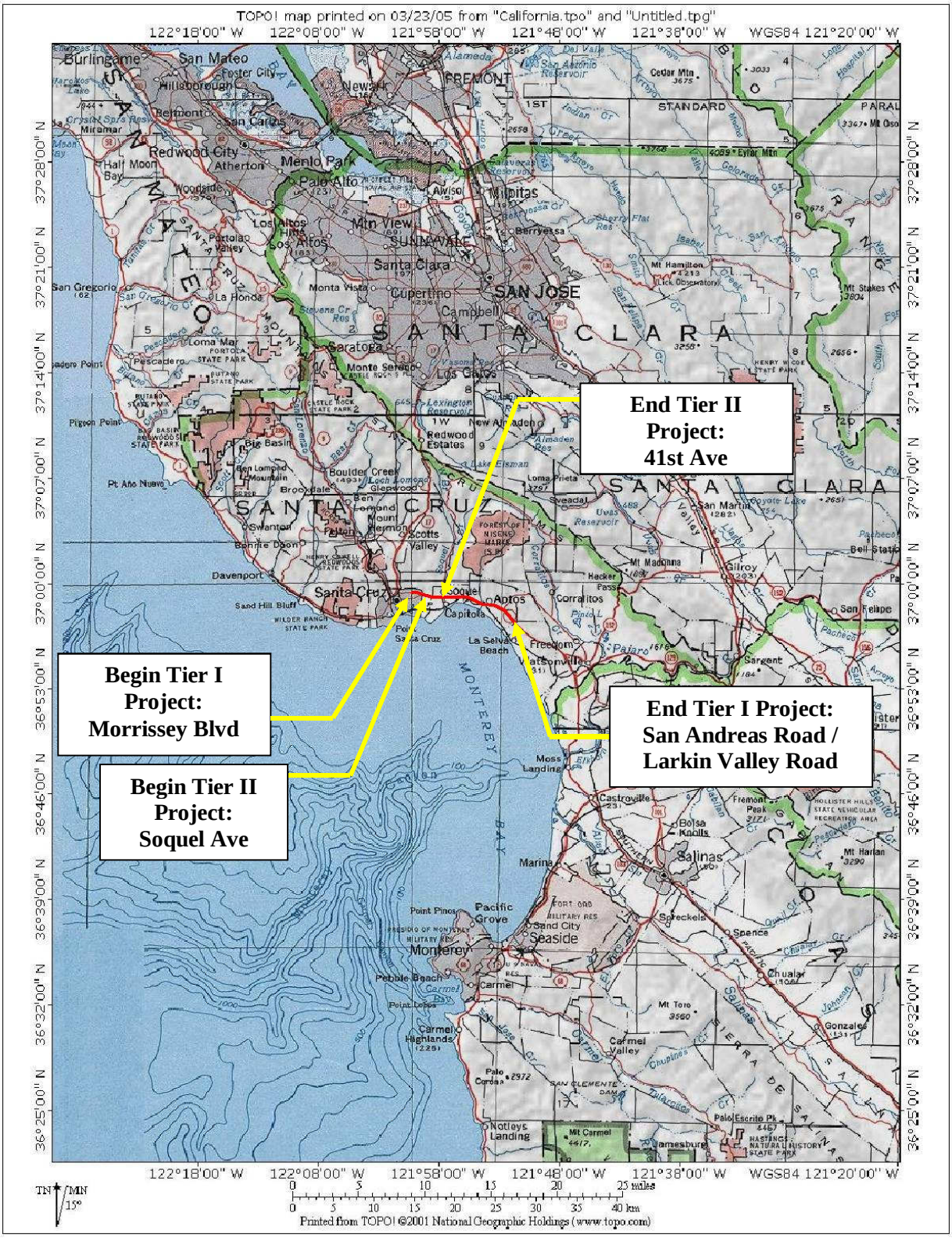

Figure 1. Location Map

Source: United States Geological Survey (USGS)

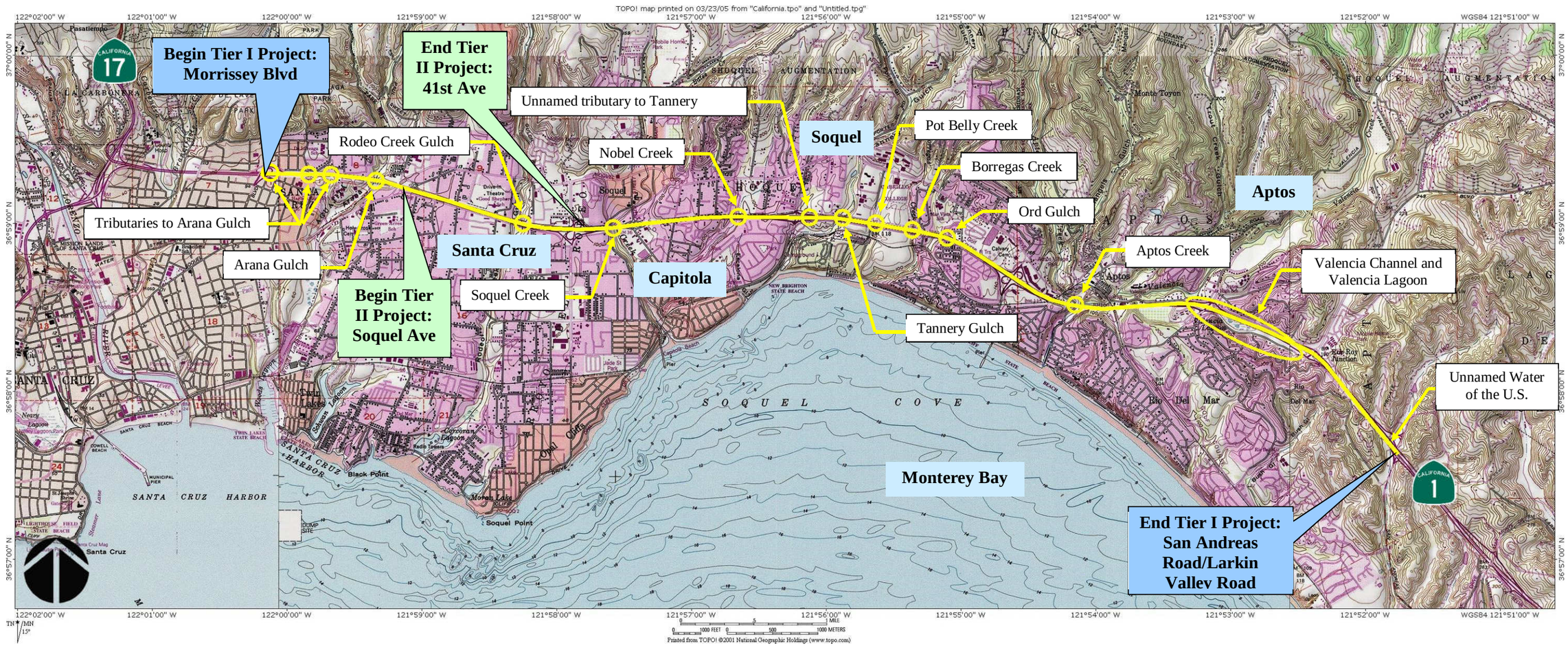

Figure 2. Vicinity Map and Waterway Crossings

Source: USGS

1.5 Reference Documents

1.5.1 As-Built Record Documents

- EA 04-116984 (Caltrans, 1990)
- EA 04-133844 (Caltrans, 1968)
- EA 04-135334 (Caltrans, 2001)

1.5.2 Preliminary Layout Sheets

- Tier I Project: Transportation System Management
- Tier I Project: High Occupancy Vehicle Lane
- Tier II Project: Build Alternative

1.5.3 Geographical References

Project maps were based on the following quadrangles from the United States Geological Survey (USGS): Santa Cruz, Soquel, Watsonville West, Laurel, Loma Prieta, and Felton.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) and flood profiles from the Flood Insurance Study (FIS) for Santa Cruz County, CA Unincorporated and Incorporated Areas were reviewed for base flood elevations at Highway 1 waterway crossings (2006). The base flood is a flood that has a 1% chance of occurrence in any given year.

The vertical control for the elevations in the FIRM and FIS are based on the National Geodetic Vertical Datum of 1929 (NGVD 29). The survey for this Project is based on the North American Vertical Datum of 1988 (NAVD 88).

Using an orthometric height conversion tool from the National Geodetic Survey website, the datum shift (from NAVD 88 to NGVD 29) was calculated based on the locations of each waterway crossing along Route 1. The calculated datum shifts are summarized in Table 1.

Table 1. Datum Shifts

Location	Latitude	Longitude	Datum Shift	
			(ft)	(m)
Aptos Creek	36.97527° N	121.90088° W	2.74	0.836
Nobel Creek	36.98416° N	121.94322° W	2.76	0.840
Soquel Creek	36.98298° N	121.95897° W	2.75	0.838
Rodeo Creek Gulch	36.98333° N	121.96992° W	2.75	0.837
Arana Gulch	36.98767° N	121.98811° W	2.74	0.834

Elevations from the FEMA FIS and FIRMs were adjusted by adding the datum shift to convert from NGVD 29 to NAVD 88. For example, the base flood elevations at Aptos Creek were adjusted by adding 0.836 m (2.74 ft) to convert from NGVD 29 to NAVD 88.

1.6 Soil Characteristics

A Geologic and Seismic Section report was prepared for the Project by Nolte Associates, Inc. in 2008. In general the following geologic units for the Project are described below:

- Qt: Marine terrace deposits (Pleistocene) – Weakly consolidated to semi consolidated, moderately to poorly sorted silt, silty clay, sand, and gravel mostly deposited in a fluvial environment
- Qpa: Alluvium (Pleistocene) – Sand, fine sand, silt, and one or more buried soils capping mesas, broad interfluves, and adjacent low-angle slopes
- Qha: Alluvium (Holocene) – Poorly to moderately sorted clay, silt, sand, and minor gravel in the active, incised channel of larger tributary arroyos
- Qs: Beach and dune sand (Quaternary) – Unconsolidated alluvial clay, silt, sand, and gravel along rivers and streams, includes beach, bar, and dune sands, marine terraces, and estuarine mud and sands in coastal areas
- Tmps: Sedimentary rock (Pliocene) – Mostly soft, tan, gray, yellow, brown, pink, and green, thin- to medium- bedded, mostly planar-bedded, fine to coarse-grained sandstone, siltstone, and conglomerate

Source: Nolte Associates, Inc.

The aforementioned Geologic and Seismic Section report also included erosion and sedimentation evaluations for the Project. Table 2 summarizes the underlying native soil units and their impact from drainage and permeability.

Based on the evaluated soil listed in Table 2, there are two types of soil units that have high runoff potential: Baywood loamy sand (105, 106) and Zayante coarse sand (182). The evaluated soil units also revealed a high erosion hazard for Baywood loamy sand (105, 106). The Geologic and Seismic Section report concluded that the upper soil zone appears to have been prepared during construction activities. The highway might have been constructed in the native upper soil for the existing condition and the upper pavement section consists of import material (base and subbase). Soils in the Project area are mainly loam to sandy loam. The permeability (hydraulic conductivity) of the area is moderately high to high and runoff is very slow to high. Drainage features for the soils in the Project area were classified as poorly drained to excessively drained and the erosion hazard is moderately low to high. Logs of Test Borings that were evaluated are submerged cohesionless subsoils and were classified as primarily medium dense to very dense. Liquefaction susceptibility was low in the majority of the Project area, except for two locations, the Park Avenue undercrossing (UC) and Bay Area Avenue UC, where loose sands were encountered.

Table 2. Soil Units, Erosion Potential, Permeability, Drainage, Runoff, and Erosion Hazard

Soil Unit	Map Unit Name	Surface texture	Permeability	Drainage	Runoff	Hydrologic Soil Group
105 106	Baywood loamy sand	Loamy sand	High	Excessively drained	High	A
114	Ben Lomond - Felton	Sandy loam	High	Well drained	Moderately slow	B
116	Bonny Doon loam	Loam	Moderately high	Excessively drained	Slow	NF
124	Danville loam	Loam	High	Well drained	Slow	NF
129 130	Elder sandy loam	Sandy loam	Moderately high	Well drained	Moderately slow	NF
133 134 135 136	Elkhorn sandy loam	Sandy loam	High	Well drained	Moderately slow	B
143	Lompico-Felton complex	Loam	High	Well drained	Moderately slow	B
161 162	Pinto loam	Loam	Moderately high	Moderately well drained	Slow	C
170 171	Soquel loam	Loam	Moderately high	Moderately well drained	Moderately slow	B
174	Tierra Watsonville Complex	Sandy loam	Moderately high	Moderately well drained	Very slow	NF
176 177 178 179	Watsonville loam	Loam	Moderately high	Poorly drained	Very slow	NF
182	Zayante coarse sand	Coarse sand	High	Excessively drained	High	A

Source: Nolte Associates, Inc.

1.7 Land Use

1.7.1 Tier I Project

The land use in the vicinity of the Tier I Project is developed with some open lots and surrounding vegetation. The adjacent areas are mostly residential with the exception of the span between the 41st Street exit and Soquel Drive, which is mostly commercial.

1.7.2 Tier II Project

The land use in the vicinity of Tier II Project, the span between the 41st Street exit and Soquel Drive, is mostly commercial.

1.8 Creeks, Streams, and River Crossings

1.8.1 Tier I Project

Fifteen waterways cross Route 1 within the Tier I Project limits (see Figure 2). The sizes and types of these crossings within the Tier I Project limits are listed in Table 3. These are the highway's direct receiving water bodies. These crossings were located by reviewing as-built record drawings, site visits, and the *Wetland Assessment* report (Morro Group, 2008).

Table 3. Drainage Facilities at Major Crossings – Tier I Project

Waterway	Station at Route 1 Crossing	Drainage Facility	
		English	Metric
Unnamed water of the U.S.	49+65	84 in. corrugated steel pipe	2100 mm corrugated steel pipe
Valencia Channel	75+30	culvert size unknown	culvert size unknown
Aptos Creek[1,2]	90+00	concrete bridge	concrete bridge
Ord Gulch	107+85	48 in. concrete culvert	1200 mm concrete culvert
Borregas Creek	110+69	48 in. concrete culvert	1200 mm concrete culvert
Pot Belly Creek	114+90	30 in. reinforced concrete pipe culvert	760 mm reinforced concrete pipe culvert
Tannery Gulch	118+64	6 ft x 6 ft reinforced concrete box culvert	1830 mm x 1830 mm reinforced concrete box culvert
Unnamed tributary to Tannery Gulch	122+66	48 in. reinforced concrete pipe culvert	1200 mm reinforced concrete pipe culvert
Nobel Creek	130+08	6 ft x 6 ft reinforced concrete box culvert	1830 mm x 1830 mm reinforced concrete box culvert
Soquel Creek[2]	143+60	98 ft wide, 323 ft span concrete arch span bridge	29.9 m wide, 98.5 m span concrete arch span bridge
Rodeo Creek Gulch	154+24	9 ft concrete arch culvert	2700 mm concrete arch culvert
Arana Gulch	171+03	72 in. (height) concrete arch culvert	1800 mm (height) concrete arch culvert
Tributary to Arana Gulch	175+98	36 in. reinforced concrete pipe culvert	900 mm reinforced concrete pipe culvert
Tributary to Arana Gulch	177+92	4 ft x 4 ft reinforced concrete box culvert	1220 mm x 1220 mm reinforced concrete box culvert
Tributary to Arana Gulch	183+01	30 in. reinforced concrete pipe culvert	760 mm reinforced concrete pipe culvert

Notes: 1. WRECO staff observed that scour from Aptos Creek resulted in loss of bed material at the Aptos bridge piers.

2. Concrete bags at the pier footings are deteriorating due to scour from Soquel Creek. Scouring at the Aptos Creek crossing and the deterioration of gravel bags at the Soquel Creek crossing will be addressed in the Tier I project. When the projects that include those creeks' bridges move forward as Tier II projects, further studies of the hydraulic modifications required will be part of their project approval and documentation.

1.8.2 Tier II Project

Within the Tier II Project limits, there is one major waterway crossing: the Rodeo Creek Gulch crossing, which is a 9-ft concrete arch culvert. Although they are outside of the Tier II Project limits, Soquel Creek and Arana Gulch would also receive runoff from the Tier II Project due to the existing topography. The Tier II Project would add impervious areas that would affect three streams: Soquel Creek, Rodeo Creek Gulch, and Arana Gulch, all of which have associated floodplains.

1.9 Existing Drainage and Drainage Design Issues

1.9.1 Tier I Project

Tier I Project has two build alternatives under consideration: the Transportation System Management Alternative and the HOV Lane Alternative. The HOV Lane Alternative includes all elements of the Transportation System Management Alternative and, in addition, widens the existing highway by adding new HOV lanes. Therefore, the HOV Lane Alternative would have more impacts to existing drainage systems in the median than the Transportation System Management Alternative.

The existing drainage system within the Tier I Project limits is composed mostly of cross culverts, bridge crossings over major creeks, asphalt concrete dikes with inlets to collect storm water at shoulders, overside drains, and roadside drainage ditches in the median. For both alternatives under the Tier I Project, the principal feature that would impact existing drainage facilities is the widening of the roadway and the construction of new retaining walls and sound walls proposed at the edge of shoulders. The Soquel Creek and Aptos Creek bridges would both be widened as part of the Tier I Project. Culverts in serviceable condition would have to be extended to address the proposed widening and to maintain existing drainage patterns. Undersized culverts would have to be replaced with larger sizes and additional inlets, and new longitudinal systems may need to be specified to meet the current drainage design requirements (time of concentration of 5 minutes). Existing drainage systems at the edge of shoulders may need to be relocated, or new systems would need to be proposed to address new retaining walls and sound walls. There are no proposed drainage improvements outside Caltrans' right-of-way. Upstream off-site drainage areas flowing through cross culverts would be maintained, and downstream drainage systems would need to be evaluated for any impacts.

For the HOV Lane Alternative, the proposed widening in the median, along with new concrete median barriers, would affect existing drainage systems within the median. New longitudinal systems and inlets would need to be proposed at these locations to convey the flow that would be blocked by these barriers.

In general, this Tier I Project would not significantly affect the existing drainage patterns and would try to address the increased roadway runoff from the proposed widening by implementing outlet protection, velocity dissipation devices, and possible peak flow attenuation basins. The additional flows are not significant in comparison to the overall

watershed of the receiving water bodies of the Tier I Project. The Tier I Project design goal will be to maintain pre-construction storm water flows by metering or detaining these flows to pre-construction rates prior to discharging to a receiving water body or municipal separate storm sewer system.

1.9.2 Tier II Project

The existing drainage systems along the Route 1 corridor within the Tier II Project limits consist primarily of cross culverts, asphalt concrete dikes with inlets to collect storm water at shoulders, overside drains, and roadside drainage ditches in the median.

For the Tier II Project, the principal features that would impact existing drainage facilities are the widening of the roadway and the construction of new retaining walls. As with the Tier I Project, the existing cross culverts along the Tier II Project would likely be extended due to the proposed roadway widening.

In general, the Tier II Project would not significantly affect the existing drainage patterns and would try to address the increased roadway runoff resulting from the proposed roadway widening by implementing outlet protection, velocity dissipation devices, and possible peak flow attenuation basins. As with the Tier I Project, the additional flows are not significant in comparison to the overall watershed of the receiving water bodies. The Tier II Project design goal will be to maintain pre-construction storm water flows by metering or detaining these flows to pre-construction rates prior to discharge to a receiving water body or municipal separate storm sewer system.

1.10 Drainage Design Criteria

During the Plans, Specifications, and Estimates (PS&E) phase, the drainage design for the Route 1 HOV Lane Widening Project will be based on procedures presented in the updated fifth edition of the Highway Design Manual (HDM) from Caltrans and the Hydraulic Engineering Circular Number 22 (HEC-22) publication for highway pavement drainage from the Federal Highway Administration (FHWA). For cross culverts, drainage improvements will be evaluated and designed based on the criteria of passing the entire 10-year event within the cross culvert and the 100-year event without objectionable backwater. The final on-site hydrology calculations for this segment should utilize the Rational Method to predict storm water runoff. Roadway drainage design discharges for the longitudinal systems will be based on the 25-year recurrence interval with water spread in the shoulder area permitted, as detailed in Section 830 of the HDM, Table 831.3.

In addition, the HDM recommends a time of concentration of 5 minutes for paved areas. A time of concentration of 5 minutes will be used for the calculations for this Tier I Project because the watersheds are mostly paved surfaces.

The County of Santa Cruz Design Criteria was used to determine rainfall intensity and intensity-duration-frequency (IDF) curves.

1.10.1 Tier I Project

The Tier I Project is located in the communities of Santa Cruz, Live Oak, Soquel, Capitola, Seacliff, Aptos, and Rio Del Mar. Any drainage improvements proposed for local roads and/or any other off-site drainage systems impacted by the Tier I Project will conform to applicable local agency requirements. At this point in the Tier I Project development, the detailed drainage design is not finalized. Additional discussion and calculations will be prepared pending the selection of the preferred alternative.

1.10.2 Tier II Project

The Tier II Project is located in the city of Santa Cruz. Any drainage improvements proposed for local roads and/or any other off-site drainage systems impacted by the Tier II Project will conform to local agency requirements. At this point in the Tier II Project development, the detailed drainage design is not finalized. Additional discussion and calculations will be prepared pending selection of the preferred alternative.

1.11 Special Circumstances

Floodplains and environmentally sensitive areas (ESAs) exist within the Project limits. Impact to the ESAs shall be minimized to the maximum extent practicable. Preliminary studies by the environmental team are currently ongoing, and wetlands to be protected within the Project limits will be shown on the Project plans. Flows currently discharging into ESAs should not be diverted by the Project.

1.12 Agencies Impacting Design

1.12.1 Tier I Project

As previously noted, the Tier I Project is located in the communities of Santa Cruz, Live Oak, Soquel, Capitola, Seacliff, Aptos, and Rio Del Mar. Any drainage improvements proposed for local roads and/or any other off-site drainage systems impacted by the Tier I Project will conform to local agency requirements.

Due to potential impacts to water resources within the Tier I Project limits, the Tier I Project team will address requirements from regulatory agencies. The main areas where potential water quality impacts may occur are within the creeks crossing Route 1, and the biotic/aquatic or wetland areas adjacent to creek crossings and parallel to Route 1. Surface water resources within the Tier I Project limits are under the jurisdiction of the United States Army Corps of Engineers (USACE), the Central Coast Regional Water Quality Control Board (CCRWQCB), the California Department of Fish and Wildlife (CDFW), and the California Coastal Commission (CCC).

1.12.2 Tier II Project

The Tier II Project is located in the City of Santa Cruz. Drainage improvements proposed for local roads and/or any other off-site drainage systems impacted by the Tier II Project would conform to local agency requirements.

As with the Tier I Project, there are potential impacts to water resources within the Tier II Project limits. The Tier II Project team would address requirements from regulatory agencies. The main areas where potential water quality impacts may occur are within the creeks crossing Route 1, and the biotic/aquatic or wetland areas adjacent to creek crossings and parallel to Route 1. Potential impacts and proposed mitigation are discussed in the *Water Quality Study Report* and the *Wetland Assessment*, respectively. Within the Tier II Project limits, Rodeo Creek Gulch is the only major creek crossing. As with the Tier I Project, surface water resources within the Tier II Project limits are under the jurisdiction of the USACE, the CCRWQCB, the CDFW, and the CCC.

2 OFFSITE HYDROLOGY

2.1 Watershed and Basin Characteristics

2.1.1 Tier I Project

Most of the runoff within the Tier I Project limits flows south to Monterey Bay and eventually to the Pacific Ocean. All of the cross drainages directly convey flow southward to Monterey Bay. The north end of the Tier I Project, between Morrissey Boulevard and Arana Gulch, also drains southward to Monterey Bay. North of this segment lies De Laveaga Park, which is within the northern limits of this watershed. The area to the north of this drains to Branciforte Creek.

Large off-site watersheds cross Route 1 within the Tier I Project limits. The delineated off-site watersheds for the Tier I Project can be found in the Watershed Map in Appendix C. The existing drainage facilities for major crossings within the Tier I Project limits are shown in Table 3.

The Soquel Creek watershed drains an area of approximately 42 mi² (108.8 km²) with a steep elevation drop of nearly 3,000 ft (914 m). Soquel Creek collects the flow from many tributaries, including Rodeo Creek Gulch, Nobel Creek, Tannery Gulch, and Borregas Creek. Flooding occurs due to fast volume increases during heavy rainfall, additional volumes from joining tributaries, and natural obstacles in the watershed. Flood events have occurred in the past as a result of obstacles and debris blockages at roadway bridges.

The Aptos Creek watershed drains an area of approximately 25 mi² (64.7 km²) with an elevation drop of approximately 2,000 ft (610 m). Like the Soquel Creek watershed, inundation in the Aptos Creek watershed occurs during periods of heavy rain. The steep elevation drop and narrow canyons contribute to the rapid increase in runoff volume. Physical barriers in the watershed can cause backwater flooding.

The Valencia Creek watershed drains an area of approximately 6.42 mi^2 (16.6 km^2) with a steep elevation drop of 1,500 ft (457 m). The Valencia Creek watershed collects flows from many unnamed tributaries and valleys such as Bear Valley, Deer Valley, and Long Valley. This watershed is within the Aptos Creek watershed and eventually drains into the Aptos Creek crossing of Route 1.

2.1.2 Tier II Project

As with the Tier I Project, most of the runoff within the Tier II Project limits flows south toward Monterey Bay and eventually to the Pacific Ocean. All of the cross drainages directly convey flow southward to Monterey Bay.

Large off-site watersheds cross Route 1 within the Tier II Project limits. The delineated off-site watersheds can be found in the Watershed Map in Appendix C. The Tier II Project would add impervious areas that would affect three streams: Soquel Creek, Rodeo Creek Gulch, and Arana Gulch. Within the Tier II Project limits, there is only one major waterway crossing, the Rodeo Creek Gulch crossing. Although outside of the Tier II Project limits, Soquel Creek and Arana Gulch would also receive runoff from the Tier II Project due to the existing topography.

2.2 Estimating Design Discharge

2.2.1 Tier I Project

Water surface elevations for the remaining crossings with culverts of known dimensions were ascertained using design charts from Waananen and Crippen (1977); the diameter of the culvert (D) and design discharge (Q) were used in these calculations.

Design discharge was calculated using Regional Flood-Frequency Equations (Waananen & Crippen, 1977). The Regional Flood-Frequency Equation for the Central Coast Region is expressed as:

$$Q_{100} = 19.7A^{0.88}p^{0.84}H^{-0.33}$$

Where:

- Q = Peak discharge in cfs, with subscript indicating recurrence interval in years;
- A = Drainage area in mi^2;
- p = Mean annual precipitation in in.;
- H = Altitude index in thousands of ft: the average of the elevations at the locations 10% and 85% of the distance from the Project site to the basin divide, measured along the main channel of the stream and the overland travel path to the basin divide.

Drainage area and altitude index were determined by delineating watersheds for each crossing of interest. Mean annual precipitation values were obtained from SCAS PRISM mapping data (Spatial Climate Analysis [SCAS] Oregon State University, 2003).

Headwater depths were determined using culvert design charts (FHWA 2001) with design discharges and known culvert sizes. The upstream water surface elevation is the sum of this value and the elevation of the culvert at the inlet.

Culvert soffit elevations were not available and were approximated based on topographic survey. This information will need to be updated in the design phase as more detailed information becomes available.

2.2.2 Tier II Project

The Rational Method was utilized to estimate additional flows from the added impervious surfaces.

2.3 Rainfall Data and Intensities

Santa Cruz County has a Mediterranean climate with low humidity and sunshine about 300 days a year. The general climate pattern in the Project area is characterized by relatively stable temperatures year round, with average temperatures in the range of 50ºF to 65ºF (10˚C to 18.3˚C) and precipitation occurring primarily from October to March.

In the southern part of the Project area, the mean annual precipitation is between 25 and 28 in. (63.5 and 71.1 cm), the mean annual air temperature is 58°F (25.4˚C), and the frost-free season is between 245 and 275 days. The part of the Project area near Aptos has a mean annual precipitation of 29 in. (73.7 cm), a mean annual temperature of about 58°F (25.4˚C), and a frost-free season ranging from 245 to 275 days (USDA-NRCS website).

Marine influence and buffering from mountains contribute to moderate temperatures. The wet season is from October to May; the official rainy season is October 15 to April 15. Most flood-producing rainfall occurs from December to March. Snowfall is infrequent (FEMA, 1986).

The design rainfall intensities are estimated using the County of Santa Cruz Design Criteria. The equations used to find the intensities for a 25-year storm event are as follows:

$$Intensity = 1.20 \cdot \frac{(4.29112)(1.195^{P_{60}})}{Duration^{(0.60924)(0.78522^{P_{60}})}}$$

Where:

Intensity =	Rainfall intensity for a given storm event (in/hr)
Duration =	Duration of given storm event (min)
P_{60} =	Rainfall intensity for 60-minute duration and a 100-year storm obtained from the isopleths for Santa Cruz County (in/hr)

This intensity equation is based on the 10-year intensity equation given by the County of Santa Cruz Design Criteria. It can be used to get the desired storm if multiplied by the specified factor. In this case, the multiplier for a 25-year storm event is 1.20. The following conservative values for a 25-year, 5-minute storm were used for this Project:

Duration = 5 min
P_{60} = 1.50 in/hr
Therefore, intensity = 3.40 in/hr

The rainfall intensity plots and the isopleths for Santa Cruz County are in Appendix A.1.

2.4 Points of Concentration and Outfalls

The points of concentration for the Project are defined at the upstream end of the cross culverts. The outfalls are defined as the point of discharge of the cross culverts.

3 OFFSITE HYDRAULICS

The objective of the drainage design is to limit the design water surface elevations and velocities to no greater than the existing conditions and to maintain the existing drainage pattern.

New cross drainage systems will be designed to convey the 100-year storm event without objectionable backwater and pass the 10-year storm within the culvert cross section, as required in the HDM. Existing cross culvert systems that are capable of passing the 10-year event and the 100-year event without objectionable backwater and in good condition would be extended to accommodate the proposed roadway widening.

Culverts that are undersized and/or in poor condition would be replaced with alternative pipe culverts (APC), as necessary. The cross culvert drainage systems used for conveying off-site runoff will be studied to determine their capacity for the 10- and 100-year peak flows, pending additional survey information.

Tier I Project

The existing capacity of the crossings was determined by comparing the elevation of the roadway to the water surface elevations corresponding to a 100-year peak discharge. Water surface elevations (see Table 4) for five of the fifteen crossings were obtained from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs). Upstream and downstream water surface elevations were available for Aptos Creek, Soquel Creek, Rodeo Creek Gulch, and Arana Gulch, while only the downstream water surface elevation was available for Nobel Creek. Upstream water surface elevations for Pot Belly Creek, Tannery Gulch, unnamed tributary to Tannery Gulch, Nobel Creek, and the tributary to Arana Gulch (Station 177+92) were calculated, as described in Section 2.2.1 of this report. Culvert capacity evaluations for four crossings were not available due to a lack of information; these fields are indicated with “N/A” in Table 4.

The hydraulic regime for most creek crossings at Route 1 is upstream controlled. The FEMA *Flood Insurance Study* (FIS) documents debris buildup and ponding during past, severe, storm events. Debris buildup and ponding has the potential to occur at the upstream end of the culverts, which could attenuate peak flows.

The 72’’ (1800 mm) (height) concrete arch culvert for Arana Gulch at Station 171+03, the 4 ft x 4 ft (1220 mm by 1220 mm) reinforced concrete box culvert at the tributary to Arana Gulch at Station 177+92, and the 48 in. (1200 mm) reinforced concrete pipe culvert at the tributary to Tannery Gulch are undersized. Based on preliminary hydraulic calculations, the water surface elevations would be higher than the roadway surface at these culverts. It is recommended that drainage improvements be implemented to address existing capacity issues while also trying to maintain existing flow rates. For example, additional culverts can be added parallel to the existing cross culverts. The

Caltrans 100-year design storm criteria may be deemed infeasible for the cross culvert at the tributary to Arana Gulch at Station 177+92 due to environmental concerns in the Tier I Project area. The downstream end of the culvert is within both USACE and CDFW jurisdictional wetlands. Caltrans will make the final decisions for the drainage improvements for this Tier I Project based on two factors: 1) serving the needs and purpose of the Tier I Project, and 2) minimizing environmental impacts. No wetlands have been identified at the tributary to Tannery Gulch area.

The additional discharge that would be conveyed downstream should be metered such that pre-construction flows meet post-construction flows. A detailed analysis of the drainage improvements will be made during the PS&E phase when survey data will be available. Table 4 lists water surface elevations and culvert capacities at major creek crossings. See Appendix B for the locations of the proposed drainage systems.

Tier II Project

Within the Tier II Project limits, there is one major waterway crossing: the Rodeo Creek Gulch crossing, which is a 9-ft concrete arch culvert. Although they are outside of the Tier II Project limits, Soquel Creek and Arana Gulch would also receive runoff from the Tier II Project due to the existing topography.

For the Tier II Project, the drainage systems at Soquel Creek and Rodeo Creek Gulch were assessed to be sufficiently sized to pass the 100-year design discharge. Due to the negligible increase in impervious area resulting from the Tier II Project (less than for the Tier I Project), the drainage systems should still be sufficiently sized to pass the 100-year design discharge. The drainage system at Arana Gulch was assessed to be undersized to pass the 100-year design discharge and would need to be replaced with larger sizes (or parallel systems).

The existing cross culvert systems within the Tier II Project that are capable of passing the 10-year event and the 100-year event without objectionable backwater and in good condition would be extended to accommodate the proposed roadway widening. As with the Tier I Project, the additional discharge that would be conveyed downstream should be metered such that pre-construction flows meet post-construction flows. Potential drainage improvement locations have been delineated and are included as Appendix B.

Table 4. Hydraulic Data at Major Creek Crossings – Tier I Project

Reach	Station	100-Year Peak Discharge		Drainage Area		Upstream Water Surface Elevation		Downstream Water Surface Elevation		Culvert Capacity
		[cfs]	[m^3/s]	[sq mi]	[ha]	[ft]	[m]	[ft]	[m]	
Valencia Channel	75+30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aptos Creek	90+00	8,280	234.5	24	6,216	27	8.2	25	7.5	Sufficiently sized to pass 100-year design discharge
Ord Gulch	107+85	149	4.2	0.24	62	N/A	N/A	N/A	N/A	N/A
Borregas Creek	110+69	115	3.3	0.18	47	N/A	N/A	N/A	N/A	N/A
Pot Belly Creek	114+90	90	2.5	0.13	34	N/A	N/A	N/A	N/A	Appears to be adequate to pass 100-year flow (evaluated using HDS 5 culvert design charts)
Tannery Gulch	118+64	568	16.1	1.25	324	N/A	N/A	N/A	N/A	Appears to be adequate to pass 100-year flow (evaluated using HDS 5 culvert design charts)
Unnamed tributary to Tannery Gulch	122+66	143	4.0	0.23	60	N/A	N/A	N/A	N/A	Culvert is undersized (evaluated using HDS 5 culvert design charts)
Nobel Creek	130+08	560	15.9	1.2	311	N/A	N/A	78	23.7	Appears to be adequate to pass 100-year flow (evaluated using HDS 5 culvert design charts)
Soquel Creek	143+60	14,700	416.3	43	11,137	33	10.0	32	9.7	Sufficiently sized to pass 100-year design discharge
Rodeo Creek Gulch	154+24	1,540	43.6	N/A	N/A	81	24.6	70	21.3	Sufficiently sized to pass 100-year design discharge
Arana Gulch	171+03	1,650	46.7	3.5	906	68	20.6	49	14.9	Culvert is undersized (evaluated using HEC-HMS)
Tributary to Arana Gulch	175+98	100	2.8	0.11	28	N/A	N/A	N/A	N/A	N/A
Tributary to Arana Gulch	177+92	145	4.1	0.18	47	N/A	N/A	N/A	N/A	Culvert is undersized (evaluated using HDS 5 culvert design charts)
Tributary to Arana Gulch	183+01	71	2.0	0.08	21	Not calculated[1]				

Notes: 1. not calculated because the Tier I Project will not impact this crossing

3.1 Culvert Material

3.1.1 Tier I Project

New culverts will be specified as alternative pipe culverts (APCs). A list of allowable materials will be specified in the Contract Documents, per recommendations from the Materials Report, during the PS&E phase of the Tier I Project. Drainage improvements at major creek crossings are located at Arana Gulch, at the tributary to Arana Gulch at Station 177+92 and at the tributary to Tannery Gulch. These will be specified as APCs. Other existing cross culverts along the Tier I Project length would likely be extended due to the proposed roadway widening. These extensions, as well as new longitudinal systems, will be specified as APCs.

3.1.2 Tier II Project

New culverts will be specified as alternative pipe culverts (APCs). A list of allowable materials will be specified in the Contract Documents, per recommendations from the Materials Report, during the PS&E phase of the Tier II Project. Existing cross culverts along the Tier II Project length would likely be extended due to the proposed roadway widening. These extensions, as well as new longitudinal systems, will be specified as APCs.

3.2 Inlet and Outlet Treatment and Energy Dissipation

3.2.1 Tier I Project

Hydraulic Engineering Circular No. 14, "Hydraulic Design of Energy Dissipaters for Culverts and Channels" (Federal Highway Administration, 2006) and the *Rock Energy Dissipater at Culvert Outlet* (Caltrans District 1, August 1999) will be used as guidelines for energy dissipation requirements for the inlets and outlets of each cross culvert. *California Bank and Shore Rock Slope Protection Design Guide*, published by Caltrans, should be used when determining rock size and placement for inlet and outlet treatment.

Rock slope protection is recommended at culvert entrances and outfalls to prevent scour and erosion. Typical inlet and outlet treatments for cross culverts are either flared end sections or standard Caltrans headwalls, and they will be specified on Project Drainage Plans during the PS&E phase.

The drainage design will be such that the alteration of natural watercourses and drainage patterns is minimized. This can be achieved with the implementation of detention devices. The Tier I Project would adhere to the City of Santa Cruz's Post Construction Storm Water Management Program and the County of Santa Cruz's *Design Criteria*.

3.2.2 Tier II Project

Refer to Section 3.2.1 for inlet and outlet treatment energy dissipation for Tier II Project.

4 ONSITE ROADWAY DRAINAGE

Calculations for the design of on-site drainage systems will be finalized during the PS&E phase pending more complete survey data or as-built information.

4.1 Tier I Project

Both build alternatives under the Tier I Project include sound walls, retaining walls, and gutters to be installed along the Tier I Project limits. These structures would impact existing drainage facilities within the edge of shoulders or may create new concentrated flows that warrant the need for new drainage systems. In general, new longitudinal systems are proposed in front of retaining walls. The HOV Lane Alternative proposes roadway widening in the median and concrete median barriers. These improvements would block flows that were collected in the median. As such, new inlets and longitudinal systems would be proposed along these barriers. New outfalls, or connections, are proposed to tie the new longitudinal systems to the existing cross culverts. Other areas where drainage systems may need to be proposed will be in the areas where permanent stormwater treatment Best Management Practices (BMPs) are proposed. The drainage systems will be designed to route flows to the permanent stormwater treatment BMPs.

Analyses will be performed during the PS&E phase to determine the need for additional longitudinal systems near these structures to accommodate the flows. The existing longitudinal systems will also be evaluated to ensure that new flows can be accommodated per the Caltrans HDM.

4.1.1 Recurrence Interval

The Tier I Project site is a multi-lane highway with speeds over 45 mph (75 kph). According to Table 831.3 of the HDM, the design storm is the 25-year storm. The design water spread cannot spread onto the traveled way. According to Section 831.4 of the HDM, no more than 0.1 cfs (0.003 m^3/s) of sheet flow should be allowed to flow across the roadway. Storm water flows would be concentrated in drainage ditches, roadside gutters, and along dikes, barriers, or retaining walls.

4.1.2 Grate Interception and Gutter Capacity

Spread width and inlet capacities would be estimated using the methods and procedures described in the FHWA's HEC-22. The allowable spread width would vary between 5.9 ft and 9.8 ft (1.8 m and 3 m) in both directions of travel, depending on the proposed shoulder width per location.

4.1.3 Stormwater Best Management Practices

The Tier I Project Team will consider storm water quality measures to address potential temporary and permanent water quality impacts of the Project, as defined in the Caltrans *Storm Water Quality Handbook, Project Planning and Design Guide* (2010 with May

2012 revisions) for major reconstruction projects. Storm water quality measures that were considered include temporary construction site BMPs, design pollution prevention BMPs, and permanent stormwater treatment BMPs. Detailed stormwater BMP information can be found in the *Storm Water Data Report* (WRECO, 2013).

4.2 Tier II Project

The build alternative under the Tier II Project includes retaining walls to be installed as part of the roadway widening by the addition of auxiliary lanes. These structures would impact existing drainage facilities within the edge of shoulders or may create new concentrated flows that warrant the need for new drainage systems. In general, new longitudinal systems are proposed in front of retaining walls. Other areas where drainage systems may need to be proposed will be in the areas where permanent stormwater treatment BMPs are proposed. The drainage systems will be designed to route flows to the permanent stormwater Treatment BMPs.

Refer to Sections 4.1.1, 4.1.2, and 4.1.3 for design guidelines on recurrence interval, grate interception and gutter capacity, and stormwater BMPs for Tier II Project.

5 TEMPORARY DRAINAGE SYSTEMS

5.1 Tier I Project

Four perennial streams exist within the Tier I Project limits: Soquel Creek, Rodeo Creek Gulch, Aptos Creek, and Valencia Creek. Any proposed work in these areas would need to use temporary creek diversion plans or dewatering specifications.

If the creeks are flowing, temporary drainage pipes or systems would be needed during the stage construction to maintain drainage flows. The design of the temporary drainage systems will begin after receipt of the detour and/or stage construction plans, which should be available during the PS&E phase.

5.2 Tier II Project

Within the Tier II Project limits, there is only one major waterway crossing, the Rodeo Creek Gulch crossing. Refer to Section 5.1 for temporary drainage systems that may be needed during the construction phase.

6 FLOODPLAIN INFORMATION

6.1 Tier I Project

Three FEMA FIRMs were reviewed for the Tier I Project (Map Numbers: 06087C0351D, 06087C0352D, and 06087C0357D). The FIRMs indicate that 100-year base floodplains exist at the following crossings of Route 1: Aptos Creek, Nobel Creek, Soquel Creek, Rodeo Creek Gulch, and Arana Gulch. The FIRMs covering the Tier I Project limits are included in Appendix D. Detailed floodplain information can be found in the *Location Hydraulic Study Report* (WRECO, 2013).

6.2 Tier II Project

Two FEMA FIRMs were reviewed for the Tier II Project (Map Numbers: 06087C0352D and 06087C0351D). The FIRMs indicate that 100-year base floodplains exist at the following crossings of Route 1 within the Tier II Project limits: Soquel Creek, Rodeo Creek Gulch, and Arana Gulch. The FIRMs covering the Tier II Project limits are included in Appendix D. Detailed floodplain information can be found in the *Location Hydraulic Study Report* (WRECO, 2013).

7 COST ESTIMATE

7.1 Tier I Project

HOV Lane Alternative

The total estimated cost (excluding right-of-way items) for the HOV Lane Alternative under the Tier I Project is estimated to be $377 million escalated at 3.5% for the Year of 2015. The costs will be updated and revised as the Tier I Project progresses through the PS&E phase.

The construction cost for drainage improvements at this stage for the HOV Lane Alternative in the Tier I Project is anticipated to be $28.1 million. This cost includes the proposed longitudinal drainage systems, gutters and ditches, cross culvert adjustments, and improvements to existing drainage systems. This cost estimate is based on current unit costs; prices may fluctuate depending on the unit costs at the time of construction.

The estimated cost does not include the expected cost for permanent stormwater treatment BMPs. Anticipated Tier I Project construction costs for these BMPs are shown in the Tier I Project Report.

Transportation System Management Alternative

The total estimated cost (excluding right-of-way items) for the Transportation System Management Alternative under the Tier I Project is estimated to be $207 million escalated at 3.5% for the Year of 2015. The costs will be updated and revised as the Tier I Project progresses through the PS&E phase.

The construction cost for drainage improvements at this stage for the Transportation System Management Alternative in the Tier I Project is anticipated to be $22.5 million. This cost includes proposed longitudinal drainage systems, gutters and ditches, cross culvert adjustments, and improvements to existing drainage systems. This cost estimate is based on current unit costs; prices may fluctuate depending on the unit costs at the time of construction.

The estimated cost does not include the expected cost for permanent stormwater treatment BMPs. Anticipated Tier I Project construction costs for these BMPs are shown in the Tier I Project Report.

7.2 Tier II Project

The current total estimated cost (excluding right-of-way items) for the Tier II Project is estimated to be $17.4 million. The costs would be updated as the Tier II Project progresses through the PS&E phase.

The construction cost for the drainage and stormwater management for the Tier II Project is anticipated to be $1.1 million. This cost estimate is based on current unit costs; prices may fluctuate depending on the unit costs at the time of construction.

The estimated cost does not include the expected cost for permanent stormwater treatment BMPs. Anticipated Tier II Project construction costs for these BMPs are shown in the Tier II Project Report.

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Appendix A Hydrologic Data

Appendix A.1 Rainfall Intensity Curve

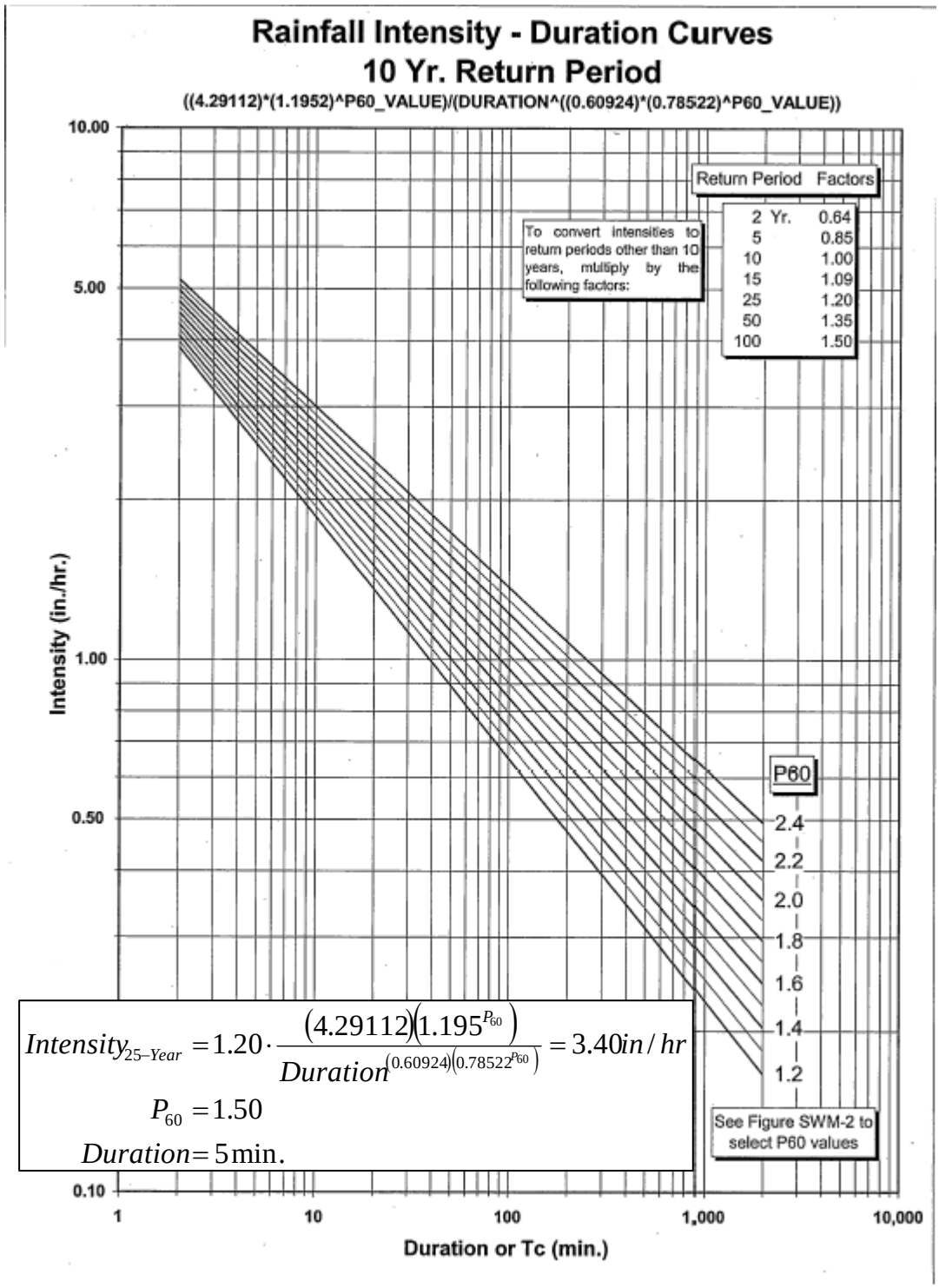


Figure SWM-3 Rainfall Intensity-Duration Curves

Source: County of Santa Cruz

Appendix A.2 Isopleths

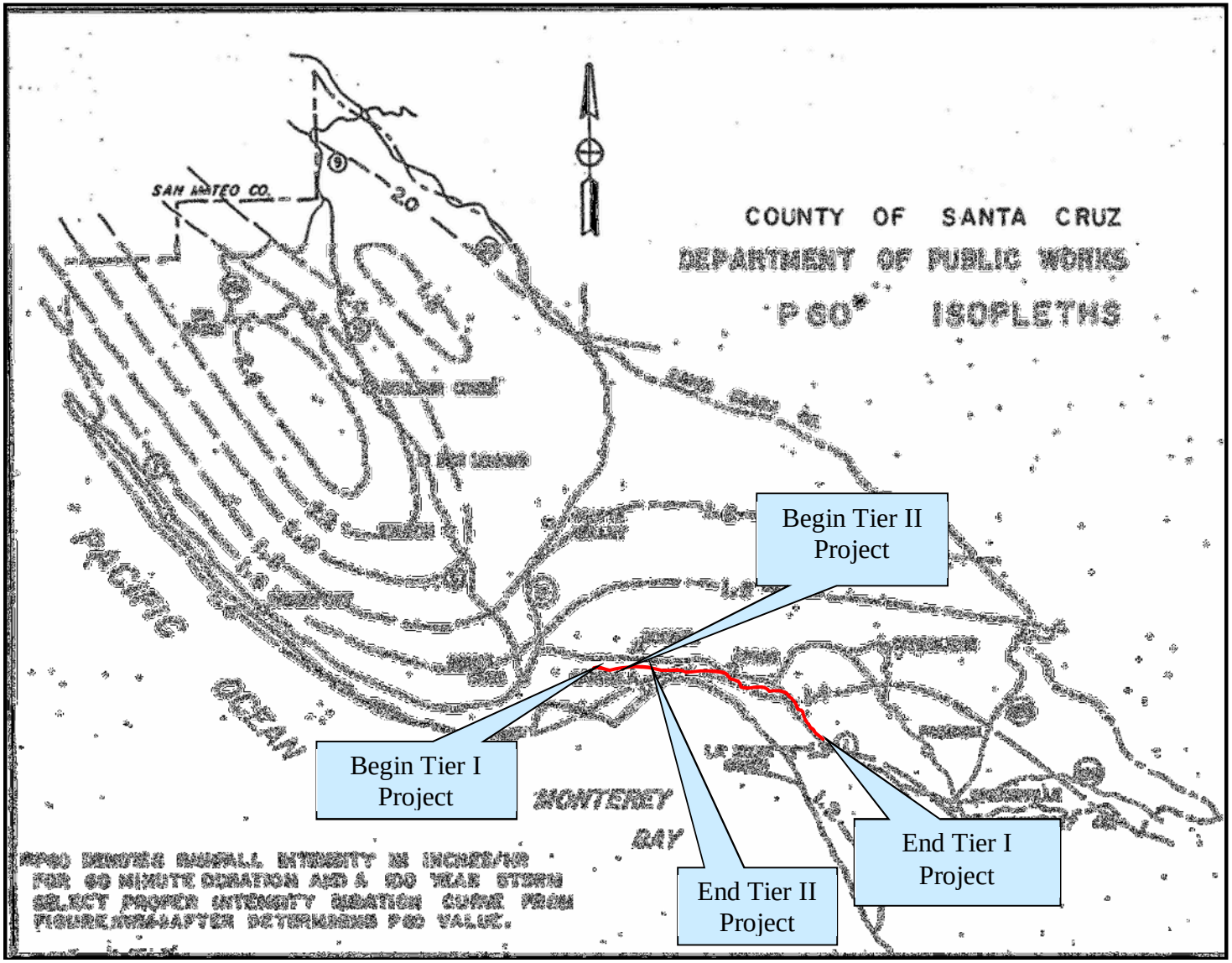


Figure SWM-2 P60 Isopleths

Appendix B Drainage Improvement Locations

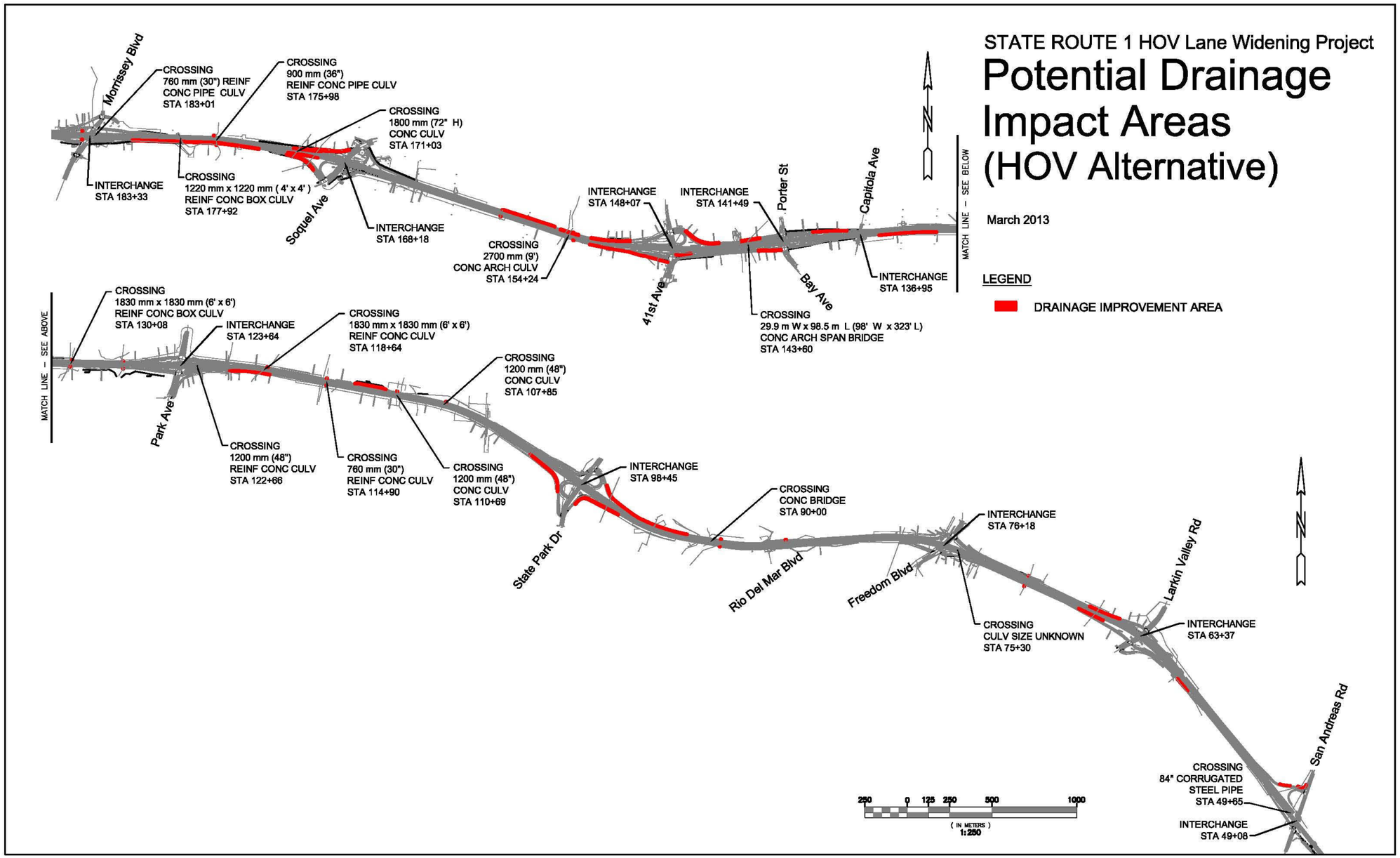


Figure B-1 Potential Drainage Impact Areas (HOV Lane Alternative)

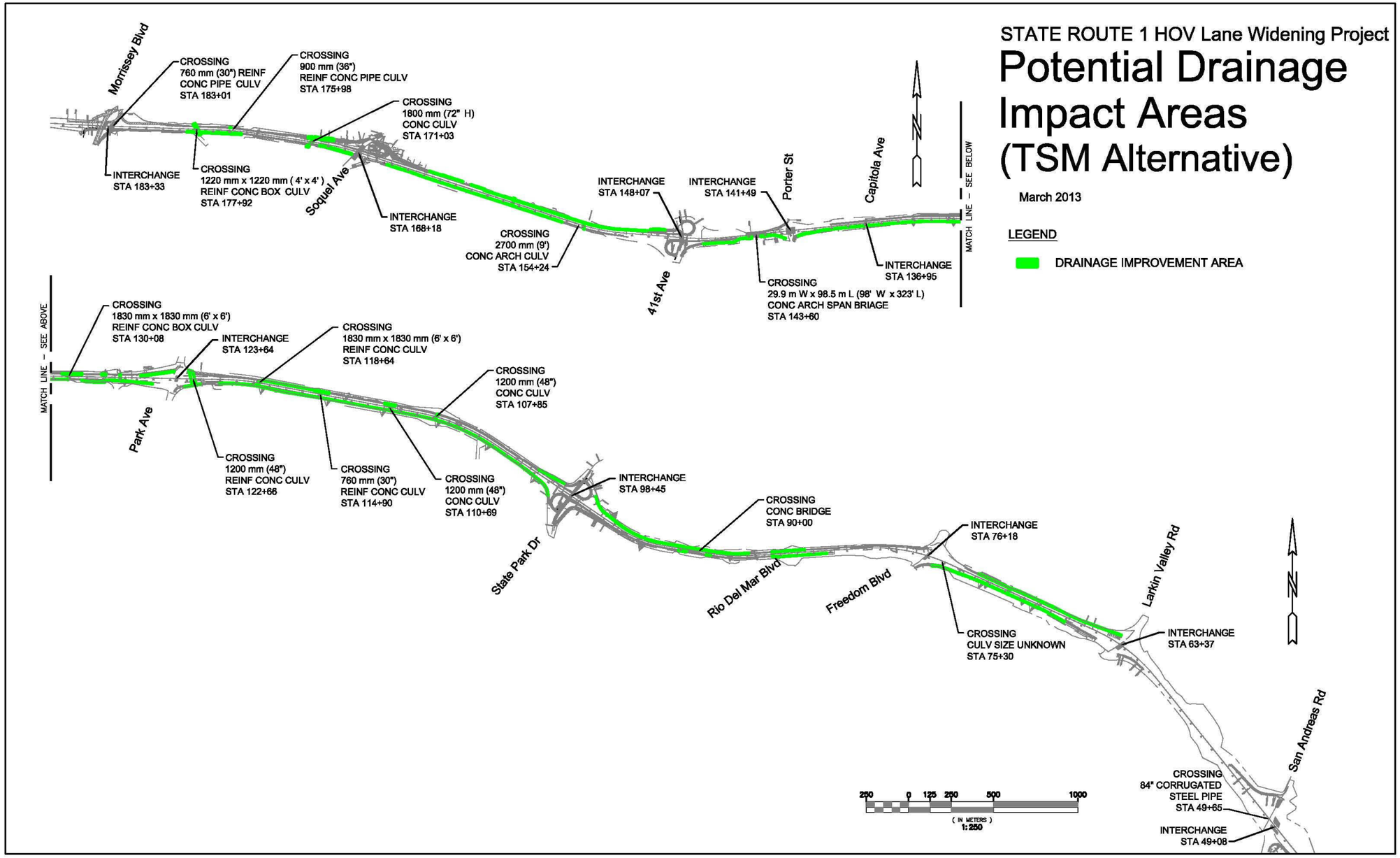


Figure B-2 Potential Drainage Impact Areas (TSM Alternative)

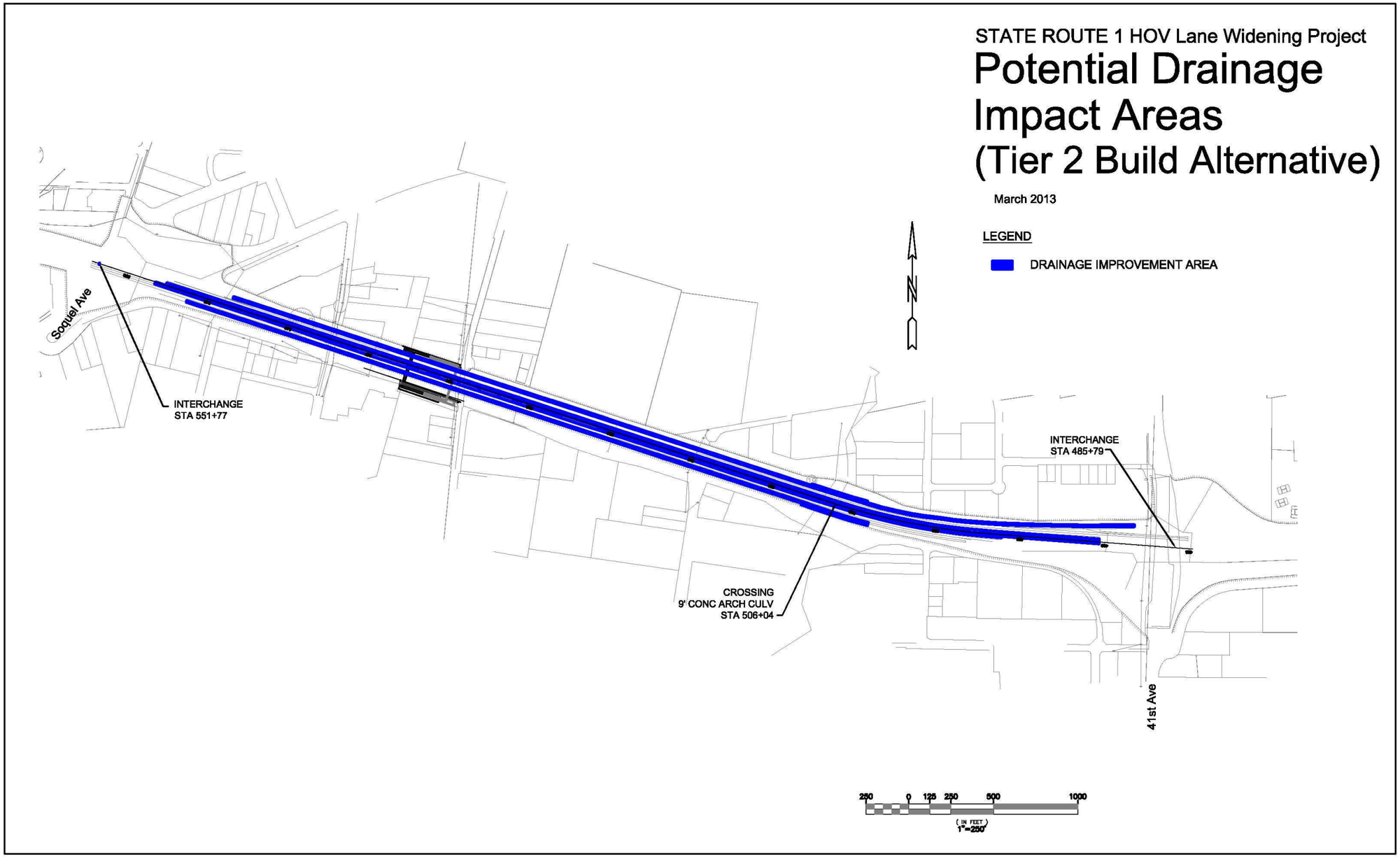
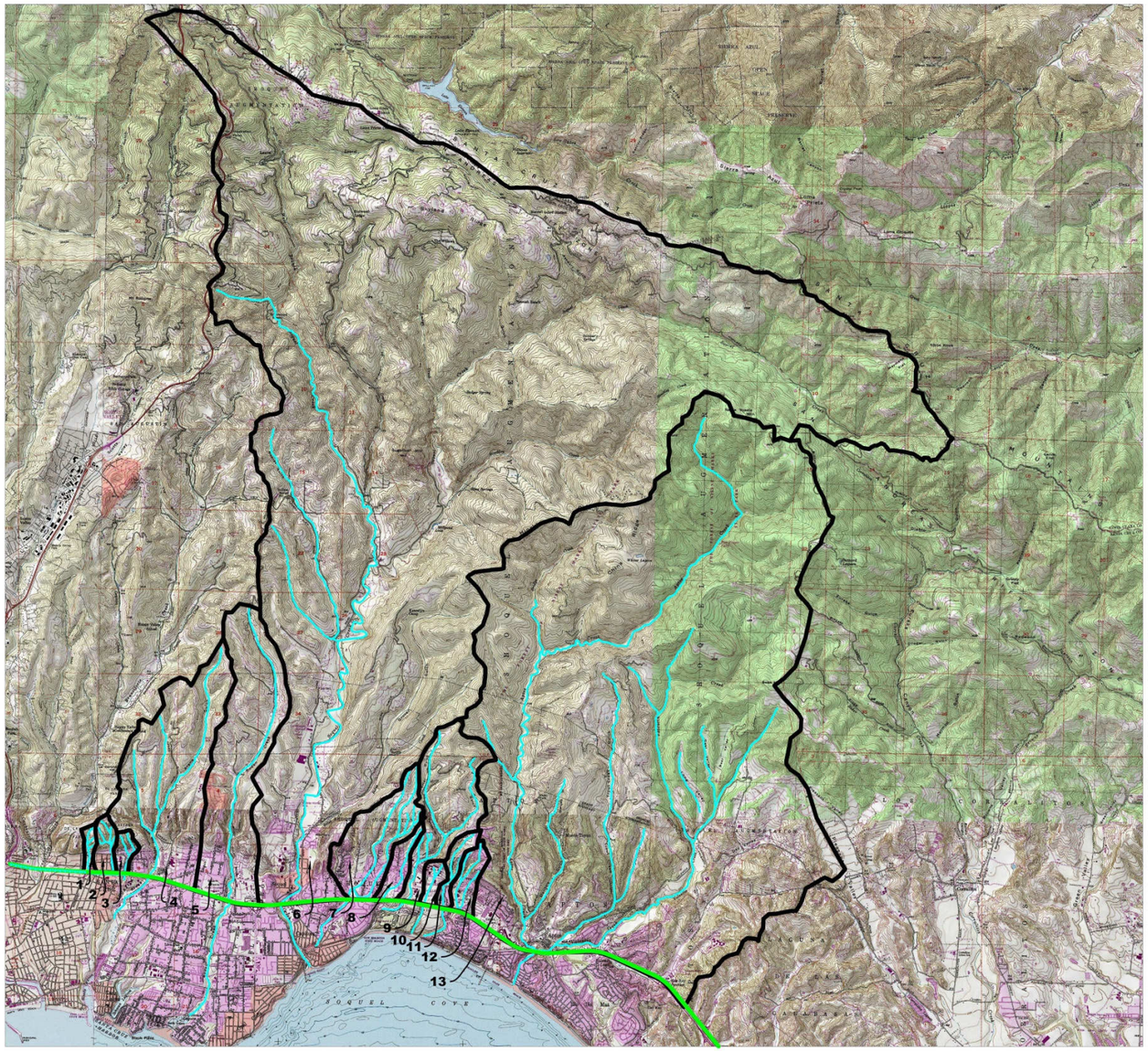


Figure B-3 Potential Drainage Impact Areas (Tier II Build Alternative)

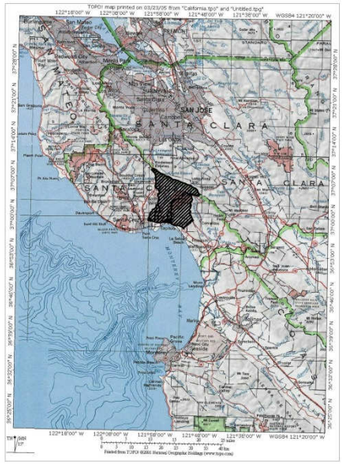
Appendix C Offsite Watershed Map



Highway 1 HOV Lane Widening Project

Watershed Map

November 2012



LEGEND
- WATERSHED BOUNDARY
- CHANNEL

WATERSHEDS
1 - TRIBUTARY TO ARANA GULCH
2 - TRIBUTARY TO ARANA GULCH
3 - TRIBUTARY TO ARANA GULCH
4 - ARANA GULCH
5 - RODEO CREEK GULCH
6 - SOQUEL CREEK
7 - NOBEL CREEK
8 - UNNAMED TRIBUTARY TO TANNERY GULCH
9 - TANNERY GULCH
10 - POT BELLY CREEK
11 - BORREGAS CREEK
12 - ORD GULCH
13 - APTOS CREEK

N

0 5000 10000 ft

0 5000 10000 m

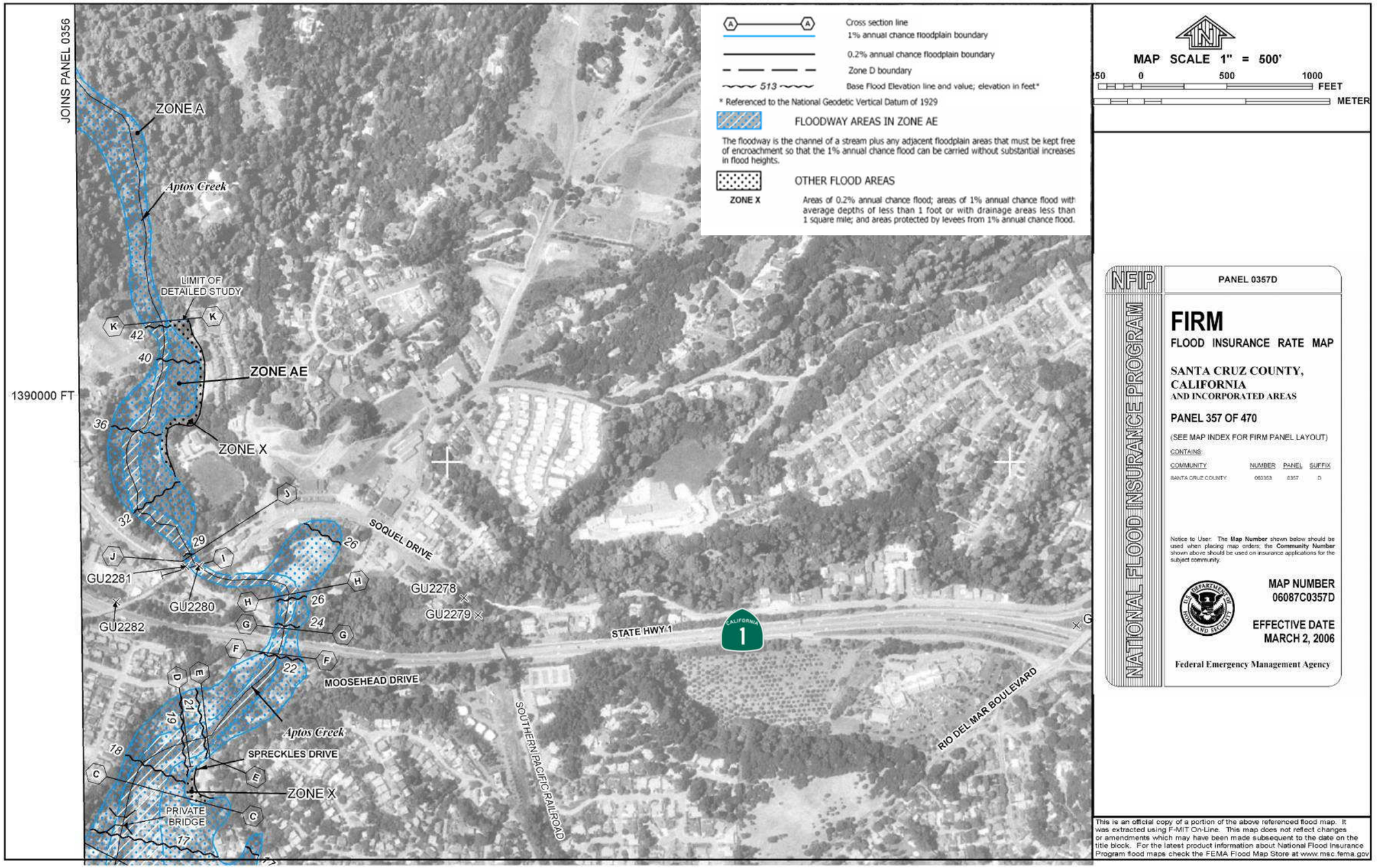
Source: United States Geological Survey

Note: Delineated watershed boundaries only encompass areas upstream of the respective Highway 1 crossings

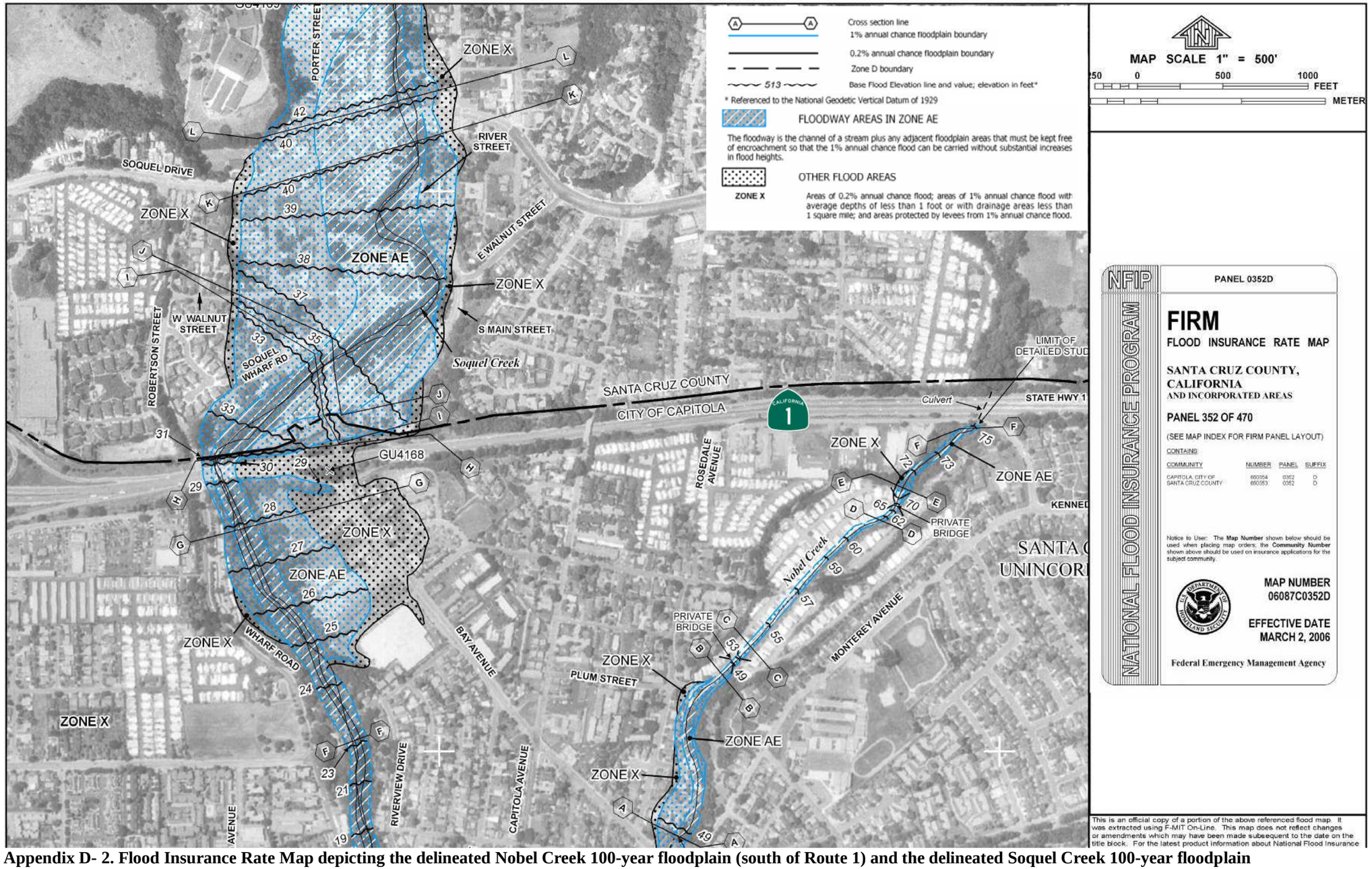
Figure C-1 Offsite Watershed Map

Source: United States Geological Survey

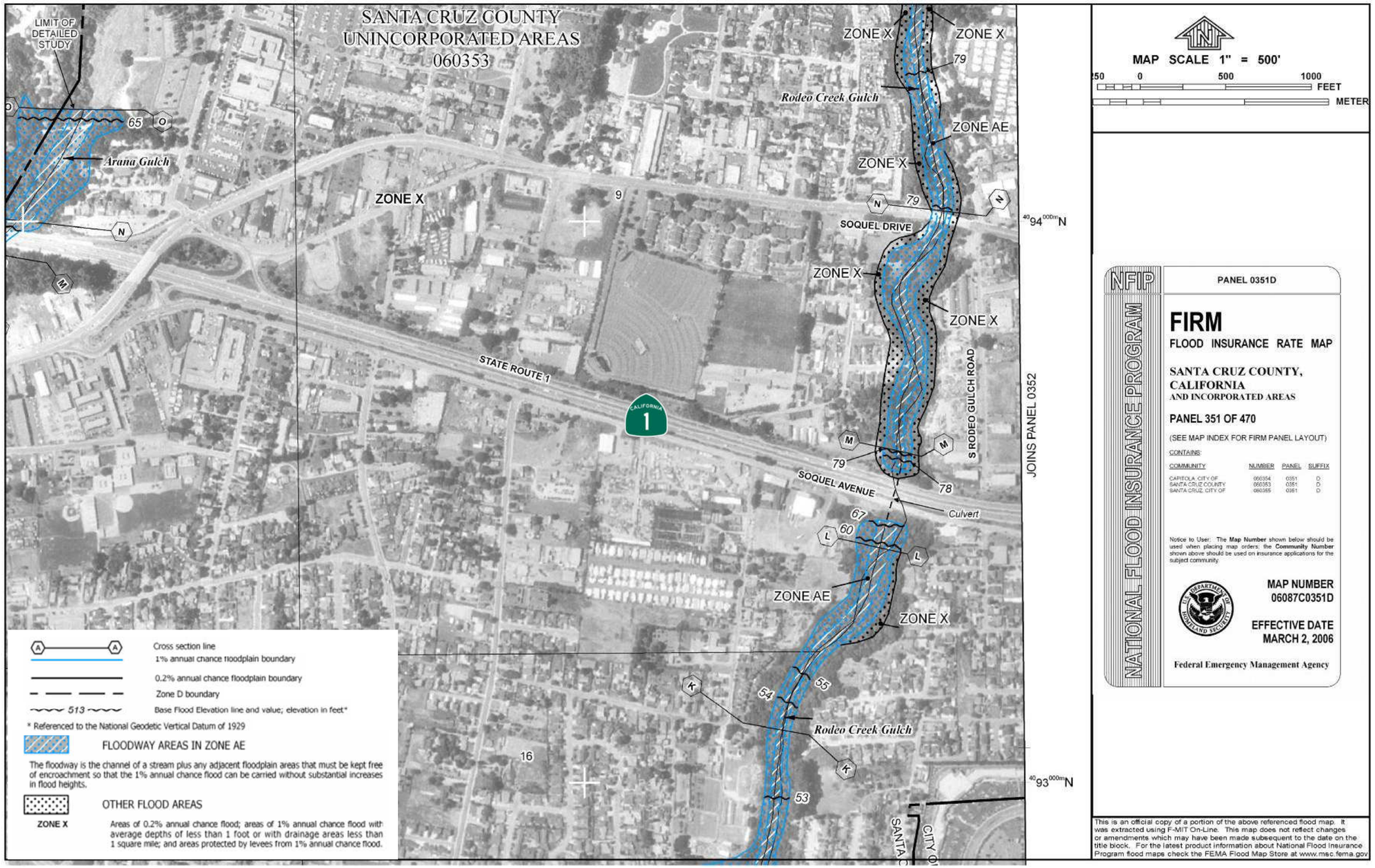
Appendix D Flood Insurance Rate Maps



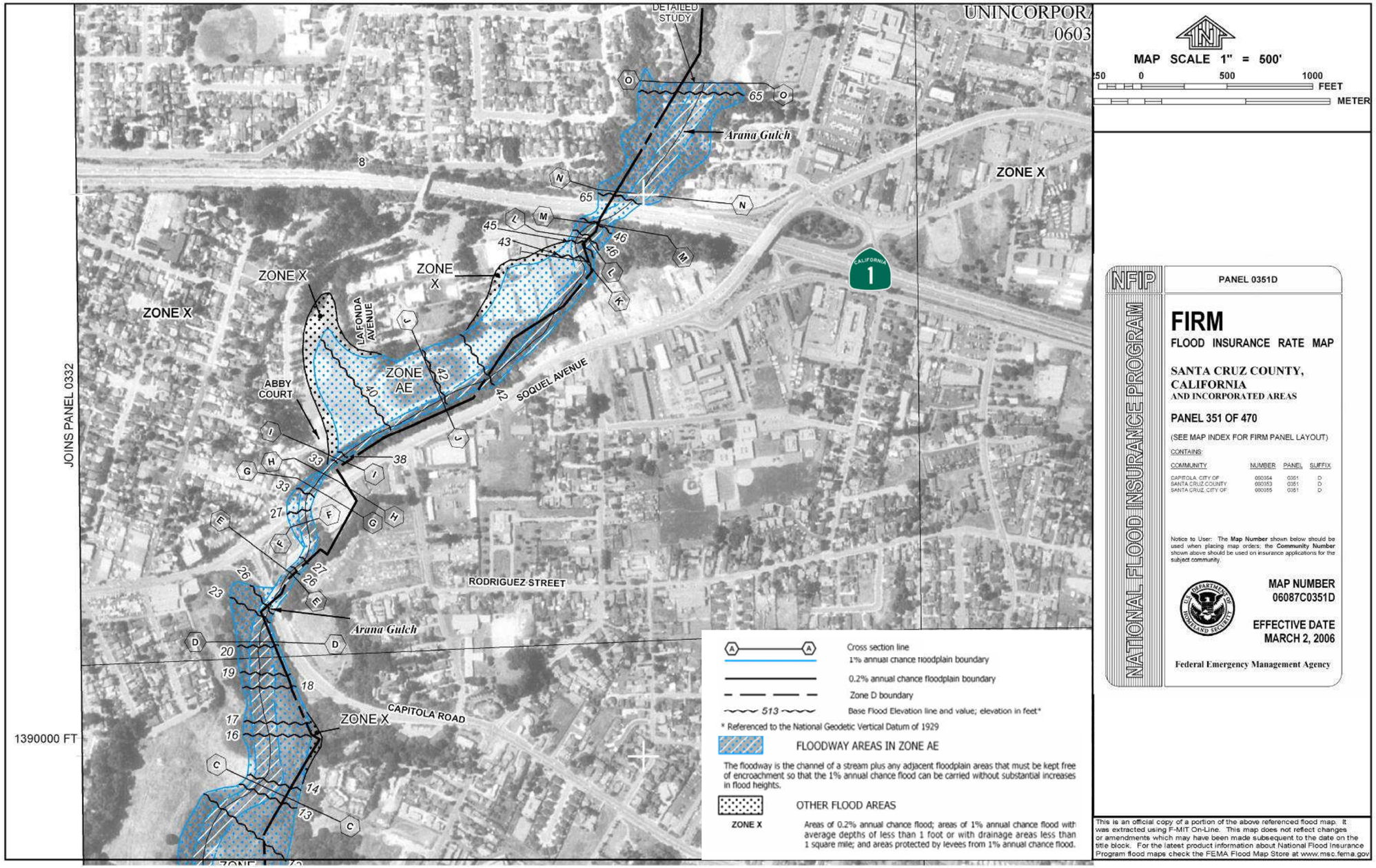
Appendix D- 1. Flood Insurance Rate Map depicting the delineated Aptos Creek 100-year floodplain



Appendix D- 2. Flood Insurance Rate Map depicting the delineated Nobel Creek 100-year floodplain (south of Route 1) and the delineated Soquel Creek 100-year floodplain



Appendix D- 3. Flood Insurance Rate Map depicting the delineated Rodeo Creek Gulch 100-year floodplain



Appendix D- 4. Flood Insurance Rate Map depicting the delineated Arana Gulch 100-year floodplain

Appendix E Project Photographs

Photo 1. Tributary to Arana Gulch at Holway Drive crossing

Photo 2. Tributary to Arana Gulch

Photo 3. Arana Gulch (downstream)

Photo 4. Arch culvert at Arana Gulch (downstream)

Photo 5. Arch culvert at Arana Gulch (downstream)

Photo 6. Rodeo Creek Gulch (downstream)

Photo 7. Rodeo Creek Gulch (upstream)

Photo 8. Rodeo Creek Gulch (downstream)

Photo 9. Concrete bags at base of bridge footing at Soquel Creek

Photo 10. Concrete bags at base of bridge footing at Soquel Creek

Photo 11. Soquel Creek

Photo 12. Bridge piers at Soquel Creek

Photo 13. Bridge at Soquel Creek

Photo 14. Soquel Creek (upstream)

Photo 15. Soquel Creek

Photo 16. Concrete box culvert at Nobel Creek (downstream)

Photo 17. Nobel Creek (downstream)

Photo 18. Nobel Creek (upstream)

Photo 19. Energy dissipater at unnamed tributary to Tannery Gulch

Photo 20. Debris at unnamed tributary to Tannery Gulch

Photo 21. Tannery Gulch (downstream)

Photo 22. Tannery Gulch (upstream)

Photo 23. Borregas Creek (downstream)

Photo 24. Storm drain leading to Borregas Creek (upstream)

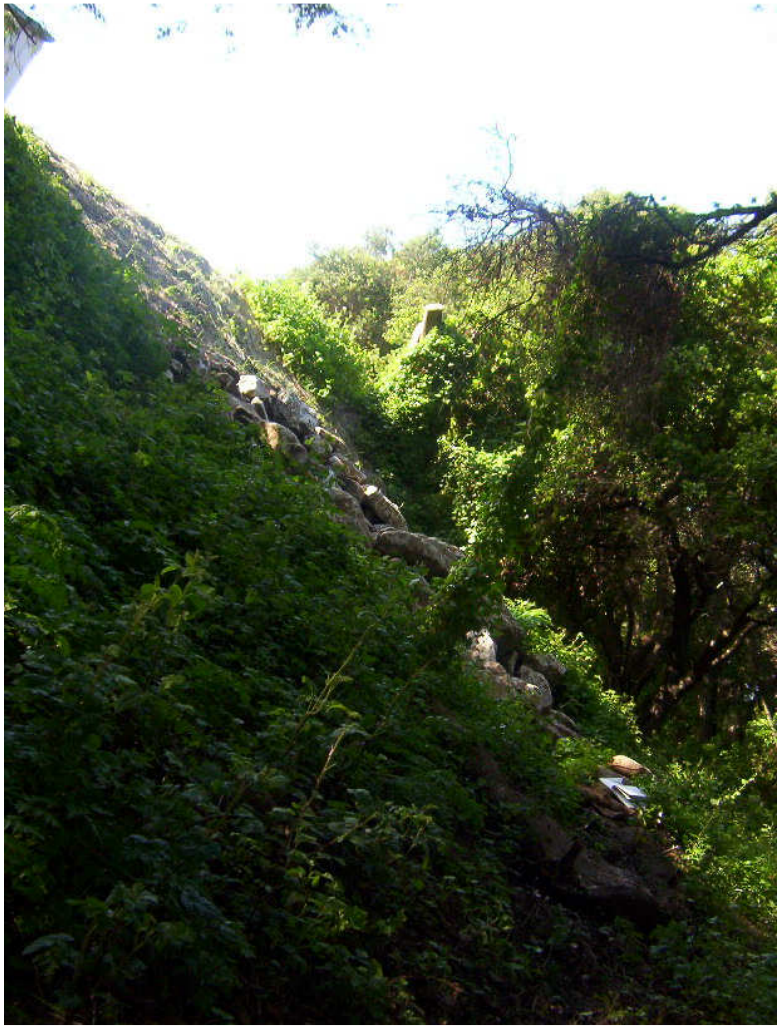


Photo 25. Borregas Creek (upstream)

Photo 26. Aptos Creek

Photo 27. Scour at Aptos Creek near footing

Photo 28. Bridge 36-0011 at Aptos Creek

Photo 29. Scour at Aptos Creek

Photo 30. Aptos Creek

Photo 31. Homes adjacent to Aptos Creek

Photo 32. Valencia Channel (at outlet)

Photo 33. Valencia Lagoon