STATE ROUTE 1 HOV LANE WIDENING PROJECT
(FROM MORRISSEY BOULEVARD TO SAN ANDREAS ROAD)

TRAFFIC OPERATIONS REPORT

Prepared for:

Santa Cruz County Regional Transportation Commission

APRIL 2012

State Route 1 HOV Lane Widening Project
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Errata

June 10, 2015

1. **"Baseline" Conditions.** This Errata sheet revises the Traffic Operations Report's descriptions of 2003 conditions and any usage of the term "baseline". With the inclusion of this Errata sheet, 2003 conditions are considered as the "baseline" conditions. This change supersedes any use of the term "baseline" in the report. The project team conducted a series of traffic counts within the study corridor, twice in 2001 and once in 2003. As the study area expanded southward during the course of this study, additional counts were conducted in 2003 for the southern portion of the study area. In November 2010, new traffic counts were collected by Caltrans (Caltrans 2010, Traffic and Vehicle Data System) for the study area and were used to compare against the 2001/2003 counts. In the middle and south segments portions of the corridor, the 2010 traffic volumes were 4 to 5 percent lower than the 2001/2003 counts. In the northern portion, 2010 volumes were 22 percent lower than the earlier counts. This variation is expected due to the economic downturn, especially at the northern end of the corridor, which is a job destination and a gateway to jobs in the Santa Clara Valley and San Francisco Bay Area. Despite these reductions in volumes, and even if these reduced volumes were sustained until opening year of the project, the purpose and need for the project would remain and changes to the final project design would likely be insignificant. Therefore, baseline traffic was based on the 2001 and 2003 traffic data.

2. **Extended Peak Period.** This Errata sheet revises the Traffic Operations Report to explain the report's usage of the extended peak periods of 6 a.m. to 12 p.m. and 2 p.m. to 8 p.m. These extended periods were used in order to observe the "heating up" and "cooling off" of traffic conditions before and after the respective a.m. and p.m. peak periods of 7 a.m. to 10 a.m. and 3 p.m. to 6 p.m. In each case, one hour is included prior to the peak period, and two hours are included following the end of the peak period, in order to provide context for better understanding the peak period conditions.

3. **Correction of typo on page 3-10.** The following typo in the second sentence of the first paragraph of Section 3.5, on page 3-10, is hereby corrected: "AM Peak period – 7 AM to 9 AM" is corrected to "AM Peak period – 7 AM to 10 AM".

4. **Project Description.** The project description text provided in Section 1.3 of the report is hereby changed to replace the existing text of Section 1.3 with the following text.

   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 2016.

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 HOV Lane and TSM 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 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.

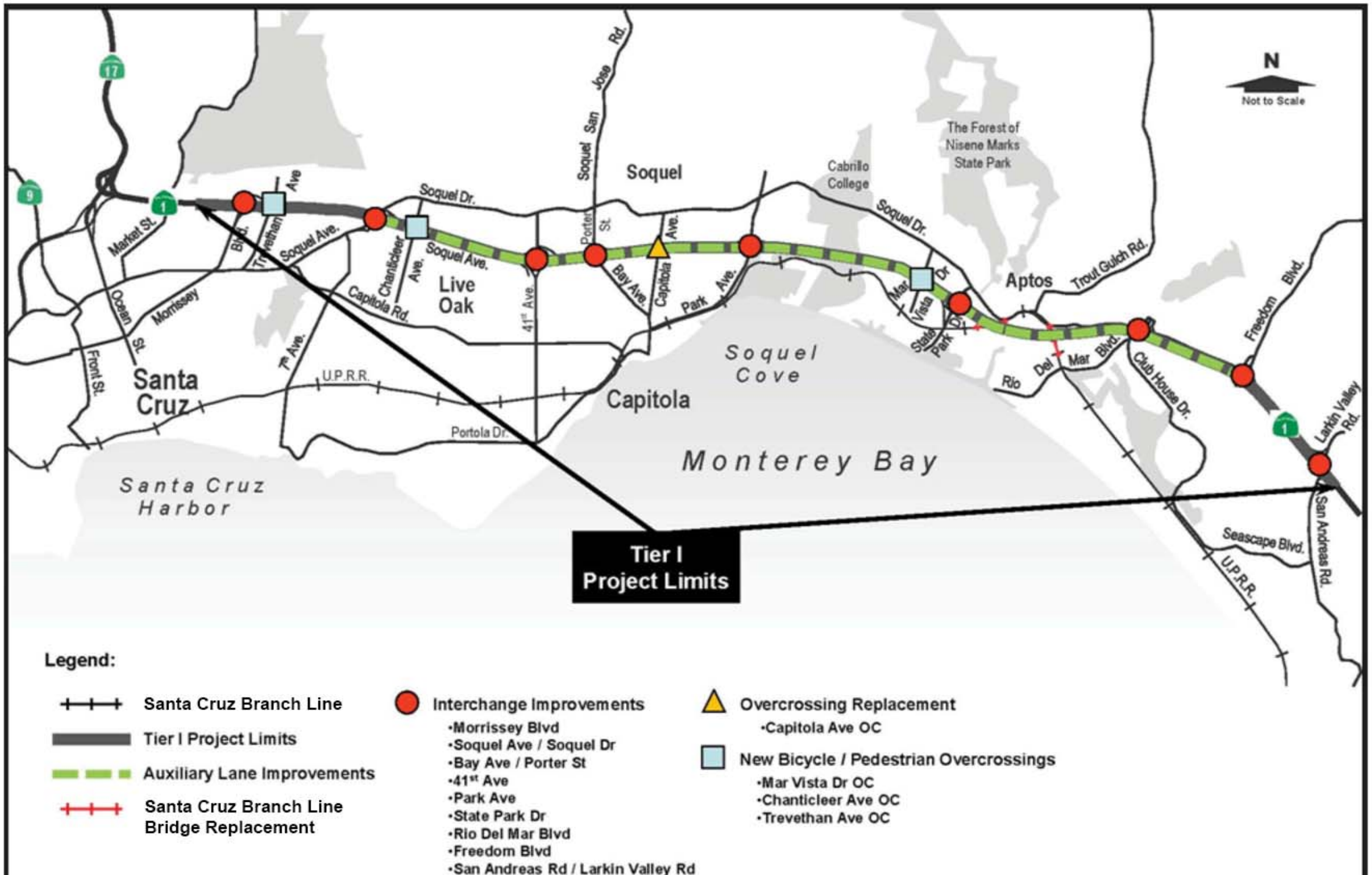
- Highway mainline to include northbound and southbound HOV lanes throughout the project limits;
- Auxiliary lanes;

- 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.

Table 1: 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.			



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

Figure 1: 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.

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

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 2.

Table 2: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.	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.
		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

Table 2: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.	Tier I Corridor HOV Lane Alternative Features
		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.
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.

Table 2: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.	Tier I Corridor HOV Lane Alternative Features
		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.
		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.

Table 2: Interchange Improvements and Reconfigurations
Tier I Corridor HOV Lane Alternative

Route 1 Interchange Location	Project Plan Sheet No.	Tier I Corridor HOV Lane Alternative Features
		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.

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

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

Auxiliary Lanes

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

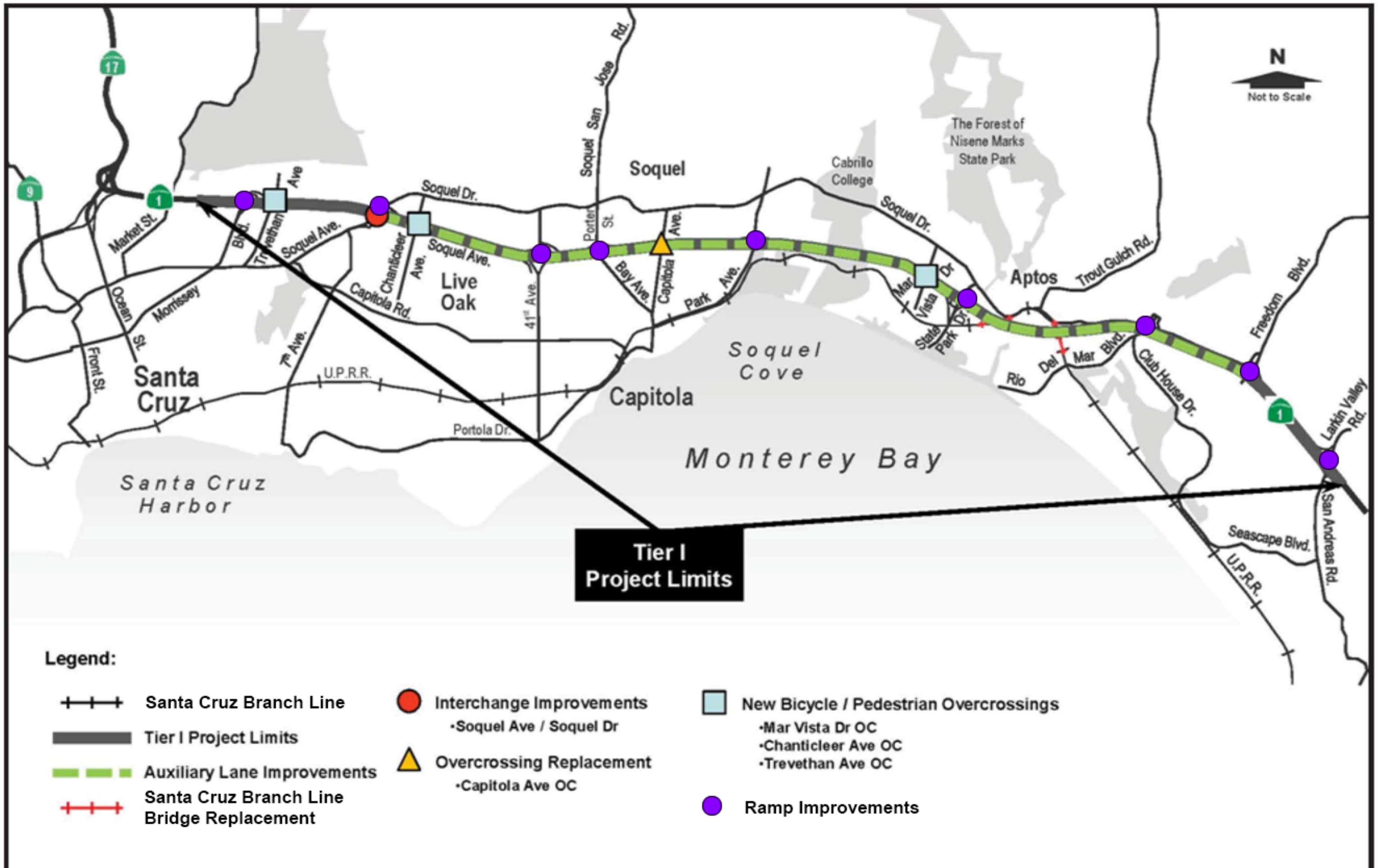
- Improve existing nonstandard geometric elements at various ramps.
- Provide HOV bypass lanes on all except northbound Morrissey Boulevard on-ramps.
- Add California Highway Patrol enforcement areas at on-ramps with HOV bypass lanes.

New Pedestrian/Bicycle Overcrossings

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

Other Improvements

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



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

Figure 2: 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 3 shows features of the Auxiliary Lane Alternative. 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.

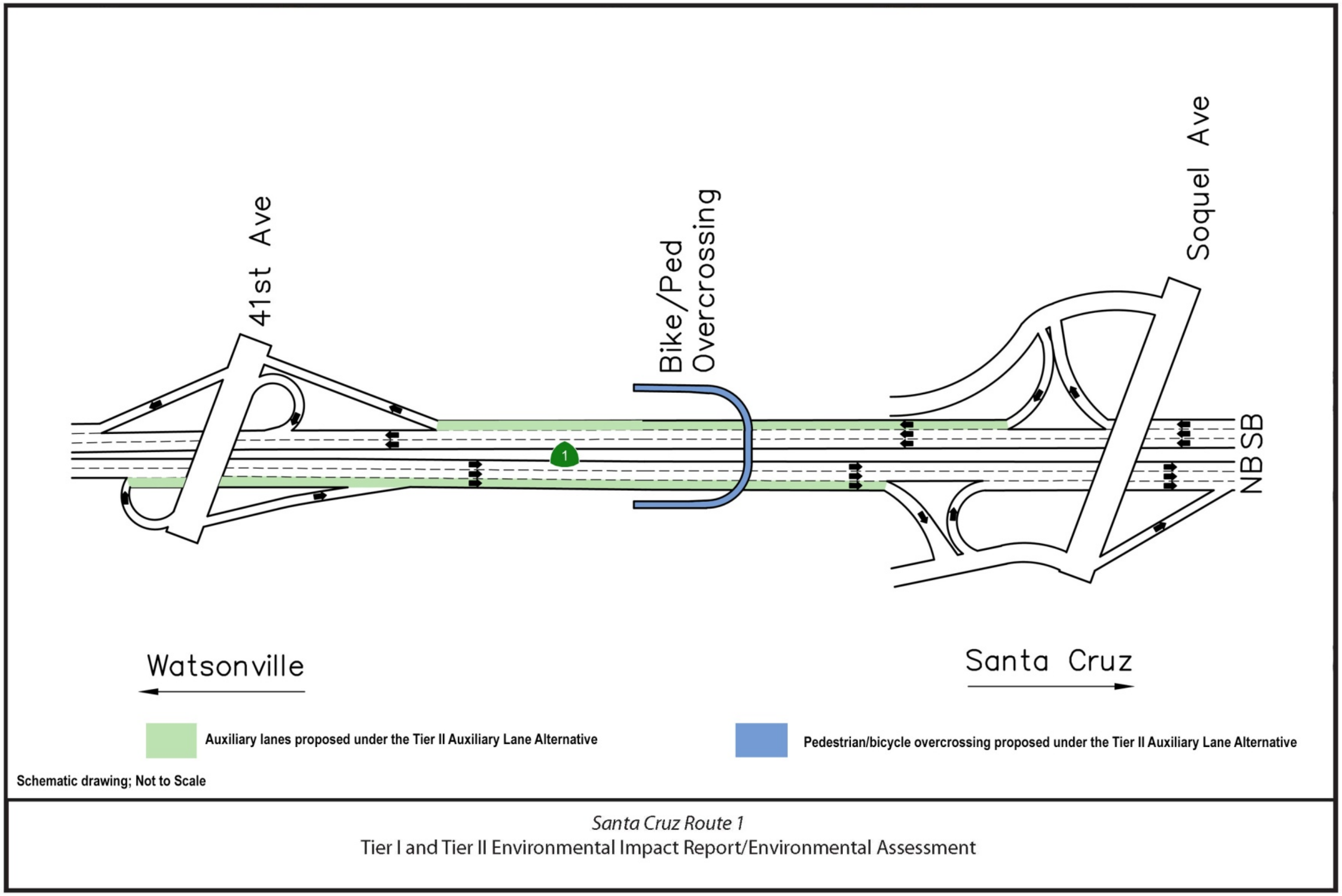


Figure 3: Tier II Auxiliary Lane Alternative – Project Features

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

[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.

- 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.

TABLE OF CONTENTS

Chapter 9 - Summary and Conclusions

Glossary of Terms

Appendix

TABULATIONS

ILLUSTRATIONS

APPENDIX

A: Previously Submitted Reports and Technical Memorandums

A-1: Existing Conditions Final Report
A-2: Intersection LOS Criteria Technical Memorandum
A-3: Soquel Avenue Alternatives Technical Memorandum
A-4: Interchange Configurations Summary Technical Memorandum
A-5: Soquel Avenue Interchange – Traffic Operational Analysis Technical Memorandum
A-6: Future Traffic Projection Technical Memorandum
A-7: HOV Build Operating Conditions Technical Memorandum
A-8: TSM Build Operating Conditions Technical Memorandum
A-9: Use of AMBAG Model Technical Memorandum

B: Signal Warrant Analysis Calculation Sheets

B-1: Year 2035 HOV Build Conditions
B-2: Year 2015 HOV Build Conditions

C: Calculation Sheets – Intersection Operation Analysis

C-1: Existing Conditions
C-2: Year 2035 No Build Conditions
C-3: Year 2035 HOV Build Conditions
C-4: Year 2035 TSM Build Conditions
C-5: Year 2015 No Build Conditions
C-6: Year 2015 HOV Build Conditions
C-7: Year 2015 TSM Build Conditions

D: SimTraffic Calculation Sheets

D-1: Existing Conditions
D-2: Year 2035 HOV Build Conditions
D-3: Year 2015 HOV Build Conditions

E: FREQ Output Sheets

E-1: Existing Conditions
E-2: Year 2035 No Build Conditions
E-3: Year 2035 HOV Build Conditions
E-4: Year 2035 TSM Build Conditions
E-5: Year 2015 No Build Conditions
E-6: Year 2015 HOV Build Conditions
E-7: Year 2015 TSM Build Conditions

F: HSIS Statistics

G: Basic Average Accident Rate Table – Highways

H: FREQ Subsections and Graphical Outputs – Prioritization of Auxiliary Lane Improvements

I: Methodology of Ranking Auxiliary Lane Improvements

J: Modifications Performed to the TOR

EXECUTIVE SUMMARY

1. PROJECT OVERVIEW

The Santa Cruz County Regional Transportation Commission (SCCRTC), in cooperation with the California Department of Transportation (Caltrans), initiated the State Route 1 (SR-1) High Occupancy Vehicle (HOV) Lane Widening project to explore alternatives to relieve and manage traffic congestion on SR-1 between Morrissey Boulevard and San Andreas Road/ Larkin Valley Road. HOV lane addition was selected as one of the build alternatives. The proposed State Route 1 HOV lanes would add one HOV lane per direction. The overall goal of the project was to analyze the feasibility of the alternatives considered for HOV lane widening.

The Traffic Operations report includes an analysis of existing conditions and two future analysis year conditions – Design Year (Year 2035) and Opening Year (Year 2015). In each future analysis year, three alternatives were analyzed:

- **No-Build –** Future year conditions incorporating only planned transportation improvements that are expected to be implemented by the analysis years
- **Transportation System Management (TSM) Build –** Future year scenario, incorporating only ramp metering and auxiliary lanes
- **HOV Build –** No-Build scenario incorporating the HOV lanes, ramp metering, and supporting auxiliary lanes

2. SUMMARY

Based on the traffic analysis results, it was observed that the freeway operations would improve under the HOV Build and TSM Build scenarios compared to the No-Build scenario. Furthermore, the freeway operating conditions would be substantially improved under the HOV Build scenario than the TSM Build scenario.

Freeway Operations Summary - HOV Build Scenario

The addition of the HOV lane and other geometric improvements would increase the average travel speed and reduce the average travel time, vehicle delay, and density, thus improving the LOS of the freeway.

Average travel times would improve depending on the direction and the peak period. Under Year 2035 Conditions, the maximum travel time in the AM peak hour would drop from 59 minutes in the No-Build scenario to 16 minutes in the HOV Build scenario and the maximum travel time in the PM peak hour would reduce from 61 minutes in the No-Build scenario to 19 minutes in the HOV Build scenario. Similarly, under Year 2015 Conditions, the maximum travel time in the AM peak hour would drop from 24 minutes in the No-Build scenario to 10 minutes in the HOV Build scenario and in the PM peak hour would reduce from 47 minutes in No-Build scenario to 10 minutes in the HOV Build scenario.

Similar to average travel times, the vehicle throughput would increase under the HOV Build scenario. Under Year 2035 HOV Build Conditions, the vehicle throughput in the northbound direction would increase by 63 percent and 57 percent (compared to No-Build scenario) during the AM and PM peak hours, respectively; whereas, the vehicle throughput in the southbound direction would increase by 37 percent and 79 percent (compared to No-Build scenario) during the AM and PM peak hours respectively. Under Year 2015 HOV Build Conditions, the vehicle throughput in the northbound direction would increase by three percent and by 39 percent in the southbound direction during the PM peak hour.

Also, the improved freeway corridor conditions under HOV Build Conditions would divert vehicles traveling on parallel arterials onto State Route 1. This would then relieve the local city streets from excessive cut-through commuter traffic.

Freeway Operations Summary – TSM Build Scenario

The addition of ramp metering and auxiliary lanes within the study area would improve the freeway operations, but not as significantly as under HOV Build scenario.

Compared to Year 2035 No-Build Conditions, average travel time under Year 2035 TSM Build Conditions would reduce by 42 percent in the northbound and 15 percent in the southbound directions during the AM peak hour. However, the average travel time in the southbound direction during the PM peak hour would slightly increase by two percent. This would probably be caused by the high increase of traffic along State Route 1 under Year 2035 Conditions. Compared to Year 2015 No-Build Conditions, average travel time under Year 2015 TSM Build scenario would improve by nine percent to 64 percent, with the highest gains occurring in the northbound direction during AM peak hour (46 percent increase) and southbound direction during the PM peak hour (64 percent increase).

In the northbound direction during the AM peak hour, vehicle throughput under Year 2035 TSM Build Conditions would increase by 44 percent compared to Year 2035 No-Build Conditions; whereas, in the northbound direction during PM peak hour and in the southbound direction during the AM as well as the PM peak hours, the increase in vehicle throughput would be 24 percent only. Under Year 2015 Conditions, the gains in vehicle throughput during TSM Build scenario with respect to the No-Build scenario are not as high as under Year 2035 Conditions. The maximum gain in the throughput was observed in the southbound direction during the PM peak hour where there would be an increase in throughput by 27 percent.

Therefore, providing ramp metering and auxiliary lanes would not relieve the congestion, but would only increase the corridor's ability to carry more vehicles.

3. INTERCHANGE IMPROVEMENTS

To improve the operating conditions of the study interchanges and to increase the mobility of traffic flow to and from the freeway mainlines, the geometric layout of the following four interchanges under Year 2035 HOV Build conditions are proposed to be modified:

- Morrissey Boulevard Interchange
- Soquel Avenue Interchange
- 41st Avenue and Porter Street/Bay Avenue Interchanges
- Larkin Valley Road/San Andreas Road Interchange

Morrissey Boulevard Interchange

Of the three alternatives analyzed, Alternative 2 provided the best results in terms of intersection operations and 95th percentile queue lengths at ramps. Alternative 2 included the following modifications to the existing Morrissey Boulevard Interchange:

1. Realign southbound off-ramp so that it intersects Morrissey Boulevard instead of Fairmount Avenue.
2. Remove the existing southbound on-ramp from Fairmount Avenue and realign the southbound on-ramp from Morrissey Boulevard so that it aligns with the proposed southbound off-ramp.
3. Create two different intersections of Morrissey Boulevard/ Rooney Street and Morrissey Boulevard/ Pacheco Avenue/ SR-1 Northbound Ramps.
4. Signalize the three intersections Morrissey Boulevard/ Pacheco Avenue. SR-1 Northbound Ramps, Morrissey Boulevard/ Rooney Street, and Morrissey Boulevard/ SR-1 Southbound Ramps.

Soquel Avenue Interchange

Of the nine plans analyzed, Plan I provided the best intersection operations and 95th percentile queue lengths of the ramps. The geometric layout of Plan I provides access to Commercial Way from the State Route 1 northbound off-ramp. However, access from the Commercial Way to the northbound off-ramp is prohibited. Plan I includes the following modifications to the existing Soquel Avenue interchange:

1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
2. Construct another southbound loop on-ramp to directly connect Soquel Drive north of the intersection Soquel Drive/ Southbound Off-Ramp/ Soquel Avenue. This ramp would serve the vehicles traveling southbound on Soquel Drive. The existing southbound hook ramp off Soquel Avenue would serve all the vehicles traveling northbound on Soquel Drive and along Soquel Avenue.
3. Prohibit access from the Commercial Way to the northbound off-ramp. Redirect vehicles traveling along westbound Commercial Way to access Soquel Drive using Commercial Crossing.
4. Construct a deceleration lane of approximately 300 feet length along northbound off-ramp so that the vehicles accessing Commercial Way from the northbound off-ramp would slow down from 65 mph (free-flow speed along State Route 1) to 25 mph (free-flow speed along Commercial Way) on this lane. This deceleration lane would be provided south of the access from northbound off-ramp to Commercial Way.

41st Avenue and Porter Street/ Bay Avenue Interchanges

Of the three alternatives analyzed, Alternative 3 provided the best queuing results in terms of shorter 95th percentile queue lengths on 41st Avenue and Porter Street/Bay Avenue southbound on-ramps. This alternative combined 41st Avenue and Porter Street/ Bay Avenue interchanges using shared ramps. The main characteristics of this alternative are:

1. 41st Avenue and Porter Street/ Bay Avenue interchanges are connected to SR-1 using shared off- and on-ramps.
2. The shared ramps would be constructed in the northbound as well as the southbound directions. In the northbound direction, there will only be one off-ramp diverge location and one on-ramp merge location. Also, a slip ramp would be constructed for the 41st Avenue northbound off-ramp vehicles to bypass Porter Street interchange. In the southbound direction, there will be one off-ramp diverge location and two separate on-ramp merge location. Also, a slip ramp would be constructed for the 41st Avenue northbound off-ramp vehicles to bypass Porter Street interchange. In the southbound direction, there will be one off-ramp diverge location and two separate on-ramp merge locations for 41st Avenue southbound on-ramp and Bay Avenue southbound on-ramp.
3. In the southbound direction, the traffic from the 41st Avenue interchange would merge directly with the mainline traffic; whereas, the traffic from the Porter Street/ Bay Avenue interchange would initially enter the proposed auxiliary lane between Porter Street/ Bay Avenue and Park Avenue interchanges and then weave to merge with the mainline traffic.
4. In the northbound direction, vehicles from Porter Street/ Bay Avenue interchange would travel through the intersection 41st Avenue/ SR-1 Northbound Ramps to access State Route 1.
5. In the southbound direction, vehicles exiting from State Route 1 would travel through the intersection 41st Avenue/ SR-1 Southbound Ramps to access Porter Street/ Bay Avenue interchange.

Larkin Valley Road/ San Andreas Road Interchange

The following modifications are proposed at the Larkin Valley Road/ San Andreas Road interchange to improve traffic operating conditions of the Larkin Valley Road/ SR-1 Northbound On-Ramp and Larkin Valley Road/ SR-1 Northbound Off-Ramp intersections:

1. Realign northbound off-ramp to connect Larkin Valley Road at the intersection Larkin Valley Road/ SR-1 Northbound On-Ramp. This ramp would form the eastbound approach of this intersection. Thus, in the HOV Build Conditions, there would only be one intersection Larkin Valley Road/ SR-1 Northbound Ramps, instead of two intersections Larkin Valley Road/ SR-1 Northbound Off-Ramp and Larkin Valley Road/ SR-1 Northbound On-Ramp.
2. Signalize the intersection Larkin Valley Road/ SR-1 Northbound Ramps.

4. INTERSECTION IMPROVEMENTS

To improve the traffic operating conditions, the following nine study intersections were signalized under the 2035 HOV Build conditions:

- Morrissey Boulevard/ Rooney Street

- Morrissey Boulevard/ Pacheco Avenue/ SR-1 Northbound Ramps
- Park Avenue/ Kennedy Drive/ McGregor Drive
- State Park Road/ McGregor Drive
- Freedom Boulevard/ SR-1 Northbound Ramps
- Freedom Boulevard/ SR-1 Southbound Ramps
- Freedom Boulevard/ Bonita Drive
- San Andreas Road/ Larkin Valley Road/ SR-1 Northbound Ramps
- San Andreas Road/ SR-1 Southbound Ramps

5. PRIORITIZATION OF PROPOSED IMPROVEMENTS

To identify the hierarchy of proposed improvements under a limited funding scenario, the proposed auxiliary lane improvements are prioritized as follows from the traffic operations perspective:

Northbound Direction

1. Alternative N1 – From 41st Avenue On-ramp to Soquel Avenue Off-ramp
2. Alternative N2 – From Park Avenue On-ramp to Bay Avenue/Porter Street Off-ramp
3. Alternative N3 – From State Park Drive On-ramp to Park Avenue Off-ramp
4. Alternative N4 – From Rio Del Mar Boulevard On-ramp to State Park Drive Off-ramp
5. Alternative N5 – From Freedom Boulevard On-ramp to Rio Del Mar Boulevard Off-ramp

Southbound Direction

1. Alternative S2 – From Bay Avenue/Porter Street On-ramp to Park Avenue Off-ramp
2. Alternative S4 – From State Park Drive On-ramp to Rio Del Mar Boulevard Off-ramp
3. Alternative S5 – From Rio Del Mar Boulevard On-ramp to Freedom Boulevard Off-ramp
4. Alternative S3 – From Park Avenue On-ramp to State Park Drive Off-ramp
5. Alternative S1 – From Soquel Avenue On-ramp to 41st Avenue Off-ramp

Similarly, the proposed interchange and intersection improvements are prioritized as follows from the traffic operations perspective:

1. Morrissey Boulevard interchange improvements
2. Soquel Avenue interchange improvements
3. Freedom Boulevard/Highway 1 Northbound Ramps intersection improvements
4. Freedom Boulevard/Bonita Drive intersection improvements
5. Freedom Boulevard/Highway 1 Southbound Ramps intersection improvements
6. Rio Del Mar Boulevard/Soquel Drive intersection improvements
7. Rio Del Mar Boulevard/SR 1 Northbound Ramps intersection improvements
8. San Andreas Road/Larkin Road interchange improvements
9. Park Avenue/SR 1 Northbound Ramps intersection improvements
10. Park Avenue/SR 1 Southbound Ramps intersection improvements
11. 41st Avenue/ Porter Street interchange improvements
12. Any other improvements

6. TIER 2 PROJECT

Because of its operational independence and funding likelihood, the Alternatives N1 and S1 (northbound and southbound auxiliary lanes between 41St Avenue and Soquel Avenue interchanges), together with the Chanticleer pedestrian overhead crossing, have been identified as the Tier 2 project in the ED for the Highway 1 HOV Project. A FONSI will be sought only for this Tier 2 project.

The provision of auxiliary lanes on Highway 1 between the Soquel Avenue and 41st Avenue interchanges is expected to:

- Negligibly improve the Highway 1 corridor operations in the non-peak directions of travel, southbound in the AM peak hour and northbound in the PM peak hour;
- Improve traffic operations along the northbound corridor in the AM peak hour;
- Slightly worsen traffic operations along the southbound corridor in the PM peak hour; and
- Eliminate the existing bottleneck located between the Soquel Avenue and 41st Avenue interchanges in the northbound direction.

7. CONCLUSIONS

The provision of HOV lanes, ramp metering, and auxiliary lanes along State Route 1 between San Andreas Road/ Larkin Valley Road and Morrissey Boulevard interchanges is expected to:

- Improve the future freeway operations by increasing the average vehicle speed and reducing the vehicle delays as well as the average travel time;
- Encourage the commuters to carpool to take advantage of the HOV lanes, resulting in the vehicle throughput increase;
- Eliminate the existing bottleneck located near the Bay Avenue/ Porter Street interchange in the southbound direction;
- Improve the operations of the arterials located parallel to State Route 1 (like Soquel Drive) by reducing the inter-city commuter traffic along them;
- Enhance the operating conditions of the ramp terminal intersections as well as the intersections located next to them from the proposed interchange and intersection improvements; and
- Improve the traffic safety conditions by reducing the future crash rates compared to No-Build Conditions.

Chapter 1
INTRODUCTION

1.1 PROJECT OVERVIEW

The Santa Cruz County Regional Transportation Commission (SCCRTC), in cooperation with the California Department of Transportation (Caltrans), initiated the State Route 1 (SR-1) High Occupancy Vehicle (HOV) Lane Widening project to explore alternatives that would relieve and manage traffic congestion on SR-1 between Morrissey Boulevard and San Andreas Road/ Larkin Valley Road. HOV lane addition was selected as one of the build alternatives. The study aims to perform preliminary engineering leading to Project Approvals (PA), conduct environmental technical studies, and to prepare the Project Report (PR) and Environmental Document (ED) for the proposed HOV lane widening on this corridor. This traffic operations report was performed as part of the required documents above.

1.2 PROJECT BACKGROUND

Within the study area, State Route 1 has two travel lanes in each direction (with no existing HOV lanes) and consists of nine interchanges. State Route 1 serves local traffic between the cities and communities in the County of Santa Cruz; commute traffic within the County and to/from Santa Clara and Monterey Counties; and tourist traffic. In addition, State Route 1 is the primary route for goods movement to/from most communities in the County of Santa Cruz.

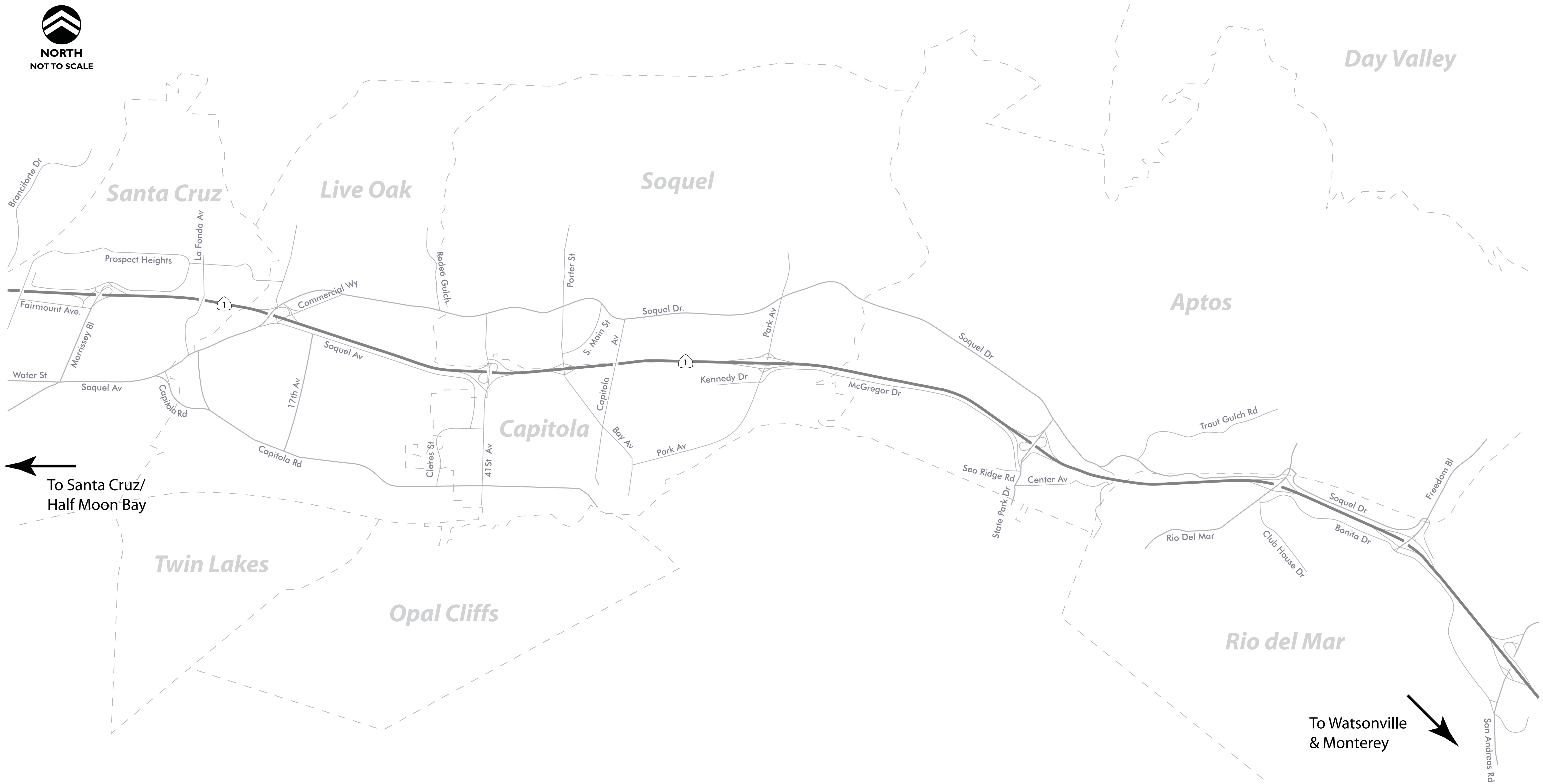
Initially, Caltrans completed Project Study Reports (PSRs) for operational improvements and widening alternatives in the northern segment of State Route 1, between Morrissey Boulevard and State Park Drive. However, traffic studies performed as part of this exercise indicated that the project limits for environmental consideration should be extended south from State Park Drive to San Andreas/Larkin Valley Road (the "southern segment") for the following reasons:

- In the northbound direction, the primary bottleneck is the State Route 1/ State Route 17 junction. Congestion caused by this bottleneck begins at Soquel Avenue and the State Route 1/ State Route 17 junction and extends beyond Freedom Boulevard during peak hours.
- In the southbound direction, there are multiple bottlenecks with the primary bottleneck located near the Bay Avenue/ Porter Street interchange. Due to these constraints, congestion between Ocean Street and Bay Avenue/ Porter Street functions as a meter. If the northern segment is improved and congestion is relieved, vehicles will spill into the southern segment and overwhelm the highway's capacity, creating a new bottleneck near or south of State Park Drive.

Congestion in the southern segment can only be understood in the context of the entire corridor and is presented together with northern segment data in this report. Figure 1-1 presents the project location and Figure 1-2 illustrates the study corridor for this report, from the northerly end of Morrissey Boulevard to the southerly end of San Andreas Road/ Larkin Valley Road.

ENGINEERS
PLANNERS
ECONOMISTS
WilburSmith
ASSOCIATES

Figure 1-1
PROJECT LOCATION
393070/BASE - 04/02/07



ENGINEERS
PLANNERS
ECONOMISTS
WilburSmith
ASSOCIATES

Figure 1-2
PROJECT STUDY AREA

393070\VOLUMES - 04/02/07

1.3 PROJECT DESCRIPTION

The proposed State Route 1 HOV lanes would add one HOV lane per direction, extending approximately 8.25 miles, between the Morrissey Boulevard interchange and the San Andreas Road/ Larkin Valley Road interchange. The interchange spacing is about one mile, with the exception of a spacing of about 0.42 miles between the Bay Avenue/ Porter Street and 41st Avenue interchanges, and a spacing of 1.55 miles between the State Park Drive and Park Avenue interchanges.

This report includes an analysis of existing conditions and two future analysis year conditions – Design Year (Year 2035) and Opening Year (Year 2015). In each future analysis year, three alternatives were analyzed:

- **No-Build –** Future year conditions incorporating only planned transportation improvements that are expected to be implemented by the analysis years (i.e., *Route 1/17 Widening for Merge Lanes* and *Highway 1 Soquel to Morrissey Auxiliary Lanes Project* improvements)
- **Transportation System Management (TSM) Build –** Future year scenario, incorporating only ramp metering (as part of Caltrans long-term plan for the region) and auxiliary lanes
- **HOV Build –** No-Build scenario incorporating the HOV lanes, ramp metering, and supporting auxiliary lanes

1.4 REPORT STRUCTURE

This Traffic Operations Report for the study is divided into eight chapters. *Chapter 2* discusses the study approach in detail, while the existing conditions are presented in *Chapter 3*. The methodology used to determine future volumes and traffic patterns through the use of travel demand models is described in *Chapter 4*.

Once the future traffic patterns were established, the project team analyzed various future scenarios under different analysis years: Design Year (2035) and Opening Year (2015). They are presented in *Chapters 5 and 6*, respectively. *Chapter 7* presents the results of the collision analysis, *Chapter 8* discusses the prioritization of the proposed auxiliary lane alternatives and Tier 2 project, while the study conclusions and recommendations are summarized in *Chapter 9*.

Chapter 2
STUDY APPROACH

Overview

The overall goal of the project is to analyze the feasibility of the alternatives considered for the HOV lane widening project. As such, the project team followed the analysis approach summarized in *Figure 2-1*. The analysis was based on the balanced traffic forecasts developed for this project using the Year 2030 Association of Monterey Bay Area Governments (AMBAG) Regional Travel Demand Model. The AMBAG model assumes growth in population, housing and employment based on approved jurisdictional plans. The travel demand modeling methodology is introduced in *Section 2.1*, and discussed further in *Chapter 4*. The travel demand model synthesized the land use, socioeconomic/demographic, and roadway networks into future travel patterns as well as traffic volumes. The project team then extrapolated the year 2030 projections to year 2035 (design year) and 2015 (opening year) conditions.

FREQ macro-simulation software was used to simulate the freeway traffic operations based on the traffic patterns and volumes obtained from the travel demand models. Local arterial and intersection operations analysis was performed using *Synchro/SimTraffic* micro-simulation software. Various Measures of Effectiveness (MOEs) were extracted from the simulation tools to forecast future traffic operations within the study area, including average travel time, travel speed, vehicle volume and delay, vehicle and person trips, total travel distance, queue length, and Level of Service (LOS).

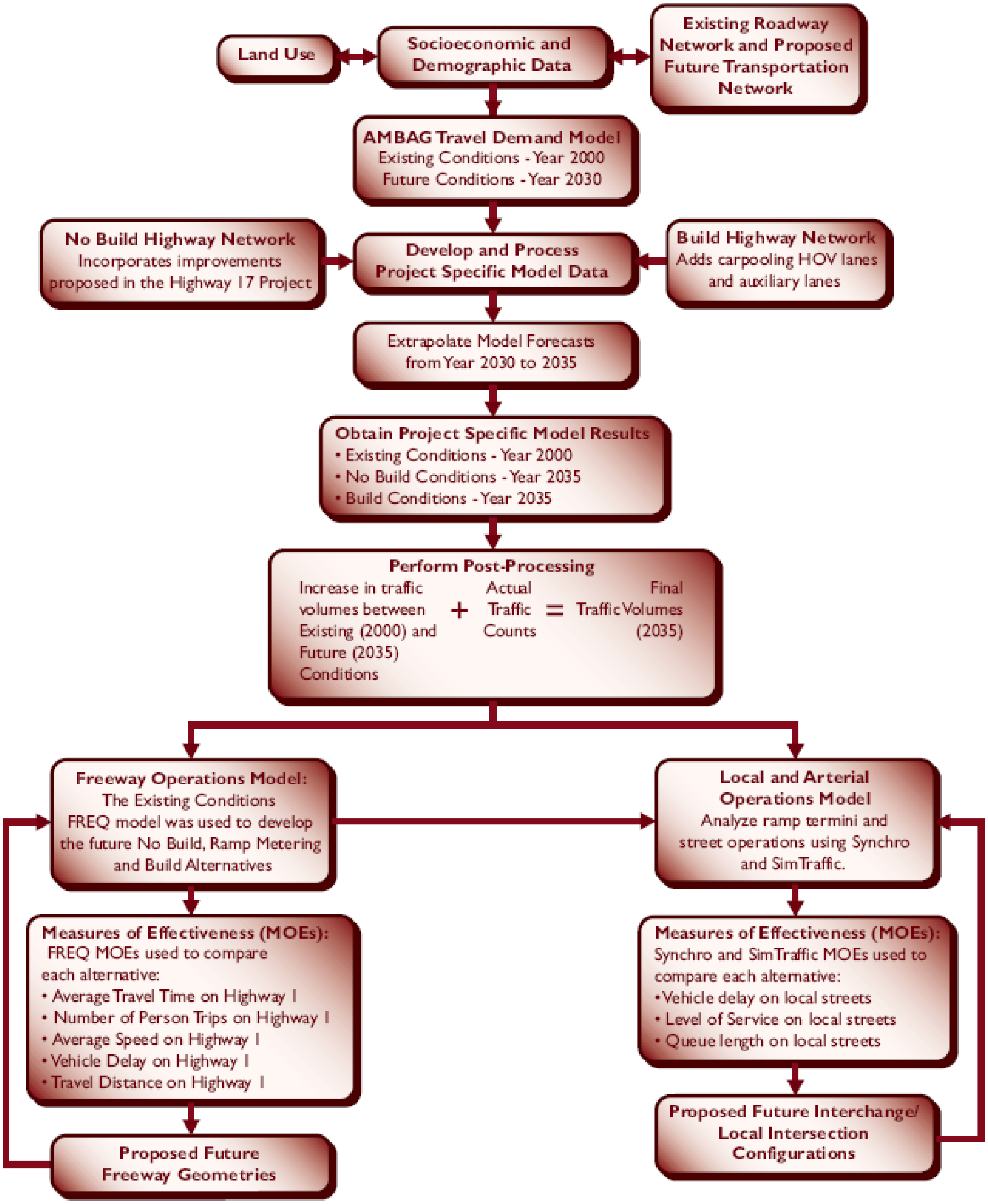
2.1 TRAVEL DEMAND MODELING

The primary tool for travel demand forecasting in the study area is the AMBAG Regional Travel Demand Model. The AMBAG Model is a computer model which forecasts transportation demand on the roadway network for the tri-county area of Santa Cruz, Monterey, and San Benito Counties. It was originally created in the mid-1990's using *MINUTP* transportation modeling software, and has since been implemented in *TransCAD* with its superior data management and reporting capabilities.

The AMBAG Travel Demand Model is a traditional four-step travel demand forecasting model using trip generation, trip distribution, mode choice, and traffic assignment modules. Land use inputs are developed by AMBAG and accounted for within nearly 1,400 Traffic Analysis Zones (TAZs), which are connected to a roadway network. This roadway network in the AMBAG Model represents the physical roadway network. This network was originally imported from an *AutoCAD* drawing of Santa Cruz and Monterey Counties, with San Benito County added from a *Tranplan* model network. Land use forecasts are based on the adopted AMBAG forecasts.

A working version of the travel demand model used in this study has been available since April 2005 (version 1.1), and is currently being refined. This version of the model includes both year 2000 baseline and year 2030 future scenarios. The year 2030 scenario includes the projects that are included in the adopted metropolitan transportation plan.

Figure 2-1
Highway 1 HOV Lane Study Process



Transportation consultants under contract with AMBAG are currently working on additional model refinements, including development of an improved user interface, adding interim years of analysis, incorporating more time periods, performing transit assignments, and carrying out the validation of the entire model. The model is currently validated for daily conditions at the screenline level on a regional basis. An updated version of the model, which includes a resolution of the carpool assignment issues that previously plagued the model, has been furnished to the consultants for this study.

2.2 FREEWAY TRAFFIC OPERATIONS ANALYSIS (FREQ)

FREQ Version 2.08 (developed by the Institute of Transportation Studies, University of California at Berkeley) was used to model existing conditions, identify future freeway operations conditions, and test various future improvement alternatives for the freeway mainlines.

FREQ is a macroscopic deterministic simulation model, based on demand-supply analytical framework. This model was developed in cooperation with Caltrans, and was developed to evaluate various freeway facilities for numerous design and operation improvements. It has been updated over a course of 30 years.

The *FREQ* model requires four data sets to model the existing operation conditions of the freeway:

- Supply side
- Demand side
- Control side
- Traffic performance

The "Supply side" data is required to build the network which includes the freeway geometric details; for example, number of lanes on the freeway and ramps, length of freeway main line sections between ramps, locations of on/off-ramps on the freeway, and the freeway operational parameters like sub-section capacities, free flow speed and lower limb speed.

Traffic demand (Demand side) is defined as the quantity of traffic volume that would likely travel over a subsection of the freeway in a particular time interval. Demand side data needed "origin" counts such as freeway mainline and ramp entrance demands and destination counts such as exit demand. Vehicle type classification and vehicle occupancy rate are also part of the demand side input.

"Control side" data includes the following features: ramp metering, HOV lanes, speed limits, and land use control. The ramp meter, HOV lane, and land use control features were not included as part of the existing conditions model. However, the speed limit feature was used in the model to provide information on the expected free-flow speed and measure the effects of the geometric design changes to traffic operations.

"Traffic performance" data are used for the calibration and validation process. The data typically includes traffic counts and travel time surveys ("tach runs"). Tach runs were used to calibrate the existing conditions network. Traffic counts from detectors provide the advantage of collecting data over long periods of time. They also assist in developing the percentage of occupancy and speed along the freeway. By using the detector data, an analyst can develop traffic counts and speed contour maps used for the calibration process. Detector data from on/off-ramps can be used to develop Origin-Destination (O-D) demand tables from the count data.

FREQ provides outputs of speed, delay, travel time, density, pollutants, noise level, and fuel consumptions over time and by geographic segments.

Model Development

An existing model from Caltrans for the northbound AM, northbound PM, and southbound PM conditions was used as the base model for this study. The Caltrans models were originally developed for the PSR.

The *FREQ* model duration extended from 6 AM to 12 PM during the morning peak period, and from 2 PM to 8 PM for the evening peak period, for both northbound and southbound directions. The six-hour peak period was used to capture the entire congestion period along the study corridor, since some congestions may last for several hours. Also, as congestion increases over time due to population and traffic growth, "peak spreading," or the lengthening of the peak period towards earlier or latter hours may occur. The longer study duration would ensure that any peak spreading in the future years would be captured by the model.

Existing Conditions Supply Side Input

The northbound direction network limits were north of Mar Monte Avenue and north of Highway 17 off-ramp, while the southbound corridor was modeled between south of River Street and south of the Larkin Street on-ramp. In the model, the study corridor was divided into various subsections, based on changes in traffic demand (typically occurring at the on and off-ramps) and changes in capacity along the freeway (typically occurring at lane drops, lane additions, or significant changes in grades). A summarized view of the lane configurations for the study corridor is presented in *Chapter 3 (Figure 3-1)*.

Existing Conditions Demand Side Input

The existing conditions demands were modeled using traffic volumes collected by the project team. Refer to *Chapter 3 (Section 3.3)* for discussions on the existing traffic volumes. On the other hand, the occupancy and truck percentages were obtained from the *2003 Transportation Monitoring Report* (SCCRTC, April 2004). Detailed vehicle occupancy discussions may be found in the *State Route 1 Widening/HOV Project: Existing Conditions Final Report*.

Speed and Travel Time Calibration

The models were calibrated for the existing conditions using tach runs performed by the project team, which included continuous speed and travel time data for both directions within the study corridor. Refer to the *Existing Conditions Final Report* (Appendix A-1) for a detailed discussion on the existing travel time and speed data collection effort. To calibrate the models, the speed output from each subsection of the corridor was compared against the field speed data. A statistical "chi-square" test was used to assess the difference between observed and modeled values. The lower the chi-square value, the better the model represents field conditions. This process was performed iteratively, until both observed and modeled conditions for the entire corridor fall within an acceptable range.

2.3 FREEWAY AND INTERSECTION OPERATIONS

Level of Service Definition

Level of Service (LOS) is a measure used to rate roadway facilities, based on their traffic conditions. It is a qualitative description of traffic flow based on factors including speed, travel time, delay, and freedom to maneuver. Six levels of service are defined for each facility type, varying from LOS A to LOS F. LOS A indicates that traffic flows freely, with little or no delay and LOS F indicates that traffic demand exceeds the capacity, generally resulting in long queues and delays. The freeway LOS descriptions are based on the average vehicular density recorded for each freeway segment in terms of passenger cars per mile per lane (pcpmpl), while the intersection LOS descriptions are based on vehicular delay in seconds per vehicle.

Signalized Intersections Analysis

Signalized intersections LOS and delay analyses were performed using methodologies approved by Caltrans, based on the guidelines provided in *Highway Capacity Manual (HCM) 2000, Chapter 16*. The LOS is based on the average delay (in seconds per vehicle) for the various movements within the intersection. A combined weighted average delay and LOS are presented for each of the signalized intersections. They are calculated using *Synchro Version 6.0* traffic analysis software, which allows input of geometric lane configurations, traffic volumes, signal timing, and signal coordination parameters to simulate actual intersection operations. Individual movements through the intersection would have varying levels of delay due to the unique conditions affecting each movement. The performance measures obtained from the process include vehicle delay, total delay, queue length, and LOS. The LOS criteria for signalized intersections are presented in *Table 2-1*.

Unsignalized Intersections Analysis

Operations of the unsignalized intersections were evaluated using the methodology contained in *Chapter 17* of *HCM 2000*. The LOS rating is based on the weighted average control delay expressed in seconds per vehicle. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration. At two-way or side street-controlled intersections, LOS is calculated for each controlled movement, not for the intersection as a whole. For approaches composed of a single lane, the control delay is computed as the average of all movements in that lane. For all-way stop controlled locations, LOS is computed for the intersection as a whole. For this study, *Synchro* analysis tool was used to calculate unsignalized intersection delays, requiring the same input as signalized intersections, except the signal timing and signal coordination parameters. *Table 2-2* exhibits the LOS criteria for unsignalized intersections.

Table 2-1
Level of Service Criteria – Signalized Intersections

Level of Service	Description of Operations	Average Delay
A	Operations with very low delay occurring with favorable progression and/or short cycle length.	≤ 10.0
B	Operations with low delay occurring with good progression and/or short cycle lengths.	10.1 – 20.0
C	Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	20.1 – 35.0
D	Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable.	35.1 – 55.0
E	Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay.	55.1 – 80.0
F	Operation with delays unacceptable to most drivers occurring due to over saturation, poor progression, or very long cycle lengths.	≥ 80.1

Source: Highway Capacity Manual, Transportation Research Board, 2000
NOTES:
Delay presented in seconds per vehicle.

Table 2-2
Level of Service Criteria – Unsignalized Intersections

Level of Service	Description of Operations	Average Delay
A	No Delay for stop-controlled approaches.	≤ 10.0
B	Operations with minor delays.	10.1 – 15.0
C	Operations with moderate delays.	15.1 – 25.0
D	Operations with some delays.	25.1 – 35.0
E	Operations with high delays, and long queues.	35.1 – 50.0
F	Operations with extreme congestion, with very high delays and long queues unacceptable to most drivers.	≥ 50.1

Source: Highway Capacity Manual, Transportation Research Board, 2000
NOTES:
Delay presented in seconds per vehicle.

Freeway Segment Analysis

Freeway segment operating conditions were evaluated using the *HCM* 2000 methodology. HCM methodology computes LOS for basic freeway segments using density as the measure of effectiveness. Based on the values of the input parameters (geometric data, volume, and base free-flow speed) flow rate and speed are determined. Adjustments are typically made to the base free-flow speed to account for lane width, number of lanes, interchange density, and lateral clearance. Using the flow rate and speed, density of the freeway segment is computed. *Table 2-3* presents the LOS criteria for freeway segments using density as the performance measure.

Table 2-3
Level of Service Criteria – Basic Freeway Segments

Level of Service	Density
A	0.0 – 11.0
B	11.1 – 18.0
C	18.1 – 26.0
D	26.1 – 35.0
E	35.1 – 45.0
F	> 45.0

Source: Highway Capacity Manual, Transportation Research Board, 2000
NOTES:
DEC – Demand Exceeds Capacity.
Density is presented in passenger cars per hour per lane.

Freeway Weaving Analysis

A weaving section is a length of one-way roadway where vehicles are crossing paths, changing lanes, or margining with through traffic as they enter or exit a freeway or collector-distributor road.

The FREQ model applies the LOS D methodology as per the 1965 *Highway Capacity Manual* for performing weaving analysis at the on-and off-ramps[1]. The LOS D methodology provides a method for determining the adequacy of weaving sections near single lane ramps. The LOS D method can be used to project volumes along a weaving section. These volumes can be compared to the capacities along the same weaving section[2].

Queuing Analysis

Queuing analysis at several previously-identified study intersections were analyzed using *SimTraffic 6.0* simulation tool, which is a companion product to *Synchro* analysis tool for performing microscopic simulation and animation. *SimTraffic* is a stochastic model, which means that traffic behaviors may be simulated at random.

For this study, each scenario was simulated ten (10) times, at 60 minutes intervals. The simulation was run multiple times to capture randomness that may occur in reality. The average of the ten (10) simulation outputs was reported, and the key output obtained from the runs was the queue length. In *SimTraffic* tool, queue length is reported individually for each lane; a vehicle is considered queued when its travel speed is less than 10 feet per second and is either at the stop bar or following another queued vehicle. In this study, the project team reported both average and 95th percentile queue lengths. The 95th percentile queue length describes the length at which 95 percent of vehicles are queuing at or below during a given time period, such that the remaining five (5) percent of vehicles are observed to exceed this length.

[1] Tsutomu Imada and Adolf D. May, *FREQ8PE: A Freeway Corridor Simulation and Ramp Metering Optimization Model*, June 1985
[2] Caltrans Highway Design Manual, 5th Edition

2.4 STUDY AREA

As shown in *Figure 1-2*, the study area for this project extends from San Andreas Boulevard/ Larkin Valley Road interchange to Morrissey Boulevard interchange along State Route 1. As part of the project, the following 25 study intersections are analyzed:

1. Morrissey Blvd./ Rooney St./ Pacheco Ave.
2. Rooney St./ SR-1 NB Ramps
3. Fairmount Ave./ SR-1 SB Ramps
4. Morrissey Blvd./ Fairmount Ave.
5. Soquel Ave./ SR-1 SB Ramps
6. Soquel Dr./ Paul Sweet Rd./ Commercial Way
7. 41^{st} Ave./ SR-1 NB Off-Ramp
8. 41^{st} Ave./ SR-1 SB Ramps
9. Porter St./ S. Main St.
10. Porter St./ SR-1 NB Ramps
11. Bay Ave./ SR-1 SB Ramps
12. Park Ave./ SR-1 NB Ramps
13. Park Ave./ SR-1 SB Ramps
14. Park Ave./ Kennedy Dr./ McGregor Dr.
15. State Park Dr./ SR-1 NB Ramps
16. State Park Dr./ SR-1 SB Ramps
17. State Park Dr./ McGregor Dr.
18. Rio Del Mar Blvd./ SR-1 NB Ramps
19. Rio Del Mar Blvd./ SR-1 SB Ramps
20. Rio Del Mar Blvd./ Soquel Dr.
21. Freedom Blvd./ SR-1 NB Ramps
22. Freedom Blvd./ SR-1 SB Ramps
23. Freedom Blvd./ Bonita Dr.
24. San Andreas Rd. Larkin Rd./ SR-1 NB Off-Ramp
25. San Andreas Rd./ SR-1 SB Ramps

Of the 25 study intersections, 15 are signalized intersections, four (4) are All-Way Stop Controlled (AWSC) intersections, and six (6) are Two-Way Stop Controlled intersections. *Figure 2-2* exhibits the locations of the study intersections and identifies the signalized and unsignalized intersections.

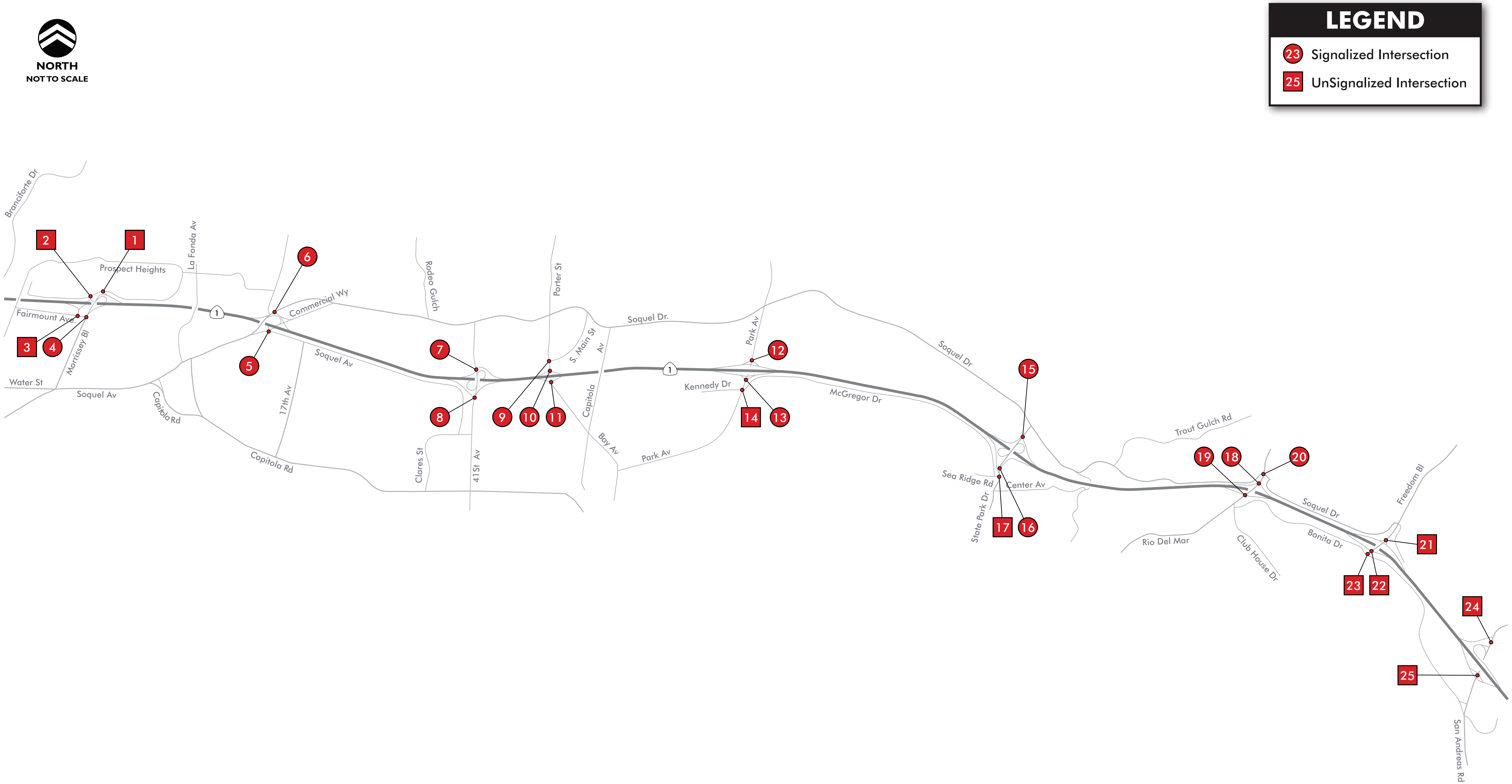


Figure 2-2
PROJECT STUDY INTERSECTIONS
393070\VOLUMES - 04/02/07

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Chapter 3
EXISTING CONDITIONS ANALYSIS

Overview

The expanded State Route 1 study corridor extends approximately 8.25 miles from the north end of the Morrissey Boulevard interchange to the south end of the San Andreas Road/ Larkin Valley Road interchange. This study presents all available corridor data within the study area boundaries, from State Route 1/ State Route 17 interchange ramps to San Andreas Road/ Larkin Valley Road interchange.

This chapter discusses existing roadway conditions, with data collection performed between years 2001 and 2003. The purpose of the field data overview is to validate that the travel demand model accurately reflects existing traffic patterns and operations, before projecting the future traffic. This chapter contains discussions on the corridor's physical characteristics, traffic volumes, travel times, and operations of the local arterials and intersections. It should be noted that this chapter was prepared as a supplement to the Existing Conditions Report prepared in June 2005 (attached in *Appendix A-1*).

3.1 ROADWAY CHARACTERISTICS

On State Route 1 within the study area, spacing between the interchanges are as follows:

- Between the Highway 17 off-ramp and Morrissey Boulevard – 1.0 miles
- Between Morrissey Boulevard and Soquel Drive – 0.96 miles
- Between Soquel Drive and 41st Avenue – 1.2 miles
- Between 41st Avenue and Bay/Porter Streets – 0.42 miles
- Between Bay/Porter Streets and Park Avenue – 1.1 miles
- Between Park Avenue and State Park Drive – 1.5 miles
- Between State Park Drive and Rio Del Mar Boulevard – 1.4 miles
- Between Rio Del Mar Boulevard and Freedom Boulevard – 0.8 miles
- Between Freedom Boulevard and San Andreas Road/ Larkin Valley Road – 0.7 miles

Auxiliary lanes exist at the following locations:

- In the northbound direction – Between the Porter Street on-ramp and the 41st Avenue off-ramp
- In the southbound direction – Between the 41st Avenue on-ramp and the Bay Street off-ramp.

Figure 3-1 presents the lane line diagram of the State Route 1 study area under Existing Conditions.

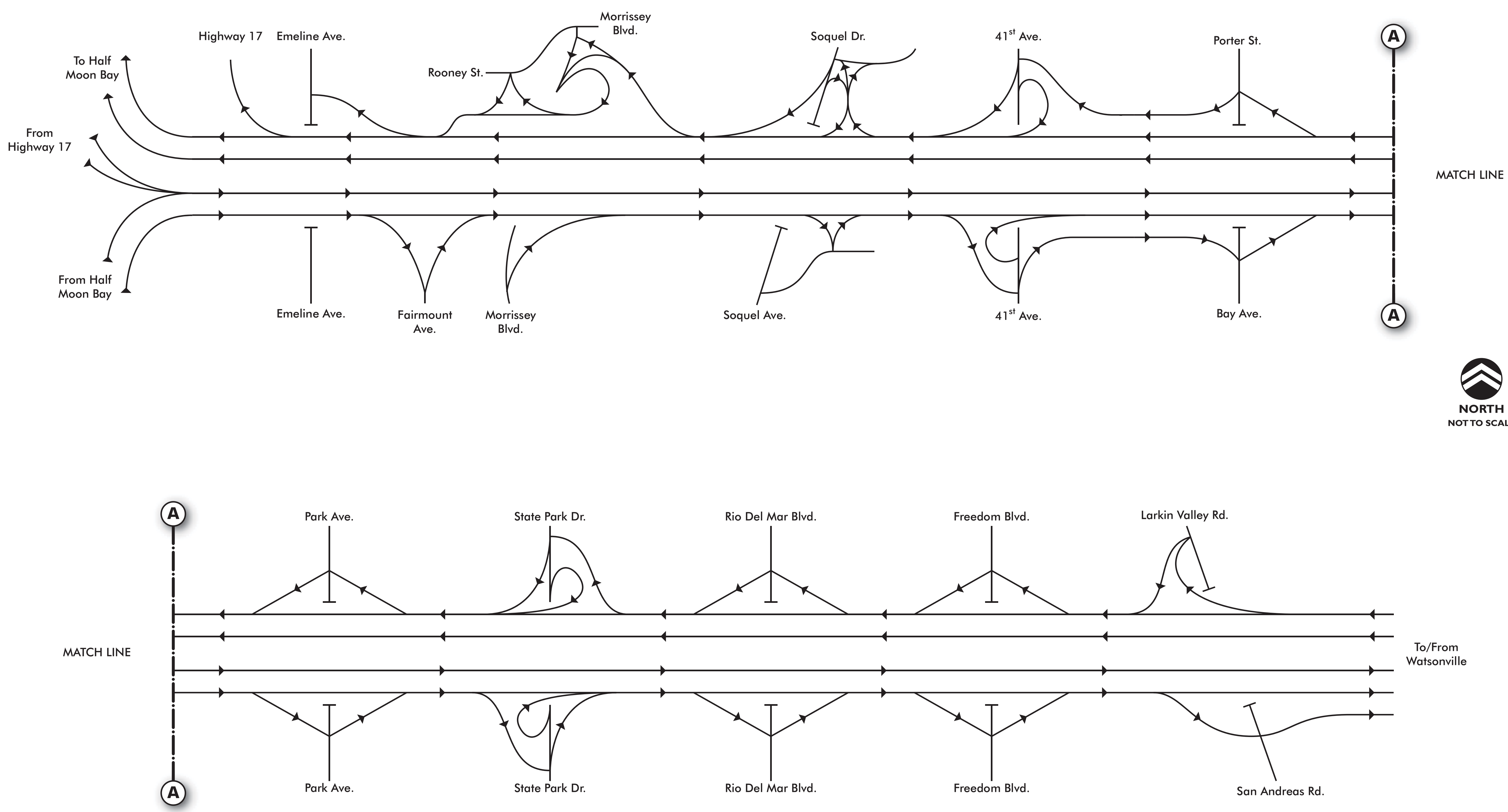

Figure 3-1
STATE ROUTE 1 LANE LINE DIAGRAM
EXISTING CONDITIONS
393070/HWY BASE - 05/08/07

3.2 EXISTING ARTERIAL CHARACTERISTICS

This section provides a discussion of the existing local roadway system located in the project study area, including the roadway designation, number of travel lanes, and traffic flow directions. Each of the arterials described below feeds into State Route 1. In addition, each arterial is striped with a Class II bicycle lane.

41st Avenue is the most heavily traveled of all of the arterials in the study area. It travels north and south in two directions for two miles between Soquel Drive and East Cliff Drive on the waterfront. It is two lanes in most locations, but it can be as wide as six lanes in sections between Soquel Drive and Capitola Road. 41st Avenue comprises Santa Cruz's main retail corridor.

Porter Street and Bay Avenue are the northern and southern segments of an alignment that runs from Monterey Avenue, across State Route 1 to the foot of the Santa Cruz Mountains. North of Soquel Drive, Porter Street turns into Old San Jose Road. Together, the Porter Street and Bay Avenue segments create an alignment about one (1) mile long. Very heavily traveled, Porter Street is two lanes wide and travels in two directions. Bay Avenue, with slightly lower volumes, is four lanes in two directions. Both provide access from State Route 1 to Capitola Avenue, south of the Highway, and Soquel Drive to the north.

Soquel Drive is the main parallel route to State Route 1 in the study area. It runs for about eight (8) miles in two directions, starting in the east at its intersection with Soquel Avenue and ending at Freedom Boulevard at the western end of the study area. It is two lanes wide for most of its trip. East of State Park Drive it is primarily an access road for State Route 1.

Soquel Avenue serves the southwestern part of the study area. To the east, it begins at Pacific Avenue and crosses over the San Lorenzo River. Just south of State Route 1, Soquel Avenue turns right and continues along south of the Highway to Gross Road. Also at this junction, Soquel Avenue feeds into Soquel Drive, crossing over the Highway and paralleling it on the north side. It is a three a half mile, primarily two-lane road that widens in some sections.

Rio Del Mar Boulevard provides the primary access route from State Route 1 to the community of Rio Del Mar. It runs north-south for 1.4 miles in two directions along two lanes from Beach Drive (private road) to Soquel Drive.

State Park Drive is a short (less than one mile long), two lane road providing access from State Route 1 to Seacliff Beach State Park to the south and Soquel Drive to the north. Its heavy volumes are a function of its connection with Soquel Drive and the Rancho Del Mar Shopping Center.

Park Avenue divides the City of Capitola to the west from the community of Aptos to the east. It runs in two directions along four lanes. It begins in the hilly northern side of Capitola and runs south to Monterey Avenue, turning west to parallel the ocean after Coronado Street. It is 1.8 miles long.

3.3 EXISTING FREEWAY AND RAMP VOLUMES

The project team conducted a series of traffic counts at the study corridor, twice in 2001 and once in 2003. As the study area expanded southward during the course of this study, additional counts were conducted in year 2003 in the southern segment. Compatibility of the traffic data from years 2001 and 2003 were analyzed. The project team determined that the volumes were about ten percent of each other, which is within the acceptable range of variability.

State Route 1 travel lanes were videotaped at the Capitola Avenue overcrossing and near the Freedom Boulevard interchange. The traffic volumes were counted from the videotapes. These traffic volumes represent the number of vehicles passing these locations during each hour of the survey period, presented in vehicles per hour (vph). They do not reflect the capacity of the corridor, but the throughput at these locations.

Table 3-1 summarizes the existing traffic volume counts in the study area. A detailed breakdown of data from each data collection effort is provided in the *Existing Conditions Final Report* (*Appendix A-1*).

Table 3-1
Existing State Route 1 Hourly Traffic Volume Counts

Time Period	Spring 2001 @ Capitola O/C		Summer 2001 @ Capitola O/C		Fall 2003 @ Freedom I/C		Peak Period Average	
	NB	SB	NB	SB	NB	SB	NB	SB
6:00 AM to 7:00 AM	3,100	1,350	2,500	1,200	2,700	1,300		
7:00 AM to 8:00 AM	***3,850***	***3,050***	***3,100***	***2,200***	***2,400***	***2,600***	***3,440***	***2,800***
8:00 AM to 9:00 AM	***3,300***	***3,050***	***3,850***	***3,050***	***2,000***	***2,600***		
9:00 AM to 10:00 AM	***3,450***	***2,800***	***3,100***	***2,650***	***1,950***	***2,000***		
10:00 AM to 11:00 AM	3,050	2,400	3,050	2,650	1,800	1,900		
11:00 AM to 12:00 PM	3,150	2,900	2,550	3,000	1,800	1,950		
12:00 PM to 1:00 PM	3,200	3,300	3,300	3,200	1,800	2,000		
1:00 PM to 2:00 PM	3,050	3,200	3,550	3,200	1,900	2,200		
2:00 PM to 3:00 PM	3,400	3,600	3,350	3,300	2,100	2,400		
3:00 PM to 4:00 PM	***3,950***	***3,550***	***3,350***	***3,100***	***2,300***	***2,800***	***3,640***	***3,500***
4:00 PM to 5:00 PM	***3,500***	***3,600***	***3,750***	***3,450***	***2,350***	***3,000***		
5:00 PM to 6:00 PM	***3,400***	***3,700***	***3,850***	***3,600***	***2,300***	***3,150***		
6:00 PM to 7:00 PM	2,800	3,650	3,000	3,700	2,400	3,200		

Source: Wilbur Smith Associates, 2001 and 2003
NOTES:
Volumes rounded to nearest 50 vehicles.
Bold italics indicate AM and PM peak period values.

Under Existing Conditions, traffic volumes were introduced into the *FREQ* simulation network to obtain the freeway and ramp volumes under AM as well as PM peak periods. *Figures 3-2A* and *3-2B* present the corridor and ramp volumes at select junctions under AM and PM peak periods, respectively.

NORTH
NOT TO SCALE

LEGEND

- ### Volumes During timeperiod 6-7:00 AM
- ### Volumes During timeperiod 7-8:00 AM
- ### Volumes During timeperiod 8-9:00 AM
- ### Volumes During timeperiod 9-10:00 AM

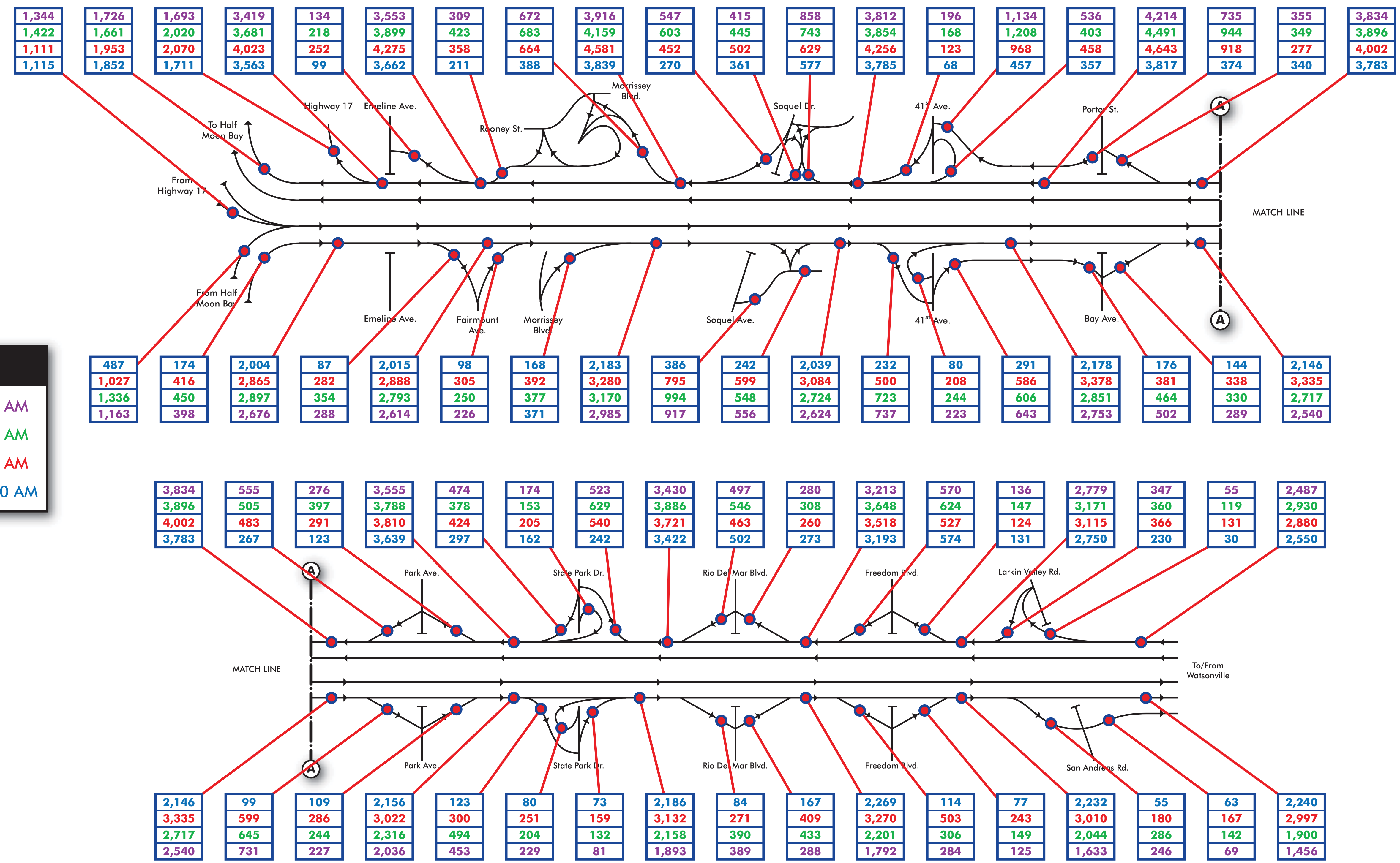

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Figure 3-2A
STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
EXISTING CONDITIONS (AM PEAK)

393070/FWY-RAMP - 04/02/07

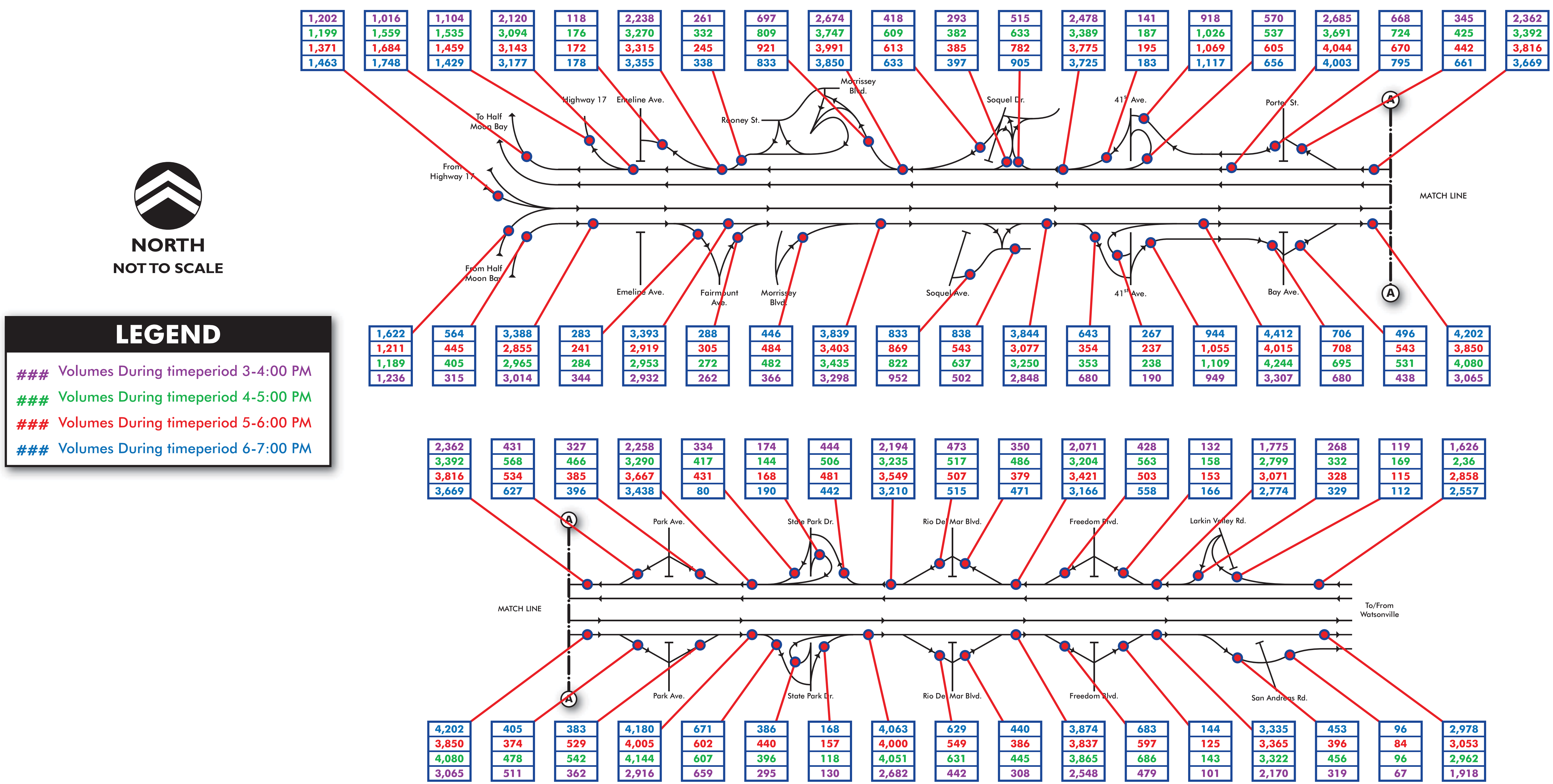

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Figure 3-2B
STATE ROUTE 1 FREEWAY AND RAMP VOLUMES EXISTING CONDITIONS (PM PEAK)

393070/FWY-RAMP - 04/02/07

3.4 EXISTING FREEWAY OPERATIONS

Travel time surveys were conducted along the State Route 1 study corridor in October 2003 during weekday AM, midday, and PM peak periods. The route surveyed for travel time and delay study extended for 8.8 miles between San Andreas Road/ Larkin Valley Road and Branciforte Drive overcrossing, just south of the State Route 1/ State Route 17 interchange.

The travel times were used to calculate the average travel speeds during these time periods. These travel times would be used to validate the traffic operations model for the existing freeway operations during weekday AM and PM peak hour conditions. *Table 3-2* summarizes the year 2003 runs per peak period and direction, along with the travel time and speed summaries.

Based on the travel time runs, peak period traffic along State Route 1 exhibited heavy directionality. During the morning peak period, the northbound direction was heavy with commuters heading into the downtown area; whereas, during the evening peak period, the majority of the traffic traveled southbound from downtown Santa Cruz. With recurrent congestion defined as average travel speeds at 35 mph or less on incident-free weekdays, during rush hours, for a duration of at least 15 minutes, it would seem that northbound State Route 1 during the AM peak and southbound State Route 1 during the PM peak fall under this category.

Table 3-2
State Route 1 Travel Time Run Summary
Between San Andreas Road/ Larkin Valley Road and Branciforte Drive

	AM Peak	Midday Peak	PM Peak
Number of Runs			
NB	2	3	2
SB	2	2	3
Average Travel Time (mm:ss)			
NB	15:39	7:55	8:58
SB	8:52	8:39	15:21
Average Speed (mph)			
NB	34	66	56
SB	61	63	34

Source: Wilbur Smith Associates, 2003

Table 3-3 exhibits the existing peak hour freeway operating conditions, while *Table 3-4* summarizes the peak hour density and LOS of the freeway segments within the study area. *Appendix E-1* exhibits the *FREQ* output under Existing Conditions.

Under the existing AM peak hour conditions, five (5) of the 24 freeway segments operate at LOS D or above in the northbound direction. These freeway segments include segments located south of Freedom Boulevard on-ramp and north of State Route 17 off-ramp. The other 19 freeway segments are operating at LOS E or F. In the southbound direction, all the 24 freeway segments operate at LOS D or above during the AM peak hour.

Table 3-3
Freeway Operations - Existing Conditions

Measure of Effectiveness	Existing	
	AM	PM
Northbound		
Average Travel Time (minutes)	23 ***16***	15 ***12***
Average Speed (mph)	30 ***44***	39 ***52***
Delay (minutes per vehicle)	14 ***4***	6 ***2***
No. of Vehicle Trips (per hour)	2,923 ***3,045***	3,235 ***2,805***
No. of Persons Trips (per hour)	3,308 ***3,447***	4,024 ***3,489***
Freeway Travel Time (VHT)	1,274 ***821***	823 ***544***
Travel Distance (VMT)	38,517 ***35,933***	32,349 ***28,045***
Avg. Vehicle Occupancy (persons/vehicle)	1.13 ***1.13***	1.24 ***1.24***
Density (pcpmpl)	49 ***35***	41 ***27***
Level of Service	F ***D***	E ***D***
Southbound		
Average Travel Time (minutes)	10 ***10***	27 ***18***
Average Speed (mph)	60 ***61***	26 ***39***
Delay (minutes per vehicle)	0 ***0***	15 ***6***
No. of Vehicle Trips (per hour)	2,918 ***2,332***	3,101 ***2,885***
No. of Persons Trips (per hour)	3,385 ***2,705***	3,664 ***3,405***
Freeway Travel Time (VHT)	507 ***400***	1,391 ***858***
Travel Distance (VMT)	30,348 ***24,251***	35,661 ***33,182***
Avg. Vehicle Occupancy (persons/vehicle)	1.16 ***1.16***	1.18 ***1.18***
Density (pcpmpl)	24 ***19***	60 ***37***
Level of Service	C ***C***	F ***E***

Source: Wilbur Smith Associates, February 2007

NOTES:
Non-italicized and non-bold values represent peak hour values.
Bold *italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.

Table 3-4
Corridor Segment LOS and Density Summary - Existing Conditions

Freeway Segment		Existing			
		AM		PM	
From	To	Density	LOS	Density	LOS
Northbound					
Start	Larkin Rd. Off-Ramp	24.3	C	22.1	C
Larkin Rd. Off-Ramp	Larkin Rd. On-Ramp	23.1	C	20.8	C
Larkin Rd. On-Ramp	Freedom Blvd. Off-Ramp	26.0	C	24.2	C
Freedom Blvd. Off-Ramp	Freedom Blvd. On-Ramp	25.0	C	21.4	C
Freedom Blvd. On-Ramp	Rio Del Mar Blvd. Off-Ramp	40.4	E	26.4	D
Rio Del Mar Blvd. Off-Ramp	Rio Del Mar Blvd. On-Ramp	56.5	F	22.8	C
Rio Del Mar Blvd. On-Ramp	Seacliff Rd. Off-Ramp	56.7	F	27.6	D
Seacliff Rd. Off-Ramp	State Park Dr. EB On-Ramp	86.9	F	24.7	C
State Park Dr. EB On-Ramp	State Park Dr. WB On-Ramp	75.4	F	26.0	C
State Park Dr. WB On-Ramp	Park Ave. Off-Ramp	79.2	F	30.1	D
Park Ave. Off-Ramp	Park Ave. On-Ramp	101.1	F	50.9	F
Park Ave. On-Ramp	Bat/Porter St. Off-Ramp	85.1	F	61.5	F
Bay/Porter St. Off-Ramp	Bat/Porter St. On-Ramp	91.8	F	84.1	F
Bay/Porter St. On -Ramp	41st Ave. Off-Ramp	79.1	F	92.5	F
41st Ave. Off-Ramp	41st Ave. EB On-Ramp	95.3	F	102.6	F
41st Ave. EB On-Ramp	41st Ave. WB On-Ramp	72.1	F	82.0	F
41st Ave. WB On-Ramp	Soquel Dr. Off-Ramp	71.3	F	74.3	F
Soquel Dr. Off-Ramp	Soquel Dr./ Commercial Way On-Ramp	96.0	F	84.7	F
Soquel Dr./Commercial Way On-Ramp	Soquel Dr./ Paul Sweet Rd. On-Ramp	75.3	F	69.9	F
Soquel Dr./Paul Sweet Rd. On-Ramp	Morrissey Blvd. Off-Ramp	40.1	E	38.0	E
Morrissey Blvd. Off-Ramp	Morrissey Blvd. On-Ramp	47.2	F	25.6	C
Morrissey Blvd. On-Ramp	Emeline Ave. Off-Ramp	41.2	E	28.2	D
Emeline Ave. Off-Ramp	SR-17 Off-Ramp	35.8	E	27.5	D
SR-17 Off-Ramp	End	13.9	B	16.0	B
Southbound					
Start	Ocean Ave. On-Ramp	11.9	B	91.2	F
Ocean Ave. On-Ramp	SR-17 SB On-Ramp	16.2	B	144.9	F
SR-17 SB On-Ramp	Fairmount Ave. Off-Ramp	27.3	D	87.0	F
Fairmount Ave. Off-Ramp	Fairmount Ave. On-Ramp	21.4	C	100.6	F
Fairmount Ave. On-Ramp	Morrissey Blvd. On-Ramp	24.2	C	89.5	F
Morrissey Blvd. On-Ramp	Soquel Dr. Off-Ramp	28.5	D	77.8	F
Soquel Dr. Off-Ramp	Soquel Ave. On-Ramp	20.1	C	108.7	F
Soquel Ave. On-Ramp	41st Ave. Off-Ramp	25.4	C	82.7	F
41st Ave. Off-Ramp	41st Ave. WB On-Ramp	20.3	C	91.8	F
41st Ave. WB On-Ramp	41st Ave. EB ON-Ramp	22.2	C	81.2	F
41st Ave. EB On-Ramp	Bay/Porter St. Off-Ramp	18.1	C	73.1	F
Bay/Porter St. Off-Ramp	Bay/Porter St. On-Ramp	24.3	C	65.1	F
Bay/Porter St. On-Ramp	Park Ave. Off-Ramp	28.6	D	54.1	F
Park Ave. Off-Ramp	Park Ave. On-Ramp	21.2	C	61.6	F
Park Ave. On-Ramp	State Park Dr. Off-Ramp	23.9	C	39.0	E
State Park Dr. Off-Ramp	State Park Dr. WB On-Ramp	20.6	C	28.8	D
State Park Dr. WB On-Ramp	State Park Dr. EB On-Ramp	22.9	C	34.4	D
State Park Dr. EB On-Ramp	Rio Del Mar Blvd. Off-Ramp	24.5	C	36.5	E
Rio Del Mar Blvd. Off-Ramp	Rio Del Mar Blvd. On-Ramp	21.7	C	27.3	D
Rio Del Mar Blvd. On-Ramp	Freedom Blvd. Off-Ramp	25.6	C	33.4	D
Freedom BLvd. Off-Ramp	Freedom Blvd. On-Ramp	21.2	C	25.7	C
Freedom Blvd. On-Ramp	Freedom Blvd. On-Ramp	23.4	C	27.0	D
Larkin Rd. Off-Ramp	Larkin Rd. On-Ramp	21.3	C	21.4	C
Larkin Rd. On-Ramp	End	15.1	B	14.7	B

Source: Wilbur Smith Associates, February 2007

Under the existing PM peak hour conditions, 10 of the 24 study freeway segments operate at LOS E or F in the northbound direction. The segments include freeway segments located between Park Avenue off-ramp and Morrissey Boulevard off-ramp. The remaining 14 freeway segments operate at LOS D or above. In the southbound direction, eight (8) of the 24 freeway segments operate at LOS D or above. These segments are located between State Park Drive off-ramp and State Park Drive Eastbound on-ramp as well as south of Rio Del Mar Boulevard off-ramp. The remaining freeway segments operate at LOS E or worse.

Overall, within the study area, the freeway segment would operate at LOS F and LOS C in the northbound and southbound directions, respectively during existing AM peak hour; whereas, during the PM peak hour, the freeway segment would operate at LOS E and LOS F in the northbound and southbound directions, respectively.

3.5 EXISTING INTERSECTION VOLUMES

The peak-hour turning movement counts at the study intersections were collected in October 2003. The traffic movements were counted and recorded in 15 minute intervals during the peak commute periods (AM Peak period – 7 AM to 9 AM, PM Peak period– 3 PM to 6 PM). These counts were then analyzed to determine the peak one-hour traffic volumes at each intersection. *Figures 3-3A, 3-3B,* and *3-3C* exhibit the geometric configurations of the study intersections under Existing Conditions, while *Figures 3-4A*, *3-4B*, and *3-4C* present the turning movement volumes at the study intersections under existing AM and PM peak hours.

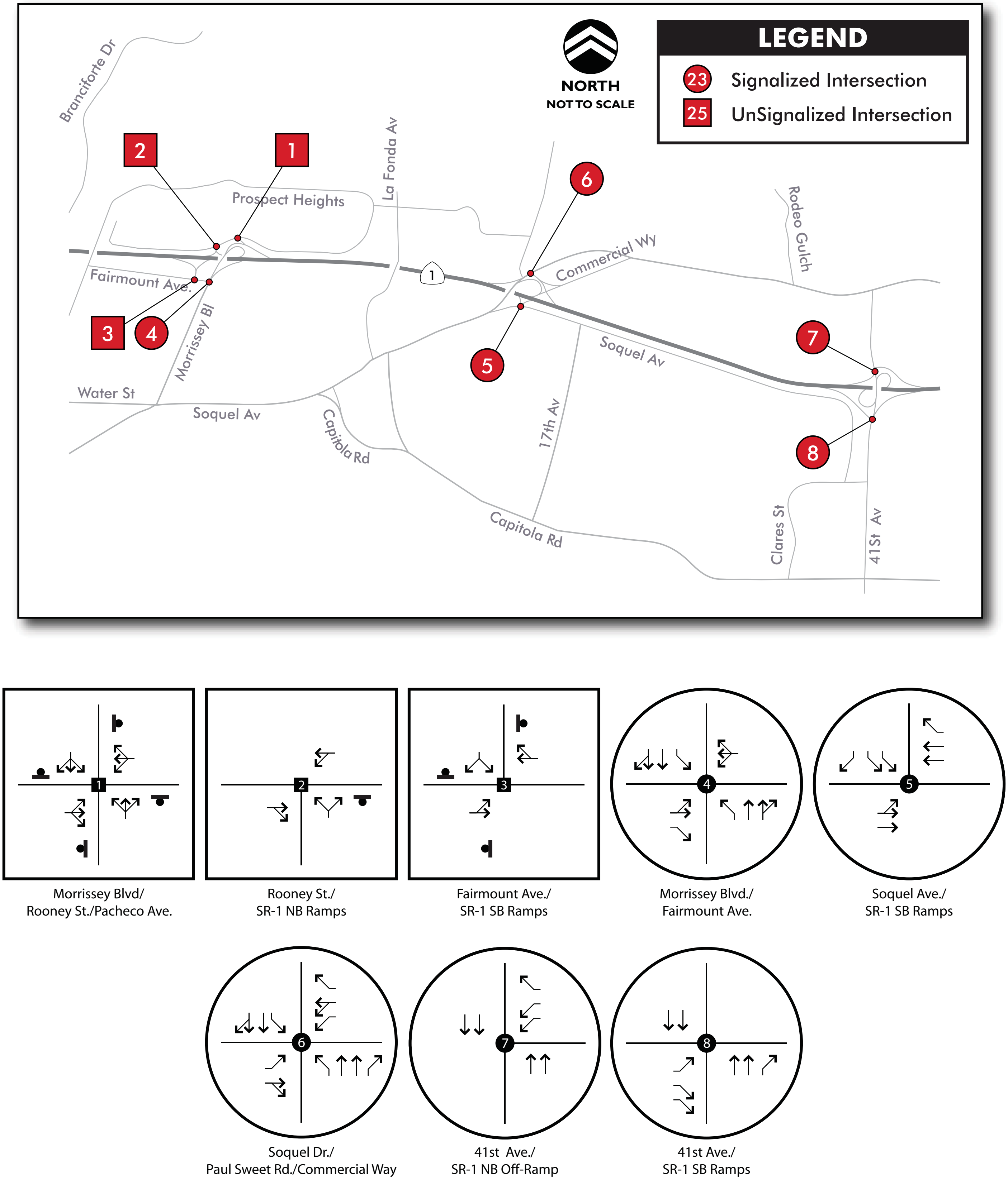

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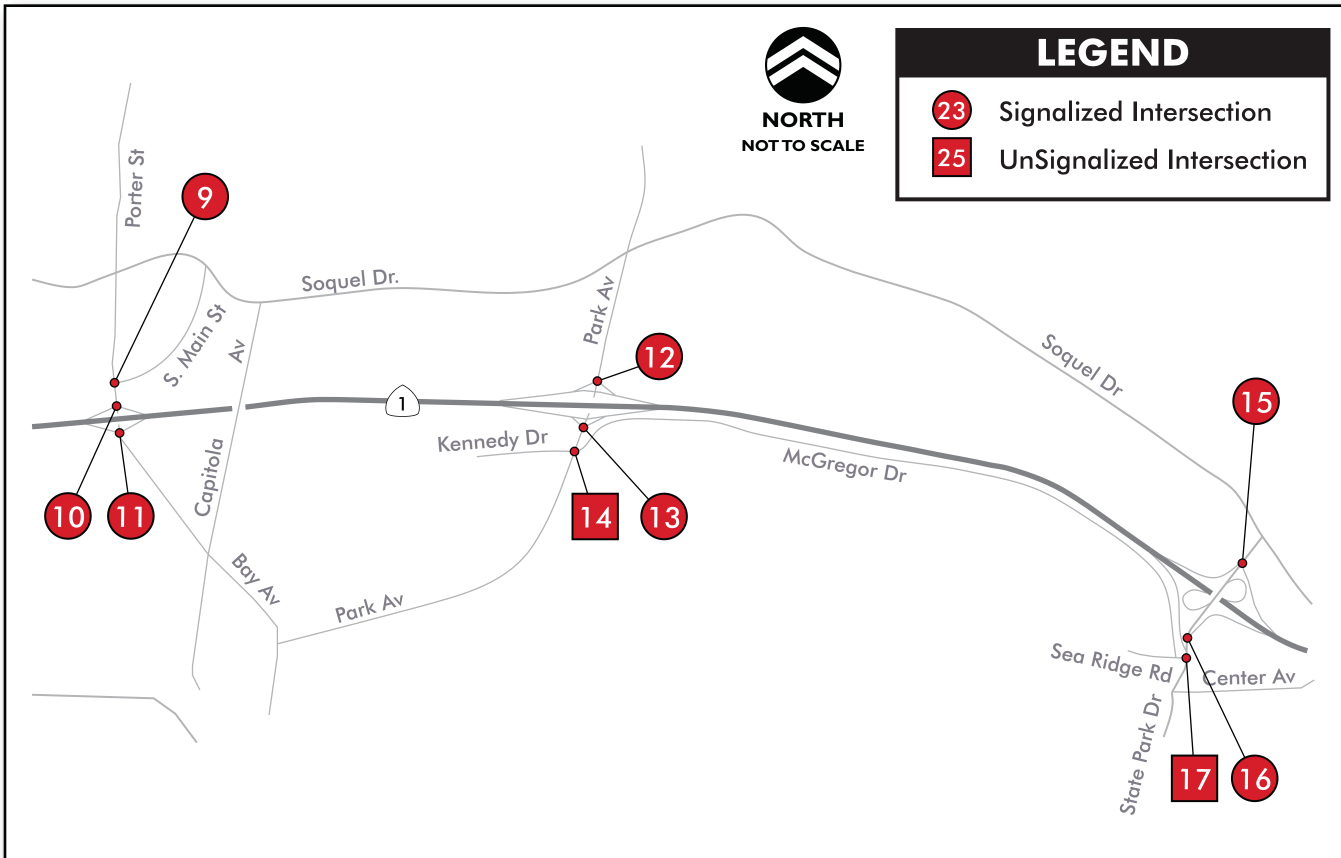
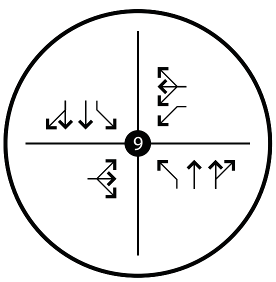
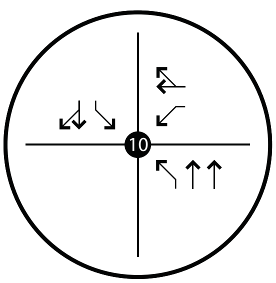
Figure 3-3A
INTERSECTION GEOMETRIC CONFIGURATIONS
EXISTING CONDITIONS

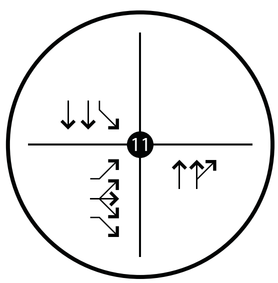




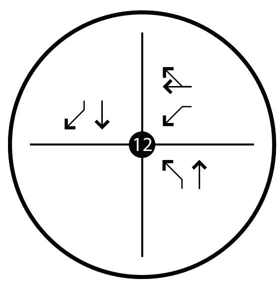
Porter St./
S. Main St.



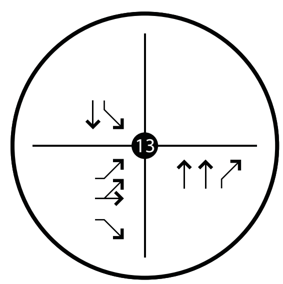
Porter St./
SR-1 NB Ramps



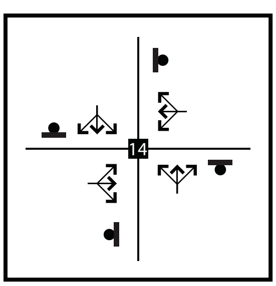
Bay ave./
SR-1 SB Ramps



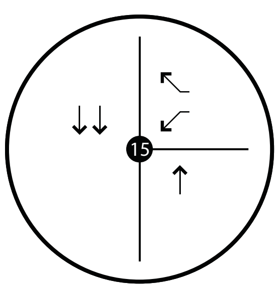
Park Ave./
SR-1 NB Ramps



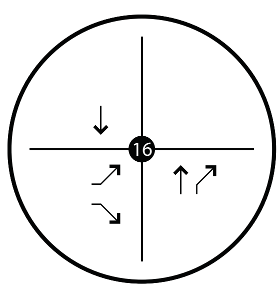
Park Ave./
SR-1 SB Ramps



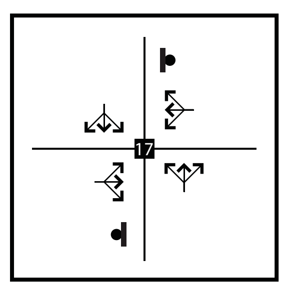
Park Ave./
Kennedy Dr./McGregor Dr.



State Park Dr./
SR-1 NB Ramps



State Park Dr./
SR-1 SB Ramps



State Park Dr./
McGregor Dr.

Figure 3-3B
INTERSECTION GEOMETRIC CONFIGURATIONS
EXISTING CONDITIONS

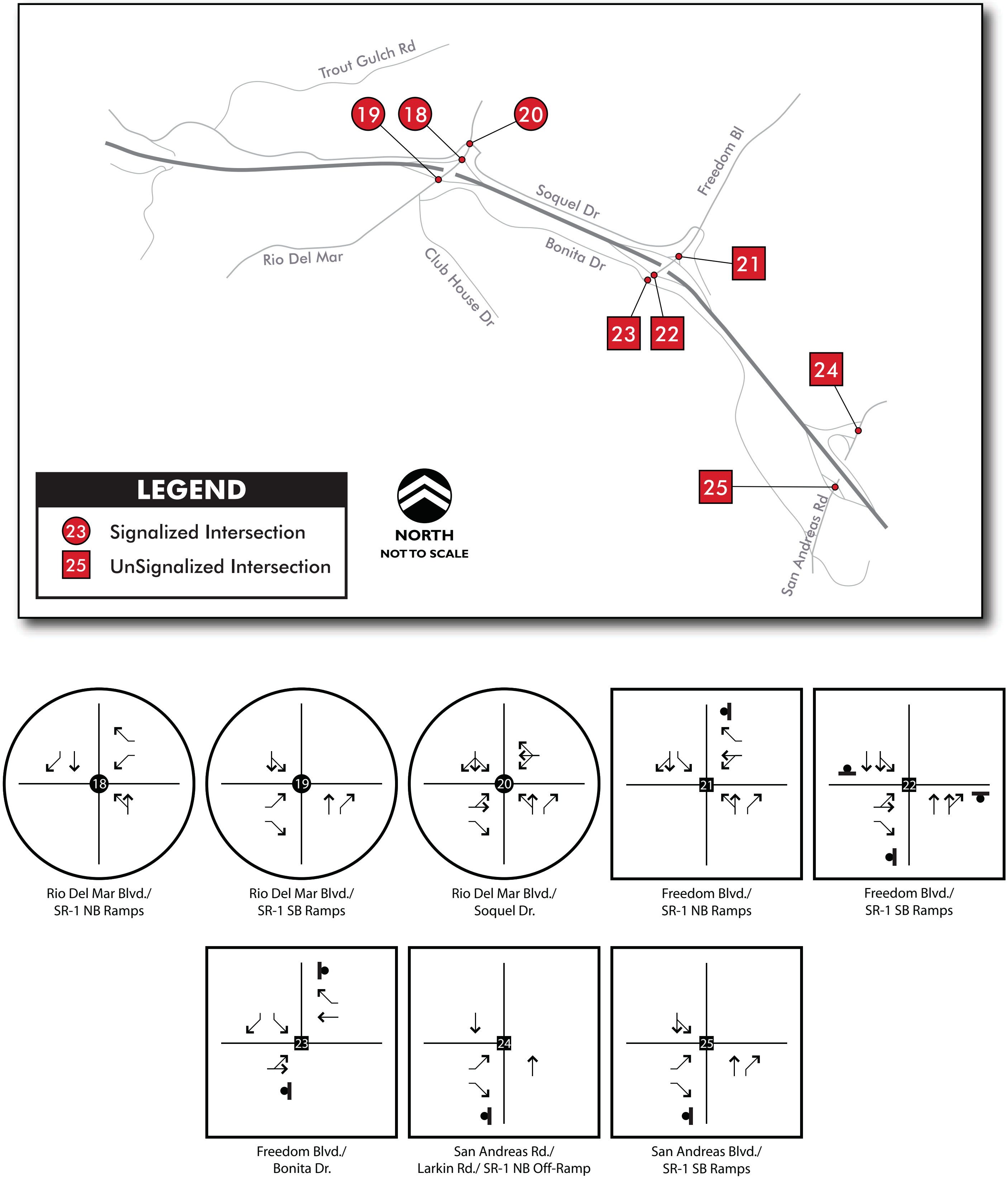


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Figure 3-3C
INTERSECTION GEOMETRIC CONFIGURATIONS
EXISTING CONDITIONS

393070/BASE - 04/02/07

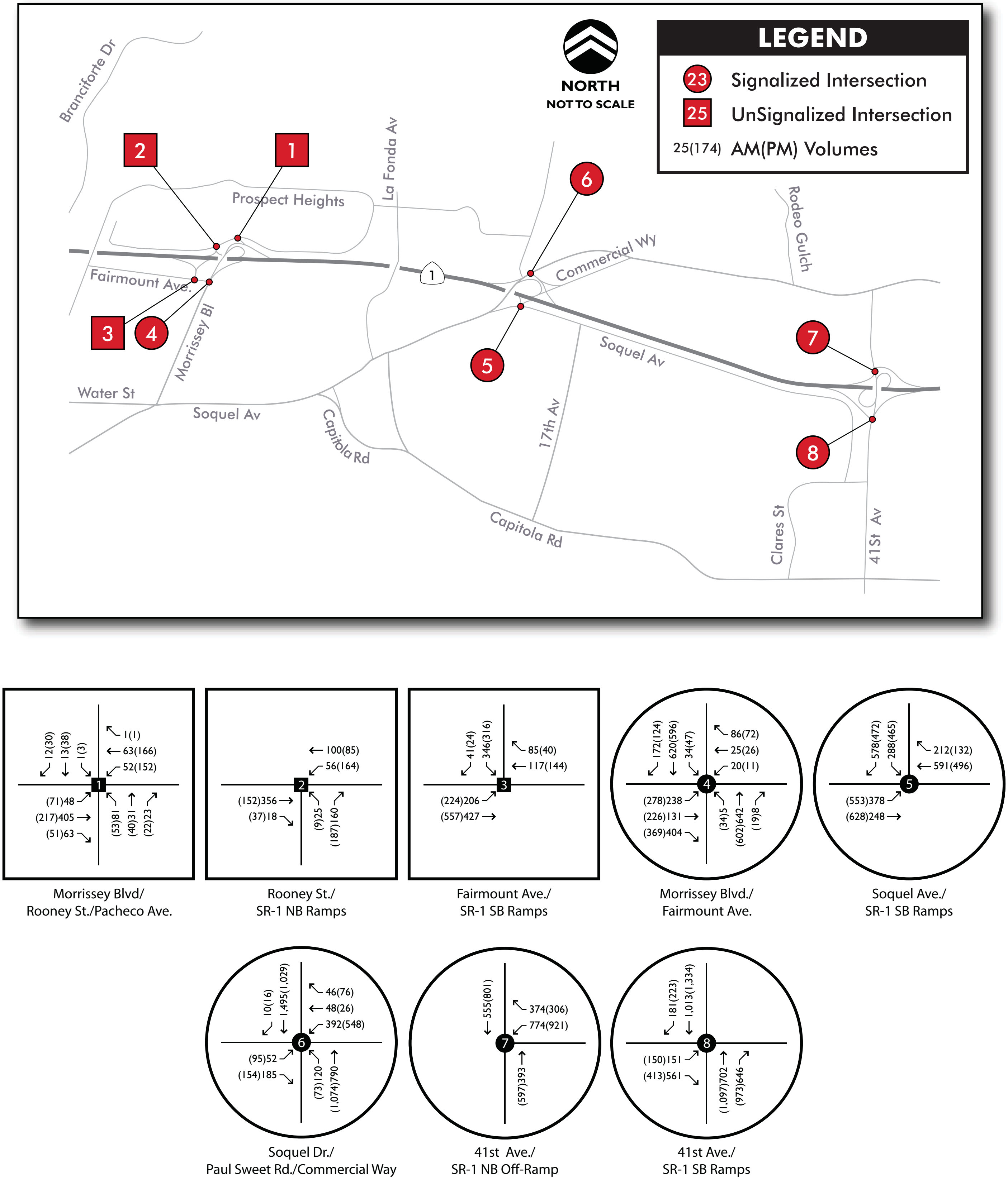

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Figure 3-4A
PEAK HOUR INTERSECTION VOLUMES
EXISTING CONDITIONS

393070/BASE - 04/02/07

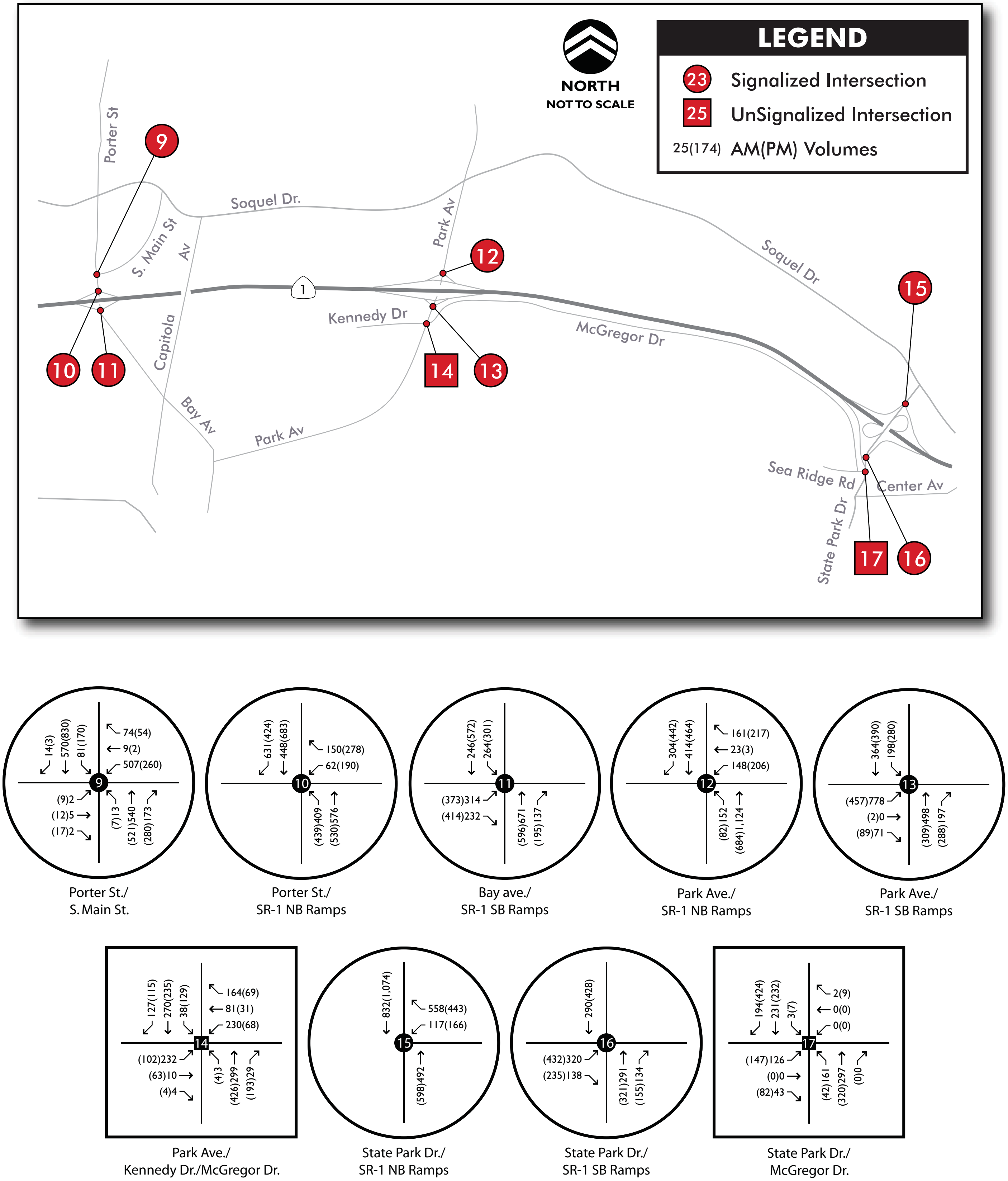

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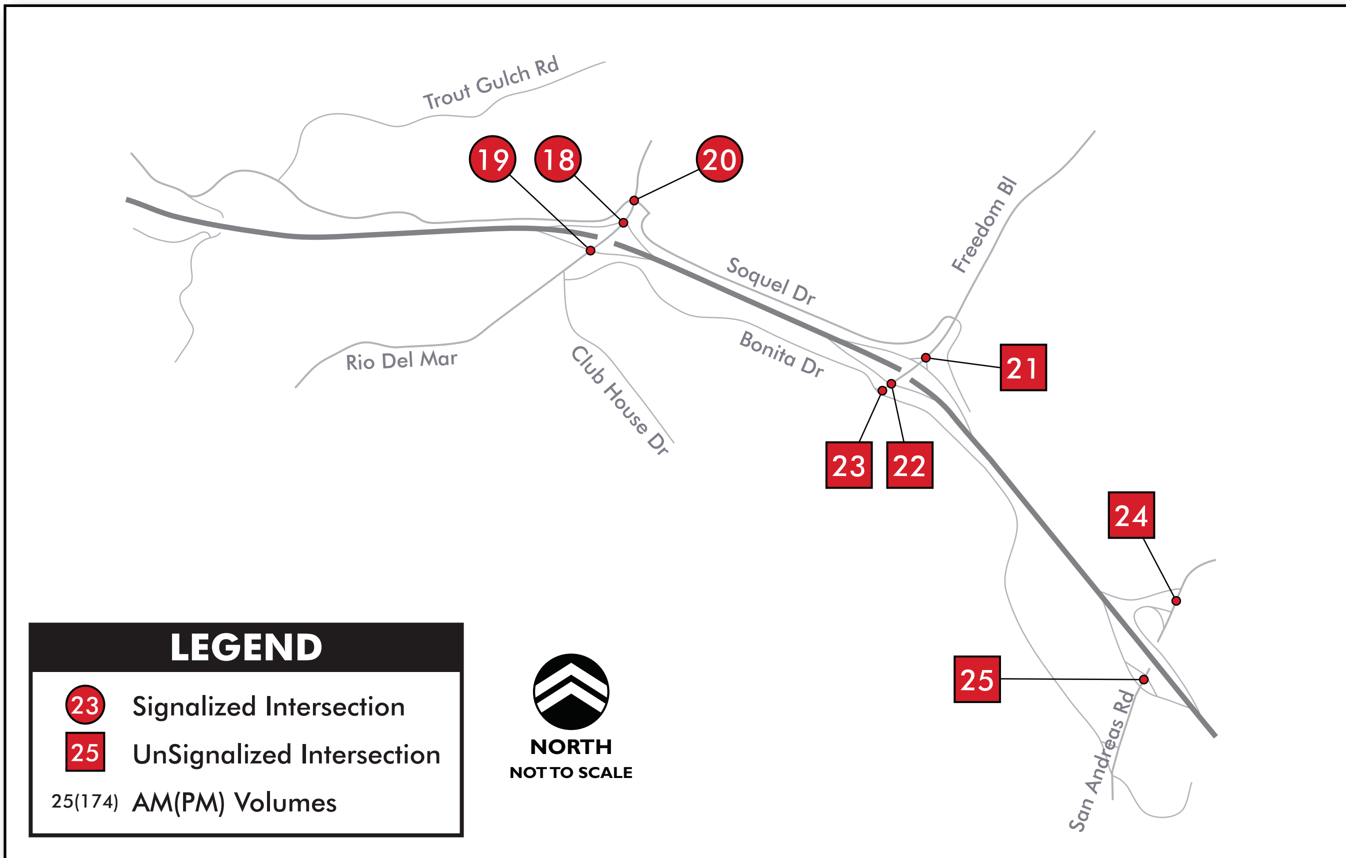
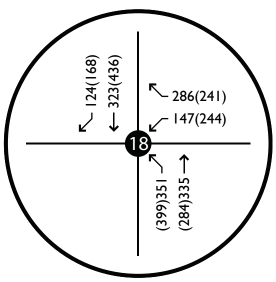
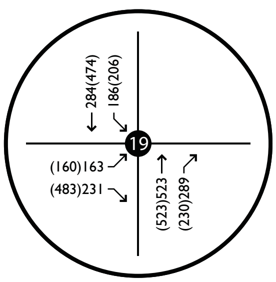
Figure 3-4B
PEAK HOUR INTERSECTION VOLUMES
EXISTING CONDITIONS

393070/BASE - 04/02/07

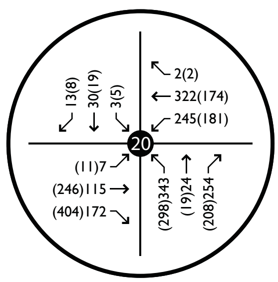




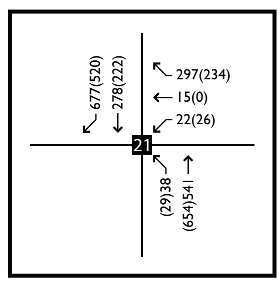
Rio Del Mar Blvd./
SR-1 NB Ramps



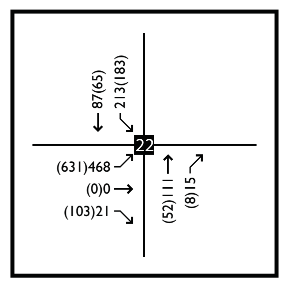
Rio Del Mar Blvd./
SR-1 SB Ramps



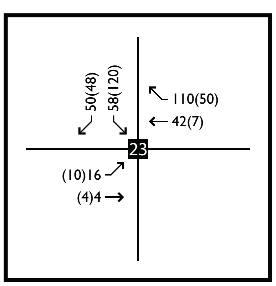
Rio Del Mar Blvd./
Soquel Dr.



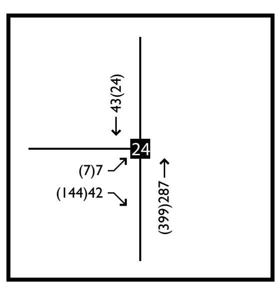
Freedom Blvd./
SR-1 NB Ramps



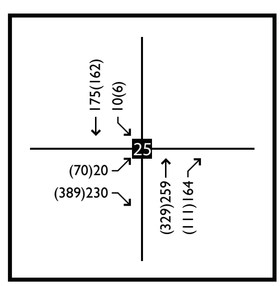
Freedom Blvd./
SR-1 SB Ramps



Freedom Blvd./
Bonita Dr.



San Andreas Rd./
Larkin Rd./ SR-1 NB Off-Ramp



San Andreas Blvd./
SR-1 SB Ramps

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Figure 3-4C
PEAK HOUR INTERSECTION VOLUMES
EXISTING CONDITIONS

393070/BASE - 04/02/07

3.6 INTERSECTION LOS THRESHOLDS

This project consists of 25 study intersections located on either side of State Route 1, between Morrissey Boulevard and San Andreas Road/ Larkin Valley Road interchanges. Of the 25 study intersections, one (1) intersection is operated by the City of Santa Cruz, one (1) intersection is operated by the City of Capitola, four (4) intersections are operated by the County of Santa Cruz, and the remaining 19 intersections are operated by Caltrans. The LOS thresholds for each of these jurisdictions are discussed below.

LOS Threshold - Caltrans

At the intersections located on State Highway facilities, the following guidelines serve as LOS thresholds for the intersection operating conditions:

1. Caltrans recommends a target LOS at the transition between LOS C and LOS D.
2. In case the recommended LOS is not achievable, Caltrans should be consulted in order to determine the target LOS.
3. If the intersection, under existing conditions, operates worse than the appropriate target LOS, then the existing LOS should be maintained.

LOS Threshold – County of Santa Cruz

The guidelines serving as LOS thresholds for the operating conditions of the intersections located within the jurisdiction of the County of Santa Cruz are as follows:

1. The goal of the County is to maintain LOS C at all the intersections.
2. At intersections where capacity improvement is considered infeasible due to costs involved, right-of-way constraints, and/or environmental impacts, LOS D is recognized as the minimum acceptable level of service.

LOS Threshold – City of Santa Cruz

At the intersections located within the jurisdiction of the City of Santa Cruz, the following guidelines serve as LOS thresholds for the intersection operating conditions:

1. For intersections located within the City of Santa Cruz, the minimum acceptable level of service is LOS D.
2. For intersections located in the City's Central Core Area, the minimum acceptable level of service is LOS E. Located between the Downtown and the Beach Area, the Central Core Area is surrounded by SR-1, Chestnut Street, Ocean Street, and the beach.
3. LOS E is the acceptable level of service for intersections located on:
    - Mission Street
    - Ocean Street
    - Riverside Street
    - Beach Street

- Front Street (Soquel Avenue – Beach Street)
- Soquel Avenue (Ocean Street – Front Street)
- Barson Street (Ocean Street – Riverside Street)

The study intersection operated by the City of Santa Cruz is not located in the City's Central Core Area.

LOS Threshold – City of Capitola

At the intersections located within the jurisdiction of the City of Capitola, the following guidelines serve as LOS thresholds for the intersection operating conditions:

1. For intersections located within the City of Capitola, LOS C is the acceptable standard for circulation.
2. For intersections located in the Capitola Village, LOS D is the acceptable level of service. Capitola Village is defined as the areas bounded by the beach, the railroad right-of-way, Monterey Avenue, and Soquel Creek.

The study intersection operated by the City of Capitola is not located in the Capitola Village.

Technical memorandum *Intersection LOS Criteria Memo*, dated November 16, 2006 (*Appendix A-2*) provides a detailed discussion about the LOS thresholds under each of the above mentioned jurisdictions.

Table 3-5 displays the jurisdiction in which each study intersection is located and the LOS threshold for each of them.

Table 3-5
Intersection LOS Thresholds

#	Intersection	Jurisdiction	Traffic Controller	LOS Threshold
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	City of Santa Cruz	AWSC	D
2	Rooney St./ SR-1 NB Ramps	Caltrans	TWSC	C/D[1]
3	Fairmount Ave./ SR-1 SB Ramps	Caltrans	AWSC	C/D[1]
4	Morrissey Blvd./ Fairmount Ave.	Caltrans	Signal	C/D[1]
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	C/D[1]
7	41st Ave./ SR-1 NB Off-Ramp	Caltrans	Signal	C/D[1]
8	41st Ave./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	C
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	C/D[1]
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	C/D[1]
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	AWSC	C
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	C/D[1]
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	TWSC	C
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	C/D[1]
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	C/D[1]
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	C
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	TWSC	C/D[1]
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	AWSC	C/D[1]
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	TWSC	C
24	San Andreas Rd. Larkin Rd./ SR-1 NB Off-Ramp	Caltrans	TWSC	C/D[1]
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	TWSC	C/D[1]

Source: Wilbur Smith Associates, February 2007

NOTES:
1. Represents a target LOS at the transition between LOS C and LOS D
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control

3.7 EXISTING INTERSECTION OPERATIONS

Using the existing intersection geometric configurations and the peak hour turning movement volumes, the operating conditions of the study intersections were analyzed to identify the LOS and delay values for each of the 25 study intersections during AM and PM peak hours. The results of the existing LOS analysis are presented in *Table 3-6.*

Results from the existing intersection analysis show that the study intersections vary in performance, from LOS A to LOS F. During the AM peak hour conditions, all the study intersections operate under an acceptable level of service, with the exception of the following seven (7) intersections:

- Fairmount Avenue/ State Route 1 Southbound Ramps
- Park Avenue/ State Route 1 Northbound Ramps
- Park Avenue/ Kennedy Drive/ McGregor Drive
- State Park Drive/ McGregor Drive
- Rio Del Mar Boulevard/ Soquel Drive
- Freedom Boulevard/ State Route 1 Northbound Ramps
- Freedom Boulevard/ State Route 1 Southbound Ramps

The above intersections operate at LOS E, or F.

During existing PM peak period, 20 of the 25 study intersection operate under acceptable conditions. The five (5) intersections operating under an unacceptable level of service are:

- Fairmount Avenue/ State Route 1 Southbound Ramps
- Park Avenue/ Kennedy Drive/ McGregor Drive
- State Park Drive/ McGregor Drive
- Rio Del Mar Boulevard/ Soquel Drive
- Freedom Boulevard/ State Route 1 Southbound Ramps

The *Synchro* calculation sheets for the study intersections under Existing Conditions are presented in *Appendix C-1*.

Table 3-6
Intersection LOS Summary – Existing Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	City of Santa Cruz	AWSC	24.1	C	12.1	B
2	Rooney St./ SR-1 NB Ramps	Caltrans	TWSC	20.5 (NB)	C	11.5 (NB)	B
3	Fairmount Ave./ SR-1 SB Ramps	Caltrans	AWSC	**115.6**	**F**	**112.5**	**F**
4	Morrissey Blvd./ Fairmount Ave.	Caltrans	Signal	28.0	C	26.9	C
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	23.2	C	23.3	C
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	36.9	D	22.7	C
7	41st Ave./ SR-1 NB Off-Ramp	Caltrans	Signal	9.8	A	11.8	B
8	41st Ave./ SR-1 SB Ramps	Caltrans	Signal	13.6	B	14.5	B
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	27.0	C	28.7	C
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	18.5	B	23.9	C
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	24.4	C	24.8	C
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	**84.7**	**F**	16.5	B
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	29.8	C	22.5	C
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	AWSC	**91.9**	**F**	**75.0**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	5.4	A	6.5	A
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	14.0	B	16.3	B
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	TWSC	**386.4** (EB)	**F**	**239.6** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	22.6	C	41.3	D
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	8.5	A	8.5	A

Table 3-6
Intersection LOS Summary – Existing Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	**249.2**	**F**	**36.1**	**D**
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	TWSC	**46.1** (NWB)	**E**	16.7 (NWB)	C
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	AWSC	**55.6**	**F**	**124.4**	**F**
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	TWSC	11.3 (EB)	B	11.5 (EB)	B
24	San Andreas Rd. Larkin Rd./ SR-1 NB Off-Ramp	Caltrans	TWSC	9.6 (EB)	A	9.5 (EB)	A
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	TWSC	14.6 (SEB)	B	14.7 (SEB)	B

Source: Wilbur Smith Associates, July 2007

NOTES:
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

3.8 OFF-RAMP OPERATIONS - QUEUING ANALYSIS

Table 3-7 presents the 95^{th} percentile queue lengths on the off-ramps located within the study area. As described in *Section 2.3*, these queue lengths are obtained from 10 multiple *SimTraffic* simulations. *Appendix D-1* presents the *SimTraffic* output sheets for existing AM and PM peak hour conditions.

Table 3-7
95^{th} Percentile Queue Lengths – Off-Ramp Locations (Existing Conditions)

#	Interchange	Ramp	Approximate Storage Length (ft)	Maximum 95^{th} Percentile Queue Length (ft) AM Peak	PM Peak
1	Morrissey Boulevard Interchange	NB Off-Ramp	750	35	50
		SB Off-Ramp	700	162	154
2	Soquel Avenue Interchange	NB Off-Ramp	450[1]	23	36
		SB Off-Ramp	550	105	45
3	41^{st} Avenue Interchange	NB Off-Ramp	1100	152	182
		SB Off-Ramp	1200	147	126
4	Porter Street/ Bay Avenue Interchange	NB Off-Ramp	700	86	237
		SB Off-Ramp	500	450	406
5	Park Avenue Interchange	NB Off-Ramp	700	135	143
		SB Off-Ramp	800	616	151
6	State Park Drive Interchange	NB Off-Ramp	1100	97	111
		SB Off-Ramp	1250	205	366
7	Rio Del Mar Boulevard Interchange	NB Off-Ramp	750	492	542
		SB Off-Ramp	1150	658	648
8	Freedom Boulevard Interchange	NB Off-Ramp	800	113	97
		SB Off-Ramp	800	370	408
9	San Andreas Road/ Larkin Valley Road Interchange	NB Off-Ramp	1000	63	56
		SB Off-Ramp	900	71	122

Source: Wilbur Smith Associates, April 2007

NOTES:
1. Ramp length available from the SR-1 NB Off-Ramp/ Commercial Way intersection.

Under the AM peak hour conditions, 16 of the 18 off-ramps located within the study area have their 95^{th} percentile queue lengths lower than the available storage lengths. The two ramps, Porter Street/ Bay Avenue southbound off-ramp and Park Avenue southbound off-ramp have their 95^{th} percentile queue lengths closer to their available storage lengths.

Under the PM peak hour conditions, 17 off-ramp ramps have their 95th percentile lower than the available storage lengths. The Porter Street/ Bay Avenue southbound off-ramp is having its 95th percentile queue lengths closer to its available storage lengths.

Chapter 4
TRAVEL DEMAND FORECASTING

As discussed in the *Use of AMBAG Travel Demand Forecast Model for the State Route 1 Widening/ HOV Project* technical memorandum, dated March 18, 2005 (*Appendix A-9*), AMBAG's travel demand forecasting model was used to estimate future highway and transit travel demand in the study area, using *TransCAD* modeling software. This chapter presents in greater detail the methodology utilized to forecast traffic volumes for the years 2015 and year 2035.

4.1 TRAVEL DEMAND MODELING METHODOLOGY OVERVIEW

The latest version available of the AMBAG travel demand model at the time of the study (version 1.1, April 2005) was used. The structure of that model provides highway trip tables and assignments that represent daily, AM peak hour and PM peak hour conditions. The model is also able to generate transit origin-destination trip tables but does not assign transit trips to the transit system; therefore transit forecasts have been evaluated off-model.

The highway assignment information obtained from AMBAG's travel demand model is then entered into two separate traffic operations models (*FREQ* and *Synchro/SimTraffic*). These models are used to analyzed traffic conditions on the freeway (*FREQ*) and on the local roadway systems, (*Synchro/SimTraffic*) for all of the study alternatives, including those alternatives calling for relatively smaller changes to the highway network, such as implementation auxiliary lanes or changes to the freeway ramp lane configuration.

The following describes the study's overall approach to the travel demand estimation process:

- Obtained from AMBAG the most recent travel demand modeling software files and data sets (version 1.1, April 2005), which included Year 2000 and Year 2030 scenarios.

- Modified the highway networks provided by AMBAG to define both existing and proposed future State Route 1 characteristics to a higher level of detail appropriate for the study's purposes.

- Run the AMBAG travel demand model and extracted the daily as well as the AM, and PM peak hour assignment volumes on the highway network for the baseline year 2000.

- Compared daily, AM, and PM peak hour baseline year 2000 assignments for all the major roadway facilities on a screenline basis within the study area using the information obtained from the network files; developed assignment adjustment factors to account for validation discrepancies where necessary.

- Extrapolated Year 2030 origin/destination trip tables provided by AMBAG to Year 2035 to represent opening year-plus-25 years horizon.

- Created a Year 2035 No-Build highway network using AMBAG's future highway network files that is consistent with the study's definition of the future transportation system under No Project conditions in the study area.

- Modified AMBAG's future highway network impedance values (number of lanes, capacity adjustments) within the study area to represent Year 2035 Build conditions and to reflect any changes to the roadway system that might not be have been included by AMBAG, such as the addition of HOV lanes on State Route 1 all the way to San Andreas Road.

- Assigned the daily, AM, and PM peak hour trip tables; extrapolated to year 2035 onto the year 2035 highway networks using the AMBAG travel demand model; and extracted daily, AM, and PM peak hour zone-to-zone vehicle trip tables within the study area for the year 2035 Scenarios, including No-Build and HOV-Build scenarios.

- Performed an adjustment of the year 2035 highway volumes using a pivot-point redistribution technique and a screenline comparison methodology. These reassignments also incorporated the bottleneck analysis.

- Incorporated the forecasted results into the traffic operations and simulation models (*Synchro* and *FREQ*).

4.2 MODEL PERFORMANCE AND VALIDATION

Although the results of the AMBAG Year 2000 model had been validated by AMBAG staff several years ago by means of screenline comparisons, these were done on a regional basis and did not guarantee that the closeness of "fit" of the model on a localized scale was sufficient to use for an operations-level traffic analysis. To validate the Year 2000 model for this purpose, a series of detailed screenlines were defined within the study area, as shown in *Figures 4-1* and *4-2*. These include both north-south and east-west screenlines in close proximity to State Route 1.

Tables 4-1 and *4-2* depict the Year 2000 model's results at the north-south and east-west screenlines respectively, for the AM and PM peak hour traffic, while *Tables 4-3* and *4-4* depict the model's screenline results for daily traffic. It should be noted that the compass directions referred to in this report follow the geographic north and south directions, but not the Caltrans convention for State Route 1, with the freeway defined as a north-south facility and the City of Santa Cruz being located at the north end of the study area.

As shown in *Table 4-1*, at all of the ten north-south screenlines (measuring the combined east-west travel on State Route 1 and parallel sections of Capitola Road, west of State Route 1 and Soquel Road, east of State Route 1) the Year 2000 model assignment forecasts higher volumes than the observed counts in both directions during the AM and PM peak hours. The over-prediction ranged from a nominal three percent between Freedom Boulevard and State Park Road (northbound direction in the PM peak) to a 58 percent between State Park Road and Park Avenue (northbound in the AM peak). In general, Year 2000 model assignment over-prediction was most pronounced in the mid-corridor and peak direction of travel.

At the two east-west screenlines (*Table 4-2*), measuring north-south traffic to and from freeway interchanges or traveling across the freeway, the Year 2000 model assignment over-forecasts traffic in almost every instance south of State Route 1 and under-forecasts traffic north of State Route 1. The highest over-forecasting occurs for the AM peak hour traffic accessing State Route 1 from the south (32% over-forecasting for the traffic diverging from the freeway and 26 percent over-forecasting for the traffic merging the freeway). The most pronounced under-forecasting occurs for the PM peak hour traffic accessing State Route 1 from the north, with southbound traffic (traffic towards State Route 1) under-predicted by 28 percent, and northbound traffic (traffic traveling away from State Route 1) under-predicted by 23 percent compared to observed counts.

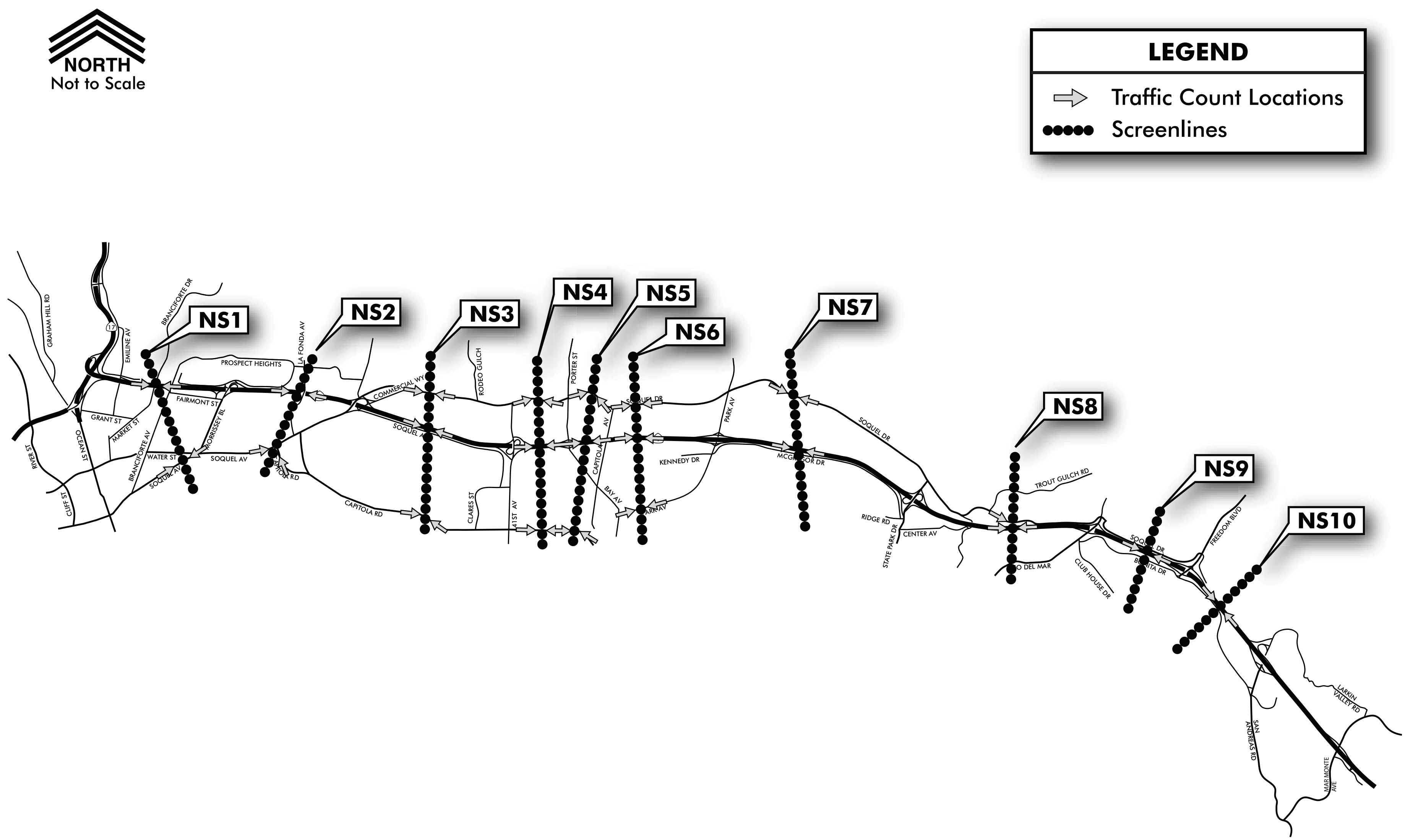

Figure 4-1
NORTH - SOUTH SCREENLINES
YEAR 2000 AMBAG MODEL VALIDATION

393070\LRGBASEMAP - 04/02/07

WilburSmith ASSOCIATES
ENGINEERS PLANNERS ECONOMISTS

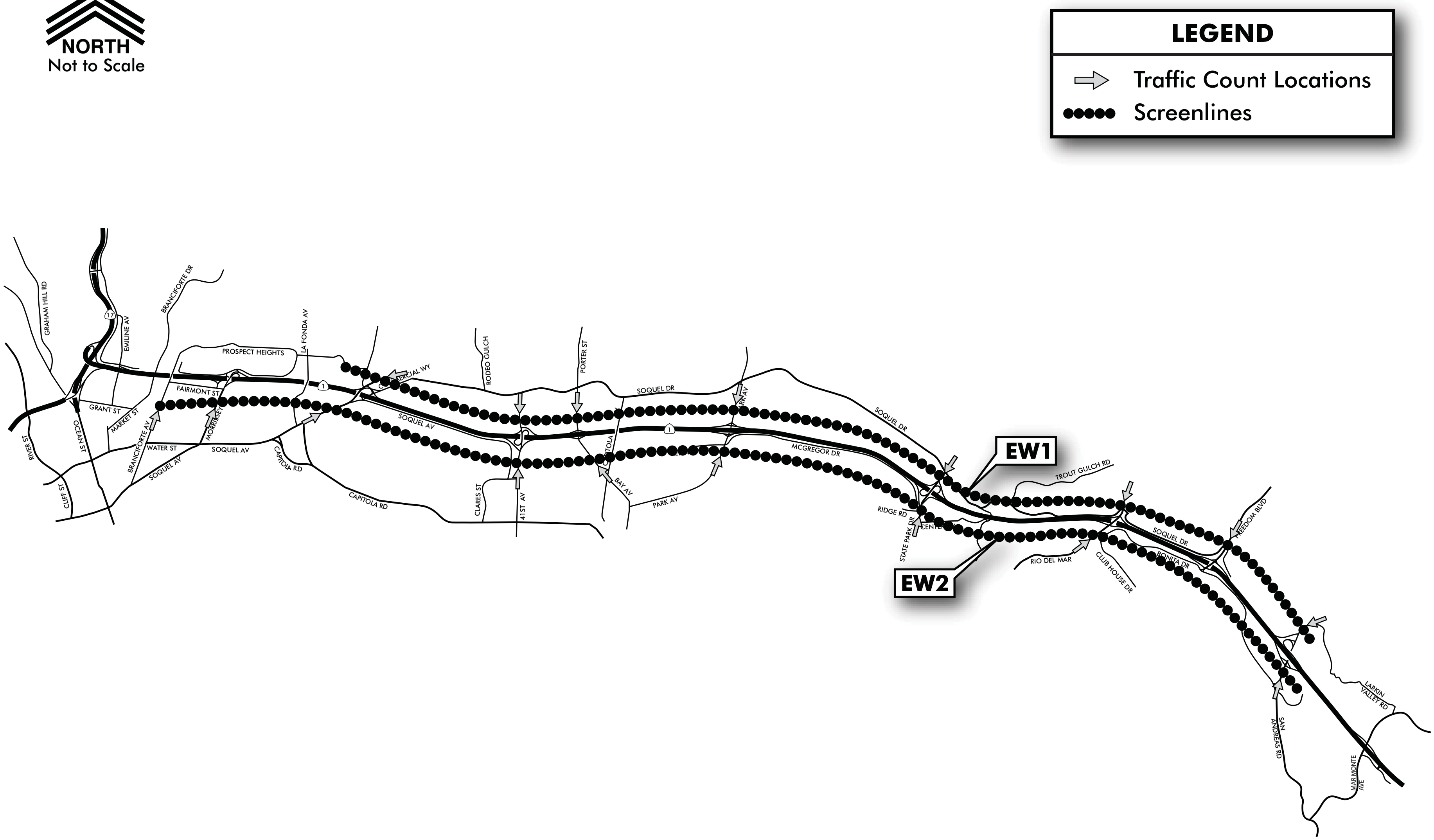

Figure 4-2
EAST - WEST SCREENLINES
YEAR 2000 AMBAG MODEL VALIDATION
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Table 4-1
North-South Screenline Peak Hour Summary
Year 2000 AMBAG Model Estimated Volumes versus Observed Traffic Counts – State Route 1 plus Parallel Arterials

	Freeway Segment		Westbound				Eastbound			
Screenline	From	To	Model Volume	Observed Count	Difference	Percent Difference	Model Volume	Observed Count	Difference	Percent Difference
AM Peak Hour										
NS01	SR-17	Morrissey Blvd.	5100	4900	200	4.1%	4700	3200	1500	46.9%
NS02	Morrissey Blvd.	Soquel Ave.	5600	5300	300	5.7%	4800	3700	1100	29.7%
NS03	Soquel Ave.	41st St.	7700	5700	2000	35.1%	4800	3900	900	23.1%
NS04	41st St.	Porter St.	8000	5400	2600	48.1%	4700	3500	1200	34.3%
NS05	Porter St.	Capitola Rd.	7500	4800	2700	56.3%	4700	3500	1200	34.3%
NS06	Capitola Rd.	Park Ave.	7600	5100	2500	49.0%	4400	3300	1100	33.3%
NS07	Park Ave.	State Park Rd.	6800	4300	2500	58.1%	4100	3400	700	20.6%
NS08	State Park Rd.	Rio Del Mar Blvd.	5500	4100	1400	34.1%	3500	3200	300	9.4%
NS09	Rio Del Mar Blvd.	Freedom Blvd.	4900	3700	1200	32.4%	3300	3000	300	10.0%
NS10	Freedom Blvd.	San Andreas Rd.	3800	2800	1000	36.6%	3100	2800	300	10.7%
PM Peak Hour										
NS01	SR-17	Morrissey Blvd.	4500	4400	100	2.3%	4600	3100	1500	48.4%
NS02	Morrissey Blvd.	Soquel Ave.	4800	4800	0	0.0%	5200	4700	500	10.6%
NS03	Soquel Ave.	41st St.	5100	4500	600	13.3%	6800	5000	1800	36.0%
NS04	41st St.	Porter St.	5400	4600	800	17.4%	7400	5800	1600	27.6%
NS05	Porter St.	Capitola Rd.	4800	4100	700	17.1%	7100	5400	1700	31.5%
NS06	Capitola Rd.	Park Ave.	5300	4600	700	15.2%	6800	5300	1500	28.3%
NS07	Park Ave.	State Park Rd.	4400	4200	200	4.8%	6200	5100	1100	21.6%
NS08	State Park Rd.	Rio Del Mar Blvd.	3700	3600	100	2.8%	5300	4200	1100	26.2%
NS09	Rio Del Mar Blvd.	Freedom Blvd.	3400	3300	100	3.0%	4900	4500	400	8.9%
NS10	Freedom Blvd.	San Andreas Rd.	3200	2600	600	23.1%	4300	3000	1300	43.3%

Source: Wilbur Smith Associates, April 2007

Note:

Table 4-2
East-West Screenline Peak Hour Summary
Year 2000 AMBAG Model Estimated Volumes versus Observed Traffic Counts - State Route 1 Approaches

			Southbound				Northbound			
Screenline	Location	Peak Period	Model Volume	Observed Count	Difference	Percent Difference	Model Volume	Observed Count	Difference	Percent Difference
EW-1	North of SR-1	AM Peak	6000	6600	-600	-9.1%	5700	6600	-900	-13.6%
EW-2	South of SR-1	AM Peak	8200	6200	2000	32.3%	7800	6200	1600	25.8%
EW-1	North of SR-1	PM Peak	4100	5700	-1600	-28.1%	4100	5300	-1200	-22.6%
EW-2	South of SR-1	PM Peak	7200	7300	-100	-1.4%	8600	7300	1300	17.8%

Source: Wilbur Smith Associates, April 2007

Note:
Screenline volumes include the north-south traffic approaching SR-1 interchanges and traffic crossing the freeway at Morrissey Boulevard and San Andreas Road interchanges. See Figure 4-2 for screenline location

Table 4-3
North-South Daily Screenline Summary
Year 2000 AMBAG Model Estimated Volumes versus Observed Traffic Counts - State Route 1 Plus Parallel Arterials

Screenline	Freeway Section From	Freeway Section To	Daily Bi-Directional Traffic Model Volume	Observed Count	Difference	Percent Difference
NS01	SR-17	Morrissey Blvd.	112,964	119,500	-6536	-5.5%
NS02	Morrissey Blvd.	Soquel Ave.	116,680	129,700	-13020	-10.0%
NS03	Soquel Ave.	41st St.	132,288	141,600	-9312	-6.6%
NS04	41st St.	Porter St.	134,819	141,300	-6481	-4.6%
NS05	Porter St.	Capitola Rd.	125,336	129,220	-3884	-3.0%
NS06	Capitola Rd.	Park Ave.	131,931	123,040	8891	7.2%
NS07	Park Ave.	State Park Rd.	110,774	108,900	1874	1.7%
NS08	State Park Rd.	Rio Del Mar Blvd.	107,354	98,590	8764	8.9%
NS09	Rio Del Mar Blvd.	Freedom Blvd.	90,069	81,200	8869	10.9%
NS10	Freedom Blvd.	San Andreas Rd.	80,584	70,400	10184	14.5%

Source: Wilbur Smith Associates, April 2007

Note:

Screenline volumes include traffic volume on SR-1 plus traffic volume on parallel sections of Capitola Road as well as Park Avenue located south of SR-1 and Soquel Drive located north of SR-1. See Figure 4-1 for screenline location

Table 4-4
East-West Daily Screenline Summary
Year 2000 AMBAG Model Estimated Volumes versus Observed Traffic Counts - State Route 1 Approaches

Screenline	Location	Daily Bi-Directional Traffic Model Volume	Observed Count	Difference	Percent Difference
EW-1	North of SR-1	114,149	132,910	-18761	-14.1%
EW-2	South of SR-1	171,358	150,390	20968	13.9%

Source: Wilbur Smith Associates, April 2007

Note:

Screenline volumes include the north-south traffic approaching SR-1 interchanges and traffic crossing the freeway at Morrissey Boulevard and San Andreas Road interchanges. See Figure 4-2 for screenline location

A screenline comparison was also performed for daily traffic on arterials, which is shown in *Table 4-5*. Unlike State Route 1, no 24-hour counts were available for surface streets; as such, a nominal assumption was made for the arterials that the peak hour traffic volume represents about ten percent of the daily traffic volume. Based on this assumption, Year 2000 model volumes for the east-west screenlines was generally within a ten percent difference (lower than observed traffic volume at the east end, and higher at the west end). At two of the ten screenlines, greater variance was identified, with Year 2000 model traffic 14.5 percent higher than the observed traffic between Freedom Boulevard and San Andreas Road and 22 percent lower than the observed traffic between Morrissey Boulevard and Soquel Drive. At the north-south screenlines (for traffic approaching or crossing the freeway), Year 2000 Model predicted traffic about 14 percent higher than the observed traffic traveling to and from the west of State Route 1, and 14 percent lower than the observed traffic traveling to and from the east of State Route 1.

Table 4-5
East-West Daily Screenline Summary
Year 2000 AMBAG Model Estimated Volumes versus Observed Traffic Counts
Individual State Route 1 Approaches

Location	Bi-Directional Traffic			
	Model Volume	Observed Count	Difference	Percent Difference
North of Highway 1				
Soquel Dr.	26,860	22,900	3960	17.3%
41st Ave.	16,678	16,390	288	1.8%
Porter St.	19,590	19,150	440	2.3%
Park Ave.	16,663	18,070	-1407	-7.8%
State Park Rd.	18,776	18,770	6	0.0%
Rio Del Mar Blvd.	8,694	11,290	-2596	-23.0%
Freedom Blvd.	13,091	16,430	-3339	-20.3%
San Andreas Rd.	1,274	9,910	-8636	-87.1%
South of Highway 1				
Morrissey Ave.	19,133	16,980	2153	12.7%
Soquel Ave.	24,882	25,540	-658	-2.6%
41st Ave.	56,042	38,170	17872	46.8%
Bay Ave.	13,150	17,770	-4620	-26.0%
Park Ave.	19,218	10,760	8458	78.6%
State Park Rd.	16,411	14,160	2251	15.9%
Rio Del Mar Blvd.	13,329	17,100	-3771	-22.1%
San Andreas Rd.	9,194	9,910	-716	-7.2%

Source: Wilbur Smith Associates, April 2007

4.3 MODEL ADJUSTMENTS

This section provides a more detailed explanation of the three adjustments of model inputs and outputs that have been described above and that were conducted as part of the modeling process.

4.3.1 Model Input: 2030 to 2035 Model Growth

Although the horizon year for the AMBAG Model was the year 2030, it was considered prudent to generate and use a Year 2035 Scenario to ensure compliance with California Department of Transportation requirements that call for an opening year plus 20 year horizon. Four possible methodologies were considered for extrapolating the forecasts obtained from the AMBAG model for the year 2030 to the year 2035:

Approach 1 – Calculate annual growth rate between year 2000 and year 2030 on a link-by-link basis and apply it to the year 2030 assigned volumes to come up with the year 2035 volumes. This method is the most simple and straightforward, but does not account for travel path changes due to capacity constraints on the highway network, and assumes same trend in population and employment growth from year 2000 to year 2030.

Approach 2 – Prior to assignment, calculate annual growth rate between year 2000 and year 2030 for the trip tables and apply it to the year 2030 trip table to develop year 2035 trip table values and assign year 2035 trip table onto the network. This approach is relatively simple, and the assignment accounts for travel path changes due to highway capacity constraints.

Approach 3 – Obtain year 2035 total population, housing, and employment information at the Transportation Analysis Zone (TAZ) level and calculate 2030 to 2035 growth factors for each TAZ; this method would account for geographical changes in population and employment growth as well as travel path changes due to highway capacity constraints, but necessitates consensus on population and employment data for year 2035 at the TAZ level from AMBAG and requires a fairly complicated iterative modeling process that may not converge to the appropriate solution.

Approach 4 – Obtain year 2035 information (involving population, housing, schools, and employment data) at the TAZ level as detailed as the Year 2000 Model and run the entire model from beginning to end to obtain year 2035 results. This approach requires vast amounts of information from AMBAG for year 2035 conditions at the TAZ level that the regional and local agencies must agree upon as well as time consuming updates of all input variables.

After discussions within the Traffic Operations Sub-committee and with the agreement of AMBAG staff, Approach 2 was selected as the most appropriate to extrapolate 2035 data due to its relative simplicity and its accounting for highway capacity constraints. Approaches 3 and 4 would have substantially impacted the study's budget and more importantly its schedule. Also, they would have required further and more in-depth involvement by AMBAG staff to produce only marginally better forecasts.

4.3.2 Model output: Better Model Results Validation

Two approaches were considered to post-process model outputs and reflect differences between observed traffic counts and model forecasted volumes: an incremental approach and a growth factor approach.

The *incremental approach* consists of calculating the arithmetic difference between volumes forecasted by the validated Existing Base Year (year 2000) model and applying this difference to model outputs for all future scenario runs. The *growth factor approach* consists of calculating the percentage growth (future year model over existing base year model) and applying this growth percentage to actual base year traffic counts.

The incremental approach was considered the most suitable for input to freeway mainline analysis (performed with *FREQ*) because of the generally larger volume values, while the growth factor approach was considered more suitable for the local roadway analysis (performed with *Synchro*), where the volume values are generally lower. However, given that some arterial streets also have high volume values, both incremental and growth factor adjustments were calculated for all the links on the local roadway system, and the most conservative adjustment growth result was selected on a case by case basis.

4.3.3 Model output: Bottleneck Analysis

It was anticipated at the beginning of the modeling work that the highway assignments produced by the AMBAG travel demand forecasting model would exceed the capacity at some of the sections of State Route 1 as well as at other parallel facilities within the study area, mostly under the future No-Build conditions. Thus, a bottleneck analysis was performed to determine for each future alternative the maximum traffic flows that can use the highway during the peak hours. Then the travel forecasts obtained from the AMBAG model were adjusted to reflect these maximum flow values throughout the corridor, with surplus traffic being diverted to either time periods outside of the peak hour (*peak spreading*) or to alternative surface street routes where additional capacity may be available (*traffic diversion*).

In summary, after the future year 2035 highway assignments were estimated using the AMBAG model they were reviewed and post-processed to account for model validation errors, after which they were manually adjusted as part of the subsequent bottleneck analysis.

4.4 FREEWAY MAINLINE AND RAMP TRAFFIC FORECAST RESULTS

The traffic forecast results for the Year 2035 Build and No-Build scenarios are provided in *Tables 4-6* and *4-7*. *Table 4-6* presents the traffic forecasts on freeway mainline and ramps in the northbound directions, while *Table 4-7* presents the traffic forecasts in the southbound direction.

Table 4-6
Traffic Forecasts - Northbound State Route 1

Location	Existing ADT	Year 2035 No-Build ADT	Year 2035 No-Build Volume Growth	Year 2035 No-Build Percentage Growth	Year 2035 HOV Build ADT	Year 2035 HOV Build Volume Growth	Year 2035 HOV Build Percentage Growth
START	**35,730**	**45,168**	**9,438**	**26%**	**46,040**	**10,310**	**29%**
Larkin Rd. Off-Ramp	1,488	2,922	1,434	96%	1,488	0	0%
Mainline	**34,242**	**42,246**	**8,004**	**23%**	**44,552**	**10,310**	**30%**
Larkin Rd. On-Ramp	4,636	8,406	3,770	81%	15,320	10,684	230%
Mainline	**38,878**	**50,652**	**11,774**	**30%**	**59,872**	**20,994**	**54%**
Freedom Blvd. Off-Ramp	2,220	2,220	0	0%	2,806	586	26%
Mainline	**36,658**	**48,432**	**11,774**	**32%**	**57,066**	**20,408**	**56%**
Freedom Blvd. On-Ramp	7,752	11,183	3,431	44%	14,780	7,028	91%
Mainline	**44,410**	**59,615**	**15,205**	**34%**	**71,846**	**27,436**	**62%**
Rio Del Mar Blvd. Off-Ramp	4,934	6,131	1,197	24%	15,956	11,022	223%
Mainline	**39,476**	**53,485**	**14,009**	**35%**	**55,891**	**16,415**	**42%**
Rio Del Mar Blvd. On-Ramp	7,277	10,688	3,411	47%	15,006	7,729	106%
Mainline	**46,753**	**64,172**	**17,419**	**37%**	**70,896**	**24,143**	**52%**
Seacliffe Rd. Off-Ramp	6,603	16,912	10,309	156%	21,592	14,989	227%
Mainline	**40,150**	**47,260**	**7,110**	**18%**	**49,304**	**9,154**	**23%**
St. Park EB On-Ramp	2,675	3,245	570	21%	8,117	5,442	203%
Mainline	**42,825**	**50,505**	**7,680**	**18%**	**57,421**	**14,596**	**34%**
St Park WB On-Ramp	6,594	7,451	857	13%	12,981	6,387	97%
Mainline	**49,419**	**57,956**	**8,537**	**17%**	**70,402**	**20,983**	**42%**
Park Ave. Off-Ramp	4,540	6,303	1,763	39%	12,231	7,691	169%
Mainline	**44,879**	**51,653**	**6,774**	**15%**	**58,172**	**13,293**	**30%**
Park Ave. On-Ramp	8,747	9,570	823	9%	26,173	17,426	199%
Mainline	**53,626**	**61,223**	**7,597**	**14%**	**84,344**	**30,718**	**57%**
Bay/Porter St. Off-Ramp	5,596	8,275	2,679	48%	10,904	5,308	95%
Mainline	**48,030**	**52,948**	**4,918**	**10%**	**73,440**	**25,410**	**53%**
Bay/Porter St. On-Ramp	11,415	20,854	9,439	83%	18,529	7,114	62%
Mainline	**59,445**	**73,802**	**14,357**	**24%**	**91,969**	**32,524**	**55%**

Table 4-6
Traffic Forecasts - Northbound State Route 1

Location	Existing ADT	Year 2035 No-Build ADT	Year 2035 No-Build Volume Growth	Year 2035 No-Build Percentage Growth	Year 2035 HOV Build ADT	Year 2035 HOV Build Volume Growth	Year 2035 HOV Build Percentage Growth
41st Off-Ramp	15,204	21,130	5,926	39%	20,210	5,006	33%
Mainline	**44,241**	**52,672**	**8,431**	**19%**	**71,759**	**27,518**	**62%**
41st EB On-Ramp	9,401	9,401	0	0%	10,588	1,187	13%
Mainline	**53,642**	**62,073**	**8,431**	**16%**	**82,347**	**28,705**	**54%**
41st WB On-Ramp	2,677	2,677	0	0%	5,254	2,577	96%
Mainline	**56,319**	**64,750**	**8,431**	**15%**	**87,602**	**31,283**	**56%**
Soquel Dr. Off-Ramp	11,156	11,156	0	0%	32,335	21,179	190%
Mainline	**45,163**	**53,594**	**8,431**	**19%**	**55,267**	**10,104**	**22%**
Soquel Dr./ Commercial Rd. On-Ramp	6,037	7,827	1,790	30%	22,030	15,993	265%
Mainline	**51,200**	**61,421**	**10,221**	**20%**	**77,297**	**26,097**	**51%**
Soquel Dr./ Paul Sweet Rd. On-Ramp	7,987	23,059	15,072	189%	14,382	6,395	80%
Mainline	**59,187**	**84,480**	**25,293**	**43%**	**91,679**	**32,492**	**55%**
Morrissey Blvd. Off-Ramp	11,181	17,407	6,226	56%	19,864	8,683	78%
Mainline	**48,006**	**67,073**	**19,067**	**40%**	**71,815**	**23,809**	**50%**
Morrissey Blvd. On-Ramp	4,706	6,904	2,198	47%	4,993	287	6%
Mainline	**52,712**	**73,977**	**21,265**	**40%**	**76,808**	**24,096**	**46%**
Emeline Ave. Off-Ramp	2,422	9,549	7,127	294%	10,545	8,123	335%
Mainline	**50,290**	**64,428**	**14,138**	**28%**	**66,263**	**15,973**	**32%**
SR-17	24,658	26,228	1,570	6%	26,848	2,190	9%
END	**25,632**	**38,200**	**12,568**	**49%**	**39,415**	**13,783**	**54%**

Source: Wilbur Smith Associates, April 2007

Table 4-7
Traffic Forecasts - Southbound State Route 1

Location	Existing ADT	Year 2035 No-Build ADT	Year 2035 No-Build Volume Growth	Year 2035 No-Build Percentage Growth	Year 2035 HOV Build ADT	Year 2035 HOV Build Volume Growth	Year 2035 HOV Build Percentage Growth
START	**19,937**	**35,801**	**15,864**	**80%**	**37,203**	**17,266**	**87%**
Ocean St. On-Ramp	6,206	9,081	2,875	46%	9,479	3,273	53%
Mainline	**26,143**	**44,882**	**18,739**	**72%**	**46,682**	**20,539**	**79%**
SR-17 SB On-Ramp	21,130	21,397	267	1%	22,138	1,008	5%
Mainline	**47,273**	**66,279**	**19,006**	**40%**	**68,820**	**21,547**	**46%**
Fairmount Ave. Off-Ramp	4,862	9,354	4,492	92%	5,665	803	17%
Mainline	**42,411**	**56,924**	**14,513**	**34%**	**63,154**	**20,743**	**49%**
Fairmount Ave. On-Ramp	3,639	4,199	560	15%	4,753	1,114	31%
Mainline	**46,050**	**61,123**	**15,073**	**33%**	**67,907**	**21,857**	**47%**
Morrissey Blvd. On-Ramp	6,114	12,374	6,260	102%	15,136	9,022	148%
Mainline	**52,164**	**73,497**	**21,333**	**41%**	**83,043**	**30,879**	**59%**
Soquel Ave. Off-Ramp	14,108	23,055	8,947	63%	27,653	13,545	96%
Mainline	**38,056**	**50,443**	**12,387**	**33%**	**55,391**	**17,335**	**46%**
Soquel Ave. On-Ramp	9,016	9,016	0	0%	17,526	8,510	94%
Mainline	**47,072**	**59,459**	**12,387**	**26%**	**72,917**	**25,845**	**55%**
41st St. Off-Ramp	10,601	10,601	0	0%	12,387	1,786	17%
Mainline	**36,471**	**48,858**	**12,387**	**34%**	**60,530**	**24,059**	**66%**
41st St. WB On-Ramp	3,203	5,505	2,302	72%	3,580	377	12%
Mainline	**39,674**	**54,363**	**14,689**	**37%**	**64,110**	**24,436**	**62%**
41st St. EB On-Ramp	12,674	20,444	7,770	61%	20,405	7,731	61%
Mainline	**52,348**	**74,807**	**22,459**	**43%**	**84,515**	**32,167**	**61%**
Bay/Porter St. Off-Ramp	10,038	24,761	14,723	147%	10,506	468	5%
Mainline	**42,310**	**50,046**	**7,736**	**18%**	**74,009**	**31,699**	**75%**
Bay/Porter St. On-Ramp	5,726	17,490	11,764	205%	9,510	3,784	66%
Mainline	**48,036**	**67,536**	**19,500**	**41%**	**83,519**	**35,483**	**74%**
Park Ave. Off-Ramp	7,989	24,758	16,769	210%	38,580	30,591	383%
Mainline	**40,047**	**42,778**	**2,731**	**7%**	**44,939**	**4,892**	**12%**

Table 4-7
Traffic Forecasts - Southbound State Route 1

Location	Existing ADT	Year 2035 No-Build ADT	Year 2035 No-Build Volume Growth	Year 2035 No-Build Percentage Growth	Year 2035 HOV Build ADT	Year 2035 HOV Build Volume Growth	Year 2035 HOV Build Percentage Growth
Park Ave. On-Ramp	4,791	15,464	10,673	223%	28,165	23,374	488%
Mainline	**44,838**	**58,242**	**13,404**	**30%**	**73,104**	**28,266**	**63%**
State Park Rd. Off-Ramp	8,859	12,946	4,087	46%	28,520	19,661	222%
Mainline	**35,979**	**45,296**	**9,317**	**26%**	**44,584**	**8,605**	**24%**
State Park Rd. WB On-Ramp	4,580	10,242	5,662	124%	4,580	0	0%
Mainline	**40,559**	**55,538**	**14,979**	**37%**	**49,164**	**8,605**	**21%**
State Park Rd. EB On-Ramp	1,818	5,770	3,952	217%	20,456	18,638	1025%
Mainline	**42,377**	**61,308**	**18,931**	**45%**	**69,620**	**27,243**	**64%**
Rio Del Mar Blvd. Off-Ramp	7,085	10,178	3,093	44%	15,654	8,569	121%
Mainline	**35,292**	**51,130**	**15,838**	**45%**	**53,966**	**18,674**	**53%**
Rio Del Mar Blvd. On-Ramp	5,218	6,893	1,675	32%	17,121	11,903	228%
Mainline	**40,510**	**58,024**	**17,514**	**43%**	**71,088**	**30,578**	**75%**
Freedom Blvd. Off-Ramp	7,018	13,535	6,517	93%	19,216	12,198	174%
Mainline	**33,492**	**44,489**	**10,997**	**33%**	**51,872**	**18,380**	**55%**
Freedom Blvd. On-Ramp	2,061	2,442	381	18%	4,532	2,471	120%
Mainline	**35,553**	**46,930**	**11,377**	**32%**	**56,403**	**20,850**	**59%**
Larkin Rd. Off-Ramp	5,005	9,972	4,967	99%	5,752	747	15%
Mainline	**30,548**	**36,958**	**6,410**	**21%**	**50,651**	**20,103**	**66%**
Larkin Rd. On-Ramp	1,480	17,002	15,522	1049%	4,731	3,251	220%
END	**32,028**	**53,960**	**21,932**	**68%**	**55,382**	**23,354**	**73%**

Source: Wilbur Smith Associates, April 2007

4.5 YEAR 2035 INTERSECTION VOLUMES

Traffic volumes under Year 2035 Conditions were estimated based on the forecasts provided by the Year 2030 AMBAG Model extrapolated to Year 2035 Conditions. This approach results in a cumulative impact assessment for future conditions and takes into account any anticipated developments expected in year 2035 near the study area, plus the expected growth in housing and employment for the remainder of the region. This model output was used to determine the traffic volumes at the study intersections under year 2035 Conditions.

Since the AMBAG model was developed as a tool to forecast future traffic volumes on major regional traffic facilities and on major local streets, post-processing of the model output was conducted to identify future intersection turning movement volumes. The AM and PM peak hour roadway segment volumes for each of the approaches of the intersections under year 2035 conditions, as predicted by the AMBAG Model, were utilized to calculate the turning movement volumes under future conditions. Year 2035 intersection turning movement volumes were developed using a *Furness* process. The *Furness* process used in this study is in accordance with *NCHRP 255: Highway Traffic Data for Urbanized Area Project Planning & Design (Chapter 8)* and involves balancing the intersection volumes using an iterative process to compare them to the existing traffic distribution. The iterative process seeks to balance the total inbound and outbound volumes from each approach as projected by the transportation model. While performing the Furness Process, the on-ramp and off-ramp volumes forecasted by the AMBAG Model were replaced with the corresponding *FREQ* model outputs for the on and off-ramps. This ensured that the ramp volumes matched with the dynamic results provided by the *FREQ* model under Year 2035 Conditions.

The above mentioned methodology was applied to the AMBAG Model forecasts under Year 2035 No-Build, Year 2035 HOV Build, and Year 2035 TSM Build scenarios to develop the corresponding intersection volumes under each of the scenarios. *Figures 5-3, 5-7* and *5-10* provided in *Chapter 5*, exhibits the peak hour intersection turning movements volumes under Year 2035 No-Build, Year 2035 HOV Build and Year 2035 TSM Build scenarios, respectively.

The AMBAG model was not run to develop volumes for the TSM alternative. This is explained in more detail as follows. The only difference between the TSM alternative and the No-Build alternative was that the TSM alternative implemented ramp metering whereas the No-Build alternative did not. From a travel demand perspective, there was no difference in the output generated by the AMBAG model between the two alternatives since the number of lanes remained the same for both. For the operational analysis of the TSM alternative, the volume generated by the AMBAG model was input in the FREQ simulation model along with the ramp metering logic. Since ramp metering represented a constrained condition, the volume generated by the FREQ model was different than that for the No-Build alternative.

4.6 YEAR 2015 INTERSECTION VOLUMES

Traffic volumes under Year 2015 Conditions were estimated from the existing intersection volumes and the turning movement volumes developed under Year 2035 Conditions. The development of turning movement volumes was performed to use for the opening year (2015) analysis.

Using the intersection volumes under Existing and Year 2035 Conditions, Year 2015 turning movement volumes were interpolated based on a straight-line methodology. *Figures 6-2, 6-4,* and *6-6* provided in *Chapter 6*, show the peak hour intersection turning movement volumes under Year 2015 No-Build, Year 2015 HOV Build, and Year 2015 TSM Build scenarios.

4.7 ARTERIAL TRAFFIC FORECAST RESULTS

The average daily traffic volumes on the State Route 1 corridor and parallel arterials (including Soquel Drive, Capitola Road, and Park Avenue) under Existing, Year 2035 No-Build, and Year 2035 HOV Build Conditions are exhibited in *Tables 4-8* and *4-9* for the northbound and southbound directions, respectively.

In both the northbound and southbound directions, the traffic volumes on State Route 1 and parallel arterials would increase from Existing Conditions to Year 2035 No-Build Conditions. However, there would be contrasting growth of traffic volumes on the freeway corridor and arterials from Year 2035 No-Build Condition to Year 2035 HOV Build Condition. The traffic volumes on arterials would decrease between Year 2035 No-Build and Year 2035 HOV Build Conditions; whereas, the traffic volumes on freeway corridor would increase. This can be explained due to the fact that the improved freeway corridor conditions under HOV Build Conditions (implementing HOV lanes, ramp metering, and auxiliary lanes) would divert vehicles traveling on parallel arterials onto State Route 1, relieving the local city streets from excessive cut-through commuter traffic.

At select screenline locations, *Figure 4-3* exhibits the traffic volumes on arterials parallel to State Route 1 and *Figure 4-4* exhibits the variation in traffic volumes on the freeway mainline corridor and parallel arterials under Existing, Year 2035 No-Build, and Year 2035 HOV Build Conditions.

Table 4-8
Average Daily Traffic Demand - Northbound State Route 1 Corridor and Arterials

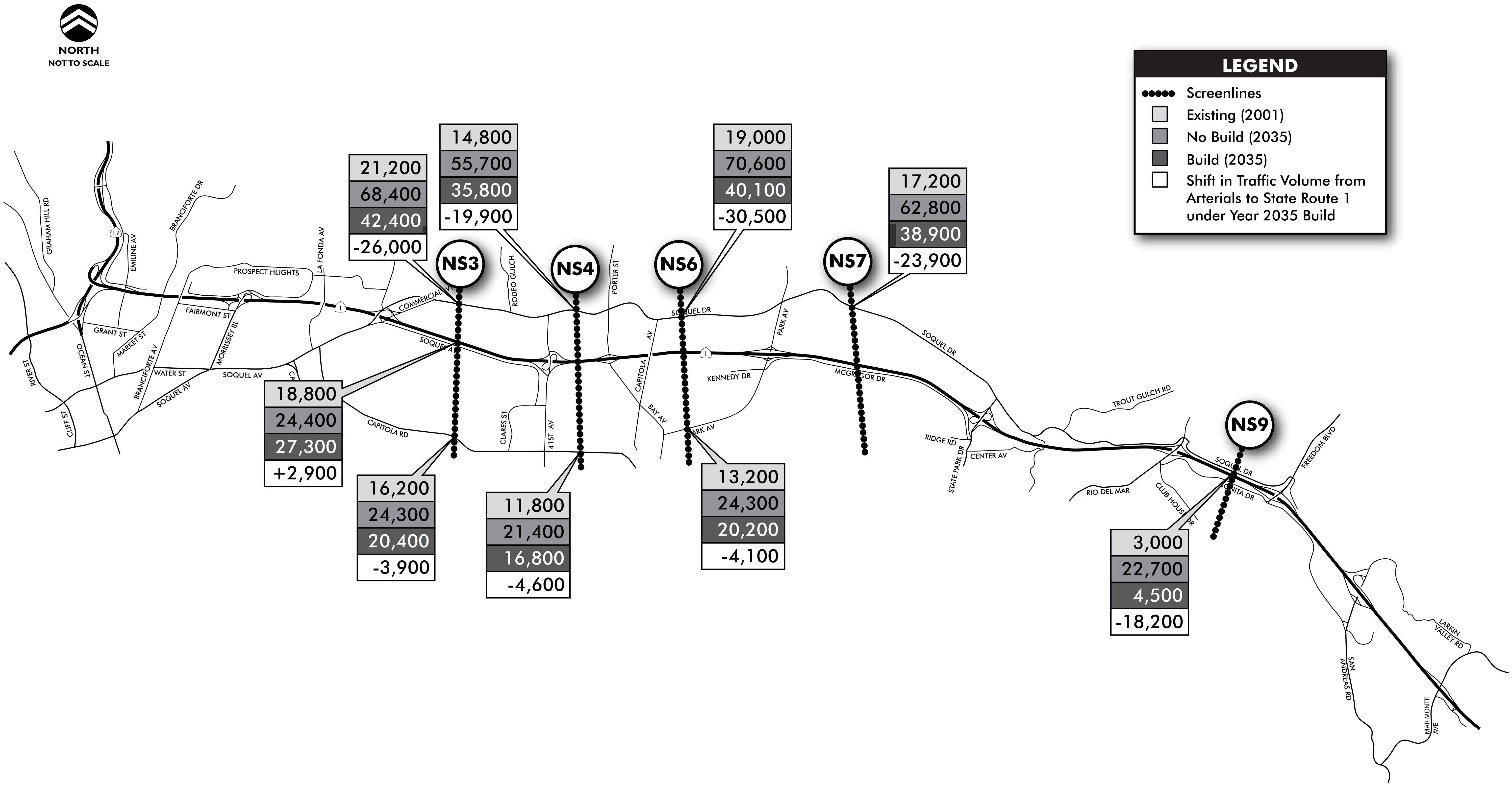
Location	SR-1	Soquel Dr.	Capitola Rd.	Park Ave.	Total
Existing Conditions					
Larkin Valley Rd. to Freedom Blvd.	38,900				38,900
Freedom Blvd. to Rio Del Mar Blvd.	44,400	1,500			45,900
Rio Del Mar Blvd. to State Park Dr.	46,800	4,100			50,900
State Park Dr. to Park Ave.	49,400	8,600			58,000
Park Ave. to Bay St./Porter St.	53,600	9,500		6,600	69,700
Bay St./Porter St. to 41st Ave.	59,400	7,400	5,900		72,700
41st Ave. to Soquel Dr.	56,300	10,600	8,100		84,400
Soquel Dr. to Morrissey Blvd.	59,200				59,200
Morrissey Blvd. to SR-17	50,200				50,200
Year 2035 No Build Conditions					
Larkin Valley Rd. to Freedom Blvd.	50,700				50,700
Freedom Blvd. to Rio Del Mar Blvd.	59,600	11,350			70,950
Rio Del Mar Blvd. to State Park Dr.	64,200	12,250			76,450
State Park Dr. to Park Ave.	58,000	31,400			89,400
Park Ave. to Bay St./Porter St.	61,200	35,300		12,150	108,650
Bay St./Porter St. to 41st Ave.	73,800	27,850	10,700		112,350
41st Ave. to Soquel Dr.	64,800	34,200	12,150		123,350
Soquel Dr. to Morrissey Blvd.	84,500				84,500
Morrissey Blvd. to SR-17	64,400				64,400
Year 2035 HOV Build Conditions					
Larkin Valley Rd. to Freedom Blvd.	59,900				59,900
Freedom Blvd. to Rio Del Mar Blvd.	71,800	2,250			74,050
Rio Del Mar Blvd. to State Park Dr.	70,900	10,850			81,750
State Park Dr. to Park Ave.	70,400	19,450			89,850
Park Ave. to Bay St./Porter St.	84,300	20,050		10,100	114,450
Bay St./Porter St. to 41st Ave.	92,000	17,900	8,400		118,300
41st Ave. to Soquel Dr.	87,600	21,200	10,200		132,650
Soquel Dr. to Morrissey Blvd.	91,700				91,700
Morrissey Blvd. to SR-17	66,300				66,300
Growth from Existing to Year 2035 No Build Conditions					
Larkin Valley Rd. to Freedom Blvd.	11,800				11,800
Freedom Blvd. to Rio Del Mar Blvd.	15,200	9,850			25,050
Rio Del Mar Blvd. to State Park Dr.	17,400	8,150			25,550
State Park Dr. to Park Ave.	8,600	22,800			31,400
Park Ave. to Bay St./Porter St.	7,600	25,800		5,550	38,950
Bay St./Porter St. to 41st Ave.	14,400	20,450	4,800		39,650
41st Ave. to Soquel Dr.	8,500	23,600	4,050		38,950
Soquel Dr. to Morrissey Blvd.	25,300				25,300
Morrissey Blvd. to SR-17	14,200				14,200
Growth from Year 2035 No Build to HOV Build Conditions					
Larkin Valley Rd. to Freedom Blvd.	9,200				9,200
Freedom Blvd. to Rio Del Mar Blvd.	12,200	-9,100			3,100
Rio Del Mar Blvd. to State Park Dr.	6,700	-1,400			5,300
State Park Dr. to Park Ave.	12,400	-11,950			450
Park Ave. to Bay St./Porter St.	23,100	-15,250		-2,050	5,800
Bay St./Porter St. to 41st Ave.	18,200	-9,950	-2,300		5,950
41st Ave. to Soquel Dr.	22,800	-13,000	-1,950		9,300
Soquel Dr. to Morrissey Blvd.	7,200				7,200
Morrissey Blvd. to SR-17	1,900				1,900

Source: Wilbur Smith Associates, April 2007

Table 4-9
Average Daily Traffic Demand - Southbound State Route 1 Corridor and Arterials

Location	SR-1	Soquel Dr.	Capitola Rd.	Park Ave.	Total
Existing Conditions					
SR-17 to Morrissey Blvd.	47,300				47,300
Morrissey Blvd. to Soquel Dr.	52,200				52,200
Soquel Dr. to 41st Ave.	47,100	10,600	8,100		75,200
41st Ave. to Bay St./Porter St.	52,300	7,400	5,900		65,600
Bay St./Porter St. to Park Ave.	48,000	9,500		6,600	64,100
Park Ave. to State Park Dr.	44,800	8,600			53,400
State Park Dr. to Rio Del Mar Blvd.	42,400	4,100			46,500
Rio Del Mar Blvd. to Freedom Blvd.	40,500	1,500			42,000
Freedom Blvd. to Larkin Valley Rd.	35,600				35,600
Year 2035 No Build Conditions					
SR-17 to Morrissey Blvd.	66,300				66,300
Morrissey Blvd. to Soquel Dr.	73,500				73,500
Soquel Dr. to 41st Ave.	59,500	34,200	12,150		118,050
41st Ave. to Bay St./Porter St.	74,800	27,850	10,700		113,350
Bay St./Porter St. to Park Ave.	67,500	35,300		12,150	114,950
Park Ave. to State Park Dr.	58,200	31,400			89,600
State Park Dr. to Rio Del Mar Blvd.	61,300	12,250			73,550
Rio Del Mar Blvd. to Freedom Blvd.	58,000	11,350			69,350
Freedom Blvd. to Larkin Valley Rd.	46,900				46,900
Year 2035 HOV Build Conditions					
SR-17 to Morrissey Blvd.	68,800				68,800
Morrissey Blvd. to Soquel Dr.	83,000				83,000
Soquel Dr. to 41st Ave.	72,900	21,200	10,200		117,950
41st Ave. to Bay St./Porter St.	84,500	17,900	8,400		110,800
Bay St./Porter St. to Park Ave.	83,500	20,050		10,100	113,650
Park Ave. to State Park Dr.	73,100	19,450			92,550
State Park Dr. to Rio Del Mar Blvd.	69,600	10,850			80,450
Rio Del Mar Blvd. to Freedom Blvd.	71,100	2,250			73,350
Freedom Blvd. to Larkin Valley Rd.	56,400				56,400
Growth from Existing to Year 2035 No Build Conditions					
SR-17 to Morrissey Blvd.	19,000				19,000
Morrissey Blvd. to Soquel Dr.	21,300				21,300
Soquel Dr. to 41st Ave.	12,400	23,600	4,050		42,850
41st Ave. to Bay St./Porter St.	22,500	20,450	4,800		47,750
Bay St./Porter St. to Park Ave.	19,500	25,800		5,550	50,850
Park Ave. to State Park Dr.	13,400	22,800			36,200
State Park Dr. to Rio Del Mar Blvd.	18,900	8,150			27,050
Rio Del Mar Blvd. to Freedom Blvd.	17,500	9,850			27,350
Freedom Blvd. to Larkin Valley Rd.	11,300				11,300
Growth from Year 2035 No Build to HOV Build Conditions					
SR-17 to Morrissey Blvd.	2,500				2,500
Morrissey Blvd. to Soquel Dr.	9,500				9,500
Soquel Dr. to 41st Ave.	13,400	-13,000	-1,950		-100
41st Ave. to Bay St./Porter St.	9,700	-9,950	-2,300		-2,550
Bay St./Porter St. to Park Ave.	16,000	-15,250		-2,050	-1,300
Park Ave. to State Park Dr.	14,900	-11,950			2,950
State Park Dr. to Rio Del Mar Blvd.	8,300	-1,400			6,900
Rio Del Mar Blvd. to Freedom Blvd.	13,100	-9,100			4,000
Freedom Blvd. to Larkin Valley Rd.	9,500				9,500

Source: Wilbur Smith Associates, April 2007



Note: The Numbers Indicate the Sum of Traffic Volumes (Both Ways) Across Major Local Streets at each Location.

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Figure 4-3
AVERAGE DAILY TRAFFIC VOLUMES ON ARTERIALS AT SELECT SCREENLINE LOCATIONS
EXISTING AND YEAR 2035 BUILD/NO BUILD CONDITIONS

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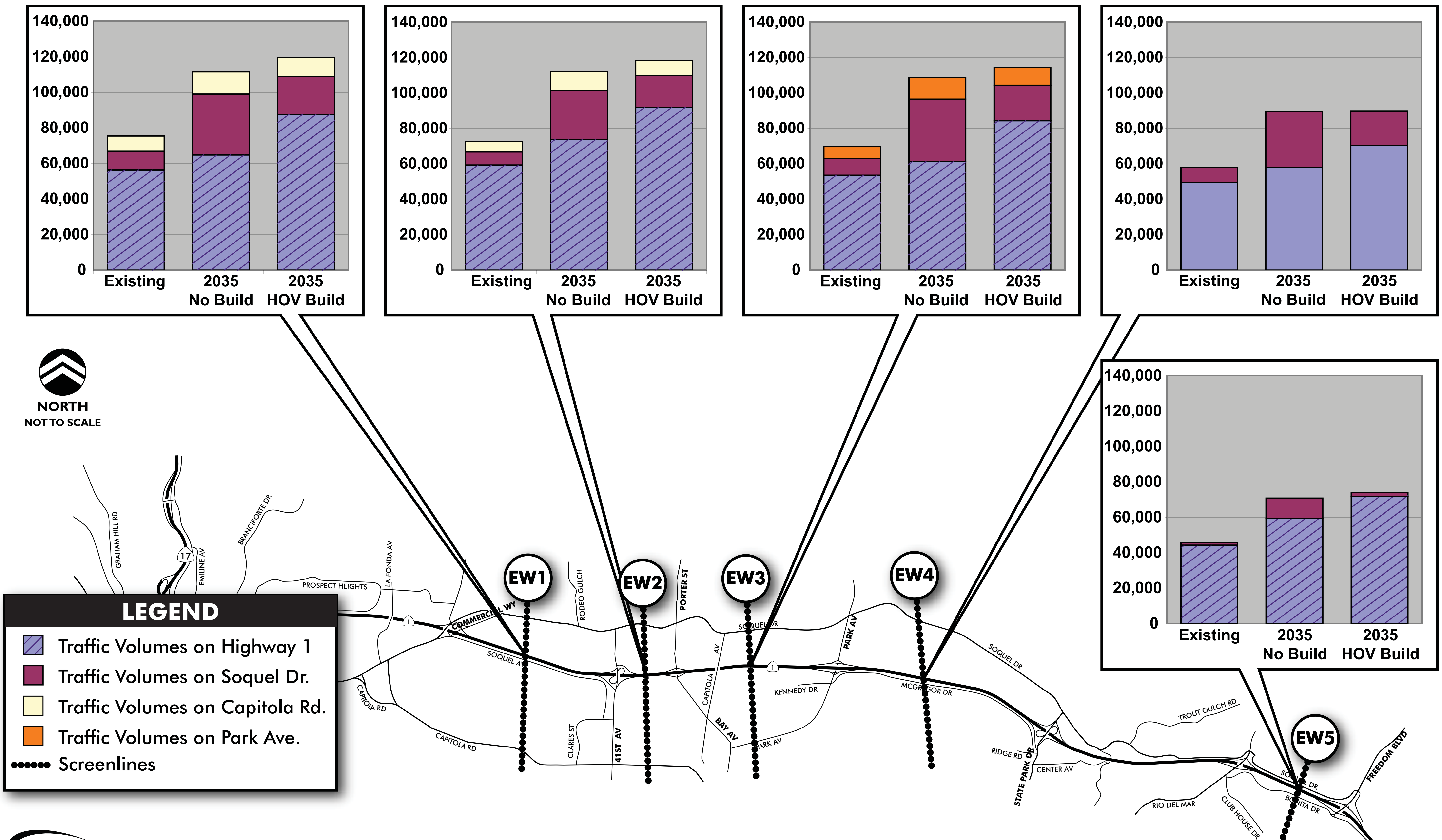

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Figure 4-4
AVERAGE DAILY TRAFFIC VOLUMES ON STATE ROUTE 1 AND PARALLEL ARTERIALS AT SELECT SCREENLINE LOCATIONS
EXISTING AND YEAR 2035 HOV BUILD/NO BUILD CONDITIONS

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Chapter 5
DESIGN YEAR 2035 TRAFFIC OPERATIONS

Overview

This chapter discusses the future geometric configuration and traffic operating conditions for the "Build" geometric alternatives under consideration for State Route 1. The *FREQ* software package was used to model future freeway traffic conditions for the Year 2035 (design year) traffic operations, using the AMBAG model's traffic patterns and volumes. *FREQ* simulation was run for the northbound and southbound directions for both the AM peak (6 AM to 12 PM) and PM peak (2 PM to 8 PM) periods. The peak hour performance measures were then obtained out of the peak period output, representing the highest one-hour time frame within the peak period.

In this study, Measures of Effectiveness (MOEs) obtained from the model include travel time, travel speed, vehicle throughput, person throughput, total network travel time (measured in vehicle-hours of travel or VHT), total network travel distance (measured in vehicle-miles of travel or VMT), average vehicle occupancy (AVO), density, and LOS. The *FREQ* macro-simulation analysis was performed to evaluate the following scenarios:

- Year 2035 No-Build
- Year 2035 HOV Build
- Year 2035 Transportation System Management (TSM) Build

5.1 Year 2035 NO-BUILD ALTERNATIVE ANALYSIS

5.1.1 Proposed Improvements and Network Assumptions

Under Year 2035 No-Build Conditions, future traffic volumes were introduced into the *FREQ* simulation network, which included existing corridor geometries plus various planned non-HOV improvements in the vicinity of the study area. These include the *State Route 17 Merge Lane* project and the *State Route 1 Auxiliary Lane Widening* project (from Morrissey Boulevard to Soquel Avenue) improvements. The finalized Year 2035 No-Build lane configurations are presented in *Figure 5-1*, while *Figures 5-2A and 5-2B* present the corridor traffic volumes at select junctions under AM and PM peak periods, respectively. Without the HOV lanes, traffic conditions are expected to substantially worsen in the future, and the results are summarized in *Table 5-1* on Page 5-5. *Appendix E-2* presents the *FREQ* output under Year 2035 No-Build Conditions. As part of *State Route 1 Auxiliary Lane* project, some improvements may be proposed at Morrissey Boulevard and Soquel Drive interchanges. However, the freeway operations (using *FREQ*) were analyzed prior to finalizing the interchange improvement plans. As such, the freeway operations were performed assuming the geometric layout of both these interchanges would remain the same as under Existing Conditions.

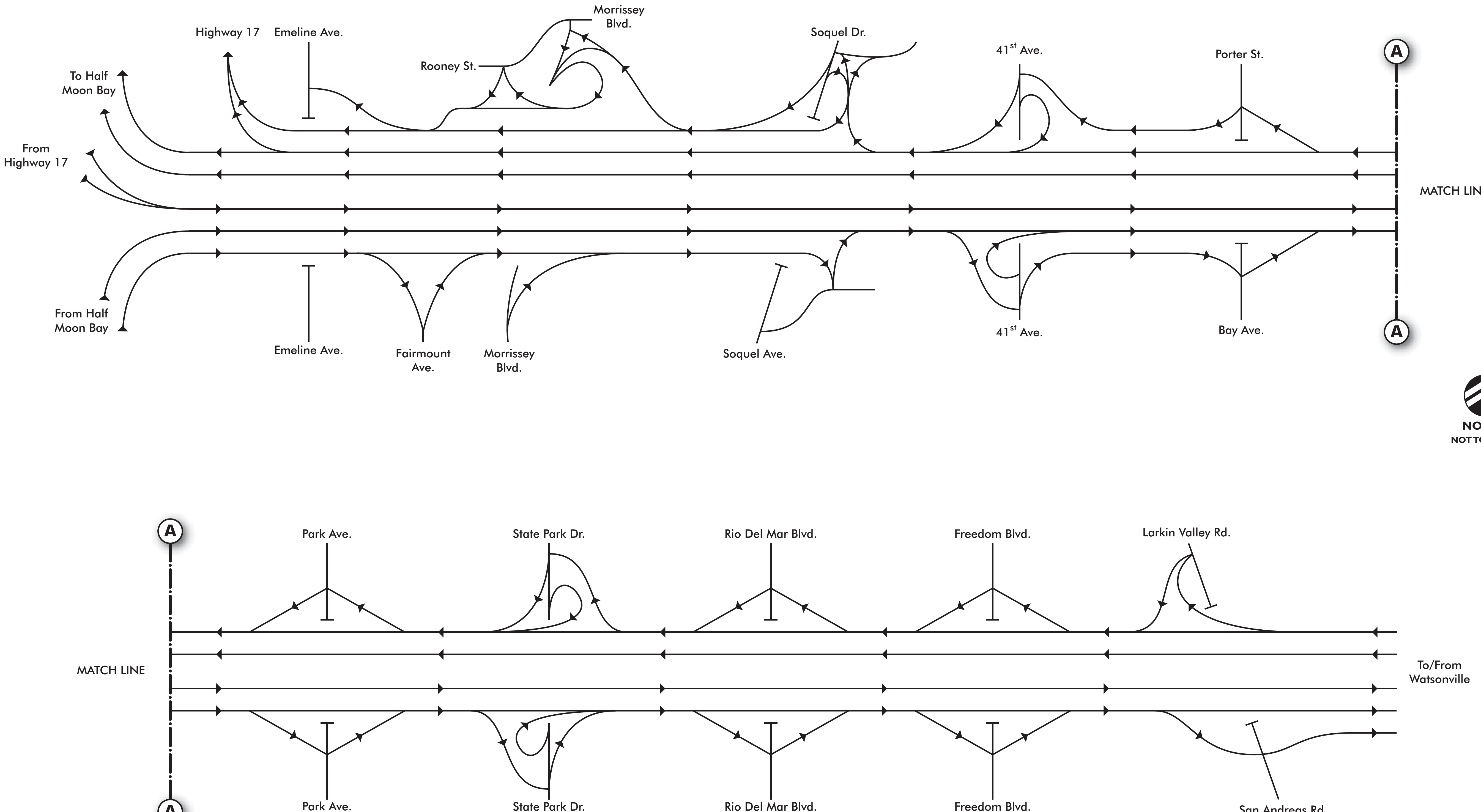

Figure 5-1

STATE ROUTE 1 LANE LINE DIAGRAM
YEAR 2035 NO BUILD CONDITIONS

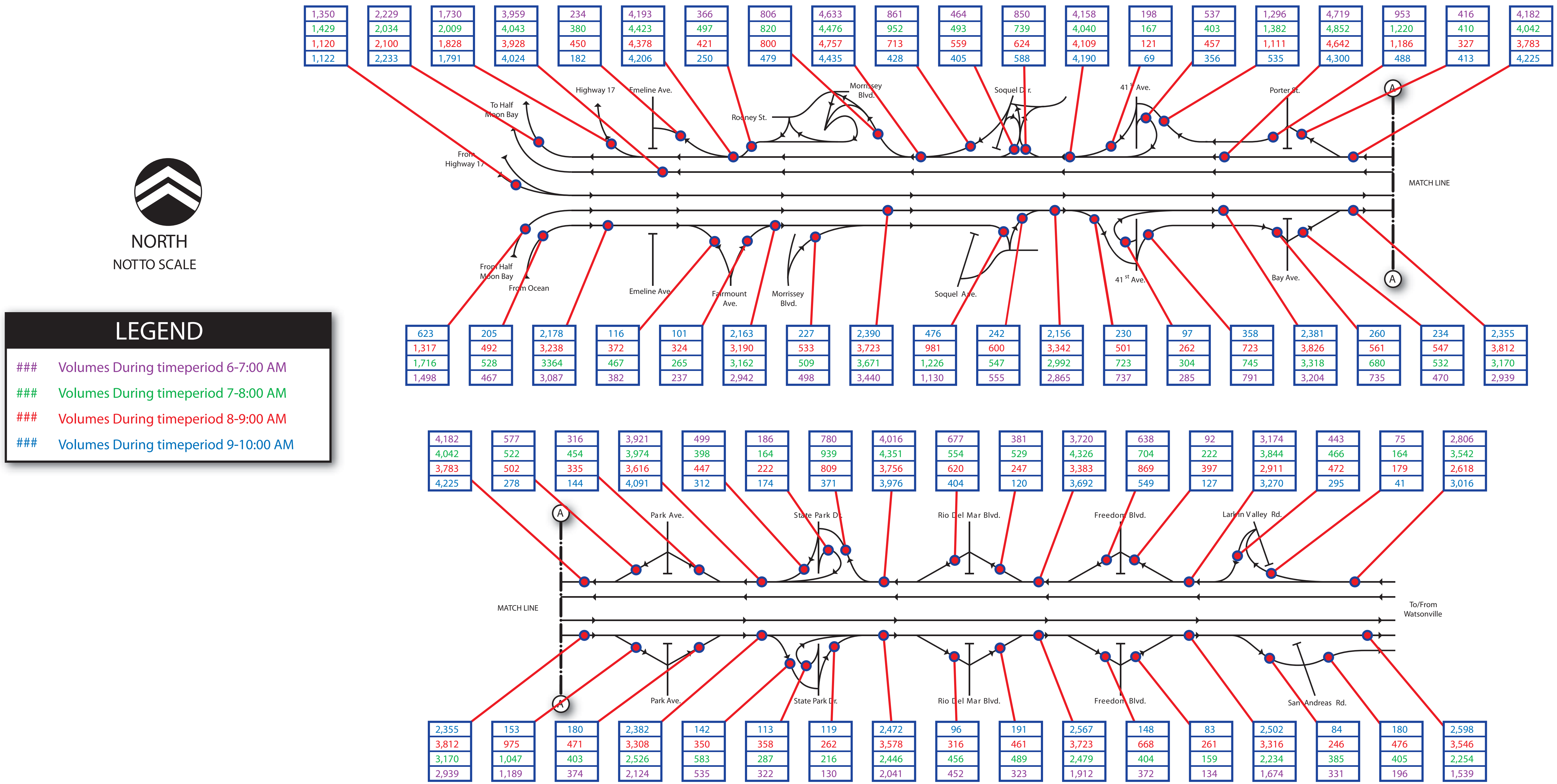

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Figure 5-2A

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2035 NO BUILD CONDITIONS (AM PEAK)

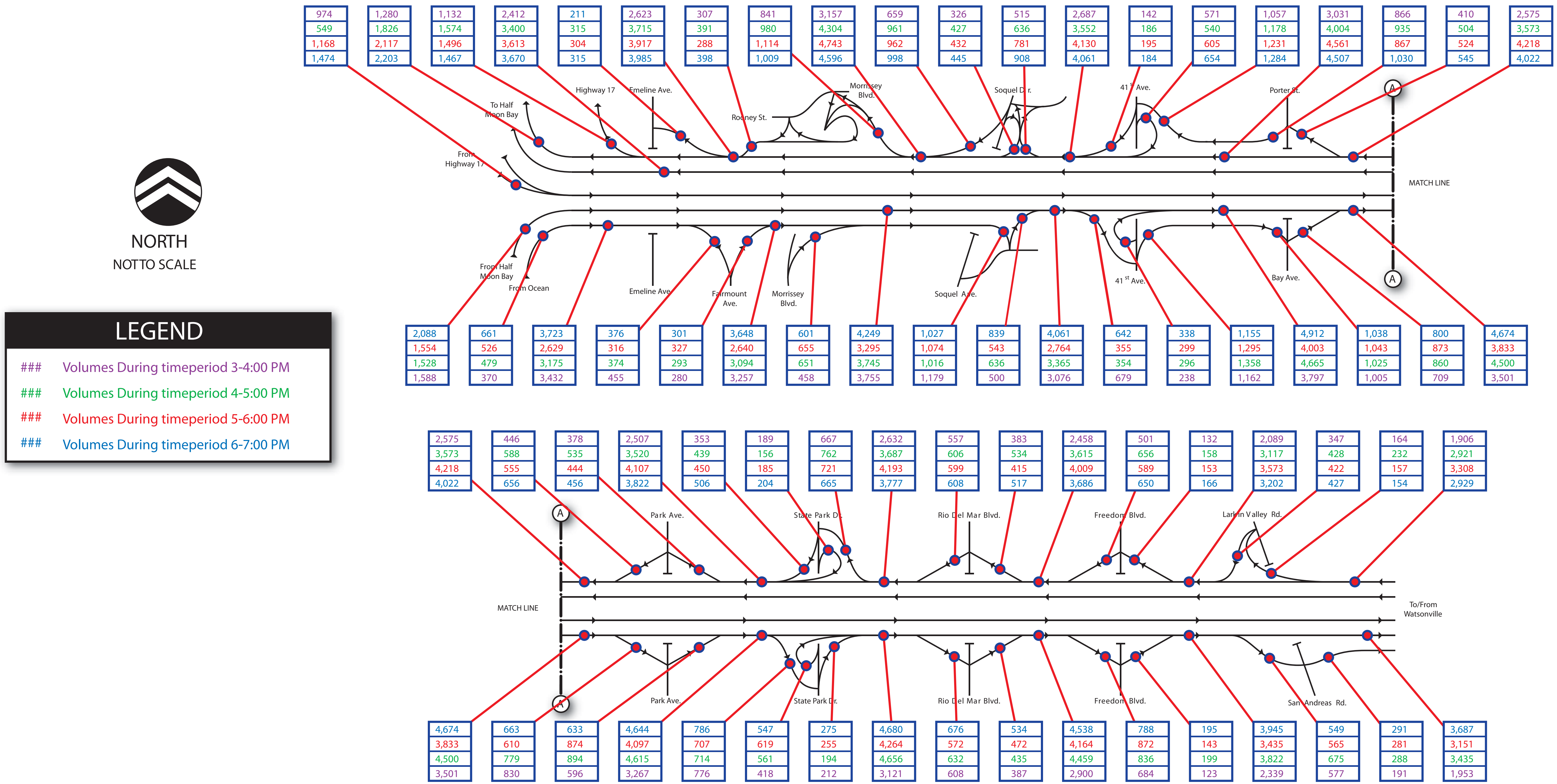


Figure 5-2B

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2035 NO BUILD CONDITIONS (PM PEAK)

Table 5-1
Comparison of Measure of Effectiveness - Existing versus Year 2035 No-Build Scenarios

Measure of Effectiveness	Existing		2035 No-Build		% Difference	
	AM	PM	AM	PM	AM	PM
Northbound						
Average Travel Time (minutes)	23 ***16***	15 ***12***	59 ***39***	34 ***22***	157% ***144%***	127% ***83%***
Average Speed (mph)	30 ***44***	39 ***52***	12 ***18***	17 ***28***	-60% ***-59%***	-56% ***-46%***
Delay (minutes per vehicle)	14 ***4***	6 ***2***	48 ***28***	25 ***12***	243% ***600%***	317% ***500%***
No. of Vehicle Trips (per hour)	2,923 ***3,045***	3,235 ***2,805***	2,767 ***3,129***	3,114 ***3,157***	-5% ***3%***	-4% ***13%***
No. of Persons Trips (per hour)	3,308 ***3,447***	4,024 ***3,489***	3,132 ***3,542***	3,874 ***3,927***	-5% ***3%***	-4% ***13%***
Freeway Travel Time (VHT)	1,274 ***821***	823 ***544***	2,749 ***2,053***	1,784 ***1,138***	116% ***150%***	117% ***109%***
Travel Distance (VMT)	38,517 ***35,933***	32,349 ***28,045***	32,646 ***36,922***	31,138 ***31,568***	-15% ***3%***	-4% ***13%***
Avg. Vehicle Occupancy (persons/vehicle)	1.13 ***1.13***	1.24 ***1.24***	1.13 ***1.13***	1.24 ***1.24***	0% ***0%***	0% ***0%***
Density (passenger cars per mile per lane)	49 ***35***	41 ***27***	115 ***87***	92 ***56***	135% ***149%***	124% ***107%***
Level of Service	F ***D***	E ***D***	F ***F***	F ***F***	N.A. ***N.A.***	N.A. ***N.A.***
Southbound						
Average Travel Time (minutes)	10 ***10***	27 ***18***	29 ***18***	61 ***47***	190% ***80%***	126% ***161%***
Average Speed (mph)	60 ***61***	26 ***39***	22 ***35***	11 ***15***	-63% ***-43%***	-58% ***-62%***
Delay (minutes per vehicle)	0 ***0***	15 ***6***	19 ***8***	49 ***35***	N/A ***N/A***	227% ***483%***
No. of Vehicle Trips (per hour)	2,918 ***2,332***	3,101 ***2,885***	3,101 ***2,968***	2,475 ***2,696***	6% ***27%***	-20% ***-7%***
No. of Persons Trips (per hour)	3,385 ***2,705***	3,664 ***3,405***	3,597 ***3,443***	2,911 ***3,168***	6% ***27%***	-21% ***-7%***
Freeway Travel Time (VHT)	507 ***400***	1,391 ***858***	1,498 ***884***	2,523 ***2,101***	195% ***121%***	81% ***145%***
Travel Distance (VMT)	30,348 ***24,251***	35,661 ***33,182***	32,248 ***30,863***	28,956 ***31,544***	6% ***27%***	-19% ***-5%***
Avg. Vehicle Occupancy (persons/vehicle)	1.16 ***1.16***	1.18 ***1.18***	1.16 ***1.16***	1.18 ***1.18***	0% ***0%***	0% ***0%***
Density (passenger cars per mile per lane)	24 ***19***	60 ***37***	70 ***42***	113 ***90***	192% ***121%***	88% ***143%***
Level of Service	C ***C***	F ***E***	F ***E***	F ***F***	N.A. ***N.A.***	N.A. ***N.A.***

Source: Wilbur Smith Associates, February 2007

NOTES:
Non-italicized and non-bold values represent peak hour values.
***Bold** italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

5.1.2 Vehicle Throughput

Under the No-Build Conditions, State Route 1 would experience a difficult time accommodating future travel demand. Under the Year 2035 No-Build scenario, vehicle throughput is expected to decline by about five percent during the northbound AM and PM peak hours. Mobility for the southbound direction would also decrease sharply, down by as much as 20 percent. When traffic flow on a corridor breaks down, it serves fewer numbers of vehicles than its maximum theoretical capacity since vehicles within the corridor are forced to stop-and-go. This will be more evident when analyzed from the delay and density standpoint, which will be discussed in the next section.

Under Year 2035 No-Build Conditions, total vehicle trips in the northbound direction increased from 3,045 (under Existing Conditions) to 3,129 during the AM peak period; whereas, northbound total vehicle trips decreased from 2,923 (under Existing Conditions) to 2,767 in the AM peak hour. Therefore, traffic in the northbound direction would exhibit “peak spreading” or redistribution of trips away from the peak hour towards the fringes of the peak period. Peak hour is a result of commuters’ collective choice of optimal time to commute from home to work or vice versa. Due to the corridor’s inability to serve higher future demand during the peak hour (experienced by the commuters as heavier traffic congestion), some drivers will choose to make the trip earlier or later than their optimal commute time. Instead of peaking sharply, traffic demand would be flatter, but would last longer.

The *FREQ* results showed that the year 2035 No-Build peak hour vehicle throughput decreased while the peak period throughput increased. This confirmed the earlier hypothesis of peak spreading described in Chapter 4. As congestion problems on State Route 1 would worsen (serving less vehicles) during the peak hour, commuters are expected to change their travel behavior to avoid congestion. However, as discussed in the next section, the project team identified that by year 2035 even peak spreading would do little to alleviate traffic congestion on State Route 1, as travel demand would far outweigh the capacity.

5.1.3 Delays and Densities

As vehicle throughput declines, the southbound direction during the AM peak, which had no delays under the existing conditions, would experience up to 49 minutes of delay by year 2035 (southbound direction during PM peak hour). This is an increase of 243 percent compared to the existing conditions (15 minutes). In the northbound direction during the AM peak, traffic delays would average 48 minutes per vehicle, which amounts to a 227 percent increase over the existing conditions (14 minutes).

Under Existing Conditions, the peak commute directions (northbound direction during AM peak hour and southbound direction during PM peak hour) are already experiencing heavy congestion, resulting in densities of 49 and 60 passenger cars per mile per lane (pcpmpl), respectively (LOS F). Refer to *Table 2-1* for descriptions of service levels and their relationships with density values. This shows that existing traffic operations on State Route 1 are already at stop-and-go conditions and operating below their optimal level.

By year 2035, conditions on State Route 1 for all peak hours and directions would operate at LOS F, with densities ranging from 113 pcpmpl (southbound direction during PM peak hour) and 115 pcpmpl (northbound direction during the AM peak hour). The reverse commute directions (northbound during the PM peak hour and southbound during AM peak hour) are expected to operate at traffic densities of 92 and 70 pcpmpl (LOS F) during the PM and AM peak hours, respectively.

Thus, the operating conditions in the reverse commute directions are also expected to breakdown in the future. In addition, the operating conditions in the peak commute direction would worsen in the future. Travel demand would continue to increase, as population grows and the region becomes fully developed. At the same time, the corridor’s ability to serve the number of vehicles would decrease, as delays and densities soar.

As previously mentioned, some commuters would choose to change the time of their travel to avoid congestion. Unfortunately, by year 2035, the demand would be so high compared to the available capacity that peak spreading would do little to alleviate congestion. Under Existing Conditions, State Route 1 during the peak period operates at LOS D or better (except in the southbound direction during PM peak hour, which operates at LOS E). By year 2035, under No-Build Conditions, all but the southbound direction during the AM peak hour (reverse commute direction) would operate at LOS F.

According to the Project Traffic Operations Sub-Committee, the peak period considered for this study is six hours long. The AM peak period is from 6 AM to 12 noon, while the PM peak period is from 2 PM to 8 PM. A corridor operating at LOS F for six continuous hours, twice a day, assuming that there would be no accidents or incidents, is in serious need of solutions, both from demand management and capacity increases.

5.1.4 Travel Speed and Travel Time

According to the traffic analysis, the corridor would experience dramatic declines in traffic performance by year 2035 under No-Build Conditions. In the northbound direction, the average vehicle speed would reduce from Existing Conditions (30 mph and 39 mph during AM and PM peak hours, respectively) to 12 mph and 17 mph during AM and PM peak hours, respectively under Year 2035 No-Build Conditions. As such, the average AM peak and PM peak travel times along the study corridor would increase by 157 percent and 127 percent, respectively. The average northbound travel time would be as high as 59 minutes, up from 23 minutes under Existing Conditions. Of the 59 minutes, 48 minutes would be attributable to traffic delays.

Likewise, a substantial dramatic decline in southbound traffic performance can also be observed. In the year 2035, travel time for the southbound direction during the PM peak hour would average 61 minutes, up from 27 minutes under Existing Conditions. Speeds would decline accordingly, with an average of 11 mph during the PM peak hour.

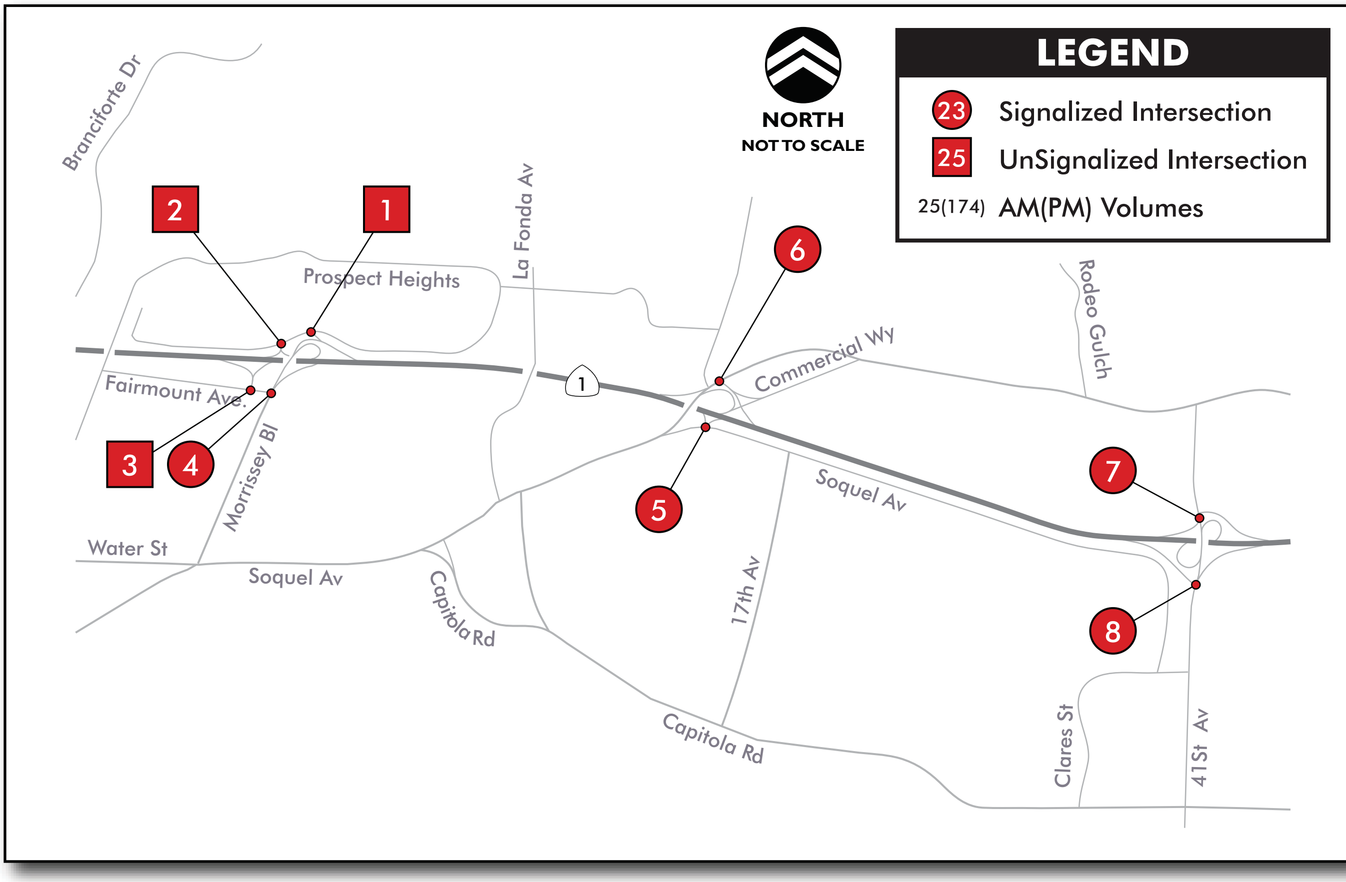
5.1.5 Intersections Operation Analysis

Using the methodology described in Section 4.4, turning movement volumes have been developed for the study intersections to represent Year 2035 No-Build Conditions during the AM and PM peak hours, which are shown in *Figures 5-3A, 5-3B,* and *5-3C*.

Under Year 2035 No-Build Conditions, most of the study intersections would operate at LOS F. All the study intersections would operate under an unacceptable level of service (LOS D or worse) during AM and PM peak hours. This is due to the fact that under Year 2035 No-Build Conditions, State Route 1 would experience a difficult time accommodating future travel demand. Hence, many vehicles will be forced to divert to side streets in order to avoid the freeway congestion.

The results of the Year 2035 No-Build Scenario LOS analysis are presented in *Table 5-2*. The above findings, combined with the freeway operations analysis indicate that in year 2035 under No-Build Conditions, traffic congestion would extend beyond the freeway mainline, onto the ramps and local streets. Vehicles would experience higher delays entering the freeway, causing backups on the arterials.

Appendix C-2 exhibits the *Synchro* calculations for the study intersections under Year 2035 No-Build peak hour conditions.



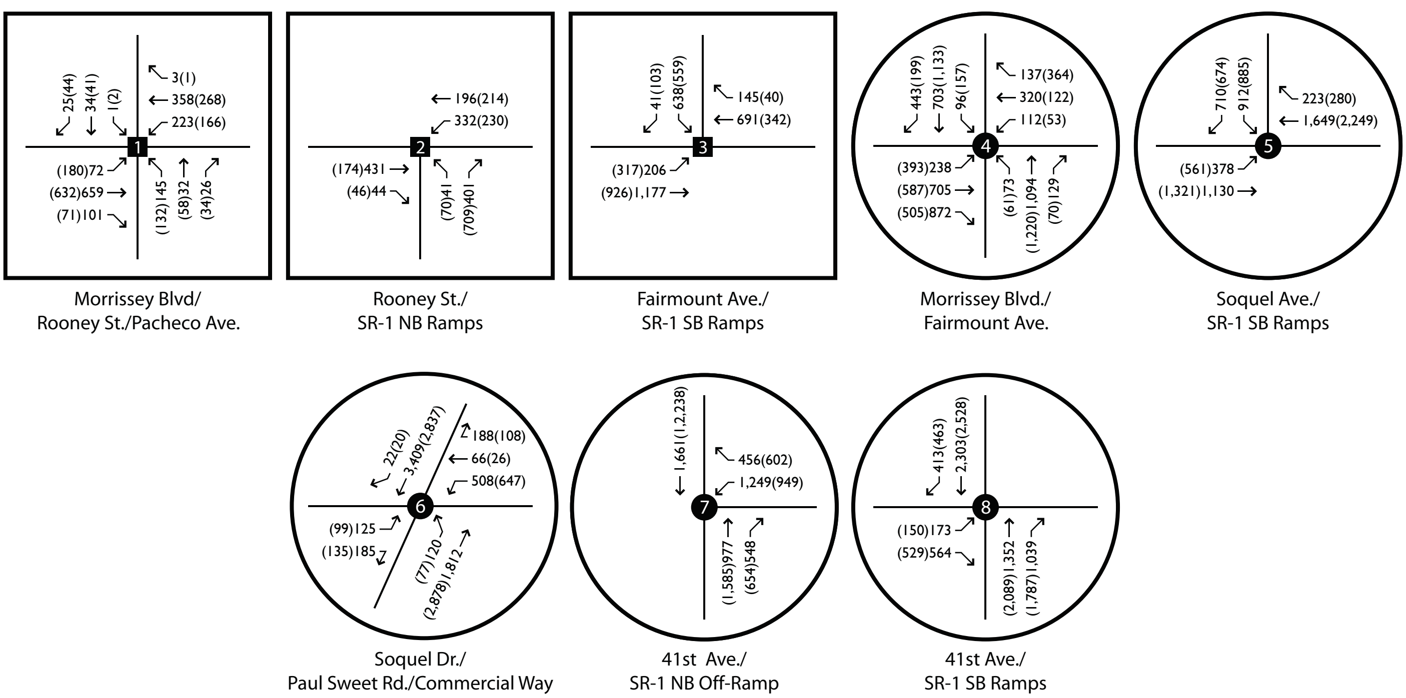


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Figure 5-3A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 NO BUILD CONDITIONS

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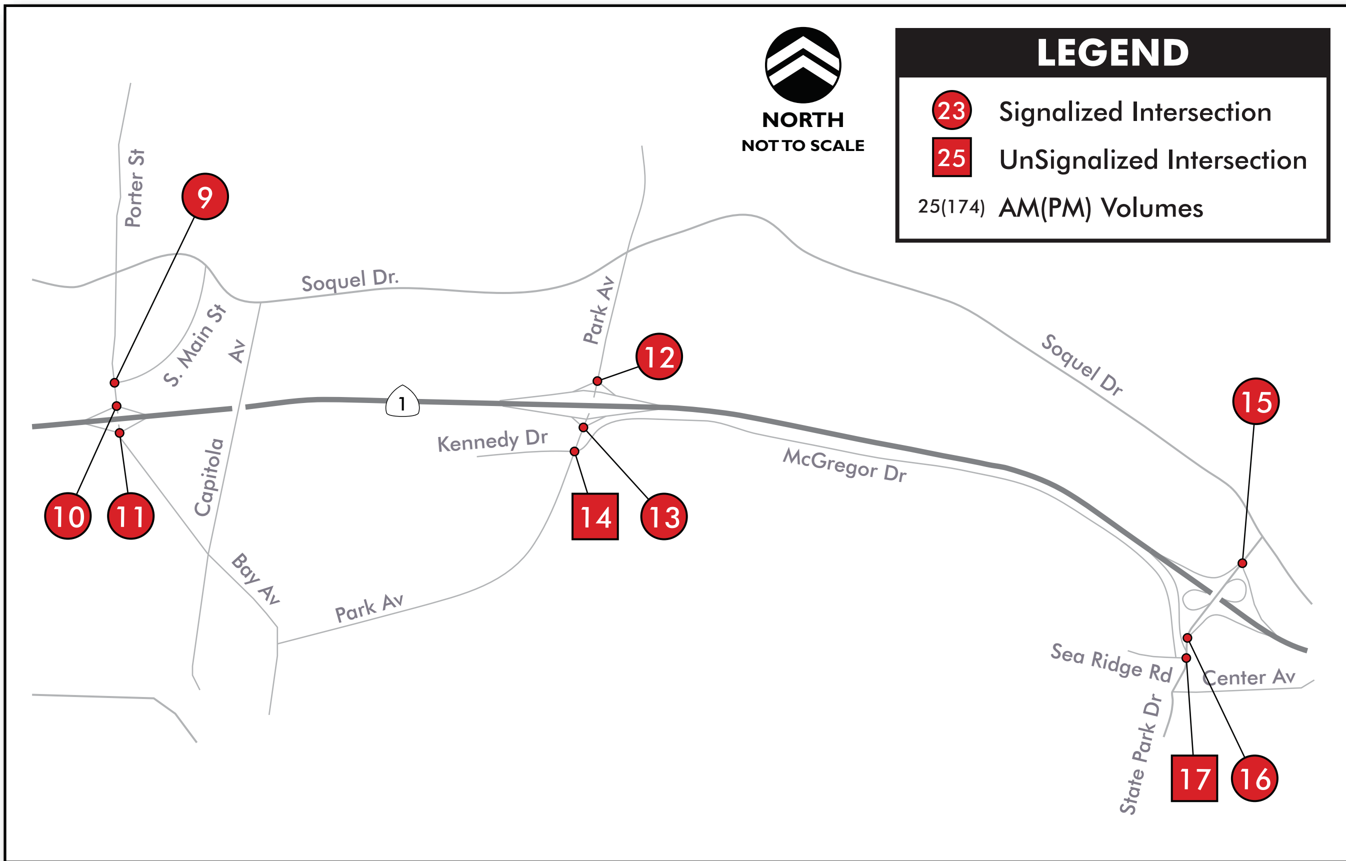

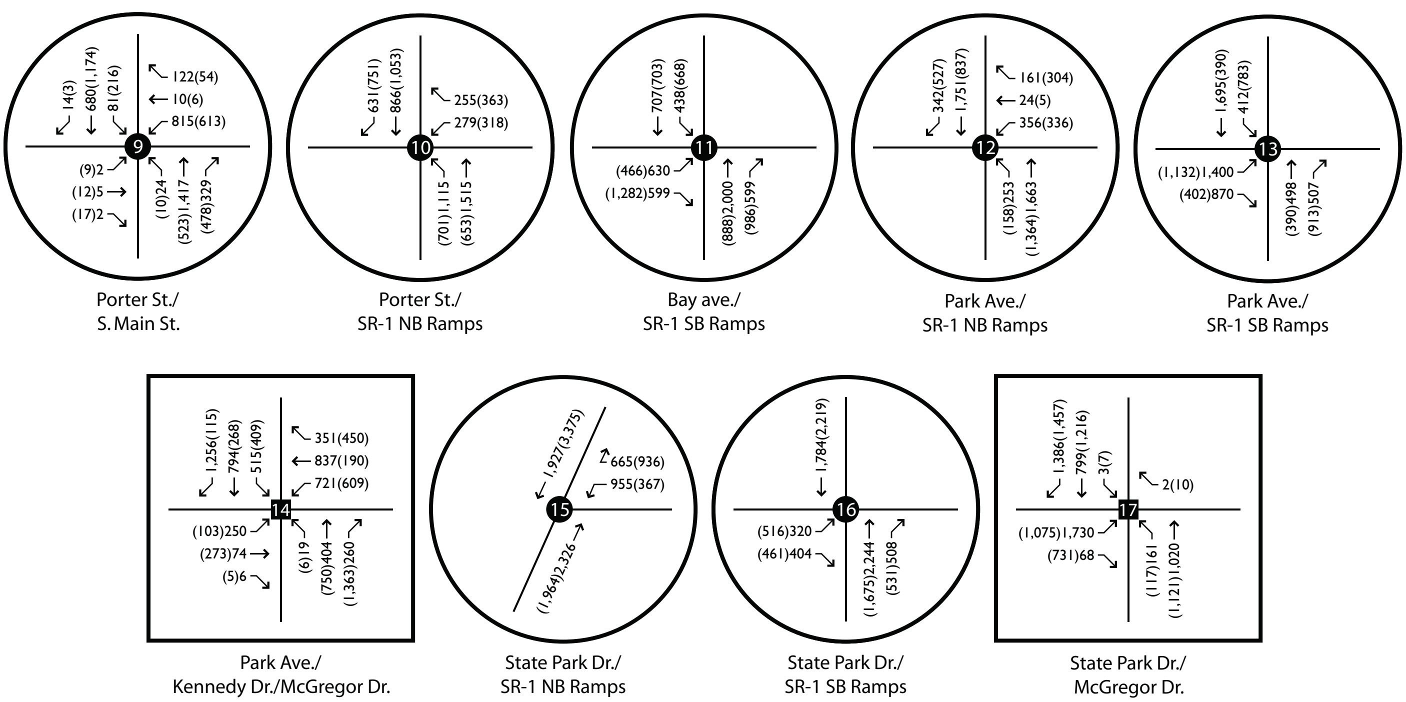

Figure 5-3B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 NO BUILD CONDITIONS

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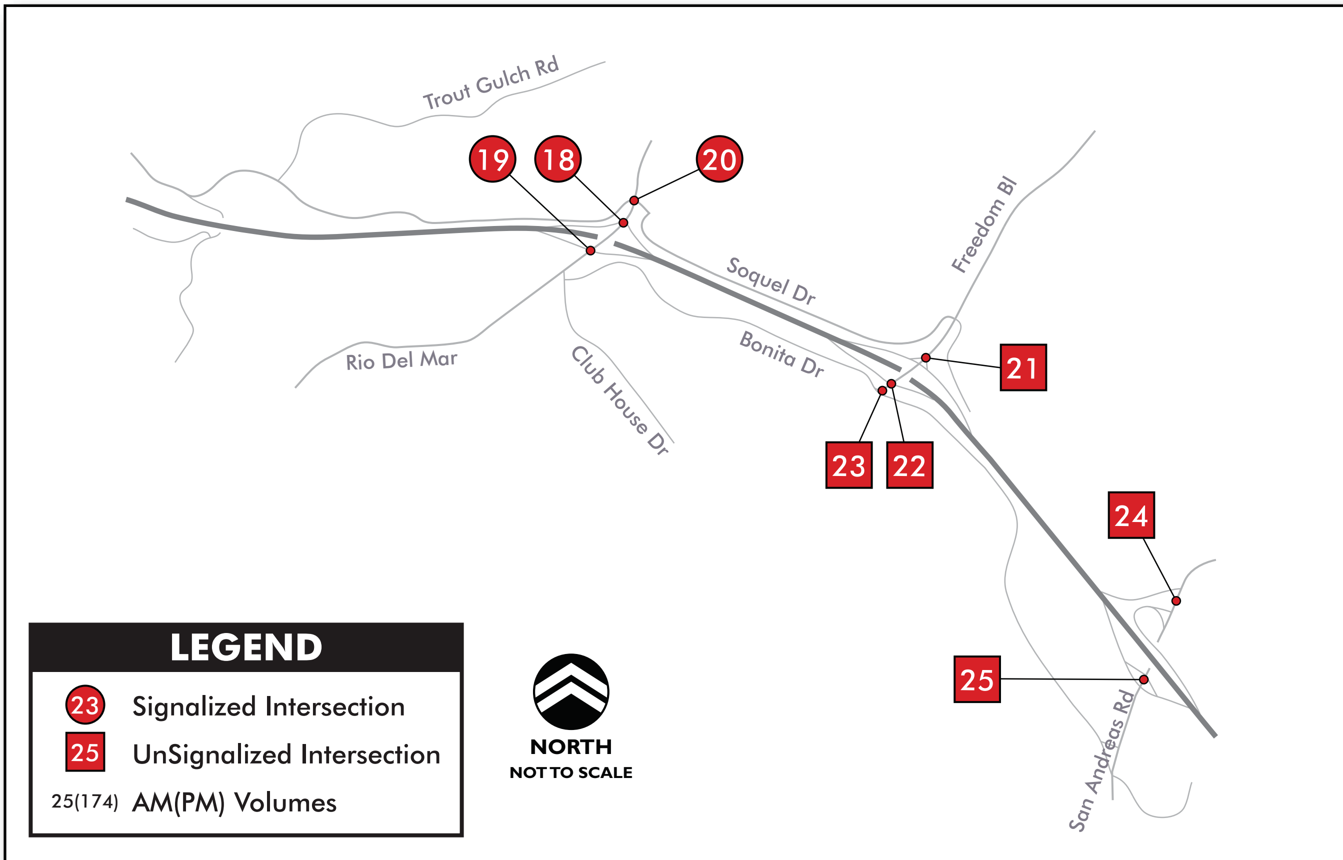

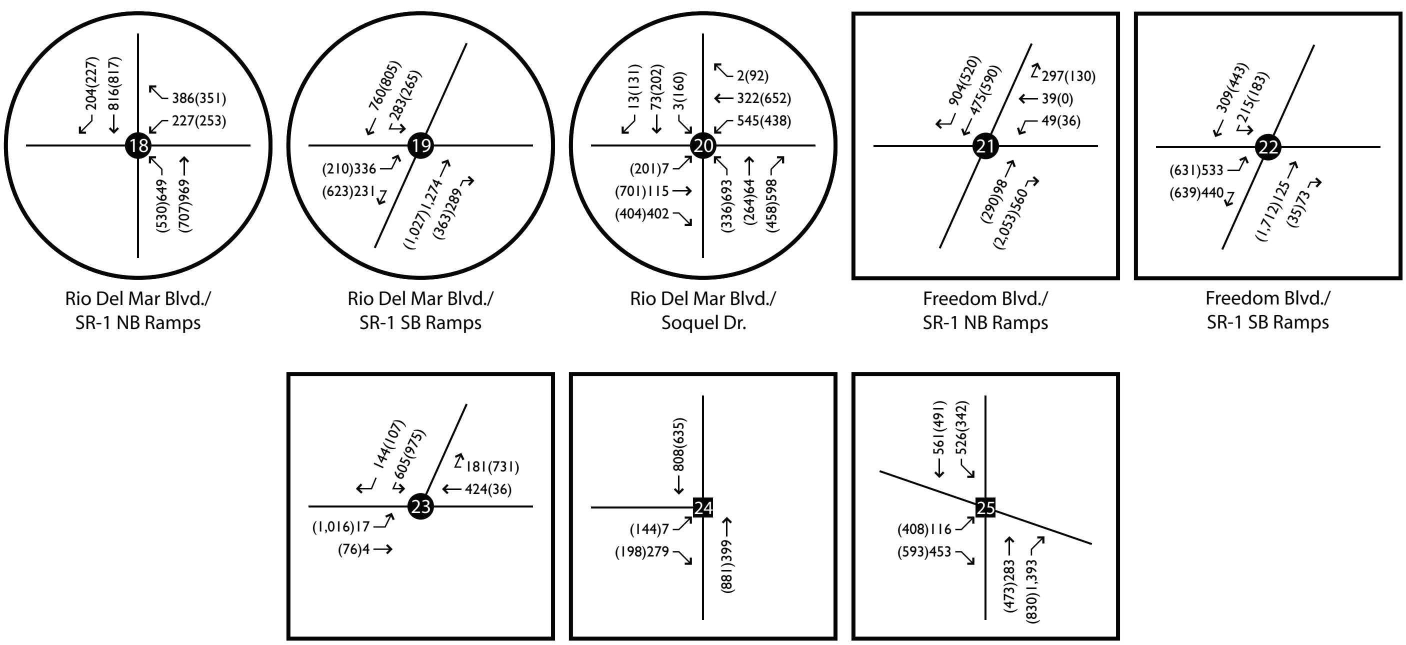

Rio Del Mar Blvd./ SR-1 NB Ramps — Rio Del Mar Blvd./ SR-1 SB Ramps — Rio Del Mar Blvd./ Soquel Dr. — Freedom Blvd./ SR-1 NB Ramps — Freedom Blvd./ SR-1 SB Ramps

Freedom Blvd./ Bonita Dr. — San Andreas Rd./ Larkin Rd./ SR-1 NB Off-Ramp — San Andreas Blvd./ SR-1 SB Ramps

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Figure 5-3C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 NO BUILD CONDITIONS

393070/BASE - 04/02/07

Table 5-2
Intersection LOS Summary – Year 2035 No-Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	City of Santa Cruz	AWSC	**276.4**	**F**	**171.2**	**F**
2	Rooney St./ SR-1 NB Ramps	Caltrans	TWSC	**839.7** (NB)	**F**	**189.8** (NB)	**F**
3	Fairmount Ave./ SR-1 SB Ramps	Caltrans	AWSC	**732.3**	**F**	**455.2**	**F**
4	Morrissey Blvd./ Fairmount Ave.	Caltrans	Signal	**316.9**	**F**	**237.1**	**F**
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	**132.0**	**F**	**202.0**	**F**
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	**208.9**	**F**	**148.1**	**F**
7	41st Ave./ SR-1 NB Off-Ramp	Caltrans	Signal	**58.1**	**E**	**82.9**	**F**
8	41st Ave./ SR-1 SB Ramps	Caltrans	Signal	**56.7**	**E**	**111.2**	**F**
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	**88.6**	**F**	**37.4**	**D**
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	**193.8**	**F**	**143.2**	**F**
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	**426.2**	**F**	**298.5**	**F**
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	**312.8**	**F**	**93.9**	**F**
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	**383.2**	**F**	**269.7**	**F**
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	AWSC	**>1000**	**F**	**>1000**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	**387.8**	**F**	**147.3**	**F**
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	**288.9**	**F**	**260.3**	**F**
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	**740.3**	**F**	**313.6**	**F**
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	**>1000**	**F**	**157.0**	**F**

Table 5-2
Intersection LOS Summary – Year 2035 No-Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	**298.7**	**F**	**495.1**	**F**
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	TWSC	**>1000** (NWB)	**E**	**>1000** (NWB)	**F**
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	AWSC	**99.7**	**F**	**603.8**	**F**
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
24	San Andreas Rd./ Larkin Rd./ SR-1 NB Off-Ramp	Caltrans	TWSC	**73.6** (EB)	**F**	**691.0** (EB)	**F**
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	TWSC	**>1000** (SEB)	**F**	**>1000** (SEB)	**F**

Source: Wilbur Smith Associates, July 2007

NOTES:
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

5.2 YEAR 2035 HOV BUILD ALTERNATIVE ANALYSIS

5.2.1 Proposed Improvements and Network Assumptions

This alternative analyzed future traffic performance on State Route 1 with the addition of HOV lanes, ramp metering (as part of Caltrans's long-term plan for the corridor), as well as various auxiliary lanes and interchange improvements. Based on the discussed improvements identified at the Project Development Team (PDT) meetings held on March 16, 2006 and on June 12, 2006, 12 preliminary scenarios for the northbound direction and 13 scenarios for the southbound direction were considered, which are described as follows:

SR-1 Northbound Geometric Scenarios

- Scenario 1 – The base "Build" proposed geometries (refer to *Appendix A* for the base alternative lane line diagrams)
- Scenario 2 – Scenario 1 with the addition of an auxiliary lane between Freedom Boulevard on-ramp and Rio Del Mar Boulevard off-ramp
- Scenario 3 – Scenario 1 with the addition of an auxiliary lane between Rio Del Mar Boulevard on-ramp and State Park Road off-ramp
- Scenario 4 – Scenario 1 with the extension of the proposed HOV lane to terminate at Branciforte Avenue
- Scenario 5 – Scenario 1 with improvements proposed in Scenarios 2 and 3
- Scenario 6 – Scenario 1 with improvements proposed in Scenarios 2 and 4
- Scenario 7 – Scenario 1 with improvements proposed in Scenarios 2, 3, and 4
- Scenario 8 – Scenario 7 without the auxiliary lane between State Park Road on-ramp and Park Avenue off-ramp
- Scenario 9 – Scenario 1 with improvements proposed in Scenarios 2 and 4, and the addition of a 300-meter acceleration lane at Rio Del Mar Boulevard on-ramp
- Scenario 10 – Scenario 9 without the auxiliary lane between State Park Road on-ramp and Park Avenue off-ramp
- Scenario 11 – Scenario 8 with the addition of a 300-meter acceleration lane at State Park Road on-ramp and a 300-meter deceleration lane at Park Avenue off-ramp
- Scenario 12 – Scenario 11 without the auxiliary lane between 41st Avenue on-ramp and Soquel Road off-ramp

SR-1 Southbound Geometric Scenarios

- Scenario 1 – The original "Build" proposed geometries (refer to *Appendix A* for the base alternative lane line diagrams)
- Scenario 2 – Scenario 1 without the proposed auxiliary lane between Freedom Boulevard on-ramp and Larkin Valley Road off-ramp
- Scenario 3 – Scenario 1 with the addition of an auxiliary lane between State Park Road on-ramp and Rio Del Mar Boulevard off-ramp
- Scenario 4 – Scenario 1 with the addition of an auxiliary lane between Soquel Avenue on-ramp and 41st Avenue off-ramp
- Scenario 5 – Scenario 1 with improvements proposed in Scenarios 3 and 4
- Scenario 6 – Scenario 1 with changes proposed in Scenarios 2 and 3
- Scenario 7 – Scenario 1 with changes proposed in Scenarios 2, 3, and 4

- Scenario 8 – Scenario 7 without the auxiliary lane between Park Avenue on-ramp and State Park Road off-ramp
- Scenario 9 – Scenario 1 with the improvements proposed in Scenarios 2 and 4, and the addition of a 300-meter deceleration lane at Rio Del Mar Boulevard off-ramp
- Scenario 10 – Scenario 9 without the auxiliary lane between Park Avenue on-ramp and State Park Road off-ramp
- Scenario 11 – Scenario 9 with the addition of a 300-meter acceleration lane at Park Avenue on-ramp and a 300-meter deceleration lane at State Park Road off-ramp
- Scenario 12 – Scenario 11 without the auxiliary lane between Soquel Avenue on-ramp and 41st Avenue off-ramp
- Scenario 13 – Scenario 7 without the auxiliary lane between Rio Del Mar Boulevard on-ramp and Freedom Boulevard off-ramp

In a technical memorandum dated August 25, 2006 (shown in *Appendix A-7*), the project team analyzed the performance benefits resulting from the various geometric alternatives and selected the final northbound and southbound geometric configurations for the Year 2035 HOV Build scenario to perform a detailed simulation analysis. Scenario 11 was selected for the northbound direction, while Scenario 7 was selected for the southbound direction. Northbound Scenario 11 and southbound Scenario 7 were chosen since they require slightly less new construction, right-of-way acquisition, and pavement area compared to the other scenarios, while providing comparable operational conditions. The State Route 1 lane line diagram under Year 2035 HOV Build Conditions is shown in *Figure 5-4*, while the freeway and ramp volumes for the Year 2035 HOV Build scenario are presented in *Figures 5-5A and 5-5B* during AM and PM peak periods, respectively.

Using the Year 2035 HOV Build scenario geometric configurations, traffic simulation analysis was performed with the help of the *FREQ* software package. The results of the Year 2035 HOV Build scenario traffic analysis are summarized in *Table 5-3*, while the *FREQ* output is exhibited in *Appendix E-3*.

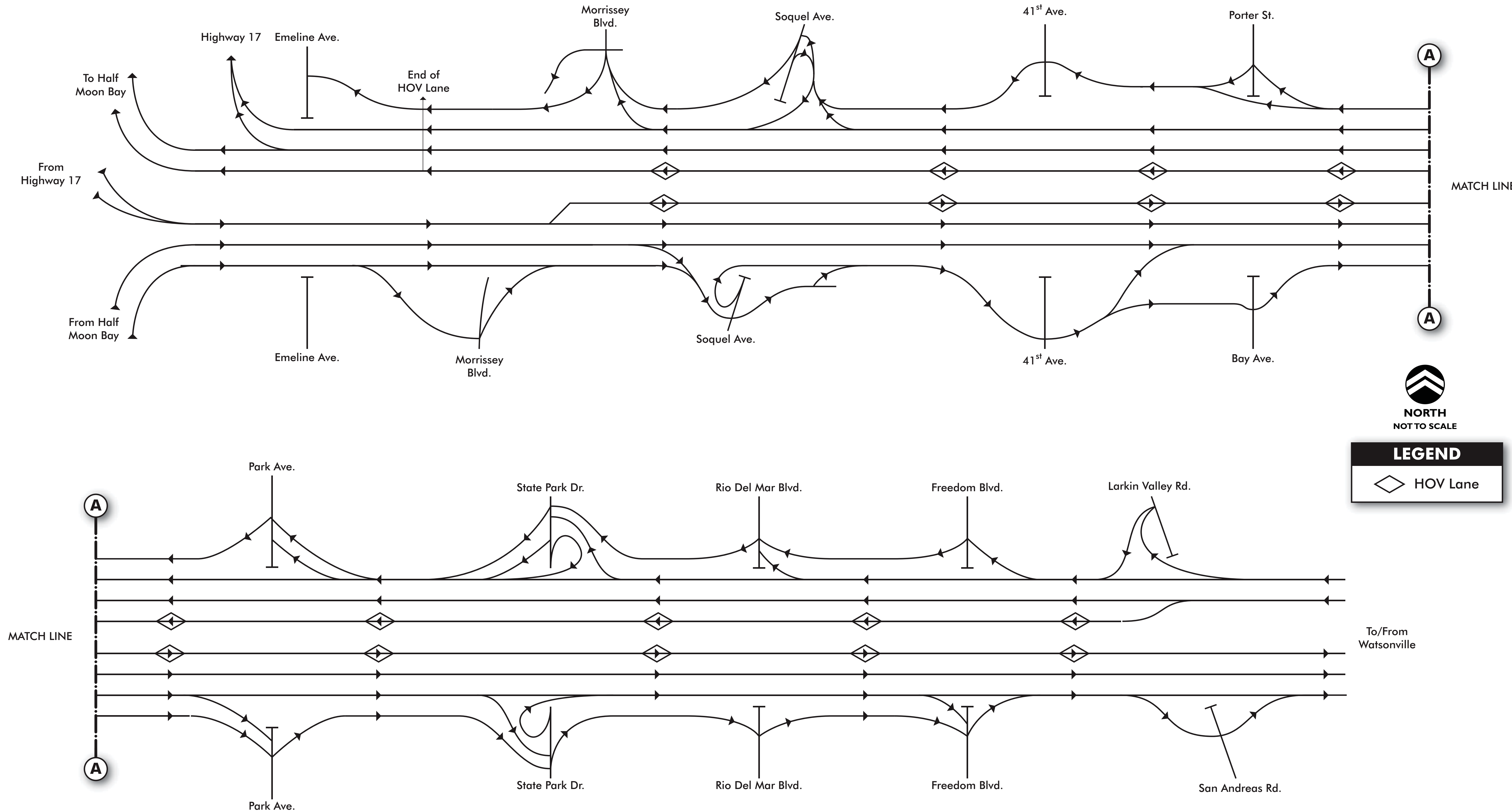

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Figure 5-4
STATE ROUTE 1 LANE LINE DIAGRAM
YEAR 2035 HOV BUILD CONDITIONS
393070/HWY BASE - 04/09/07

NORTH
NOT TO SCALE

LEGEND

- HOV Lane
- ### Volumes During timeperiod 6-7:00 AM
- ### Volumes During timeperiod 7-8:00 AM
- ### Volumes During timeperiod 8-9:00 AM
- ### Volumes During timeperiod 9-10:00 AM
- ✳ Indicates 41st Ave. and Bay Ave. SB On-Ramp Volumes

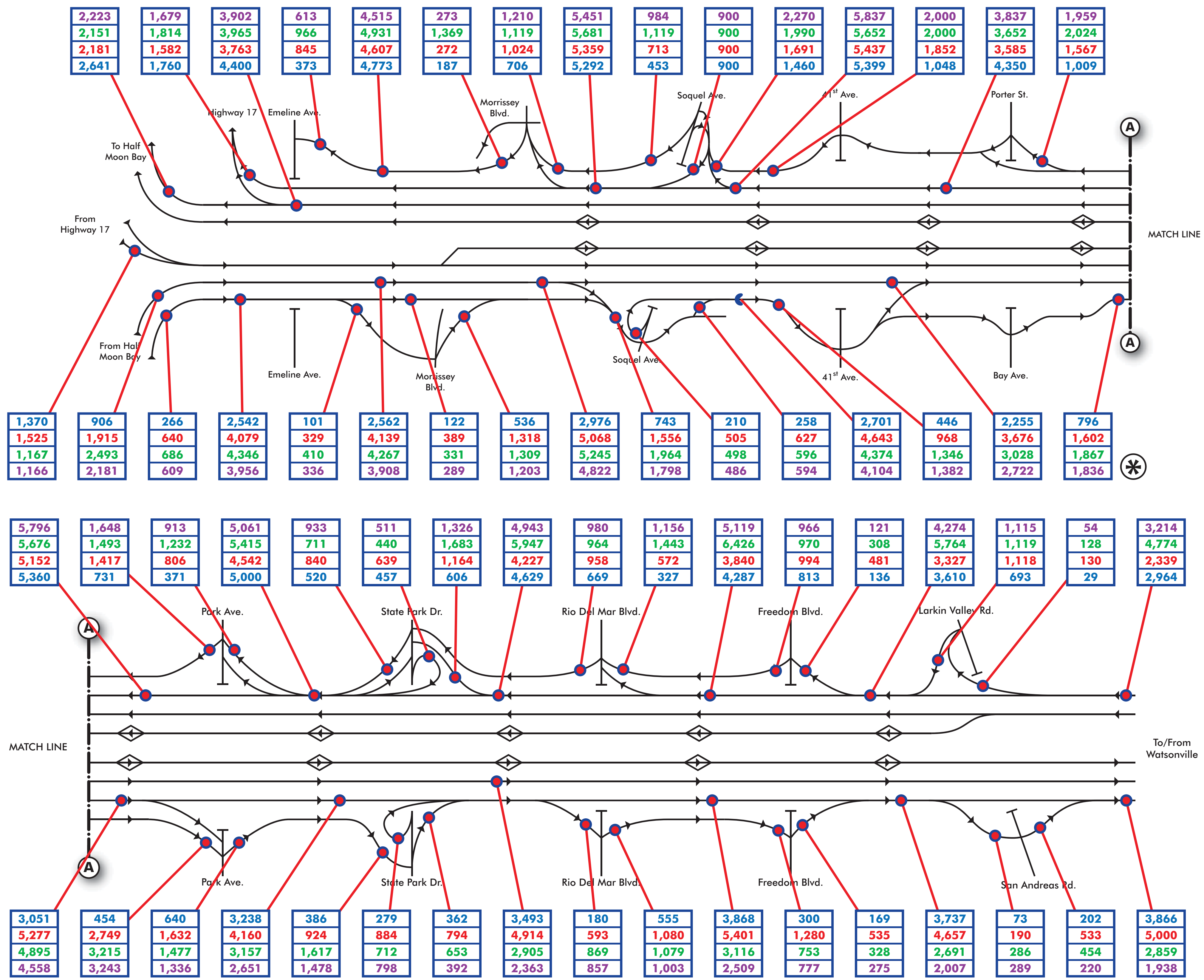
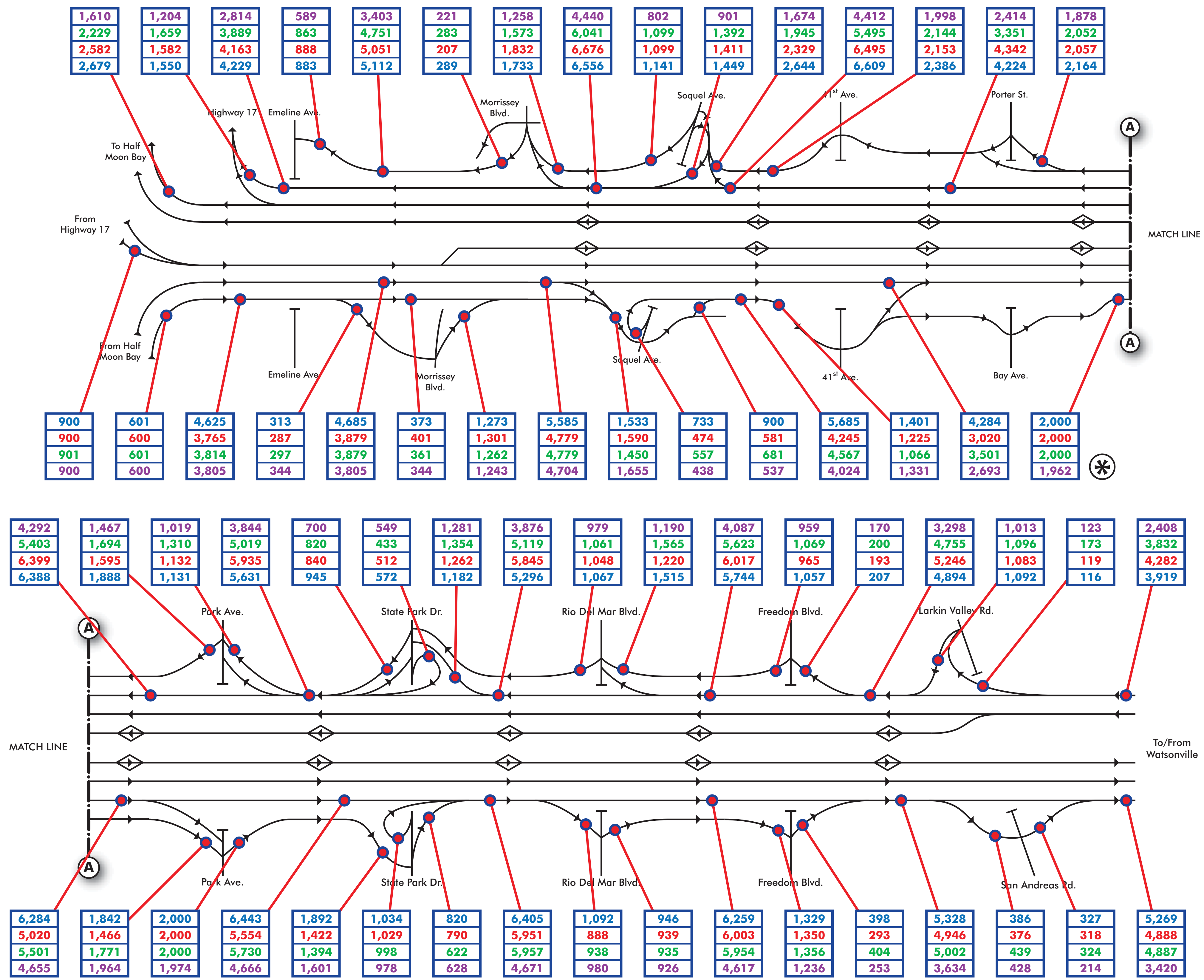


Figure 5-5A
STATE ROUTE 1FREEWAY AND RAMP VOLUMES
YEAR 2035 BUILD HOV CONDITIONS (AM PEAK)



NORTH
NOT TO SCALE

LEGEND

- ◇ HOV Lane
- ### Volumes During timeperiod 3-4:00 PM
- ### Volumes During timeperiod 4-5:00 PM
- ### Volumes During timeperiod 5-6:00 PM
- ### Volumes During timeperiod 6-7:00 PM
- ✱ Indicates 41st Ave. and Bay Ave. SB On-Ramp Volumes

Figure 5-5B

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2035 BUILD HOV SCENARIO (PM PEAK)

393070/FWY-RAMP - 04/02/07

Table 5-3
Comparison of Measure of Effectiveness - Year 2035 No-Build versus Year 2035 HOV Build Scenarios

Measure of Effectiveness	2035 No-Build AM	2035 No-Build PM	2035 HOV Build AM	2035 HOV Build PM	% Difference AM	% Difference PM
Northbound						
Average Travel Time (minutes)	59 ***39***	34 ***22***	16 ***13***	13 ***11***	-73% ***-67%***	-62% ***-50%***
Average Speed (mph)	12 ***18***	17 ***28***	39 ***46***	42 ***52***	225% ***156%***	147% ***86%***
Delay (minutes per vehicle)	48 ***28***	25 ***12***	6 ***3***	4 ***2***	-88% ***-89%***	-84% ***-83%***
No. of Vehicle Trips (per hour)	2,767 ***3,129***	3,114 ***3,157***	4,510 ***4,213***	4,898 ***4,118***	63% ***35%***	57% ***30%***
No. of Persons Trips (per hour)	3,132 ***3,542***	3,874 ***3,927***	5,742 ***5,271***	6,276 ***5,271***	83% ***49%***	62% ***34%***
Freeway Travel Time (VHT)	2,749 ***2,053***	1,784 ***1,138***	1,285 ***1,025***	1,126 ***773***	-53% ***-50%***	-37% ***-32%***
Travel Distance (VMT)	32,646 ***36,922***	31,138 ***31,568***	50,360 ***47,269***	47,555 ***40,048***	54% ***28%***	53% ***27%***
Avg. Vehicle Occupancy (persons/vehicle)	1.13 ***1.13***	1.24 ***1.24***	1.27 ***1.25***	1.28 ***1.28***	12% ***11%***	3% ***3%***
Density (passenger cars per mile per lane)	115 ***87***	92 ***56***	42 (14) ***34 (12)***	37(20) ***27 (14)***	N.A. ***N.A.***	N.A. ***N.A.***
Level of Service	F ***F***	F ***F***	E (B) ***D (B)***	E (C) ***D (B)***	N.A. ***N.A.***	N.A. ***N.A.***
Southbound						
Average Travel Time (minutes)	29 ***18***	61 ***47***	12 ***10***	19 ***15***	-59% ***-44%***	-69% ***-68%***
Average Speed (mph)	22 ***35***	11 ***15***	52 ***59***	33 ***42***	136% ***69%***	200% ***180%***
Delay (minutes per vehicle)	19 ***8***	49 ***35***	2 ***1***	9 ***5***	-89% ***-88%***	-82% ***-86%***
No. of Vehicle Trips (per hour)	3,101 ***2,968***	2,475 ***2,696***	4,253 ***3,369***	4,431 ***4,294***	37% ***14%***	79% ***59%***
No. of Persons Trips (per hour)	3,597 ***3,443***	2,911 ***3,168***	5,181 ***4,090***	5,684 ***5,443***	44% ***19%***	95% ***72%***
Freeway Travel Time (VHT)	1,498 ***884***	2,523 ***2,101***	834 ***584***	1,502 ***1,144***	-44% ***-34%***	-40% ***-46%***
Travel Distance (VMT)	32,248 ***30,863***	28,956 ***31,544***	43,081 ***34,179***	49,038 ***47,692***	34% ***11%***	69% ***51%***
Avg. Vehicle Occupancy (persons/vehicle)	1.16 ***1.16***	1.18 ***1.18***	1.22 ***1.21***	1.28 ***1.27***	5% ***5%***	9% ***8%***
Density (passenger cars per mile per lane)	70 ***42***	113 ***90***	29(11) ***20 (8)***	37(19 ***35 (13)***	N.A. ***N.A.***	N.A. ***N.A.***
Level of Service	F ***E***	F ***F***	D (A) ***C (A)***	E (B) ***E (B)***	N.A. ***N.A.***	N.A. ***N.A.***

Source: Wilbur Smith Associates, February 2007

NOTES:
28 (10) – Density of mixed-flow lanes (Density of HOV lane)
D (A) – LOS of mixed-flow lanes (LOS of HOV lane)
Non-italicized and non-bold values represent peak hour values.
Bold italicized values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

5.2.2 Vehicle Throughput

Adding HOV lanes, ramp metering, and auxiliary lanes is expected to improve the ability of State Route 1 to meet future travel demand within the study area. During the peak hours, vehicle throughput would increase by 63 percent in the northbound direction during the AM peak hour and 79 percent in the southbound direction during the PM peak hour. The improved corridor conditions would draw vehicles traveling on parallel arterials onto State Route 1, relieving the local city streets from excessive cut-through commuter traffic.

Person-mobility in the southbound direction during the PM peak hour would almost double from 2,911 to 5,684 persons per hour and in the northbound direction, during AM peak hour, person trips would increase by 83 percent, from 3,132 to 5,742 persons per hour. The simulation results show that the addition of the HOV lane would encourage commuters to carpool, increasing the average vehicle occupancy (AVO) in the corridor by 8 and 12 percent for the commute directions (northbound direction in the morning and southbound direction in the evening). The reverse commute directions would also experience increases in AVO but by a smaller margin of 3 to 5 percent. Since less congestion is expected on mixed-flow lanes in the reverse commute directions, commuters would be less compelled to carpool.

5.2.3 Delays and Densities

Compared to the Year 2035 No-Build scenario, the Year 2035 HOV Build alternative would reduce delays along the State Route 1 corridor. Vehicle delays are expected to decrease by 42 minutes (88 percent) in the northbound direction during the AM peak hour and by 40 minutes (82 percent) in the southbound direction during the PM peak hour. Similarly, the traffic density in the northbound direction during AM peak hour would improve from 115 pcpmpl (LOS F) to 42 pcpmpl (LOS E) on the mixed-flow lanes and 14 pcpmpl (LOS B) on the HOV lanes. Likewise, traffic density in the southbound direction during PM peak hour would improve from 113 pcpmpl (LOS F) to 37 pcpmpl (LOS E) on the mixed-flow lanes and 19 pcpmpl (LOS B) on the HOV lanes. Overall traffic performance would improve from LOS F to as high as LOS D for the mixed-flow lanes, and as high as LOS A for the HOV lanes.

While major LOS improvements are observed on the HOV facilities, density comparisons showed that the mixed-flow lanes would also improve, reducing vehicle density by approximately 50 percent. However, due to the extent of congestion before the addition of the HOV lanes (discussed in the Year 2035 No-Build section); the improved densities would still result in LOS E or LOS F. Nonetheless, the main goal of the HOV Lane Widening project is to improve person-mobility, and as the results show, person-mobility is expected to improve under the Year 2035 HOV Build scenario.

5.2.4 Travel Speed and Travel Time

The addition of the HOV lane and other geometric improvements would result in substantial traffic performance improvements, especially on the HOV lanes. Even during peak hours, the vehicles on the HOV lanes would operate at or near free-flow speed. Carpool Commuters traveling at speeds as low as 11 mph under the Year 2035 No-Build Conditions would be able to travel at free-flow speed (approximately 60 mph) on the HOV lanes. Overall (combining both

HOV lane and mixed-flow lane speeds), State Route 1 would operate between 33 and 52 mph, depending on time period and direction. Average travel times would also improve by a factor ranging from 50 to 73 percent, depending on the direction of travel and the peak period. For the northbound direction during the AM peak hour and in the southbound direction during the PM peak hour, the aggregate travel times would improve by 73 percent and 69 percent, respectively.

5.2.5 Proposed Future Interchange Layout and Intersection Improvements

To improve the operating conditions of the study interchanges and to increase mobility of traffic flow to and from the freeway mainlines, the geometric layout of the following four interchanges under Year 2035 HOV Build Conditions are proposed to be modified:

- Morrissey Boulevard Interchange
- Soquel Avenue Interchange
- 41st Street and Porter Street/Bay Avenue Interchanges
- Larkin Valley Road/San Andreas Road Interchange

A detailed description of the proposed interchange geometric configurations is presented below.

Morrissey Boulevard Interchange

The following three (3) alternatives were analyzed for the Morrissey Boulevard interchange:

- Alternative 1 – Geometric configuration would remain the same as under Existing Conditions

- Alternative 2 – This alternative would include the following modifications to the existing Morrissey Boulevard interchange:
    1. Realign southbound off-ramp so that it intersects Morrissey Boulevard instead of Fairmount Avenue.
    2. Remove the existing southbound on-ramp from Fairmount Avenue and realign the southbound on-ramp from Morrissey Boulevard so that it aligns with the proposed southbound off-ramp.
    3. Create two different intersections of Morrissey Boulevard/Rooney Street and Morrissey Boulevard/Pacheco Avenue/SR-1 Northbound Ramps.
    4. Signalize the three intersections Morrissey Boulevard/Pacheco Avenue. SR-1 Northbound Ramps, Morrissey Boulevard/Rooney Street, and Morrissey Boulevard/SR-1 Southbound Ramps.

- Alternative 3 – This alternative would include the following modifications to the existing Morrissey Boulevard interchange:
    1. Realign southbound off-ramp so that it intersects Morrissey Boulevard instead of Fairmount Avenue.
    2. Remove the existing southbound on-ramp from Fairmount Avenue and realign the southbound on-ramp from Morrissey Boulevard so that it aligns with the proposed southbound off-ramp.

3. Construct a roundabout to serve Morrissey Boulevard, Rooney Street, Pacheco Avenue, and SR-1 northbound ramps.

Alternative 3 is similar to Alternative 2, except that a roundabout was proposed to accommodate the intersecting traffic north of the overcrossing. Based on the traffic analysis, it was identified that the roundabout did not have sufficient capacity to accommodate the expected traffic. Alternative 1 resulted in long queues at the off-ramps and poor operating conditions (LOS F) of the study intersections. Of the three alternatives, Alternative 2 provided the best results in terms of intersection operations and 95th percentile queue lengths at the ramps. Therefore, Alternative 2 has been selected as the future geometric configuration of the Morrissey Boulevard interchange. *Figure 5-6A* presents the proposed geometric layout of the Morrissey Boulevard interchange (Alternative 2) under HOV Build Conditions.

Soquel Avenue Interchange

The following seven (7) plans (A through G) were analyzed for the Soquel Avenue interchange:

- Plan A – This plan includes the following modifications to the existing Soquel Avenue interchange:
  1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
  2. Realign southbound on-ramp so as to directly connect Soquel Drive north of the intersection Soquel Drive/Soquel Avenue. This ramp would serve the vehicles traveling northbound on Soquel Drive.
  3. Construct another southbound on-ramp (loop ramp) north of the intersection Soquel Drive/Soquel Avenue. This ramp would serve vehicles traveling southbound on Soquel Drive.
  4. Install a stop-sign on the Commercial Way approach at the intersection Northbound Off-Ramp/Commercial Way.

- Plan B – This plan includes the following modifications to the existing Soquel Avenue interchange:
  1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
  2. Realign southbound on-ramp so as to directly connect Soquel Drive at the intersection Soquel Drive/ Soquel Avenue. This ramp would be a loop ramp forming the west leg of the intersection Soquel Drive/Soquel Avenue. This ramp would serve all the vehicles traveling along Soquel Drive.
  3. Construct a connector between the intersections of Soquel Drive/Northbound Off-Ramp and Old Soquel Drive/Paul Sweet Road/Northbound On-Ramp. The connector would only serve vehicles going to and from Paul Sweet Road and vehicles going to the northbound on-ramp. Vehicles accessing the northbound on-ramp would pass through the intersection Old Soquel Drive/Paul Sweet Road/ Northbound On-Ramp.

- Plan C – This plan includes the following modifications to the existing Soquel Avenue interchange:
    1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
    2. Realign southbound on-ramp to directly connect Soquel Drive at the intersection Soquel Drive/Soquel Avenue. This ramp would be a loop ramp forming the west leg of the intersection Soquel Drive/Soquel Avenue. This ramp would serve all the vehicles traveling along Soquel Drive.
    3. Construct a one-way connector between intersections Soquel Drive/northbound off-ramp and Old Soquel Drive/Paul Sweet Road/northbound on-ramp. The connector would only serve vehicles going to Paul Sweet Road and northbound on-ramp.
    4. Construct a direct slip-ramp from the connector to the northbound on-ramp. Vehicles accessing northbound on-ramp would not pass through the intersection Old Soquel Drive/Paul Sweet Road/northbound on-ramp.

- Plan D – This plan includes the following modifications to the existing Soquel Avenue interchange:
    1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
    2. Realign southbound on-ramp so as to directly connect Soquel Drive north of the intersection Soquel Drive/Soquel Avenue. This ramp would serve the vehicles traveling northbound on Soquel Drive.
    3. Construct another southbound on-ramp (loop ramp) north of the intersection Soquel Drive/Soquel Avenue. This ramp would serve vehicles traveling southbound on Soquel Drive.
    4. Cul-de-sac Commercial Way before the intersection northbound off-ramp/ Commercial Way. Redirect vehicles traveling along Commercial Way to access Soquel Drive using Commercial Crossing.

- Plan E – This plan includes the following modifications to the existing Soquel Avenue interchange:
    1. Realign southbound off-ramp to directly intersect Soquel Drive north of the intersection Soquel Drive/Soquel Avenue.
    2. Realign southbound on-ramp so as to directly connect Soquel Drive at the intersection Soquel Drive/southbound off-ramp. This ramp would be in alignment with the southbound off-ramp and would serve all the vehicles traveling along Soquel Drive.
    3. Cul-de-sac Commercial Way before the intersection northbound off-ramp/ Commercial Way. Redirect vehicles traveling along Commercial Way to access Soquel Drive using Commercial Crossing.

- Plan F – This plan includes the following modifications to the existing Soquel Avenue interchange:

1. Realign southbound off-ramp to directly intersect Soquel Drive so that it is in alignment with Soquel Avenue.
2. Construct another southbound loop on-ramp to directly connect Soquel Drive north of the intersection Soquel Drive/southbound off-ramp/Soquel Avenue. This ramp would serve the vehicles traveling southbound on Soquel Drive. The existing southbound hook ramp off Soquel Avenue would serve all the vehicles traveling northbound on Soquel Drive and along Soquel Avenue.
3. Cul-de-sac Commercial Way before the intersection northbound off-ramp/ Commercial Way. Redirect vehicles traveling along Commercial Way to access Soquel Drive using Commercial Crossing.

- Plan G – This plan proposes construction of a Single Point Urban Interchange (SPUI) to replace the existing Soquel Avenue interchange. This alternative includes the following modifications to the existing Soquel Avenue Interchange:
    1. Realign the southbound as well as northbound on and off-ramps to intersect at the same location on Soquel Drive.
    2. Cul-de-sac Commercial Way before the intersection northbound off-ramp/ Commercial Way. Redirect vehicles traveling along Commercial Way to access Soquel Drive using Commercial Crossing.

The *Soquel Avenue Interchange Alternatives* technical memorandum, dated January 16, 2007, describes Plans A through E and is exhibited in *Appendix A-3*. The *Soquel Avenue Interchange – Traffic Operational Analysis* technical memorandum, dated March 20, 2007, provides a comparison between the traffic operations of Plans F and G, and is included in *Appendix A-5*.

Based on the results provided in these two technical memorandums, of the seven (7) plans analyzed, Plans F and G provided the best intersections operations and 95th percentile queue lengths of the ramps. The Soquel Avenue interchange would operate relatively at the same level of service under both plans; however, Plan F is expected to provide slightly better operations than Plan G. In addition, Plan F would cause fewer impacts to the wetlands and is less costly than Plan G to construct. Therefore, Plan F was selected as the future geometric configuration for the Soquel Avenue interchange. *Figure 5-6B* presents the proposed geometric layout of the Soquel Avenue interchange (Plan F) under HOV Build Conditions. This plan adds an additional study intersection to the analysis: Soquel Drive/Soquel Avenue/SR-1 Southbound Off-Ramp.

41st Avenue and Porter Street/Bay Avenue Interchanges

The following three (3) different alternatives were analyzed for the 41st Avenue and Porter Street/Bay Avenue interchanges:

- Alternative 1 – This alternative would combine 41st Avenue and Porter Street/Bay Avenue interchanges using Collector-Distribution (C-D) road. The main characteristics of this alternative are:
    1. The C-D road would be connected to SR-1 and the on as well as off-ramps of 41st Avenue and Porter Street/Bay Avenue interchanges would be connected to this C-D road instead of to SR-1 directly.

2. The C-D road would be constructed in the northbound as well as the southbound directions.

- Alternative 2 – This alternative would combine 41st Avenue and Porter Street/Bay Avenue interchanges using shared ramps. The main characteristics of this alternative are:
  1. 41st Avenue and Porter Street/Bay Avenue interchanges are connected to SR-1 using shared off- and on-ramps.
  2. The shared ramps would be constructed in the northbound as well as the southbound directions. There will be only one off-ramp diverge location and one on-ramp merge location in both the northbound and southbound directions.
  3. In the northbound direction, vehicles from Porter Street/Bay Avenue interchange would travel through the intersection 41st Avenue/SR-1 Northbound Ramps to access State Route 1.
  4. In the southbound direction, vehicles exiting from State Route 1 would travel through the intersection 41st Avenue/SR-1 Southbound Ramps to access Porter Street/Bay Avenue interchange.

- Alternative 3 – This alternative would combine 41st Avenue and Porter Street/Bay Avenue interchanges using shared ramps. The main characteristics of this alternative are:
  1. 41st Avenue and Porter Street/Bay Avenue interchanges are connected to SR-1 using shared off- and on-ramps.
  2. The shared ramps would be constructed in the northbound as well as the southbound directions. In the northbound direction, there will be only one off-ramp diverge location and one on-ramp merge location. Also, a slip ramp would be constructed for the 41st Avenue northbound off-ramp vehicles to bypass Porter Street interchange. In the southbound direction, there will be one off-ramp diverge location and two separate on-ramp merge locations for 41st Avenue southbound on-ramp and Bay Avenue southbound on-ramp.
  3. In the southbound direction, the traffic from the 41st Avenue interchange would merge directly with the mainline traffic; whereas, the traffic from the Porter Street/Bay Avenue interchange would initially enter the proposed auxiliary lane between Porter Street/Bay Avenue and Park Avenue interchanges and then weave to merge with the mainline traffic.
  4. In the northbound direction, vehicles from Porter Street/Bay Avenue interchange would travel through the intersection 41st Avenue/SR-1 Northbound Ramps to access State Route 1.
  5. In the southbound direction, vehicles exiting from State Route 1 would travel through the intersection 41st Avenue/SR-1 Southbound Ramps to access Porter Street/Bay Avenue interchange.

The results from the traffic operational analysis indicate that Alternatives 2 and 3 provided the best results in terms of intersections operations and 95th percentile queue lengths at the ramps. However, Alternative 3 provided better queuing results (shorter 95th percentile queue lengths) on 41st Avenue and Porter Street/Bay Avenue southbound on-ramps. As such, Alternative 3 was selected as the future geometric configuration for the 41st Avenue and Porter Street/Bay Avenue interchange layout. *Figure 5-6C* presents the proposed geometric configuration of the 41st Avenue and Porter Street/Bay Avenue interchange under HOV Build Conditions.

Larkin Valley Road/San Andreas Road Interchange

The following modifications are proposed at the Larkin Valley Road/San Andreas Road interchange to improve traffic operating conditions of the Larkin Valley Road/SR-1 Northbound On-Ramp and Larkin Valley Road/SR-1 Northbound Off-Ramp intersections:

- Realign northbound off-ramp to connect Larkin Valley Road at the intersection Larkin Valley Road/SR-1 Northbound On-Ramp. This ramp would form the eastbound approach of this intersection. Thus, in the HOV Build Conditions, there would be only one intersection--Larkin Valley Road/SR-1 Northbound Ramps, instead of two intersections--Larkin Valley Road/SR-1 Northbound Off-Ramp and Larkin Valley Road/ SR-1 Northbound On-Ramp.
- Signalize the intersection Larkin Valley Road/SR-1 Northbound Ramps.

Figure 5-6H presents the proposed geometric configuration of the Larkin Valley Road/San Andreas Road interchange under HOV Build Conditions.

Proposed Intersection Improvements

To improve the traffic operating conditions, the following nine study intersections would be signalized under the HOV Build Conditions:

- Morrissey Boulevard/Rooney Street
- Morrissey Boulevard/Pacheco Avenue/SR-1 Northbound Ramps
- Park Avenue/Kennedy Drive/McGregor Drive
- State Park Road/McGregor Drive
- Freedom Boulevard/SR-1 Northbound Ramps
- Freedom Boulevard/SR-1 Southbound Ramps
- Freedom Boulevard/Bonita Drive
- San Andreas Road/Larkin Valley Road/SR-1 Northbound Ramps
- San Andreas Road/SR-1 Southbound Ramps

Traffic signal warrant analysis results for these nine study intersections under Year 2035 Conditions are provided in *Appendix B-1*. Figure 4C-103 (CA) from the *California Manual of Uniform Traffic Control Devices (MUTCD)* was used to perform signal warrant analysis for these intersections. Vehicles per day on the major and minor street approaches were estimated by applying a factor of 10 to the peak hour traffic for Year 2035.

In addition, the geometric configurations at some of the study intersections would be modified to improve their operations (LOS value, delay value, and 95^{th} percentile queue lengths of the ramps) under HOV Build Conditions. *Table 5-4* summarizes the proposed future geometric configurations of the study intersections, while *Figures 5-6A to 5-6H* present the future geometric layouts of the study interchanges and intersections. Technical memorandum *Interchange Configurations Summary*, dated January 23, 2007 (shown in *Appendix A-4*), compiles the proposed future geometric configurations of the all study interchanges except Soquel Avenue interchange, which is shown in *Figure 5-6B*.

Based on the proposed modifications to the intersection configurations, the updated intersections geometric configurations are exhibited in *Figures 5-7A, 5-7B, and 5-7C*.

Table 5-4
Summary of Interchange Configurations – HOV Build Conditions

Intersection	Control	Northbound			Southbound			Eastbound			Westbound		
		L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R
Morrissey Blvd./Pacheco Ave./NB ramps	Signal												
Number of Lanes		2 / 0	0 / 0	1 / 0		0 / 1		1 / 0	1 / 0	0 / 1	1 / 0		1 / 0
Storage Length (feet)								250 / 0			300 / 0		
Morrissey Blvd./Rooney St.	Signal												
Number of Lanes		1 / 0	2 / 0			1 / 0	1 / 0	1 / 1[/A/]					
Storage Length (feet)		200 / 0						300 / 0					
Morrissey Blvd./SB ramps	Signal												
Number of Lanes			1 / 0	0 / 2	1 / 0	2 / 0		1 / 0		0 / 1			
Storage Length (feet)					250 / 0			200 / 0					
Morrissey Blvd./Fairmont Ave.	Signal												
Number of Lanes		1 / 0	2 / 0	1 / 0	1 / 0	2 / 0	1 / 0	2 / 0		1 / 0	1 / 0		1 / 0
Storage Length (feet)		300 / 0			150 / 0			400 / 0			200 / 0		
Soquel Dr./Paul Sweet Rd./NB ramps	Signal												
Number of Lanes		1 / 0	2 / 0	0 / 1		2 / 0	0 / 2	1 / 0		0 / 1	2 / 0		1 / 1
Storage Length (feet)		150 / 0					0 / 400			0 / 400	250[/B/] / 0		0 / 300
Soquel Ave./SB on-ramp	Signal												
Number of Lanes								1 / 0	1 / 0			1 / 0	0 / 1
Storage Length (feet)													0 / 300
Soquel Dr./Soquel Ave./SB off-ramp	Signal												
Number of Lanes			2 / 0	0 / 1	2 / 0	2 / 0		3 / 0	1 / 0	1 / 0	1 / 0		0 / 1
Storage Length (feet)				0 / 400	300 / 0			350[/C/] / 0					
41st Ave./NB ramps	Signal												
Number of Lanes		2 / 0	2 / 0			2 / 0	0 / 1				2 / 0	2 / 0	0 / 1
Storage Length (feet)		400 / 0					0 / 120				500 / 0		0 / 500
41st Ave./SB ramps	Signal												
Number of Lanes			2 / 0	0 / 2	1 / 0	3 / 0		1 / 1	1 / 0	0 / 2			
Storage Length (feet)					300 / 0			370 / 0		0 / 370			
Porter St./Main St.	Signal												
Number of Lanes		1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0		0 / 1		1 / 0	0 / 1	
Storage Length (feet)		75 / 0			300 / 0						500 / 0		
Porter St./NB ramps	Signal												
Number of Lanes		1 / 0	2 / 0			1 / 0	1 / 0				2[/B/] / 0		0 / 1
Storage Length (feet)											200 / 0		0 / 400

Table 5-4
Summary of Interchange Configurations – HOV Build Conditions

Intersection	Control	Northbound			Southbound			Eastbound			Westbound		
		L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R	L / LT	T / LTR	TR / R
Porter St./SB ramps	Signal												
Number of Lanes			2 / 0	0 / 1	1 / 0	2 / 0		1 / 0	0 / 1	0 / 1			
Storage Length (feet)				0 / 300				200 / 0		0 / 200			
Park Ave./NB ramps	Signal												
Number of Lanes		1 / 0	2 / 0			2 / 0	0 / 2				2[/B/] / 0		0 / 2[/B/]
Storage Length (feet)							0 / 400				300 / 0		0 / 300
Park Ave./SB ramps	Signal												
Number of Lanes			2 / 0	0 / 1	1 / 0	2 / 0		2[/B/] / 0		0 / 2[/B/]			
Storage Length (feet)								330 / 0		0 / 400			
Park Ave./Kennedy Dr.	Signal												
Number of Lanes			0 / 1		2[/B/] / 0		1 / 0	1 / 0	0 / 1		1 / 0		1 / 0
Storage Length (feet)					200 / 0			300 / 0			300 / 0		
State Park Dr./NB off-ramp	Signal												
Number of Lanes			2 / 0			3 / 0					1 / 1[/A/]		0 / 1
Storage Length (feet)													0 / 600
State Park Dr./SB ramps	Signal												
Number of Lanes			2 / 0	0 / 1		2 / 0		2[/B/] / 0		0 / 2[/B/]			
Storage Length (feet)								120 / 0		0 / 300			
State Park Dr./Sea Ridge Rd.	Signal												
Number of Lanes		1 / 0	1 / 0	1 / 0	0 / 1		1 / 0	1 / 0	0 / 1			0 / 1	
Storage Length (feet)		200 / 0											
Rio Del Mar Blvd./NB ramps	Signal												
Number of Lanes		1 / 0	2 / 0			2 / 0	0 / 1				1 / 1		0 / 2[/B/]
Storage Length (feet)		165 / 0					0 / 100				400 / 0		0 / 400
Rio Del Mar Blvd./SB ramps	Signal												
Number of Lanes			2 / 0	0 / 1	2 / 0	2 / 0		2[/B/] / 0		0 / 2			
Storage Length (feet)					165 / 0			500 / 0		0 / 200			
Rio Del Mar Blvd./Soquel Ave.	Signal												
Number of Lanes		1 / 1		1 / 0		0 / 1		0 / 1		0 / 1	1 / 0		1 / 0
Storage Length (feet)										0 / 300	400 / 0		
Freedom Rd./NB ramps	Signal												
Number of Lanes		0 / 1	1 / 0			1 / 0	0 / 2[/B/]					0 / 1	0 / 1
Storage Length (feet)							0 / 200						

Table 5-4
Summary of Interchange Configurations – HOV Build Conditions

Intersection	Control	Northbound			Southbound			Eastbound			Westbound		
		L / LT	**T / LTR**	**TR / R**	**L / LT**	**T / LTR**	**TR / R**	**L / LT**	**T / LTR**	**TR / R**	**L / LT**	**T / LTR**	**TR / R**
Freedom Rd./SB ramps	Signal												
Number of Lanes			1 / 0	1 / 0	1 / 0	1 / 0		1 / 1		0 / 1			
Storage Length (feet)								300 / 0		0 / 350			
Freedom Rd./Bonita Dr.	Signal												
Number of Lanes					2 / 0		0 / 1	0 / 1				1 / 0	0 / 1
Storage Length (feet)							0 / 200						0 / 300
Larkin Rd./NB ramps	Signal												
Number of Lanes		1 / 0	1 / 0			1 / 0	0 / 1	1 / 0		0 / 1			
Storage Length (feet)		400 / 0					0 / 300	100 / 0					
San Andreas Rd./SB ramps	Signal												
Number of Lanes			1 / 0	1 / 0	1 / 0	1 / 0		1 / 0		0 / 1			
Storage Length (feet)					200 / 0			300 / 0					

Source: Wilbur Smith Associates, April 2007

NOTES:
/A/ – Represents a shared left turn-right turn lane
/B/ - Only one lane serves as a turn-lane with storage length; remaining lanes serve as whole lanes
/C/ - Only two lanes serve as a turn-lane with storage length; remaining lane serves as a whole lane
L – Left-turn lane, T – Through lane, R – Right-turn lane
LT – Shared through-left turn lane, TR – Shared through-right turn lane, LTR – Shared through-left turn-right turn lane

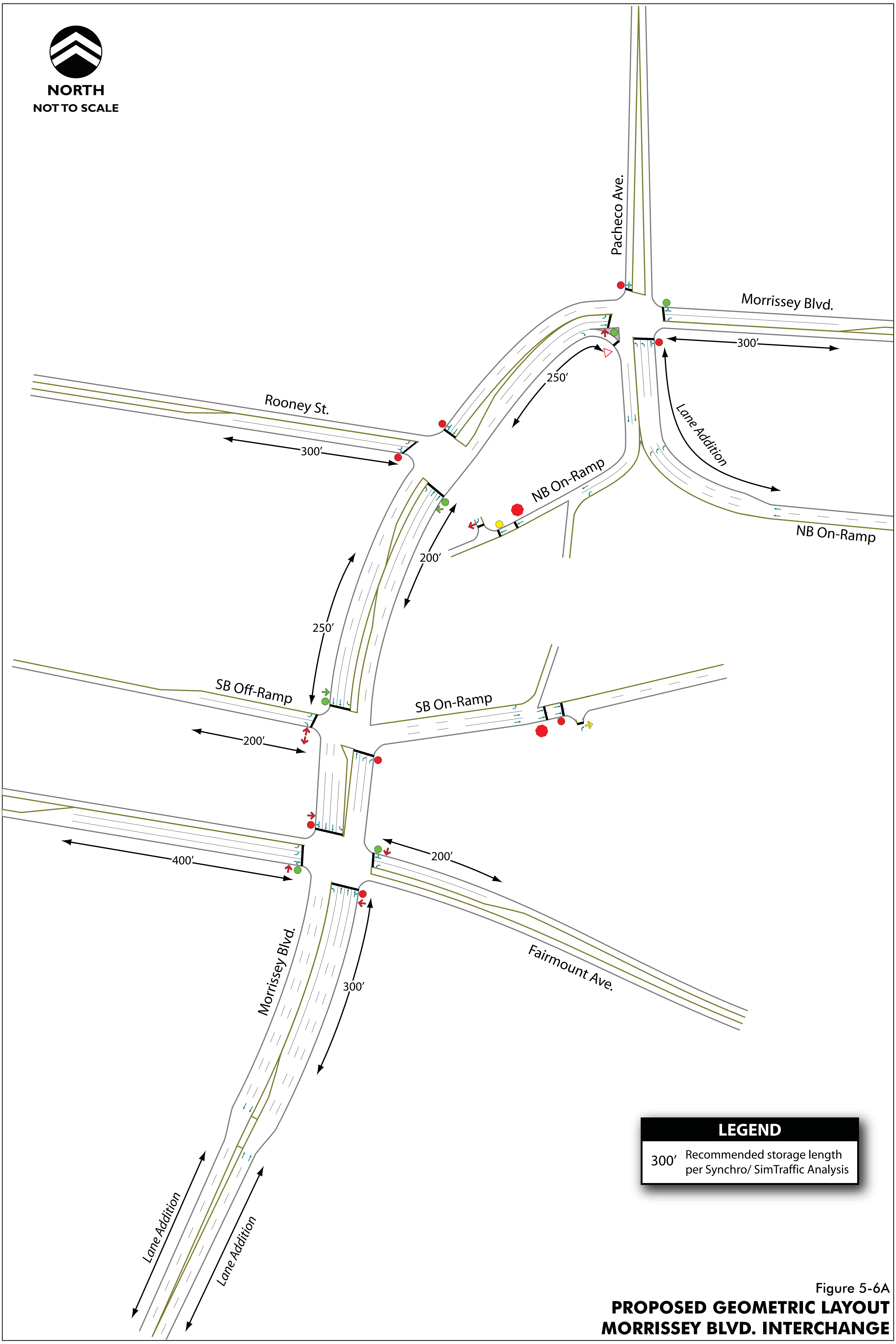


Figure 5-6A
PROPOSED GEOMETRIC LAYOUT
MORRISSEY BLVD. INTERCHANGE

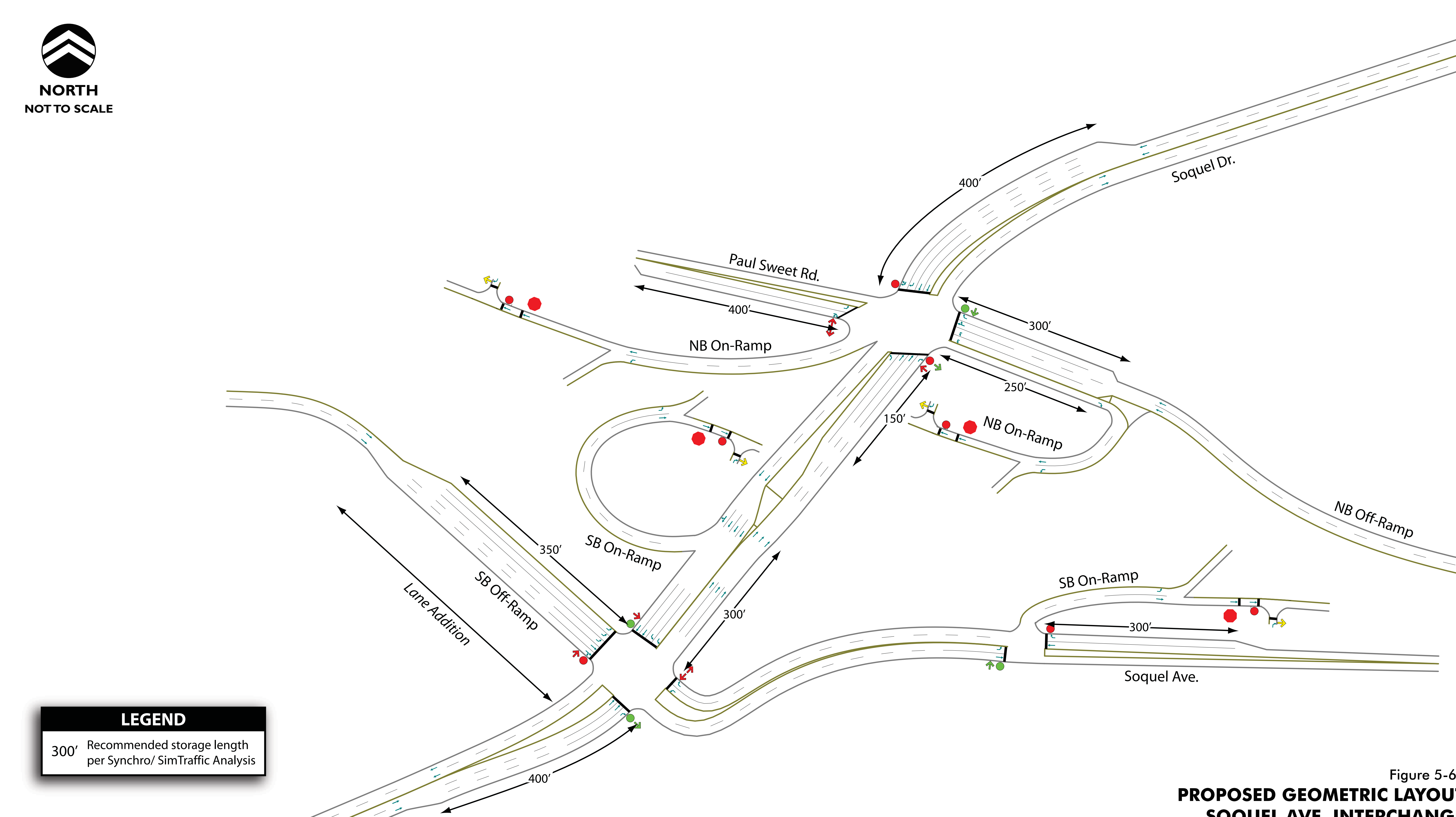


Figure 5-6B
PROPOSED GEOMETRIC LAYOUT
SOQUEL AVE. INTERCHANGE
393070/PDF - 04/05/07

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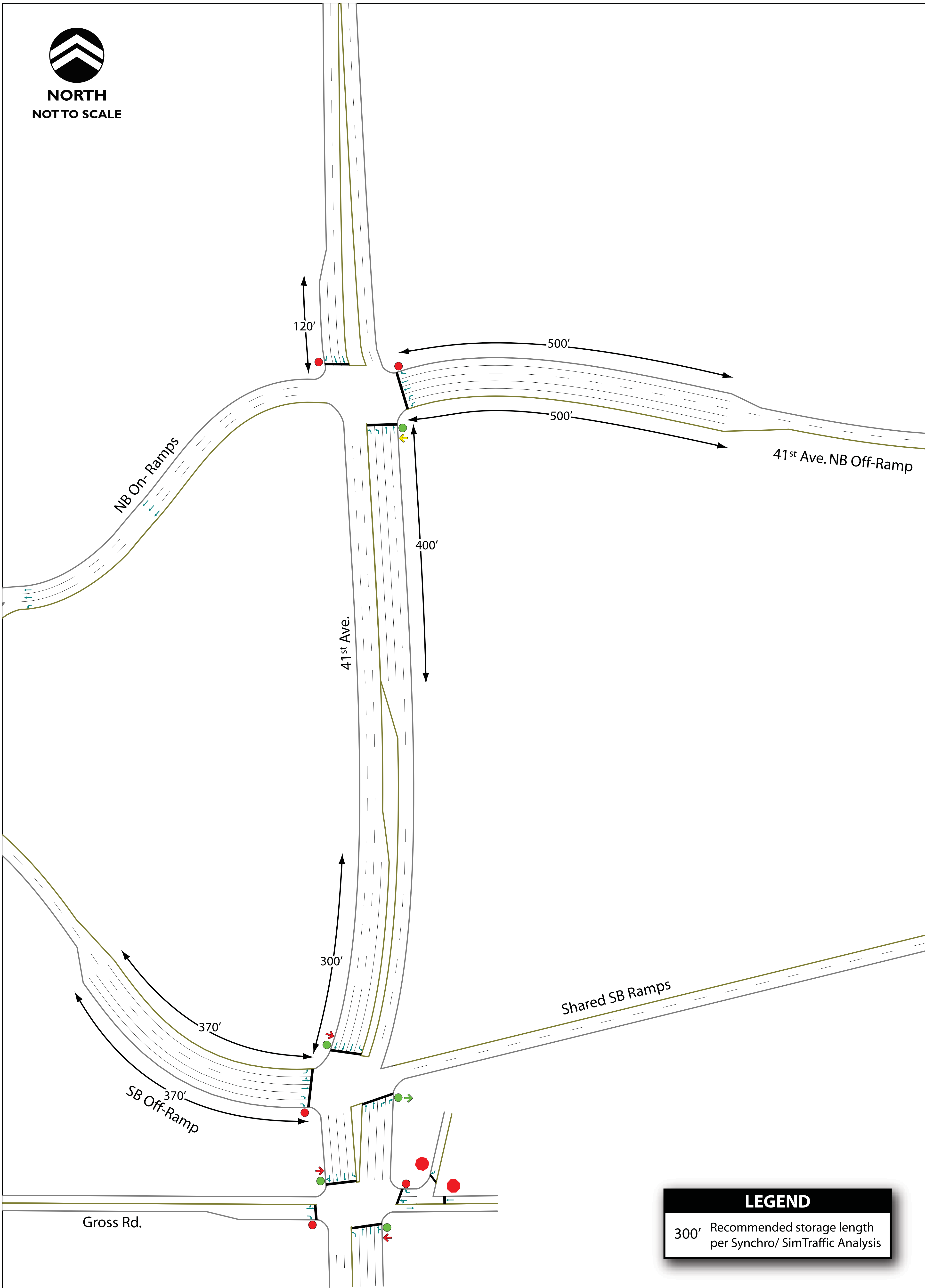

LEGEND

300'	Recommended storage length per Synchro/ SimTraffic Analysis

Figure 5-6C1

PROPOSED GEOMETRIC LAYOUT
41ST AVE. AND PORTER ST. INTERCHANGE

393070/PDF - 04/05/07

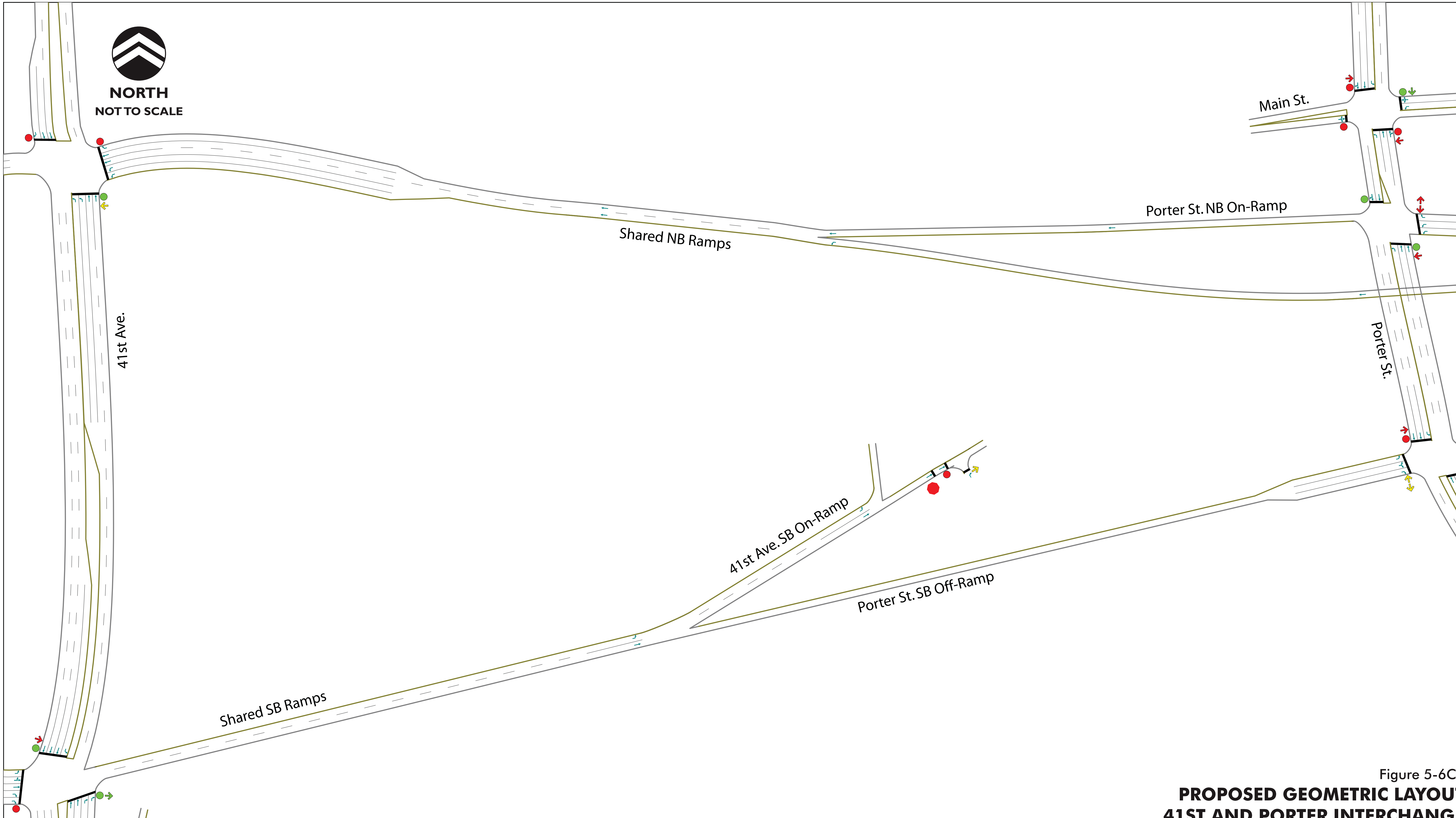

Figure 5-6C2

PROPOSED GEOMETRIC LAYOUT
41ST AND PORTER INTERCHANGE

393070/PDF - 04/05/07

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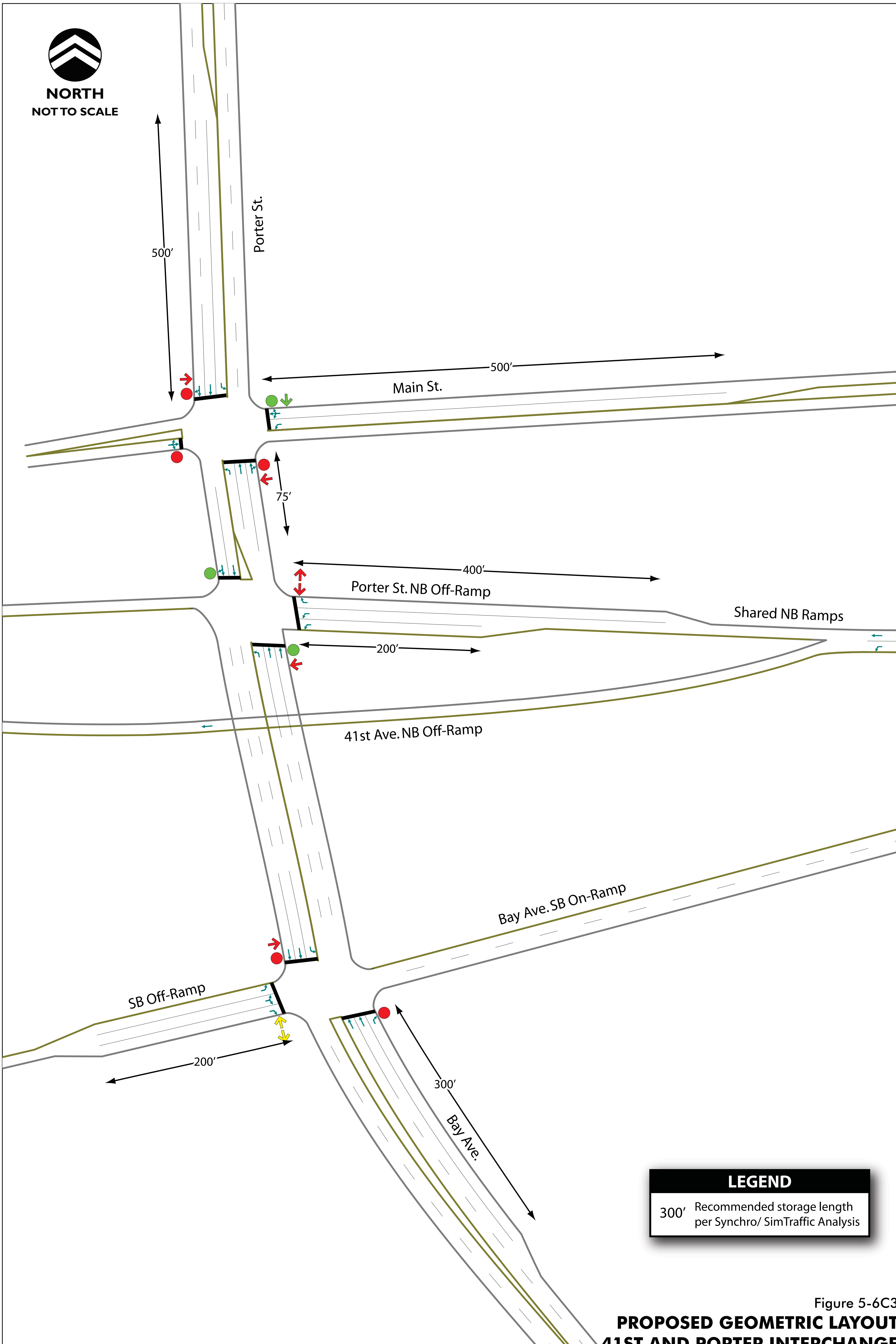

Figure 5-6C3

PROPOSED GEOMETRIC LAYOUT
41ST AND PORTER INTERCHANGE

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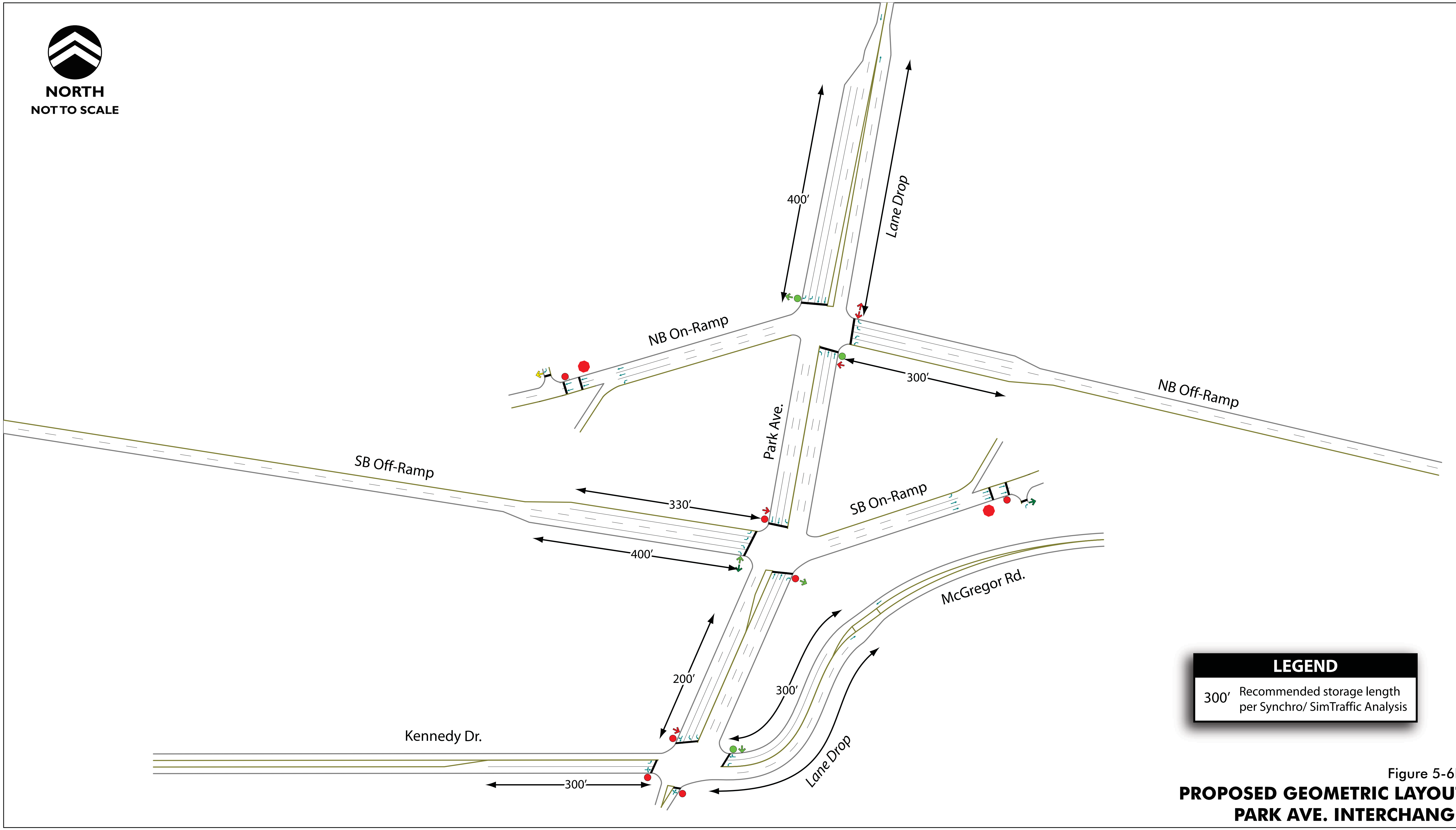

Figure 5-6D
PROPOSED GEOMETRIC LAYOUT
PARK AVE. INTERCHANGE

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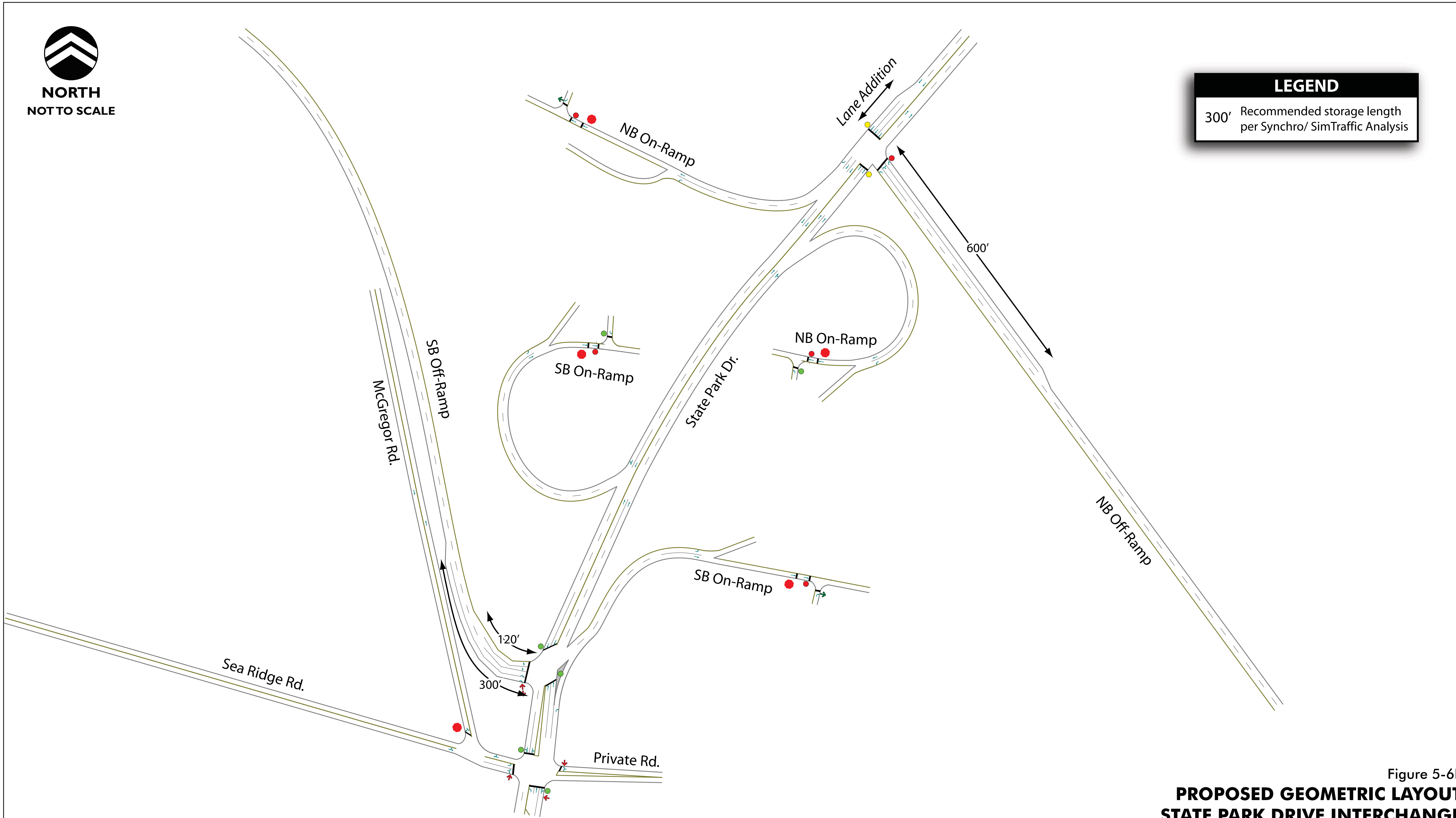

Figure 5-6E
PROPOSED GEOMETRIC LAYOUT
STATE PARK DRIVE INTERCHANGE
393070/PDF - 04/05/07

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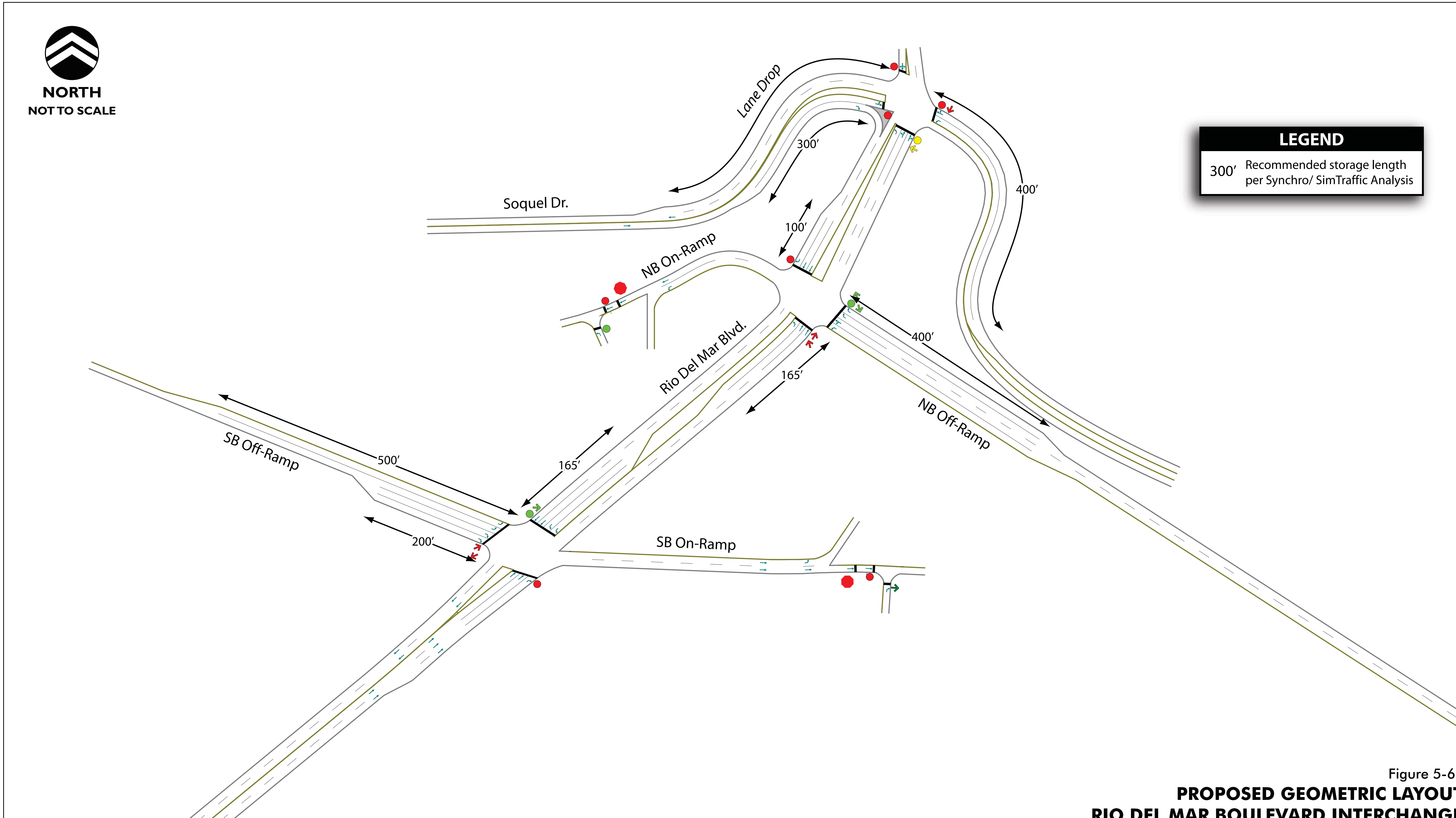

Figure 5-6F
PROPOSED GEOMETRIC LAYOUT
RIO DEL MAR BOULEVARD INTERCHANGE

393070/PDF - 04/05/07

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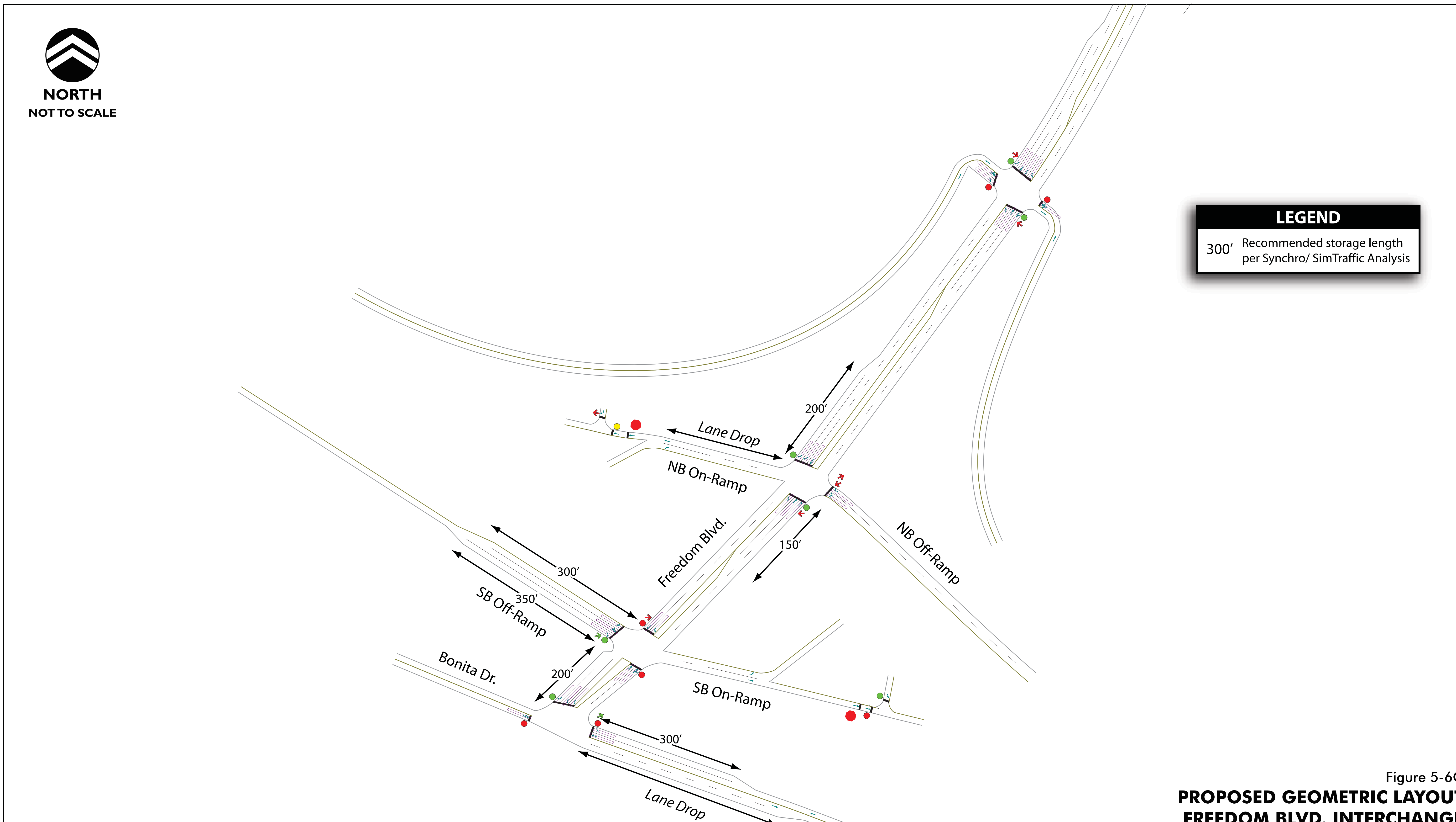

Figure 5-6G
PROPOSED GEOMETRIC LAYOUT
FREEDOM BLVD. INTERCHANGE

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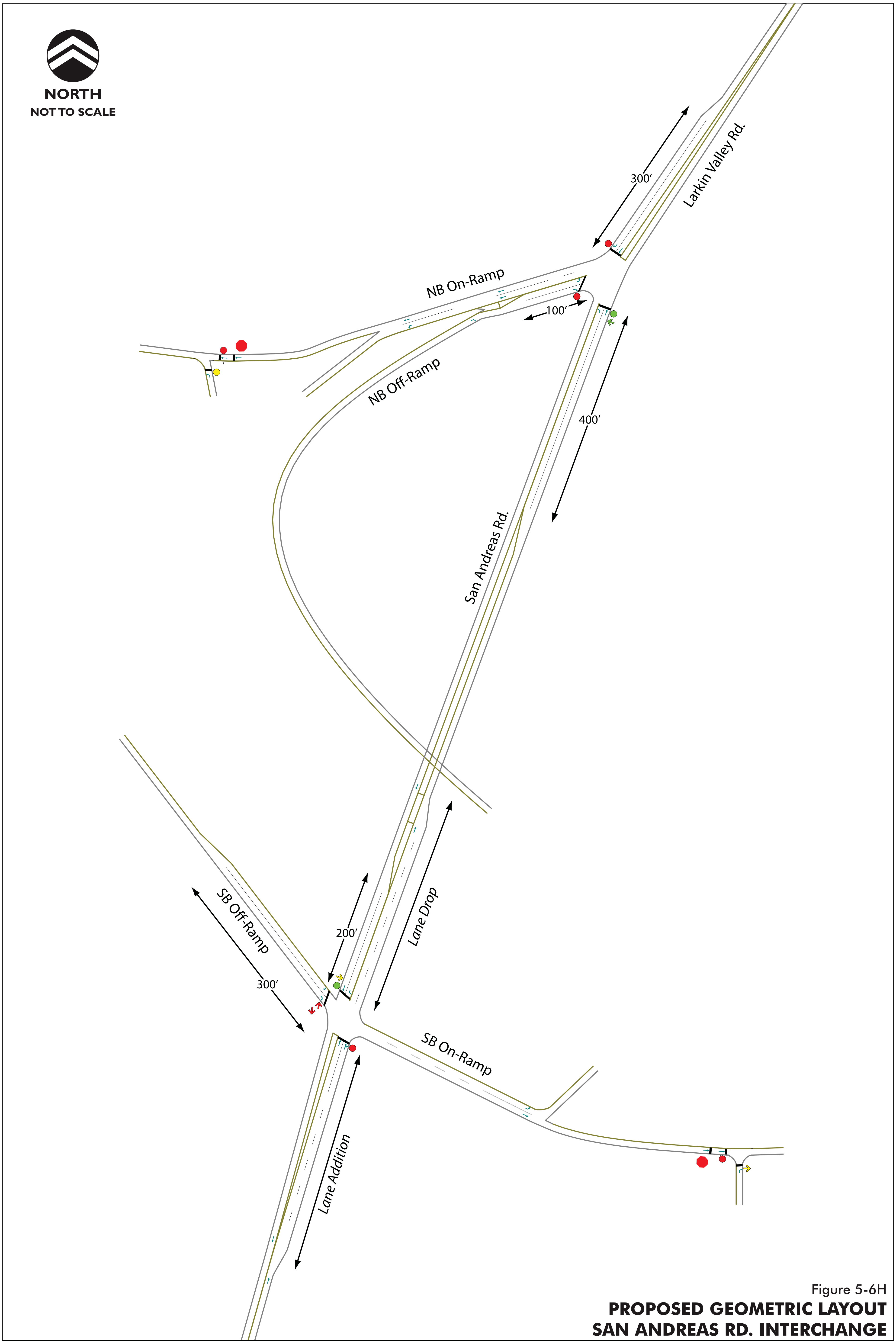
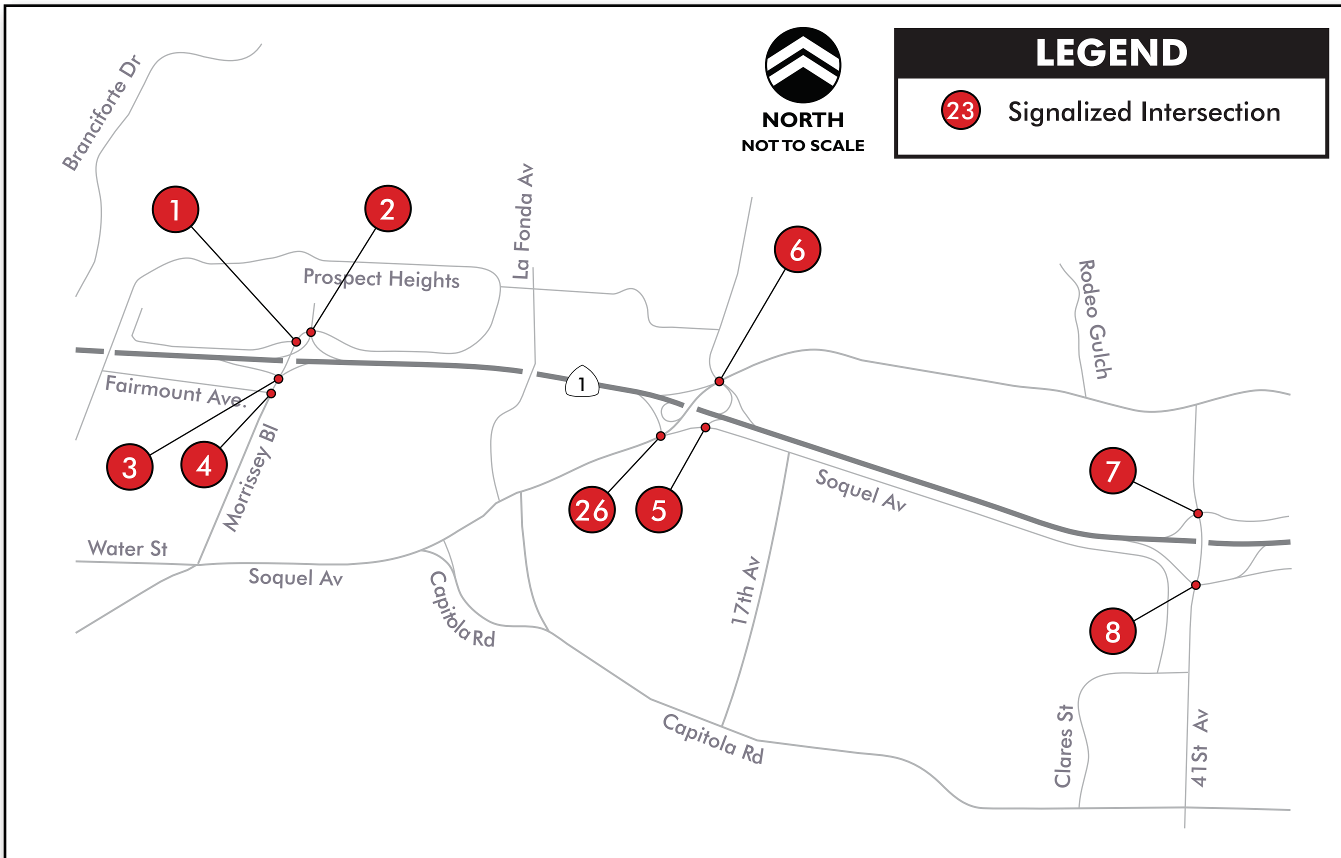
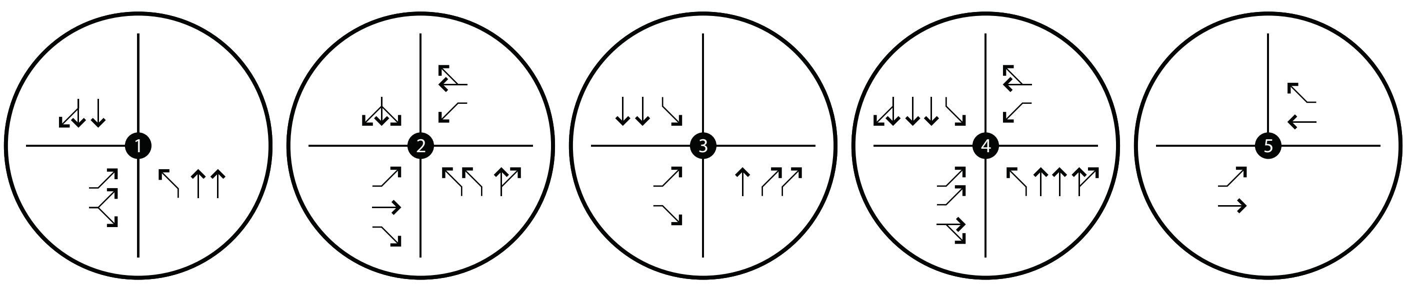


Figure 5-6H

PROPOSED GEOMETRIC LAYOUT
SAN ANDREAS RD. INTERCHANGE

393070/PDF - 04/05/07





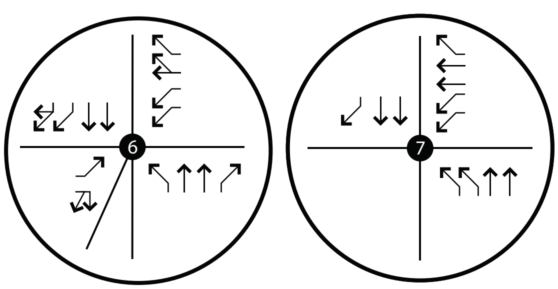
Morrissey Blvd/
Rooney St.

Morrissey Blvd/
Pacheco Ave./SR-1 NB Ramps

Morrissey Blvd/
SR-1 SB Ramps

Morrissey Blvd./
Fairmount Ave.

Soquel Ave./
SR-1 SB On-Ramp



Soquel Dr./
Paul Sweet Rd./SR-1 NB Ramps

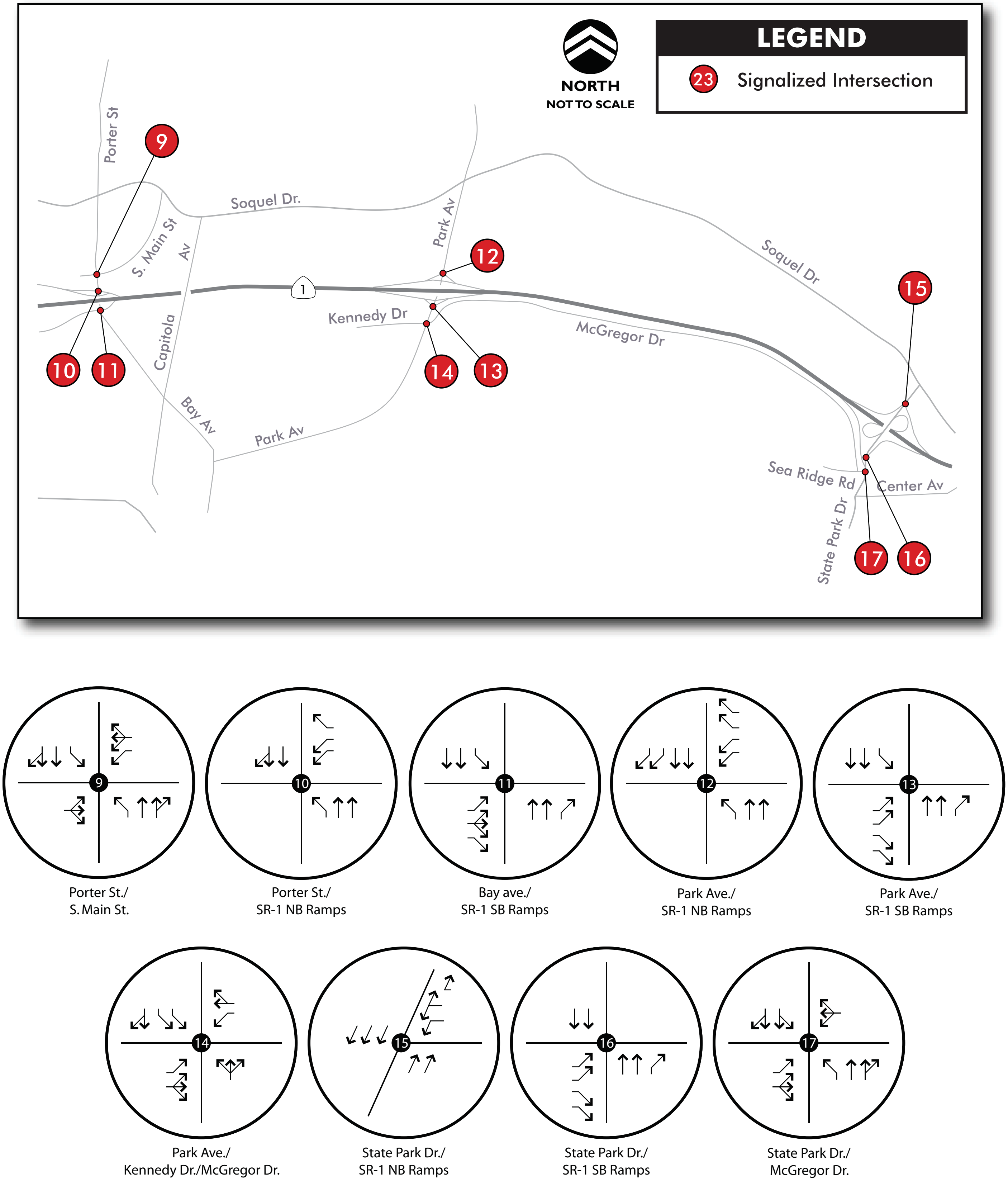
41st Ave./
SR-1 NB Off-Ramp

41st Ave./
SR-1 SB Ramps

ENGINEERS
PLANNERS
ECONOMISTS
WilburSmith
ASSOCIATES

Figure 5-7A
INTERSECTION GEOMETRIC CONFIGURATIONS
YEAR 2035 HOV BUILD CONDITIONS

393070/BASE - 04/02/07



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ECONOMISTS
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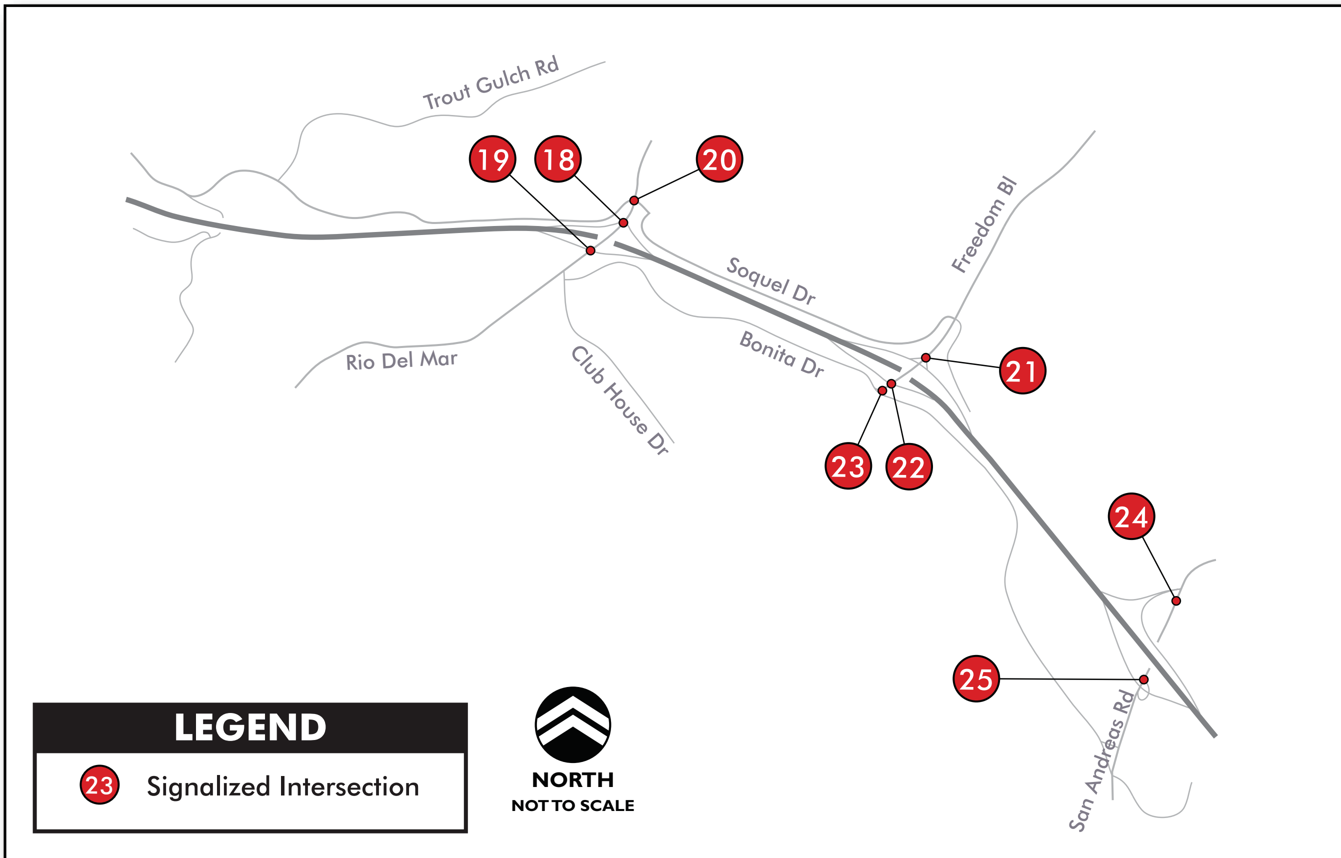
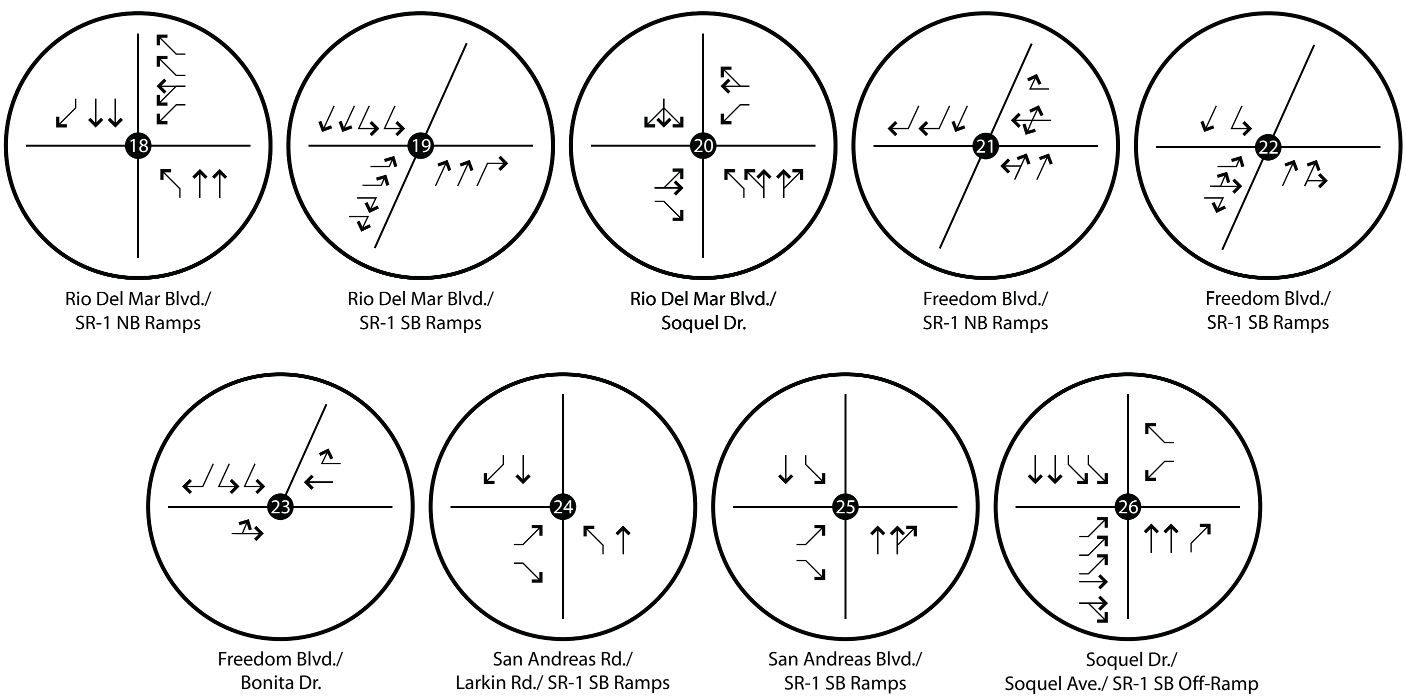
Figure 5-7B
INTERSECTION GEOMETRIC CONFIGURATIONS
YEAR 2035 HOV BUILD CONDITIONS

393070/BASE - 04/02/07





WilburSmith ASSOCIATES
ENGINEERS PLANNERS ECONOMISTS

Figure 5-7C
INTERSECTION GEOMETRIC CONFIGURATIONS
YEAR 2035 HOV BUILD CONDITIONS

393070/BASE - 04/02/07

5.2.6 Intersection Operations Analysis

Peak hour intersection turning movement volumes under Year 2035 HOV Build Conditions were developed by performing the *Furness* process on corresponding roadway segment volumes forecasted by the AMBAG Model and *FREQ* model outputs for the on and off-ramps (described in Chapter 4, Section 4.4). *Figure 5-8* exhibits the intersection turning movement volumes under Year 2035 HOV Build AM and PM peak hours.

Table 5-5 exhibits the study intersection operations, including LOS and average delay values for the Year 2035 HOV Build AM and PM peak hour conditions.

The AMBAG Model assumed major development in the study area under Year 2035 Conditions. Thus, using the methodology described in Chapter 4 *(*Section 4.4*)*, the intersection volumes developed under Year 2035 Conditions from the forecasted traffic volumes indicated significant growths. In discussions with the local governing agencies (including County of Santa Cruz, City of Santa Cruz, and City of Capitola) about the future land use development within the study area, the Project Development Team (PDT) observed that the local governing bodies indicate less development than the AMBAG Model forecasted development. Therefore, the PDT decided to use Year 2015 intersection volumes instead of Year 2035 turning movement volumes to identify the interchange and the intersection improvements for this project (as presented in this report). This methodology would aid in providing the appropriate intersection mitigations and avoid proposing more-than-necessary improvements at the intersections. The local agencies further agreed they would monitor these intersections and, if required, further modify the intersections based on actual experience at each location.

Unlike Year 2035 No-Build Conditions, under Year 2035 HOV Build Conditions, most of the study intersections would not operate at LOS F. Based on the LOS thresholds criteria discussed in Section 3.6, during AM peak hour, 16 of the 25 study intersections would operate under an acceptable level of service (LOS D or better). The following nine study intersections would operate at unacceptable level of service (LOS E or F):

- Soquel Drive/Paul Sweet Road/State Route 1 Northbound Ramps
- 41st Avenue/State Route 1 Northbound Ramps
- Park Avenue/State Route 1 Northbound Ramps
- Park Avenue/State Route 1 Southbound Ramps
- Park Avenue/Kennedy Drive/McGregor Drive
- State Park Drive/McGregor Drive
- Rio Del Mar Boulevard/State Route 1 Northbound Ramps
- Rio Del Mar Boulevard/Soquel Drive
- Soquel Drive/ Soquel Avenue/State Route 1 Southbound Off-Ramp

During the PM peak hour conditions, all of the study intersections would operate under an acceptable level of service (LOS D or better) except the following 14 intersections, which would operate at LOS E or F:

- Morrissey Boulevard/Pacheco Avenue/State Route 1 Northbound Ramps
- Morrissey Boulevard/Fairmount Avenue

- Soquel Drive/Paul Sweet Road/State Route 1 Northbound Ramps
- 41st Avenue/State Route 1 Northbound Ramps
- 41st Avenue/State Route 1 Southbound Ramps
- Porter Street/State Route 1 Northbound Ramps
- Park Avenue/State Route 1 Northbound Ramps
- Park Avenue/State Route 1 Southbound Ramps
- Park Avenue/Kennedy Drive/McGregor Drive
- State Park Drive/State Route 1 Southbound Ramps
- State Park Drive/McGregor Drive
- Rio Del Mar Boulevard/State Route 1 Northbound Ramps
- Rio Del Mar Boulevard/Soquel Drive
- Soquel Drive/ Soquel Avenue/State Route 1 Southbound Off-Ramp

Appendix C-2 includes the *Synchro* output sheets for the 25 study intersections under Year 2035 HOV Build AM and PM peak hour conditions.

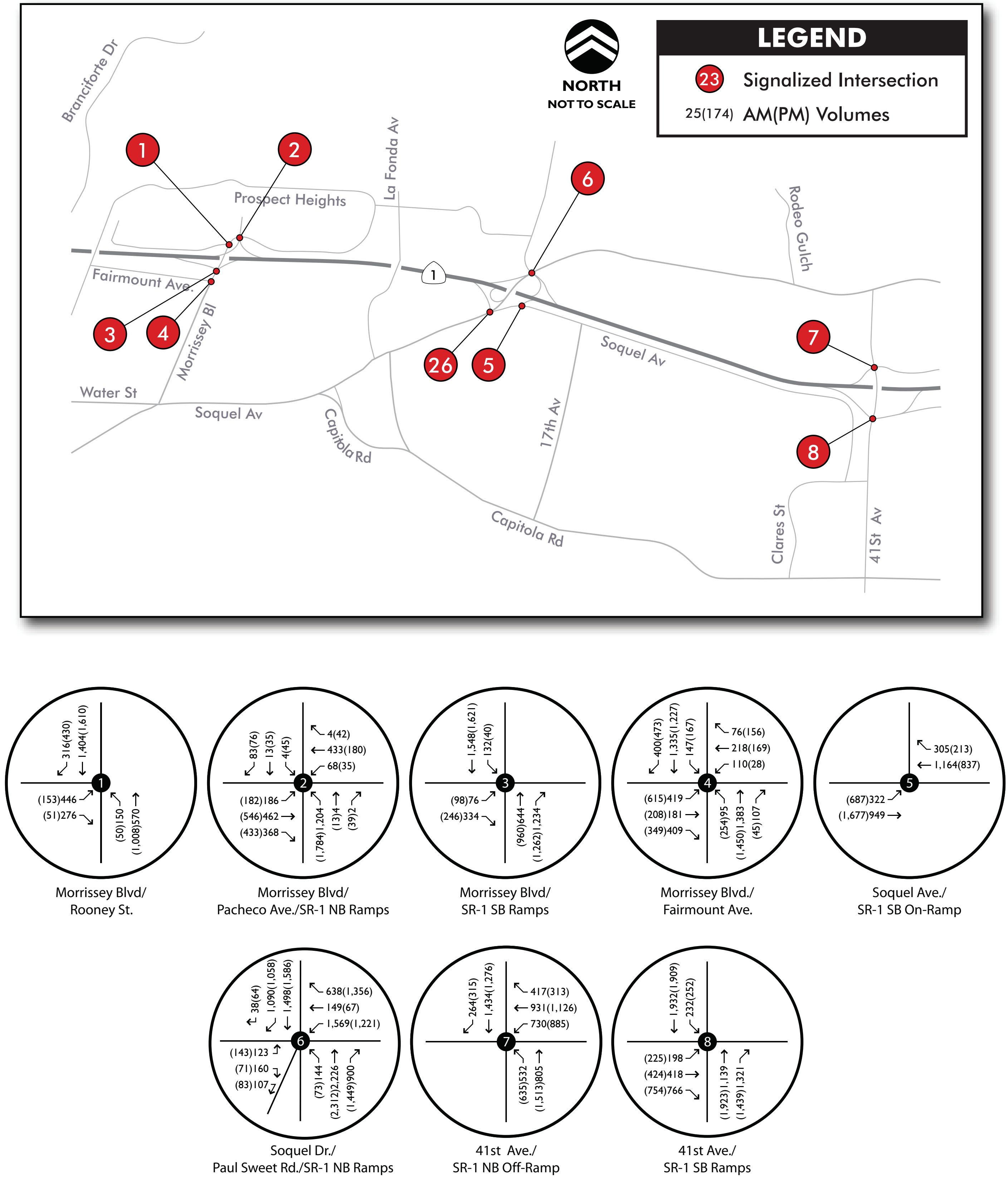


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Figure 5-8A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 HOV BUILD CONDITIONS

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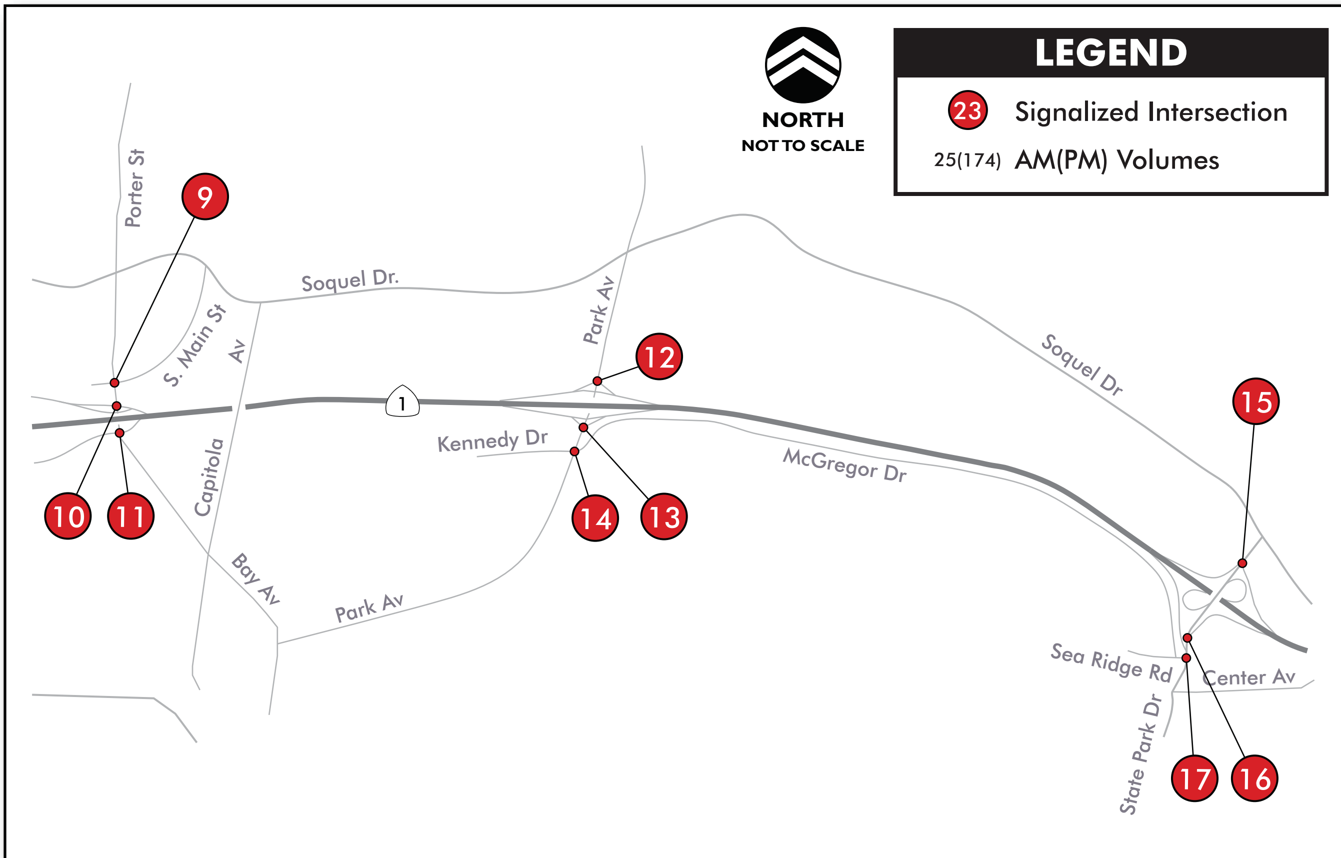

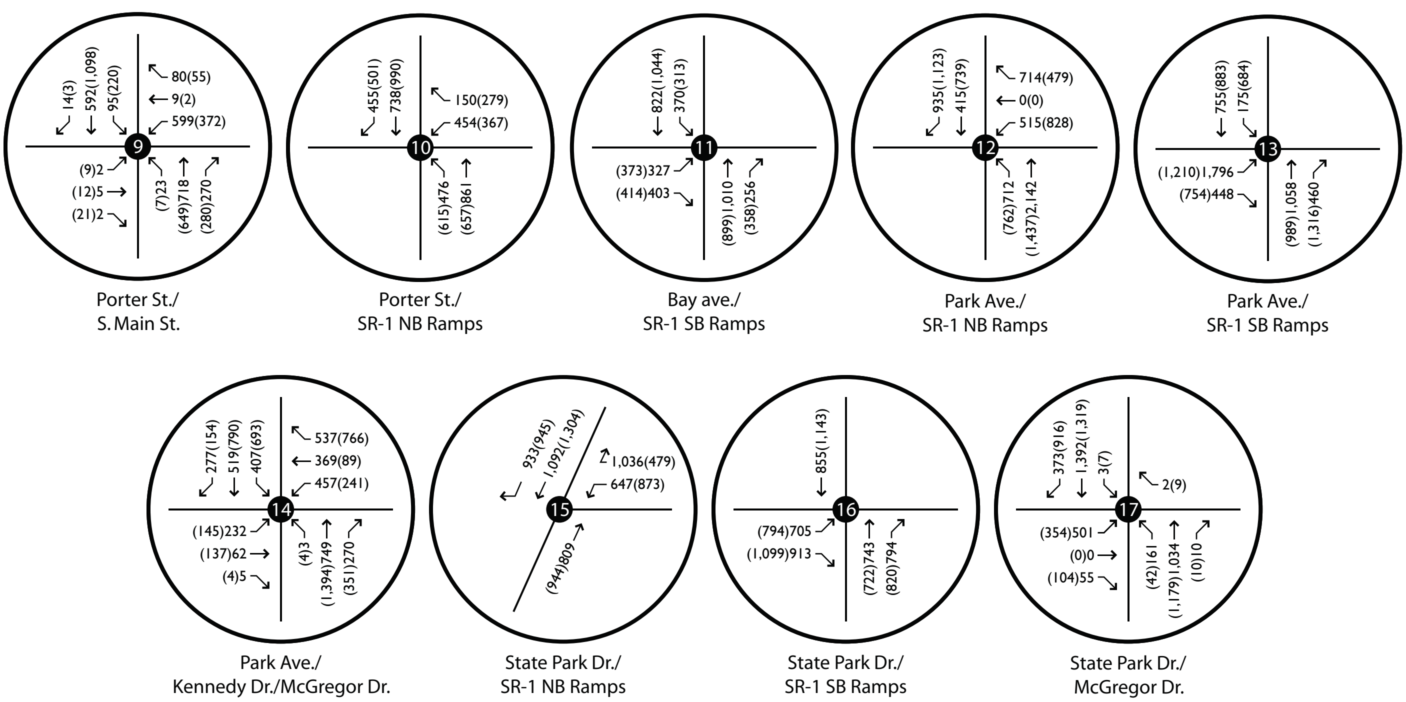

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Figure 5-8B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 HOV BUILD CONDITIONS

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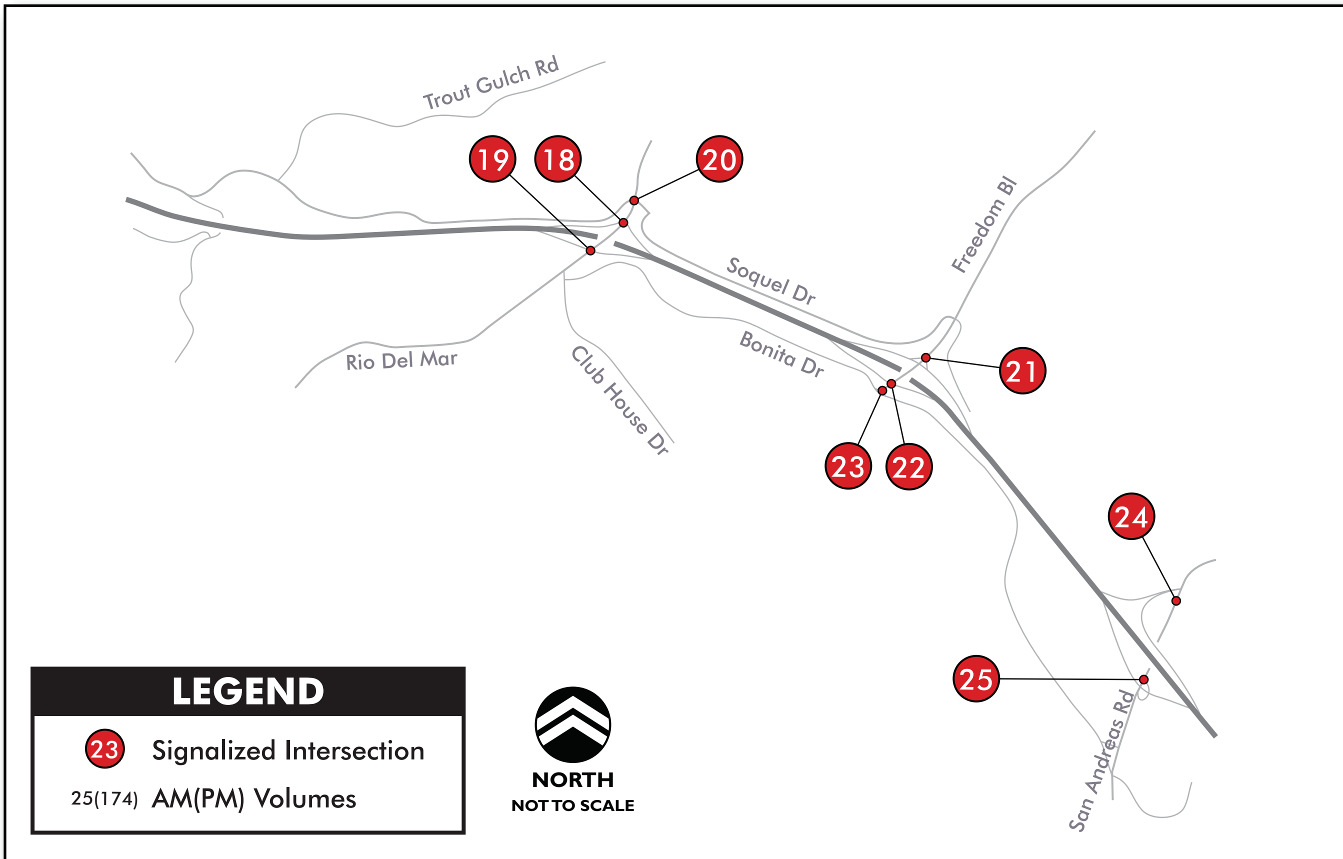

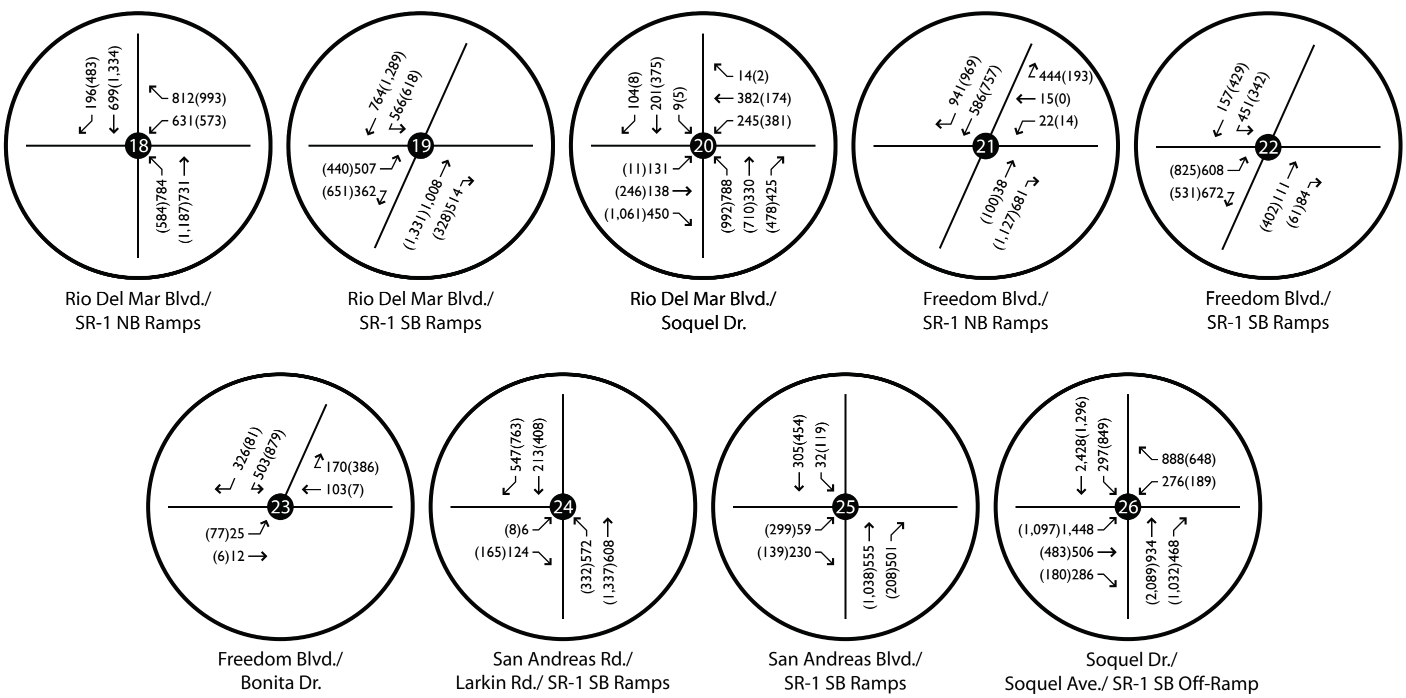

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Figure 5-8C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 HOV BUILD CONDITIONS

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Table 5-5
Intersection LOS Summary – Year 2035 HOV Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./Rooney St.	City of Santa Cruz	Signal	22.7	C	10.8	B
2	Morrissey Blvd./Pacheco Ave./SR-1 NB Ramps	Caltrans	Signal	38.8	D	**76.5**	**E**
3	Morrissey Blvd./SR-1 SB Ramps	Caltrans	Signal	9.6	A	7.6	A
4	Morrissey Blvd./Fairmount Ave.	City of Santa Cruz	Signal	53.4	D	**78.6**	**E**
5	Soquel Ave./SR-1 SB On-Ramp	Caltrans	Signal	21.3	C	33.3	C
6	Soquel Dr./Paul Sweet Rd./SR-1 NB Ramps	Caltrans	Signal	**219.3**	**F**	**176.0**	**F**
7	41st Ave./SR-1 NB Ramps	Caltrans	Signal	**59.2**	**E**	**64.7**	**E**
8	41st Ave./SR-1 SB Ramps	Caltrans	Signal	41.1	D	**69.1**	**E**
9	Porter St./S. Main St.	County of Santa Cruz	Signal	30.0	C	34.5	C
10	Porter St./SR-1 NB Ramps	Caltrans	Signal	30.7	C	**86.3**	**F**
11	Bay Ave./SR-1 SB Ramps	Caltrans	Signal	31.7	C	31.5	C
12	Park Ave./SR-1 NB Ramps	Caltrans	Signal	**94.3**	**F**	**93.5**	**F**
13	Park Ave./SR-1 SB Ramps	Caltrans	Signal	**155.3**	**F**	**246.0**	**F**
14	Park Ave./Kennedy Dr./McGregor Dr.	City of Capitola	Signal	**488.4**	**F**	**920.6**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	28.1	C	22.9	C
16	State Park Dr./SR-1 SB Ramps	Caltrans	Signal	46.5	D	**57.9**	**E**
17	State Park Dr./McGregor Dr.	County of Santa Cruz	Signal	**155.7**	**F**	**139.7**	**F**
18	Rio Del Mar Blvd./SR-1 NB Ramps	Caltrans	Signal	**84.8**	**F**	**133.9**	**F**
19	Rio Del Mar Blvd./SR-1 SB Ramps	Caltrans	Signal	29.1	C	40.5	D

Table 5-5
Intersection LOS Summary – Year 2035 HOV Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./Soquel Dr.	County of Santa Cruz	Signal	**354.0**	**F**	**284.2**	**F**
21	Freedom Blvd./SR-1 NB Ramps	Caltrans	Signal	17.5	B	13.0	B
22	Freedom Blvd./SR-1 SB Ramps	Caltrans	Signal	35.0	D	41.0	D
23	Freedom Blvd./Bonita Dr.	County of Santa Cruz	Signal	12.5	B	4.5	A
24	San Andreas Rd./Larkin Rd./SR-1 NB Ramps	Caltrans	Signal	30.0	C	28.5	C
25	San Andreas Rd./SR-1 SB Ramps	Caltrans	Signal	9.8	A	28.2	C
26	Soquel Dr./Soquel Ave./SR-1 SB Off-Ramp	Caltrans	Signal	**212.8**	**F**	**202.0**	**F**

Source: Wilbur Smith Associates, February 2007

NOTES:
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

5.2.7 Off-Ramp Operations - Queuing Analysis

Table 5-6 summarizes the 95th percentile queue lengths estimated at the off-ramps located within the study area under Year 2035 HOV Build AM and PM peak hour conditions. As described in Section 2.3, these queue lengths are obtained from ten multiple *SimTraffic* model simulations. *Appendix D-2* includes the *SimTraffic* output sheets for existing AM and PM peak hour conditions.

Table 5-6
95th Percentile Queue Lengths – Off-Ramp Locations (Year 2035 HOV Build Conditions)

#	Interchange	Ramp	Approximate Storage Length (ft)	Maximum 95th Percentile Queue Length (ft)	
				AM Peak	PM Peak
1	Morrissey Boulevard Interchange	NB off-ramp	1300	**1100**	**910**
		SB off-ramp	800	701	708
2	Soquel Avenue Interchange	NB off-ramp	1250	**1009**	**1111**
		SB off-ramp	1100	880	851
3	41st Avenue/Porter Street/Bay Avenue Interchange	NB off-ramp	700	220	345
		SB off-ramp	1180	**905**	**1110**
4	Park Avenue Interchange	NB off-ramp	920	**1335**	**1712**
		SB off-ramp	1000	**1477**	**2074**
5	State Park Drive Interchange	NB off-ramp	1000	**1617**	**1693**
		SB off-ramp	1380	**1748**	**2066**
6	Rio Del Mar Boulevard Interchange	NB off-ramp	750	**1646**	**1311**
		SB off-ramp	1300	308	1020
7	Freedom Boulevard Interchange	NB off-ramp	1050	154	105
		SB off-ramp	1400	265	**1009**
8	San Andreas Road/Larkin Valley Road Interchange	NB off-ramp	1100	69	100
		SB off-ramp	1000	76	238

Source: Wilbur Smith Associates, April 2007

NOTES:
Bold indicates 95th percentile queue length likely to exceed storage length.

During the AM peak hour, eight of the 16 study off-ramps would have 95th percentile queue lengths within their storage lengths. The remaining eight ramps would have queues exceeding their storage lengths (queued vehicles would extend onto the freeway mainline) are:

- Morrissey Boulevard Northbound Off-Ramp
- Soquel Drive Northbound Off-Ramp

- 41st Avenue/Porter Street/Bay Avenue Southbound Off-Ramp
- Park Avenue Northbound Off-Ramp
- Park Avenue Southbound Off-Ramp
- State Park Drive Northbound Off-Ramp
- State Park Drive Southbound Off-Ramp
- Rio Del Mar Boulevard Northbound Off-Ramp

During the PM peak hour, the following ten off-ramps would have 95th percentile queue lengths longer than storage lengths:

- Morrissey Boulevard Northbound Off-Ramp
- Soquel Drive Northbound Off-Ramp
- Soquel Drive Southbound Off-Ramp
- 41st Avenue/Porter Street/Bay Avenue Southbound Off-Ramp
- Park Avenue Northbound Off-Ramp
- Park Avenue Southbound Off-Ramp
- State Park Drive Northbound Off-Ramp
- State Park Drive Southbound Off-Ramp
- Rio Del Mar Boulevard Northbound Off-Ramp
- Freedom Boulevard Southbound Off-Ramp

The consultants recommend that Caltrans as owner of this project, monitor queue back up beyond the off-ramp storage length every five years from the opening year (2015). If queue spillback is observed, we recommend that a separate study be conducted at those select locations. Furthermore, we recommend modifying the signal timing plan to provide additional green time to the off-ramp traffic as a mitigation measure.

5.3 YEAR 2035 TSM BUILD ALTERNATIVE ANALYSIS

5.3.1 Proposed Improvements and Network Assumptions

This section summarizes the Year 2035 Transportation System Management (TSM) Build operating conditions for the State Route 1 corridor in Santa Cruz County. The project team analyzed the year 2035 traffic volumes on State Route 1, with the addition of ramp metering (as part of Caltrans long-term improvement for the region) and supporting auxiliary lanes.

Ramp metering restricts the inflow of traffic into the State Route 1 corridor, and in turn, helps prevent the freeway from reaching breakdown levels of traffic. Typically, when a corridor breaks down, it experiences a sudden drop in capacity and then requires a long recovery period to return back to an efficient steady state. As capacity break downs are prevented through the use of ramp metering, auxiliary lanes would also be added to increase the capacity at critical junctures.

Initially, there were three TSM Build scenarios considered in the northbound direction and two (2) scenarios considered in the southbound direction. Each TSM Build scenario in this analysis reflects changes with respect to the base geometric configurations. The TSM scenarios considered include the following:

Northbound Geometric Scenarios

- Base Scenario – The TSM proposed geometries in the northbound direction (shown in *Appendix A*)
- Scenario 1 – Base scenario with the addition of an auxiliary lane between Soquel Drive and Morrissey Boulevard from Soquel Drive/Commercial Way On-Ramp
- Scenario 2 – Scenario 1 with the addition of an auxiliary lane between 41st Street and Soquel Drive from 41st Street Northbound Loop On-Ramp
- Scenario 3 – Scenario 2 with the addition of an auxiliary lane between State Park Road Northbound On-Ramp and Park Avenue Northbound Off-Ramp

Southbound Geometric Scenarios

- Base Scenario – The TSM proposed geometries in the southbound direction (shown in *Appendix A*)
- Scenario 1 – Base scenario with the addition of an auxiliary lane between 41st Street and Bay Street/Porter Street from 41st Street Southbound Loop On-Ramp
- Scenario 2 – Scenario 1 with the addition of an auxiliary lane between State Park Road and Park Avenue from State Park Road Southbound Loop On-Ramp

The performance benefits resulting from the various geometric scenarios described above were analyzed in a technical memorandum dated October 10, 2006 and included in *Appendix A-8*. The Northbound Scenario 3 and Southbound Scenario 2 were shown to provide the greatest benefits, thus, they were selected as the future geometric configuration for the Year 2035 TSM Build Condition.

The final Year 2035 TSM Build lane configurations are presented in *Figure 5-9*. *Figures 5-10A* and *5-10B* present the freeway and ramp volumes under Year 2035 TSM Build Conditions for the AM and PM peak periods. Comparison between measures of effectiveness under the Year 2035 No-Build and Year 2035 TSM Build Conditions are summarized in *Table 5-7*. *Appendix E-4* presents the *FREQ* output under Year 2035 TSM Build Conditions.

As discussed under No-Build Conditions (Section 5.1.1, Page 5-1), as part of *State Route 1 Auxiliary Lane* project, some improvements may be proposed at Morrissey Boulevard and Soquel Drive interchanges. However, the freeway operations (using *FREQ*) were analyzed prior to finalizing the interchange improvement plans. As such, the freeway operations were performed assuming the geometric layout of both these interchanges would remain same as under Existing Conditions.

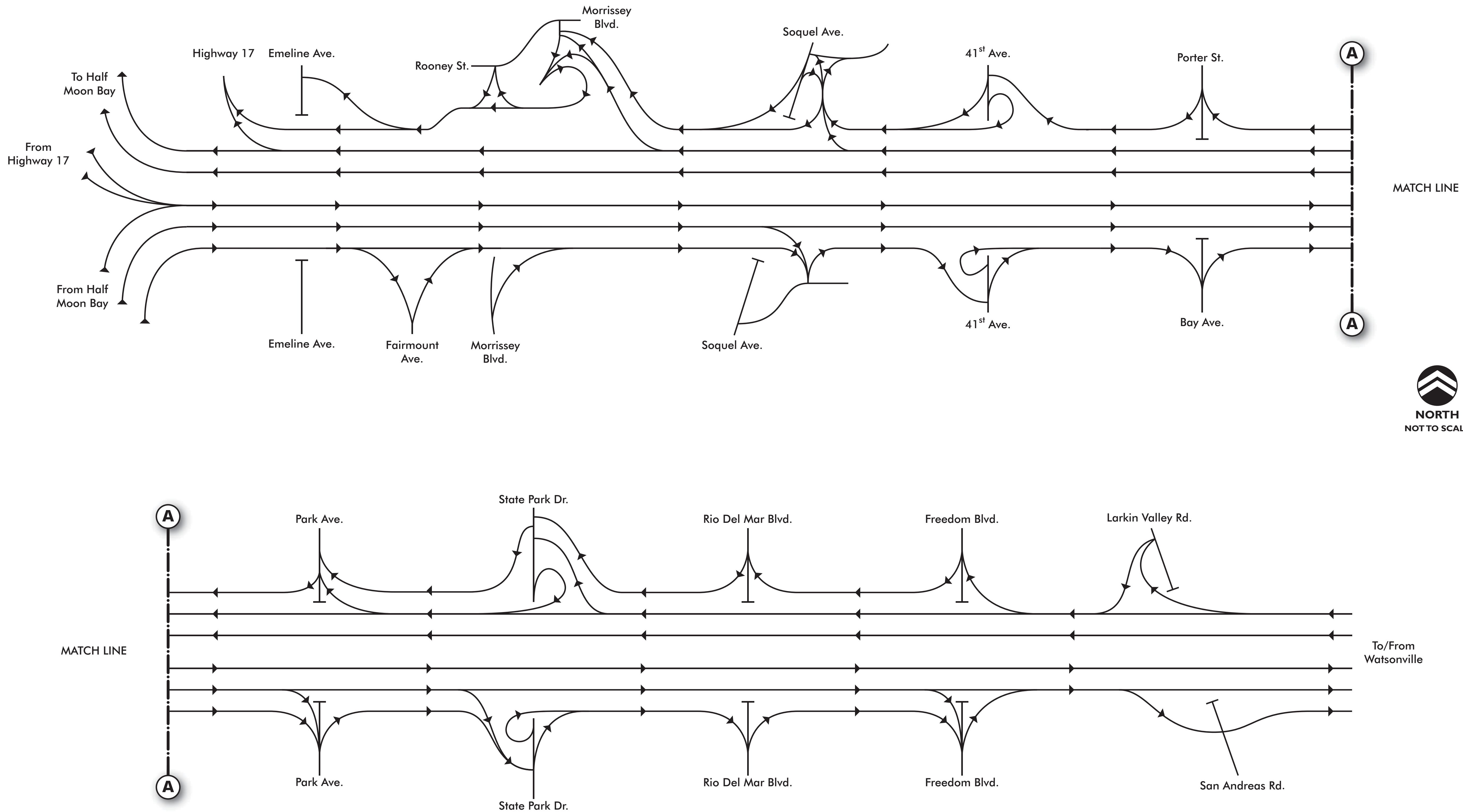

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Figure 5-9

STATE ROUTE 1 LANE LINE DIAGRAM
YEAR 2035 TSM BUILD CONDITIONS

393070/HWY BASE - 10/06/06

NORTH

NOT TO SCALE

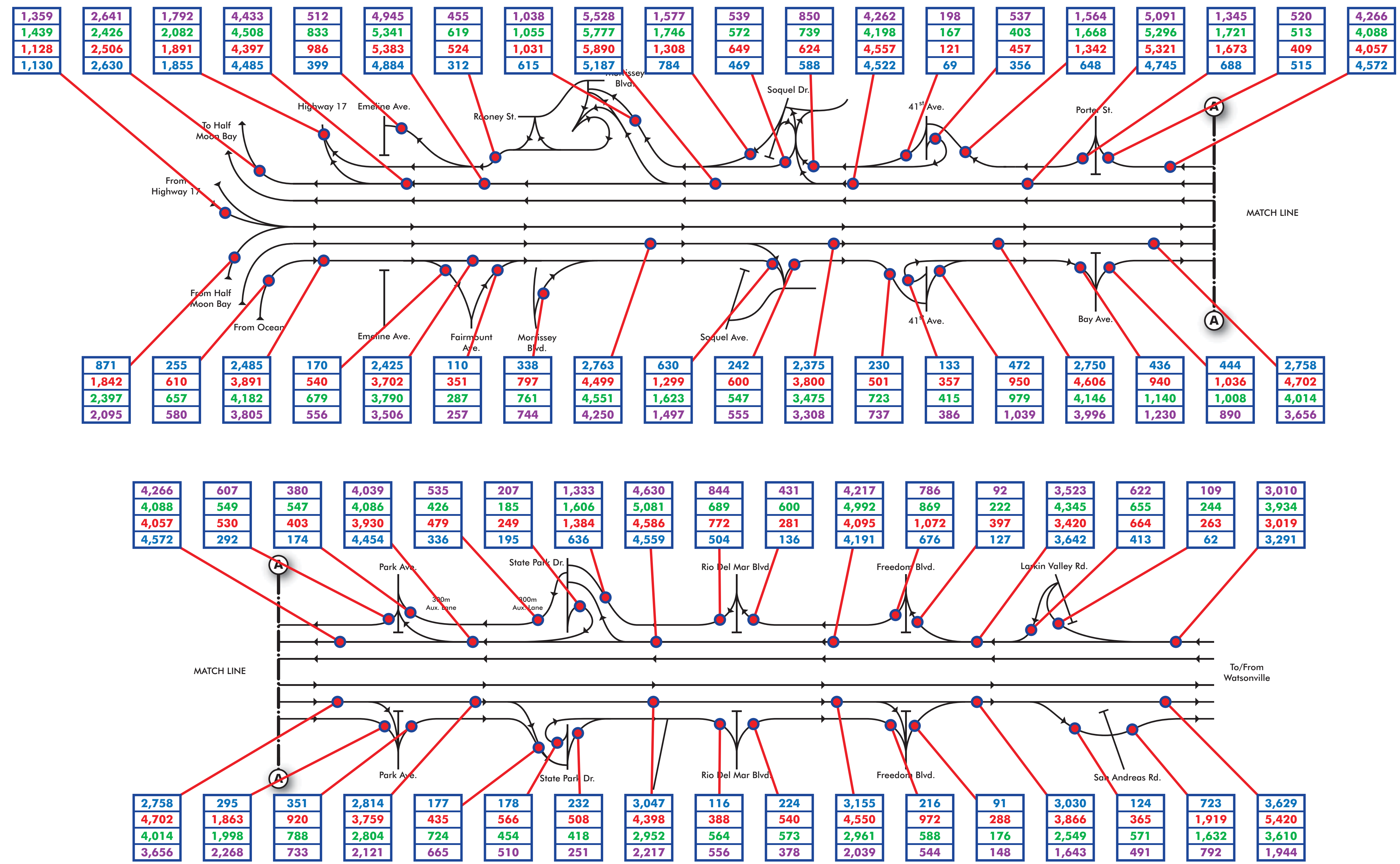

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Figure 5-10A

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2035 TSM BUILD CONDITIONS (AM PEAK)

393070/FWY-RAMP - 04/02/07

NORTH
NOT TO SCALE

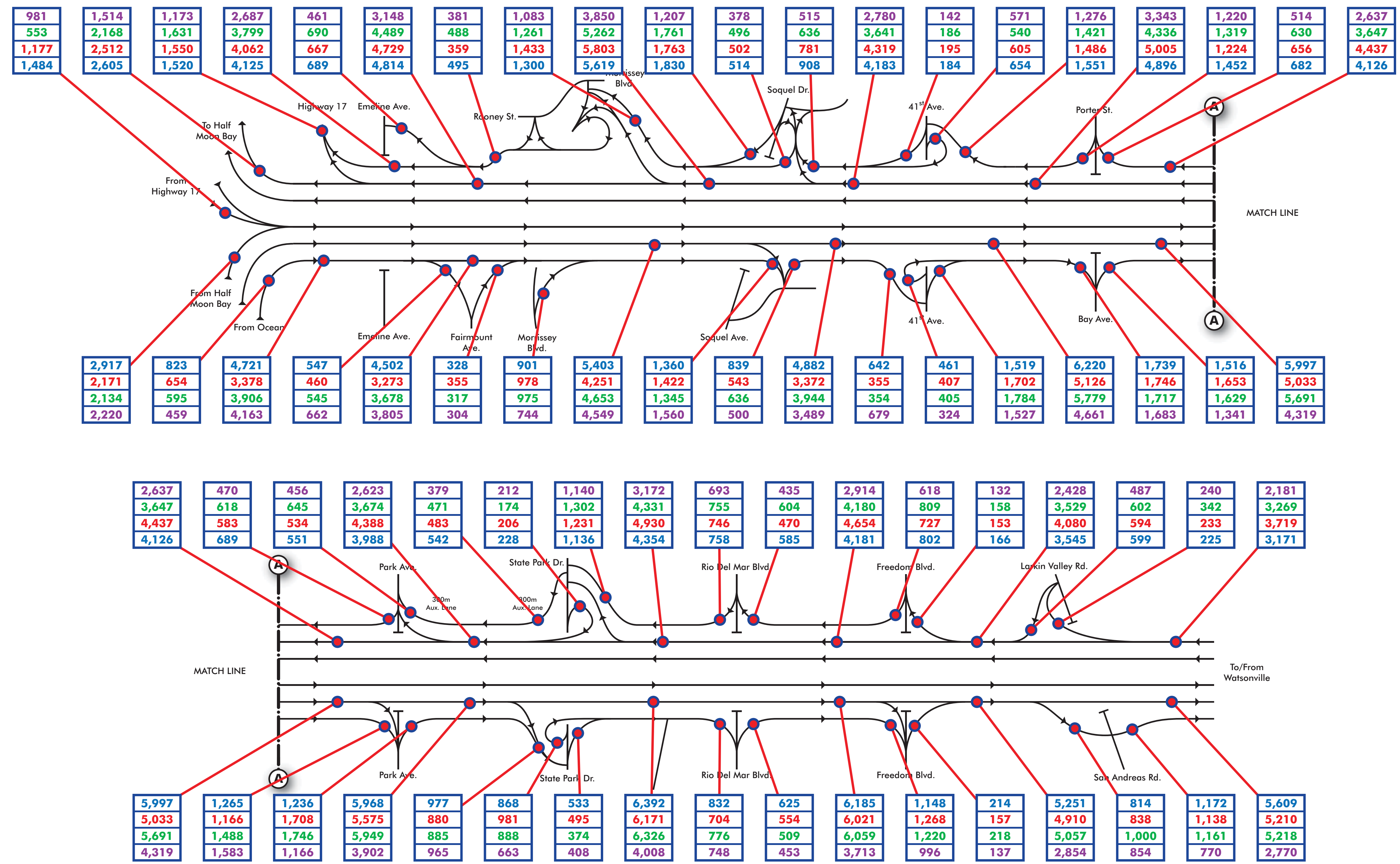

Figure 5-10B
STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2035 TSM BUILD CONDITIONS (PM PEAK)

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Table 5-7
Comparison of Measure of Effectiveness - Year 2035 No-Build versus Year 2035 TSM Build Scenarios

Measure of Effectiveness	2035 No-Build		2035 TSM Build		% Difference	
	AM	PM	AM	PM	AM	PM
Northbound						
Average Travel Time (minutes)	59	34	34	29	-42%	-15%
	39	***22***	***27***	***18***	***-31%***	***-18%***
Average Speed (mph)	12	17	21	21	75%	24%
	18	***28***	***27***	***33***	***50%***	***18%***
Delay (minutes per vehicle)	48	25	22	19	-54%	-24%
	28	***12***	***15***	***9***	***-46%***	***-25%***
No. of Vehicle Trips (per hour)	2,767	3,114	3,986	3,858	44%	24%
	3,129	***3,157***	***3,645***	***3,546***	***16%***	***12%***
No. of Persons Trips (per hour)	3,132	3,874	4,847	4,870	55%	26%
	3,542	***3,927***	***4,441***	***4,474***	***25%***	***14%***
Freeway Travel Time (VHT)	2,749	1,784	2,260	1,871	-18%	5%
	2,053	***1,138***	***1,612***	***1,080***	***-21%***	***-5%***
Travel Distance (VMT)	32,646	31,138	47,030	38,582	44%	24%
	36,922	***31,568***	***43,009***	***35,455***	***16%***	***12%***
Avg. Vehicle Occupancy	1.13	1.24	1.22	1.23	7%	1%
(persons/vehicle)	***1.13***	***1.24***	***1.22***	***1.26***	***8%***	***1%***
Density	115	92	76	73	-34%	-21%
(passenger cars per mile per lane)	***87***	***56***	***54***	***43***	-38%	-23%
Level of Service	F	F	F	F	N.A.	N.A.
	F	***F***	***F***	***E***	***N.A.***	***N.A.***
Southbound						
Average Travel Time (minutes)	29	61	12	62	-59%	2%
	18	***47***	***11***	***33***	***-39%***	***-30%***
Average Speed (mph)	22	11	54	10	145%	-9%
	35	***15***	***59***	***21***	***69%***	***40%***
Delay (minutes per vehicle)	19	49	2	50	-89%	2%
	8	***35***	***1***	***21***	***-88%***	***-40%***
No. of Vehicle Trips (per hour)	3,101	2,475	3,873	3,091	25%	25%
	2,968	***2,696***	***3,050***	***3,479***	***3%***	***29%***
No. of Persons Trips (per hour)	3,597	2,911	4,623	3,750	29%	29%
	3,443	***3,168***	***3,638***	***4,216***	***6%***	***33%***
Freeway Travel Time (VHT)	1,498	2,523	756	3,165	-50%	25%
	884	***2,101***	***540***	***1,903***	***-39%***	***-9%***
Travel Distance (VMT)	32,248	28,956	40,278	36,169	25%	25%
	30,863	***31,544***	***31,715***	***40,707***	***3%***	***29%***
Avg. Vehicle Occupancy	1.16	1.18	1.19	1.21	3%	3%
(persons/vehicle)	***1.16***	***1.18***	***1.19***	***1.21***	***3%***	***3%***
Density	70	113	29	124	-59%	10%
(passenger cars per mile per lane)	***42***	***90***	***21***	***66***	-50%	-27%
Level of Service	F	F	D	F	N.A.	N.A.
	E	***F***	***C***	***F***	***N.A.***	***N.A.***

Source: Wilbur Smith Associates, February 2007

NOTES:
Non-italicized and non-bold values represent peak hour values.
Bold *italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

5.3.2 Vehicle Throughput

The addition of ramp metering and auxiliary lanes within the study area is expected to serve more traffic demand on State Route 1 than under the No-Build Conditions. The traffic demand on State Route 1 within the project limits would increase by 44 percent in the northbound direction during the AM peak hour and 25 percent in the southbound direction during the PM peak hour. At the same time, the number of person-trips would increase by 55 percent and 29 percent in the northbound direction during AM peak hour and in the southbound direction during PM peak hour, respectively. The AVO under the Year 2035 TSM Build Condition is expected to range between 1.19 and 1.26 persons per vehicle, a slight increase from the Year 2035 No-Build Condition.

Metering the corridor's on-ramps would increase the motorists traffic delays before entering the freeway and the performance measures of the arterials and the local intersections will be discussed in the following sections. However, as shown in *Table 5-7*, the overall freeway operations would improve with ramp metering. The increase in traffic throughput in the southbound direction during the PM peak hour (25 percent) would be caused by the extra capacity provided by the auxiliary lanes. However, the additional traffic on the corridor along with the already-congested conditions in the southbound direction during the PM peak hour (under No-Build Conditions), would cause traffic operations in the corridor to worsen slightly. These are discussed in the next section.

5.3.3 Delays and Densities

In the southbound direction during the PM peak, although the total vehicle throughput would increase by approximately 25 percent, delay per vehicle and total VHT would increase by only two percent. Traffic delay in the northbound direction during the AM peak hour is expected to average 22 minutes per vehicle, while in the southbound direction during the PM peak hour it is expected to be 50 minutes per vehicle, an increase of one minute per vehicle compared to the Year 2035 No-Build scenario. Thus, in the southbound direction during the PM peak hour, the addition of ramp metering and auxiliary lanes would not improve the mainline operations.

Similarly, there would be little improvements in densities and LOS values. Densities would improve slightly but not enough to operate at a higher LOS value. The corridor would operate at densities of 76 pcpmpl (LOS F) in the northbound direction during the AM peak hour and 124 pcpmpl (LOS F) in the southbound direction during PM peak hour. The reverse commute conditions (northbound direction during PM peak hour and southbound direction during the AM peak hour) would improve, especially in the southbound direction during the AM peak hour, which would improve from LOS F to LOS D.

5.3.4 Travel Speed and Travel Time

Compared to the Year 2035 No-Build Conditions, traffic performance under Year 2035 TSM Build Conditions would show improvements during the AM peak hour, in both northbound (42 percent reduction in travel time) and southbound (15 percent reduction in travel time) directions. However, in the southbound direction during the PM peak hour, there would be a slight increase in the average travel time (62 minutes, two percent increase), while the average travel speed would slightly decrease (10 mph, nine percent decrease). As previously mentioned, this would most probably be caused by the severe breakdown of State Route 1 by year 2035. Providing ramp metering and auxiliary lanes would not relieve the congestion in the peak commute direction, although it would increase the corridor's ability to carry more vehicles.

On the other hand, since traffic demand would be considerably less on the reverse commute directions, provision of ramp metering and auxiliary lanes would substantially improve the speed and travel time, by approximately 24 percent in the northbound direction during the PM peak hour and about 145 percent in the southbound direction during the AM peak hour.

5.3.5 Intersections Operation Analysis

Using the methodology described in Section 4.4, turning movement volumes have been estimated at the study intersections to represent Year 2035 TSM Build Conditions. *Figures 5-11A*, *5-11B*, and *5-11C* exhibit the intersection volumes under Year 2035 TSM Build AM and PM peak hours.

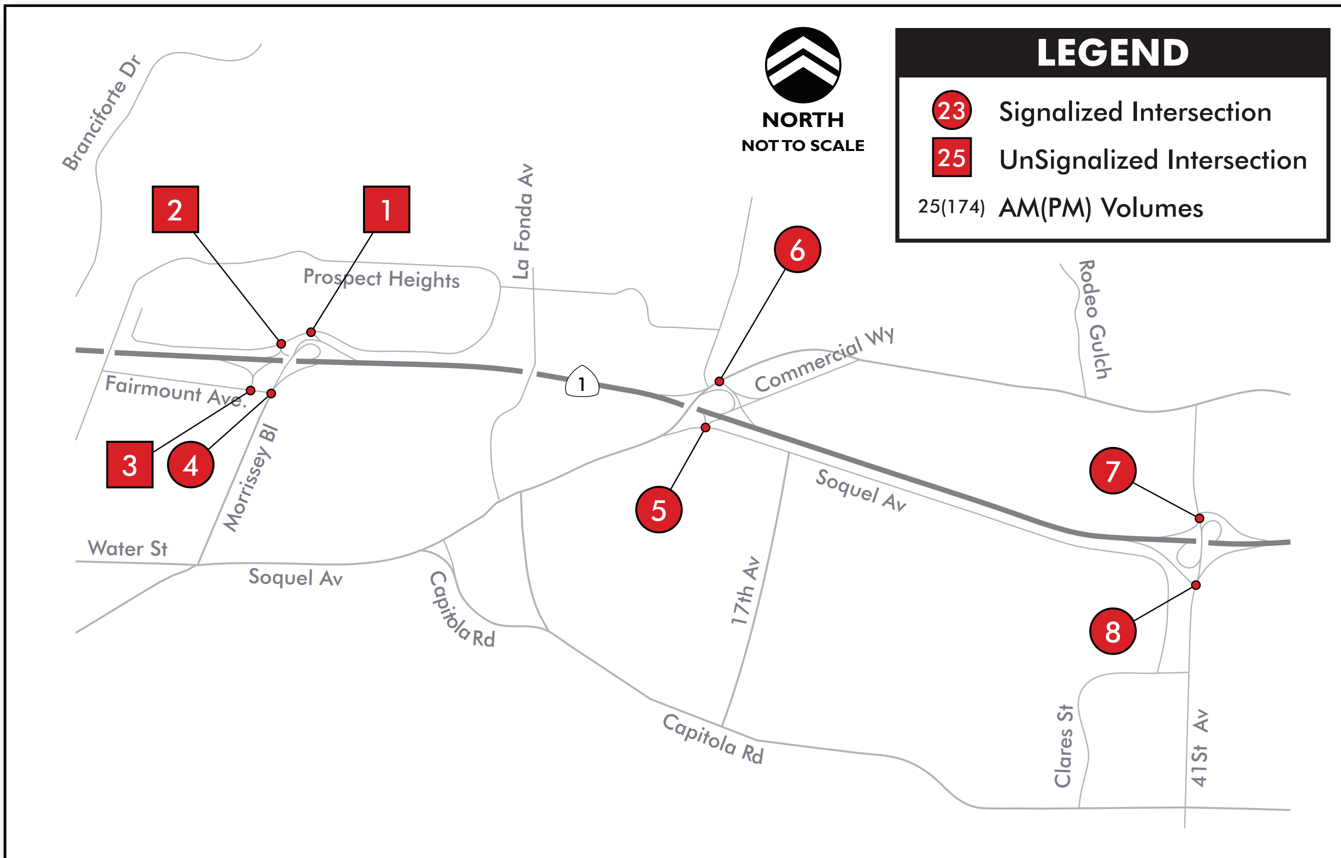
During Year 2035 TSM Build Conditions, all of the 25 study intersections would operate under an unacceptable level of service (LOS E or F) for both the AM and PM peak hours.

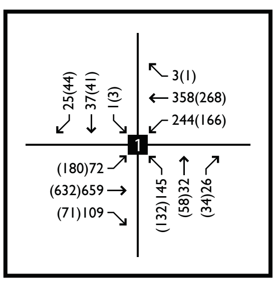
The results of Year 2035 TSM Build LOS analysis are presented in *Table 5-8*.

Compared to the Year 2035 No-Build scenario's results, traffic operations at the study intersections with TSM improvements would worsen marginally. Vehicular delays in Year 2035 TSM Build Conditions would drop slightly; however, the service levels would remain close to Year 2035 No-Build Conditions.

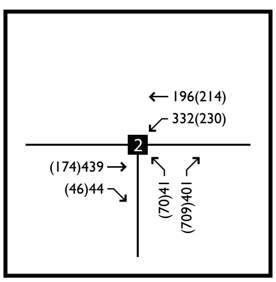
Ramp metering tends to increase delays at the on-ramp leading into the mainline but captures the lost time through better mainline operations. In a break down, traffic operating conditions such as those expected under Year 2035 Conditions, ramp metering does not appear as a viable traffic management strategy.

Appendix C-4 exhibits the *Synchro* output sheets for the study intersections under Year 2035 TSM Build peak hour conditions.

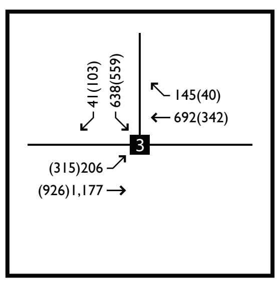




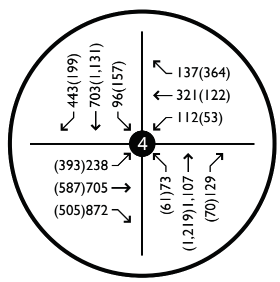
Morrissey Blvd/
Rooney St./Pacheco Ave.



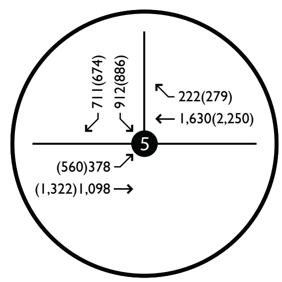
Rooney St./
SR-1 NB Ramps



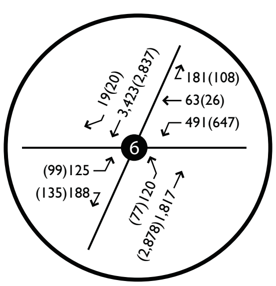
Fairmount Ave./
SR-1 SB Ramps



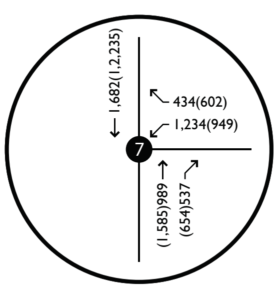
Morrissey Blvd./
Fairmount Ave.



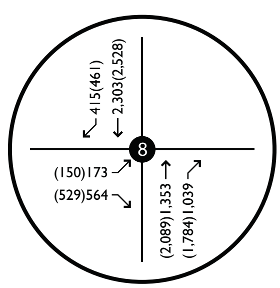
Soquel Ave./
SR-1 SB Ramps



Soquel Dr./
Paul Sweet Rd./Commercial Way



41st Ave./
SR-1 NB Off-Ramp



41st Ave./
SR-1 SB Ramps

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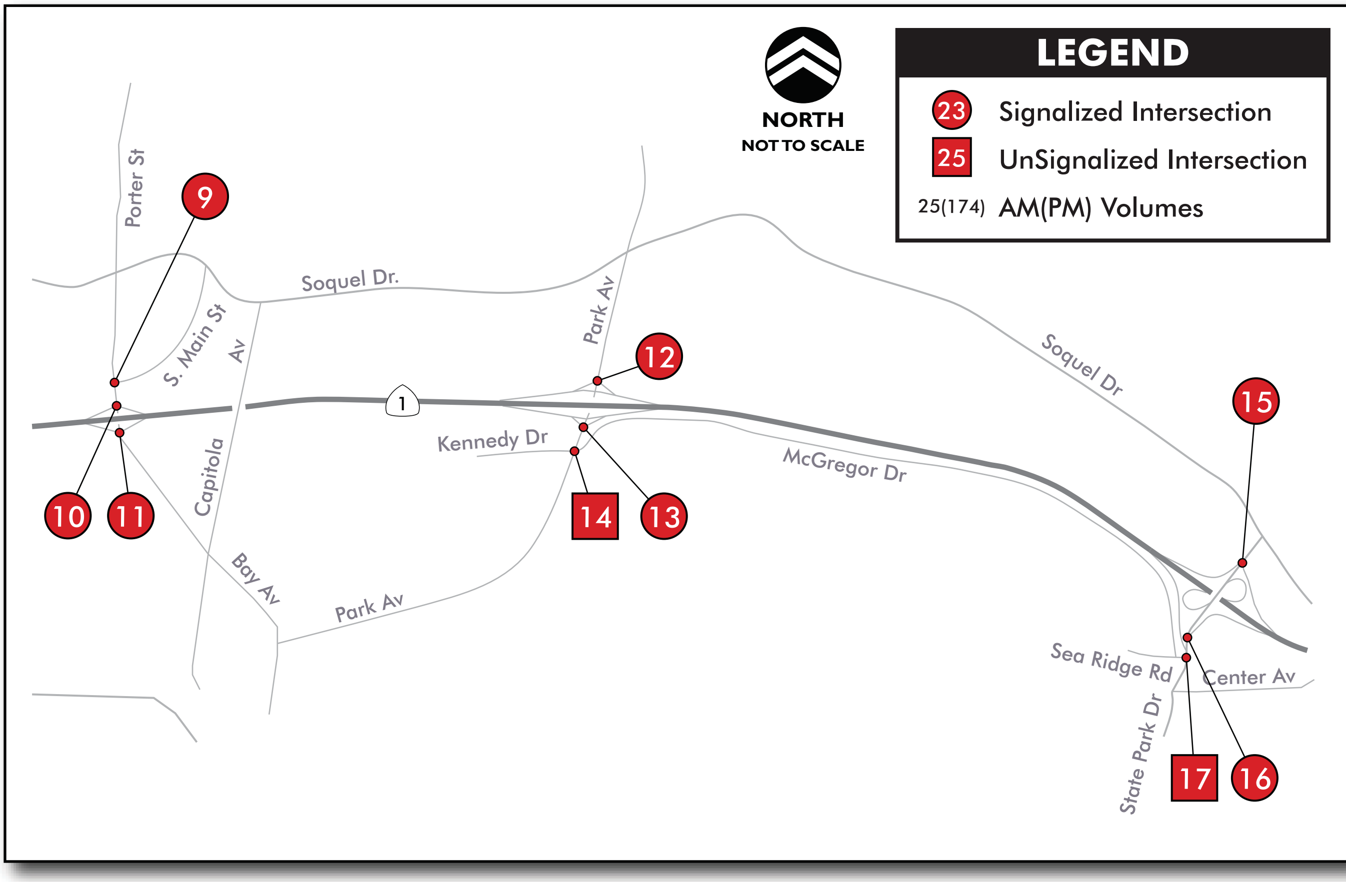
Figure 5-11A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 TSM BUILD CONDITIONS

393070/BASE - 04/02/07



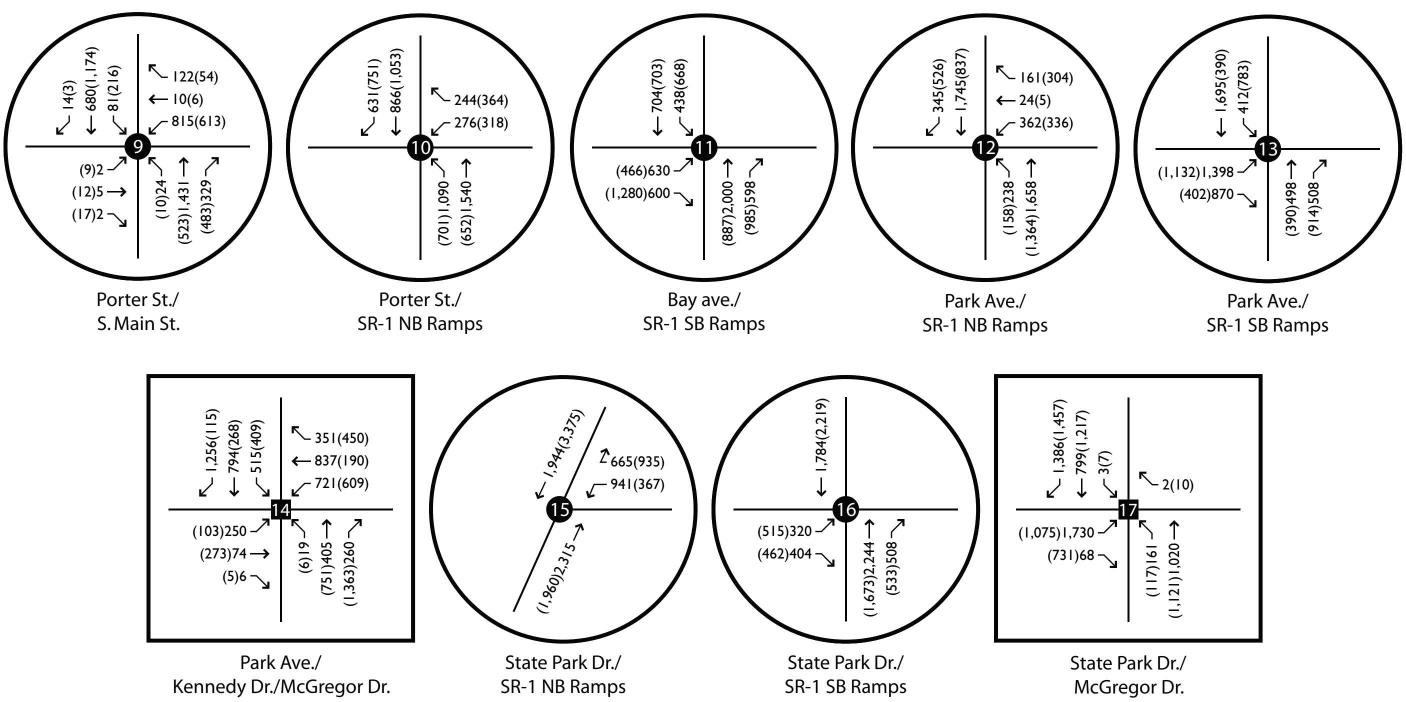


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Figure 5-11B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 TSM BUILD CONDITIONS

393070/BASE - 04/02/07

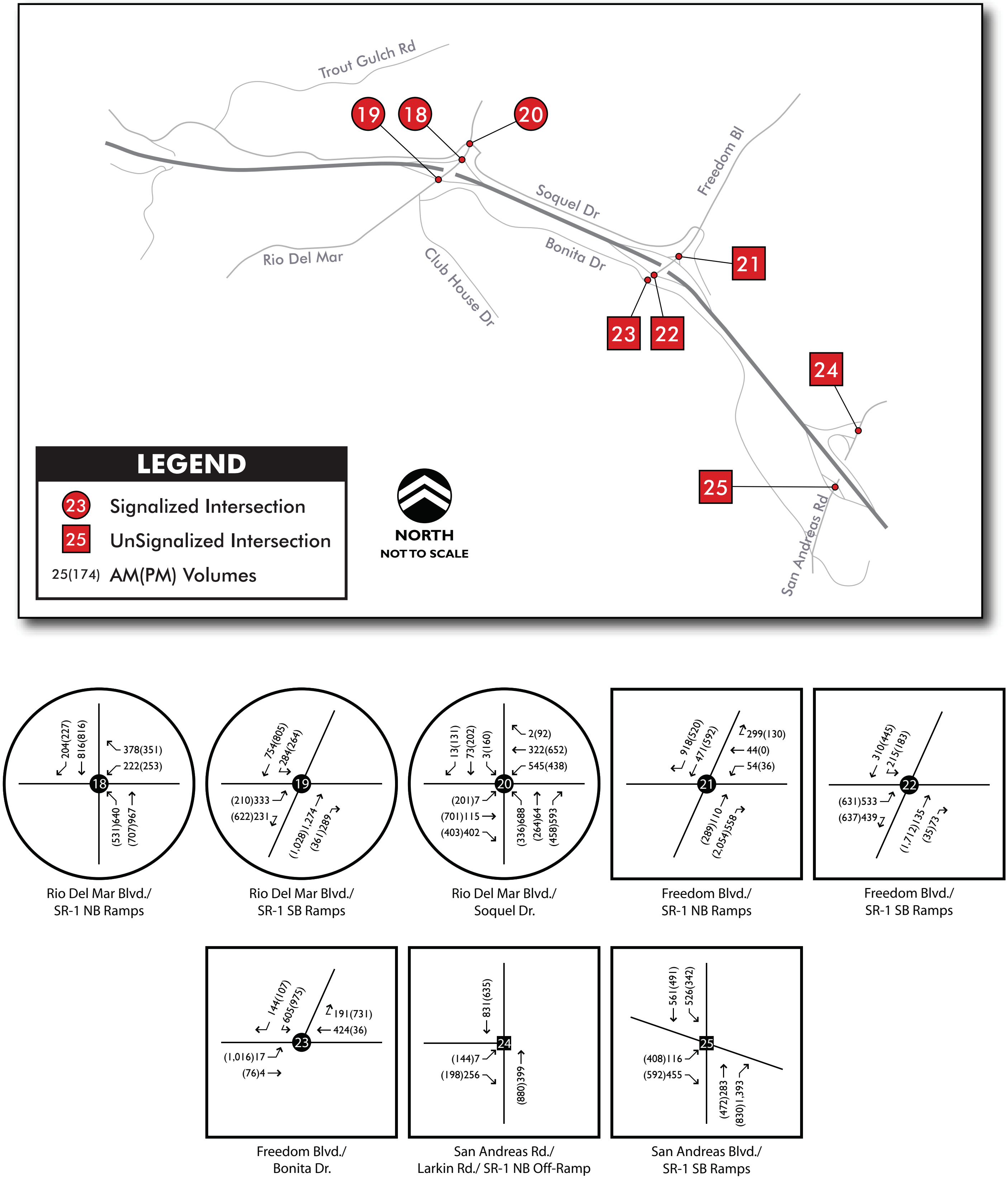

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Figure 5-11C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2035 TSM BUILD CONDITIONS

393070/BASE - 04/02/07

Table 5-8
Intersection LOS Summary – Year 2035 TSM Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./Rooney St./Pacheco Ave.	City of Santa Cruz	AWSC	**289.1**	**F**	**171.7**	**F**
2	Rooney St./SR-1 NB Ramps	Caltrans	TWSC	**867.1** (NB)	**F**	**189.8** (NB)	**F**
3	Fairmount Ave./SR-1 SB Ramps	Caltrans	AWSC	**732.5**	**F**	**453.9**	**F**
4	Morrissey Blvd./Fairmount Ave.	Caltrans	Signal	**318.9**	**F**	**236.7**	**F**
5	Soquel Ave./SR-1 SB Ramps	Caltrans	Signal	**127.7**	**F**	**202.4**	**F**
6	Soquel Dr./Paul Sweet Rd./Commercial Way	Caltrans	Signal	**207.8**	**F**	**148.1**	**F**
7	41st St./SR-1 NB Off-Ramp	Caltrans	Signal	**58.2**	**E**	**82.6**	**F**
8	41st St./SR-1 SB Ramps	Caltrans	Signal	**56.7**	**E**	**110.8**	**F**
9	Porter St./S. Main St.	County of Santa Cruz	Signal	**90.2**	**F**	**37.4**	**D**
10	Porter St./SR-1 NB Ramps	Caltrans	Signal	**186.9**	**F**	**143.3**	**F**
11	Bay Ave./SR-1 SB Ramps	Caltrans	Signal	**425.9**	**F**	**297.6**	**F**
12	Park Ave./SR-1 NB Ramps	Caltrans	Signal	**312.2**	**F**	**93.9**	**F**
13	Park Ave./SR-1 SB Ramps	Caltrans	Signal	**383.0**	**F**	**270.0**	**F**
14	Park Ave./Kennedy Dr./McGregor Dr.	City of Capitola	AWSC	**>1000**	**F**	**>1000**	**F**
15	State Park Dr./SR-1 NB Ramps	Caltrans	Signal	**381.5**	**F**	**191.9**	**F**
16	State Park Dr./SR-1 SB Ramps	Caltrans	Signal	**288.9**	**F**	**260.1**	**F**
17	State Park Rd./McGregor Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./SR-1 NB Ramps	Caltrans	Signal	**737.9**	**F**	**314.2**	**F**
19	Rio Del Mar Blvd./SR-1 SB Ramps	Caltrans	Signal	**>1000**	**F**	**156.7**	**F**

Table 5-8
Intersection LOS Summary – Year 2035 TSM Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./Soquel Dr.	County of Santa Cruz	Signal	**303.2**	**F**	**495.1**	**F**
21	Freedom Blvd./SR-1 NB Ramps	Caltrans	TWSC	**>1000** (NWB)	**E**	**>1000** (NWB)	**F**
22	Freedom Blvd./SR-1 SB Ramps	Caltrans	AWSC	**100.5**	**F**	**603.8**	**F**
23	Freedom Blvd./Bonita Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
24	San Andreas Rd./Larkin Rd./SR-1 NB Off-Ramp	Caltrans	TWSC	**65.3** (EB)	**F**	**689.5** (EB)	**F**
25	San Andreas Rd./SR-1 SB Ramps	Caltrans	TWSC	**>1000** (SEB)	**F**	**>1000** (SEB)	**F**

Source: Wilbur Smith Associates, February 2007

NOTES:
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

5.4 YEAR 2035 LOS AND VEHICLE DENSITY BY SEGMENT

Table 5-9 presents a segment-by-segment summary of the year 2035 vehicle density and service levels for State Route 1. This view provides a snapshot of vehicle density and service levels during the peak hour in the future for all analyzed conditions. In line with the trends observed for the overall State Route 1 corridor, the existing traffic conditions exhibit breakdowns on several segments, both northbound and southbound. The congestion is worse in the middle segments, where more vehicle weaving movements occur, interrupting the smooth flow of vehicle traffic.

By year 2035, traffic demand would overwhelm the available freeway capacity, and most segments under No-Build scenario would operate at LOS F, except at the terminus of the corridors. For the northbound direction, traffic relief is expected around the freeway segment from Soquel Drive to Morrissey Boulevard interchanges, while in the southbound direction freeway segments south of Rio Del Mar Boulevard and Freedom Boulevard would operate at LOS E or better. This is not due to the availability of sufficient freeway capacity at these locations, but due to the metering effect of the upstream bottlenecks. The bottlenecks located at Soquel Avenue interchange and Bay Avenue/Porter Street interchange would cause a metering effect in the northbound and southbound directions, respectively. Thus, the freeway would operate at LOS E or better at the terminus of the corridor.

With the addition of the HOV lanes and other supporting components, traffic conditions under the Year 2035 HOV Build scenario would improve. All segments with HOV lanes are expected to operate at LOS C or better, except at two continuous segments in the middle of the study area. They are the Rio Del Mar Boulevard/Seacliff Drive and Seacliff Drive/Park Avenue segments, which would operate at LOS D (still considered acceptable conditions). The HOV lanes would also slightly relieve the mixed-flow lanes, improving some segments from LOS F to LOS E or better.

Lastly, the Year 2035 TSM Build scenario is not expected to substantially improve traffic conditions in the corridor. The segment-by-segment analysis shows that the TSM strategies would improve certain segments along the corridor, but would worsen other segments. When TSM strategies such as ramp metering are introduced to the corridor, they would relieve bottlenecks at certain segments, but since traffic demand by year 2035 would be much greater than the available supply, the bottlenecks would shift to downstream segments than dissipate completely. Thus, in addition to better TSM strategies, the increased traffic demands will require an increase in supply (roadway capacity) as well.

Table 5-9
Corridor Segment LOS and Density Summary - Year 2035 Conditions

	Existing				No Build				Year 2035 HOV Build*								TSM Build			
	AM		PM		AM		PM		AM (Mixed Flow)		AM (HOV)		PM (Mixed Flow)		PM (HOV)		AM		PM	
	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS
Northbound																				
START	24.3	C	22.1	C	148.5	F	125.2	F	58.5	F	*	*	36.6	E	*	*	80.5	F	27.6	D
Larkin Rd. Off - Larkin Rd. On	23.1	C	20.8	C	161.2	F	134.9	F	76.4	F	*	*	62.5	F	*	*	85.0	F	24.9	C
Larkin Rd. On - Freedom Blvd. Off	26.0	C	24.2	C	127.9	F	112.5	F	37.0	E	*	*	36.9	E	*	*	58.1	F	31.8	D
Freedom Blvd. Off - Freedom Blvd. On	25.0	C	21.4	C	150.4	F	118.2	F	31.4	D	17.1	B	30.8	D	17.8	B	63.3	F	28.4	D
Freedom Blvd. On - Rio Del Mar Blvd. Off	40.4	E	26.4	D	99.4	F	84.8	F	24.9	C	17.1	B	24.1	C	22.7	C	89.7	F	35.2	E
Rio Del Mar Blvd. Off - Rio Del Mar Blvd. On	56.5	F	22.8	C	121.5	F	106.4	F	27.0	D	18.1	C	27.4	D	26.3	D	40.1	E	32.9	D
Rio Del Mar Blvd. On - Seacliff Rd. Off	56.7	F	27.6	D	84.1	F	74.5	F	22.9	C	18.1	C	45.2	F	31.2	D	42.1	E	70.7	F
Seacliff Rd. Off - State Park EB On	86.9	F	24.7	C	145.8	F	116.8	F	22.4	C	20.3	C	84.2	F	23.9	C	77.5	F	88.1	F
State Park EB On - State Park WB On	75.4	F	26.0	C	124.7	F	109.4	F	26.4	D	13.7	B	67.3	F	16.6	B	58.0	F	81.2	F
State Park WB On - Park Off	79.2	F	30.1	D	117.8	F	91.7	F	27.9	D	14.5	B	53.1	F	17.9	B	103.6	F	109.1	F
Park Off - Park On	101.1	F	50.9	F	134.1	F	110.9	F	25.1	C	15.7	B	25.7	C	21.1	C	64.9	F	87.5	F
Park On - Bay/Porter St. Off	85.1	F	61.5	F	116.9	F	86.4	F	24.6	C	13.1	B	25.5	C	16.6	B	102.0	F	105.6	F
Bay/Porter St. Off - Bay/Porter St. On	91.8	F	84.1	F	126.2	F	110.0	F									62.5	F	87.6	F
Bay/Porter St. On - 41st St. Off	79.1	F	92.5	F	74.1	F	81.2	F	21.9	C	14.8	B	28.2	D	20.9	C	42.0	E	64.0	F
41st St. Off - 41st St. EB On	95.3	F	102.6	F	108.1	F	112.6	F									53.9	F	92.4	F
41st St. EB On - 41st St. WB On	72.1	F	82.0	F	84.3	F	91.1	F									95.3	F	115.7	F
41st St. WB On - Soquel Dr. Off	71.3	F	74.3	F	84.0	F	83.7	F	24.1	C	9.7	A	44.0	E	13.7	B	101.6	F	109.5	F
Soquel Dr. Off - Soquel Dr./Commmercial Way On	96.0	F	84.7	F	106.3	F	94.5	F	22.3	C	14.2	B	82.0	F	17.5	B	81.5	F	74.7	F
Soquel Dr./Commercial Way On - Soquel Dr./Paul Sweet Rd. On	75.3	F	69.9	F	78.3	F	74.1	F	31.3	D	10.6	A	47.1	F	12.6	B	112.3	F	99.8	F
Soquel Dr./Paul Sweet Rd. On - Morrissey Blvd. Off	40.1	E	38.0	E	62.2	F	28.1	D	25.8	C	10.6	A	26.8	D	12.6	B	71.9	F	33.5	D
Morrissey Blvd. Off - Morrissey Blvd. On	47.2	F	25.6	C	39.1	E	32.8	D	27.8	D	10.6	A	24.9	C	12.6	B	39.1	E	35.0	D
Morrissey Blvd. On - Emeline Ave. Off	41.2	E	28.2	D	25.5	C	23.2	C	23.5	C	9.4	A	22.6	C	10.4	A	24.8	C	24.4	C
Emeline Ave. Off - SR-17 Off	35.8	E	27.5	D	20.6	C	20.4	C	20.3	C	*	*	21.4	C	*	*	22.1	C	21.4	C
END	13.9	B	16.0	B	17.1	B	21.0	C	16.4	B	*	*	22.3	C	*	*	19.2	C	21.5	C
Southbound																				
START	11.9	B	91.2	F	72.2	F	198.0	F	22.1	C	*	*	21.0	C	*	*	21.3	C	173.8	F
Ocean Ave. On - SR-17 SB On	16.2	B	144.9	F	72.5	F	174.5	F	28.8	D	*	*	27.0	D	*	*	27.7	D	153.3	F
SR-17 SB On - Fairmount Ave. Off	27.3	D	87.0	F	84.4	F	156.5	F	26.2	D	*	*	21.8	C	*	*	25.3	C	142.2	F
Fairmount Ave. Off - Fairmount Ave. On	21.4	C	100.6	F	134.6	F	171.2	F	21.1	C	*	*	18.3	C	*	*	18.9	C	156.8	F
Fairmount Ave. On - Morrissey Blvd. On	24.2	C	89.5	F	125.2	F	162.6	F	23.5	C	*	*	20.2	C	*	*	20.9	C	147.6	F
Morrissey Blvd. On - Soquel Dr. Off	28.5	D	77.8	F	95.8	F	144.8	F	22.7	C	*	*	19.3	C	*	*	22.4	C	136.8	F
Soquel Dr. Off - Soquel Ave. On	20.1	C	108.7	F	114.2	F	166.5	F	28.6	D	9.1	A	27.0	D	10.0	A	26.7	D	145.4	F
Soquel Ave. On - 41st St. Off	25.4	C	82.7	F	91.7	F	140.5	F	21.6	C	11.8	B	91.1	F	12.3	B	21.3	C	148.2	F
41st St. Off - 41st St. WB On	20.3	C	91.8	F	119.9	F	148.9	F									39.9	E	127.9	F
41st St. WB On - 41st St. EB On	22.2	C	81.2	F	99.8	F	129.5	F	33.7	D	11.8	B	102.2	F	12.3	B	63.3	F	139.4	F
41st St. EB On - Bay/Porter St. Off	18.1	C	73.1	F	84.2	F	66.0	F									43.0	E	71.6	F
Bay/Porter St. Off - Bay/Porter St. On	24.3	C	65.1	F	107.7	F	115.1	F									32.5	D	121.4	F
Bay/Porter St. On - Park Rd. Off	28.6	D	54.1	F	41.7	E	30.8	D	27.1	D	13.5	B	44.7	E	16.9	B	27.5	D	98.4	F
Park Rd. Off - Park Rd. On	21.2	C	61.6	F	47.2	F	34.5	D	13.6	B	6.4	A	90.9	F	14.5	B	20.7	C	99.6	F
Park Rd.. On - State Park Rd. Off	23.9	C	39.0	E	50.2	F	71.9	F	17.4	B	9.4	A	82.7	F	21.0	C	18.9	C	87.5	F
State Park Rd. Off - State Park Rd. WB On	20.6	C	28.8	D	57.3	F	100.7	F	17.5	B	8.1	A	91.8	F	18.1	B	24.8	C	72.9	F
State Park Rd. WB On - State Park Rd. EB On	22.9	C	34.4	D	55.7	F	66.2	F	26.0	C	9.8	A	38.9	E	22.0	C	19.2	C	96.5	F
State Park Rd. EB On - Rio Del Mar Blvd. Off	24.5	C	36.5	E	52.9	F	42.5	E	27.6	D	11.1	B	25.2	C	20.4	C	38.8	E	86.4	F
Rio Del Mar Blvd. Off - Rio Del Mar Blvd. On	21.7	C	27.3	D	74.2	F	70.0	F	41.0	E	9.9	A	32.7	D	16.4	B	34.3	D	40.9	E
Rio Del Mar Blvd. On - Freedom Blvd. Off	25.6	C	33.4	D	31.3	D	37.6	E	38.5	E	12.7	B	25.5	C	16.9	B	22.9	C	25.9	C
Freedom BLvd. Off - Freedom Blvd. On	21.2	C	25.7	C	22.1	C	25.7	C	60.6	F	11.1	A	30.1	D	13.7	B	28.3	D	33.6	D
Freedom Blvd. On - Larkin Rd. Off	23.4	C	27.0	D	24.0	C	27.7	D	33.4	D	11.1	A	35.9	E	13.7	B	32.6	D	37.1	E
Larkin Rd. Off - Larkin Rd. On	21.3	C	21.4	C	19.0	C	20.4	C	29.8	D	10.6	A	28.8	D	12.4	B	26.8	D	26.0	C
END	15.1	B	14.7	B	20.7	C	19.6	C	21.3	C	*	*	28.8	D	*	*	21.9	C	23.0	C

Source: Wilbur Smith Associates, February 2007

NOTE:
* - Segments without HOV lanes

The phenomena described above may also occur in the other scenarios, to a smaller extent. State Route 1 is a continuous corridor that can be analyzed segment-by-segment, but comparing only a particular segment across different scenarios can be misleading. When roadway improvements are provided at a particular segment, the bottleneck may disappear at that location but only to reappear elsewhere downstream. The traffic that is held up at a bottleneck can flow freely after improvements are made at that location until it reaches the next bottleneck, which might have been hidden previously because of lower traffic volumes, creating new backups at this location. Therefore, segments that were previously clear would experience added congestion, while segments that were previously congested would improve. To avoid such misconceptions, the impacts of corridor-wide improvements such as HOV lanes or TSM strategies should be measured for the corridor as a whole. The segment-by-segment analysis can then be used to identify the present location of the bottlenecks and also their future locations after roadway improvements are implemented.

5.5 YEAR 2035 CONCLUSIONS

The Year 2035 forecast analysis indicates that travel demand would far outweigh available capacity, creating high levels of congestion on the freeway, ramps, and local streets.

Under Existing Conditions, the State Route 1 corridor experiences congestion in the peak commute directions (northbound direction during AM peak hour and southbound direction during PM peak hour), operating at LOS F. On the other hand, for the reverse commute directions, most of the study ramps and study intersections perform at acceptable service levels. However, by year 2035, traffic operations at all locations would be congested during the peak hour. The study freeway segments, study ramps, and study intersections would operate at LOS F. The already-congested peak commute directions under Existing Conditions would worsen in the future; as such, fewer vehicles would be able to travel through the corridor. On the local streets, high delays and long queue lengths would exceed the typical formulaic thresholds, which make them unquantifiable and unreliable to report.

The TSM strategies such as ramp metering and the addition of auxiliary lanes would improve the operations on the non-commute freeway directions, helping to improve their efficiency as well as preventing them from breaking down. For this freeway corridor under Year 2035 Conditions, it was observed that the corridor would be too congested and broken down to gain the benefits of the TSM strategies. In fact, TSM improvements would likely worsen the traffic operations at the ramps and local intersections. This hypothesis could not be fully proven since the intersection LOS that result under the Year 2035 No-Build scenario already exceeded the modeling thresholds to develop meaningful comparisons.

The analysis of the Year 2035 HOV Build scenario emphasized that the addition of a continuous HOV lane throughout the study area would provide a needed capacity increase for the area. Furthermore, the additional capacity provided would encourage commuters to switch from solo drivers to carpool. While some of the mixed-flow lane traffic operations would operate at unacceptable LOS, traffic on the HOV lanes are expected to operate at LOS D or better. Also, the study intersection operations would improve under the HOV Build scenario. Of the 25 study intersections, 15 and 12 intersections would operate under acceptable conditions during AM and PM peak hours, respectively.

Chapter 6
OPENING YEAR 2015 TRAFFIC OPERATIONS

Overview

This chapter discusses the year 2015 traffic operating conditions for the No-Build, HOV Build, and TSM Build scenarios on State Route 1.

The traffic operations models were run for the same geometrics assumed for the Year 2035 Conditions analysis, (HOV Build Scenario: northbound Scenario 11 and southbound Scenario 7; TSM Build Scenario: northbound Scenario 3 and southbound Scenario 2), *FREQ* software package was run to model the year 2015 traffic conditions, for the AM peak period (6 AM to 12 PM) and PM peak period (2 PM to 8 PM).

6.1 2015 NO-BUILD ALTERNATIVE ANALYSIS

6.1.1 Proposed Improvements and Network Assumptions

Year 2015 traffic volumes estimated from the AMBAG travel demand forecasting model were incorporated into the freeway simulation model (*FREQ*), assuming some changes to the existing corridor geometries to account for various non-HOV improvements already planned by Caltrans, including auxiliary lanes, interchange improvements, and intersection improvements. The *Highway 1 Soquel to Morrissey Auxiliary Lanes Project* is included in Year 2015 projections. The same freeway lane configurations were used for Year 2015 No-Build Conditions as shown in *Chapter 5 (Figure 5-1)* for Year 2035 No-Build Conditions. The year 2015 traffic volumes at select junctions of the corridor for the Year 2015 AM and PM peak periods are exhibited in *Figures 6-1A* and *6-1B*, respectively. A summary of the results from various Measures of Effectiveness (MOEs) is presented in *Table 6-1*, while the *FREQ* output is presented in *Appendix E-5*.

6.1.2 Vehicle Throughput

Traffic demand on State Route 1 under Year 2015 No-Build scenario is expected to increase when compared to Existing Conditions. The additional demand would be served by the corridor, in most cases, resulting in an overall increase in the vehicle throughput. The northbound direction would carry approximately 3,500 vehicles during the AM peak hour; up by 18 percent compared to the Existing Conditions.

On the other hand, the southbound direction would carry 2,900 vehicles during the PM peak hour, a decrease of six percent from the Existing Conditions. The southbound direction already experiences heavy congestion during the PM peak hour under Existing Conditions, with a traffic density of 59 passenger cars per mile per lane (pcpmpl), which represents LOS F conditions. The decline in vehicle throughput is caused by the corridor's inability to serve the additional demand and the worsening of congestion levels by year 2015.

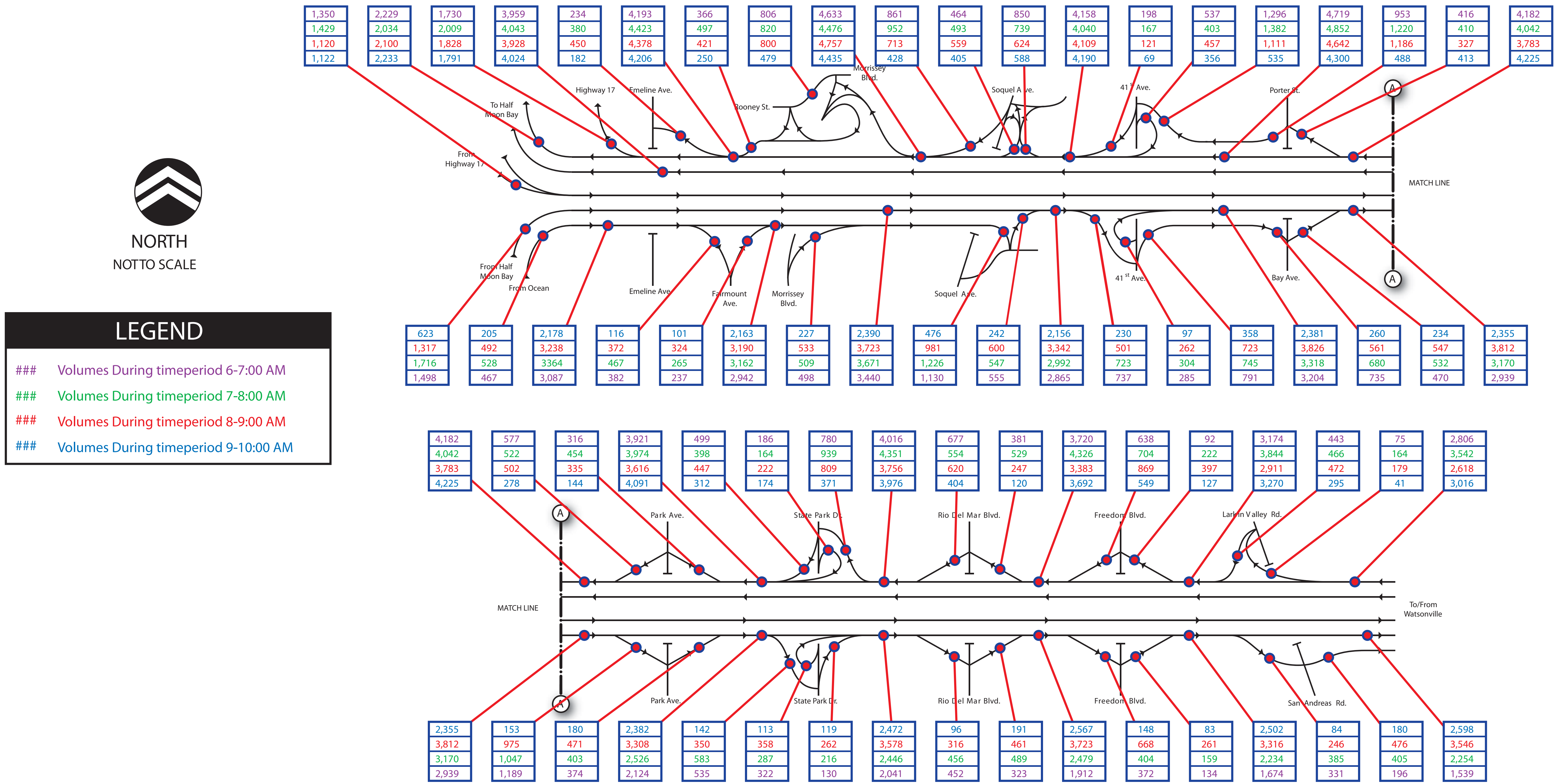

Figure 6-1A

FREEWAY AND RAMP VOLUMES
YEAR 2015 NO BUILD SCENARIO (AM PEAK)

NORTH
NOT TO SCALE

LEGEND

- ### Volumes During timeperiod 3-4:00 PM
- ### Volumes During timeperiod 4-5:00 PM
- ### Volumes During timeperiod 5-6:00 PM
- ### Volumes During timeperiod 6-7:00 PM

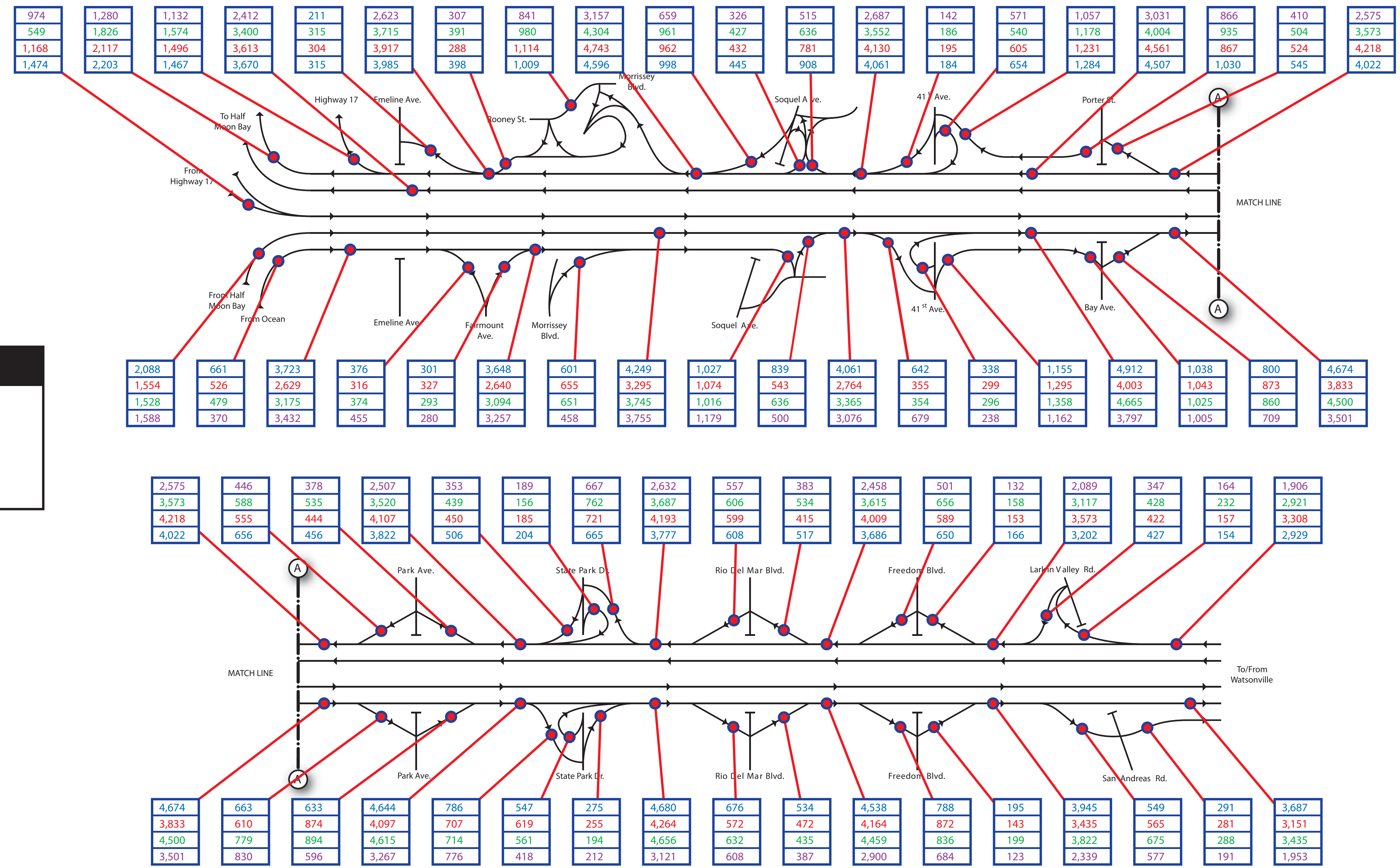

Figure 6-1B
FREEWAY AND RAMP VOLUMES
YEAR 2015 NO BUILD SCENARIO (PM PEAK)

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Table 6-1
Comparison of Measure of Effectiveness - Existing versus Year 2015 No-Build Scenarios

Measure of Effectiveness	Existing AM	Existing PM	2015 No-Build AM	2015 No-Build PM	% Difference AM	% Difference PM
Northbound						
Average Travel Time (minutes)	23	15	24	12	4%	-20%
	16	***12***	***20***	***11***	***25%***	***-8%***
Average Speed (mph)	30	39	29	49	-3%	26%
	44	***52***	***36***	***53***	***-18%***	***2%***
Delay (minutes per vehicle)	14	6	13	3	-7%	-50%
	4	***2***	***8***	***2***	***100%***	***0%***
No. of Vehicle Trips (per hour)	2,923	3,235	3,449	3,878	18%	20%
	3,045	***2,805***	***3,376***	***3,189***	***11%***	***14%***
No. of Persons Trips (per hour)	3,308	4,024	3,904	4,825	18%	20%
	3,447	***3,489***	***3,822***	***3,967***	***11%***	***14%***
Freeway Travel Time (VHT)	1,274	823	1,436	797	13%	-3%
	821	***544***	***1,119***	***602***	***36%***	***11%***
Travel Distance (VMT)	38,517	32,349	40,698	38,783	6%	20%
	35,933	***28,045***	***39,841***	***31,889***	***11%***	***14%***
Avg. Vehicle Occupancy	1.13	1.24	1.13	1.24	0%	0%
(persons/vehicle)	***1.13***	***1.24***	***1.13***	***1.24***	***0%***	***0%***
Density	49	41	59	40	20%	-2%
(passenger cars per mile per lane)	***35***	***27***	***47***	***30***	***34%***	***11%***
Level of Service	F	E	F	E	N.A.	N.A.
	D	***D***	***F***	***D***	***N.A.***	***N.A.***
Southbound						
Average Travel Time (minutes)	10	27	12	47	20%	74%
	10	***18***	***11***	***28***	***10%***	***56%***
Average Speed (mph)	60	26	51	15	-15%	-42%
	61	***39***	***58***	***25***	***-5%***	***-36%***
Delay (minutes per vehicle)	0	15	2	35	N.A.	133%
	0	***6***	***1***	***16***	***170%***	***167%***
No. of Vehicle Trips (per hour)	2,918	3,101	3,239	2,900	11%	-6%
	2,332	***2,885***	***2,596***	***2,933***	***11%***	***2%***
No. of Persons Trips (per hour)	3,385	3,664	3,757	3,421	11%	-7%
	2,705	***3,405***	***3,011***	***3,456***	***11%***	***1%***
Freeway Travel Time (VHT)	507	1,391	661	2,254	30%	62%
	400	***858***	***463***	***1,371***	***16%***	***60%***
Travel Distance (VMT)	30,348	35,661	33,683	33,929	11%	-5%
	24,251	***33,182***	***26,996***	***34,311***	***11%***	***3%***
Avg. Vehicle Occupancy	1.16	1.18	1.16	1.18	0%	0%
(persons/vehicle)	***1.16***	***1.18***	***1.16***	***1.18***	***0%***	***0%***
Density	24	60	32	97	33%	62%
(passenger cars per mile per lane)	***19***	***37***	***22***	***59***	***16%***	***59%***
Level of Service	C	F	D	F	N.A.	N.A.
	C	***E***	***C***	***F***	***N.A.***	***N.A.***

Source: Wilbur Smith Associates, April 2007

NOTES:
Non-italicized and non-bold values represent peak hour values.
Bold *italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

As discussed in *Chapter 5*, a corridor would only be able to serve a smaller number of vehicles when it breaks down, since vehicles within the corridor are forced to stop-and-go, reducing efficient and smooth travel that would result in lower average speeds and flow capacities. The existing bottlenecks within the study area would increase the additional traffic demand, worsening the overall performance and experiencing a decline in vehicle throughput and an increase in average vehicle delays. Levels of service and travel delay as performance measures will be discussed in greater detail in the following sections.

6.1.3 Delays and Densities

By year 2015, traffic operations are expected to deteriorate when compared to the Existing Conditions. Under the Year 2015 No-Build Conditions, the vehicle density in the northbound direction during the AM peak hour would increase from the existing 49 passenger cars per mile per lane (pcpmpl) (LOS F) to 59 pcpmpl (LOS F). For a complete description of service levels and their relationships with density values, refer to *Table 2-3* in *Chapter 2*.

In the northbound direction during the PM peak hour (reverse commute), future traffic operations show a slight improvement; traffic densities would decrease from 41 pcpmpl (LOS E) to 40 pcpmpl (LOS E). The improvement is likely to be caused by the implementation of the non-HOV improvements already planned by Caltrans for the area (*Route 1/17 Widening for Merge Lanes Project* and *Highway 1 Soquel to Morrissey Auxiliary Lanes Project*, between Morrissey Boulevard and Soquel Avenue interchanges) for congestion relief. There is a bigger contrast in travel delay measures, where there would be a 50 percent reduction in average delay per vehicle (from six minutes to three minutes) from the Existing Conditions to the Year 2015 No-Build Conditions. Note that, while moving in the same direction, the measures of density, LOS, and delay performance measures do not share a linear relationship with each other. When traffic operations start to break down, a relatively small number of vehicles added to the network can potentially increase delay and travel time by much larger orders of magnitude.

The southbound direction of State Route 1 would experience a higher increase in density during the PM peak hour, from 60 pcpmpl (LOS F) under existing conditions to 97 pcpmpl (LOS F) by year 2015, a 62 percent increase. As mentioned in *Section 6.1.2*, the southbound direction of State Route 1 is already experiencing heavy congestion under Existing Conditions during the PM peak hour, and would worsen by year 2015. This resulted in a travel delay increase of 133 percent, from 15 minutes per vehicle under Existing Conditions to 35 minutes per vehicle under the Year 2015 No-Build scenario.

In the northbound direction, travel time on State Route 1 would increase during the AM peak hour as speed decreases, but average delay per vehicle would also decrease. This phenomenon can be explained by the algebraic expression of average delay per vehicle which is Freeway Travel Time divided by vehicle throughput and by year 2015, vehicle throughput would increase much rapidly than the reduction in speed. As a result, although the total delay (VHT) would increase, the average delay per vehicle would decrease, due to a larger increase in the denominator.

6.1.4 Travel Speed and Travel Time

Under the Year 2015 No-Build Conditions, there would be a slight increase in travel time compared to the Existing Conditions. In the northbound direction under the AM peak hour, travel time would increase by one minute on average (up from 23 minutes to 24 minutes) and average speeds would reduce by one mph (down from 30 mph to 29 mph). In the southbound direction the average travel time would increase during the PM peak hour from 27 minutes to 47 minutes (74 percent increase) and average speed would decrease from 26 mph to 15 mph (42 percent reduction).

Following the similar trends already presented in the previous sections for the non-commute directions, the northbound direction during the PM peak hour would actually experience a slight reduction in travel time and an increase in average speed. Travel time would decrease by 20 percent, down from 15 minutes under existing conditions to 12 minutes under the Year 2015 No-Build Scenario, while speeds would increase by 26 percent, up from 39 mph to 49 mph.

6.1.5 Intersections Operation Analysis

Using the methodology described in *Section 4.5*, turning movement volumes at the study intersections were estimated for the Year 2015 No-Build Conditions. *Figures 6-2A, 6-2B,* and *6-2C* exhibit the intersection volumes under Year 2015 No-Build AM and PM peak hours.

During Year 2015 No-Build AM peak hour conditions, 17 of the 25 study intersections would operate under an unacceptable level of service (LOS E or F). The eight (8) intersections that would operate under an acceptable level of service (LOS D or better) are:

- Soquel Avenue/ State Route 1 Southbound Ramps
- 41st Avenue/ State Route 1 Northbound Off-Ramp
- 41st Avenue/ State Route 1 Southbound Ramps
- Porter Street/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Southbound Ramps
- Rio Del Mar Boulevard/ State Route 1 Southbound Ramps
- San Andreas Road/ Larkin Road/ State Route 1 Northbound Off- Ramp

During Year 2015 No-Build PM peak hour, 12 of the 25 study intersections would operate under an unacceptable level of service. The 13 intersections that would operate under an acceptable level of service are:

- Morrissey Boulevard/ Rooney Street/ Pacheco Avenue
- Rooney Street/ State Route 1 Northbound Ramps
- Soquel Drive/ Paul Sweet Road/ Commercial Way
- 41st Avenue/ State Route 1 Northbound Off-Ramp
- 41st Avenue/ State Route 1 Southbound Ramps
- Porter Street/ State Route 1 Northbound Ramps
- Bay Avenue/ State Route 1 Southbound Ramps

- Park Avenue/ State Route 1 Northbound Ramps
- Park Avenue/ State Route 1 Southbound Ramps
- State Park Drive/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Southbound Ramps
- Rio Del Mar Boulevard/ State Route 1 Southbound Ramps
- San Andreas Road/ Larkin Road/ State Route 1 Northbound Off- Ramp

The complete results of Year 2015 No-Build LOS analysis are presented in *Table 6-2*, while the results of the intersection operations model (*Synchro*) output sheets for the study intersections under Year 2015 No-Build peak hour conditions are presented in *Appendix C-5*.

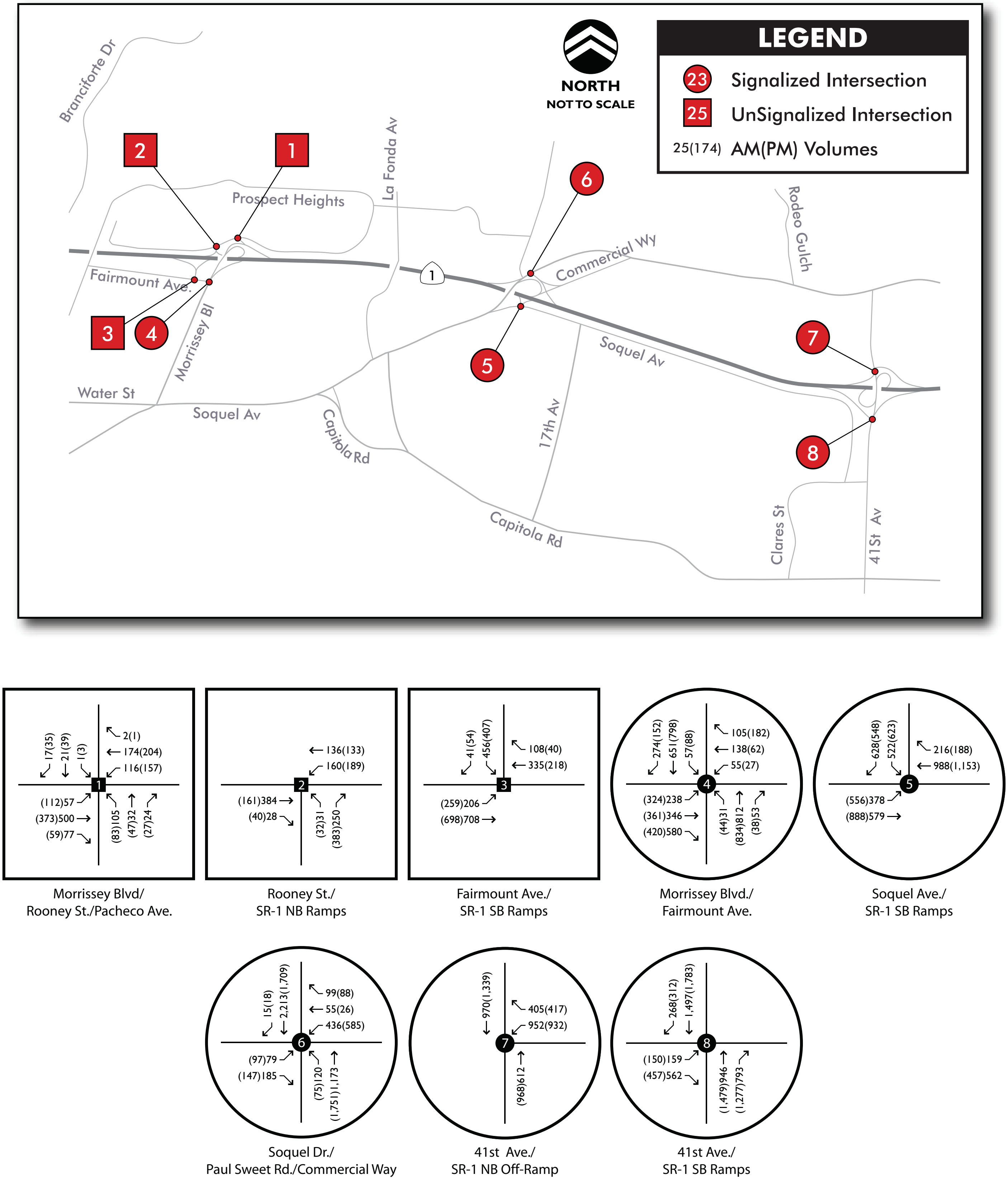

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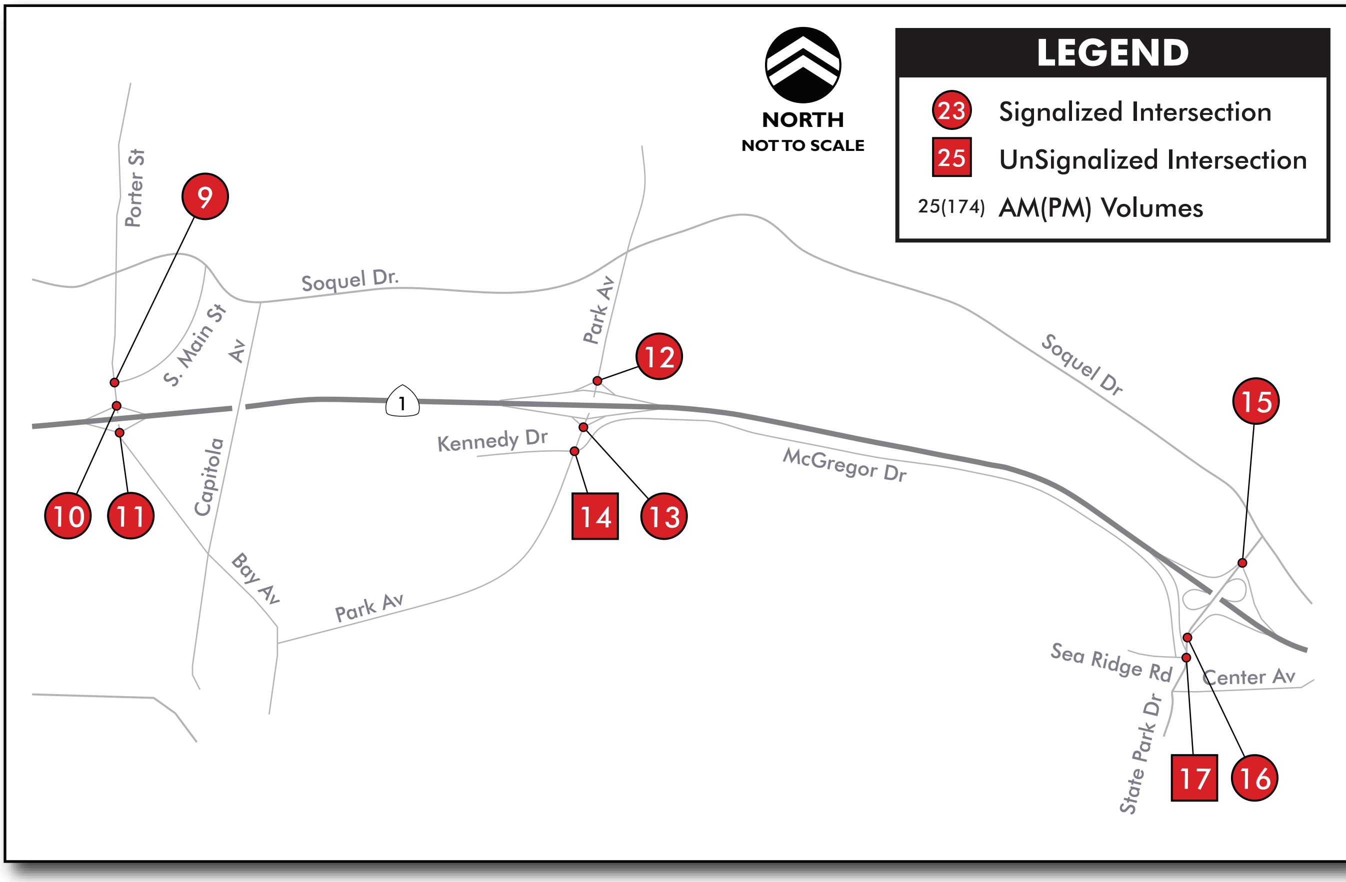
Figure 6-2A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 NO BUILD CONDITIONS



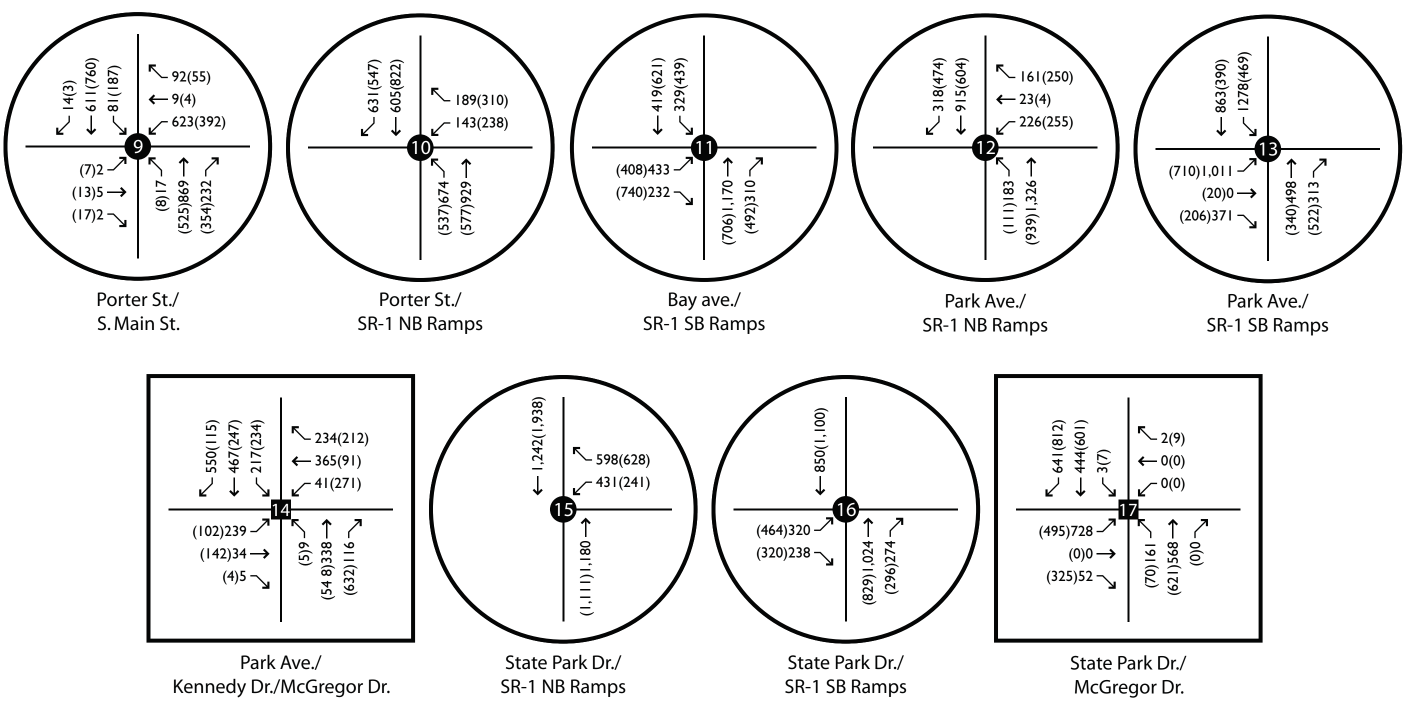


Figure 6-2B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 NO BUILD CONDITIONS

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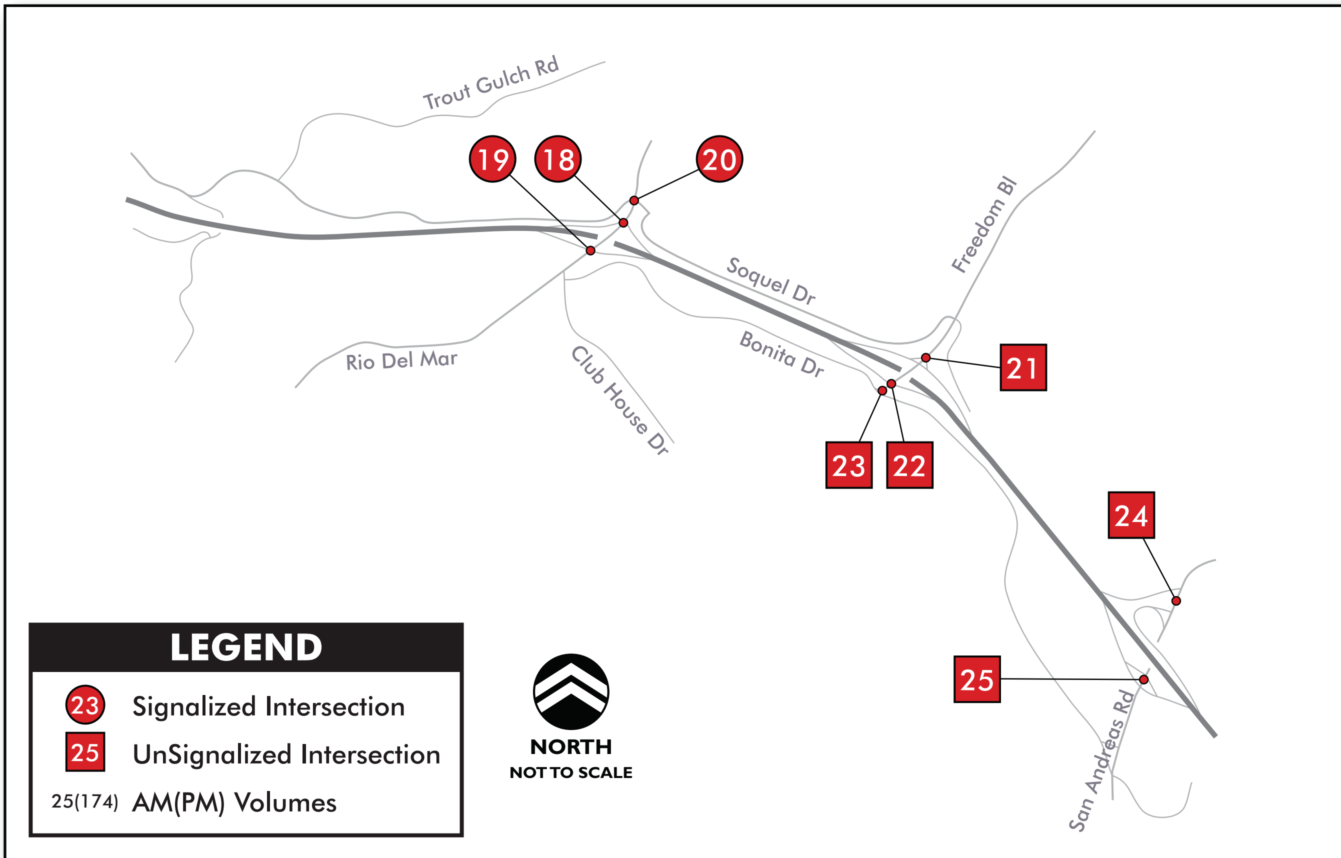

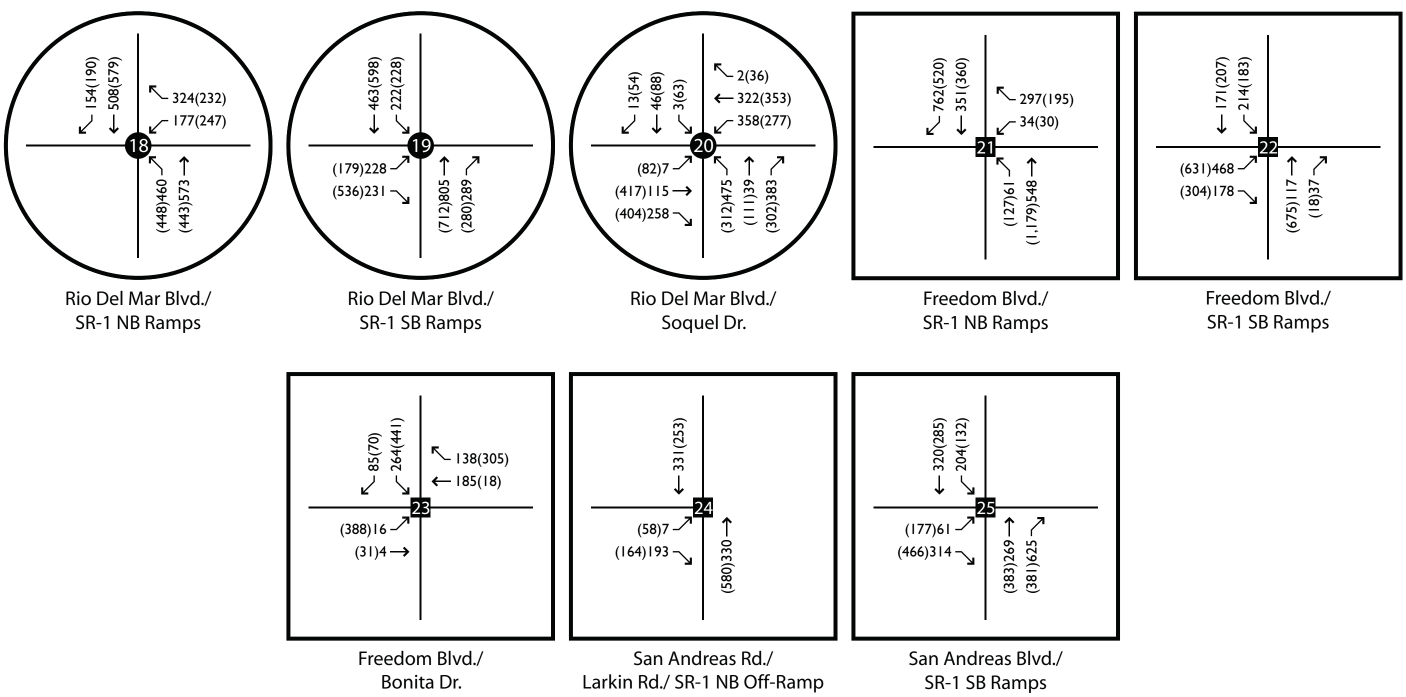

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Figure 6-2C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 NO BUILD CONDITIONS

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Table 6-2
Intersection LOS Summary – Year 2015 No-Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	City of Santa Cruz	AWSC	**83.8**	**F**	24.5	C
2	Rooney St./ SR-1 NB Ramps	Caltrans	TWSC	**74.6** (NB)	**F**	18.7 (NB)	C
2	Fairmount Ave./ SR-1 SB Ramps	Caltrans	AWSC	**341.4**	**F**	**244.5**	**F**
3	Morrissey Blvd./ Fairmount Ave.	Caltrans	Signal	**80.6**	**F**	**58.8**	**E**
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	42.4	D	**99.4**	**F**
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	**74.1**	**E**	35.9	D
7	41^{st} Ave./ SR-1 NB Off-Ramp	Caltrans	Signal	17.5	B	17.5	B
8	41^{st} Ave./ SR-1 SB Ramps	Caltrans	Signal	16.8	B	37.6	D
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	**37.9**	**D**	**36.1**	**D**
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	47.0	D	42.2	D
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	**95.0**	**F**	53.7	D
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	**108.8**	**F**	24.3	C
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	**85.1**	**F**	40.5	D
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	AWSC	**739.7**	**F**	**509.3**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	49.7	D	19.7	B
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	26.0	C	39.0	D
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	**141.1**	**F**	**110.3**	**F**
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	53.1	D	29.9	C

Table 6-2
Intersection LOS Summary – Year 2015 No-Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	**149.2**	**F**	**130.2**	**F**
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	TWSC	**>1000** (NWB)	**E**	**74.4** (NWB)	**F**
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	AWSC	**66.5**	**F**	**169.2**	**F**
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	TWSC	**143.8** (EB)	**F**	**>1000** (EB)	**F**
24	San Andreas Rd./ Larkin Rd./ SR-1 NB Off-Ramp	Caltrans	TWSC	13.4 (EB)	B	14.9 (EB)	B
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	TWSC	**111.3** (SEB)	**F**	**95.1** (SEB)	**F**

Source: Wilbur Smith Associates, April 2007

NOTES:
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

6.2 2015 HOV BUILD ALTERNATIVE ANALYSIS

6.2.1 Proposed Improvements and Network Assumptions

Similar to the Year 2035 HOV Build scenario, simulation was performed to quantify the benefits of implementing HOV lanes, ramp metering, and supporting auxiliary lanes on State Route 1, assuming the final lane and intersection geometrics evaluated and finalized in a technical memorandum dated August 25, 2006, (northbound Scenario 11 and southbound Scenario 7) and included in *Appendix A-7* of this report. The AM and PM corridor volumes for the Year 2015 HOV Build scenario are presented in *Figures 6-3A* and *6-3B*, respectively. The results of the *FREQ* analyses are summarized in *Table 6-3*, while the output is exhibited in *Appendix E-6*.

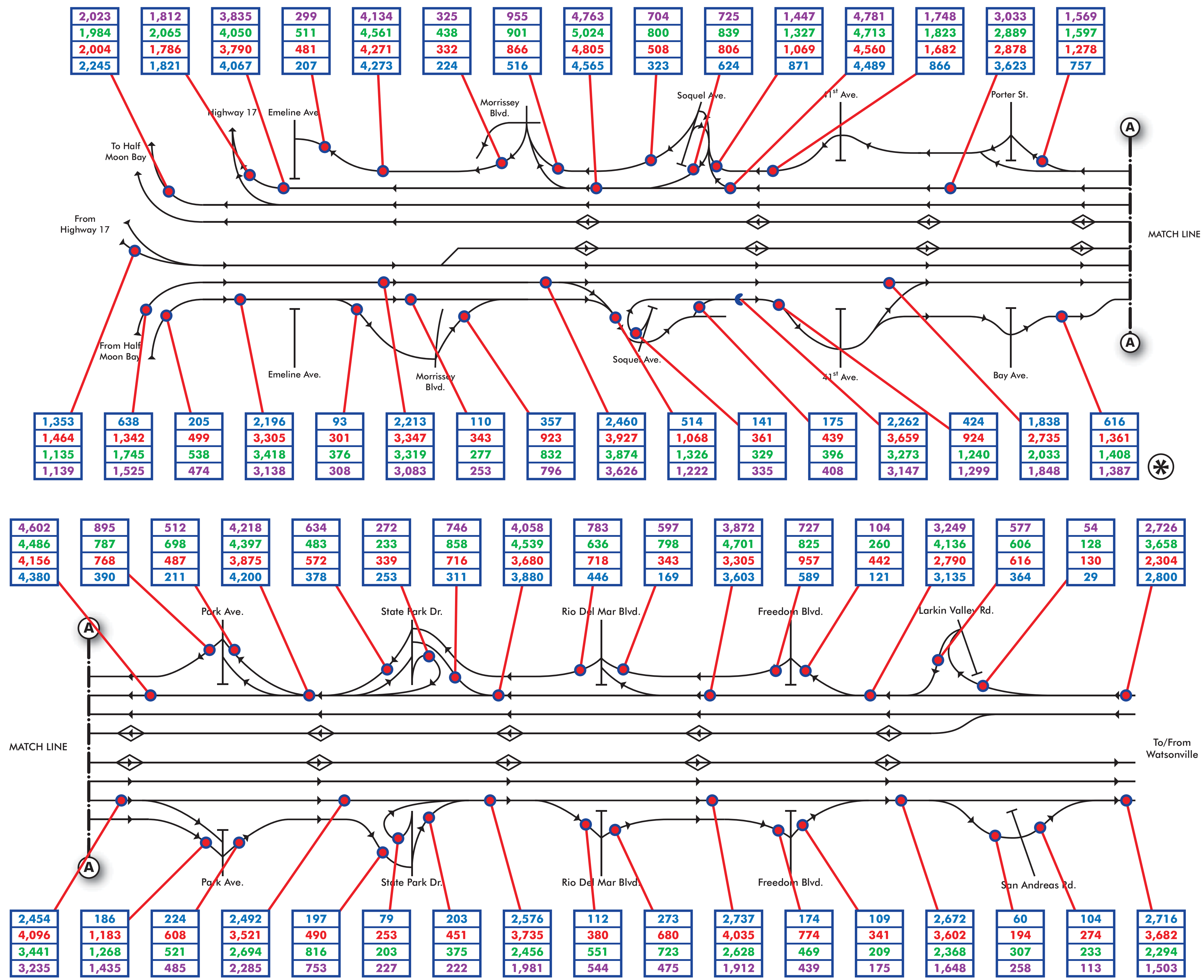
6.2.2 Vehicle Throughput

The addition of the HOV lanes, ramp metering, and auxiliary lanes within the State Route 1 study area is expected to improve overall traffic performance while at the same time increase vehicle throughput. The *FREQ* results identified that in the northbound direction during the AM peak hour, vehicle throughput would increase from 3,449 vehicles per hour under the Year 2015 No-Build scenario to 3,935 vehicles per hour under the Year 2015 HOV Build scenario, an increase of 14 percent. Similarly, the southbound direction in the PM peak hour would have a vehicle throughput increase of 39 percent, from 2,900 vehicles to 4,029 vehicles. The improved corridor conditions would draw vehicles traveling on parallel arterials onto State Route 1, relieving the local city streets from excessive cut-through commuter traffic.

Person-trips would also increase along with higher vehicle throughput, showing increases of 27 percent and 49 percent in the northbound direction during the AM peak period and southbound direction during the PM peak period, respectively. Comparing the person and vehicle throughputs, it can be observed that the Average Vehicle Occupancies (AVO) between the two scenarios would increase as well. This suggests that while the addition of the HOV lanes would increase travel demand, it would also encourage motorists to take better advantage of the new facility by carpooling. In the northbound direction during the AM peak hour, the AVO is expected to be 1.26 vehicles per person, while in the southbound direction during PM peak hour, the AVO would be 1.27 persons per vehicle.

6.2.3 Delays and Densities

The State Route 1 corridor seems to accommodate the increased travel demand with no difficulties, as the increased vehicle volumes resulted in improved levels of service, especially on the HOV lanes. The HOV lanes under this scenario would not operate below LOS B. In the northbound direction during the AM peak hour, the traffic density would improve from 59 pcpmpl (LOS F) overall to 22 pcpmpl on the mixed-flow lanes (LOS C) and 12 pcpmpl (LOS A) on the HOV lanes. In the southbound direction during the PM peak hour, densities would improve from 97 pcpmpl (LOS F) overall to 22 pcpmpl (LOS C) on the mixed-flow lanes and 12 pcpmpl (LOS B) on the HOV lanes.



NORTH
NOT TO SCALE

LEGEND

- HOV Lane
- ### Volumes During timeperiod 6-7:00 AM
- ### Volumes During timeperiod 7-8:00 AM
- ### Volumes During timeperiod 8-9:00 AM
- ### Volumes During timeperiod 9-10:00 AM
- ✱ Indicates 41st Ave. and Bay Ave. SB On-Ramp Volumes

Figure 6-3A

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 BUILD HOV CONDITIONS (AM PEAK)

393070/FWY-RAMP - 04/02/07

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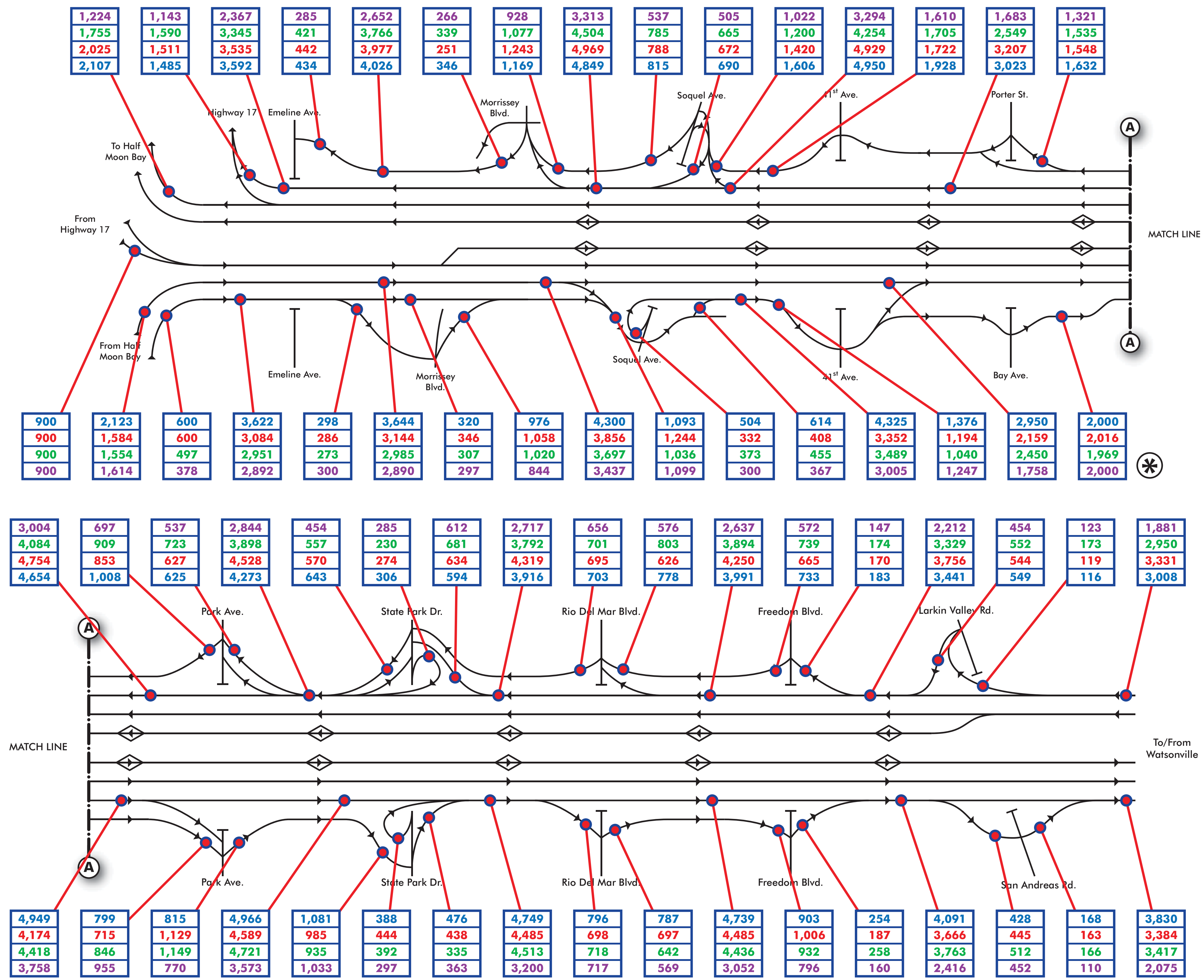

NORTH
NOT TO SCALE

LEGEND

- ◇ HOV Lane
- ### Volumes During timeperiod 3-4:00 PM
- ### Volumes During timeperiod 4-5:00 PM
- ### Volumes During timeperiod 5-6:00 PM
- ### Volumes During timeperiod 6-7:00 PM
- ⊛ Indicates 41st Ave. and Bay Ave. SB On-Ramp Volumes

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Figure 6-3B
STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 BUILD HOV CONDITIONS (PM PEAK)

393070/FWY-RAMP - 04/02/07

Table 6-3
Comparison of Measure of Effectiveness - Year 2015 No-Build versus Year 2015 HOV Build Scenarios

Measure of Effectiveness	2015 No-Build		2015 HOV Build		% Difference	
	AM	PM	AM	PM	AM	PM
Northbound						
Average Travel Time (minutes)	24 ***20***	12 ***11***	10 ***10***	9 ***9***	-58% ***-50%***	-25% ***-18%***
Average Speed (mph)	29 ***36***	49 ***53***	59 ***60***	62 ***61***	103% ***67%***	27% ***15%***
Delay (minutes per vehicle)	13 ***8***	3 ***2***	1 ***0***	0 ***0***	-95% ***-95%***	-95% ***-96%***
No. of Vehicle Trips (per hour)	3,449 ***3,376***	3,878 ***3,189***	3,935 ***3,534***	3,979 ***3,192***	14% ***5%***	3% ***0%***
No. of Persons Trips (per hour)	3,904 ***3,822***	4,825 ***3,967***	4,947 ***4,436***	5,112 ***4,070***	27% ***16%***	6% ***3%***
Freeway Travel Time (VHT)	1,436 ***1,119***	797 ***602***	754 ***658***	627 ***505***	-47% ***-41%***	-21% ***-16%***
Travel Distance (VMT)	40,698 ***39,841***	38,783 ***31,889***	44,397 ***39,599***	38,584 ***30,996***	9% ***-1%***	-1% ***-3%***
Avg. Vehicle Occupancy (persons/vehicle)	1.13 ***1.13***	1.24 ***1.24***	1.26 ***1.26***	1.28 ***1.28***	11% ***11%***	3% ***3%***
Density (passengers per mile per lane)	59 ***47***	40 ***30***	22 (12) ***19 (10)***	20 (14) ***16 (11)***	N.A. ***N.A.***	N.A. ***N.A.***
Level of Service	F ***F***	E ***D***	C (B) ***C (A)***	C (B) ***B (A)***	N.A. ***N.A.***	N.A. ***N.A.***
Southbound						
Average Travel Time (minutes)	12 ***11***	47 ***28***	9 ***9***	10 ***10***	-25% ***-18%***	-79% ***-64%***
Average Speed (mph)	51 ***58***	15 ***25***	62 ***61***	59 ***60***	22% ***5%***	293% ***140%***
Delay (minutes per vehicle)	2 ***1***	35 ***16***	0 ***0***	1 ***1***	-97% ***-79%***	-98% ***-97%***
No. of Vehicle Trips (per hour)	3,239 ***2,596***	2,900 ***2,93***	3,470 ***2,649***	4,029 ***3,207***	7% ***2%***	39% ***9%***
No. of Persons Trips (per hour)	3,757 ***3,011***	3,421 ***3,456***	4,253 ***3,224***	5,109 ***4,043***	13% ***7%***	49% ***17%***
Freeway Travel Time (VHT)	661 ***463***	2,254 ***1,371***	570 ***439***	752 ***599***	-14% ***-5%***	-67% ***-56%***
Travel Distance (VMT)	33,683 ***26,996***	33,929 ***34,311***	35,070 ***26,848***	44,740 ***35,698***	4% ***-1%***	32% ***4%***
Avg. Vehicle Occupancy (persons/vehicle)	1.16 ***1.16***	1.18 ***1.18***	1.23 ***1.22***	1.27 ***1.26***	6% ***5%***	7% ***7%***
Density (passengers per mile per lane)	32 ***22***	97 ***59***	19 (9) ***15 (6)***	22 (12) ***18 (9)***	N.A. ***N.A.***	N.A. ***N.A.***
Level of Service	D ***C***	F ***F***	C (A) ***B (A)***	C (B) ***B (A)***	N.A. ***N.A.***	N.A. ***N.A.***

Source: Wilbur Smith Associates, April 2007

NOTES:
28 (10) – Density of mixed-flow lanes (Density of HOV lane)
D (A) – LOS of mixed-flow lanes (LOS of HOV lane)
Non-italicized and non-bold values represent peak hour values.
Bold *italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

The most obvious benefit of the HOV lanes would be the decrease in travel delay, which under the Year 2015 No-Build scenario would be 35 minutes (southbound PM peak hour). In the northbound direction during the AM peak hour, delay would average one minute per vehicle, a 95 percent reduction, and in the southbound direction during the PM peak hour, the delay is expected to also average one minute per vehicle, a reduction of 98 percent.

6.2.4 Travel Speed and Travel Time

The *FREQ* results show that the average travel time would decrease in the range of 18 to 79 percent between the Year 2015 No-Build and Year 2015 HOV Build scenarios, depending on the direction of travel and time period. Specifically, the average travel time in the northbound direction during the AM peak hour would decrease from 24 minutes per vehicle to 10 minutes per vehicle (delay-free travel), an improvement of 58 percent, and travel speed would increase from 29 mph to 59 mph (free-flow speeds), an improvement of 103 percent. The average travel time and the travel speed show similar trends in the southbound direction during the PM peak hour, with average travel time decreasing from 47 minutes to 10 minutes (79 percent improvement) and travel speed increasing from 15 mph to 59 mph (293 percent improvement).

6.2.5 Intersection Operations Analysis

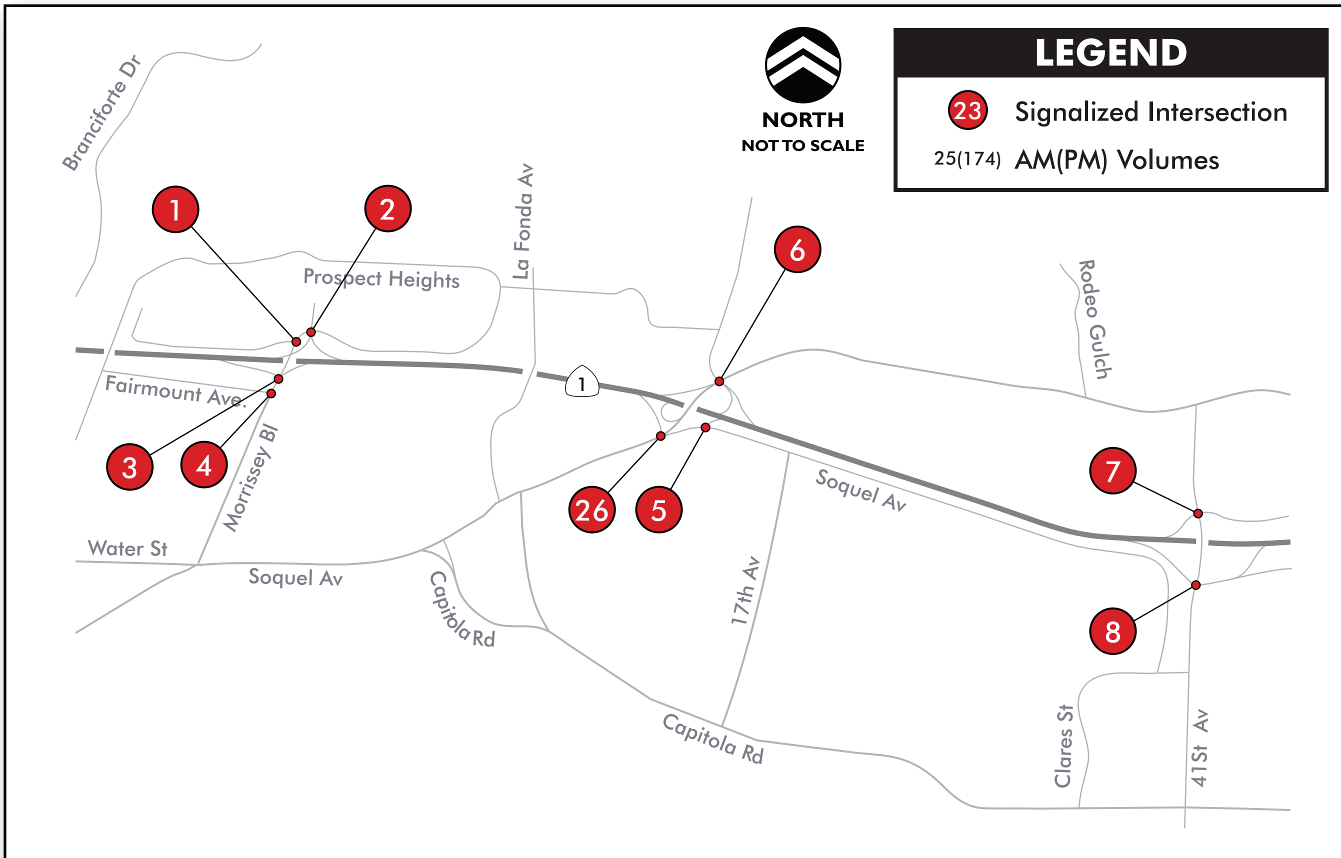
Peak hour intersection turning movement volumes under Year 2015 HOV Build Conditions were developed from the traffic volumes under Existing and Year 2035 HOV Build Conditions based on straight-line interpolation methodology (described in *Chapter 4, Section 4.5*). *Figures 6-4A, 6-4B*, and *6-4C* exhibit the intersection volumes for the Year 2015 HOV Build AM and PM peak hours.

As mentioned under Year 2035 HOV Build Conditions (*Chapter 5, Section 5.2.6*) the PDT decided to use Year 2015 intersection volumes instead of Year 2035 turning movement volumes to identify the interchange and the intersection improvements for this project (as presented in this report). This methodology would aid in providing the appropriate intersection mitigations and avoid proposing more-than-necessary improvements at the intersections. The local agencies further agreed they would monitor these intersections and, if required, further modify the intersections based on actual experience at each location.

Table 6-4 exhibits the study intersection operations, including LOS and delay values under Year 2015 HOV Build AM and PM peak hour conditions.

Based on the LOS thresholds criteria discussed in *Section 3.6*, during the AM peak hour, 24 of the 26 study intersections would operate under an acceptable level of service (LOS D or better). The following two study intersections would operate under an unacceptable level of service (LOS E or F):

- Park Avenue/ Kennedy Drive/ McGregor Drive
- Rio Del Mar Boulevard/ Soquel Drive



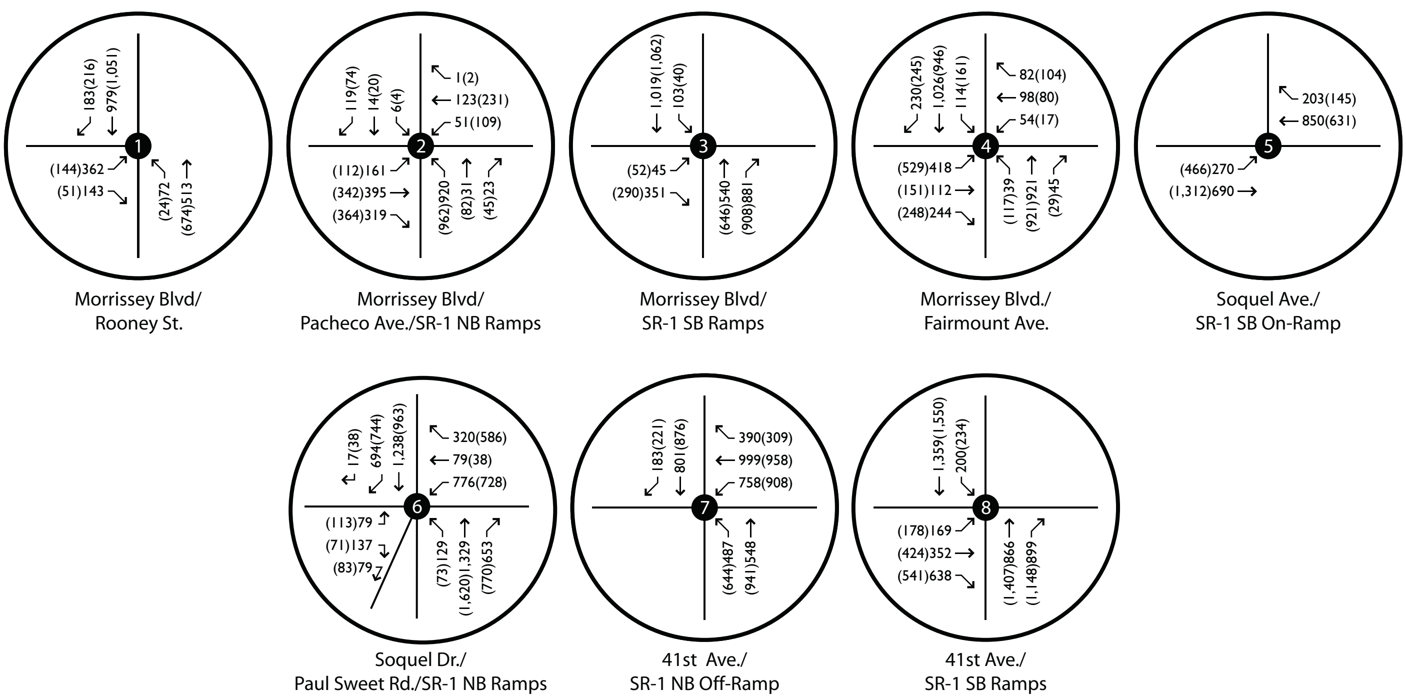


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Figure 6-4A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 HOV BUILD CONDITIONS

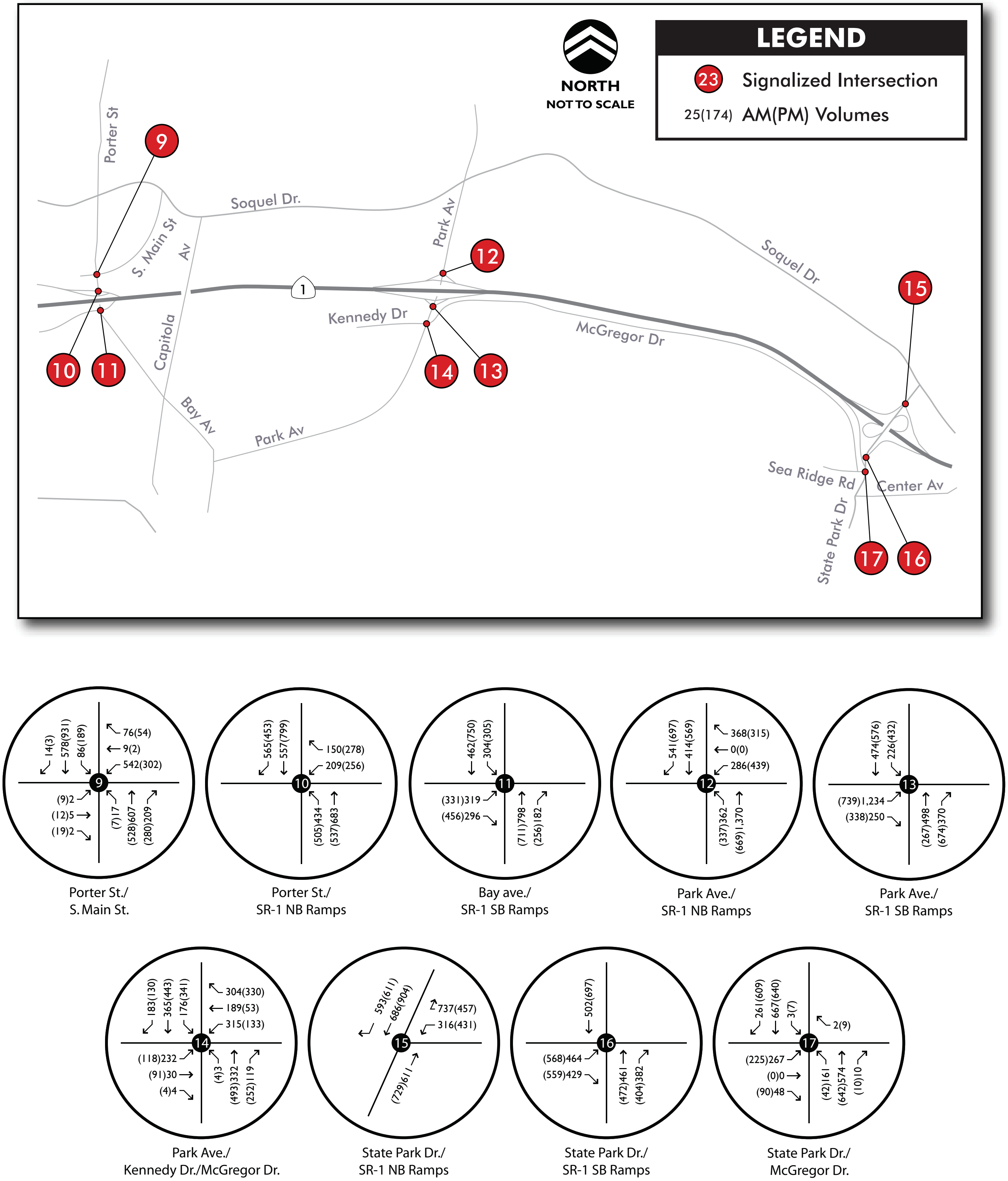

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Figure 6-4B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 HOV BUILD CONDITIONS

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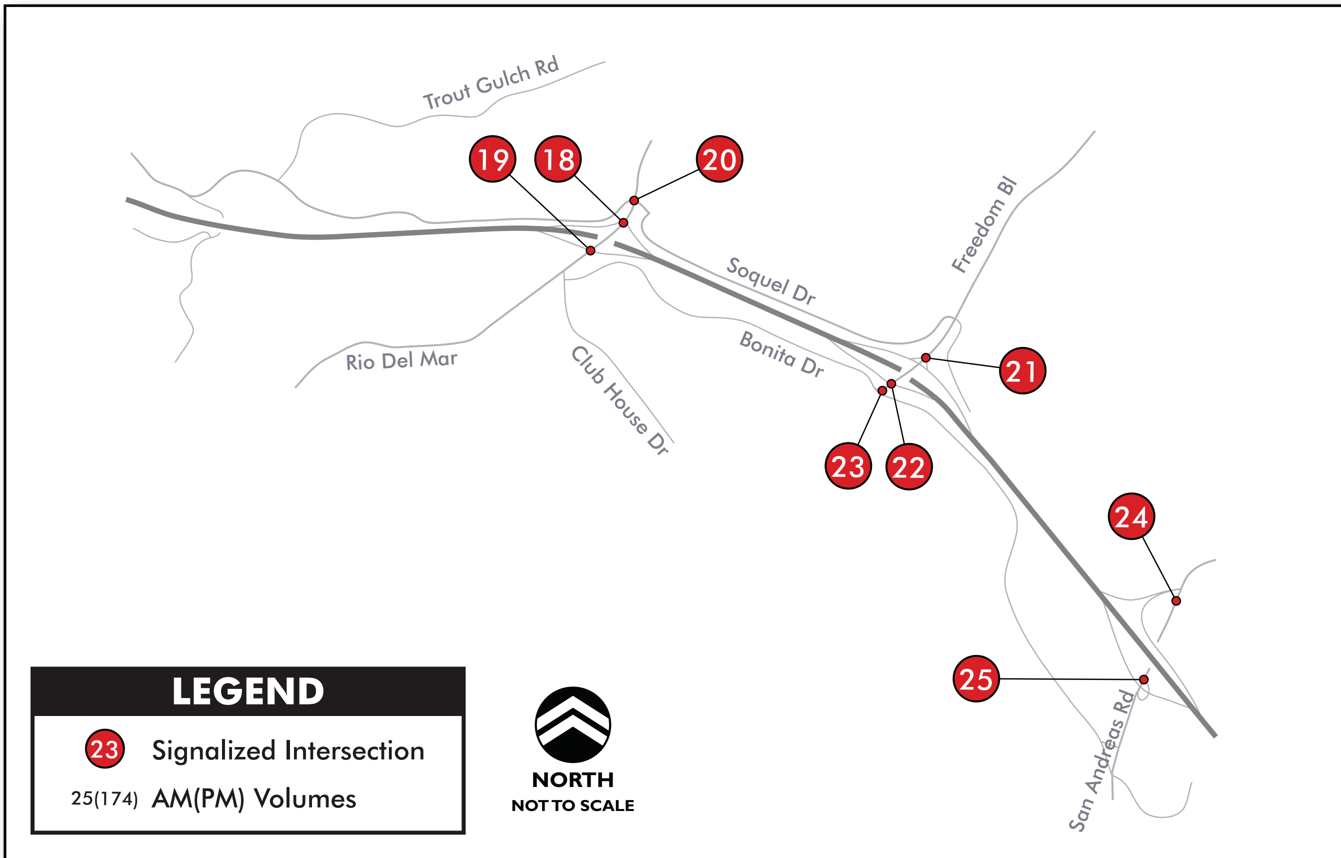

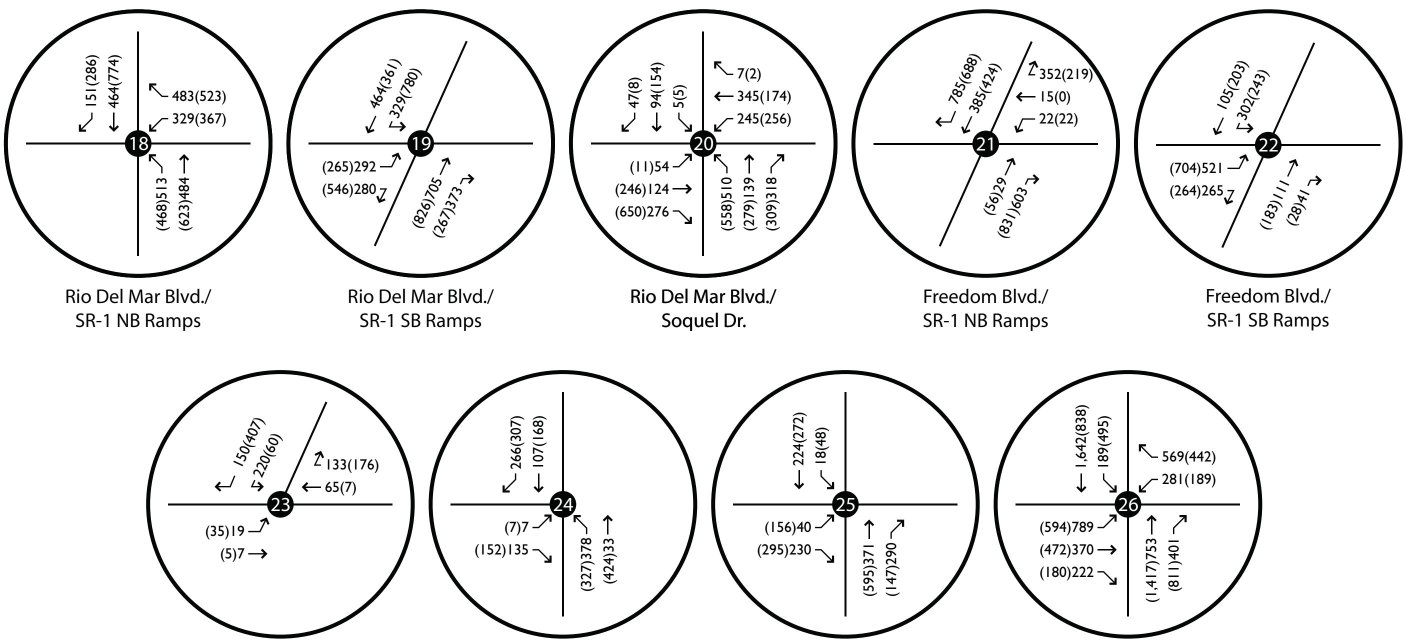

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Figure 6-4C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 HOV BUILD CONDITIONS

Table 6-4
Intersection LOS Summary – Year 2015 HOV Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./ Rooney St.	City of Santa Cruz	Signal	12.4	B	5.8	A
2	Morrissey Blvd./ Pacheco Ave./ SR-1 NB Ramps	Caltrans	Signal	25.5	C	27.6	C
3	Morrissey Blvd./ SR-1 SB Ramps	Caltrans	Signal	10.1	B	9.0	A
4	Morrissey Blvd./ Fairmount Ave.	City of Santa Cruz	Signal	25.6	C	30.5	C
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	8.8	A	9.2	A
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	44.8	D	29.6	C
7	41st Ave./ SR-1 NB Ramps	Caltrans	Signal	30.9	C	45.0	D
8	41st Ave./ SR-1 SB Ramps	Caltrans	Signal	21.8	C	29.3	C
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	26.0	C	25.8	C
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	19.9	B	**55.5**	**E**
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	27.1	C	25.1	C
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	17.8	B	24.3	C
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	35.8	D	37.3	D
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	Signal	**76.1**	**E**	**85.1**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	20.5	C	15.9	B
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	15.0	B	16.8	B
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	Signal	22.1	C	17.7	B
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	23.1	C	29.1	C
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	18.1	B	21.0	C

Table 6-4
Intersection LOS Summary – Year 2015 HOV Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	**59.8**	**E**	**56.9**	**E**
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	Signal	11.9	B	7.5	A
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	Signal	34.2	C	33.1	C
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	Signal	16.4	B	3.9	A
24	San Andreas Rd./ Larkin Rd./ SR-1 NB Ramps	Caltrans	Signal	25.1	C	17.4	B
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	Signal	7.7	A	11.9	B
26	Soquel Dr./ Soquel Ave./ SR-1 SB Off-Ramp	Caltrans	Signal	52.1	D	**72.7**	**E**

Source: Wilbur Smith Associates, April 2007

NOTES:
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

During the PM peak period, all the study intersections would operate under an acceptable level of service except the following four intersections:

- Porter Street/ State Route 1 Northbound Ramps
- Park Avenue/ Kennedy Drive/ McGregor Drive
- Rio Del Mar Boulevard/ Soquel Drive
- Soquel Drive/ Soquel Avenue/ State Route 1 Southbound Off-Ramp

Appendix C-6 exhibits the results of the intersection operations model (*Synchro*) output sheets for the study intersections under Year 2035 HOV Build peak hour conditions.

6.2.6 Off-Ramp Operations - Queuing Analysis

Table 6-5 summarizes the 95th percentile queue lengths on the off-ramps located within the study area under Year 2015 HOV Build AM and PM peak hour conditions. These queue lengths are obtained from ten multiple traffic operations model (*SimTraffic*) simulations. *Appendix D-3* presents the *SimTraffic* output sheets for existing AM and PM peak hour conditions.

During the AM peak hour, 13 of the 16 study ramps would have 95th percentile queue lengths within their storage lengths. The three ramps that would have queue lengths exceeding their storage lengths (queued vehicles would extend onto the freeway mainline) are:

- Soquel Drive Northbound Off-Ramp
- 41st Avenue/ Porter Street/ Bay Avenue Southbound Off-Ramp
- Park Avenue Southbound Off-Ramp

During the PM peak hour, all the 16 study ramps except the following five off-ramps would have 95th percentile queue lengths within their storage lengths:

- Soquel Drive Northbound Off-Ramp
- Soquel Drive Southbound Off-Ramp
- 41st Avenue/ Porter Street Northbound Off-Ramp
- Park Avenue Northbound Off-Ramp
- Park Avenue Southbound Off-Ramp

Table 6-5
95th Percentile Queue Lengths – Off-Ramp Locations (Year 2015 HOV Build Conditions)

#	Interchange	Ramp	Approximate Storage Length (ft)	Maximum 95th Percentile Queue Length (ft) AM Peak	PM Peak
1	Morrissey Boulevard Interchange	NB Off-Ramp	800	403	426
		SB Off-Ramp	800	198	291
2	Soquel Avenue Interchange	NB Off-Ramp	800	**1238**	**1269**
		SB Off-Ramp	950	526	**984**
3	41st Avenue/ Porter Street/ Bay Avenue Interchange	NB Off-Ramp	700	112	**724**
		SB Off-Ramp	750	**959**	262
4	Park Avenue Interchange	NB Off-Ramp	700	320	**972**
		SB Off-Ramp	800	**1767**	**1628**
5	State Park Drive Interchange	NB Off-Ramp	1100	400	406
		SB Off-Ramp	1250	281	361
6	Rio Del Mar Boulevard Interchange	NB Off-Ramp	750	178	145
		SB Off-Ramp	1150	161	232
7	Freedom Boulevard Interchange	NB Off-Ramp	800	430	94
		SB Off-Ramp	800	658	259
8	San Andreas Road/ Larkin Valley Road Interchange	NB Off-Ramp	1000	64	70
		SB Off-Ramp	900	285	105

Source: Wilbur Smith Associates, April 2007

NOTES:
Bold indicates 95th percentile queue length likely to exceed storage length.

6.3 YEAR 2015 TSM ALTERNATIVE ANALYSIS

6.3.1 Proposed Improvements and Network Assumptions

This section summarizes the Year 2015 Transportation Systems Management (TSM) ramp operating conditions for the State Route 1 study area. The *FREQ* analysis was performed using the corridor network definition evaluated and finalized in the technical memorandum dated October 10, 2006 (northbound Scenario 3 and southbound Scenario 2) and included in exhibited in *Appendix A-8* of this report. The results of these analyses are presented in *Table 6-6*, while the freeway and ramp volumes under Year 2015 AM and PM peak hour conditions are illustrated in *Figures 6-5A* and *6-5B*. *Appendix E-7* exhibits the *FREQ* output under Year 2015 TSM Build Conditions.

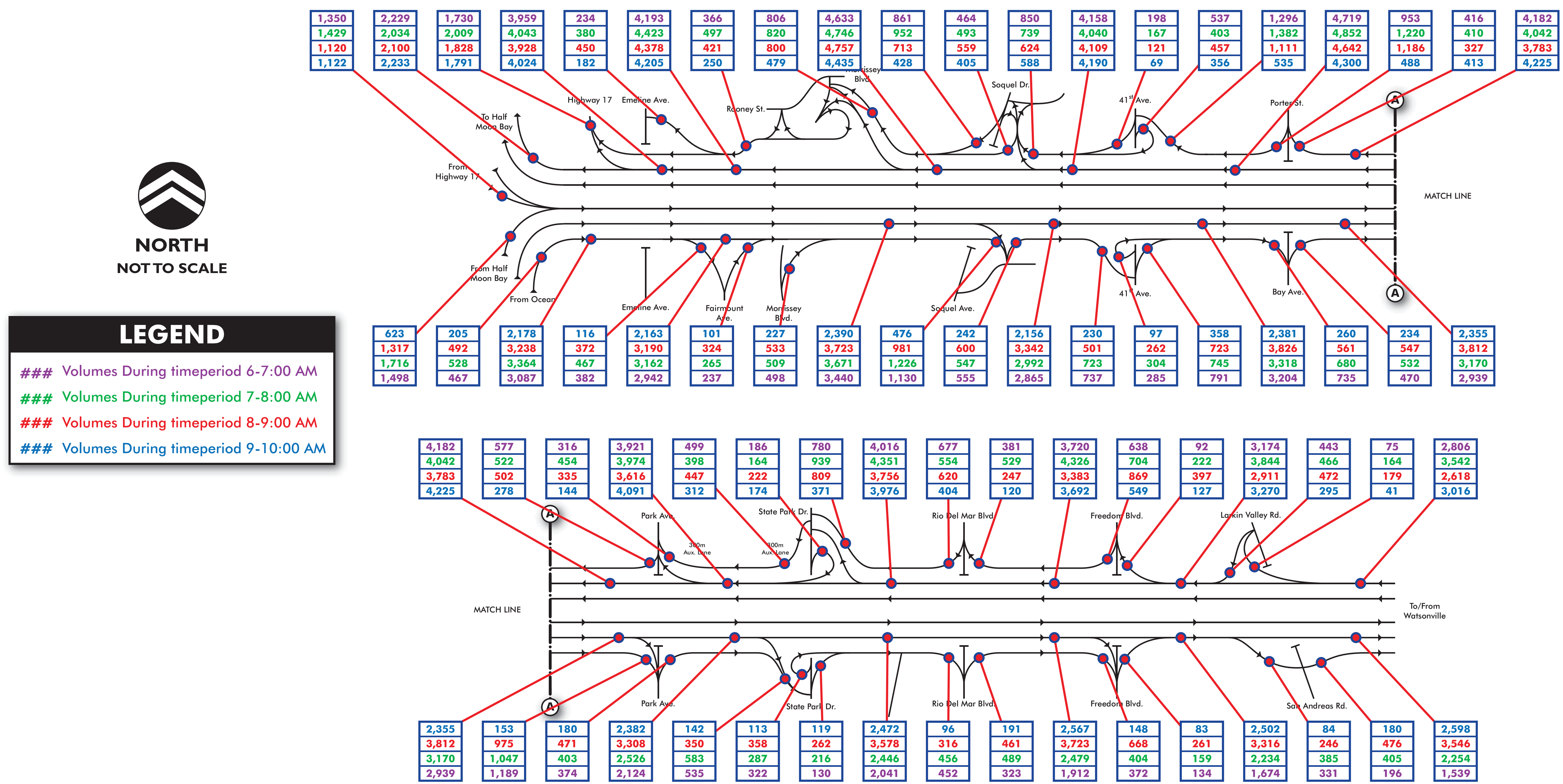

Figure 6-5A

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 TSM BUILD CONDITIONS (AM PEAK)

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393070/FWY-RAMP - 04/02/07

NORTH
NOT TO SCALE

LEGEND

- ### Volumes During timeperiod 3-4:00 PM
- ### Volumes During timeperiod 4-5:00 PM
- ### Volumes During timeperiod 5-6:00 PM
- ### Volumes During timeperiod 6-7:00 PM

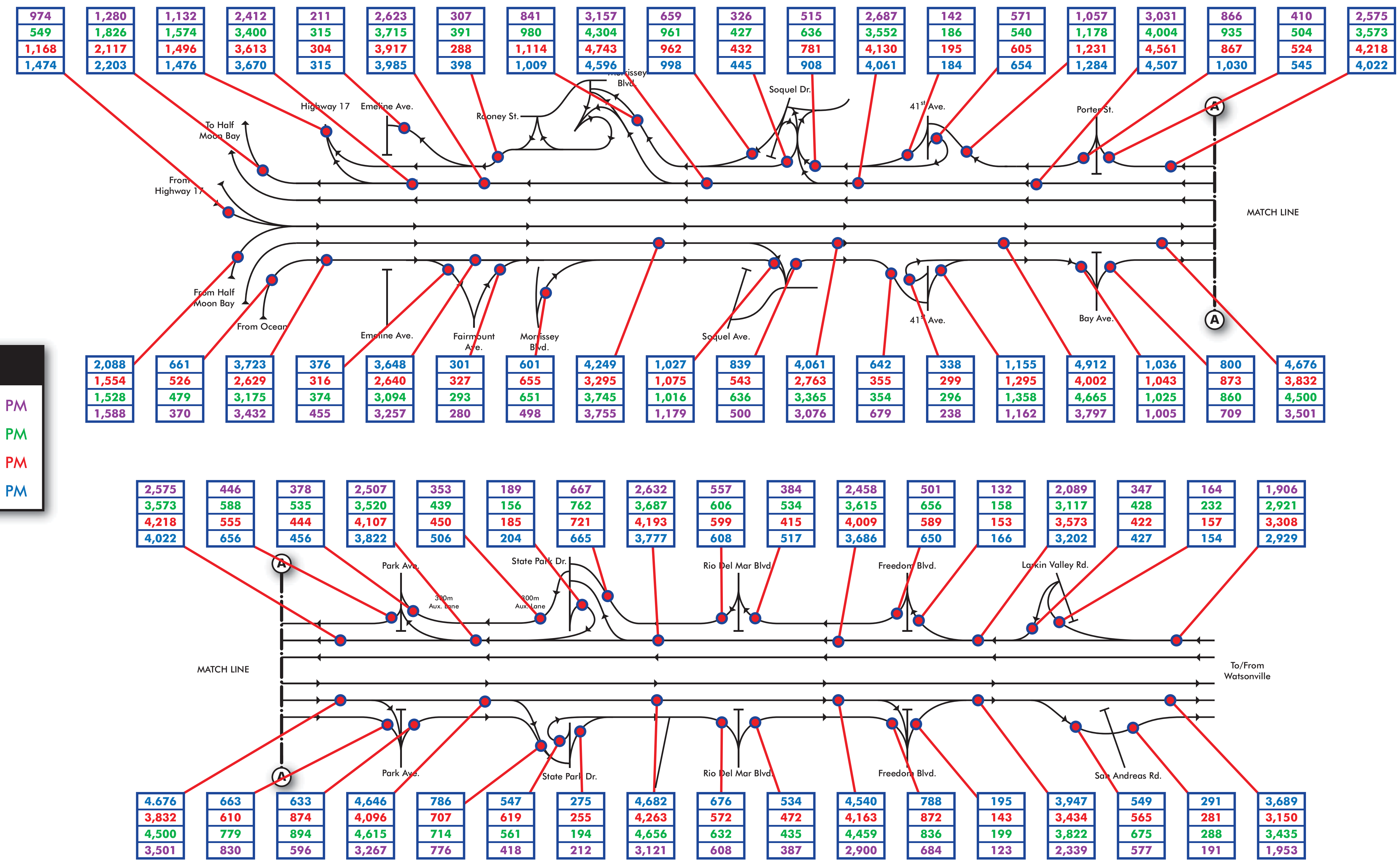

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Figure 6-5B

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 TSM BUILD CONDITIONS (PM PEAK)

393070/FWY-RAMP - 04/02/07

Table 6-6
Comparison of Measure of Effectiveness - Year 2015 No-Build versus Year 2015 TSM Build Scenarios

Measure of Effectiveness	2015 No-Build AM	2015 No-Build PM	2015 TSM Build AM	2015 TSM Build PM	% Difference AM	% Difference PM
Northbound						
Average Travel Time (minutes)	24 ***20***	12 ***11***	13 ***12***	10 ***10***	-46% ***-40***%	-17% ***-9***%
Average Speed (mph)	29 ***36***	49 ***53***	53 ***58***	60 ***60***	83% ***61***%	22% ***13***%
Delay (minutes per vehicle)	13 ***8***	3 ***2***	2 ***0***	0 ***0***	-85% ***-94***%	-90% ***-88***%
No. of Vehicle Trips (per hour)	3,449 ***3,376***	3,878 ***3,189***	3,690 ***3,377***	3,846 ***3,186***	7% ***0***%	-1% ***0***%
No. of Persons Trips (per hour)	3,904 ***3,822***	4,825 ***3,967***	4,486 ***4,118***	4,875 ***4,028***	15% ***8***%	1% ***2***%
Freeway Travel Time (VHT)	1,436 ***1,119***	797 ***602***	830 ***691***	639 ***527***	-42% ***-38***%	-20% ***-12***%
Travel Distance (VMT)	40,698 ***39,841***	38,783 ***31,889***	43,540 ***39,844***	38,463 ***31,855***	7% ***0***%	-1% ***0***%
Avg. Vehicle Occupancy (persons/vehicle)	1.13 ***1.13***	1.24 ***1.24***	1.22 ***1.22***	1.27 ***1.26***	7% ***8***%	2% ***2***%
Density (passenger cars per mile per lane)	59 ***47***	40 ***30***	28 ***23***	26 ***21***	-53% ***-49***%	-35% ***-30***%
Level of Service	F ***F***	E ***D***	D ***C***	C ***C***	N.A. ***N.A.***	N.A. ***N.A.***
Southbound						
Average Travel Time (minutes)	12 ***11***	47 ***28***	10 ***10***	17 ***14***	-17% ***-9***%	-64% ***-50***%
Average Speed (mph)	51 ***58***	15 ***25***	61 ***61***	41 ***51***	20% ***5***%	173% ***104***%
Delay (minutes per vehicle)	2 ***1***	35 ***16***	0 ***0***	5 ***2***	-89% ***-68***%	-85% ***-86***%
No. of Vehicle Trips (per hour)	3,239 ***2,596***	2,900 ***2,93***	3,332 ***2,601***	3,674 ***3,076***	3% ***0***%	27% ***5***%
No. of Persons Trips (per hour)	3,757 ***3,011***	3,421 ***3,456***	3,979 ***3,105***	4,456 ***3,727***	6% ***3***%	30% ***8***%
Freeway Travel Time (VHT)	661 ***463***	2,254 ***1,371***	571 ***445***	1,037 ***713***	-14% ***-4***%	-54% ***-48***%
Travel Distance (VMT)	33,683 ***26,996***	33,929 ***34,311***	34,649 ***27,045***	42,986 ***35,989***	3% ***0***%	27% ***5***%
Avg. Vehicle Occupancy (persons/vehicle)	1.16 ***1.16***	1.18 ***1.18***	1.19 ***1.19***	1.21 ***1.21***	3% ***3***%	3% ***3***%
Density (passenger cars per mile per lane)	32 ***22***	97 ***57***	22 ***17***	36 ***24***	-31% ***23***%	-63% ***-59***%
Level of Service	D ***C***	F ***F***	C ***B***	E ***C***	N.A. ***N.A.***	N.A. ***N.A.***

Source: Wilbur Smith Associates, February 2007

NOTES:
Non-italicized and non-bold values represent peak hour values.
Bold *italicized* values represent peak period (6 AM – 12 PM and 2 PM – 8 PM) values.
N.A. – Not Applicable

6.3.2 Vehicle Throughput

With the implementation of only ramp metering and auxiliary lanes as part of the TSM Build scenario, the State Route 1 corridor is expected to improve only marginally over the Year 2015 No-Build Conditions. There would be a minor increase in vehicle throughput. In the northbound direction during the AM peak hour, vehicle throughput would increase by seven percent.

The major improvement would be experienced in the southbound direction during the PM peak hour. This commute traffic direction currently serves approximately 3,100 vehicles during the peak hour, which would be reduced to 2,900 vehicles under the Year 2015 No-Build scenario. With the addition of ramp metering and auxiliary lanes under the TSM Build scenario, vehicle throughput is expected to increase to approximately 3,700 vehicles during the peak hour. Thus, the ramp metering and auxiliary lanes planned for State Route 1 would help alleviate the existing bottlenecks in the southbound direction and prevent the freeway from reaching breakdown point.

The person throughput would increase by 15 percent in the northbound direction during the AM peak and 30 percent in the southbound direction during the PM peak. Also, the AVOs would increase slightly, in the range of two to seven percent. Thus, even without the addition of the HOV lanes, the increased travel demand in the year 2015 TSM Build Alternative would encourage some motorists to carpool, although not to the extent observed under the Year 2015 HOV Build scenario.

Vehicle trips would decrease slightly, by about 30 vehicles, in the northbound direction during the PM peak hour, while the travel time would decrease and the average speed would increase. There is no operational explanation for this slight drop in throughput, which is likely caused by changes in travel demand patterns that would slightly reduce travel demand for the reverse commute direction in year 2015 compared to the Existing Conditions. However, the decrease is small enough to be negligible.

6.3.3 Delays and Densities

Compared to the Year 2015 No-Build Conditions, the Year 2015 TSM Build scenario would show improvements in LOS, although not as substantial as under Year 2015 HOV Build scenario. In the northbound direction during AM peak hour, the density would improve from 59 pcpmpl (LOS F) to 28 pcpmpl (LOS D). Under Year 2015 HOV Build scenario, the density would be 22 pcpmpl (LOS C) for the mixed-flow lanes and 12 pcpmpl (LOS B) for the HOV lanes, one or two service levels better, depending on lane type. Similarly, the southbound direction during the PM peak hour would improve from 97 pcpmpl (LOS F) to 36 pcpmpl (LOS E) under the Year 2015 TSM Build scenario. On the other hand, under the Year 2015 HOV Build scenario it is expected that the mixed-flow lanes would operate at LOS C and the HOV lanes operate at LOS B.

Similar to the Year 2015 HOV Build scenario discussion presented in the *Section 6.2*, the reductions in delay would be the most drastic. In the northbound direction during the AM peak hour, average delay would be two minutes per vehicle, an 85 percent reduction, and in the southbound direction during PM peak hour, the average delay would be five minutes per vehicle, a reduction of 85 percent.

6.3.4 Travel Speed and Travel Time

Compared to Year 2015 No-Build Conditions, travel time under this scenario would improve by 9 to 64 percent, with the highest gains occurring in the northbound direction during the AM peak hour (46 percent for travel time and 83 percent for travel speed) and southbound direction during the PM peak hour (64 percent for travel time and 50 percent for travel speed). These results suggest that metering the corridor would work well in improving freeway speeds and travel times. With little increase in vehicle throughput but significant improvements in travel speed and travel time under this scenario, it was concluded that the corridor would operate near its optimal state, with a delicate balance between throughput and traffic performance.

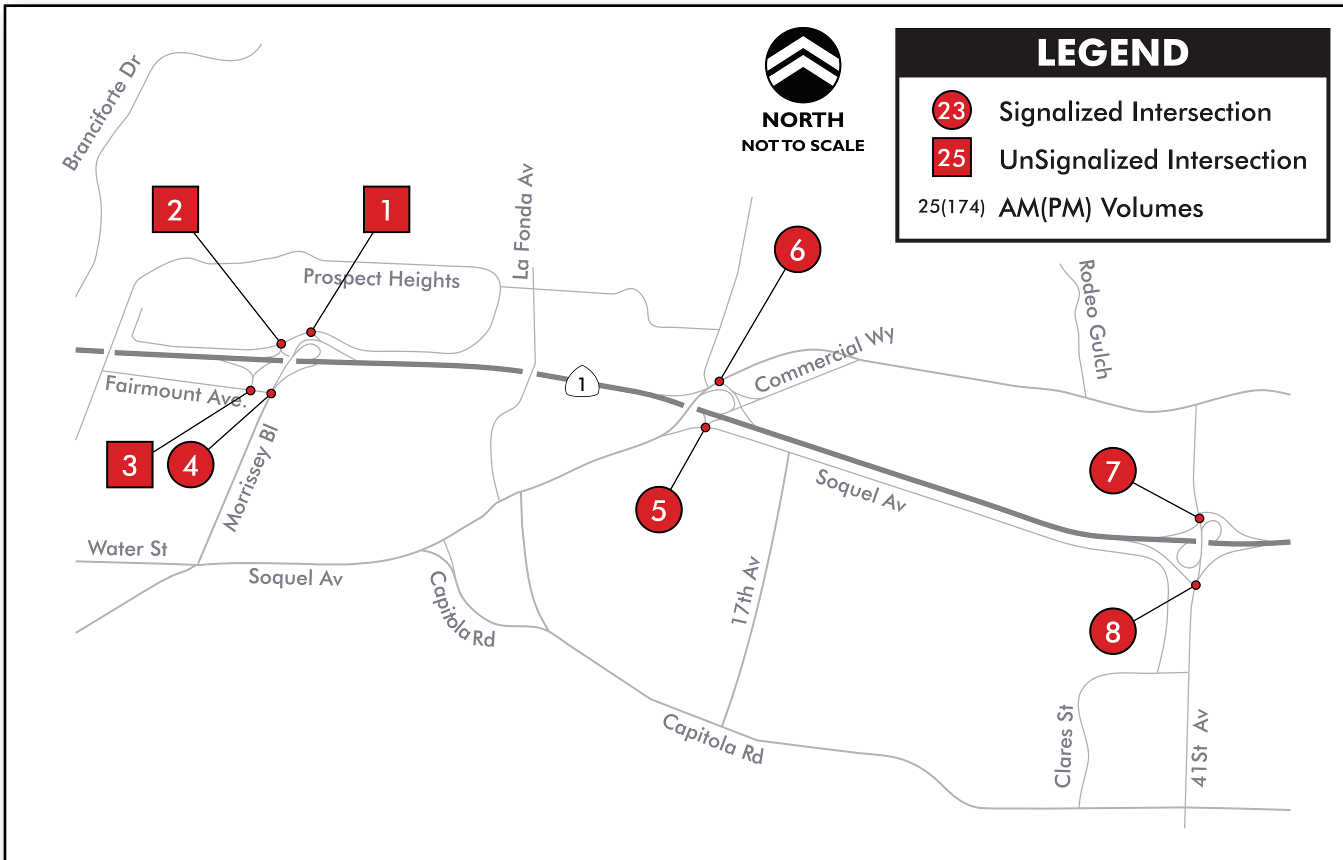
6.3.5 Intersection Operations Analysis

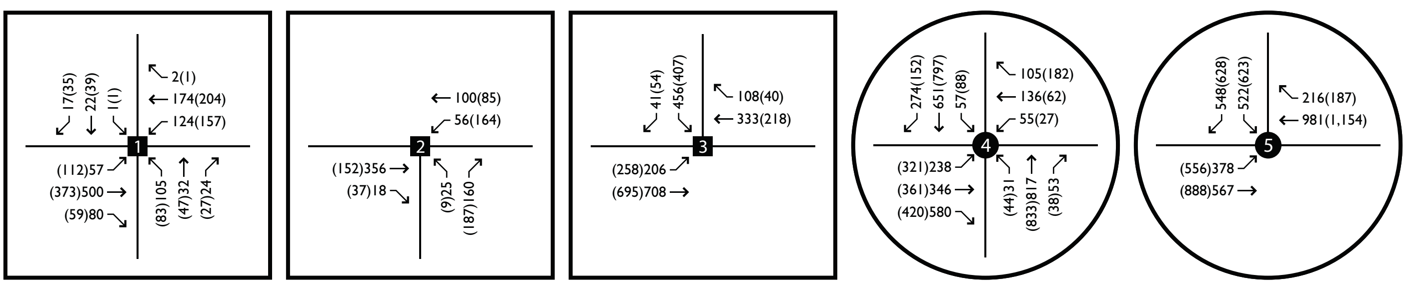
Using the methodology described in *Section 4.5*, turning movement volumes at the study intersections were developed to represent Year 2015 TSM Build Conditions. *Figures 6-6A, 6-6B,* and *6-6C* exhibit the intersection volumes under Year 2015 TSM Build AM and PM peak hours.

Analysis under the Year 2015 TSM Build scenario resulted in identical service levels compared to the Year 2015 No-Build scenario. The vehicular delays at each of the study intersections vary slightly. *Table 6-7* summarizes the study intersection operations under Year 2015 TSM Build Conditions.

Similar to Year 2015 No-Build Conditions, 17 of the 25 study intersections would operate under an unacceptable level of service (LOS E or F) during Year 2015 TSM Build AM peak hour Conditions. The eight intersections that would operate under an acceptable level of service (LOS D or better) are:

- Soquel Avenue/ State Route 1 Southbound Ramps
- 41st Avenue/ State Route 1 Northbound Off-Ramp
- 41st Avenue/ State Route 1 Southbound Ramps
- Porter Street/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Southbound Ramps
- Rio Del Mar Boulevard/ State Route 1 Southbound Ramps
- San Andreas Road/ Larkin Road/ State Route 1 Northbound Off- Ramp





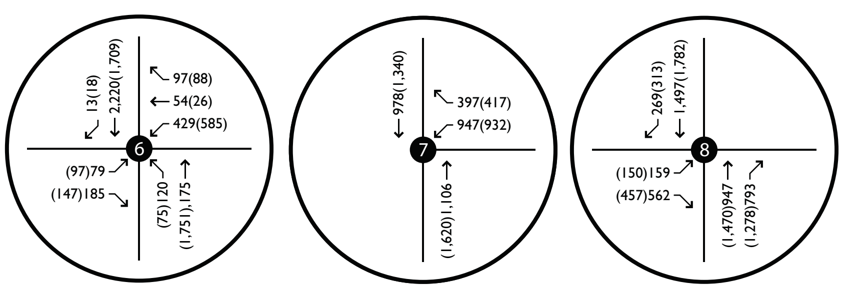
Morrissey Blvd/
Rooney St./Pacheco Ave.

Rooney St./
SR-1 NB Ramps

Fairmount Ave./
SR-1 SB Ramps

Morrissey Blvd./
Fairmount Ave.

Soquel Ave./
SR-1 SB Ramps



Soquel Dr./
Paul Sweet Rd./Commercial Way

41st Ave./
SR-1 NB Off-Ramp

41st Ave./
SR-1 SB Ramps

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Figure 6-6A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 TSM BUILD CONDITIONS

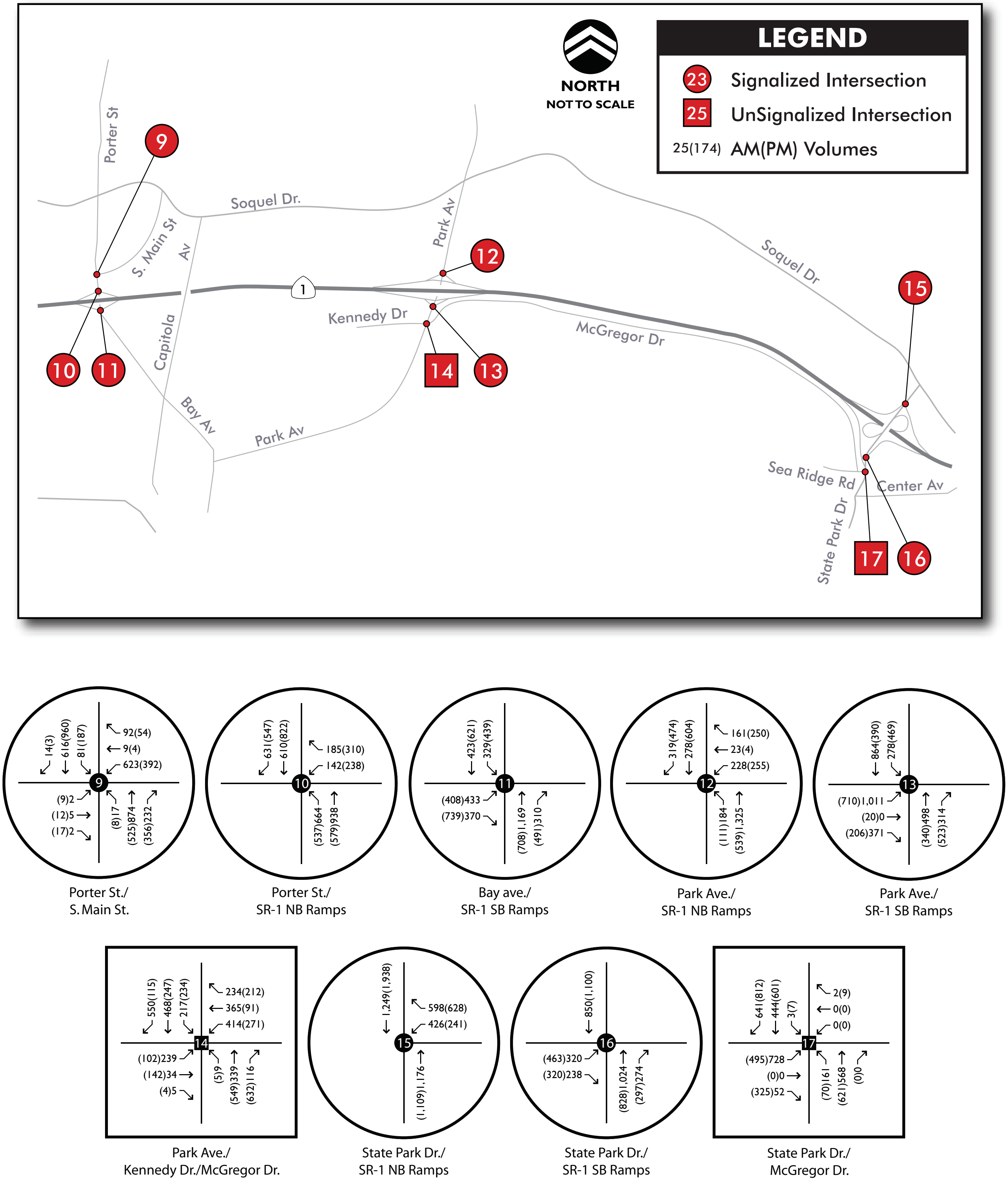

Figure 6-6B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 TSM BUILD CONDITIONS

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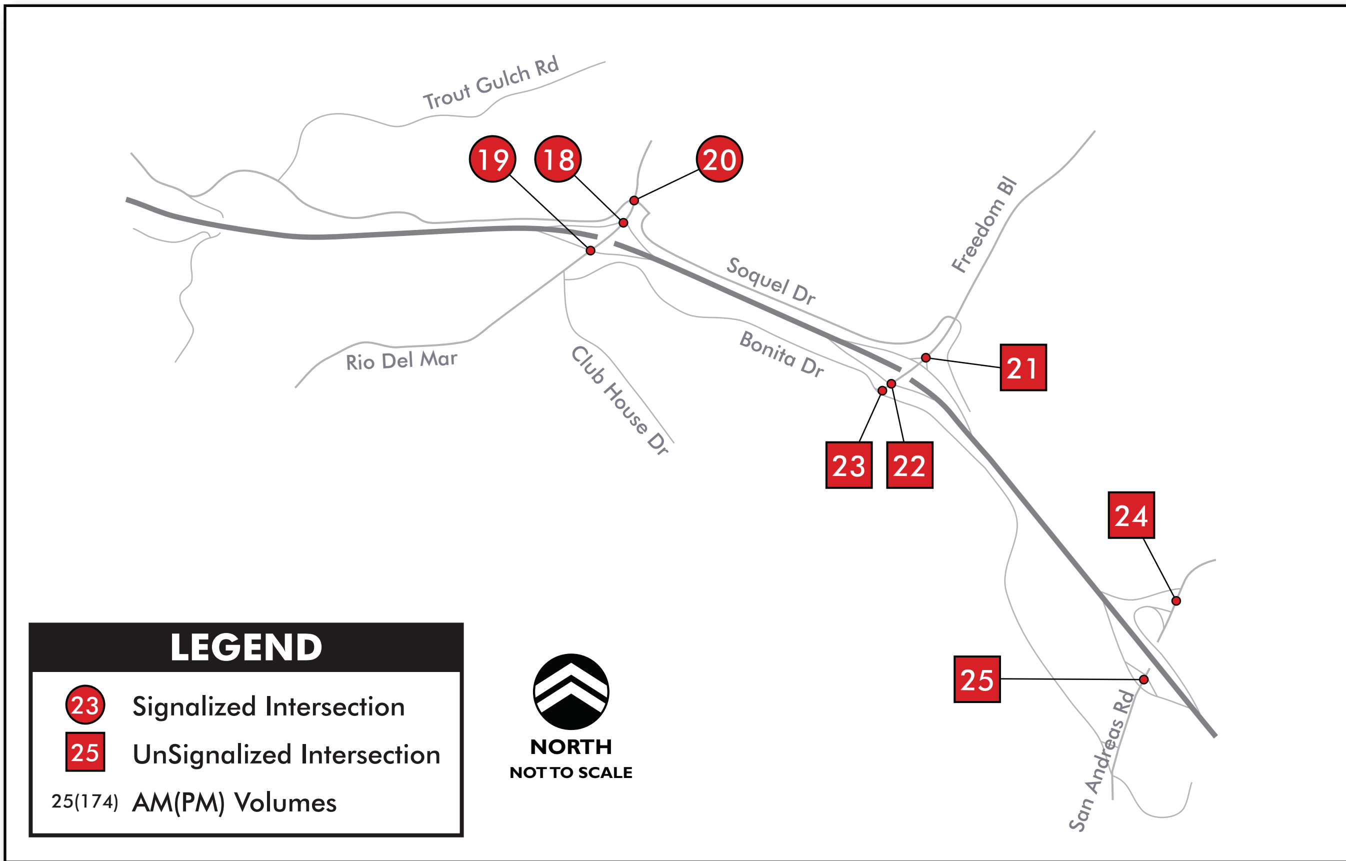

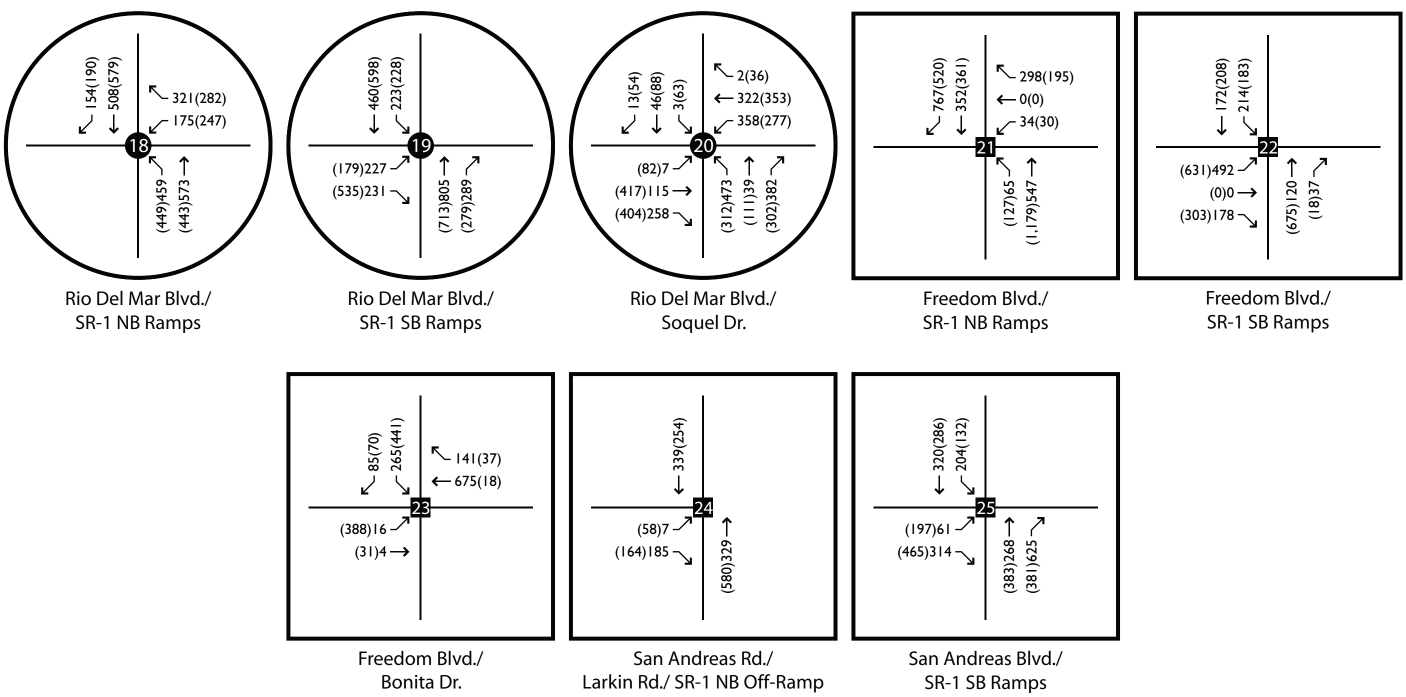

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Figure 6-6C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2015 TSM BUILD CONDITIONS

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Table 6-7
Intersection LOS Summary – Year 2015 TSM Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	City of Santa Cruz	AWSC	**86.7**	**F**	24.5	C
2	Rooney St./ SR-1 NB Ramps	Caltrans	TWSC	**76.3** (NB)	**F**	18.8 (NB)	C
3	Fairmount Ave./ SR-1 SB Ramps	Caltrans	AWSC	**89.4**	**F**	**61.2**	**F**
4	Morrissey Blvd./ Fairmount Ave.	Caltrans	Signal	**81.1**	**F**	**58.7**	**E**
5	Soquel Ave./ SR-1 SB Ramps	Caltrans	Signal	41.3	D	**99.4**	**F**
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Caltrans	Signal	**74.0**	**E**	35.7	D
7	41st Ave./ SR-1 NB Off-Ramp	Caltrans	Signal	17.4	B	17.5	B
8	41st Ave./ SR-1 SB Ramps	Caltrans	Signal	16.8	B	37.6	D
9	Porter St./ S. Main St.	County of Santa Cruz	Signal	**40.7**	**D**	**36.0**	**D**
10	Porter St./ SR-1 NB Ramps	Caltrans	Signal	45.3	D	42.1	D
11	Bay Ave./ SR-1 SB Ramps	Caltrans	Signal	**94.9**	**F**	52.9	D
12	Park Ave./ SR-1 NB Ramps	Caltrans	Signal	**109.0**	**F**	24.3	C
13	Park Ave./ SR-1 SB Ramps	Caltrans	Signal	**85.1**	**F**	40.5	D
14	Park Ave./ Kennedy Dr./ McGregor Dr.	City of Capitola	AWSC	**740.4**	**F**	**510.0**	**F**
15	State Park Dr./ SR-1 NB Ramps	Caltrans	Signal	48.5	D	19.7	B
16	State Park Dr./ SR-1 SB Ramps	Caltrans	Signal	26.0	C	38.9	D
17	State Park Dr./ McGregor Dr.	County of Santa Cruz	TWSC	**>1000** (EB)	**F**	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Caltrans	Signal	**140.0**	**F**	**110.5**	**F**
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Caltrans	Signal	52.7	D	30.2	C

Table 6-7
Intersection LOS Summary – Year 2015 TSM Build Conditions

#	Intersection	Jurisdiction	Traffic Controller	AM Peak Delay	AM Peak LOS	PM Peak Delay	PM Peak LOS
20	Rio Del Mar Blvd./ Soquel Dr.	County of Santa Cruz	Signal	**148.7**	**F**	**130.2**	**F**
21	Freedom Blvd./ SR-1 NB Ramps	Caltrans	TWSC	**>1000** (NWB)	**E**	**74.5** (NWB)	**F**
22	Freedom Blvd./ SR-1 SB Ramps	Caltrans	AWSC	**66.9**	**F**	**169.3**	**F**
23	Freedom Blvd./ Bonita Dr.	County of Santa Cruz	TWSC	**162.8** (EB)	**F**	**>1000** (EB)	**F**
24	San Andreas Rd./ Larkin Rd./ SR-1 NB Off-Ramp	Caltrans	TWSC	13.4 (EB)	B	14.9 (EB)	B
25	San Andreas Rd./ SR-1 SB Ramps	Caltrans	TWSC	**111.3** (SEB)	**F**	**95.1** (SEB)	**F**

Source: Wilbur Smith Associates, April 2007

NOTES:
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

During Year 2015 No-Build PM peak hour Conditions, 12 of the 25 study intersections would operate under an unacceptable level of service (LOS E or F). The 13 intersections that would operate under an acceptable level of service are (LOS D or better):

- Morrissey Boulevard/ Rooney Street/ Pacheco Avenue
- Rooney Street/ State Route 1 Northbound Ramps
- Soquel Drive/ Paul Sweet Road/ Commercial Way
- 41st Avenue/ State Route 1 Northbound Off-Ramp
- 41st Avenue/ State Route 1 Southbound Ramps
- Porter Street/ State Route 1 Northbound Ramps
- Bay Avenue/ State Route 1 Southbound Ramps
- Park Avenue/ State Route 1 Northbound Ramps
- Park Avenue/ State Route 1 Southbound Ramps
- State Park Drive/ State Route 1 Northbound Ramps
- State Park Drive/ State Route 1 Southbound Ramps
- Rio Del Mar Boulevard/ State Route 1 Southbound Ramps
- San Andreas Road/ Larkin Road/ State Route 1 Northbound Off- Ramp

The complete results of Year 2015 No-Build LOS analysis are presented in *Table 6-2*, while the results of the intersection operations model (*Synchro*) output sheets for the study intersections under Year 2015 No-Build peak hour conditions are presented in *Appendix C-5*.

6.4 YEAR 2015 LOS AND DENSITY BY SEGMENT

Table 6-8 summarizes the density and service levels for all State Route 1 segments located within the study area under Year 2015 No-Build, Year 2015 HOV Build, and Year 2015 TSM Build conditions. As mentioned previously, State Route 1 is a continuous corridor that may be analyzed segment-by-segment, but comparing only a particular segment across different scenarios can be misleading. The segment-by-segment analysis is useful to gain a sense of the bottlenecks locations and where they may be located after corridor improvements, but it is strongly recommended that the impacts of corridor-wide improvements such as HOV lanes or TSM should be measured for the corridor as a whole.

Under the Year 2015 No-Build scenario, the peak commute directions (northbound in the AM and southbound on the PM) would operate slightly worse than the Existing Conditions, with congestion spreading out towards the edges of the study area. The reverse commute directions would also experience slight decrease in traffic performance, but would generally operate at LOS E or better.

With the addition of the HOV lanes and other supporting components, the performance of the study segments under the Year 2015 HOV Build Conditions would improve. All the segments with HOV lanes are expected to operate at LOS B or better, and all the mixed-flow segments would operate at LOS D or better.

Based on traffic analysis, the TSM Build scenario would generally improve traffic conditions particularly in the reverse commute directions, although the peak commute directions would also be relieved with the addition of ramp metering. In the northbound direction during the AM peak hour, there would be corridor segments operating at LOS F, but they would not be continuous. This indicates that there would be small bottlenecks that would easily recover outside the peak hour, when traffic decreases. In the southbound direction during the PM peak hour, there would be a cluster of three segments in the Soquel Avenue/ 41st Avenue study location that would operate at LOS F, which indicates that the congestion in the southbound direction during the PM peak hour would be greater than in the northbound direction during the AM peak hour.

Table 6-8
Corridor Segment LOS and Density Summary - Year 2015 Conditions

	Existing				No Build				Year 2015 HOV Build*								TSM Build			
	AM		PM		AM		PM		AM (Mixed Flow)		AM (HOV)		PM (Mixed Flow)		PM (HOV)		AM		PM	
	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS
Northbound																				
START	24.3	C	22.1	C	104.6	F	26.2	D	31.5	D	*	*	27.5	D	*	*	23.0	C	26.2	D
Larkin Rd. Off - Larkin Rd. On	23.1	C	20.8	C	118.1	F	24.6	C	26.4	D	*	*	22.8	C	*	*	21.8	C	24.6	C
Larkin Rd. On - Freedom Blvd. Off	26.0	C	24.2	C	95.4	F	62.7	F	27.1	D	*	*	23.9	C	*	*	26.4	D	29.6	D
Freedom Blvd. Off - Freedom Blvd. On	25.0	C	21.4	C	115.2	F	61.5	F	25.3	C	13.1	B	21.1	C	13.8	B	23.0	C	26.6	D
Freedom Blvd. On - Rio Del Mar Blvd. Off	40.4	E	26.4	D	77.3	F	50.5	F	20.9	C	13.1	B	17.1	B	13.8	B	20.0	C	20.4	C
Rio Del Mar Blvd. Off - Rio Del Mar Blvd. On	56.5	F	22.8	C	89.8	F	65.8	F	24.5	C	14.0	B	21.4	C	15.0	B	29.6	D	29.2	D
Rio Del Mar Blvd. On - Seacliff Rd. Off	56.7	F	27.6	D	62.2	F	36.4	E	19.7	C	14.0	B	17.2	B	15.0	B	45.0	E	22.0	C
Seacliff Rd. Off - State Park EB On	86.9	F	24.7	C	96.4	F	29.9	D	22.4	C	14.8	B	22.2	C	17.2	B	78.6	F	29.6	D
State Park EB On - State Park WB On	75.4	F	26.0	C	75.7	F	31.9	D	24.6	C	11.8	B	24.1	C	14.6	B	34.6	D	31.6	D
State Park WB On - Park Off	79.2	F	30.1	D	68.5	F	39.6	E	22.5	C	12.2	B	21.9	C	15.4	B	22.8	C	23.0	C
Park Off - Park On	101.1	F	50.9	F	84.5	F	61.5	F	24.4	C	13.1	B	21.9	C	17.0	B	35.3	E	29.3	D
Park On - Bay/Porter St. Off	85.1	F	61.5	F	70.0	F	39.8	E	20.5	C	11.5	B	18.6	C	15.0	B	23.7	C	21.5	C
Bay/Porter St. Off - Bay/Porter St. On	91.8	F	84.1	F	78.2	F	30.9	D									36.1	E	30.7	D
Bay/Porter St. On - 41st St. Off	79.1	F	92.5	F	64.3	F	24.8	C	17.9	B	12.4	B	17.4	B	16.7	B	28.7	D	24.5	C
41st St. Off - 41st St. EB On	95.3	F	102.6	F	74.7	F	27.5	D									35.7	E	27.3	D
41st St. EB On - 41st St. WB On	72.1	F	82.0	F	46.4	F	34.8	D									23.8	C	21.1	C
41st St. WB On - Soquel Dr. Off	71.3	F	74.3	F	40.6	E	38.5	E	20.5	C	7.7	A	19.8	C	10.9	A	24.4	C	22.2	C
Soquel Dr. Off - Soquel Dr./Commmercial Way On	96.0	F	84.7	F	44.8	E	35.2	E	21.9	C	11.8	B	22.2	C	14.4	B	33.0	D	29.1	D
Soquel Dr./Commercial Way On - Soquel Dr./Paul Sweet Rd. On	75.3	F	69.9	F	38.5	E	36.6	E	29.1	D	9.7	A	28.3	D	11.4	B	23.4	C	21.8	C
Soquel Dr./Paul Sweet Rd. On - Morrissey Blvd. Off	40.1	E	38.0	E	29.7	D	27.6	D	23.2	C	9.7	A	23.2	C	11.4	B	26.7	D	27.4	D
Morrissey Blvd. Off - Morrissey Blvd. On	47.2	F	25.6	C	36.7	E	32.5	D	24.5	C	9.7	A	21.6	C	11.4	B	38.4	E	32.3	D
Morrissey Blvd. On - Emeline Ave. Off	41.2	E	28.2	D	23.9	C	22.6	C	22.5	C	8.7	A	20.0	C	9.5	A	24.1	C	22.6	C
Emeline Ave. Off - SR-17 Off	35.8	E	27.5	D	21.4	C	21.5	C	22.0	C	*	*	20.7	C	*	*	21.9	C	21.4	C
END	13.9	B	16.0	B	17.2	B	20.9	C	16.0	B	*	*	20.3	C	*	*	17.9	B	20.8	C
Southbound																				
START	11.9	B	91.2	F	15.3	B	172.9	F	13.4	B	*	*	21.3	C	*	*	13.2	B	18.0	B
Ocean Ave. On - SR-17 SB On	16.2	B	144.9	F	20.4	C	149.4	F	18.4	C	*	*	27.3	D	*	*	18.1	C	23.0	C
SR-17 SB On - Fairmount Ave. Off	27.3	D	87.0	F	20.8	C	140.6	F	20.0	C	*	*	22.0	C	*	*	19.7	C	19.9	C
Fairmount Ave. Off - Fairmount Ave. On	21.4	C	100.6	F	16.0	B	150.6	F	16.1	B	*	*	18.5	C	*	*	15.4	B	16.3	B
Fairmount Ave. On - Morrissey Blvd. On	24.2	C	89.5	F	17.9	B	142.1	F	18.0	B	*	*	20.3	C	*	*	17.2	B	18.2	C
Morrissey Blvd. On - Soquel Dr. Off	28.5	D	77.8	F	20.6	C	128.5	F	16.4	B	*	*	18.4	C	*	*	17.5	B	18.7	C
Soquel Dr. Off - Soquel Ave. On	20.1	C	108.7	F	26.3	D	128.1	F	21.4	C	6.8	A	25.1	C	8.5	A	22.1	C	23.8	C
Soquel Ave. On - 41st St. Off	25.4	C	82.7	F	39.0	E	103.3	F	16.7	B	8.5	A	20.3	C	10.7	A	18.0	B	70.2	F
41st St. Off - 41st St. WB On	20.3	C	91.8	F	56.9	F	114.6	F									23.0	C	75.3	F
41st St. WB On - 41st St. EB On	22.2	C	81.2	F	55.5	F	101.1	F	17.6	B	8.5	A	19.0	C	10.7	A	16.7	B	108.7	F
41st St. EB On - Bay/Porter St. Off	18.1	C	73.1	F	60.9	F	71.5	F									20.6	C	42.0	E
Bay/Porter St. Off - Bay/Porter St. On	24.3	C	65.1	F	67.0	F	89.3	F									27.8	D	35.9	E
Bay/Porter St. On - Park Rd. Off	28.6	D	54.1	F	35.5	E	53.4	F	18.1	C	11.3	B	22.0	C	15.7	B	20.5	C	47.2	F
Park Rd. Off - Park Rd. On	21.2	C	61.6	F	21.4	C	76.8	F	18.9	C	8.8	A	27.8	D	14.0	B	23.0	C	37.2	E
Park Rd.. On - State Park Rd. Off	23.9	C	39.0	E	25.7	C	54.1	F	15.4	B	10.2	A	22.0	C	15.9	B	17.8	B	25.4	C
State Park Rd. Off - State Park Rd. WB On	20.6	C	28.8	D	21.8	C	83.5	F	19.5	C	9.4	A	25.1	C	14.0	B	24.2	C	34.8	D
State Park Rd. WB On - State Park Rd. EB On	22.9	C	34.4	D	25.2	C	58.8	F	21.3	C	9.9	A	28.7	D	14.6	B	17.8	B	24.5	C
State Park Rd. EB On - Rio Del Mar Blvd. Off	24.5	C	36.5	E	28.3	D	39.9	E	16.3	B	10.8	A	20.9	C	15.6	B	19.2	C	26.0	C
Rio Del Mar Blvd. Off - Rio Del Mar Blvd. On	21.7	C	27.3	D	24.4	C	43.1	E	21.9	C	9.8	A	25.7	C	13.3	B	27.4	D	37.4	E
Rio Del Mar Blvd. On - Freedom Blvd. Off	25.6	C	33.4	D	29.9	D	39.1	E	17.7	B	11.3	B	21.2	C	13.7	B	20.0	C	24.8	C
Freedom BLvd. Off - Freedom Blvd. On	21.2	C	25.7	C	23.1	C	27.4	D	21.2	C	9.7	A	26.0	C	11.5	B	25.0	C	32.3	D
Freedom Blvd. On - Larkin Rd. Off	23.4	C	27.0	D	25.6	C	29.4	D	24.2	C	9.7	A	28.5	D	11.5	B	28.0	D	34.3	D
Larkin Rd. Off - Larkin Rd. On	21.3	C	21.4	C	22.8	C	22.3	C	22.6	C	9.3	A	23.4	C	10.3	A	25.2	C	26.0	C
END	15.1	B	14.7	B	17.7	B	16.3	B	16.6	B	*	*	23.4	C	*	*	19.1	C	18.3	C

Source: Wilbur Smith Associates, February 2007

NOTE:
* - Segments without HOV lanes

Chapter 7
CRASH ANALYSIS

7.1 EXISTING CONDITIONS

This section presents accident data on State Route 1 within the study area. *Table 7-1* presents the safety data for State Route 1 between Morrissey Boulevard and Larkin Valley Road/San Andreas Road interchanges during the period from July 2003 to June 2006 per Caltrans' Selective Accident Rate Calculations. Within the study area, the safety data is presented for seven freeway segments with different rate groups. *Appendix G* exhibits the *Basic Average Accident Rate Table* for highways provided by Caltrans.

Within a three-year study period between 2003 and 2006, the study area had a total of 765 accidents with three fatalities and 206 injuries. The total accident rates for the seven freeway segments within the study area are below the statewide average for corresponding rate groups, except for the following two freeway segments:

- From north of Bay Avenue interchange to south of 41st Avenue interchange
- From south of 41st Avenue interchange to north of 41st Avenue interchange

Approximately three-fourths of the total accidents within the study area occurred at the following three freeway segments:

- From Freedom Boulevard interchange to location between State Park Drive and Park Avenue interchanges
- From location between State Park Drive and Park Avenue interchanges to north of Bay Avenue interchange
- North of 41st Avenue interchange to north of Soquel Avenue interchange

Of the 765 accidents that occurred within the study area, 608 involved multiple vehicles. Exactly 622 accidents occurred during daylight and 658 crashes occurred during normal (dry) conditions.

Table 7-1
State Route 1 Between Morrissey Boulevard and Larkin Valley Road Interchanges
Three Year Accident Data, Years 2003 - 2006 (Accidents Per Million Vehicle Miles)

SR-1 Segment			Actual			California Average		
From	To	Rate Group[A]	Fatal	Fatal plus Injury	Total	Fatal	Fatal plus Injury	Total
Larkin Valley Rd. interchange (7.670)[B]	Freedom Blvd. interchange (8.354)	H 60	0.000	0.140	0.500	0.010	0.270	0.740
Freedom Blvd. interchange (8.354)	Between State Park Dr. and Park Ave. interchanges (11.797)	H 59	0.009	0.220	0.800	0.014	0.450	1.170
Between State Park Dr. and Park Ave. interchanges (11.797)	N/O Bay Ave. interchange (13.277)	H 63	0.000	0.250	0.970	0.016	0.520	1.410
N/O Bay Ave. interchange (13.277)	S/O 41st Avenue interchange (13.460)	H 64	0.000	0.330	1.230	0.006	0.300	0.980
S/O 41st Avenue interchange (13.460)	N/O 41st Ave. interchange (13.732)	H 63	0.000	0.480	1.940	0.016	0.530	1.440
N/O 41st Ave. interchange (13.732)	N/O Soquel Ave. interchange (15.050)	H 59	0.000	0.270	0.970	0.015	0.480	1.270
N/O Soquel Ave. interchange (15.050)	Morrissey Blvd. interchange (15.819)	H 63	0.000	0.290	0.920	0.017	0.560	1.530

Source: Caltrans Selective Accident Rate Calculations
NOTES:
A – For rate groups, please refer to Appendix G.
B – Location (Post mile)

7.2 FUTURE YEAR CONDITIONS

Future year crash rates were obtained from the Basic Average Accident Rate Table for highways provided by Caltrans (*Appendix G*). The methodology used for developing future accident rates involved the following steps:

- Obtaining base crash rate for corresponding highway rate group from the Basic Average Accident Rate Table
- Calculating the accident rate obtained from the Annual Daily Traffic (ADT) Factor corresponding to each highway rate group
- Adding the base crash rate and the accident rate obtained from ADT Factor to identify total crash rate

The accident rates based on the ADT Factor are calculated using the ADT values forecasted by the future AMBAG Travel Demand Model. Future crash rates were calculated under Year 2015 and 2035 Conditions for No-Build, HOV Build, and TSM Build scenarios. *Tables 7-2* and *7-3* present the total crash rates for No-Build, HOV Build, and TSM Build scenarios under Year 2015 and Year 2035 Conditions, respectively.

Since the future ADT values and the number of lanes on the freeway are same for No-Build and TSM Build scenarios, the freeway segments' total crash rates are the same for both scenarios.

Under Year 2015 Conditions, the total crash rates for No-Build and TSM Build scenarios are forecasted to be higher than under Existing Conditions, except for the following two freeway segments:

- Freeway segment from north of Bay Avenue interchange to south of 41st Avenue interchange
- Freeway segment from south of 41st Avenue interchange to north of 41st Avenue interchange

The total crash rates under Year 2015 HOV Build Conditions are expected to be higher than the existing crash rates, except at the following three freeway segments:

- Freeway segment from north of Bay Avenue interchange to south of 41st Avenue interchange
- Freeway segment from south of 41st Avenue interchange to north of 41st Avenue interchange
- Freeway segment from north of 41st Avenue interchange to north of Soquel Avenue interchange

However, the forecasted total crash rates under Year 2015 HOV Build Conditions would be lower than those under Year 2015 No-Build and TSM Build Conditions.

Table 7-2
Year 2015 Crash Rate Analysis

Freeway Segment		No-Build Conditions						HOV Build Conditions						TSM Build Conditions					
From	To	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate
Larkin Valley Rd. interchange (7.670) /a/	Freedom Blvd. interchange (8.354)	4-lane Suburban Freeway	H 60	82,925	0.500	0.004	0.832	6-lane Suburban Freeway	H 61	87,095	0.200	0.006	0.723	4-lane Suburban Freeway	H 60	82,925	0.500	0.004	0.832
Freedom Blvd. interchange (8.354)	Between State Park Dr. and Park Ave. interchanges (11.797)	4-lane Suburban Freeway	H 59	103,367	0.750	0.005	1.267	6-lane Suburban Freeway	H 61	112,872	0.200	0.006	0.877	4-lane Suburban Freeway	H 59	103,367	0.750	0.005	1.267
Between State Park Dr. and Park Ave. interchanges (11.797)	N/O Bay Ave. interchange (13.277)	4-lane Urban Freeway	H 63	112,288	0.400	0.010	1.523	6-lane Urban Freeway	H 64	125,374	0.400	0.005	1.027	4-lane Urban Freeway	H 63	112,288	0.400	0.010	1.523
N/O Bay Ave. interchange (13.277)	S/O 41st Ave. interchange (13.460)	6-lane Urban Freeway	H 64	125,991	0.400	0.005	1.030	8-lane Urban Freeway	H 65	135,094	0.400	0.004	0.940	6-lane Urban Freeway	H 64	125,991	0.400	0.005	1.030
S/O 41st Ave. interchange (13.460)	N/O 41st Ave. interchange (13.732)	4-lane Urban Freeway	H 63	102,328	0.400	0.010	1.423	6-lane Urban Freeway	H 64	112,267	0.400	0.005	0.961	4-lane Urban Freeway	H 63	102,328	0.400	0.010	1.423
N/O 41st Ave. interchange (13.732)	N/O Soquel Ave. interchange (15.050)	4-lane Suburban Freeway	H 59	111,566	0.750	0.005	1.308	6-lane Suburban Freeway	H 61	123,814	0.200	0.006	0.943	4-lane Suburban Freeway	H 59	111,566	0.750	0.005	1.308
N/O Soquel Ave. interchange (15.050)	Morrissey Blvd. interchange (15.819)	4-lane Urban Freeway	H 63	128,136	0.400	0.010	1.681	6-lane Urban Freeway	H 64	133,839	0.400	0.005	1.069	4-lane Urban Freeway	H 63	128,136	0.400	0.010	1.681

Source: Wilbur Smith Associates, June 2007

NOTES:

/a/ - Location (Post mile)

Table 7-3
Year 2035 Crash Rate Analysis

Freeway Segment		No-Build Conditions						HOV Build Conditions						TSM Build Conditions					
From	To	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate	Freeway Type	Rate Group	ADT	Base Rate	ADT Factor	Total Crash Rate
Larkin Valley Rd. interchange (7.670) /a/	Freedom Blvd. interchange (8.354)	4-lane Suburban Freeway	H 60	101,791	0.500	0.004	0.907	6-lane Suburban Freeway	H 61	121,768	0.200	0.006	0.931	4-lane Suburban Freeway	H 60	101,791	0.500	0.004	0.907
Freedom Blvd. interchange (8.354)	Between State Park Dr. and Park Ave. interchanges (11.797)	4-lane Suburban Freeway	H 59	127,608	0.750	0.005	1.388	6-lane Suburban Freeway	H 61	149,846	0.200	0.006	1.099	4-lane Suburban Freeway	H 59	127,608	0.750	0.005	1.388
Between State Park Dr. and Park Ave. interchanges (11.797)	N/O Bay Ave. interchange (13.277)	4-lane Urban Freeway	H 63	130,750	0.400	0.010	1.708	6-lane Urban Freeway	H 64	171,105	0.400	0.005	1.256	4-lane Urban Freeway	H 63	130,750	0.400	0.010	1.708
N/O Bay Ave. interchange (13.277)	S/O 41st Ave. interchange (13.460)	6-lane Urban Freeway	H 64	155,198	0.400	0.005	1.176	8-lane Urban Freeway	H 65	184,324	0.400	0.004	1.137	6-lane Urban Freeway	H 64	155,198	0.400	0.005	1.176
S/O 41st Ave. interchange (13.460)	N/O 41st Ave. interchange (13.732)	4-lane Urban Freeway	H 63	107,392	0.400	0.010	1.474	6-lane Urban Freeway	H 64	138,671	0.400	0.005	1.093	4-lane Urban Freeway	H 63	107,392	0.400	0.010	1.474
N/O 41st Ave. interchange (13.732)	N/O Soquel Ave. interchange (15.050)	4-lane Suburban Freeway	H 59	113,401	0.750	0.005	1.317	6-lane Suburban Freeway	H 61	151,350	0.200	0.006	1.108	4-lane Suburban Freeway	H 59	113,401	0.750	0.005	1.317
N/O Soquel Ave. interchange (15.050)	Morrissey Blvd. interchange (15.819)	4-lane Urban Freeway	H 63	147,788	0.400	0.010	1.878	6-lane Urban Freeway	H 64	164,436	0.400	0.005	1.222	4-lane Urban Freeway	H 63	147,788	0.400	0.010	1.878

Source: Wilbur Smith Associates, June 2007

NOTES:

/a/ - Location (Post mile)

Under Year 2035 Conditions, the total crash rates for No-Build, HOV Build, and TSM Build scenarios are higher than the existing crash rates at five of the seven freeway segment locations. The two freeway segment locations where the forecasted Year 2035 total crash rates would be lower than the existing crash rates include the following:

- Freeway segment from north of Bay Avenue interchange to south of 41st Avenue interchange
- Freeway segment from south of 41st Avenue interchange to north of 41st Avenue interchange

However, similar to Year 2015 Conditions, the forecasted total crash rates under Year 2035 HOV Build Conditions would be lower than those under Year 2035 No-Build and TSM Build Conditions, except at the freeway segment located between Larkin Valley Road interchange and Freedom Boulevard interchange. At this location, the total crash rate under HOV Build Conditions is forecasted to be 0.931, while the total crash rate under No-Build and TSM Build Conditions is expected to be 0.907.

Chapter 8
TRAFFIC PRIORITIZATION METHODOLOGY AND TIER 2 IMPROVEMENTS

The Project Development Team recognized that funding sources to construct either of the HOV or TSM alternatives described in previous chapter would be limited in the short term and that implementation of the project would occur over a multi-year period. In order to make a decision as to the nature of transportation improvements that would occur within the corridor in the future an alternative would need to be identified. The team decided to study the HOV Lane and TSM alternatives in a Tier I or Master Plan environmental document. The Tier I/Tier II DEIR/EA will allow for the identification of a preferred alternative for the 9 mile corridor and facilitate the programming of funds. At the same time, the team also recognized that there was sufficient funding to construct a smaller construction level project within the corridor that would have congestion relief benefits. A Tier II Auxiliary Lane Alternative is also analyzed in the Tier I /Tier II DEIR/EA. Therefore, to identify the hierarchy of proposed improvements under a limited funding scenario, a prioritization of those improvements is discussed in this chapter.

The prioritization of the proposed improvements was performed separately for freeway and interchange improvements based on their potential to relieve congestion and minimize/avoid hot spots in the corridor. The following are primary elements of potential phased independent utility improvements to be incorporated in the ED as components of the proposed action under a limited funding scenario:

1. Construct pedestrian overcrossings and auxiliary lanes in phases, including limited ramp improvements, widening outside to accommodate future HOV lanes;
2. Construct full interchange improvements, including widening of local roadways/bridges; and
3. Construct new median HOV lanes, including UPRR and local road bridges as needed.

The improvements listed above were prioritized based on traffic operational conditions. Thus, auxiliary lane/interchange/HOV lane improvements within the study corridor were ranked based on the estimated vehicle delay, queuing, and VMT along the Highway 1 corridor.

8.1 PRIORITIZATION OF AUXILIARY LANE IMPROVEMENTS

8.1.1 Methodology

Auxiliary lane improvements were prioritized by conducting traffic operational analysis using the *FREQ* simulation tool. The following auxiliary lane improvement alternatives within the study corridor were sequentially ranked based on their potential to improve study corridor's operational performance:

Northbound Direction

Alternative N1 – From 41st Avenue On-ramp to Soquel Avenue Off-ramp
Alternative N2 – From Park Avenue On-ramp to Bay Avenue/Porter Street Off-ramp
Alternative N3 – From State Park Drive On-ramp to Park Avenue Off-ramp
Alternative N4 – From Rio Del Mar Boulevard On-ramp to State Park Drive Off-ramp
Alternative N5 – From Freedom Boulevard On-ramp to Rio Del Mar Boulevard Off-ramp

Southbound Direction
Alternative S1 – From Soquel Avenue On-ramp to 41st Avenue Off-ramp
Alternative S2 – From Bay Avenue/Porter Street On-ramp to Park Avenue Off-ramp
Alternative S3 – From Park Avenue On-ramp to State Park Drive Off-ramp
Alternative S4 – From State Park Drive On-ramp to Rio Del Mar Boulevard Off-ramp
Alternative S5 – From Rio Del Mar Boulevard On-ramp to Freedom Boulevard Off-ramp

A *FREQ* base model under Year 2015 conditions was developed for the entire study corridor. The base model was developed for the No Build alternative, assuming HOV lanes and ramp metering are not operational along the corridor. This assumption takes into account a constrained funding scenario and thus the analysis focuses on prioritizing the auxiliary lane improvements independent of HOV lane operations. For each auxiliary lane improvement mentioned above, a separate *FREQ* model was developed from the base model by incorporating individual auxiliary lane improvements in the northbound and southbound directions. Each auxiliary lane improvement was evaluated independently by comparing the study corridor operations with and without auxiliary lane scenarios. This was performed by comparing the *FREQ* analysis results of each auxiliary lane model with those of the base model. The MOEs used for comparison include average travel time, average travel speed, average vehicle delay, number of vehicle-trips, number of person-trips, vehicle-miles traveled, vehicle-hours traveled, average vehicle occupancy, average density, and average LOS.

8.1.2 Corridor Operations

Based on the *FREQ* model outputs, freeway operations under with and without (baseline) auxiliary lane scenarios are summarized in *Tables 8-1, 8-3, 8-4, and 8-5* for the northbound and southbound directions separately. Corresponding *FREQ* graphical outputs showing the variation of vehicle speeds along the study corridor during the AM and PM peak periods are provided in *Appendix H* along with the descriptions of *FREQ* model subsections (SS) along Highway 1 in the northbound and southbound directions.

Northbound SR 1 – AM Peak Period

A comparison of the performance measures in *Table 8-1* indicate that the proposed auxiliary lanes (Alternatives N1 to N5) would improve the overall corridor operations along Highway 1 under Year 2015 Conditions during the AM peak period. Alternative N1 would provide the most improvement in freeway operations, while Alternative N5 would provide the least improvement. However, the AVO value for the study corridor would not change with any of the auxiliary lane improvements; the study corridor would continue to have an AVO value of 1.13 during the AM peak period. The average LOS of the corridor would improve from LOS F to LOS E during the

AM peak period with Alternatives N1, N2, and N3, but would remain the same at LOS F with the remaining two alternatives.

Based on the *FREQ* graphical outputs, hotspots created in the study corridor along northbound Highway 1 during the AM peak period due to the auxiliary lane improvements are summarized in *Table 8-2*. Alternatives N1, N2, and N3 would create minor hotspots. However, Alternatives N4 and N5 would create no hotspots.

Table 8-1
Summary of Freeway Operations - Northbound SR 1 (AM Peak Period)

Measure of Effectiveness	Units	Time Period	Base Model	N1	% Difference to Base	N2	% Difference to Base	N3	% Difference to Base	N4	% Difference to Base	N5	% Difference to Base
Average Travel Time	minutes per vehicle	Peak Hour	24	19	-22%	21	-15%	22	-11%	23	-7%	25	2%
		Peak Period	20	17	-14%	18	-8%	19	-6%	19	-5%	20	0%
Average Speed	mph	Peak Hour	29	37	28%	34	18%	33	12%	31	8%	28	-2%
		Peak Period	36	42	17%	39	8%	38	6%	37	5%	36	0%
Travel Delay	minutes per vehicle	Peak Hour	13	7	-46%	9	-31%	10	-23%	11	-15%	13	0%
		Peak Period	8	5	-38%	7	-13%	7	-13%	7	-13%	8	0%
No. of Vehicle Trips (vehicle throughput)	vehicles per hour	Peak Hour	3,449	3,619	5%	3,564	3%	3,536	3%	3,456	0%	3,447	0%
		Peak Period	3,376	3,399	1%	3,391	0%	3,391	0%	3,381	0%	3,380	0%
No. of Person Trips (person throughput)	persons per hour	Peak Hour	3,904	4,097	5%	4,034	3%	4,003	3%	3,912	0%	3,903	0%
		Peak Period	3,822	3,848	1%	3,839	0%	3,838	0%	3,827	0%	3,827	0%
Freeway Travel Time (VHT)	vehicle-hours	Peak Hour	1,436	1,151	-20%	1,231	-14%	1,280	-11%	1,304	-9%	1,429	0%
		Peak Period	1,119	967	-14%	1,036	-7%	1,063	-5%	1,066	-5%	1,120	0%
Travel Distance (VMT)	vehicle-miles	Peak Hour	40,698	42,707	5%	42,052	3%	41,730	3%	40,782	0%	40,680	0%
		Peak Period	39,841	40,112	1%	40,014	0%	40,008	0%	39,894	0%	39,890	0%
Average Vehicle Occupancy	persons per vehicle	Peak Hour	1.13	1.13	0%	1.13	0%	1.13	0%	1.13	0%	1.13	0%
		Peak Period	1.13	1.13	0%	1.13	0%	1.13	0%	1.13	0%	1.13	0%
Average Density	passenger cars per mile per lane	Peak Hour	59	49	-18%	52	-12%	54	-9%	55	-7%	61	2%
		Peak Period	47	41	-14%	44	-7%	45	-5%	45	-5%	47	0%
Average Level of Service (LOS)	-	Peak Hour	F	F	-	F	-	F	-	F	-	F	-
		Peak Period	F	E	-	E	-	E	-	F	-	F	-

Table 8-2
Hotspots Created Due to Auxiliary Lane Improvements – Northbound SR 1 (AM Peak Period)

Auxiliary Lane Improvement Alternative	Hotspots Created
N1	SS 15 and 16 (Park Avenue On-Ramp to Porter Street Off-Ramp) – Bottleneck operating from 6:30 AM to 6:45 AM and from 9:15 AM to 10 AM under base model gets extended till 7:45 AM and 11:15 AM, respectively.
N2	SS 12 and 13 (State Park Drive On-Ramp to Park Avenue Off-Ramp) – Hidden bottleneck exposed between 6:30 and 7:15 AM, and between 9:45 and 10:15 AM.
N3	SS 11 (Between eastbound and westbound State Park Drive On-Ramps) – Hidden bottleneck exposed between 6:15 and 6:45 AM.
N4	None
N5	None

Northbound SR 1 – PM Peak Period

The summary of performance measures in *Table 8-3* indicate that the proposed auxiliary lanes would improve overall corridor operations under Year 2015 Conditions during the PM peak period, similar to the AM peak period. With respect to the average travel time, average speed, and average density, Alternative N1 would provide the most improvement in freeway operations, while Alternative N3 would provide the least improvement. However, other MOEs such as the number of vehicle and person trips, VMT, AVO value, and average LOS value would remain the same as under 2015 No Build conditions. During the PM peak period, Highway 1 in the northbound direction would operate at LOS A with an AVO of 1.24 under both with and without auxiliary lane scenarios.

A comparison of the *FREQ* graphical outputs indicate that no hotspots are created in the study corridor during the PM peak period under Alternatives N1, N2, N3, N4, and N5.

Table 8-3
Summary of Freeway Operations - Northbound SR 1 (PM Peak Period)

Measure of Effectiveness	Units	Time Period	Base Model	N1	% Difference to Base	N2	% Difference to Base	N3	% Difference to Base	N4	% Difference to Base	N5	% Difference to Base
Average Travel Time	minutes per vehicle	Peak Hour	12	12	-1%	12	-5%	12	-1%	12	-4%	12	-2%
		Peak Period	11	11	-6%	11	-2%	11	-1%	11	-1%	11	-1%
Average Speed	mph	Peak Hour	49	49	1%	51	5%	49	1%	51	4%	50	2%
		Peak Period	53	56	6%	54	2%	53	1%	54	1%	53	1%
Travel Delay	minutes per vehicle	Peak Hour	3	2	-33%	2	-33%	3	0%	2	-33%	2	-33%
		Peak Period	2	1	-50%	1	-50%	2	0%	2	0%	2	0%
No. of Vehicle Trips (vehicle throughput)	vehicles per hour	Peak Hour	3,878	3,878	0%	3,879	0%	3,881	0%	3,867	0%	3,870	0%
		Peak Period	3,189	3,190	0%	3,191	0%	3,189	0%	3,187	0%	3,187	0%
No. of Person Trips (person throughput)	persons per hour	Peak Hour	4,825	4,825	0%	4,826	0%	4,827	0%	4,811	0%	4,815	0%
		Peak Period	3,967	3,969	0%	3,969	0%	3,967	0%	3,965	0%	3,965	0%
Freeway Travel Time (VHT)	vehicle-hours	Peak Hour	797	787	-1%	758	-5%	793	-1%	765	-4%	781	-2%
		Peak Period	602	569	-5%	592	-2%	599	0%	595	-1%	598	-1%
Travel Distance (VMT)	vehicle-miles	Peak Hour	38,783	38,783	0%	38,791	0%	38,805	0%	38,674	0%	38,702	0%
		Peak Period	31,889	31,903	0%	31,906	0%	31,892	0%	31,872	0%	31,873	0%
Average Vehicle Occupancy	persons per vehicle	Peak Hour	1.24	1.24	0%	1.24	0%	1.24	0%	1.24	0%	1.24	0%
		Peak Period	1.24	1.24	0%	1.24	0%	1.24	0%	1.24	0%	1.24	0%
Average Density	passenger cars per mile per lane	Peak Hour	40	39	-1%	38	-5%	40	-1%	38	-4%	39	-2%
		Peak Period	30	28	-6%	30	-2%	30	-1%	30	-1%	30	-1%
Average Level of Service (LOS)	-	Peak Hour	E	E	-	E	-	E	-	E	-	E	-
		Peak Period	D	D	-	D	-	D	-	D	-	D	-

Southbound SR 1 – AM Peak Period

The summary of performance measures in *Table 8-4* indicates that only Alternative S2 would improve the overall corridor operations under Year 2015 Conditions during the AM peak period. Alternatives S1, S3, S4, and S5 would have either negligible or no affect on the MOE's of the overall corridor operations. During the AM peak period, the study corridor in the southbound direction would operate at LOS A with an AVO value of 1.16 under with and without auxiliary lane scenarios

A comparison of the *FREQ* graphical outputs indicate that no hotspots are created in the study corridor during the AM peak period due to Alternatives S1, S3, S4, and S5. However, Alternative S2 would expose a hidden bottleneck in subsections 21, 22, and 24 (from Eastbound State Park Drive On-Ramp to Rio Del Mar Boulevard Off-Ramp and from Rio Del Mar Boulevard On-Ramp to Freedom Boulevard Off-Ramp) between 7:15 and 7:45 AM.

Southbound SR 1 – PM Peak Period

As shown in *Table 8-5*, alternatives S2, S4, and S5 would improve the overall corridor operations under Year 2015 Conditions during the PM peak period. Alternatives S1 and S3 would worsen the traffic operations of the overall study corridor in the southbound direction. A comparison of the average travel time, average speed, travel delay, freeway travel time, and average density values under with and without auxiliary lane scenarios indicate that Alternative S5 would provide the most improvement in the overall freeway operations, while Alternative S1 would provide the least improvement. However, similar to the AM peak period, the average LOS and AVO values for the study corridor will not change with any of the auxiliary lane improvements. During the PM peak period, Southbound SR 1 would operate at LOS F with an AVO value of 1.18 under with and without auxiliary lane scenarios.

Based on the *FREQ* graphical outputs, hotspots created along Southbound SR 1 during the PM peak period due to the auxiliary lane improvements are summarized in *Table 8-6*. Alternatives S2, S3, and S4 create hotspots. However, Alternatives S1 and N5 create none.

Table 8-4
Summary of Freeway Operations - Southbound SR 1 (AM Peak Period)

Measure of Effectiveness	Units	Time Period	Base Model	S1	% Difference to Base	S2	% Difference to Base	S3	% Difference to Base	S4	% Difference to Base	S5	% Difference to Base
Average Travel Time	minutes per vehicle	Peak Hour	12	12	1%	11	-12%	12	0%	12	0%	12	0%
		Peak Period	11	11	0%	10	-3%	11	-1%	11	-1%	11	-1%
Average Speed	mph	Peak Hour	51	50	-1%	58	13%	51	0%	51	0%	51	0%
		Peak Period	58	58	0%	60	4%	58	1%	58	1%	58	1%
Travel Delay	minutes per vehicle	Peak Hour	2	2	0%	1	-50%	2	0%	2	0%	2	0%
		Peak Period	1	1	0%	0	-100%	1	0%	1	0%	1	0%
No. of Vehicle Trips (vehicle throughput)	vehicles per hour	Peak Hour	3,239	3,242	0%	3,272	1%	3,239	0%	3,239	0%	3,239	0%
		Peak Period	2,596	2,598	0%	2,601	0%	2,596	0%	2,596	0%	2,596	0%
No. of Person Trips (person throughput)	persons per hour	Peak Hour	3,757	3,760	0%	3,796	1%	3,757	0%	3,757	0%	3,757	0%
		Peak Period	3,011	3,013	0%	3,018	0%	3,011	0%	3,011	0%	3,011	0%
Freeway Travel Time (VHT)	vehicle-hours	Peak Hour	661	669	1%	589	-11%	659	0%	658	0%	659	0%
		Peak Period	463	465	0%	450	-3%	462	0%	462	0%	462	0%
Travel Distance (VMT)	vehicle-miles	Peak Hour	33,683	33,714	0%	34,032	1%	33,683	0%	33,683	0%	33,683	0%
		Peak Period	26,996	27,015	0%	27,054	0%	26,996	0%	26,996	0%	26,996	0%
Average Vehicle Occupancy	persons per vehicle	Peak Hour	1.16	1.16	0%	1.16	0%	1.16	0%	1.16	0%	1.16	0%
		Peak Period	1.16	1.16	0%	1.16	0%	1.16	0%	1.16	0%	1.16	0%
Average Density	passenger cars per mile per lane	Peak Hour	32	33	3%	28	-13%	32	0%	32	0%	32	0%
		Peak Period	22	22	0%	22	-3%	22	-1%	22	-1%	22	-1%
Average Level of Service (LOS)	-	Peak Hour	D	D	-	D	-	D	-	D	-	D	-
		Peak Period	C	C	-	C	-	C	-	C	-	C	-

Table 8-5
Summary of Freeway Operations - Southbound SR 1 (PM Peak Period)

Measure of Effectiveness	Units	Time Period	Base Model	S1	% Difference to Base	S2	% Difference to Base	S3	% Difference to Base	S4	% Difference to Base	S5	% Difference to Base
Average Travel Time	minutes per vehicle	Peak Hour	47	50	8%	47	1%	50	6%	46	-1%	46	-1%
		Peak Period	28	29	4%	25	-10%	29	2%	28	0%	28	-1%
Average Speed	mph	Peak Hour	15	14	-7%	15	-1%	14	-6%	15	1%	15	1%
		Peak Period	25	24	-4%	28	11%	25	-2%	25	0%	25	1%
Travel Delay	minutes per vehicle	Peak Hour	35	39	11%	35	0%	38	9%	35	0%	35	0%
		Peak Period	16	18	13%	14	-13%	17	6%	16	0%	16	0%
No. of Vehicle Trips (vehicle throughput)	vehicles per hour	Peak Hour	2,900	2,902	0%	2,952	2%	2,941	1%	2,968	2%	2,895	0%
		Peak Period	2,933	2,964	1%	2,988	2%	2,965	1%	2,951	1%	2,933	0%
No. of Person Trips (person throughput)	persons per hour	Peak Hour	3,421	3,422	0%	3,481	2%	3,468	1%	3,500	2%	3,415	0%
		Peak Period	3,456	3,493	1%	3,521	2%	3,494	1%	3,477	1%	3,456	0%
Freeway Travel Time (VHT)	vehicle-hours	Peak Hour	2,254	2,433	8%	2,314	3%	2,434	8%	2,289	2%	2,237	-1%
		Peak Period	1,371	1,444	5%	1,258	-8%	1,415	3%	1,377	0%	1,362	-1%
Travel Distance (VMT)	vehicle-miles	Peak Hour	33,929	33,955	0%	34,542	2%	34,409	1%	34,723	2%	33,868	0%
		Peak Period	34,311	34,681	1%	34,961	2%	34,693	1%	34,525	1%	34,314	0%
Average Vehicle Occupancy	persons per vehicle	Peak Hour	1.18	1.18	0%	1.18	0%	1.18	0%	1.18	0%	1.18	0%
		Peak Period	1.18	1.18	0%	1.18	0%	1.18	0%	1.18	0%	1.18	0%
Average Density	passenger cars per mile per lane	Peak Hour	97	104	7%	99	2%	105	8%	98	1%	96	-1%
		Peak Period	59	62	5%	54	-8%	61	3%	59	0%	58	-1%
Average Level of Service (LOS)	-	Peak Hour	F	F	-	F	-	F	-	F	-	F	-
		Peak Period	F	F	-	F	-	F	-	F	-	F	-

Table 8-6
Hotspots Created Due to Auxiliary Lane Improvements – Southbound SR 1 (PM Peak Period)

Auxiliary Lane Improvement Alternative	Hotspots Created
S1	None
S2	SS 10 (Between 41st Avenue Off- and Westbound On-Ramps) – Hidden bottleneck exposed between 6:30 and 6:45 PM. SS 16 (Between Park Avenue On- and Off-Ramps) – Congestion between 3:30 and 6:00 PM under base model gets extended from 3:00 to 6:45 PM. SS 17 and 18 (Park Avenue On-Ramp to State Park Drive Off-Ramp) – Hidden bottleneck exposed between 2:45 and 3:30 PM. SS 21 and 22 (Eastbound State Park Drive On-Ramp to Rio Del Mar Boulevard Off-Ramp) – Congestion starting from 3:30 PM under base model starts early from 3:00 PM. SS 24 (Between Rio Del Mar Boulevard On- and Off-Ramps) – Hidden bottleneck exposed between 3:00 and 3:45 PM.
S3	SS 14 and 15 (Bay Avenue On-Ramp to Park Avenue Off-Ramp) – Bottleneck between 2:30 and 3:30 PM under base model extends to 5:00 PM. SS 24 (Between Rio Del Mar Boulevard On- and Off-Ramps) – Hidden bottleneck exposed between 4:45 and 5:30 PM.
S4	SS 17 and 18 (Park Avenue On-Ramp to State Park Drive Off-Ramp) – Hidden bottleneck exposed between 3:45 and 6:30 PM. SS 24 (Between Rio Del Mar Boulevard On- and Off-Ramps) – Hidden bottleneck exposed between 3:30 and 3:45 PM, and between 5:45 and 6:15 PM.
S5	None

8.1.3 Ranking of Freeway Improvements

Based on the operational benefit of each auxiliary lane improvement, a ranking system was developed to better define the prioritization of proposed auxiliary lane improvements. The auxiliary lane that would cause the most improvement in the study corridor operations and would result in minimal or no hot spots in the study area was given the highest priority. The following methodology was adopted to rank the freeway improvements:

Each of the five auxiliary lane alternatives proposed were assessed using a measurement scale of 1 to 5. The scoring was performed separately for the northbound and southbound directions. The performance measures of each auxiliary lane alternative were compared to those under the baseline conditions. The auxiliary lane alternatives were then scored on a scale of 1 to 5, 1 representing the alternative that would result in the least improvement in overall corridor operations and 5 representing the alternative that would result in the most improvement. Scoring of alternatives was based on the level of improvement/worsening of MOE values, relative to baseline conditions.

The next step was to assign a weightage factor to each MOE. The most relevant MOE's were assigned a higher weightage factor. Weightage factors assigned to each MOE are shown in *Appendix I*.

Based on the peak direction of travel, weightage factors were assigned to each peak period. In other words, for all the improvements proposed along northbound Highway 1, a higher weightage factor was assigned to the AM peak period than the PM peak period. This is because, for the study corridor, the northbound direction is the peak direction of travel and northbound PM is the non-peak direction of travel. These peak period adjustment factors ensure that higher weightage is given to auxiliary lane improvements that provide greater relief in congestion along the peak direction of travel. The peak period weightage factors used for this study are shown in *Appendix I* for the northbound and southbound directions.

Using the evaluation scores, MOE weightage factors, and peak period weightage factors described above, an overall score was developed for each auxiliary lane improvement. This score falls between 1 and 5. Using these overall scores, the auxiliary lane improvements were ranked and prioritized. The auxiliary lanes with the highest overall score was ranked first and given the highest priority. The overall scores and prioritization of the auxiliary lane improvements are shown in *Table 8-7*.

A detailed description of the methodology adopted to rank the auxiliary lane alternatives is provided in *Appendix I*.

Table 8-7
Prioritization of Auxiliary Lane Improvements

Northbound Highway 1 Auxiliary Lane Alternatives	Overall Score	Priority Ranking	Southbound Highway 1 Auxiliary Lane Alternatives	Overall Score	Priority Ranking
N1	5.00	1	S1	2.86	5
N2	4.32	2	S2	5.00	1
N3	3.05	3	S3	3.52	4
N4	3.08	3	S4	4.00	2
N5	2.39	4	S5	3.76	3

8.2 PRIORITIZATION OF INTERCHANGE AND INTERSECTION IMPROVEMENTS

This methodology would prioritize the implementation of interchange and intersection improvements that are proposed within the study corridor. These improvements may occur in addition to/alongside/independent of the freeway improvements along Highway 1 depending on the available funding.

The intersection and interchange improvements have been ranked based on their potential to improve the traffic operations under Year 2015 Conditions. Using this approach, a prioritized list of these improvements is shown in *Table 8-8*. These improvements would result in better operational conditions at the interchanges and would not lead to hot spots in the study area.

8.3 Tier 2 Project

Because of its operational independence and funding likelihood, the Alternatives N1 and S1 (northbound and southbound auxiliary lanes between 41St Avenue and Soquel Avenue interchanges), together with the Chanticleer pedestrian overhead crossing, have been identified as the Tier 2 project in the ED for the Highway 1 HOV Project. A FONSI will be sought only for this Tier 2 project. The geometric configuration of the Tier 2 project is exhibited in *Figure 8-1*, while the corresponding freeway and ramp volumes are shown in *Figures 8-2 and 8-3*.

8.3.1 Summary of Corridor Operations

The following section provides a summary of Highway 1 traffic operations under Year 2015 No-Build and Year 2015 Tier 2 Project Conditions. A comparison of performance measures related to the Highway 1 corridor located between Highway 17 and San Andreas Road/Larkin Valley Road interchanges is provided *Table 8-9*.

Under 2015 Conditions, the implementation of the Tier 2 project would improve traffic operations along Northbound Highway 1, but would slightly worsen them along Southbound Highway 1 as follows:

Northbound Highway 1 Corridor

- It would reduce the average travel time along the corridor by 3 minutes per vehicle (from 20 to 17 minutes per vehicle) and average travel delay by 3 minutes per vehicle (from 8 to 5 minutes per vehicle) during the AM peak period;
- It would increase the average travel speed along the corridor by 6 mph (from 36 mph to 42 mph) during the AM peak period;
- It would improve the vehicle throughput from 3,376 to 3,399 vehicles per hour and person throughput from 3,822 to 3,848 persons per hour during the AM peak period;
- It would decrease the average vehicle density from 47 to 41 passenger cars per mile per lane during the AM peak period; and
- It would improve the average LOS of the corridor from LOS F to LOS E during the AM peak period.

Table 8-8
Prioritization of Interchange and Intersection Improvements

Priority Rank	Proposed Improvement	Reason
1	Morrissey Boulevard interchange improvements	Reduces delay at Morrissey Blvd/Rooney St from 84 seconds to 40 seconds Reduces delay at SR 1 Northbound Ramps from 75 seconds to 30 seconds Reduces delay at SR 1 Southbound Ramps from 341 seconds to 17 seconds Reduces delay at Morrissey Blvd/Fairmount Ave from 81 seconds to 20 seconds
2	Soquel Avenue interchange improvements	Reduces delay at SR 1 Southbound Ramps from 99 seconds to 9 seconds Reduces delay at SR 1 Northbound Ramps from 74 seconds to 52 seconds
3	Freedom Boulevard/SR 1 Northbound Ramps intersection improvements	Reduces the delay at this intersections from >1,000 seconds to 17 seconds
3	Freedom Boulevard/Bonita Drive intersection improvements	Reduces the delay at this intersections from >1,000 seconds to 10 seconds
4	Park Avenue/Kennedy Drive/McGregor Drive intersection improvements	Reduces the delay at this intersections from 740 seconds to 164 seconds
5	Freedom Boulevard/SR 1 Southbound Ramps intersection improvements	Reduces the delay at this intersections from 169 seconds to 36 seconds
6	Rio Del Mar Boulevard/Soquel Drive intersection improvements	Reduces the delay at this intersections from 149 seconds to 66 seconds
7	Rio Del Mar Boulevard/SR 1 Northbound Ramps intersection improvements	Reduces the delay at this intersections from 141 seconds to 35 seconds
8	San Andreas Road/Larkin Road interchange improvements	Reduces delay at SR 1 Southbound Ramps from 111 seconds to 12 seconds
9	Park Avenue/SR 1 Northbound Ramps intersection improvements	Improves the operations of 1 intersection from 109 seconds to 23 seconds
10	Park Avenue/SR 1 Southbound Ramps intersection improvements	Improves the operations of 1 intersection from 85 seconds to 41 seconds
11	41st Avenue/ Porter Street interchange improvements	Reduces delay at Bay Ave SR 1 Southbound Ramps from 95 seconds to 18 seconds
12	Any other improvements	

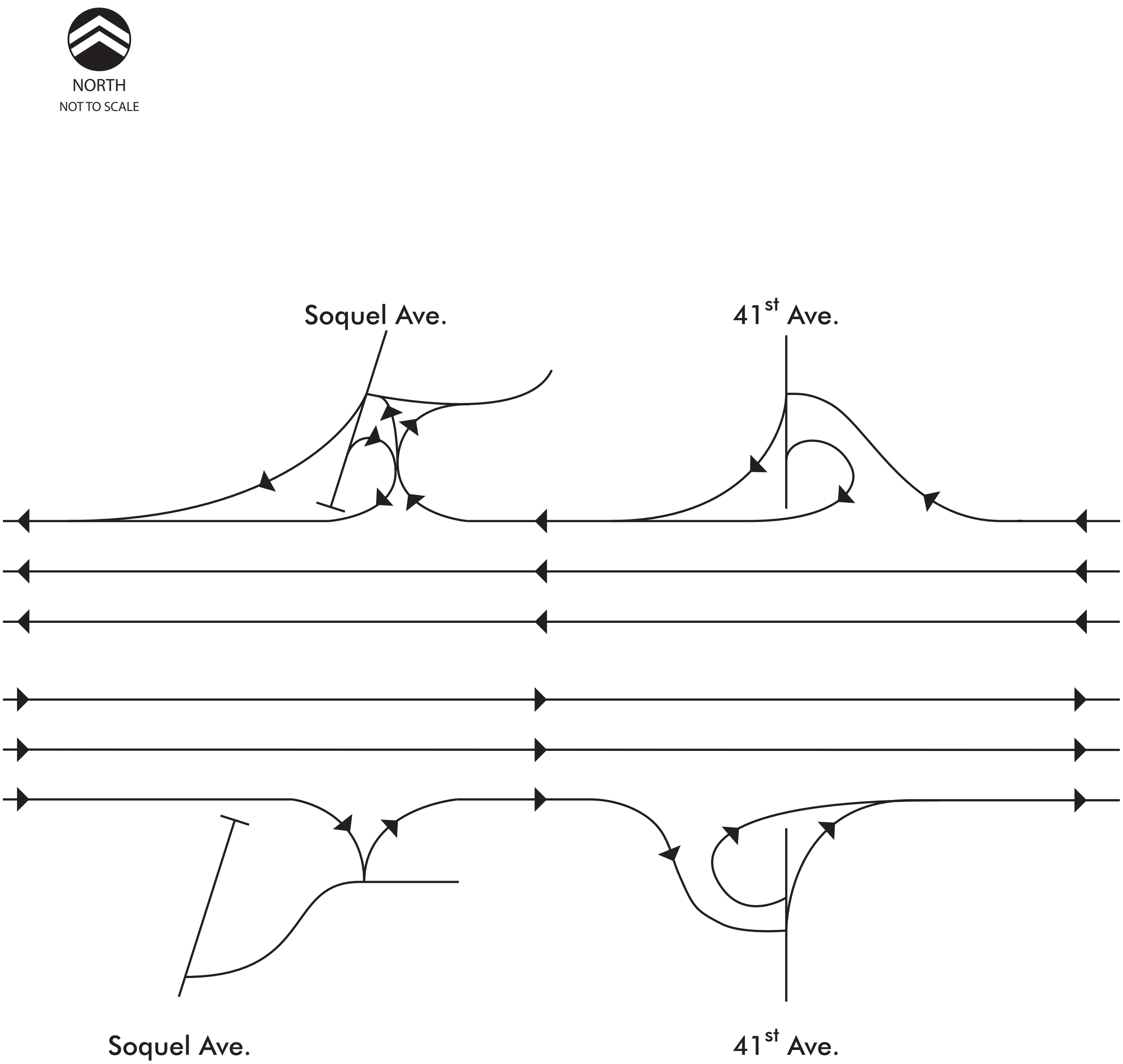
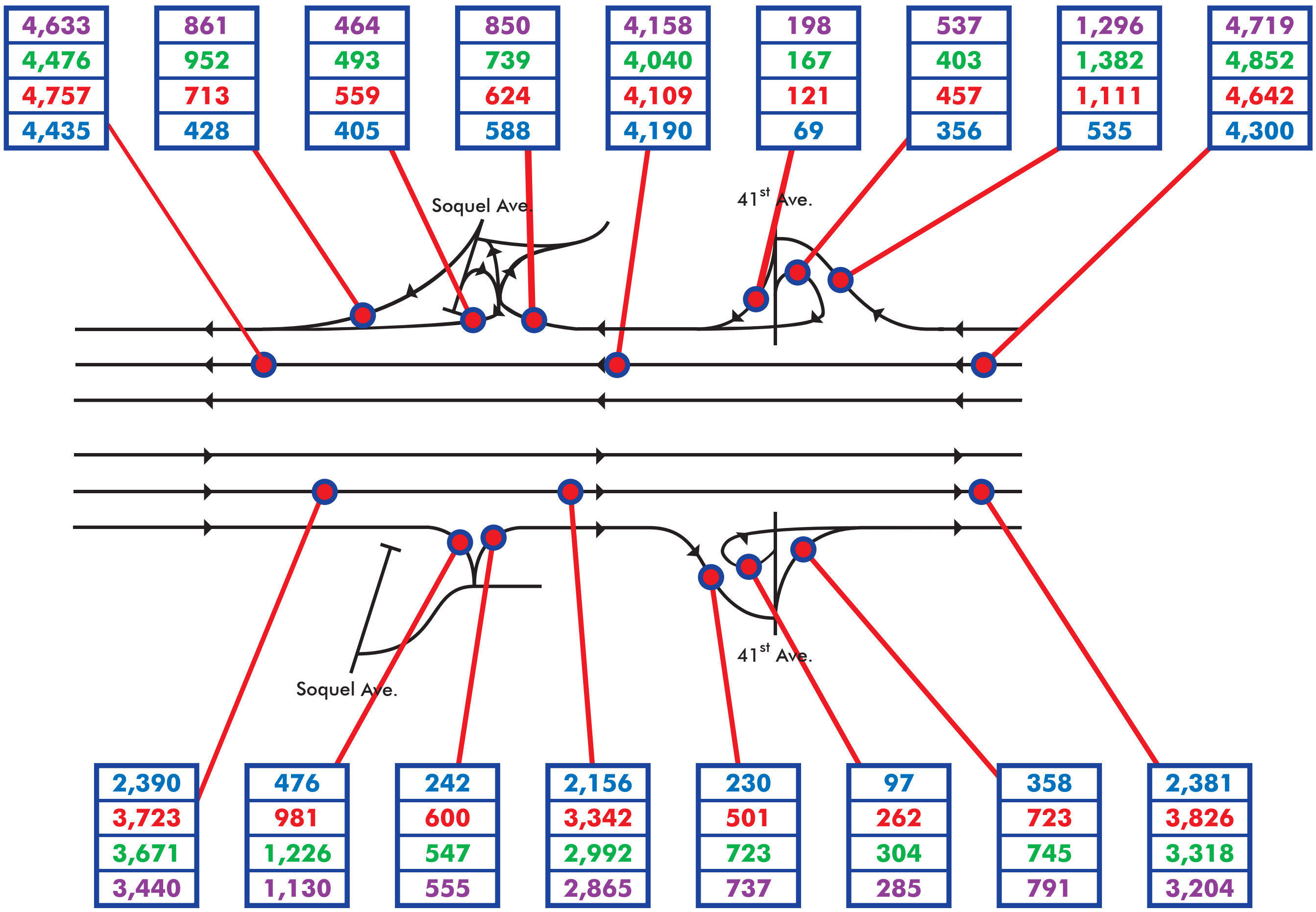


Figure 8-1
TIER II PROJECT LANE LINE DIAGRAM



LEGEND

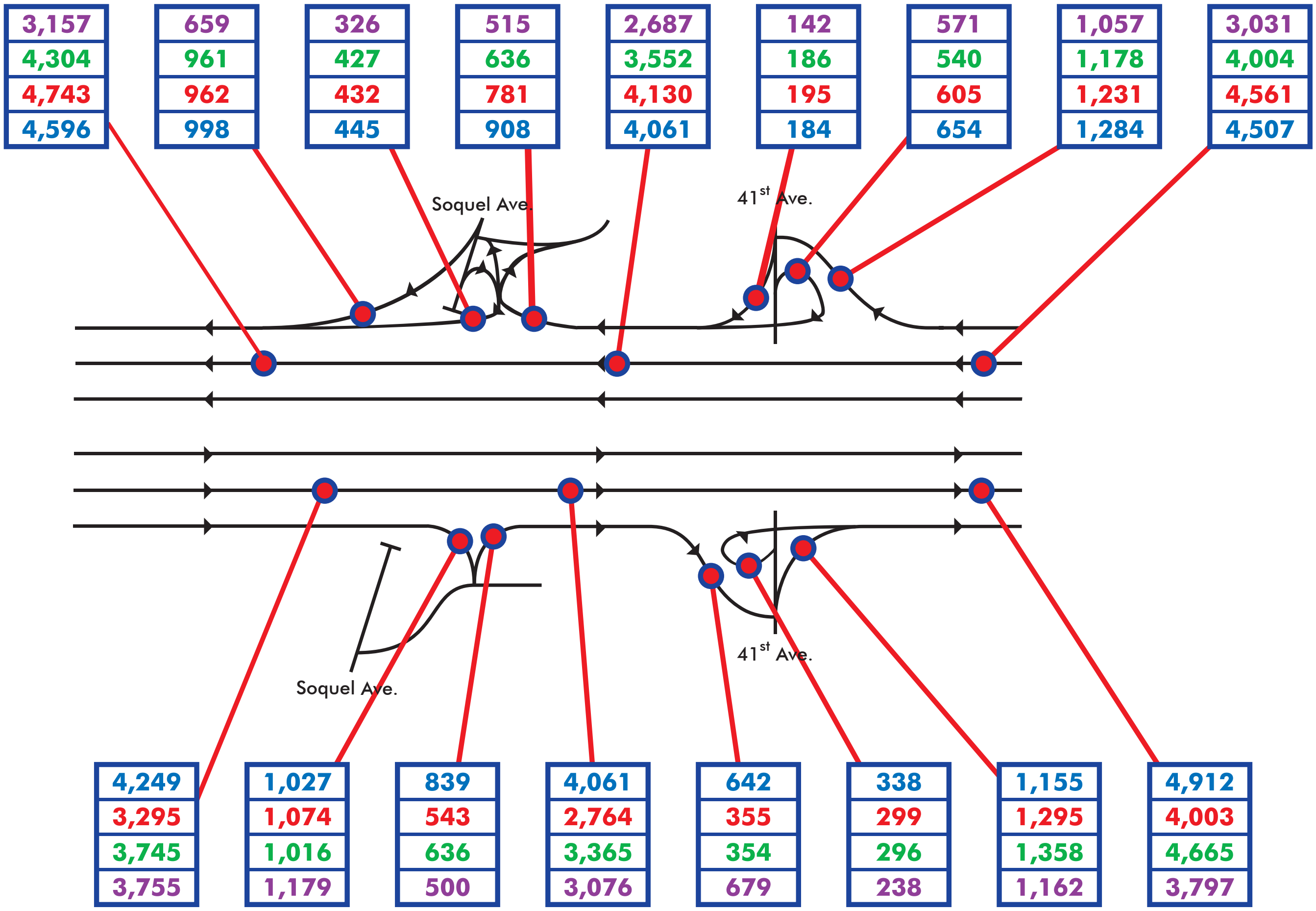
- ### Volumes During timeperiod 6-7:00 AM
- ### Volumes During timeperiod 7-8:00 AM
- ### Volumes During timeperiod 8-9:00 AM
- ### Volumes During timeperiod 9-10:00 AM

NORTH
NOT TO SCALE

Figure 8-2

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 CONDITIONS (AM PEAK)

ENGINEERS PLANNERS ECONOMISTS
Wilbur Smith Associates



LEGEND

- ### Volumes During timeperiod 3-4:00 PM
- ### Volumes During timeperiod 4-5:00 PM
- ### Volumes During timeperiod 5-6:00 PM
- ### Volumes During timeperiod 6-7:00 PM

NORTH
NOT TO SCALE

ENGINEERS
PLANNERS
ECONOMISTS
Wilbur Smith Associates

Figure 8-3

STATE ROUTE 1 FREEWAY AND RAMP VOLUMES
YEAR 2015 CONDITIONS (PM PEAK)

Table 8-9
Comparison of 2015 Peak Period Performance Measures
(Highway 1 – Highway 17 to San Andreas Road/Larkin Valley Road Interchanges)

Measure of Effectiveness	2015 No Build		2015 Tier 2 Project	
	AM	PM	AM	PM
Average Travel Time (minutes per vehicle)				
Northbound	20	11	17	11
Southbound	11	28	11	29
Average Speed (mph)				
Northbound	36	53	42	56
Southbound	58	25	58	24
Travel Delay (minutes per vehicle)				
Northbound	8	2	5	1
Southbound	1	16	1	18
Number of Vehicle Trips (vehicles per hour)				
Northbound	3,376	3,189	3,399	3,190
Southbound	2,596	2,933	2,598	2,964
Number of Person Trips (persons per hour)				
Northbound	3,822	3,967	3,848	3,969
Southbound	3,011	3,456	3,013	3,493
Average Vehicle Occupancy (persons per vehicle)				
Northbound	1.13	1.24	1.13	1.24
Southbound	1.16	1.18	1.16	1.18
Average Density (vpmpl)				
Northbound	47	30	41	28
Southbound	22	59	22	62
Average Level of Service				
Northbound	F	D	E	D
Southbound	C	F	C	F

Southbound Highway 1 Corridor

- It would increase the average travel time along the corridor by 1 minute per vehicle (from 28 to 29 minutes per vehicle) and average travel delay by 2 minutes per vehicle (from 16 to 18 minutes per vehicle) during the PM peak period;
- It would reduce the average travel speed along the corridor by 1 mph (from 25 mph to 24 mph) during the PM peak period;
- It would marginally improve the vehicle throughput from 2,933 to 2,964 vehicles per hour and person throughput from 3,456 to 3,493 persons per hour during the PM peak period; and
- It would increase the average vehicle density from 59 to 62 passenger cars per mile per lane during the PM peak period; however, it would not modify the LOS of the corridor.

The implementation of the Tier 2 project would add capacity to Southbound Highway 1 between Soquel Avenue On-Ramp and 41st Avenue Off-Ramp. This increase in capacity would relieve congestion between Soquel Avenue On-Ramp and 41st Avenue Off-Ramp, but the relieved traffic would add to the queues at the downstream bottleneck located between Bay Avenue On-Ramp and Park Avenue Off-Ramp, increasing queue lengths at that location. Therefore, traffic operations along the southbound corridor would slightly worsen during the PM peak period with the Tier 2 project.

Since the northbound PM peak and southbound AM peak are the non-peak directions of travel, the Tier 2 project would result in negligible modifications to the corridor operations during those periods.

8.3.2 Conclusions

The provision of auxiliary lanes on Highway 1 between the Soquel Avenue and 41st Avenue interchanges is expected to:

- Negligibly improve the Highway 1 corridor operations in the non-peak directions of travel, southbound in the AM peak hour and northbound in the PM peak hour;
- Improve traffic operations along the northbound corridor in the AM peak hour;
- Slightly worsen traffic operations along the southbound corridor in the PM peak hour, but improve vehicle and person throughputs; and
- Eliminate the existing bottleneck located between the Soquel Avenue and 41st Avenue interchanges in the northbound direction.

Unlike in the northbound direction, the proposed auxiliary lane between Soquel Avenue and 41st Avenue would not provide the most improvement to the corridor operations in the southbound direction. However, to avoid construction disruption associated with constructing disconnected segments in the northbound and southbound directions as well as to coordinate with the proposed improvements at Highway 1/Highway 17 and Morrissey Boulevard interchanges that are working their way southward through the most congested portion of the study corridor, the proposed southbound auxiliary lane between Soquel Avenue and 41st Avenue interchanges is included as part of the Tier 2 project.

Chapter 9
SUMMARY AND CONCLUSIONS

9.1 SUMMARY

The traffic analysis included in this report has analyzed the peak hour traffic operations of State Route 1 within the study area under Existing Conditions and the following three future scenarios:

1. No-Build Scenario (includes *Route 1/17 Widening for Merge Lanes and Highway 1 Soquel to Morrissey Auxiliary Lanes* project, between Morrissey Boulevard and Soquel Avenue interchanges)
2. TSM Build Scenario (includes ramp metering and auxiliary lanes)
3. HOV Build Scenario (includes HOV lanes, ramp metering, and auxiliary lanes)

Future year traffic analysis includes analysis under Year 2035 (design year) and Year 2015 (opening year) Conditions.

Table 8-1 summarizes the State Route 1 traffic operational analysis results under Existing, Year 2015, and Year 2035 Conditions. Based on the traffic analysis results, it can be observed that the freeway operations would improve under the HOV Build and TSM Build scenarios as compared to the No-Build scenario. Furthermore, the freeway operating conditions would be substantially improved under the HOV Build scenario than the TSM Build scenario.

9.1.1 Freeway Operations Summary - HOV Build Scenario

The addition of the HOV lane and other geometric improvements would increase the average travel speed and reducing the average travel time, vehicle delay, and density, thus improving the LOS of the freeway. Even during the peak hours, speeds on the HOV lanes would operate at or near free-flow speed. Commuters traveling at speeds of as low as 11 mph and 15 mph under the Year 2035 and Year 2015 No-Build Conditions would be able to travel at free-flow speed (approximately 60 mph) on the HOV lanes. Overall (combining both HOV lane and mixed-flow lane speeds), travel speeds on State Route 1 would vary from 33 mph to 52 mph and 59 mph to 62 mph under Year 2035 and Year 2015 Conditions, depending on the time period and the direction.

Average travel times would also improve depending on the direction and the peak period. Under Year 2035 Conditions, the maximum travel time in the AM peak hour would drop from 59 minutes in the No-Build scenario to 16 minutes in the HOV Build scenario and the maximum travel time in the PM peak hour would reduce from 61 minutes in the No-Build scenario to 19 minutes in the HOV Build scenario. Similarly, under Year 2015 Conditions, the maximum travel time in the AM peak hour would drop from 24 minutes in the No-Build scenario to 10 minutes in the HOV Build scenario and in the PM peak hour would reduce from 47 minutes in No-Build scenario to 10 minutes in the HOV Build scenario.

Table 9-1
State Route 1 Traffic Operational Analysis Summary – Peak Hour Conditions

Measure of Effectiveness	Existing Conditions		Year 2035 Conditions						Year 2015 Conditions					
			No-Build		HOV Build		TSM Build		No-Build		HOV Build		TSM Build	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Average Travel Time (minutes)														
Northbound	23	15	59	34	16	13	34	29	24	12	10	9	13	10
Southbound	10	27	29	61	12	19	12	62	12	47	9	10	10	17
Average Speed (mph)														
Northbound	30	39	12	17	39	42	21	21	29	49	59	62	53	60
Southbound	60	26	22	11	52	33	54	10	51	15	62	59	61	41
Delay (minutes per vehicle)														
Northbound	14	6	48	25	6	4	22	19	13	3	1	0	2	0
Southbound	0	15	19	49	2	9	2	50	2	35	0	1	0	5
No. of Vehicle Trips (per hour)														
Northbound	2,923	3,235	2,767	3,114	4,510	4,898	3,986	3,858	3,449	3,878	3,935	3,979	3,690	3,846
Southbound	2,918	3,101	3,101	2,475	4,253	4,431	3,873	3,091	3,239	2,900	3,470	4,029	3,332	3,674
No. of Person Trips (per hour)														
Northbound	3,308	4,024	3,132	3,874	5,742	6,276	4,847	4,870	3,904	4,825	4,947	5,112	4,486	4,875
Southbound	3,385	3,664	3,597	2,911	5,181	5,684	4,623	3,750	3,757	3,421	4,253	5,109	3,979	4,456
Avg. Vehicle Occupancy (persons/vehicle)														
Northbound	1.13	1.24	1.13	1.24	1.27	1.28	1.22	1.23	1.13	1.24	1.26	1.28	1.22	1.27
Southbound	1.16	1.18	1.16	1.18	1.22	1.28	1.19	1.21	1.16	1.18	1.23	1.27	1.19	1.21
Density (pcpmpl)														
Northbound	49	41	115	92	42 (14)	37 (20)	76	73	59	40	22(12)	20 (14)	28	26
Southbound	24	60	70	42	29 (11)	37 (19)	29	124	32	97	19 (9)	22 (12)	22	36
Level of Service														
Northbound	F	E	F	F	E (B)	E (C)	F	F	F	E	C (B)	C (B)	D	C
Southbound	C	F	F	F	D (A)	E (B)	D	F	D	F	C (A)	C (B)	C	E

Source: Wilbur Smith Associates, April 2007

<u>NOTES:</u>
N.A. – Not Applicable
28 (10) – Density of mixed-flow lanes (Density of HOV lane)
D (A) – LOS of mixed-flow lanes (LOS of HOV lane)

Similar to the average speed, the vehicle throughput would increase under the HOV Build scenario. Under Year 2035 HOV Build Conditions, the vehicle throughput in the northbound direction would increase by 63 percent and 57 percent (compared to No-Build scenario) during the AM and PM peak hours, respectively; whereas, the vehicle throughput in the southbound direction would increase by 37 percent and 79 percent (compared to No-Build scenario) during the AM and PM peak hours.

Under Year 2015 Conditions, compared to the No-Build, the HOV Build scenario would have a three percent increase in vehicle throughput in the northbound direction during the PM peak hour and a 39 percent increase in vehicle throughput in the southbound direction during the PM peak hour.

With more people carpooling to take advantage of the HOV lane, the person trips per hour as well as the average vehicle occupancy (AVO) will increase under the HOV Build scenario. Under Year 2035 HOV Build Conditions, the person trips in the northbound direction would increase by 83 percent and 44 percent (compared to No-Build scenario) during the AM and PM peak hours, respectively; whereas the person trips per hour in the southbound direction would increase by 62 percent and 95 percent (compared to No-Build scenario) during the AM and PM peak hours respectively. The increase in the person trips along with an increase in the AVO indicates that the HOV lanes will carry more people in fewer vehicles, thus improving mobility along State Route 1.

Also, the improved freeway corridor conditions under HOV Build Conditions would divert vehicles traveling on parallel arterials onto State Route 1. This would then relieve the local city streets from excessive cut-through commuter traffic.

Tables 8-2A and *8-2 B* summarize the operations of the study intersections under AM and PM peak hours, respectively. With the proposed improvements at the Morrissey Boulevard interchange, Soquel Avenue interchange, 41st Avenue and Porter Street interchange, and San Andreas Road/ Larkin Valley Road interchange, the intersection operations under HOV Build Conditions would improve as compared to the No-Build scenario. Under Year 2035 No-Build Conditions, all the study intersections would operate at an unacceptable level of service during AM and PM peak hours; whereas, with the proposed intersection improvements, 11 of the 26 study intersections would operate with an acceptable level of service during the peak hours. Similarly under Year 2015 Conditions, only 8 study intersections would operate under an acceptable level of service during the AM and PM peak hours in the No-Build scenario, while 22 of the 26 study intersections would operate at an acceptable level of service during the AM and PM peak hours in the HOV Build scenario. Only 4 study intersections would operate with an unacceptable level of service under the Year 2015 HOV Build Conditions.

9.1.2 Freeway Operations Summary – TSM Build Scenario

The addition of ramp metering and auxiliary lanes within the study area would improve the freeway operations, but not as significantly as under HOV Build scenario. Compared to the Year 2035 No-Build Conditions, the average speed under Year 2035 TSM Build Conditions would increase from -10 percent to 150 percent depending on the time period and direction of travel.

The average speed would decrease in the southbound direction during PM peak hour, but it would increase in all other scenarios. Under the 2035 TSM Build Conditions, strategies such as ramp metering would relieve bottlenecks at certain segments, but since traffic demand by year 2035 would be much greater than the available supply, the bottlenecks would shift to other segments rather than dissipating completely. Thus, in addition to better TSM strategies, an increase in supply (roadway capacity) would be required to manage the increase in demand.

Depending on the time period and direction of travel, the average speed under Year 2015 TSM Build Conditions would increase by a factor of 19 percent to 173 percent compared to the Year 2015 No-Build Conditions. Overall, the freeway would operate at or near free-flow speed during Year 2015 TSM Build Conditions (average speeds would vary from 41 mph to 61 mph) and below free-flow speeds during Year 2035 TSM Build Conditions (average speeds would vary from 10 mph to 54 mph).

Compared to Year 2035 No-Build Conditions, average travel time under Year 2035 TSM Build Conditions would reduce during the AM peak hour in northbound (42 percent reduction) and southbound (15 percent reduction) directions. However, the average travel time in the southbound direction during the PM peak hour would slightly increase (62 minutes, two percent increase). As mentioned above, this would probably be caused by the high increase of traffic along State Route 1 under Year 2035 Conditions. On the other hand, since traffic demand would be considerably less on the reverse commute directions, provision of ramp metering and auxiliary lanes would significantly improve the travel time, by approximately 24 percent in the northbound direction during the PM peak hour and about 145 percent in the southbound direction during the AM peak hour. The maximum travel time during the AM peak hour would reduce from 59 minutes in the No-Build scenario to 16 minutes in the TSM Build scenario; whereas, the maximum travel time during the PM peak hour would increase from 61 minutes under the No-Build scenario to 62 minutes in the TSM Build scenario.

Compared to Year 2015 No-Build Conditions, average travel time under Year 2015 TSM Build scenario would improve by nine percent to 64 percent, with the highest gains occurring in the northbound direction during AM peak hour (46 percent increase) and southbound direction during the PM peak hour (64 percent increase). The maximum travel times would drop from 24 minutes to 13 minutes and from 47 minutes to 17 minutes during AM and PM peak hours, respectively.

In the northbound direction during the AM peak hour, vehicle throughput under Year 2035 TSM Build Conditions would increase by 44 percent compared to Year 2035 No-Build Conditions; whereas, in the northbound direction during PM peak hour and in the southbound direction during the AM as well as the PM peak hours, the increase in vehicle throughput would be 24 percent only.

Under Year 2015 Conditions, the gains in vehicle throughput during TSM Build scenario with respect to the No-Build scenario are not as high as under Year 2035 Conditions. The vehicle throughput in all the scenarios would increase, except in the northbound direction during PM peak hour. In this scenario, the vehicle throughput would drop by approximately one percent.

The maximum gain in the throughput was observed in the southbound direction during the PM peak hour where there would be an increase in throughput by 27 percent.

Therefore, providing ramp metering and auxiliary lanes would not relieve the congestion, but would only increase the corridor's ability to carry more vehicles.

Intersection operations under TSM Build scenario would have similar service levels as under No-Build scenario. Thus, under Year 2035 Conditions, the TSM Build and No-Build scenarios would have all of the study intersections operating at an unacceptable level of service; while under Year 2015 Conditions, both these scenarios would have 17 of the 25 study intersections operating at an unacceptable level of service.

Table 9-2A
Intersection LOS Summary – AM Peak Hour Conditions

#	Intersection	Traffic Controller[1]	Existing Conditions		Year 2035 Conditions						Year 2015 Conditions					
					No-Build		HOV Build		TSM Build		No-Build		HOV Build		TSM Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	AWSC	24.1	C	**276.4**	**F**	39.3	D	**289.1**	**F**	**83.8**	**F**	12.4	B	**86.7**	**F**
2	Rooney St./ SR-1 NB Ramps	TWSC	20.5 (NB)	C	**839.7** (NB)	**F**	39.9	D	**867.1** (NB)	**F**	**74.6** (NB)	**F**	25.5	C	**76.3** (NB)	**F**
3	Fairmount Ave./ SR-1 SB Ramps	AWSC	**115.6**	**F**	**732.3**	**F**	9.3	A	**732.5**	**F**	**341.4**	**F**	10.1	B	**89.4**	**F**
4	Morrissey Blvd./ Fairmount Ave.	Signal	28.0	C	**316.9**	**F**	50.4	D	**318.9**	**F**	**80.6**	**F**	25.6	C	**81.1**	**F**
5	Soquel Ave./ SR-1 SB Ramps	Signal	23.7	C	**132.0**	**F**	21.3	C	**127.7**	**F**	42.4	D	8.8	A	41.3	D
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Signal	36.9	D	**208.9**	**F**	**274.9**	**F**	**207.8**	**F**	**74.1**	**E**	44.8	D	**74.0**	**E**
7	41st Ave./ SR-1 NB Off-Ramp	Signal	9.8	A	**58.1**	**E**	**59.2**	**E**	**58.2**	**E**	17.5	B	30.9	C	17.4	B
8	41st Ave./ SR-1 SB Ramps	Signal	13.5	B	**55.2**	**E**	41.1	D	**56.7**	**E**	16.8	B	21.8	C	16.8	B
9	Porter St./ S. Main St.	Signal	27.0	C	**80.6**	**F**	30.0	C	**90.2**	**F**	**37.9**	**D**	26.0	C	**40.7**	**D**
10	Porter St./ SR-1 NB Ramps	Signal	18.5	B	**193.8**	**F**	30.7	C	**186.9**	**F**	47.0	D	19.9	B	45.3	D
11	Bay Ave./ SR-1 SB Ramps	Signal	22.6	C	**426.2**	**F**	31.8	C	**425.9**	**F**	**95.0**	**F**	27.1	C	**94.9**	**F**
12	Park Ave./ SR-1 NB Ramps	Signal	**61.3**	**E**	**312.8**	**F**	**94.3**	**F**	**312.2**	**F**	**108.8**	**F**	17.8	B	**109.0**	**F**
13	Park Ave./ SR-1 SB Ramps	Signal	31.0	C	**383.2**	**F**	**154.2**	**F**	**383.0**	**F**	**85.1**	**F**	35.8	D	**85.1**	**F**
14	Park Ave./ Kennedy Dr./ McGregor Dr.	AWSC	**91.9**	**F**	**>1000**	**F**	**486.5**	**F**	**>1000**	**F**	**739.7**	**F**	**76.1**	**E**	**740.4**	**F**
15	State Park Dr./ SR-1 NB Ramps	Signal	5.3	A	**387.8**	**F**	28.1	C	**381.5**	**F**	49.7	D	20.5	C	48.5	D
16	State Park Dr./ SR-1 SB Ramps	Signal	14.2	B	**288.9**	**F**	46.5	D	**288.9**	**F**	26.0	C	15.0	B	26.0	C
17	State Park Dr./ McGregor Dr.	TWSC	**383.0** (EB)	**F**	**>1000** (EB)	**F**	**155.7**	**F**	**>1000** (EB)	**F**	**>1000** (EB)	**F**	22.1	C	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Signal	24.5	C	**740.3**	**F**	**84.8**	**F**	**737.9**	**F**	**141.1**	**F**	23.1	C	**140.0**	**F**
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Signal	8.5	A	**>1000**	**F**	29.1	C	**>1000**	**F**	53.1	D	18.1	B	52.7	D
20	Rio Del Mar Blvd./ Soquel Dr.	Signal	**249.2**	**F**	**298.7**	**F**	**354.0**	**F**	**303.2**	**F**	**149.2**	**F**	**59.8**	**E**	**148.7**	**F**
21	Freedom Blvd./ SR-1 NB Ramps	TWSC	**46.1** (NWB)	**E**	**>1000** (NWB)	**E**	14.2	B	**>1000** (NWB)	**E**	**>1000** (NWB)	**E**	11.9	B	**>1000** (NWB)	**E**
22	Freedom Blvd./ SR-1 SB Ramps	AWSC	**55.6**	**F**	**99.7**	**F**	35.8	D	**100.5**	**F**	**66.5**	**F**	34.2	C	**66.9**	**F**
23	Freedom Blvd./ Bonita Dr.	TWSC	11.3 (EB)	B	**>1000** (EB)	**F**	12.6	B	**>1000** (EB)	**F**	**143.8** (EB)	**F**	16.4	B	**162.8** (EB)	**F**
24	San Andreas Rd. Larkin Rd./ SR-1 NB Off-Ramp	TWSC	9.6 (EB)	A	**73.6** (EB)	**F**	30.0	C	**65.3** (EB)	**F**	13.4 (EB)	B	25.1	C	13.4 (EB)	B
25	San Andreas Rd./ SR-1 SB Ramps	TWSC	12.4 (SEB)	B	**>1000** (SEB)	**F**	9.8	A	**>1000** (SEB)	**F**	**111.3** (SEB)	**F**	7.7	A	**111.3** (SEB)	**F**
26	Soquel Dr./ Soquel Ave./ SR-1 SB Off-Ramp	Signal	-	-	-	-	**202.5**	**F**	-	-	-	-	52.1	D	-	-

Source: Wilbur Smith Associates, April 2007

NOTES:
1. Traffic controller under Existing, No-Build, and TSM Build Conditions only. Under HOV Build Conditions, all intersections are signalized.
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

Table 9-2B
Intersection LOS Summary – PM Peak Hour Conditions

#	Intersection	Traffic Controller[1]	Existing Conditions		Year 2035 Conditions						Year 2015 Conditions					
					No-Build		HOV Build		TSM Build		No-Build		HOV Build		TSM Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Morrissey Blvd./ Rooney St./ Pacheco Ave.	AWSC	12.1	B	**171.2**	**F**	10.8	B	**171.7**	**F**	24.5	C	5.8	A	24.5	C
2	Rooney St./ SR-1 NB Ramps	TWSC	11.5 (NB)	B	**189.8** (NB)	**F**	**76.5**	**E**	**189.8** (NB)	**F**	18.7 (NB)	C	27.6	C	18.8 (NB)	C
3	Fairmount Ave./ SR-1 SB Ramps	AWSC	**112.5**	**F**	**455.2**	**F**	7.6	A	**453.9**	**F**	**244.5**	**F**	9.0	A	**61.2**	**F**
4	Morrissey Blvd./ Fairmount Ave.	Signal	26.9	C	**237.1**	**F**	**78.6**	**E**	**236.7**	**F**	**58.8**	**E**	30.5	C	**58.7**	**E**
5	Soquel Ave./ SR-1 SB Ramps	Signal	23.5	C	**202.0**	**F**	**150.4**	**F**	**202.4**	**F**	**99.4**	**F**	9.2	A	**99.4**	**F**
6	Soquel Dr./ Paul Sweet Rd./ Commercial Way	Signal	22.7	C	**148.1**	**F**	**187.6**	**F**	**148.1**	**F**	35.9	D	29.6	C	35.7	D
7	41st Ave./ SR-1 NB Off-Ramp	Signal	11.8	B	**82.9**	**F**	**64.7**	**E**	**82.6**	**F**	17.5	B	45.0	D	17.5	B
8	41st Ave./ SR-1 SB Ramps	Signal	14.3	B	**106.9**	**F**	**69.1**	**E**	**110.8**	**F**	37.6	D	29.3	C	37.6	D
9	Porter St./ S. Main St.	Signal	28.7	C	**37.4**	**D**	34.5	C	**37.4**	**D**	**36.1**	**D**	25.8	C	**36.0**	**D**
10	Porter St./ SR-1 NB Ramps	Signal	23.9	C	**143.2**	**F**	**86.3**	**F**	**143.3**	**F**	42.2	D	**55.5**	**E**	42.1	D
11	Bay Ave./ SR-1 SB Ramps	Signal	22.5	C	**298.5**	**F**	31.5	C	**297.6**	**F**	53.7	D	25.1	C	52.9	D
12	Park Ave./ SR-1 NB Ramps	Signal	15.3	B	**93.9**	**F**	**93.5**	**F**	**93.9**	**F**	24.3	C	24.3	C	24.3	C
13	Park Ave./ SR-1 SB Ramps	Signal	20.8	C	**269.7**	**F**	**267.1**	**F**	**270.0**	**F**	40.5	D	37.3	D	40.5	D
14	Park Ave./ Kennedy Dr./ McGregor Dr.	AWSC	**75.0**	**F**	**>1000**	**F**	**919.8**	**F**	**>1000**	**F**	**509.3**	**F**	**85.1**	**F**	**510.0**	**F**
15	State Park Dr./ SR-1 NB Ramps	Signal	6.3	A	**147.3**	**F**	22.9	C	**191.9**	**F**	19.7	B	16.2	B	19.7	B
16	State Park Dr./ SR-1 SB Ramps	Signal	16.5	B	**260.3**	**F**	**57.9**	**E**	**260.1**	**F**	39.0	D	16.9	B	38.9	D
17	State Park Dr./ McGregor Dr.	TWSC	**236.1** (EB)	**F**	**>1000** (EB)	**F**	**139.7**	**F**	**>1000** (EB)	**F**	**>1000** (EB)	**F**	17.8	B	**>1000** (EB)	**F**
18	Rio Del Mar Blvd./ SR-1 NB Ramps	Signal	44.7	D	**313.6**	**F**	**133.9**	**F**	**314.2**	**F**	**110.3**	**F**	29.1	C	**110.5**	**F**
19	Rio Del Mar Blvd./ SR-1 SB Ramps	Signal	8.5	A	**157.0**	**F**	40.5	D	**156.7**	**F**	29.9	C	21.0	C	30.2	C
20	Rio Del Mar Blvd./ Soquel Dr.	Signal	**36.1**	**D**	**495.1**	**F**	**284.2**	**F**	**495.1**	**F**	**130.2**	**F**	**56.9**	**E**	**130.2**	**F**
21	Freedom Blvd./ SR-1 NB Ramps	TWSC	16.7 (NWB)	C	**>1000** (NWB)	**F**	10.3	B	**>1000** (NWB)	**F**	**74.4** (NWB)	**F**	7.5	A	**74.5** (NWB)	**F**
22	Freedom Blvd./ SR-1 SB Ramps	AWSC	**124.4**	**F**	**603.8**	**F**	40.3	D	**603.8**	**F**	**169.2**	**F**	33.1	C	**169.3**	**F**
23	Freedom Blvd./ Bonita Dr.	TWSC	11.5 (EB)	B	**>1000** (EB)	**F**	4.5	A	**>1000** (EB)	**F**	**>1000** (EB)	**F**	3.9	A	**>1000** (EB)	**F**
24	San Andreas Rd. Larkin Rd./ SR-1 NB Off-Ramp	TWSC	9.5 (EB)	A	**691.0** (EB)	**F**	28.5	C	**689.5** (EB)	**F**	14.9 (EB)	B	17.4	B	14.9 (EB)	B
25	San Andreas Rd./ SR-1 SB Ramps	TWSC	14.7 (SEB)	B	**>1000** (SEB)	**F**	28.2	C	**>1000** (SEB)	**F**	**95.1** (SEB)	**F**	11.9	B	**95.1** (SEB)	**F**
26	Soquel Dr./ Soquel Ave./ SR-1 SB Off-Ramp	Signal	-	-	-	-	**203.9**	**F**	-	-	-	-	**72.7**	**E**	-	-

Source: Wilbur Smith Associates, April 2007

NOTES:
1. Traffic controller under Existing, No-Build, and TSM Build Conditions only. Under HOV Build Conditions, all intersections are signalized.
AWSC – All-Way Stop Control
TWSC – Two-Way Stop Control
LOS – Level of Service
Delay is presented in seconds per vehicle.
Bold represents intersections operating under unacceptable conditions.

9.2 CONCLUSIONS

The provision of HOV lanes, ramp metering, and auxiliary lanes along State Route 1 between San Andreas Road/ Larkin Valley Road and Morrissey Boulevard interchanges is expected to:

- Improve the future freeway operations by increasing the average vehicle speed and reducing the vehicle delays as well as the average travel time
- Encourage the commuters to carpool to take advantage of the HOV lanes, resulting in the vehicle throughput increase
- Eliminate the existing bottleneck located near the Bay Avenue/ Porter Street interchange in the southbound direction
- Improve the operations of the arterials located parallel to State Route 1 (like Soquel Drive) by reducing the inter-city commuter traffic along them
- Enhance the operating conditions of the ramp terminal intersections as well as the intersections located next to them from the proposed interchange and intersection improvements
- Improve the traffic safety conditions by reducing the future crash rates compared to No-Build Conditions

Additionally, from the traffic operations perspective, the proposed auxiliary lane improvements are prioritized as follows:

Northbound Direction
1. Alternative N1 – From 41st Avenue On-ramp to Soquel Avenue Off-ramp
2. Alternative N2 – From Park Avenue On-ramp to Bay Avenue/Porter Street Off-ramp
3. Alternative N3 – From State Park Drive On-ramp to Park Avenue Off-ramp
4. Alternative N4 – From Rio Del Mar Boulevard On-ramp to State Park Drive Off-ramp
5. Alternative N5 – From Freedom Boulevard On-ramp to Rio Del Mar Boulevard Off-ramp

Southbound Direction
1. Alternative S2 – From Bay Avenue/Porter Street On-ramp to Park Avenue Off-ramp
2. Alternative S4 – From State Park Drive On-ramp to Rio Del Mar Boulevard Off-ramp
3. Alternative S5 – From Rio Del Mar Boulevard On-ramp to Freedom Boulevard Off-ramp
4. Alternative S3 – From Park Avenue On-ramp to State Park Drive Off-ramp
5. Alternative S1 – From Soquel Avenue On-ramp to 41st Avenue Off-ramp

However, traffic operational analysis also suggests that some of these improvements, when constructed alone, would create hotspots, including new bottlenecks and more congestion within the study corridor. Therefore, to avoid/minimize hotspots, it is recommended that a more detailed analysis be conducted that takes into account the construction of complementary auxiliary lane improvements at the same time.

Similarly, the proposed interchange and intersection improvements are prioritized as follows from the traffic operations perspective:
1. Morrissey Boulevard interchange improvements
2. Soquel Avenue interchange improvements

3. Freedom Boulevard/Highway 1 Northbound Ramps intersection improvements
4. Freedom Boulevard/Bonita Drive intersection improvements
5. Freedom Boulevard/Highway 1 Southbound Ramps intersection improvements
6. Rio Del Mar Boulevard/Soquel Drive intersection improvements
7. Rio Del Mar Boulevard/SR 1 Northbound Ramps intersection improvements
8. San Andreas Road/Larkin Road interchange improvements
9. Park Avenue/SR 1 Northbound Ramps intersection improvements
10. Park Avenue/SR 1 Southbound Ramps intersection improvements
11. 41st Avenue/ Porter Street interchange improvements
12. Any other improvements

GLOSSARY OF TERMS

Acceleration lane - A paved auxiliary lane, including tapered areas, allowing vehicles to accelerate when entering the through-traffic lane of the roadway.

Access point - An intersection, driveway, or opening on the right-hand side of a roadway. An entry on the opposite side of a roadway or a median opening also can be considered as an access point if it is expected to influence traffic flow significantly in the direction of interest.

Adjustment - An additive or subtractive quantity that adjusts a parameter for a base condition to represent a prevailing condition.

Adjustment factor - A multiplicative factor that adjusts a parameter for a base condition to represent a prevailing condition.

Aggregate delay - The summation of delays for multiple lane groups usually aggregated for an approach, an intersection, or an arterial route.

Analysis period - A single time period during which a capacity analysis is performed on a transportation facility. If the demand exceeds capacity during an analysis period, consecutive analysis periods can be selected to account for initial queue from the previous analysis period. Also referred to as **time interval**.

Average Daily Traffic (ADT) - is defined as the total traffic volume during a given period (from 1 to 364 days) divided by the number of days in that period. Current ADT volumes can be determined by continuous traffic counts or periodic counts. Where only periodic traffic counts are taken, ADT volume can be established by applying correction factors such as for season or day of week. For roadways having traffic in two directions, the ADT includes traffic in both directions unless specified otherwise.

Average Weekday Daily Traffic (AWDT) - The total traffic for an average weekday. An average weekday is a representative weekday computed as the mathematical average of several typical weekdays selected at random throughout the year. A typical weekday has no anomaly such as heavy traffic due to a special public event or light traffic due to inclement weather. Average Saturday and Sunday data, including holiday service, are determined the same way.

Annual average daily traffic (AADT) - The total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year.

Approach - A set of lanes at an intersection that accommodates all left-turn, through, and right-turn movements from a given direction.

Approach grade - The grade of an intersection approach, expressed as a percentage, with positive values for upgrade and negative for downgrade.

Arterial - A signalized street that primarily serves through-traffic and that secondarily provides access to abutting properties, with signal spacing of 2.0 mi or less.

Auxiliary lane - An additional lane on a freeway to connect an on-ramp and an off-ramp.

Average travel speed - The length of the highway segment divided by the average travel time of all vehicles traversing the segment, including all stopped delay times.

Base condition - The best possible characteristic in terms of capacity for a given type of transportation facility; that is, further improvements would not increase capacity; a condition without hindrances or delays.

Base saturation flow rate - The maximum steady flow rate, expressed in passenger cars per hour per lane, at which previously stopped passenger cars can cross the stop line of a signalized intersection under base conditions, assuming that the green signal is available and no lost times are experienced.

Basic freeway segment - A length of freeway facility whose operations are unaffected by weaving, diverging, or merging.

Bottleneck - A road element on which demand exceeds capacity.

Breakdown - The onset of a queue development on a freeway facility.

Breakdown flow - Also called forced flow, occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity of a planned facility.

Calibration - The process of comparing model parameters with real-world data to ensure that the model realistically represents the traffic environment. The objective is to minimize the discrepancy between model results and measurements or observations.

Capacity - The maximum sustainable flow rate at which vehicles or persons reasonably can be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions; usually expressed as vehicles per hour, passenger cars per hour, or persons per hour.

Congested flow - A traffic flow condition caused by a downstream bottleneck.

Congestion Management System (CMS) - Provides information on transportation system performance and finds alternative ways to alleviate congestion and enhance the mobility of people and goods to levels that meet state, regional and local needs. TEA-21 requires each Transportation Management Area (TMA) to develop a CMS that is a systematic process for managing congestion. Through the use of travel demand reduction and operational management strategies, the CMS provides information on transportation systems performance and identifies alternative ways to alleviate congestion and enhance the mobility of people and goods, to levels that meet state and regional/local needs.

Constrained operation - An operating condition in a weaving segment, involving geometric and traffic constraints, that prevents weaving vehicles from occupying a large portion of the lanes available to achieve balanced operation.

Control condition - The traffic controls and regulations in effect for a segment of street or highway, including the type, phasing, and timing of traffic signals; stop signs; lane use and turn controls; and similar measures.

Corridor - A set of essentially parallel transportation facilities designed for travel between two points. A corridor contains several subsystems, such as freeways, rural (or two-lane) highways, arterials, transit, and pedestrian and bicycle facilities.

Critical lane group - The lane groups that have the highest flow ratio for a given signal phase.

Critical speed - The speed at which capacity occurs for a facility, usually expressed as miles per hour.

Critical volume to capacity ratio - The proportion of available intersection capacity used by vehicles in critical lane groups.

Crown line - A lane marking that connects from the entrance gore area directly to the exit gore area.

Deceleration lane - A paved auxiliary lane, including tapered areas, allowing vehicles leaving the through-traffic lane of the roadway to decelerate.

Default value - A representative value that may be appropriate in the absence of local data.

Delay - The additional travel time experienced by a driver, passenger, or pedestrian.

Demand - The number of users desiring service on the highway system, usually expressed as vehicles per hour or passenger cars per hour.

Demand to capacity ratio - The ratio of demand flow rate to capacity for a traffic facility.

Density - The number of vehicles on a roadway segment averaged over space, usually expressed as vehicles per mile or vehicles per mile per lane.

Design hour - An hour with a traffic volume that represents a reasonable value for designing the geometric and control elements of a facility.

Design-hour factor (K-factor) - The proportion of the 24-h volume that occurs during the design hour.

Design speed - A speed used to design the horizontal and vertical alignments of a highway.

Diamond interchange - An interchange that results in two or more closely spaced surface intersections, so that one connection is made to each freeway entry and exit, with one connection per quadrant.

Directional design-hour volume - The traffic volume for the design hour in the peak direction of flow, in vehicles per hour.

Directional distribution - A characteristic of traffic, that volume may be greater in one direction than in the other during any particular hour on a highway.

Directional flow rate - The flow rate of a highway in one direction.

Directional segment - A length of two-lane highway in one travel direction, with homogeneous cross sections and relatively constant demand volume and vehicle mix.

Directional split - The directional distribution of hourly volume on a highway, expressed in percentages.

Diverge - A movement in which a single lane of traffic separates into two lanes without the aid of traffic control devices.

Downstream - The direction of traffic flow.

Driver population - A parameter that accounts for driver characteristics and their effects on traffic.

Duration of congestion - A measure of the maximum amount of time that congestion occurs anywhere in the transportation system.

85th-percentile speed - A speed value that is less than 15 percent of a set of field measured speeds.

Entrance ramp - A ramp that allows traffic to enter a freeway.

Exit ramp - A ramp for traffic to depart from a freeway.

Facility - A length of highway composed of connected sections, segments, and points.

Flow rate - The equivalent hourly rate at which vehicles, bicycles, or persons pass a point on a lane, roadway, or other trafficway; computed as the number of vehicles, bicycles, or persons passing the point, divided by the time interval (usually less than 1 h) in which they pass; expressed as vehicles, bicycles, or persons per hour.

Flow ratio - The ratio of the actual flow rate to the saturation flow rate for a lane group at an intersection.

Free flow - A flow of traffic unaffected by upstream or downstream conditions.

Free-flow speed - (1) The theoretical speed of traffic, in miles per hour, when density is zero, that is, when no vehicles are present; (2) the average speed of vehicles over an urban street segment without signalized intersections, under conditions of low volume; (3) the average speed of passenger cars over a basic freeway or multilane highway segment under conditions of low volume.

Freeway - A multilane, divided highway with a minimum of two lanes for the exclusive use of traffic in each direction and full control of access without traffic interruption.

Freeway facility - An aggregation of sections comprising basic freeway segments, ramp segments, and weaving segments.

Geometric condition - The spatial characteristics of a facility, including approach grade, the number and width of lanes, lane use, and parking lanes.

Geometric delay - The component of delay that results when geometric features cause vehicles to reduce their speed in negotiating a facility.

Gore area - The area located immediately between the left edge of a ramp pavement and the right edge of the roadway pavement at a merge or diverge area.

Growth factor - A percentage increase applied to current traffic demands to estimate future demands.

High-occupancy vehicle (HOV) - A vehicle with a defined minimum number of occupants (>1); HOVs often include buses, taxis, and carpools, when a lane is reserved for their use.

High Occupancy Vehicle (HOV) Lane - Exclusive road or traffic lane limited to buses, vanpools, carpools, emergency vehicles, and in some cases, single occupant motorcycles. HOV lanes typically have higher operating speeds and lower traffic volumes than adjacent general purpose lanes.

Intelligent transportation system (ITS) - A transportation technology that enhances the safety and efficiency of vehicles and roadway systems.

Intensity of congestion - A measure of the total number of person-hours of delay and mean trip speed or mean delay per person-trip.

Interchange density - The average number of interchanges per mile, computed for 6 mi of freeway including the basic freeway segment.

Interchange ramp terminal - A junction with a surface street to serve vehicles entering or exiting a freeway.

Internal link - The segment between two signalized intersections at an interchange ramp terminal.

Internal zone - A diamond-shaped area identified in a corridor analysis for each arterial street segment that lies between intersections. An internal zone represents the geographic area likely to generate trips to each segment.

Interrupted flow - A category of traffic facilities characterized by traffic signals, stop signs, or other fixed causes of periodic delay or interruption to the traffic stream.

Intersection delay - The total additional travel time experienced by drivers, passengers, or pedestrians as a result of control measures and interaction with other users of the facility, divided by the volume departing from the corresponding cross section of the facility.

Lane distribution - A parameter used when two or more lanes are available for traffic in a single direction, and the volume distribution varies widely, depending on traffic regulation, traffic composition, speed and volume, the number of and location of access points, the origin-destination patterns of drivers, the development environment, and local driver habits.

Lane group - A set of lanes established at an intersection approach for separate capacity and level-of-service analysis.

Lane utilization - The distribution of vehicles among lanes when two or more lanes are available for a movement; however, as demand approaches capacity, uniform lane utilization develops.

Lane width - The arithmetic mean of the lane widths of a roadway in one direction, expressed in feet.

Lateral clearance - (1) The total left- and right-side clearance from the outside edge of travel lanes to fixed obstructions on a multilane highway; (2) the right-side clearance distance from the rightmost travel lane to fixed obstructions on a freeway.

Level of service (LOS) - A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience.

Link - A segment of highway ending at a major intersection on an urban street or at a ramp merge or diverge point on a freeway. Links have a node at each end.

Loop ramp - A ramp requiring vehicles to execute a left turn by turning right, accomplishing a 90-degree left turn by making a 270-degree right turn.

Mainline - The primary through roadway as distinct from ramps, auxiliary lanes, and collector-distributor roads.

Major diverge segment - A segment in which one freeway segment with multiple lanes diverges, to form two primary freeway segments.

Major merge segment - A segment in which two primary freeway segments, each with multiple lanes, merge to form a single freeway segment.

Major street - The street not controlled by stop signs at a two-way stop-controlled intersection.

Major weaving segment - A weaving segment with at least three entry and exit legs, each with two or more lanes.

Measure of effectiveness (MOE) - A quantitative parameter indicating the performance of a transportation facility or service. MOE include average vehicle speed, vehicle stops, delays, vehicle hours of travel, vehicle miles of travel, fuel consumption and pollutant emissions. MOE provide insight into the effects on the traffic stream of the applied improvement strategy.

Merge - A movement in which two separate lanes of traffic combine to form a single lane without the aid of traffic signals or other right-of-way controls.

Minor arterial - A functional category of a street allowing trips of moderate length within a relatively small geographical area.

Minor movement - A vehicle making a specific directional entry into an unsignalized intersection from a minor street.

Minor street - The street controlled by stop signs at a two-way stop-controlled intersection; also referred to as a side street.

Mobility - Mobility refers to the time and costs required for travel. Mobility is higher when average travel times, variations in travel times, and travel costs are low. Indicators of mobility are indicators of travel times and costs and variability in travel times and costs.

Multilane highway - A highway with at least two lanes for the exclusive use of traffic in each direction, with no control or partial control of access, but that may have periodic interruptions to flow at signalized intersections no closer than 2 mi.

Multimodal - A transportation facility for different types of users or vehicles.

Multiple weaving segment - A segment formed when one merge is followed by two diverge points, or two merge points are followed by one diverge point.

95th percentile queue length - The 95th-percentile queue is defined to be the queue length (in vehicles) that has only a 5-percent probability of being exceeded during the analysis time period. It is a useful parameter for determining the appropriate length of turn pockets, but it is not typical of what an average driver would experience.

Off-ramp - See definition for **Exit ramp**.

On-ramp - See definition for **Entrance ramp**.

Operational application - A use of capacity analysis to determine the level of service on an existing or projected facility, with known or projected traffic, roadway, and control conditions.

Operational improvement - A capital improvement for installation or implementation of a transportation system management and operations program. This includes traffic and transportation security surveillance and control equipment; a computerized signal system; a motorist information system; an integrated traffic control system; an incident management program; equipment and programs for transportation response to man-made and natural disasters; or a transportation demand management facility, strategy, or program; and such other capital improvements to a public road as the Secretary may designate by regulation. The term does not include a resurfacing, restorative, or rehabilitative improvement; construction of an additional lane, interchange, or grade separation; or construction of a new facility on a new location.

Operations - The provision of integrated systems and services that make the best use of existing transportation systems in order to preserve and improve customer-related performance. This is done in anticipation of, or in response to, both recurring and non-recurring conditions. Operations includes a range of activities in both urban and rural environments, including: routine traffic and transit operations, public safety responses, incident management, snow and ice management, network/facility management, planned construction disruptions, and traveler/shipper information.

Operations and Maintenance (O&M) - The range of activities and services provided by the transportation system and the upkeep and preservation of the existing system. Specifically, operations include the range of activities/services provided by transportation system. Maintenance relates to the upkeep and preservation of the existing system.

Opposing approach - The approach approximately 180 degrees opposite the subject approach at an all-way stop-controlled intersection.

Opposing flow rate - The flow rate for the direction of travel opposite to the direction under analysis.

Oversaturation - A traffic condition in which the arrival flow rate exceeds capacity.

Partial cloverleaf interchange - Also called a parclo, an interchange with one or two loop ramps.

Partial diamond interchange - A diamond interchange with fewer than four ramps, so that not all of the freeway-street or street-freeway movements are served.

Passing lane - A lane added to improve passing opportunities in one direction of travel on a conventional two-lane highway.

Passing sight distance - The visibility distance required for drivers to execute safe passing maneuvers in the opposing traffic lane of a two-lane, two-way highway.

Peak-hour factor (PHF) - The hourly volume during the maximum-volume hour of the day divided by the peak 15-min flow rate within the peak hour; a measure of traffic demand fluctuation within the peak hour.

Performance-based planning - A way of relating agency planning and project implementation to public benefits.

Performance measure - A quantitative or qualitative characteristic describing the quality of service provided by a transportation facility or service.

Person capacity - The maximum number of persons, in persons per hour, that reasonably can be expected to be carried past a given point on a highway or transit right-of-way during a given time period, under specified operating conditions, without unreasonable delay, hazard, or restriction.

Person miles of travel (PMT) - PMT is a primary measure of person travel. When one person travels one mile, one person mile of travel results. Where 2 or more persons travel together in the same vehicle, each person makes the same number of person miles as the vehicle miles. Therefore, four persons traveling 5 miles in the same vehicle results in 20 person miles (4 x 5 = 20).

Person trip - A trip by one person in any mode of transportation. This is the most basic and universal measure of personal travel. Each person is considered as making one person trip. For example, four persons traveling together in one auto are counted as four person trips.

Principal arterial - A major surface street with relatively long trips between major points, and with through-trips entering, leaving, and passing through the urban area.

Queue - A line of vehicles, bicycles, or persons waiting to be served by the system in which the flow rate from the front of the queue determines the average speed within the queue. Slowly moving vehicles or people joining the rear of the queue are usually considered part of the queue. The internal queue dynamics can involve starts and stops. A faster-moving line of vehicles is often referred to as a moving queue or a platoon.

Queue discharge - A flow with high density and low speed, in which queued vehicles start to disperse. Usually denoted as Level of Service F.

Queue discharge flow - A traffic flow that has passed through a bottleneck and is accelerating to the free-flow speed of the freeway.

Queue storage ratio - The parameter that uses three parameters (back of queue, queued vehicle spacing, and available storage space) to determine if blockage will occur.

Ramp - A short segment of roadway connecting two traffic facilities.

Ramp junction - A short segment of highway along which vehicles transfer from an entrance ramp to the main roadway or from the main roadway to an exit ramp.

Ramp meter - A traffic signal that controls the entry of vehicles from a ramp onto a limited access facility; the signal allows one or two vehicles to enter on each green or green flash.

Ramp roadway - See definition for **Ramp**.

Ramp segment - See definition for **Ramp**.

Ramp-street terminal - The roadway segment over which an entrance or an exit ramp joins with a surface street.

Ramp-weave segment - A weaving segment formed by a one-lane entrance ramp followed by a one-lane exit ramp joined by a continuous auxiliary lane.

Roadside obstruction - An object or barrier along a roadside or median that affects traffic flow, whether continuous (e.g., a retaining wall) or not continuous (e.g., light supports or bridge abutments).

Roadway characteristic - A geometric characteristic of a street or highway, including the type of facility, number and width of lanes (by direction), shoulder widths and lateral clearances, design speed, and horizontal and vertical alignments.

Roadway occupancy - The proportion of roadway length covered by vehicles, used to identify the proportion of time a roadway cross section is occupied by vehicles. Because it is easier to measure in the field, roadway occupancy is used as a surrogate for density in control systems.

Saturation flow rate - The equivalent hourly rate at which previously queued vehicles can traverse an intersection approach under prevailing conditions, assuming that the green signal is available at all times and no lost times are experienced, in vehicles per hour or vehicles per hour per lane.

Saturation headway - The average headway between vehicles occurring after the fourth vehicle in the queue and continuing until the last vehicle in the initial queue clears the intersection.

Segment - A portion of a facility on which a capacity analysis is performed; it is the basic unit for the analysis, a one-directional distance. A segment is defined by two endpoints.

Shoulder - A portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, emergency use, and lateral support of the subbase, base, and surface courses.

Shoulder bypass lane - A portion of the paved shoulder opposite the minor-road leg at a three-leg intersection, marked as a lane for through traffic to bypass vehicles that are slowing or stopped to make a left turn.

Simple weaving segment - A segment formed by a single merge point followed by a single diverge point.

Simulation model - A computer program that uses mathematical models to conduct experiments with traffic events on a transportation facility or system over extended periods of time.

Single-point diamond interchange - A diamond interchange that combines all the ramp movements into a single signalized intersection.

Spacing - The distance, in meters, between two successive vehicles in a traffic lane, measured from the same common feature of the vehicles (e.g., rear axle, front axle, or front bumper).

Specific grade - A single grade of a roadway segment or extended roadway segment expressed in percentage.

Speed - A rate of motion expressed as distance per unit of time.

Split-diamond interchange - Diamond interchanges in which freeway entry and exit ramps are separated at the street level, creating four intersections.

System level of service - The quality of service provided by the transportation system.

System performance measure - A parameter that measures the efficiency of the transportation system.

System performance report card - A list of measures depicting the use of the transportation system, for decision making.

System speed - A space mean speed, in miles per hour, of vehicles both in the ramp influence area and in the outer lanes of a 1,500-ft freeway segment.

Through vehicles - All vehicles passing directly through a street segment and not turning.

Time interval - See Analysis period.

Time interval scale factor - The ratio of the total freeway entrance demands to the freeway exit counts in each time interval.

Time mean speed - The arithmetic average of individual vehicle speeds passing a point on a roadway or lane, in miles per hour.

Total delay - The sum of all components of delay for any lane group, including control delay, traffic delay, geometric delay, and incident delay. Also see definition for **Aggregate delay**.

Total lateral clearance - The total width of the left side plus the right side along one direction of a roadway.

Traffic condition - A characteristic of traffic flow, including distribution of vehicle types in the traffic stream, directional distribution of traffic, lane use distribution of traffic, and type of driver population on a given facility.

Traffic delay - The component of delay that results when the interaction of vehicles causes drivers to reduce speed below the free-flow speed.

Traffic pressure - A parameter that reflects driver aggressiveness due to heavier volumes or long delays in a confined area.

Transportation System Management (TSM) - Actions or construction that control or improve the movement of cars and trucks on the highway system and buses on the transit system. TSM also includes the coordination of the available transportation systems for more efficient operation. A typical TSM activity is a low-cost, short-term, high-impact transportation-related improvement. A TSM action is not the construction of a new freeway, but it may be the use of a freeway shoulder as an added traffic lane during peak traffic flow conditions. TSM examples include using traffic signals at freeway on-ramps to meter traffic, improving existing signal timings, and using changeable message signs (ahead traffic condition information), lane control signs, and changeable speed signs. TSM involves making implementable improvements, or additions, to existing transportation facilities.

Travel speed - The average speed, in miles per hour, of a traffic stream computed as the length of a highway segment divided by the average travel time of the vehicles traversing the segment.

Travel time - The average time spent by vehicles traversing a highway segment, including control delay, in seconds per vehicle or minutes per vehicle.

Turnout - A short segment of a lane - usually a widened, unobstructed shoulder area - added to a two-lane, two-way highway, allowing slow-moving vehicles to leave the main roadway and stop so that faster vehicles can pass.

Two-lane Class I highway - A two-lane highway that generally serves long-distance trips or provides connecting links between facilities that serve long-distance trips.

Two-lane Class II highway - A two-lane highway that generally serves relatively short trips, the beginning and ending portions of longer trips, or trips for which sightseeing activities play a significant role in route choice.

Two-lane highway - A roadway with a two-lane cross section, one lane for each direction of flow, on which passing maneuvers must be made in the opposing lane.

Two-sided weaving segment - A weaving segment in which vehicles entering the highway approach on the right and vehicles departing the highway depart on the left, or vice versa; weaving vehicles must cross the mainline highway flow.

Unconstrained operation - An operating condition when the geometric constraints on a weaving segment do not limit the ability of weaving vehicles to achieve balanced operation.

Uncontrolled ramp terminal - A ramp terminal without a traffic control device.

Undersaturation - A traffic condition in which the arrival flow rate is lower than the capacity or the service flow rate at a point or uniform segment of a lane or roadway.

Uniform delay - The first term of the equation for lane group control delay, assuming uniform arrivals.

Uninterrupted flow - A category of facilities that have no fixed causes of delay or interruption external to the traffic stream; examples include freeways and unsignalized sections of multilane and two-lane rural highways.

Upstream - The direction from which traffic is flowing.

Urban - An area typified by high densities of development or concentrations of population, drawing people from several areas within a region.

Urban street - A street with relatively high density of driveway access located in an urban area and with traffic signals no farther than 2 mi apart.

Urban street class - A category of urban street based on functional and design categories.

Utility - A measure of the value a traveler places on a trip choice.

Utility equation - A mathematical function for evaluating the use of highway facilities; the numerical values depend on the attributes of the travel options and on the characteristics of the traveler.

Validation - Determining whether the selected model is appropriate for the given conditions and for the given task; it compares model prediction with measurements or observations.

Variability - The probability of congestion or a confidence interval for measures of congestion (intensity, duration, and extent).

Vehicle capacity - (1) The maximum number of passengers that a transit vehicle is designed to accommodate comfortably, seated and standing; also known as normal vehicle capacity or total vehicle capacity; (2) the maximum number of vehicles that can be accommodated in a given time by a transit facility.

Vehicle hours of travel (VHT) - A measurement of the total hours traveled by all vehicles. It is calculated by multiplying the number of vehicles times the travel time of those vehicles on specific routes or links.

Vehicle miles of travel (VMT) - One vehicle mile of travel is the movement of one privately operated vehicle (POV) for one mile, regardless of the number of people in the vehicle.

Vehicle occupancy - It is generally computed as person miles of travel per vehicle mile. The other commonly-used definition of vehicle occupancy is persons per vehicle trip.

Vehicle trip - A trip by a single privately operated vehicle (POV) regardless of the number of persons in the vehicle.

Volume - The number of persons or vehicles passing a point on a lane, roadway, or other traffic-way during some time interval, often 1 h, expressed in vehicles, bicycles, or persons per hour.

Volume to capacity ratio - The ratio of flow rate to capacity for a transportation facility. The V/C may be the actual or projected rate of flow on a designated lane group during a peak 15-minute interval divided by the capacity of the lane group. The V/C ratio is a measure of capacity sufficiency, that is, whether or not the physical geometry provides sufficient capacity for the subject movement. Low V/C ratios depict relatively free flow conditions. High V/C ratios depict more congested conditions. Actual V/C ratios are calculated from vehicle count data (defining volume) and the geometrics of a roadway (determining capacity). V/C ratios are used to broadly define problem areas on a freeway and to make preliminary operational decisions concerning the freeway (e.g., ramp metering rates).

Weave type - A classification scheme that categorizes weaving configuration into one of the three types (Types A, B, C).

Weaving - The crossing of two or more traffic streams traveling in the same direction along a significant length of highway, without the aid of traffic control devices (except for guide signs).

Weaving configuration - The organization and continuity of lanes in a weaving segment, which determines lane-changing characteristics.

Weaving diagram - A schematic drawing of flows in a weaving segment, used in analysis.

Weaving flow - The traffic movements in a weaving segment that are engaged in weaving movements.

Weaving length - The length from a point on the merge gore at which the right edge of the freeway shoulder lane and the left edge of the merging lane are 0.6 m apart to a point on the diverge gore at which the edges are 3.7 m apart.

Weaving segment - A length of highway over which traffic streams cross paths through lane-changing maneuvers, without the aid of traffic signals; formed between merge and diverge points.

Weaving width - The total number of lanes between the entry and exit gore areas, including the auxiliary lane, if present.

Zone - A geographic aggregation defined by land use, which generates trips within a corridor.