Interstate 80/US Highway 50 Managed Lanes

Transportation Analysis Report

Prepared for:

Caltrans

May 2023

FEHR PEERS

Transportation Analysis Report

Interstate 80/US Highway 50 Managed Lanes

04-SOL-80 PM 40.91, 03-YOL PM VAR,
and 03-SAC-80/50 PM VAR

EA 03-3H900
Project ID 03 1800 0085

November 2023

This report was prepared under my direction and responsible charge. I attest to the technical information contained herein and have judged the qualification of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

David Stanek, P.E. Date
Registered Professional Civil Engineer
Fehr & Peers

SA22-0177

Table of Contents

Appendix

A. 2019 Stick Diagrams
B. Existing Conditions Operations Analysis Results
C. Collision History
D. Forecast Model Performance Measures
E. Opening Year 2029 Forecast Volumes
F. Horizon Year 2049 Forecast Volumes
G. Transit Ridership
H. Traffic Index
I. Opening Year 2029 Operations Analysis Results
J. Horizon Year 2049 Operations Analysis Results
K. Bus Travel Time Comparison
L. Ramp Meter Storage

List of Figures

List of Tables

Executive Summary

This transportation analysis report was prepared for the Interstate 80 (I-80)/US Highway 50 (US 50) Managed Lanes project in Yolo and Sacramento counties. This report analyzes the project design alternatives and their effects on the transportation network and documents the findings for the Project Approval and Environmental Document stage of project development.

Purpose and Need

The purpose of the proposed project is summarized below.

- Ease congestion and improve overall person throughput[1]
- Improve freeway operation on the mainline, ramps, and at system interchanges
- Support reliable transport of goods and service through the region
- Improve modality[2] and travel time reliability
- Provide expedited traveler information and monitoring systems

The proposed project is needed for the following reasons:

- Recurring congestion during morning and afternoon peak periods exceeds current design capacity limiting person throughput.
- Operational inefficiencies lead to the formation of bottlenecks due to short weaving and merging areas and lane drops.
- Inefficient movement of goods and services impedes regional and interstate economic sustainability.
- The corridor users rely heavily on single-occupancy vehicles with limited multimodal options such as transit, carpool, bicycle, and pedestrian facilities, resulting in unreliable travel times.
- Lack of real-time traveler information and coordinated traffic communication systems impede timely response to roadway incidents resulting in secondary collisions and increased non-recurring congestion.

[1] Throughput is the number of people moving efficiently trough a region.
[2] Modality is the variety in modes of transportation and includes access and multiple options for the movement of people and goods. Examples include access to transit, carpool, bicycle, and pedestrian facilities.

Project Description

The project proposes to improve freeway operations along I-80 and US 50 in Yolo and Sacramento counties by adding a lane through widening and re-striping or by converting the existing general-purpose (GP) lane to a managed lane. Managed lanes are restricted to certain vehicle modes or types and may include tolling. The managed lane would start and end at the Solano County line and connect with the existing HOV lane on I-80 west of West El Camino Avenue and the HOV lane under construction on US 50 at I-5. The project includes installing ramp meters at five locations: eastbound I-80 at SR 113, Old Davis Road, and Richards Boulevard and westbound I-80 at Mace Boulevard and County Road 32A. The project has an opening year of 2029.

The project alternatives analyzed in this report are described below.

- Alternative 1 – No Build
- Alternative 2 (Add HOV) – Add one lane restricted to high occupancy vehicles (HOVs) in each direction, where an HOV has two or more passengers
- Alternative 3 (Add HOT2+) – Add one high occupancy toll (HOT) lane in each direction where vehicles with two or more occupants are free but single occupant vehicles (SOVs) pay a toll (HOT2+)
- Alternative 4 (Add HOT3+) – Add one HOT lane in each direction where vehicles with three or more occupants are free, but vehicles with two occupants pay a reduced toll, and SOVs pay the full toll (HOT3+)
- Alternative 5 (Add Toll) – Add one express lane in each direction (everyone pays)
- Alternative 6 (Add Transit) – Add one transit lane in each direction
- Alternative 7 (Convert HOV) – Convert current left lane (Lane 1) to HOV
- Alternative 8 (Add HOV with Median Ramps) – Add one HOV lane in each direction with HOV median ramps at the I-80/US 50 interchange
- Alternative 9 (Add HOV without Enterprise Crossing) – Add one HOV lane in each direction without Enterprise Crossing, a planned bridge on Enterprise Boulevard at the deep water ship channel

Analysis Methodology

The study area boundaries are I-80 at Pedrick Road in Solano County to the west and I-80 at Northgate Boulevard and US 50 at State Route (SR) 51/SR 99 in Sacramento to the east. Due to the COVID-19 pandemic, historical traffic volume and speed data from October 2019 were used for the existing conditions analysis. A modified version of the SACSIM19 regional travel demand model was applied to forecast traffic volumes and performance measures for opening year 2029 and horizon year 2049 under typical weekday conditions. Freeway operations were analyzed for the 6:00 to 10:00 AM and 3:00 to 7:00 PM peak periods using Vissim traffic simulation software so that congestion can be modeled across time and space. This analysis does not consider how the freeway would operate under peak winter and summer seasonal and weekend/holiday conditions that are heavily influenced by long-distance travel between the San Francisco Bay Area and Tahoe/Reno area.

Existing Conditions

The project area has several bottlenecks that delay travelers during the AM and PM peak periods. The bottlenecks and the approximate duration of congestion are listed below.

- Eastbound I-80 at Mace Boulevard – from 7:30 to 8:00 AM and from 2:30 to 6:30 PM
- Eastbound I-80 at County Road 32B – from 3:30 to 6:30 PM
- Eastbound I-80 at Reed Avenue – from 4:15 to 6:15 PM
- Eastbound US 50 at I-5 – from 3:15 to 6:00 PM
- Westbound I-80 at West Capitol Avenue – from 6:30 to 10:00 AM and from 5:00 to 6:15 PM
- Westbound US 50 at Jefferson Boulevard – from 5:15 to 6:15 PM

Bottlenecks also exist in the study area eastbound and westbound on I-80 at I-5 and on eastbound and westbound US 50 in downtown Sacramento between I-5 and SR 51/SR 99. The most severe congestion occurs eastbound during the PM peak hour when average travel time from I-80 at Kidwell Road to US 50 at SR 51/SR 99 is about twice the travel time at free-flow speeds.

Collision History

The five-year collision history shows 25 fatality collisions in the project area. The fatality, fatality and injury, and total collision rate exceeds the statewide average for US 50 between I-80 and I-5. This is also the case for westbound I-80 from the end of the HOV lane to US 50. The fatality and injury collision rate for eastbound I-80 from the Solano County line to US 50 also exceeds the corresponding statewide rate. The locations with high collision rates also experience congested conditions. The most frequent collision type is a rear end collision, which is 61 percent of all collisions. Rear end and sideswipe collisions, which are associated with congested conditions, are 81 and 92 percent of all collisions during the AM and PM peak periods, respectively.

Traffic Forecasts

Vehicle volume forecasts were prepared for opening year 2029 and horizon year 2049 for the nine project alternatives. For Alternative 1, PM peak hour demand volume is expected to increase 22 percent at the Yolo Causeway by horizon year 2049. For alternatives with an added lane for HOVs and/or toll vehicles

(Alternatives 2 through 5, 8, and 9), the volume growth from existing conditions would range from 27 to 37 percent. At the Sacramento River bridges on I-80 and US 50, the growth rates would be higher for Alternative 1 (35 and 29 percent, respectively), but the added lane alternatives would have similar or higher growth rates.

In addition to the forecasts, the travel demand model was used to forecast regional and corridor performance measures including vehicle miles of travel (VMT). For opening year 2029, the model predicted higher VMT with Alternatives 2 through 9 compared to Alternative 1, as expected. By horizon year 2049, I-80 and US 50 in the project area would become so congested that travelers would seek longer paths to have a lower travel time. I-5 between Woodland and Sacramento County would have a higher demand volume under Alternative 1. With the additional capacity provided under the other alternatives, travelers would shift back to I-80.

However, the travel demand model does not pass the *Transportation Analysis Framework* (Caltrans 2020) checklist for travel demand model sensitivity to induced vehicle travel. Therefore, the California Induced Travel Calculator from the National Center for Sustainable Transportation (NCST) was applied, which estimates induced VMT based on the number of lane-miles added. Since Alternatives 2 through 9 would include some additional capacity, all would increase VMT. VMT cannot be estimated for Alternative 6 using the NCST calculator since it restricts the new lane to buses. Alternative 7 would have the lowest increase in VMT over Alternative 1 (No Build). The increase in VMT under Alternatives 2 through 5 and 9 would be the same and would be more than 40 times the VMT increase for Alternative 7. Alternative 8 would have the highest VMT increase since it would add the most lane-miles.

Opening Year 2029 Conditions

For the AM peak period, eastbound I-80 and US 50 would have the same bottleneck locations as existing conditions, and congestion in the project area under Alternative 1 would be about the same. Alternatives 2 through 6, 8, and 9 would eliminate the 45 minutes of congestion at Mace Boulevard under Alternative 1. Alternative 7 would have about two-and-a-half hours of congestion in the GP lanes at Mace Boulevard. Westbound I-80 congestion at the Yolo Causeway would grow under Alternative 1 to extend outside the AM peak period and extend upstream to I-5 on both US 50 and I-80. Alternative 6 would have conditions similar to Alternative 1, and Alternative 7 would have worse congestion extending into downtown Sacramento on US 50. Congestion under Alternatives 2 through 5, 8, and 9 would also extend outside the peak period, but the queue would extend upstream only to Harbor Boulevard on US 50. Alternative 8 (Add HOV with Median Ramps) would have the least upstream congestion on I-80.

For the PM peak period, congestion on eastbound I-80 at Mace Boulevard and County Road 32B would expand to outside the PM peak period under Alternatives 1 and 6. Alternatives 2 through 5, 8, and 9 would have increased throughput at Mace Boulevard and would eliminate the County Road 32B bottleneck. However, the increased throughput would increase downstream congestion on US 50 and I-80 at I-5 although a planned project at the I-5/I-80 interchange to address congestion is scheduled to be completed a few years after the opening year. Under these alternatives, the congestion at the I-5/I-80 interchange would extend back to Mace Boulevard. Alternative 7 would be congested for the entire peak period due to major bottlenecks at Mace Boulevard, Harbor Boulevard, and I-5. In the westbound direction, additional congestion upstream on US 50 in downtown Sacramento would result in less congestion at the Yolo Causeway under Alternative 1. Except for Alternative 7, the other alternatives would have similar congestion for an hour or less at the West Capitol Avenue interchange. Alternative 7 would have about two-and-a-half hours of congestion at the Yolo Causeway that would extend back into the I-80/US 50 interchange.

Horizon Year 2049 Conditions

Forecasts and analysis for horizon year 2049 conditions involved unique modifications to the modeling process to account for traffic growth beyond SACSIM19's original 2040 forecast year. Further, the model structure is not fully sensitive to how severe congestion may influence travel behavior such as suppressing trip making because the time cost of travel is too high. As such, the 2049 conditions analysis contains greater uncertainty than 2029 conditions.

For the AM peak period, eastbound I-80 congestion under Alternative 1 at Mace Boulevard would grow to two-and-a-half hours and congestion at the County Road 32B bottleneck would be about an hour. On eastbound US 50, congestion from the I-5 bottleneck would extend back to I-80. Alternative 6 (Add Transit) would have less congestion at Mace Boulevard and County Road 32B (less than an hour at each). Alternatives 2 through 5, 8, and 9 would have no congestion at Mace Boulevard and County Road 32B, and I-5 congestion would only extend to about Jefferson Boulevard. Alternative 7 would have bottlenecks at Mace Boulevard, County Road 32B, and South River Road that would start around 7:00 AM and extend beyond 10:00 AM.

Westbound I-80 AM peak period congestion at the Yolo Causeway would grow under Alternatives 1 and 6 to extend outside the AM peak period and extend upstream to SR 51/SR 99 on US 50 and merge with a bottleneck at West El Camino Avenue on I-80 to extend upstream beyond Northgate Boulevard. Alternative 7 would have worse congestion upstream on both US 50 and I-80 with speeds lower than 20 miles per hour (mph) for most of the AM peak period. Under alternatives 2 through 5, 8, and 9, congestion at the Yolo Causeway bottleneck would be lower, but a new bottleneck would form at the lane drop after the US 50 off-ramp. The combined congested area would extend outside the peak period and extend upstream to Harbor Boulevard on US 50. Alternative 8 would have the least upstream congestion on both US 50 and I-80 with the additional capacity provided by the median ramp from I-80 and the reduced volume in the weaving section on I-80 between US 50 and West Capitol Avenue.

For the PM peak period, congestion on eastbound I-80 at Mace Boulevard, County Road 32B, and South River Road would expand to outside the PM peak period under Alternatives 1 and 6. Congestion at Mace Boulevard would extend upstream of Pedrick Road in Solano County by 4:00 PM. Alternatives 2 through 5, 8, and 9 would have increased throughput at Mace Boulevard and would delay the congestion at Pedrick Road until 5:00 PM. Congestion at the County Road 32B and South River Road bottlenecks would be reduced, but the congestion at the I-80/US 50 interchange due to queuing from the I-5/I-80 and/or I-

80/Reed Avenue interchanges would be similar to Alternative 1. Alternative 7 would be congested for the entire peak period due to major bottlenecks at Mace Boulevard, Harbor Boulevard, and I-5.

In the westbound direction during the PM peak period, a new bottleneck at the Jefferson Boulevard and I-80 off-ramps on US 50 would have one-and-a-half hours of congestion under Alternative 1. Congestion on I-80 at the Yolo Causeway would last more than three hours and extend upstream to US 50. Congestion at the Yolo Causeway would be reduced to two-and-a-half hours or less under Alternatives 2 through 6, 8, and 9. Like Alternative 1, Alternatives 2, 3, and 6 through 9 would also have a bottleneck at the Jefferson Boulevard off-ramp. Alternatives 2 through 4 and 6 through 9 would also have a bottleneck at the I-80 off-ramp. The I-80 off-ramp bottleneck would be caused by ramp demand exceeding capacity, which would result in more than three hours of congestion for Alternative 9 due to the travel pattern changes without the planned Enterprise Crossing. The Reed Avenue off-ramp would also have high demand volumes leading to congested conditions for the ramp diverge under all project alternatives.

Safety Impacts

Under Alternative 1, collision rates would likely be the same or higher than existing conditions. With the forecasted increase in traffic volumes, congestion and congestion-related collisions would increase. The freeway segments with higher-than-average collision rates would continue to experience the same collision rates, and segments with increased congestion would likely have an increased collision rate. Alternatives 2 through 5, 8, and 9 would reduce congestion compared to Alternative 1. Reducing congestion and increasing the average speed to or near the free-flow speed would reduce congestion-related collision types, such as the most common type in the project area, rear end collision. The *Highway Safety Manual* (AASHTO, 2014) equations that predict the safety performance of freeways show that having more freeway lanes is associated with lower collision frequency for most collision types. As a result, Alternatives 2 through 6, 8, and 9 would be expected to lower the collision rate since these alternatives add a lane.

Transit Impacts

Although transit service was not changed among the analysis years, transit ridership will differ based on the travel time performance under the project alternatives. Alternative 6 would have the highest ridership since only buses would have the travel time savings provided by the managed lanes. Alternatives 2 through 5, 8, and 9 would have similar transit ridership and an increase over Alternative 1. Alternative 7 would have the lowest ridership and a decrease compared to Alternative 1 due to network congestion.

The traffic operations model was used to measure travel time savings for bus routes. Route 138, the Causeway Connection between the UC Davis main campus and the medical center in Sacramento would have a PM peak hour travel time savings of about 25 minutes in the eastbound direction and four minutes in the westbound direction under horizon year 2049 for Alternatives 2 through 5, 8, and 9.

Alternatives 2 through 9 include the construction of a mobility hub in the southeast quadrant of the I-80/Enterprise Boulevard interchange. The mobility hub would provide 300 parking spaces, e-scooter and e-bike parking, and a transit transfer station. The additional parking spaces would help to meet the park-and-ride demand for this location.

Bicycle and Pedestrian Impacts

Alternatives 2 through 9 include improvements to the Class IV bicycle/pedestrian path on the Yolo Causeway. The pavement would be rehabilitated, and the concrete barrier height would be raised to meet current design standards. On the west end, a new connection would be constructed along the County Road 32A off-ramp. The new connection would provide a more direct connection to County Road 32A and would eliminate the need for eastbound bicyclists and pedestrians to cross County Road 32A. Westbound bicyclists and pedestrians could choose the existing connection to avoid crossing County Road 32A or use the new connection to cross County Road 32A at the I-80 Westbound Ramps intersection where drivers are expecting conflicting traffic.

Freight Impacts

I-80 and US 50 serve as important regional connections for freight distribution and are National Network Surface Transportation Assistance Act (STAA) routes. Davis and West Sacramento have warehouse and manufacturing land uses adjacent to I-80 and US 50, including the Port of West Sacramento, which is accessed via the US 50/Harbor Boulevard interchange. Traffic congestion under the project alternatives would affect trucks similarly to passenger vehicles in the GP lanes; therefore, alternatives that serve more vehicles with lower travel times would also perform well for trucks.

Alternatives Comparison

Table ES-1 provides a qualitative assessment of selected performance measures for the horizon year 2049.

Table ES-1: Alternatives Comparison – Horizon Year 2049

	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative
Performance Measure	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Regional VMT	5	2	3	2	1	4	2	3	3
Corridor PMT	5	2	1	3	4	5	5	2	3
Persons served at bottlenecks	3.5	1	2	2.5	2.5	3.5	5	1	1
GP peak hour travel time	3.5	1.5	1.5	2	2	3	5	2	1.5
GP peak hour planning time index	4	2	2	2.5	1.5	3	5	2.5	2.5
Managed lane peak hour travel time	4.5	2	1.5	1.5	1.5	3	5	1.5	2
Vehicle hours of delay	4	2	2.5	2	1.5	2.5	5	1.5	2
Average speed	4	1.5	2.5	2	2	2.5	5	1	2
Total vehicles served	3.5	1.5	2	3	3	3	5	1	2
Total persons served	3	1	2	4	3	2.5	5	1	1.5
Deficient segments	5	2.5	2.5	2	1.5	3	4	1.5	2.5
Average score	4.1	1.7	2.0	2.4	2.1	3.2	4.6	1.6	2.1

Note: The scale is 1 for very good performance and 5 for very poor performance.

Alternatives 2 and 8 have the best overall performance including very good performance in two categories for Alternative 2 and four categories for Alternative 8. Alternative 2 would have at least good performance for all categories, and Alternative 8 would have neutral performance for only regional VMT. These alternatives would increase freeway capacity in the form of a HOV lane so that faster travel time would be available to vehicles eligible for the HOV lane. These alternatives would increase both vehicle and person throughput at the key bottlenecks: eastbound I-80 at Mace Boulevard and westbound I-80 at the Yolo Bypass. Alternative 8 would perform better than all other alternatives during the AM peak period since the median ramps at I-80/US 50 would provide a travel time advantage to HOVs, but PM peak hour travel time would be worse since fewer GP lanes would be provided on eastbound I-80 between Enterprise Boulevard and US 50. The AM peak period performance leads Alternative 8 to have the best overall average score.

Alternatives 3, 4, and 5 would perform well although not as high as Alternatives 2 and 8. For Alternative 3, performance would be worse because more vehicles would be eligible for the managed lane than in the other alternatives, so congestion would be higher where vehicles are entering and leaving the managed lane. In particular, the transition section from the HOT lane to the existing HOV lane on eastbound I-80 near West El Camino Avenue would have more turbulence than the other alternatives in a location where the GP lanes are congested from a downstream bottleneck at I-5. The additional turbulence would result in longer travel times and lower network average speed. Alternative 4 would also have turbulence at the transition sections. Additionally, Alternative 4 would serve fewer people overall since HOV2s would have to pay to use the managed lane. For Alternative 5, restricting the managed lane to tolled vehicles would restrict vehicles served and persons served since ridesharing would not provide a travel time savings. However, these alternatives would perform better than Alternatives 1 and 7 and would offer better travel time reliability in the managed lane than the HOV lane alternatives.

Alternative 6 would not perform well compared to the other alternatives. While person throughput could be improved if additional bus service were provided, the forecasted passenger vehicle volume would be constrained by the network capacity resulting in performance like Alternative 1 for many performance measures. Alternative 7 would also perform poorly. While the HOV lane would provide lower travel time than in the GP lanes, the GP lanes would be so congested that HOVs would be severely delayed entering and exiting the HOV lane.

Alternative 9 has the same freeway configuration as Alternative 2, but the demand volumes are different due to the missing ship canal bridge on Enterprise Boulevard. The worse performance for Alternative 9 shows the benefit of the planned Enterprise Boulevard bridge. The new bridge would shift demand from the US 50/Harbor Boulevard and I-80/Reed Avenue interchanges to the I-80/Enterprise Boulevard/West Capitol Avenue interchange, thereby improving operations at the I-80/US 50 interchange.

Additional alternatives were considered that would add the managed lane median ramps at the I-80/US 50 interchange to Alternatives 3 through 7. Since this is the same change when going from Alternative 2 to 8, the comparison of operational performance of these two alternatives can be extended to Alternatives 11 through 15. As noted previously, the biggest benefit for Alternative 8 would be the reduced westbound AM peak hour travel time due to the proximity of the bottleneck at the Yolo Causeway. The reduction in eastbound GP lanes between Enterprise Boulevard and US 50 results in a higher PM peak hour travel time. As a result, Alternatives 11 through 15 would likely have a better overall score for the horizon year 2049 performance measures than Alternatives 3 through 7.

Importantly, the above findings do not fully account for how induced vehicle travel effects could affect the demand volumes used in the operations analysis. Higher travel speeds could attract more demand than predicted thereby dampening the operational benefits of the alternatives. However, alternatives with managed lanes that include tolling have a greater ability to manage demand and balance the project's multiple purpose and need objectives while minimizing environmental effects associated with induced vehicle travel effects.

1. Introduction

This transportation analysis report was prepared for the Interstate 80 (I-80)/US Highway 50 (US 50) Managed Lanes project in Yolo and Sacramento counties. The report contains the results and findings of the traffic operations analyses; the detailed analysis calculations are compiled in a separate appendix. This report also addresses the requirements of Section 149 of the Streets and Highways Code and Section 21655.5 of the Vehicle Code by describing the effects of the managed lane facility on safety, congestion, and highway capacity.

This report analyzes the project design alternatives and their effects on the transportation network. The report focuses on a comparison of alternatives that are designed to improve current and future traffic operations. Portions of the analysis results will also be used to comply with environmental impact analysis requirements for the California Environmental Quality Act (CEQA).

1.1 Purpose and Need

The purpose of the proposed project is to:

- Ease congestion and improve overall person throughput[3]
- Improve freeway operation on the mainline, ramps, and at system interchanges
- Support reliable transport of goods and service through the region
- Improve modality[4] and travel time reliability
- Provide expedited traveler information and monitoring systems.

The proposed project is needed for the following reasons:

- Recurring congestion during morning and afternoon peak periods exceeds current design capacity limiting person throughput.
- Operational inefficiencies lead to the formation of bottlenecks due to short weaving and merging areas and lane drops.
- Inefficient movement of goods and services impedes regional and interstate economic sustainability.
- The corridor users rely heavily on single-occupancy vehicles with limited multimodal options such as transit, carpool, bicycle, and pedestrian facilities, resulting in unreliable travel times.

[3] Throughput is the number of people moving efficiently through a region.
[4] Modality is the variety in modes of transportation and includes access and multiple options for the movement of people and goods. Examples include access to transit, carpool, bicycle, and pedestrian facilities.

- Lack of real-time traveler information and coordinated traffic communication systems impede timely response to roadway incidents resulting in secondary collisions and increased non-recurring congestion.

1.2 Project Description

The project proposes to improve freeway operations along I-80 and US 50 in Yolo and Sacramento counties by adding a lane through widening and re-striping or by converting the existing general-purpose (GP) lane to a managed lane. Managed lanes are restricted to certain vehicle modes or types and may include tolling. The managed lane would start and end at the Solano County line and connect with the existing HOV lane on I-80 west of West El Camino Avenue and the HOV lane under construction on US 50 at I-5. The project includes installing ramp meters at five locations: eastbound I-80 at SR 113, Old Davis, Road, and Richards Boulevard and westbound I-80 at Mace Boulevard and County Road 32A. The project has an opening year of 2029.

1.3 Project Alternatives

The project alternatives analyzed in this report are listed below and then described in detail in the following sections.

- Alternative 1 – No Build
- Alternative 2 (Add HOV) – Add one lane restricted to high occupancy vehicles (HOVs) in each direction, where an HOV has two or more passengers
- Alternative 3 (Add HOT2+) – Add one high occupancy toll (HOT) lane in each direction where vehicles with two or more occupants are free but single occupant vehicles (SOVs) pay a toll (HOT2+)
- Alternative 4 (Add HOT3+) – Add one HOT lane in each direction where vehicles with three or more occupants are free but vehicles with two occupants pay a reduced toll, and SOVs pay the full toll (HOT3+)
- Alternative 5 (Add Toll) – Add one express lane in each direction (everyone pays)
- Alternative 6 (Add Transit) – Add one transit lane in each direction
- Alternative 7 (Convert HOV) – Convert current left lane (Lane 1) to HOV
- Alternative 8 (Add HOV with Median Ramps) – Add one HOV lane in each direction with HOV median ramps at the I-80/US 50 interchange
- Alternative 9 (Add HOV without Enterprise Crossing) – Add one HOV lane in each direction without Enterprise Crossing, a planned bridge on Enterprise Boulevard at the deep water ship channel

1.3.1 Alternative 1

Alternative 1 is the no build alternative. The current configuration of I-80 and US 50 would remain essentially unchanged in Yolo County. However, the following separately planned projects in the study area are expected to be constructed by the horizon year 2049 and are assumed to be in place for all project alternatives. **Table 1** lists the separate projects and the analysis year that they are included in.

Table 1: Separate Projects

	Analysis Year	Analysis Year
Project	Opening Year 2029	Horizon Year 2049
US 50 Managed Lanes in Sacramento County	Included	Included
Pole Line Road/Olive Drive Connection	Included	Included
I-80/Richards Boulevard Interchange	Included	Included
I-5/I-80 Interchange	Not included	Included
US 50/Jefferson Boulevard Interchange	Not included	Included
Ramp meters	Included	Included

- US 50 Managed Lanes in Sacramento County – Construction began in 2021 on a project to add HOV lanes between I-5 and Watt Avenue in Sacramento County.
- Pole Line Road/Olive Drive Connection – A pedestrian/bicycle ramp was constructed to connect the Pole Line Road overcrossing with Olive Drive and the pedestrian/bicycle shared use path that runs along the north side of I-80. As part of the project, the Olive Drive westbound off-ramp was closed. The project was completed in 2022.
- I-80/Richards Boulevard Interchange – The north side of the interchange is planned to be converted from a full cloverleaf to a diamond configuration. A traffic signal would be installed at the new ramp terminal intersection, and Richards Boulevard would be widened north to the Olive Drive intersection. This project is planned to be constructed at about the same time as the I-80/US 50 Managed Lanes project's opening year of 2029.
- I-5/I-80 Interchange – By 2049, direct HOV lane connectors would be constructed to provide median ramps from northbound to eastbound and westbound to southbound. A new eastbound to northbound connector ramp would be constructed to eliminate the collector distributor road in the eastbound direction.
- US 50/Jefferson Boulevard Interchange – By 2049, improvements would be made to the Jefferson Boulevard and 5th Street/South River Road interchanges on US 50 in West Sacramento. The eastbound on-ramp would be widened to two lanes. The westbound off-ramp would be widened to two lanes with two lanes going to Jefferson Boulevard and one lane branching off to 5th Street.

- Ramp meters – Several projects (both current and future) will install ramp meters on local street on-ramps that do not currently have them. The five locations that will have ramp meters constructed or modified under this project are excluded (see **Section 1.3.2**). The connector ramps at the I-80/US 50, I-5/I-80, US 50/I-5, and US 50/SR 51/SR 99 system interchanges are not expected to have ramp meters.

1.3.2 Alternative 2

In Alternative 2 (Add HOV), managed lanes (one each direction) would be constructed in the median of I-80 from the Solano/Yolo County line eastward and continuing along US 50 in West Sacramento to connect with the managed lanes currently under construction in downtown Sacramento. Also, managed lanes would be added in the median of I-80 from US 50 eastward, across the Sacramento River, to connect with the existing HOV lanes in Sacramento County. Access to the managed lane would be restricted to vehicles with two or more occupants.

The following lane adjustments would be provided to accommodate the addition of the managed lane or to improve traffic operations.

Eastbound

- An auxiliary lane would be added to the Richards Boulevard off-ramp.
- The lane drop between the off- and on-ramps would be removed at the I-80/US 50 interchange.
- The US 50 off-ramp to I-5 would be reconfigured so that the right lane would drop at the exit and the adjacent lane would become an optional exit lane. This change would move the lane drop after the 5th Street off-ramp upstream to the I-5 off-ramp.

Westbound

- The lane drop downstream of the US 50 off-ramp to I-5 would be removed (this feature will be added by the US 50 Managed Lanes project currently under construction).
- An auxiliary lane would be added between Jefferson Boulevard/Tower Bridge Gateway and Harbor Boulevard.
- The left lane would be converted to a managed lane rather than adding a managed lane from Jefferson Boulevard/Tower Bridge Gateway on-ramp to the I-80 on-ramp.
- The lane drop between the off- and on-ramps would be removed at the I-80/West Capitol Avenue interchange.
- The I-80 off-ramp to eastbound US 50 would be widened to two lanes.
- The Richards Boulevard on-ramp would be converted from a lane addition to a merge condition.

Alternative 2 and the other build alternatives include the installation of ramp meters at the following five locations.

- Eastbound I-80 at SR 113
- Eastbound I-80 at Old Davis Road
- Eastbound I-80 at Richards Boulevard
- Westbound I-80 at Mace Boulevard
- Westbound I-80 at County Road 32A

Signal heads would be installed on the existing HOV preferential lanes at the eastbound I-80 on-ramps from southbound and northbound Mace Boulevard. In addition, ITS elements will be installed along the corridor.

1.3.3 Alternative 3

In Alternative 3 (Add HOT2+), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2. Access to the managed lane would be restricted to vehicles with two or more occupants and to SOVs that pay a toll. Two-axle trucks would also be eligible to pay a toll to use the managed lane even though they are typically restricted to using the two rightmost freeway lanes. This managed lane operation is known as a HOT lane. Using signs and pavement markings, a transition zone would be used to connect the HOT2+ lane directly to the HOV lane on I-80 between the Sacramento River and West El Camino Avenue and on US 50 between the I-5 off-ramp and on-ramp.

1.3.4 Alternative 4

In Alternative 4 (Add HOT3+), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2. Access to the managed lane would be restricted to vehicles with three or more occupants, vehicles with two occupants that pay a reduced toll, and SOVs that pay a toll. Two-axle trucks would also be eligible to pay a toll to use the managed lane even though they are typically restricted to using the two rightmost freeway lanes. Using signs and pavement markings, a transition zone would be used to connect the HOT3+ lane directly to the HOV lane on I-80 between the Sacramento River and West El Camino Avenue and on US 50 between the I-5 off-ramp and on-ramp.

1.3.5 Alternative 5

In Alternative 5 (Add Toll), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2. Access to the managed lane would be restricted to HOVs that pay a reduced toll and SOVs that pay the full toll. Two-axle trucks would also be eligible to pay a toll to use the managed lane even though they are typically restricted to using the two rightmost freeway lanes. Using signs and pavement markings, a transition zone would be used to connect the toll lane directly to the HOV lane on I-80 between the Sacramento River and West El Camino Avenue and on US 50 between the I-5 off-ramp and on-ramp.

1.3.6 Alternative 6

In Alternative 6 (Add Transit), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2. Access to the managed lane would be restricted to buses. Using signs and pavement markings, a transition zone would be used to connect the bus lane directly to the HOV lane on I-80 between the Sacramento River and West El Camino Avenue and on US 50 between the I-5 off-ramp and on-ramp.

1.3.7 Alternative 7

In Alternative 7 (Convert HOV), managed lanes would be added to I-80 and US 50 by converting the existing leftmost lanes. The lane adjustments would differ from those in the other build alternatives. The changes from Alternative 1 are described below.

Eastbound

- A mainline lane would drop at the Richards Boulevard off-ramp.
- At the Enterprise Boulevard overcrossing, the lanes would shift so that two lanes are added on the right rather than one lane each added on the left and right.

Westbound

- An auxiliary lane would be added between Jefferson Boulevard/Tower Bridge Gateway and Harbor Boulevard.

As in Alternative 2, access to the HOV lane would be restricted to vehicles with two or more occupants. Alternative 7 would include the five new ramp meters and the signalization of the two HOV preferential lanes at Mace Boulevard.

1.3.8 Alternative 8

In Alternative 8 (Add HOV with Median Ramps), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2, and access to the managed lane would also be the same (vehicles with two or more occupants). In addition, direct median ramps would be constructed at the I-80/US 50 interchange to provide a direct connection for the managed lanes on I-80 east and west of US 50. To provide room in the median for the direct ramps, an eastbound auxiliary lane between Enterprise Boulevard and US 50 would be removed.

1.3.9 Alternative 9

In Alternative 9 (Add HOV without Enterprise Crossing), the addition of the managed lanes and associated roadway changes would be the same as Alternative 2, and access to the managed lane would also be the same (vehicles with two or more occupants). In this alternative, the planned crossing of the deep-water ship channel at Enterprise Boulevard would not be constructed. This alternative will be used to determine the effect of the Enterprise Crossing on traffic operations at the I-80/Enterprise Boulevard/West Capitol Avenue and US 50/Harbor Boulevard interchanges.

1.3.10 Other Alternatives

In the *I-80/US 50 Managed Lanes Travel Demand Modeling Report* (March 2023), travel demand volume forecasts were prepared for six other alternatives. No operational analysis was prepared for Alternatives 10 through 15.

- Alternative 10 – Add one GP lane in each direction
- Alternative 11 – Add one HOT2+ lane in each direction with I-80/US 50 median connector ramps
- Alternative 12 – Add one HOT3+ lane in each direction with I-80/US 50 median connector ramps
- Alternative 13 – Add one express lane in each direction with I-80/US 50 median connector ramps
- Alternative 14 – Add one transit lane in each direction with I-80/US 50 median connector ramps
- Alternative 15 – Convert current left lane to HOV2+ with I-80/US 50 median connector ramps

Alternative 10 was used to determine the effect of the managed lane access restrictions on traffic forecast volumes and regional traffic performance. Travel demand forecasts were also prepared for five alternatives that combined the I-80/US 50 median ramps in Alternative 8 with Alternatives 3 through 7. The median ramps at the I-80/US 50 interchange are considered to be a second phase, or Phase B, of the project. Alternatives 11 through 15 are Alternatives 3 through 7 with Phase B.

Peak period conditions for Alternatives 2 and 8, which are the HOV lane alternatives with and without the managed lane median ramps at the I-80/US 50 interchange, were modeled using a calibrated traffic simulation model. The changes in traffic conditions between these two alternatives are also expected to apply and be similar to Alternatives 3 versus 11, Alternatives 4 versus 12, etc., as the only difference between these respective alternatives would be the addition of the managed lane median ramps. Therefore, operational analyses were not conducted for Alternatives 11 through 15, but a qualitative discussion of the expected operations is provided in **Section 8**. Further detail from the travel demand modeling analysis is provided in the *I-80/US 50 Travel Demand Modeling Report* (2023).

2. Data Collection

This chapter describes the study area and the collected volume data. Further details about the data collection are provided in the *I-80/US 50 Managed Lanes Traffic Data* memorandum (January 8, 2021).

2.1 Study Area

The project area covers I-80 from just west of the Solano/Yolo County line near Davis to just west of West El Camino Avenue in Sacramento County and US 50 from I-80 in West Sacramento to just east of I-5 in Sacramento. However, the traffic study area extends further west and east to account for changes in travel patterns on adjacent facilities.

The study area boundaries are I-80 at Pedrick Road in Solano County to the west and I-80 at Northgate Boulevard and US 50 at SR 51/SR 99 in Sacramento to the east. **Figure 1** shows the study area.

2.2 Volume Data

The following traffic volume data were collected for this project: freeway volume, bicycle and pedestrian volume, and vehicle classification (vehicle occupancy and heavy vehicles).

2.2.1 Freeway Volume

Freeway volume estimates for existing conditions were provided by two sources. The California Performance Measurement System (PeMS) online database was used to provide mainline and ramp volume counts from October 2019, where available. The counts were averaged for midweek (Tuesday, Wednesday, and Thursday) for the 15-minute intervals during the peak periods: 6:00 to 10:00 AM and 3:00 to 7:00 PM. The hour before the peak period (5:00 to 6:00 AM and 2:00 to 3:00 PM) was also included in the data to provide volumes for the seeding interval of the simulation model.

For locations where PeMS data was unavailable (either due to no traffic monitoring station or poor detector health), hourly and daily volume estimates were obtained from StreetLight Data for midweek days (Tuesday, Wednesday, and Thursday) in October 2019. StreetLight Data uses location-based services data and GPS data (anonymized location records from smartphones and navigation devices). StreetLight Data then calibrates their data using permanent traffic count stations. For this project, a calibration zone set was employed using the mainline PeMS count data from a few locations in each direction to improve the StreetLight Data volume estimates.

\\fpgisdevApp01\DevGISLibrary\ServiceMXDs\SA\SA220177_TO15_D3_I-80_US50_Managed_Lanes\Fig01_StudyArea.mxd

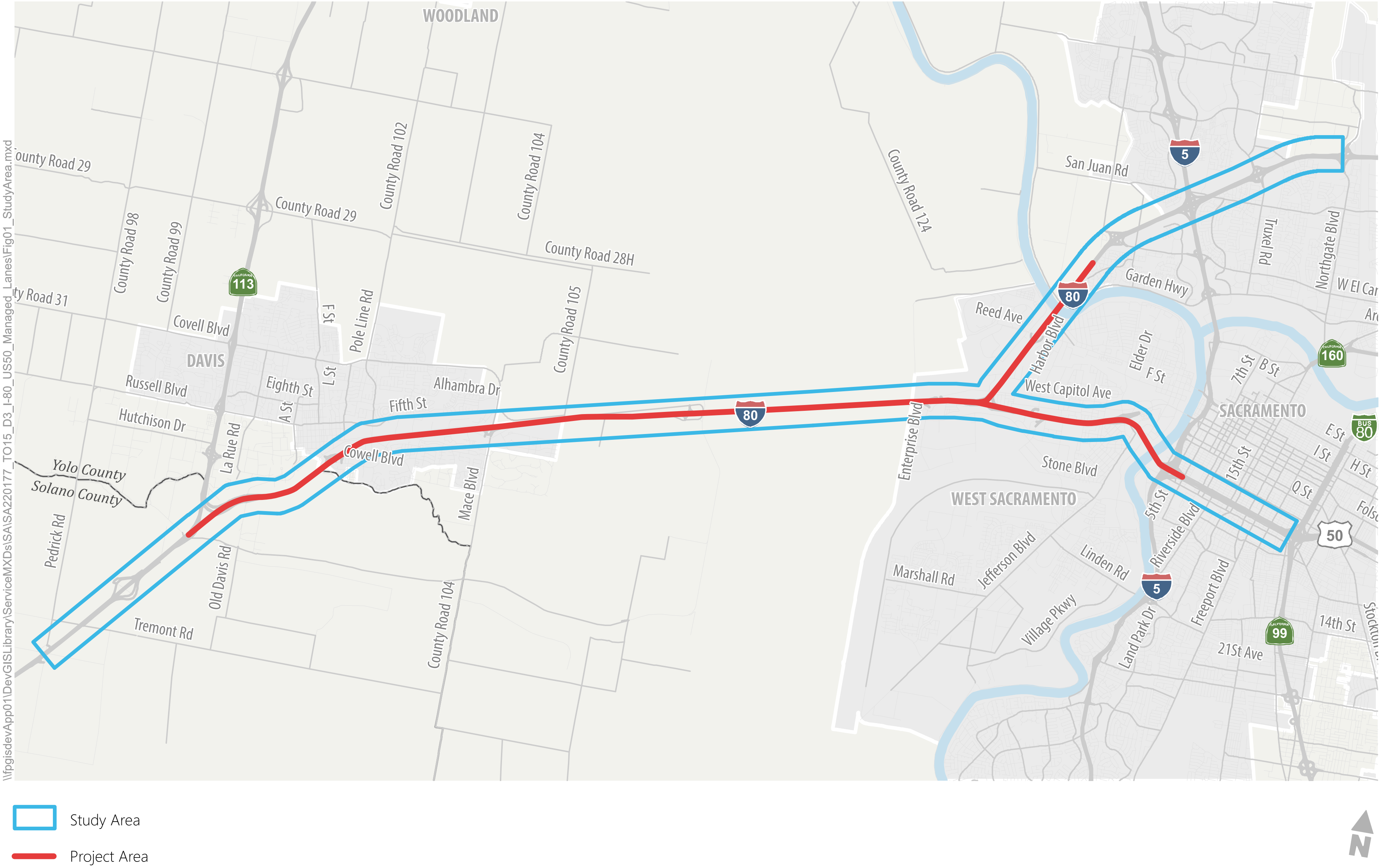


Figure 1

Study Area

The PeMS and StreetLight Data were then combined. In each direction, a mainline location was selected to be a fixed point for volume balancing. The selected location was located towards the upstream end of the corridor and had data collected from PeMS. Then, volumes were balanced along the corridor. The balanced volume was compared with the counted volume at mainline segments. At some locations, the PeMS data was found to be unreasonable (for example, the PeMS data was about double the balanced volume for two locations in Solano County) and discarded. In other locations the StreetLight Data volume estimates for ramps were unreasonable, with single lane volumes that exceeded the ramp capacity. The volumes at these locations were manually adjusted to better match adjacent PeMS volume counts.

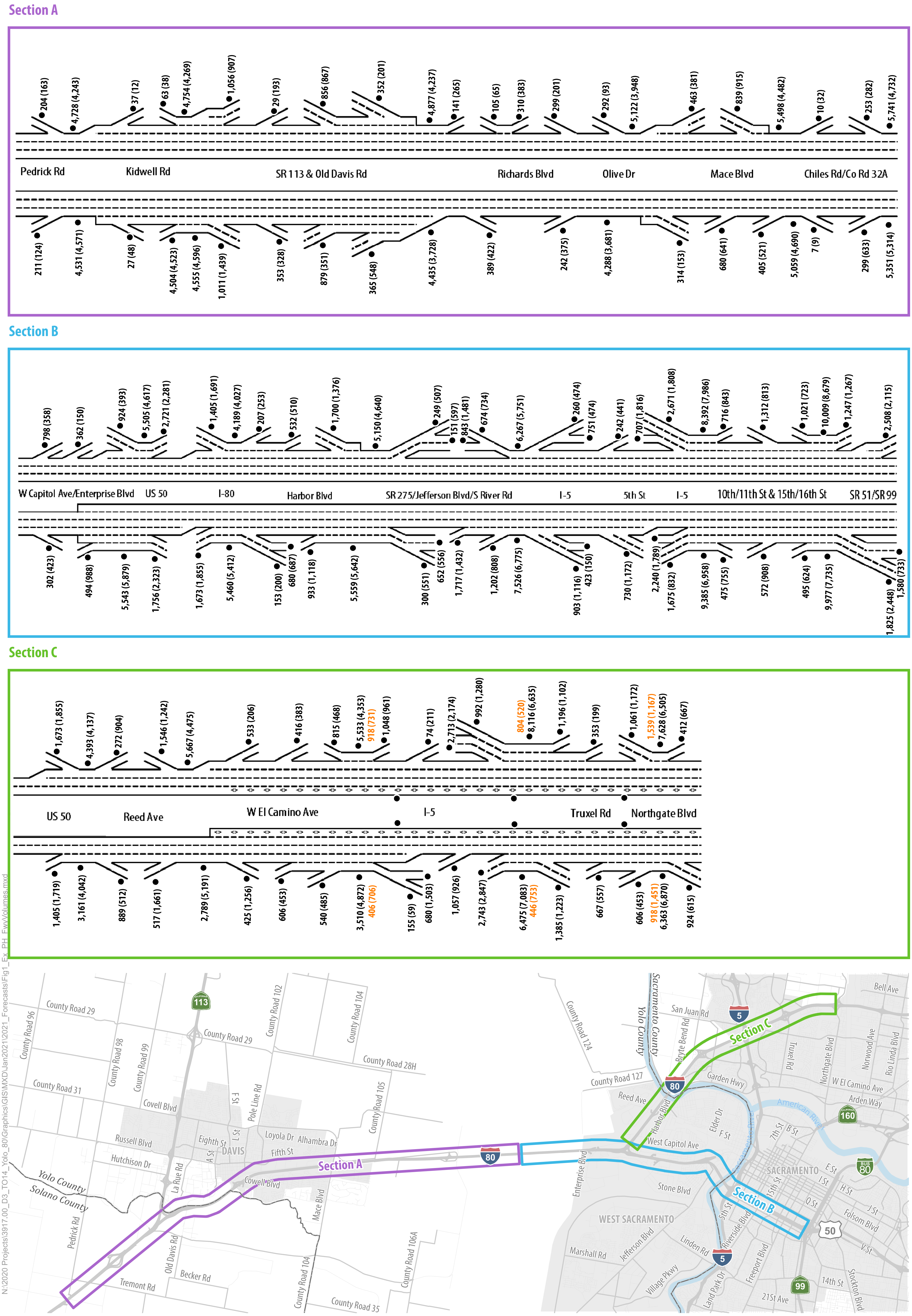
The October 2019 balanced demand volumes for the AM and PM peak hour volumes are shown in **Figure 2**. The peak hour volumes along with the AM peak period, PM peak period, and daily volumes are shown on the stick diagrams in **Appendix A**.

Using the PeMS database, the average midweek daily volume in October 2019 was compared to the average daily volume of all days in 2019 at three freeway detector stations (one eastbound and two westbound stations) that reported good detector health (greater than 97 percent observed data). The average adjustment factor for average daily traffic (ADT) to annual average daily traffic (AADT) for the three locations was 1.005. Since the values differ by less than 1 percent, the reported average daily volume can be assumed equivalent to the AADT.

2.2.2 Bicycle and Pedestrian Volume

Bicycle and pedestrian volume counts were collected at 17 locations in the study area: seven intersections, seven bicycle trail locations, and three park-and-ride lots. The counts were collected on Thursday, October 29 and Saturday, October 31, 2020. At two bicycle trail locations (west of Mace Boulevard and east of County Road 32A), three additional days of counts were collected on Sunday, Tuesday, and Wednesday of the following week. **Figure 3** shows the existing conditions weekday and weekend peak hour bicycle and pedestrian volumes. For this figure, the peak hour can occur throughout the counted time period from 7:00 AM to 7:00 PM.

Table 2 shows the 12-hour volume on the bicycle trail that parallels I-80 from Olive Drive in Davis to West Capitol Avenue in West Sacramento. For the two locations, counts were collected on multiple, so the highest volume day is reported in the table. On weekdays, the highest two-way volume of 44 bicycles was measured at Olive Drive and east of County Road 32A (that is, the west end of the Yolo Causeway). The highest weekend volume of 109 bicycles, which is more than twice the highest weekday volume, was also measured east of County Road 32A.



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

◇ Managed Lane

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

N

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Jan2021\2021_Forecasts\Fig1_Ex_PH_FwyVolumes.mxd

Note: Weekday peak hours are 7-8 AM & 4-5 PM as measured for October 2019.

Figure 2

Existing AM & PM Peak Hour Freeway Volumes

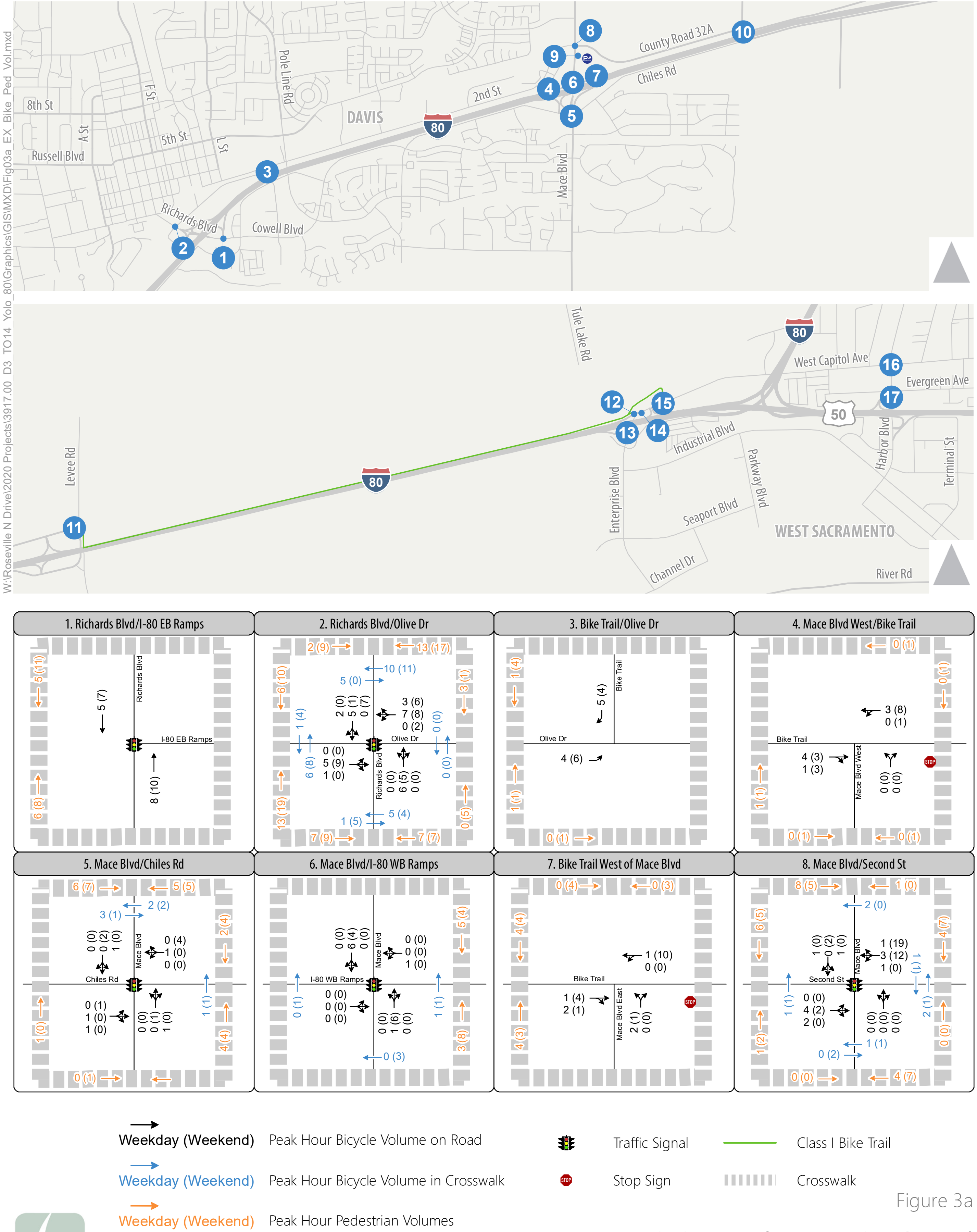


Figure 3a

Existing Peak Hour Bicycle and Pedestrian Volumes

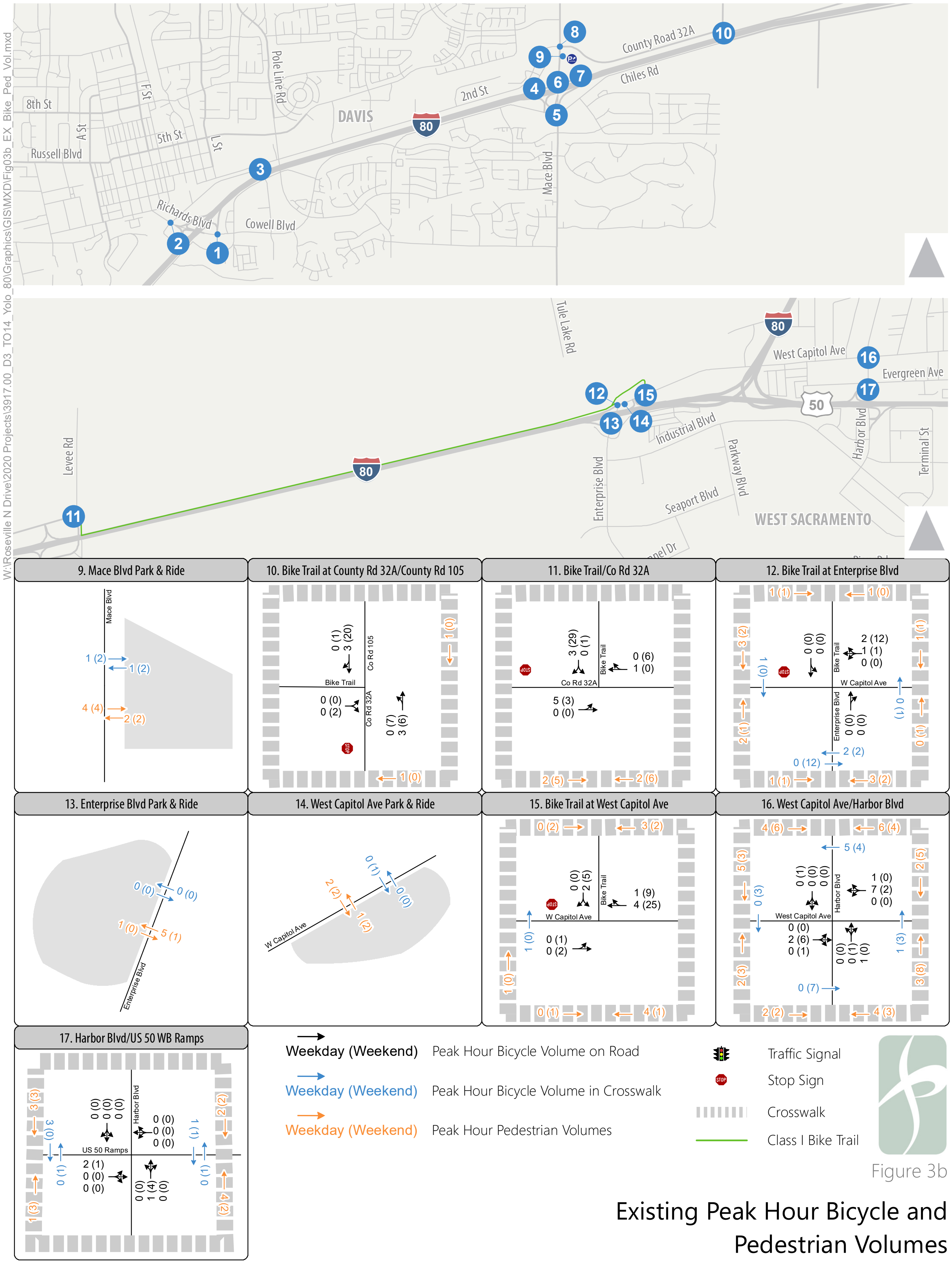


Figure 3b

Existing Peak Hour Bicycle and Pedestrian Volumes

Table 2: Bicycle Volume on the I-80 Bicycle Trail

	Bicycles during Daylight (7:00 AM to 7:00 PM)	Bicycles during Daylight (7:00 AM to 7:00 PM)	Bicycles during Daylight (7:00 AM to 7:00 PM)	Bicycles during Daylight (7:00 AM to 7:00 PM)	Bicycles during Daylight (7:00 AM to 7:00 PM)	Bicycles during Daylight (7:00 AM to 7:00 PM)
	Weekday	Weekday	Weekday	Weekend	Weekend	Weekend
Location	Eastbound	Westbound	Total	Eastbound	Westbound	Total
East of Olive Dr	22	22	44	29	33	62
West of Mace Blvd	10	15	25	26	31	57
East of Mace Blvd	4	4	8	16	18	34
West of County Rd 32A	1	2	3	14	18	32
East of County Rd 32A	26	18	44	51	58	109
West of Enterprise Blvd	0	3	3	2	21	23
North of W Capitol Ave	10	11	21	42	23	65

Source: W&S Solutions (2021)

2.2.3 Vehicle Classification

Peak period vehicle classification counts were conducted at two locations on I-80 in October 2020: the Dave Pelz Overcrossing in Davis (between Richards Boulevard and Mace Boulevard) and the Gateway Oaks Overcrossing in Sacramento (between West El Camino Avenue and I-5). The counts classified vehicles according to type – passenger vehicles, motorcycles, trucks, buses, etc. – and classified passenger vehicles according to occupancy – 1, 2, or 3 or more occupants. Since these counts were conducted during the COVID-19 pandemic, when people were encouraged to work from home and schools were closed, the observed HOV and heavy vehicle percentages were compared with similar average percentages measured in 2019 on other Sacramento area freeways with HOV lanes (US 50, SR 99, and I-80 east of the study area). Like the intersection counts, the vehicle classification counts were collected on one day only. **Table 3** shows the resulting HOV percentages, and **Table 4** shows the resulting heavy vehicle percentages.

Table 3: Average HOV Percentages – Existing Conditions

	AM Peak Period	AM Peak Period	PM Peak Period	PM Peak Period
Direction	6 to 8 AM	8 to 10 AM	3 to 5 PM	5 to 7 PM
Eastbound	14%	14%	20%	22%
Westbound	20%	20%	20%	22%

Note: HOVs are passenger vehicles with two or more passengers.

The vehicle classification counts included SOVs in the HOV lane. The HOV lane violators, as a percentage of the total volume in all lanes, varied from 4 to 6 percent at the comparison sites. On I-80 at Gateway Oaks Crossing, there were 11 to 14 percent HOV lane violators during the AM peak period and 5 to 6 percent during the PM peak period. Since the average value of HOV lane violators is 5 percent at the comparison sites, this value was used in the model. The HOV lane volume therefore includes HOVs and HOV lane violators. The HOV lane volume for mainline locations is provided in Appendix L of the *I-80/US 50 Managed Lanes Travel Demand Modeling Report* (March 2023).

Table 4: Average Heavy Vehicle Percentages – Existing Conditions

	AM Peak Period	AM Peak Period	PM Peak Period	PM Peak Period
Direction	**6 to 8 AM**	**8 to 10 AM**	**3 to 5 PM**	**5 to 7 PM**
Eastbound	7%	8%	7%	6%
Westbound	8%	9%	5%	5%

The recommended heavy vehicle percentages above are for the mainline gateways to the study area. For some on-ramps, truck percentages are available from previous traffic counts for two or more hours in the peak period. For other locations, no truck percentage information was available since neither PeMS nor StreetLight Data sources included truck volumes. For reasonableness, the ramp truck percentages were manually adjusted such that the truck percentage matched adjacent land uses (higher in industrial areas and lower in residential areas) and was in line with values at adjacent ramps and the mainline. The truck percentage assigned to the mainline and ramp locations by hour and the resulting truck volumes are provided in Appendix M of the *I-80/US 50 Managed Lanes Travel Demand Modeling Report* (March 2023).

2.2.4 Travel Speed

Caltrans provided INRIX speed data for I-80 and US 50 in the study area for October 2019. The average midweek (Tuesday, Wednesday, and Thursday) peak period speeds were calculated to prepare a corridor speed contour plot. Individual day speed contour plots were reviewed to exclude days or areas where non-recurrent congestion occurred. The average speed contour plots are provided in Appendix A of the *I-80/US 50 Managed Lanes Traffic Operations Report* (April 2023).

3. Analysis Methodology

This chapter describes the methods used to analyze the transportation facilities. Further details about demand volume forecasting are provided in the *I-80/US 50 Managed Lanes Travel Demand Modeling Report* (March 2023). Further details about operations analysis are provided in the *I-80/US 50 Managed Lanes Traffic Operations Report* (April 2023).

3.1 Demand Forecasting

Project forecasts were developed using the SACSIM19 activity-based travel demand model. The model has a 2016 base year and 2027, 2035, and 2040 future years. The model covers the six-county Sacramento Area Council of Governments (SACOG) region, which includes El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties. SACOG developed the SACSIM19 regional travel demand forecasting model for the *2020 Metropolitan Transportation Plan, Sustainable Communities Strategy (MTP/SCS)*. The base year SACSIM19 model for this project incorporates changes to the model implemented for the I-5 Managed Lanes project. This section summarizes the model validation and calibration process for the SACSIM19 model and describes the process used to prepare the opening year 2029, cumulative year 2040, and horizon year 2049 forecasts.

3.1.1 Base Year Model Development

The SACSIM19 model is a regional forecasting model. Prior to applying it for corridor or local projects, the model required testing to verify its sensitivity and ability to replicate observed conditions under base year (2016) conditions within the study area. The initial base year model came from the calibrated and validated base year model prepared for the I-5 Managed Lanes project.

First, static model validation was conducted. The model was first refined by reviewing and adjusting the model network to match 2019 conditions in the study area. Next, traffic analysis zones were split so that the traffic assignment to the interchanges in the study area would better reflect actual traffic distribution. Finally, the model was expanded to cover the northeast portion of Solano County generally bounded by Pedrick Road and Tremont Road so that the study facilities were included. The model performance was tested using criteria from the *California Regional Transportation Plan Guidelines* (California Transportation Commission, 2017). The model refinements improved the model's ability to match observed volumes on study area roadways.

A dynamic validation of the base year model was also conducted. This is comprised of the following three tests to see how well the model performs: (1) adding a lane to a link, (2) adding a new link, and (3) deleting a link. The tests were conducted as both assignment-only and full model runs. The volume changes were reasonable and in the direction that was expected for these tests within the study area. However, volume changes were also noted far from the study area due to "model noise."

Further tests of the trip assignment process were conducted to look at methods to address model noise. This involved tightening the parameters involved with model convergence. The relative gap between successive runs was reduced and the maximum number of iterations was increased. These steps allow the model process to continue longer to get to a more precise result. Although these changes increased model run time, they were successful in reducing volume variation, especially on HOV lanes far from the project area.

3.1.2 Future Year Model Development

The model land use inputs for the future year scenarios were reviewed, and the reasonableness of land use growth was checked, notably for key development projects within the study area. Review of land use was completed for areas in and near the cities of Davis, West Sacramento, and Sacramento. Based on review of the SACSIM19 land use inputs, the model generally accounts for an appropriate level of development growth within the study area. According to SACOG, the SACSIM19 land use forecasts represent population and employment growth allocations based on planned land use supply in local general plans and the proposed network modifications contained in the MTP/SCS project list. As such, the land use forecasts best represent conditions for the build alternatives for the I-80/US 50 Managed Lanes project. Based on this input from SACOG and Caltrans headquarters staff, Caltrans district staff directed that the model land uses be maintained without changes from the MTP/SCS versions for all alternatives, including the no build alternative.

The roadway network and transit projects included in the SACSIM19 future year scenarios were reviewed within the study area. The MTP/SCS provides a range for the implementation timing (typically, a five-year range). Based on the project list, a set of projects to be in place by the opening year of 2029 and the horizon year of 2049 was developed.

Key roadway network and transit projects included in the future year models are listed below with implementation date noted in parentheses.

Freeway Projects

- US 50 HOV Lanes: Downtown Sacramento to 0.8 mile east of Watt Avenue (by 2029)
- I-5 HOV Lanes: Airport Boulevard to 1.1 miles south of Elk Grove Boulevard (by 2029)
- I-5 Auxiliary Lane: Southbound from US 50 to Sutterville Road (by 2029)
- I-80/I-5 HOV Connector Ramps: New HOV connector ramps from westbound I-80 to southbound I-5 and northbound I-5 to eastbound I-80, and a new eastbound I-80 to northbound I-5 connector (by 2049)

- I-80/Richards Boulevard Interchange: Reconstruct the westbound ramps to replace the loop on- and off-ramps with new ramps in diamond configuration (by 2049)[5]
- I-80/West El Camino Avenue Interchange: Expand overpass from 2 to 4 lanes and modify ramps (by 2049)
- US 50/Jefferson Boulevard Interchange: Expand ramps and signals from 1 to 2 lanes, add ramp metering and turn lanes (by 2049)
- I-5 Auxiliary Lane: Southbound from I-80 to West El Camino Avenue (by 2049)
- I-5 Auxiliary Lane: Northbound from Del Paso Boulevard to SR 99 (by 2049)
- I-5/SR 113 Connector Ramp: New connector ramp between northbound I-5 and southbound SR 113 (by 2049)
- I-5/SR 113 Connector Ramp: New connector ramp between northbound SR 113 and southbound I-5 (by 2049)

New Roadway Projects

- Riverfront Street Extension (West Sacramento): Mill Street to South River Road (by 2029)
- N Street Bridge (Sacramento): Two-lane bridge over I-5 between Front Street and 2nd Street (by 2029)
- Railyards Area Roadways (Sacramento): New Roadways within the Railyards Specific Plan Area, including South Park Street, Camille Lane, and extensions of 5th Street and 6th Street to North B Street (by 2029)
- I Street Bridge Replacement: Replace existing I Street Bridge across the Sacramento River with new two-lane bridge between Railyards Boulevard in Sacramento and C Street/3rd Street in West Sacramento (by 2029)
- Enterprise Boulevard Bridge (West Sacramento): New bridge across the Sacramento River Deep Water Ship Channel between Southport area and Port Industrial Complex within West Sacramento (by 2029)
- Broadway Bridge: New bridge across the Sacramento River between South River Road in West Sacramento to Broadway in Sacramento (by 2049)
- American River Bridge Crossing: New bridge across the American River between River District and Truxel Road in South Natomas within Sacramento (by 2049)
- East Commerce Way extension (Sacramento): Between Arena Boulevard and San Juan Road (by 2049)

[5] Since the project timing of the I-80/Richards Boulevard interchange may be earlier than the MTP/SCS timing of 2036-2040, this project was assumed to be in place for opening year 2029 conditions in the operations analysis.

Roadway Widening Projects

- Reed Avenue (West Sacramento): Reed Avenue widening from 4 to 6 lanes between Harbor Boulevard and I-80/Reed Avenue interchange (by 2029)
- Village Parkway (West Sacramento): Village Parkway widening from 2 to 4 lanes between Stonegate Drive and Davis Road (by 2029)
- Richards Boulevard (Sacramento): Widening from 4 to 6 lanes between Jibboom Street and Bercut Drive (by 2029)
- 7th Street (Sacramento): Widening from 2 to 4 lanes between F Street and Richards Boulevard (by 2029)
- Covell Boulevard (Davis): Widening from 2 to 4 lanes between Shasta Drive to Denali Drive (by 2049)
- Mace Boulevard (Davis): Widening from 2 to 4 lanes between Alhambra Drive to Alhambra Drive along Mace curve (by 2049)
- South River Road (West Sacramento): Widen from 2 to 4 lanes between Bridge Street and Locks Drive (by 2049)
- East Commerce Way (Sacramento): Widen to 6 lanes between Arena Boulevard and Natomas Crossing Drive (by 2049)
- Industrial Boulevard (West Sacramento): Widen to 6 lanes between Harbor Boulevard and Palamidessi Bridge at the Barge Canal (by 2049)
- Lake Washington Boulevard (West Sacramento): Widen to 6 lanes between Palamidessi Bridge at the Barge Canal to Jefferson Boulevard (by 2049)
- Harbor Boulevard (West Sacramento): Widen to 6 lanes between West Capitol Avenue and Industrial Boulevard (by 2049)

Roadway Narrowing/Complete Streets Projects

- Broadway (Sacramento): Narrowing from 4 to 2 lanes between 3rd Street and 24th Street (by 2029)
- Downtown Grid Roadways (Sacramento): Reduce lanes on various roads in downtown, including, 9th Street, 10th Street, 16th Street, G Street, H Street, J Street, P Street, and Q Street (by 2029)
- Downtown Grid Roadways (Sacramento): Reduce lanes or one-way to two-way conversion on various roads in downtown, including G Street, H Street, I Street, N Street, 3rd Street, 5th Street, 7th Street, 8th Street, 15th Street, and 16th Street (by 2049)

Transit Projects

- Added bus service across the Yolo Causeway between UC Davis, downtown Sacramento, and UC Davis Medical Center in Sacramento (by 2029)

- Capitol Corridor: Construct third mainline track between Sacramento and Roseville to support additional service, which includes higher frequency of trains between these stations and also through Davis to/from the San Francisco Bay Area (by 2029)
- SacRT Green Line Light Rail: Improvements to the Green Line through downtown to include a loop to the Sacramento Valley Station, relocation of tracks to H Street, and new station near North 7th Street and Railyards Boulevard (by 2029)
- SacRT Green Line Light Rail: Extend light rail from Township 9 (in Sacramento River District) to North Natomas Town Center (by 2029)
- Downtown Riverfront Streetcar Phase 1: Construct Phase 1 of the Downtown Riverfront Streetcar, between Midtown Sacramento and West Sacramento Civic Center (by 2049)
- Downtown Riverfront Streetcar Phase 2: Construct Phase 2 of the Downtown Riverfront Streetcar between Sacramento and West Sacramento, South to R Street and Broadway corridors (by 2049)

The above list includes changes to the original MTP project list based on feedback from the City of West Sacramento; a project to construct a second I-80/Enterprise Boulevard eastbound on-ramp was removed, and the Enterprise Boulevard Bridge was advanced to be constructed sooner. Roadway projects listed in the MTP as occurring after 2040 that were assumed constructed by 2049 include the Northbound SR 113 to Southbound I-5 connector and the widening of Industrial Boulevard, Lake Washington Boulevard, and Harbor Boulevard in West Sacramento.

In addition, the Downtown Riverfront Streetcar Phase 1 project was planned for implementation by 2025, as identified in the original MTP project list. However, the status of that project is uncertain based on construction bid costs in 2019 exceeding the budget and a potential project alternative of a shortened light rail segment between downtown Sacramento and Sutter Health Park in West Sacramento. As a result, both the Streetcar Phase 1 and Phase 2 projects are assumed in this analysis to be constructed by 2049.

The projects listed above were coded into the project's opening year 2029 model (for projects assumed to be built by 2029) and horizon year 2049 model (for projects assumed to be constructed by 2049). In addition, base year 2016 roadway network refinements were applied to the future year models, which included reviewing the number of lanes, capacity classifications, and speeds; updating centroid connectors as part of TAZ splits; and adding roadways and model gateways covering the northeast portion of Solano County in the study area.

The above list of model roadway changes represents Alternative 1 (No Build). As such, three projects that are included in the MTP project list – I-80 HOV Lanes from SR 113 to West El Camino Avenue, US 50 HOV Lanes from I-80 to downtown Sacramento, and I-80/US 50 HOV Connector Ramps – were removed from the model networks since they represent improvements proposed under the I-80/US 50 Managed Lanes project. For the build alternatives, the roadway networks were modified according to the description of changes in each alternative.

The Alternative 1 models also include the addition of a westbound auxiliary lane between Jefferson Boulevard/Tower Bridge Gateway and Harbor Boulevard by 2029. Originally, this was considered part of a separate project but is now included as part of the build alternatives. As a result, the Alternative 1 forecasts likely show higher volumes for the Jefferson Boulevard and Tower Bridge Gateway on-ramps than would otherwise occur without the auxiliary lane addition.

3.1.3 Performance Measures

The following performance measures were reported from the base year 2016, opening year 2029, cumulative year 2040, and horizon year 2049 models.

- Vehicle hours of travel (VHT)
- Vehicle hours of delay (VHD)
- Vehicle miles of travel (VMT)
    - Congested VMT (VMT for links where the volume to capacity ratio is greater than 1)
    - VMT by 5-mph speed bin
    - VMT per capita (VMT divided by resident population)
- Passenger miles of travel (PMT)
- PMT per lane-mile
- Vehicle trips
- Off-peak average speed

The measures were calculated both on a regional scale, which is the six-county extent of the model, and on a corridor scale, which includes only the I-80 and US 50 links within the study area. The metrics are based on all vehicles including both passenger vehicles and trucks. Overall, the 2029 and 2040 results are more similar to each other than to the 2049 results due to more congested conditions in the horizon year. Additionally, the 2040 model used for the analysis has the same roadway network as the 2049 model, so it includes separate project improvements that are planned for post-2040 conditions in the MTP/SCS.

Induced vehicle travel effects on VMT are also reported. Induced vehicle travel has short-term and long-term effects, including land use growth allocations that may occur based on differences in roadway network constraints. This project will use the same land use inputs for all project alternatives for each scenario year; therefore, the model cannot fully isolate the long-term induced vehicle travel effects between no build and build alternatives. The model does capture short-term effects where a no build and build alternative are compared for the same analysis year.

For long-term effects, the SACSIM19 model does not include a process for capturing potential changes in trip generation or land use growth allocation between no build and build alternatives. According to SACOG, the SACSIM19 model represents future conditions (including long-term induced vehicle travel effects) expected to occur under the build alternatives. The model does not capture how the no build alternative would affect long-term effects on trip generation and land use growth allocations.

As a result, long-term induced vehicle travel effects on VMT were analyzed off-model based on empirically derived elasticities contained in the NCST's California Induced Travel Calculator. These VMT forecasts are compared to the SACSIM19 forecasts as directed in the *Transportation Analysis Framework* (TAF) (Caltrans 2020). The elasticity method in the NCST calculator forecasts long-term VMT changes while controlling for variables such as population and employment growth, income changes, etc., because the method is focused on isolating the effect of just adding lane-miles. A travel demand model forecasts VMT changes based on variables such as population and employment growth, income changes, etc. Extracting just the VMT change associated with the lane-mile changes over time is not an output that can be directly calculated from the SACSIM19 model. The model's most appropriate use is to compare short-term VMT changes between alternatives in the same analysis year. These are not directly comparable to the long-term VMT change forecast by the NCST calculator and the analysis discussion will explain these differences.

The NCST calculator is also limited to producing long-term VMT forecasts for GP and HOV lane additions only. Elasticities are not available for HOT lanes, full toll lanes, or transit only lanes. For project alternatives where elasticities are not available, the potential induced VMT will be qualitatively described based on the relative difference between the NCST calculator and SACSIM19 forecasts for the alternatives with only GP or HOV lanes.

3.1.4 Forecasting Process

This section describes the process for developing the opening year 2029 and horizon year 2049 traffic forecasts.

3.1.4.1 Opening Year 2029

Opening year 2029 forecasts were developed using linear interpolation of final vehicle trip matrices between each alternative-specific 2027 and 2040 scenarios, accounting for two out of 13 years of growth. Interpolated growth between the 2027 and 2040 vehicle trip matrices was calculated on the matrix total and then applied to each origin and destination traffic analysis zone (TAZ) pair in the study area. Trip assignment of the final 2029 vehicle trip matrices was then run on each project-specific 2029 network. The 2019 existing volume trip matrix was prepared using an origin-destination (OD) matrix estimation process that used the 2019 count volumes from the base year model validation and the base year model sub-area matrix.

To account for potential differences between the base year 2016 model volumes and existing 2019 count volumes that could otherwise transfer to the opening year 2029 forecast volumes, the forecasting procedure, known as the "difference method," was used to adjust a project's 2029 scenario output volumes based on incremental growth from existing conditions. This forecasting adjustment procedure was calculated using the following formula:

2029 Forecast Volume = 2019 Existing Volume + (2029 Raw Model Volume – 2016 Raw Model Volume)

Since the 2016 base year model was validated with traffic volumes from 2016 through 2018, the difference between the base year of 2016 and the existing year of 2019 was assumed to be zero. For locations where the model predicted large decreases, the ratio method was applied so that the existing volume did not decrease unreasonably. The difference and ratio methods are described in *NCHRP 765 Analytical Travel Demand Forecasting Approaches for Project-Level Planning and Design* (Transportation Research Board, 2014). The extraction of the subarea OD vehicle trip matrices also relies on a skimming process that does not capture the final trip assignment routing. As a result, manual adjustments were made so that gateway totals for the subarea matrices better matched those from the final assignment.

The initial entry and exit volumes that were generated by the forecasting process were reviewed for reasonableness, particularly for locations where the volume was predicted to decrease compared to existing conditions. For some locations, the decrease in volume was reasonable given the planned separate projects: for example, the Enterprise Crossing bridge project will shift volumes from US 50/Harbor Boulevard to I-80/Enterprise Boulevard, and the I-5 Managed Lanes north of US 50 will shift volume away from US 50 between I-5 and I-80 and I-80 between US 50 and I-5. For the build alternatives in 2029, the added capacity on I-80 will shift volume from the County Road 32B eastbound on-ramp back to the Mace Boulevard eastbound on-ramps. For other locations, the decrease was not reasonable given that local street connections would be in place to accommodate growth at adjacent ramps: for example, Richards Boulevard and Mace Boulevard in Davis; Reed Avenue, Harbor Boulevard, and West Capitol Avenue in West Sacramento; and 5th Street, 10th/11th Street, and 15th/16th Street in Sacramento. Additionally, minor decreases – up to 20 vehicles per hour (vph) for the peak hour, for example – were zeroed out.

As noted above, four-hour AM peak period (6:00 to 10:00 AM) and four-hour PM peak period (3:00 to 7:00 PM) volumes are reported for existing conditions. The SACSIM19 model has three-hour AM and PM peak periods (6:00 to 9:00 AM and 3:00 to 6:00 PM). As a result, the model outputs for the three-hour peak periods were factored up to four-hour peak periods using the ratio determined from the existing traffic counts.

3.1.4.2 Horizon Year 2049

Horizon year 2049 forecasts were developed using extrapolation of final vehicle trip matrices beyond the refined 2040 scenario. The growth rate between the base year 2016 and future year 2040 might not follow a linear growth pattern within the study area. Therefore, vehicle trip matrices among the available SACSIM19 model years (2027, 2035, and 2040) were reviewed to compare growth rates. Based on this review, the growth rate between 2035 and 2040 was selected to extrapolate to 2049.

The growth adjustment to the 2040 scenario vehicle trip matrices was calculated between each OD matrix based on the annual growth rate from the alternative-specific 2035 and refined 2040 scenarios, extrapolating out an additional nine years of growth. Summary of trip growth by county within the SACSIM19 model was compared to population growth by county from 2040 to 2049 as outlined in the California Department of Finance Population Projections to check for reasonableness. The final 2049 vehicle trip matrices were then assigned on each project-specific 2049 network.

Similar to opening year 2029 forecasts, the difference method was applied to account for potential differences between the base year 2016 scenario and existing year 2019 traffic counts that could otherwise transfer to the 2049 scenario and traffic forecasts. This forecasting adjustment procedure was calculated using the following formula:

2049 Forecast Volume = 2019 Existing Volume + (2049 Raw Model Volume – 2016 Raw Model Volume)

Since the 2016 base year model was validated with traffic volumes from 2016 through 2018, the difference between the base year of 2016 and the existing year of 2019 was assumed to be zero. For locations where the model predicted large decreases, the ratio method was applied so that the existing volume did not decrease unreasonably. The difference and ratio methods are described in *NCHRP 765 Analytical Travel Demand Forecasting Approaches for Project-Level Planning and Design* (Transportation Research Board, 2014). The extraction of the subarea OD vehicle trip matrices also relies on a skimming process that does not capture the final trip assignment routing. As a result, manual adjustments were made so that gateway totals for the subarea matrices better matched those from the final assignment.

The initial entry and exit volumes that were generated by the forecasting process were reviewed for reasonableness, particularly for locations where the volume was predicted to decrease compared to existing conditions. Adjustments were made to improve reasonableness when decreases were unlikely to occur and to ensure balanced volumes. As in the opening year 2029 forecasts, the model outputs for the three-hour peak periods were factored up to four-hour peak periods using the ratio determined from the existing traffic counts.

3.1.4.3 Vehicle Classification

The model estimation of HOV volume for the base year matched reasonably well with the measured HOV volume at the Gateway Oaks pedestrian overcrossing on I-80 east of I-5. As a result, the future volume of vehicles eligible for the managed lane was based on the model's predicted percentage although the percentage was only allowed to increase for future years.

Managed lane volume was estimated as the sum of the model's managed lane percentage of the total volume and a violation rate of 5 percent of the total volume. The percentage of vehicles eligible for the managed lane was capped at 35 percent since the managed lane needs to operate at less than capacity to provide an advantage to drivers. For Alternatives 4 and 5 where the managed lane is either a HOT or a tolled lane, the minimum managed lane percentage was set to 5 percent since some drivers would choose the managed lane even when the adjacent freeway lanes are uncongested. In addition, the violation rate was lowered to 2 percent since enforcement is stricter for tolled lanes.

The forecast model allows on-ramp traffic to directly access the managed lane, but in practice, drivers need a half-mile or more to make the necessary lane changes to enter the managed lane from an on-ramp. As a result, the volumes from the adjacent upstream on-ramp and downstream off-ramp were first subtracted from the mainline volume before applying the managed lane percentage when forecasting the managed lane volume. For some locations, the ramps are far apart (that is, more than a mile), so the upstream on-ramp volume was not subtracted. For other locations, a portion of additional upstream or downstream ramp volume was subtracted where the ramps are closely spaced.

The model's estimation of truck volumes was reviewed. The base year 2016 model truck percentages for the freeway mainline are much higher (15 to 20 percent) compared to the measured existing year 2019 truck percentages (5 to 8 percent). The 2027 model predicted a slight increase in truck percentage overall, but the 2040 model year showed the truck percentage decreasing by about one tenth although the truck volume does continue to increase. As a result of these findings, the existing truck percentages were applied to all analysis years and alternatives.

3.1.4.4 Bicycle and Pedestrian

The SACSIM19 models provides trip tables by mode. The mode choice modeling is then fixed when modifying these models to create the project's construction year 2029 and horizon year 2049 models. As a result, the bicycle and pedestrian volume forecasts are based on growth rates developed from the 2016, 2027, and 2040 model outputs.

Bicycle and pedestrian volume growth rates were prepared for three areas: the Yolo Causeway, the I-80/Richards Boulevard interchange, and the I-80/Enterprise Boulevard/West Capitol Avenue interchange. At the Yolo Causeway, a skim matrix was run to determine the bicycle trips assigned to the link that represents the bicycle path. For the interchanges, a similar process was used to estimate bicycle and pedestrian volumes crossing the freeway. An average AM and PM peak period growth rate was then calculated based on the change in volume between the base year 2016 and the future years of 2027 and 2040.

3.1.4.5 Transit

The SACSIM19 model includes transit service as a mode when developing trip tables and assigning trips to the network. When it comes to predicting individual transit boardings per trip, the model tended to underestimate observed values and overestimate individual transit line ridership according to the model documentation[6]. Additional transit validation was not performed in the study area, but transit line coding was checked for reasonableness. Transit ridership forecasts are limited to the SACOG 2020 MTP/SCS analysis years of 2027 and 2040 since those were the only analysis years with complete land use and transit system input data.

3.1.5 Pricing Strategies

The SACSIM19 model has two versions for cumulative year 2040 conditions. The baseline version that was the starting point for the cumulative year 2040 and horizon year 2049 project scenarios has the managed lane network in the Sacramento metropolitan area as HOV lanes that allow vehicles with two or more

[6] https://www.sacog.org/sites/main/files/file-attachments/000_all_test_draft_sacsim19_model_documentation_full.pdf?1601588553

occupants, similar to the existing HOV lanes. The other SACSIM19 version has the managed lane network as priced lanes where SOVs can pay a toll to access the managed lane and a region-wide VMT tax. The model parameters for priced lanes in this alternate version (described in the following paragraph) were used to model the priced lane alternatives for this project: Alternatives 3 (Add HOT2+), 4 (Add HOT3+), and 5 (Add Toll).

In the SACSIM19 model, vehicles are assigned a value of time. If the value of time is high enough, the vehicle will be assigned to managed lane depending on the toll. The minimum toll is $0.50 for the entire length of each direction of the corridor, prorated by distance for segments along the corridor, and the toll increases depending on the congestion in the adjacent GP lanes to a maximum of $40. Commercial vehicles (i.e., trucks) can access the priced lane, but their toll is twice the toll for passenger vehicles. The toll is applied from 7:00 AM to 8:00 PM. For Alternative 4, HOVs with two occupants pay half the toll as SOVs. In Alternative 5, all passenger vehicles (SOVs and HOVs) pay the same toll.

3.1.6 Managed Lanes

The SACSIM19 model uses separate links to model managed lanes. As a result, vehicles can enter and exit the managed lanes at defined locations rather than the continuous access used on the existing managed lanes in the Sacramento area (for example, I-80 east of West El Camino Avenue). Access to the managed lanes is specified by travel mode. The model has three categories of passenger vehicles: SOVs, HOV2 (two-occupant vehicles), and HOV3+ (vehicles with three or more occupants). In addition, bus transit vehicles are assigned to the network based on their scheduled route. Existing and planned managed lanes outside of the project area are modeled as HOV lanes where HOV2, HOV3+, and bus transit vehicles are assigned to the lane.

Table 5 shows the travel modes that can use the managed lane for each project alternative.

Table 5: Managed Lane Access in Project Area

Alternative	SOV	Trucks	HOV2	HOV3+	Transit
1 (No Build)	-	-	-	-	-
2 (Add HOV)	No	No	Yes	Yes	Yes
3 (Add HOT2+)	Toll	Double Toll	Yes	Yes	Yes
4 (Add HOT3+)	Toll	Double Toll	Half Toll	Yes	Yes
5 (Add Toll)	Toll	Double Toll	Toll	Toll	Yes
6 (Add Transit)	No	No	No	No	Yes
7 (Convert HOV)	No	No	Yes	Yes	Yes
8 (Add HOV with Median Ramps)	No	No	Yes	Yes	Yes
9 (Add HOV without Enterprise Crossing)	No	No	Yes	Yes	Yes

For the alternatives that have HOV lanes (Alternatives 2, 7, 8, and 9), the same access by travel mode is used. For Alternatives 3, 4, and 5, managed lane access is open to SOVs and trucks that pay a toll. In Alternative 6, only bus transit vehicles are assigned to the managed lane in the project area.

3.1.7 Traffic Index

Using the daily volume forecasts, the traffic index for pavement design was calculated for opening year 2029 and horizon year 2049 according to the *Highway Design Manual* procedure. Data inputs include total daily volume, heavy vehicle percentage, the percentage of trucks by number of axles, and the number of lanes.

3.2 Operations Analysis

3.2.1 Planning Analysis

A planning analysis was conducted using the deterministic procedures from the *Highway Capacity Manual (HCM), 7th Edition* (Transportation Research Board, 2022). These methodologies were applied using HCS traffic analysis software. The corridor was separated into three segments to facilitate the analysis in HCS. The software's facility method was used so that the freeway corridor could be visualized and so that input values for adjacent segments could be more easily reviewed. The facility method constrains the demand volume for downstream analysis locations if the demand volume exceeds the mainline or on-ramp capacity at an upstream segment. The HCS models were calibrated by modifying the capacity adjustment factor and speed adjustment factor at bottleneck locations so that the modeled volume matched the observed volume.

Using the mainline freeway counts, peak hour factors were selected for each direction during each peak hour. Peak hour factors for the ramps were taken from counts, or, if the count data did not include 15-minute data, the peak hour factors were estimated using nearby ramps. Similarly, heavy vehicle percentages for the freeway mainline were determined from count data for several points in the study area. The percentages were adjusted for the section in between to account for a gradual change in vehicle classification. Ramp heavy vehicle percentages were determined in a similar manner as peak hour factor.

Since the *Highway Design Manual* (Caltrans, 2023) requires an alternate analysis method for freeway weave segments, the Leisch Method was used for these facilities as implemented in a spreadsheet. The Leisch Method assigns level of service based on the calculated service volume, which is a function of the weaving volume, weaving section length, and weaving section lanes.

The planning analysis used the AM and PM peak hour demand volumes for existing year 2019, opening year 2029, and horizon year 2049. The nine project alternatives were evaluated under the future years.

3.2.2 Simulation Analysis

A more detailed operations analysis was conducted using traffic simulation analysis procedures and methodologies consistent with the HCM. These methodologies were applied using Vissim traffic analysis software. Overall, the analysis covers freeway operations for:

- Two analysis years – opening year 2029 and horizon year 2049
- Two four-hour peak periods – 6:00 to 10:00 AM and 3:00 to 7:00 PM
- Nine project alternatives – No build and eight build alternatives

The following procedures and assumptions were used for developing the existing conditions traffic operations analysis model.

- Traffic volumes were entered in 15-minute intervals at the network gateways. Because the upstream entries of the network are free-flowing under existing conditions, these volumes provide a good estimate of travel demand volume. The 15-minute interval volume inputs provide sufficient variation in traffic volume reflecting the field conditions such that no peak hour factor was used.
- The heavy vehicle volumes from the overcrossing counts along with ramp counts and engineering judgment were used to prepare heavy vehicle percentages for the mainline and ramps. The percentage of heavy vehicles was applied on an hourly basis at each entry.
- The counted vehicle occupancy was applied to the entering mainline freeway and ramp volumes. The percentage of HOVs (varies from 14 to 22 percent of the total volume in all lanes) and HOV lane violators (5 percent of the total volume in all lanes) was applied on an hourly basis to the entire network with one exception. At the Mace Boulevard on-ramps, the percentage of violators was increased from 5 to 9 or 13 percent during the congested PM peak period based on reported observations from Caltrans staff.
- Travel patterns were estimated for each hour of the AM and PM peak periods using OD matrix estimation, which uses seed matrices for the AM and PM peak hour and peak periods from the base year travel demand model and the hourly traffic counts to generate vehicle routing through the study area.
- Speeds were set based on the posted speed limit.

3.2.2.1 Model Development Process

Development of the Vissim model included three basic components: (1) setup, (2) calibration, and (3) validation. The model was constructed by drawing the roadway network using aerial photography as a background. The number of lanes, vehicle restrictions, and the location of lane additions and drops were confirmed by field observations. Ramp meter signal operation (i.e., cycle lengths and timing plans) were specified based on operating parameters provided by Caltrans. Driver behavior parameters were adjusted based on field observations. The distribution of vehicle types was also calibrated to local conditions so that the percentage of heavy vehicles and HOVs match the traffic counts.

Since micro-simulation models like Vissim rely on the random arrival of vehicles, multiple runs are needed to provide a reasonable level of statistical accuracy and validity. Up to 15 separate runs, each using a different random seed number, were performed. The network delay and volume served were compared. For outliers, the individual runs were reviewed to look for and correct any coding errors. If no errors were discovered, the outlier was removed and replaced with another run until 10 separate runs were identified. The results of these 10 separate runs were averaged to determine the final results.

The Vissim model was validated to existing conditions using the criteria suggested in the *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software* (FHWA, 2004) and additional criteria developed by Fehr & Peers. Although the *Traffic Analysis Toolbox: Volume III* was revised in 2019, the updated methodology requires more data than is currently available in the study area. Therefore, the 2004 version was applied for this project, which provides an adequate model validation process that meets the objectives of this project. Several iterations were required to successively adjust the default Vissim parameters for geometrics and driver behavior until the model was validated to observed conditions.

The calibrated and validated model is used to generate performance measures that are consistent with the HCM. The validated Vissim model will serve as the basis for the alternatives analysis.

3.2.2.2 Model Set-Up

The model setup required the input of geometric, traffic control, and traffic flow data.

For the analysis area, roadway geometric data was gathered using aerial photographs (Google Maps), vehicle-based photographs (Google StreetView) and video, and field observations. The lane configurations that were taken initially from aerial photographs were confirmed based on field observations.

For the freeway, Caltrans staff provided timing information for the ramp meters that were operating when the traffic counts were collected. The posted speed limits for the freeways and ramps were collected during field observations.

For the Richards Boulevard and Enterprise Boulevard/West Capitol Avenue intersections, posted speed and traffic control were confirmed during field observations. Traffic signal timing plans were provided by the City of Davis, the City of West Sacramento, and Caltrans. Pedestrian crossing locations, bicycle lanes, and transit stops in the study area were also noted.

3.2.2.3 Model Calibration

Vissim 2020 (SP 12) was used for the analysis. Adjustments to the model focused on the model components related to driver behavior, driver performance, vehicle fleet mix, and vehicle performance. The following Vissim model parameters were adjusted during the calibration process.

- Vehicle fleet composition (passenger cars, pickup trucks, sport-utility vehicles (SUVs), HOV-lane eligible vehicles, heavy trucks, etc.)
- Vehicle headways
- Distance between stopped vehicles (standstill distance)
- Driver behavior when changing lanes
- Driver behavior at ramp junctions (i.e., weaving sections, ramp merges, etc.)

The adjusted values represent field observation and our experiences with similar projects elsewhere in the Sacramento Region (such as the I-5/SR 99 Connector Metering and I-80/SR 65 Interchange projects).

3.2.2.4 Model Validation

During validation, the model estimates are compared against observed data to measure the model's accuracy. FHWA suggests the following validation criteria (*Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software*, FHWA, 2004).

- Link volumes for more than 85 percent of cases meet the following criteria:
  - For volumes less than 700 vph, within 100 vph
  - For volumes between 700 and 2,700 vph, within 15 percent
- For volumes greater than 2,700, within 400 vph
- Link volumes for more than 85 percent of cases have a GEH statistic (a measure of goodness of fit) less than 5
- Sum of link volumes within 5 percent
- Sum of link volumes have a GEH statistic less than 4
- Average travel times within 15 percent (or one minute, if higher) for more than 85 percent of cases
- Individual link speeds have a visually acceptable speed-flow relationship
- Bottlenecks create visually acceptable queuing

Table 6 and **Table** 7 show how the results for the eastbound and westbound existing conditions models compare to the validation criteria thresholds identified above. See **Appendix B** for detailed reports for volume and travel time validation. For the four-hour peak periods, the modeled link volumes match the counted volumes for both directions. One of the four models does not meet the GEH criteria for sum of link volumes, but all four models are within 1 percent of the counted volumes.

Table 6: Validation Criteria Thresholds Comparison – Eastbound

Criteria	Criteria	Threshold	Target for % Met	AM Peak Period	PM Peak Period
Link Volumes	Volume	< 700, ±100 vph	>85%	100% / Met	100% / Met
	Volume	700-2,700, ±15%	>85%	100% / Met	100% / Met
	Volume	> 2,700, ±400 vph	>85%	100% / Met	100% / Met
	GEH	5	>85%	100% / Met	100% / Met
Sum of Link Volumes	Volume	±5%	-	-0.8% / Met	0.5% / Met
	GEH	4	-	3.9 / Met	2.6 / Met
Travel Time		±15%	>85%	100% / Met	83% / **Not Met**
Travel Speed		Match observations	Match observations	Yes / Met	Yes / Met
Queuing		Match observations	Match observations	Yes / Met	Yes / Met

Table 7: Validation Criteria Thresholds Comparison – Westbound

Criteria	Criteria	Threshold	Target for % Met	AM Peak Period	PM Peak Period
Link Volumes	Volume	< 700, ±100 vph	>85%	100% / Met	100% / Met
		700-2,700, ±15%	>85%	100% / Met	100% / Met
		> 2,700, ±400 vph	>85%	100% / Met	100% / Met
	GEH	5	>85%	100% / Met	100% / Met
Sum of Link Volumes	Volume	±5%	-	0.3% / Met	0.8% / Met
	GEH	4	-	1.5 / Met	7.5 / **Not Met**
Travel Time		±15%	>85%	83% / **Not Met**	92% / Met
Travel Speed		Match observations	Match observations	Yes / Met	Yes / Met
Queuing		Match observations	Match observations	Yes / Met	Yes / Met

Travel time was measured for the following six freeway segments during each hour of the peak periods.

- I-80 eastbound from Kidwell Road off-ramp to US 50 off-ramp
- US 50 eastbound from I-80 to SR 51/SR 99 off-ramp
- I-80 eastbound from US 50 off-ramp to Truxel Road off-ramp
- I-80 westbound from Truxel Road northbound on-ramp to US 50 on-ramp
- US 50 westbound from SR 51 on-ramp to I-80
- I-80 westbound from US 50 on-ramp to Kidwell Road off-ramp

For the eastbound AM peak period, all 12 modeled travel times (three segments and four hours) were within 15 percent of the observed travel time from INRIX. For the eastbound PM peak period, two of the 12 travel times had a deviation greater than 15 percent. These travel times were for the first and last hours of the peak period on I-80 east of US 50, where the model is showing more congestion than observed. The westbound AM peak period also has two travel times for I-80 east of US 50 where the modeled travel time is greater than the observed due to allow average speed at the Yolo Causeway bottleneck. Only one westbound PM peak period travel time is not within 15 percent.

The travel speeds and queuing are shown in the speed contour plots in **Figure 4** through **Figure** 7. Although there are some differences in duration and time of congestion, the queuing matches well between the model and the INRIX speed data. The eastbound AM model shows both the short duration bottleneck on I-80 at Mace Boulevard and the longer congestion on US 50 in downtown that extends back to Harbor Boulevard. The eastbound PM model shows the bottlenecks consistent with the INRIX speed data for the I-80 and US 50 route into downtown Sacramento. For the I-80 portion east of US 50, the Reed Avenue, I-5, and Northgate Boulevard bottlenecks also match the INRIX speed data for duration and extent.

For westbound AM, the model shows the downtown and Yolo Causeway bottlenecks on US 50 appropriately. The Yolo Causeway backup onto I-80 extends to Reed Avenue and the timing matches the INRIX data, which has two separate congested periods. For westbound PM, the downtown overlapping bottlenecks match reasonably well, but the Yolo Causeway bottleneck starts earlier in the model than in the INRIX data.

3.3 LOS Thresholds

Both the planning and simulation analysis results include a descriptive term known as level of service (LOS). LOS is a measure of traffic operating conditions, which varies from LOS A (the best) to LOS F (the worst). **Table 8** describes the LOS thresholds from the HCM for freeway sections.

Table 8: Freeway LOS Thresholds

		Density (vehicles/mile-lane)	Density (vehicles/mile-lane)
LOS	**Description**	**Basic**	**Merge, Diverge & Weave**
A	Free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver.	≤11	≤10
B	Free-flow speeds are maintained. The ability to maneuver with the traffic stream is only slightly restricted.	>11 to 18	>10 to 20
C	Flow with speeds at or near free-flow speeds. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver.	>18 to 26	>20 to 28
D	Speeds decline slightly with increasing flows. Freedom to maneuver with the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort.	>26 to 35	>28 to 35
E	Operation at capacity. There are virtually no usable gaps within the traffic stream, leaving little room to maneuver. Any disruption can be expected to produce a breakdown with queuing.	>35 to 45	>35 to 43
F	Represents a breakdown in flow.	>45 or v/c > 1[1]	>43 or v/c > 1[1]

Note: 1. Volume-to-capacity ratio (v/c) is greater than 1 (exceeds capacity)
Source: *Highway Capacity Manual, 7th Edition* (Transportation Research Board, 2022)

3.4 Evaluation Criteria

According to *Transportation Analysis under CEQA* (Caltrans, 2020), VMT is the most appropriate measure of transportation impacts. Therefore, project impacts under CEQA will be determined based on the VMT, including induced VMT, generated by the project.

The freeway segment evaluation criteria are based on the *I-80 Transportation Concept Report* (Caltrans, 2017) and the *US 50 Transportation Concept Report* (Caltrans 2014). LOS D is identified as the ultimate concept LOS for I-80 from the Yolo/Solano County line to the Mace Boulevard overcrossing. For I-80 in Solano County, LOS D will also be used as the concept LOS. The study segments in Yolo and Sacramento counties have an ultimate concept LOS E. The US 50 study segments have a concept LOS of E. In this report, a project deficiency occurs for a freeway segment when the LOS is E or F west of the Mace Boulevard overcrossing or the LOS is F east of the Mace Boulevard overcrossing. Consistent with the CEQA guidelines, traffic operational performance as measured by automobile LOS cannot be considered as a project impact for the environmental analysis.

Travel time reliability was evaluated by comparing the planning time index across the project alternatives. The planning time index is the ratio of the 95th-percentile travel time to the travel time when traveling at the free-flow speed.

The overall network performance is measured according to six performance measures. Vehicle hours of delay is the additional travel time for all vehicles when traveling at less than the free-flow speed. Vehicle hours of travel is the total travel time for all vehicles. Average speed in mph is reported for all vehicles in the network. Vehicles served is the total vehicle throughput during the analysis period. Persons served converts the vehicle throughput to person throughput using an average vehicle occupancy. Average vehicle occupancies are 3.4 passengers per HOV3+ vehicle and 35 passengers per bus. The toll vehicles are assumed to be 1.2 passengers per vehicle in Alternative 4 and 1.3 passengers per vehicle in Alternative 5. Unserved entry demand is the vehicles that cannot enter the freeway mainline entry points during the analysis period due to congestion.

3.5 Safety Evaluation

Caltrans provided a five-year collision history for the project area (see **Appendix C**). The collision history was reviewed for location and collision type. The hotspot locations and the more frequent collision types were identified. The potential for the project alternatives to improve safety was assessed.

4. Existing Year (2019)

This chapter presents the freeway operations analysis results. Additional details for the operational analysis performance are provided in **Appendix B**. The October 2019 balanced demand volumes for the AM and PM peak hour volumes are shown in **Figure 2**. The peak hour volumes along with the AM peak period, PM peak period, and daily volumes are shown on the stick diagrams in **Appendix A**.

4.1 Study Facilities

I-80 is a transcontinental highway that extends from San Francisco, CA to New York, NY. In the study area, I-80 serves commuter, freight, and recreational traffic between the San Francisco Bay Area and the Sacramento metropolitan area and provides one of two all-weather connections across the Yolo Bypass. I-80 is a six-lane freeway in most of the study area with an eight-lane portion from Kidwell Road to Old Davis Road in Solano County. System interchanges exist at SR 113, US 50, and I-5. Auxiliary lanes exist in both directions between Kidwell Road and SR 113, Enterprise Boulevard/West Capitol Avenue and US 50, West El Camino Avenue and I-5, I-5 and Truxel Road, and Truxel Road and Northgate Boulevard.

The characteristics of the ramp meters operating on I-80 under existing conditions in 2019 are listed in **Table 9**. During the operating hours, the ramp meters either rested in green or metered traffic depending on the freeway mainline volume and speed.

Table 9: Ramp Meters – Existing Conditions

Route and Direction	Location	Lanes	Cars per Green	Hours
I-80 Eastbound	Mace Blvd SB	1 GP, 1 HOV	2	6 to 9 AM, 3 to 6 PM
	Mace Blvd NB	1 GP, 1 HOV	1	6 to 9 AM, 3 to 6 PM
	County Rd 32B	1 GP	1	6 to 9 AM, 3 to 6 PM
	Enterprise Blvd	2 GP	1	6 to 9 AM, 3 to 6 PM
	W El Camino Ave EB	1 GP, 1 HOV	1	6 to 9 AM, 3 to 6 PM
	W El Camino Ave WB	1 GP, 1 HOV	1	6 to 9 AM, 3 to 6 PM
	Truxel Rd SB	2 GP	1	6 to 9 AM, 3 to 6 PM
US 50 Eastbound	Harbor Blvd	2 GP, 1 HOV	2	6 to 9 AM, 3 to 6 PM
	11th St	2 GP	1	6 to 9 AM, 3 to 6 PM
	16th St	2 GP	1	6 to 9 AM, 3 to 6 PM
US 50 Westbound	15th St	2 GP	1	6 to 9 AM, 3 to 6 PM
	Harbor Blvd NB	1 GP, 1 HOV	1	6 to 9 AM, 3 to 6 PM
	Harbor Blvd SB	1 GP, 1 HOV	1	6 to 9 AM, 3 to 6 PM

Notes: GP – metered GP lane, HOV – unmetered HOV preferential lane

US 50 is a transcontinental highway that extends from I-80 in West Sacramento to Ocean City, MD. In the study area, US 50 serves commuter, freight, and recreational traffic between Yolo and Sacramento counties. US 50 is a six-lane to eight-lane freeway in the study area. Auxiliary lanes exist in both directions between I-80 and Harbor Boulevard, Jefferson Boulevard and I-5, I-5 and 15th Street/16th Street, and 15th Street/16th Street and SR 51/SR 99. An eastbound auxiliary lane is provided from Harbor Boulevard to Jefferson Boulevard/Tower Bridge Gateway. Ramp meters operating on US 50 under existing conditions in 2019 are listed in **Table 9**.

I-5 is a north-south freeway that extends from Mexico to Canada along the west coast of the United States. In the study area, I-5 serves regional traffic through the Central Valley and commuter traffic within the Sacramento metropolitan area. I-5 intersects both US 50 and I-80 in the study area. The I-5/US 50 interchange is near downtown Sacramento, and the freeway-to-freeway ramps also provide connections to P and Q Streets. The I-5/I-80 interchange has full cloverleaf configuration except that the westbound to southbound movement uses a direct connector ramp.

SR 113 is a north-south highway that runs from SR 12 west of Rio Vista to SR 99 south of Yuba City. In the study area, SR 113 is a four-lane freeway that connects I-80 to I-5 in Woodland. The system interchange ramps at I-80/SR 113 are braided with the adjacent I-80/Old Davis Road interchange.

SR 99 is a north-south highway that runs from I-5 south of Bakersfield to I-5 in Red Bluff. In the study area, SR 99 is an eight-lane freeway that connects US 50 at SR 51 with Elk Grove, Stockton, and the southern Central Valley. SR 99 serves commuters to and from downtown Sacramento.

SR 51 is a north-south eight-lane freeway that connects US 50 at SR 99 in downtown Sacramento to I-80 in northern Sacramento County. SR 51, which is signed as Business Loop 80, serves commuters in the Sacramento area.

Brief descriptions of the local roadways served by interchanges in the study area are listed below.

- Pedrick Road is a north-south two-lane highway that serves highway commercial properties at the I-80 interchange and the surrounding agricultural parcels.
- Kidwell Road is an east-west two-lane local road that serves adjacent agricultural parcels.
- Old Davis Road is a north-south four-lane road at I-80 that serves the University of California at Davis campus.
- Richards Boulevard is a north-south arterial street that connects I-80 to downtown Davis on the north and Cowell Boulevard on th south.
- Mace Boulevard is a four-lane north-south arterial street that serves east Davis.
- County Roads 32A and 32B are the north and south frontage roads for I-80 in Yolo County between Mace Boulevard and the Yolo Bypass.
- Enterprise Boulevard is a north-south arterial street in West Sacramento that serves primarily industrial land uses in West Sacramento.

- West Capitol Avenue is an east-west arterial street in West Sacramento that serves primarily industrial land uses near I-80.
- Reed Avenue is a four-lane east-west arterial street in West Sacramento that serves industrial land uses to the west and commerical land uses to the east.
- West El Camino Avenue is an arterial street that serves residential areas of northern Sacramento and a truck stop at I-80.
- Truxel Road is a four- to six-lane north-south arterial street in the city of Sacramento that serves residential, commercial, and industrial land uses.
- Northgate Boulevard is a four-lane north-south arterial street in the city of Sacramento that serves residential, commercial, and industrial land uses.
- Harbor Boulevard is a four-lane north-south arterial street in West Sacramento that serves primarily industrial and commercial properties and the Port of West Sacramento.
- Jefferson Boulevard is a four-lane north-south arterial street in West Sacramento that serves primarily residential and commercial properties.
- Tower Bridge Gateway is a four-lane east-west arterial street on a former freeway facility that connects US 50 to downtown Sacramento via the Tower Bridge.
- South River Road is a two-lane north-south collector street in West Sacramento that serves industrial and residential areas along the Sacramento River.
- 5th Street, 10th Street, 11th Street, 15th Street, and 16th Street are local one-way streets that serve downtown Sacramento.

4.2 Freeway Operations

4.2.1 Planning Analysis

The HCM procedure for freeway analysis was applied for the AM and PM peak hours using the existing year (2019) traffic volumes. The HCS summary table for level of service and density results are provided in **Appendix B**. The Leisch Method was applied to weaving sections. **Appendix B** also provides the summary table for the Leisch Method analysis.

The HCS analysis identified the following locations with LOS F conditions under existing conditions during the AM peak hour.

- I-80 eastbound from Mace Boulevard off-ramp to Mace Boulevard northbound on-ramp
- US 50 westbound from SR 99 on-ramp to 16th Street
- US 50 westbound from 15th Street to I-5
- I-80 westbound from West Capitol Avenue eastbound on-ramp to westbound on-ramp

The Leisch Method identified three weaving sections with LOS F during the AM peak hour: US 50 eastbound from I-5 to 15th Street, I-80 eastbound from I-5 to Truxel Road, and US 50 westbound from SR 51 to 16th Street.

The observed eastbound AM peak hour bottlenecks are on I-80 at Mace Boulevard and on US 50 between I-5 and 15th Street. HCS identified the first bottleneck but not the second; however, the Leisch Method identified the second bottleneck. Although the Leisch Method identified I-80 eastbound from I-5 to Truxel Road as LOS F, the average speed only briefly drops to about 50 mph. The observed westbound AM peak hour bottlenecks are on US 50 between SR 51 and 16th Street, on I-80 at the West Capitol Avenue westbound on-ramp, and on I-80 at the I-5 off-ramp. The first two bottlenecks are identified by both analysis methods. The third bottleneck is caused by a capacity constraint on I-5 that extends onto I-80, so it cannot be identified by the analysis.

The HCS analysis identified the following locations with LOS F conditions during the PM peak hour.

- I-80 eastbound from Mace Boulevard off to on-ramp to Mace Boulevard northbound on-ramp
- I-80 eastbound from County Road 32B off to on-ramp to County Road 32B on-ramp
- I-80 eastbound from I-5 southbound on-ramp to Truxel Road
- US 50 eastbound from Jefferson Boulevard on-ramp to South River Road on-ramp
- US 50 eastbound from 11th Street on-ramp to SR 51/SR 99
- US 50 westbound from SR 99 on-ramp to 16th Street
- US 50 westbound from 15th Street to I-5
- US 50 westbound at Jefferson Boulevard off-ramp
- US 50 westbound at West Capitol Avenue westbound on-ramp

The Leisch Method identified one weaving section with LOS F during the PM peak hour: I-80 Eastbound from I-5 to Truxel Road.

The observed eastbound PM peak hour bottlenecks on I-80 Mace Boulevard, County Road 32B, and I-5 were identified by HCS and the Leisch Method. The bottleneck at Reed Avenue was missing, which may be caused by an incorrect assumption for heavy vehicle percentage for the mainline and/or the on-ramp. HCS identified the eastbound US 50 bottlenecks at I-5 and SR 51/SR 99, but the Leisch Method did not identify the bottleneck at SR 51/SR 99.

4.2.2 Simulation Analysis

The model speed contour plots for the freeway segments by direction and peak period are presented in **Figure 4** through **Figure** 7. These charts show the average link speed in 15-minute intervals during the peak periods. The bottlenecks shown in the figures are described below.

Figure 4 shows the speed contour plots for the AM and PM peak periods for the eastbound corridor from I-80 at Pedrick Road to US 50 at SR 51/SR 99. During the AM peak period, two bottlenecks occur in the eastbound direction: one on I-80 at Mace Boulevard and the other on US 50 in downtown Sacramento. The congestion at Mace Boulevard lasts from about 7:30 to 8:00 AM and is limited to the interchange itself. The downtown bottleneck is in the weaving section between I-5 and 15th Street. Congested conditions last from about 7:30 to 9:00 AM and extend back through the Harbor Boulevard interchange.

During the PM peak period, the eastbound I-80/US 50 corridor direction has several bottlenecks. The upstream bottleneck at Mace Boulevard lasts the entire peak period and results in congested speeds that extend back to Old Davis Road. The horizontal curve and the Mace Boulevard on-ramps traffic together create the bottleneck, which has a maximum throughput of about 4,800 vph and lasts from 2:30 to 6:30 PM. Like Mace Boulevard, the secondary bottleneck at County Road 32B forms due to the on-ramp volume although a ramp meter on the on-ramp works to reduce this impact. The bottleneck is also affected by the vertical curve at the beginning of the Yolo Causeway. The maximum throughput is about 5,320 vph, and congestion lasts from about 3:30 to 6:30 PM. On US 50, the I-5 off-ramp and the weaving section between 16th Street and SR 51/SR 99 are bottlenecks. The first lasts from 3:15 to 6:00 PM, and the second from 3:00 to 7:00 PM. Both the SR 51 and SR 99 freeways also have downstream bottlenecks that can affect operations on US 50.

Figure 5 shows the speed contour plots for the AM and PM peak periods for eastbound I-80 from US 50 to Northgate Boulevard. During the AM peak period, eastbound I-80 from US 50 to Northgate Boulevard is not congested. However, two bottlenecks exist during the PM peak period. The Reed Avenue on-ramp serves as a bottleneck due to the on-ramp volume combined with the grade and reduced clear zone at the Bryte Bend bridge. Congested conditions last from about 4:15 to 6:15 PM and extend back to US 50. Freeway capacity downstream of the Reed Avenue on-ramp is about 5,100 vph. The I-5 to Truxel Road weaving section is also a bottleneck due to the heavy I-5 on-ramp volume entering the freeway. Congestion lasts from about 3:45 to 5:45 PM. Downstream of the study area, a bottleneck exists at the Steelhead Creek bridge just east of the Northgate Boulevard interchange that causes congestion to extend upstream of the Northgate Boulevard off-ramp.

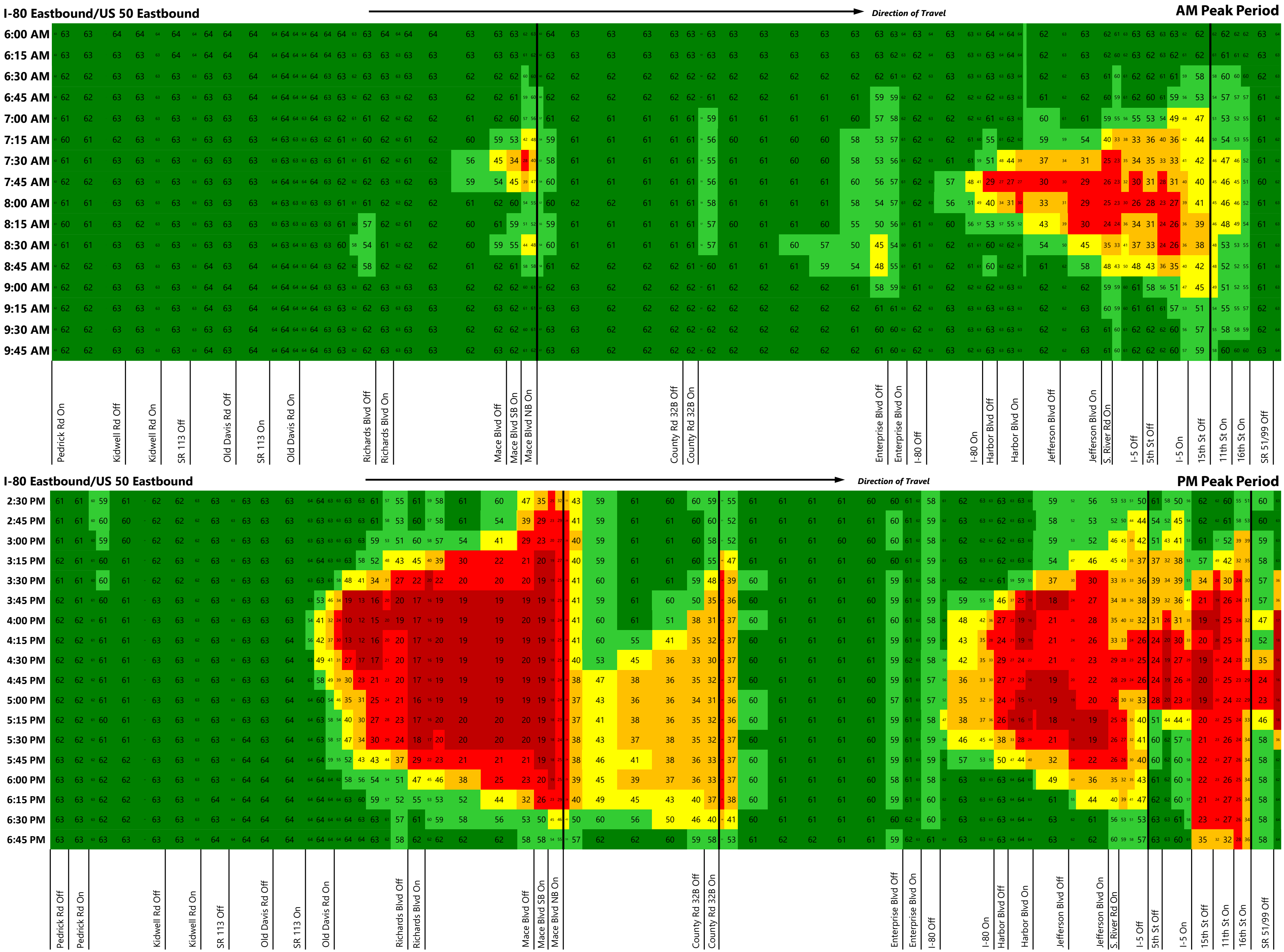


Figure 4

Eastbound Speed from I-80 at Pedrick Road to US 50 at SR 51/SR 99 - Existing Conditions

M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\AI\Traffic_Ops_Report

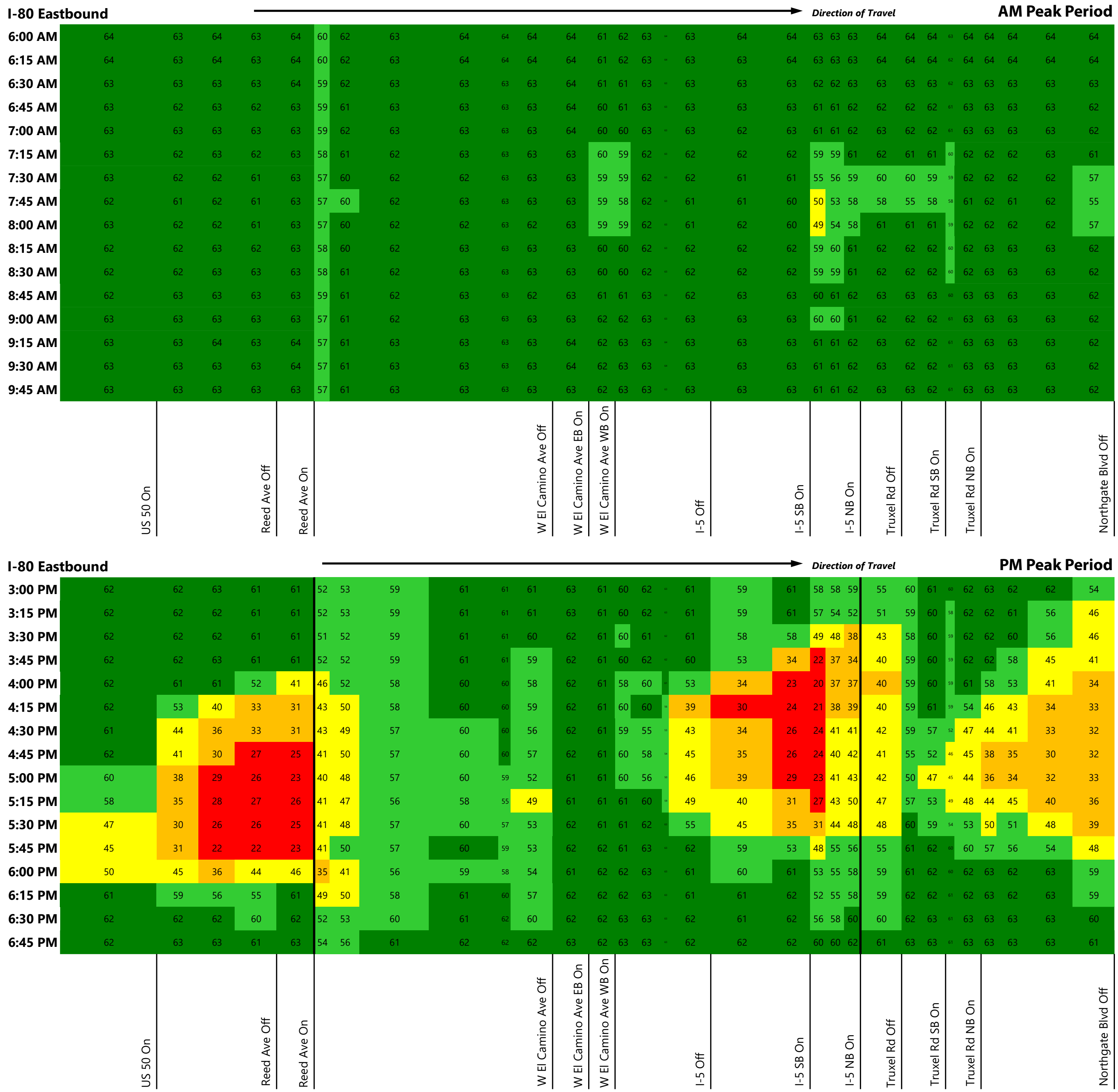


Figure 5

Eastbound Speed from I-80 at US 50 to Northgate Boulevard - Existing Conditions

Figure 6 shows the speed contour plots for the AM and PM peak periods for the westbound corridor from US 50 at SR 51/SR 99 to I-80 at Pedrick Road. During the AM peak period, the weaving section between the SR 51 on-ramp and the 16th Street off-ramp is a bottleneck from 7:00 to past 9:00 AM. Congestion also occurs at the downstream weaving segment between 15th Street and I-5. At the downstream bottleneck at the Yolo Causeway, congestion begins at 6:30 AM and lasts beyond the end of the analysis period at 10:00 AM. Congestion extends from West Capitol Avenue upstream through the I-80 interchange. The maximum throughput on the Yolo Causeway is about 5,600 vph. During the PM peak period, the downtown section of US 50 has overlapping bottlenecks at SR 51 to 16th Street and the I-5 off-ramp. The downstream Jefferson Boulevard off-ramp is also a bottleneck, with a shorter duration of about an hour compared to the three hours of congestion downtown. The lane drop at Jefferson Boulevard requires the I-5 on-ramp traffic to merge over. Additionally, the off-ramp demand volume is greater than 1,500 vph, which suggests that two off-ramp lanes are needed. Like the AM peak period, the Yolo Causeway is also a bottleneck, but the congestion is less severe, only about two-and-a-half hours in duration. The bottleneck throughput is about 4,700 vph.

Figure 7 shows the speed contour plots for the AM and PM peak periods for westbound I-80 from Northgate Boulevard to US 50. During the AM peak period, a bottleneck exists on southbound I-5 that extends onto the connector ramp from westbound I-80, which then causes congested conditions on westbound I-80 for about an hour. Congestion also extends from the Yolo Causeway bottleneck onto eastbound I-80 back to Reed Avenue. During the PM peak period, this freeway section is mostly uncongested. The only slow speeds occur near US 50 when congestion from the Yolo Causeway bottleneck extends back.

Bottlenecks are also active on weekends (see Appendix A of the *I-80/US 50 Managed Lanes Traffic Operations Report* (April 2023)). On Saturdays, eastbound I-80 is congested at the Pedrick Road on-ramp with speeds below 50 mph from 1:15 to 3:45 PM. The main bottlenecks occur at Mace Boulevard and County Road 32B like on weekdays during the PM peak period. Congested speeds start at about 1:00 PM and last until 8:15 PM. On Sundays in October 2019, eastbound I-80 did not have bottlenecks. Westbound I-80 had similar congested areas on both Saturdays and Sundays. The two bottlenecks are the Yolo Causeway and the lane drop downstream of Kidwell Road. On Saturdays, the Yolo Causeway bottleneck starts before 10:00 AM and lasts until 6:00 PM. On Sundays, congestion occurs during two periods – from about 11:00 AM to 5:30 PM and from 6:00 to 7:30 PM. The duration of the Kidwell Road bottleneck is about the same for both weekend days – 12:00 to 6:00 PM.

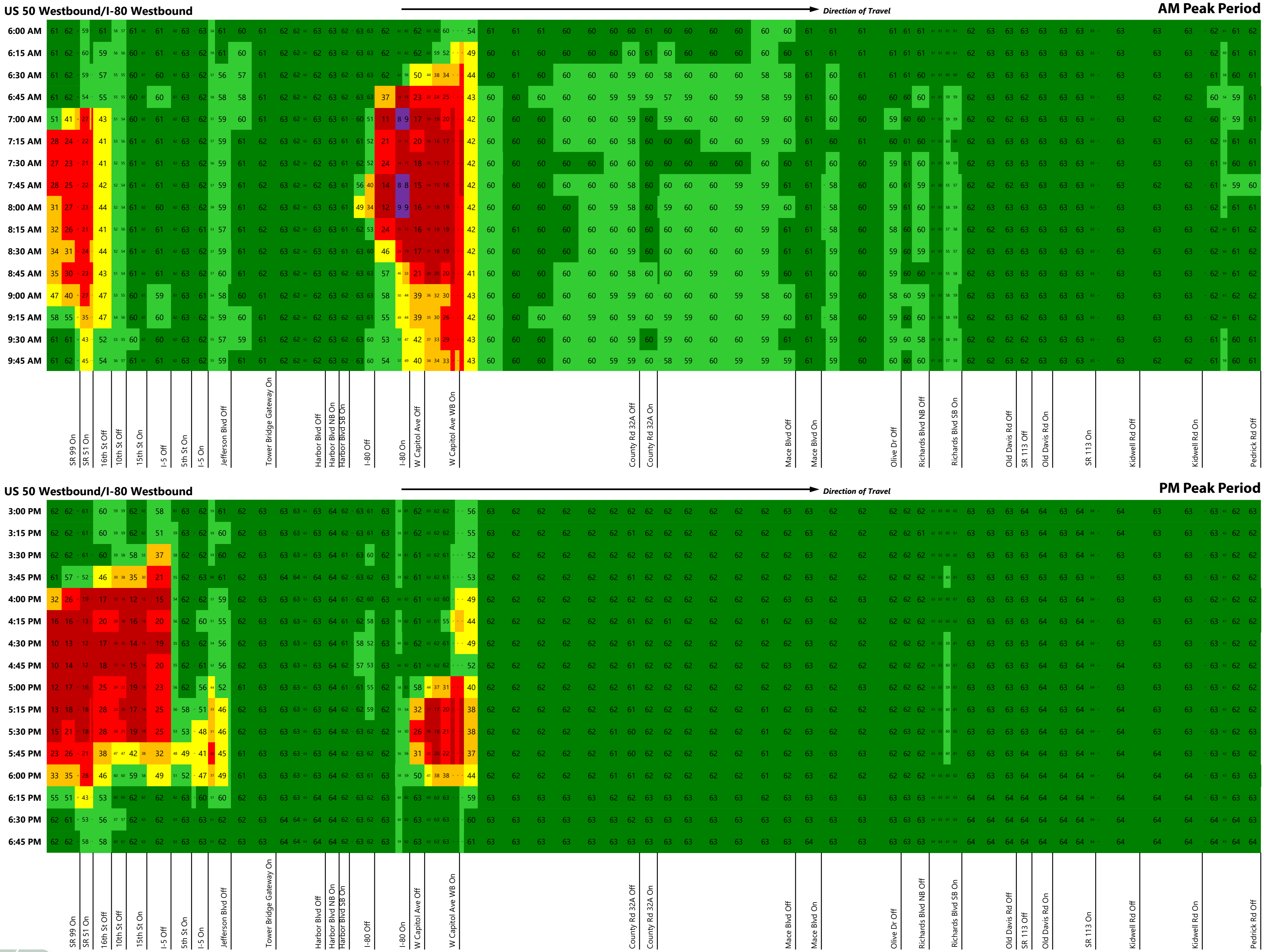


Figure 6

Westbound Speed from US 50 at SR 51/SR 99 to I-80 at Pedrick Road - Existing Conditions

I-80 Westbound — AM Peak Period

Direction of Travel →

6:00 AM	62	63	62	62	62	62	63	62	63	63	63	63	63	63	63	63	63	62	63	62	62	62	63	62	62	63	62	63	63	62	63	62
6:15 AM	62	63	61	61	62	62	62	61	63	63	63	63	63	63	63	63	63	62	62	61	61	62	62	61	61	63	62	62	62	62	63	62
6:30 AM	60	62	57	59	60	60	62	59	62	63	62	62	63	63	62	62	62	61	61	58	57	59	61	59	60	62	61	62	62	61	62	61
6:45 AM	60	62	56	59	59	60	61	58	61	62	62	62	62	63	62	62	62	61	59	54	55	58	60	57	58	62	61	61	60	57	56	41
7:00 AM	61	62	60	60	61	61	62	59	62	63	63	62	63	63	62	62	62	61	60	55	56	59	61	57	59	62	60	60	58	49	33	21
7:15 AM	60	62	57	59	60	60	61	57	61	63	62	62	62	63	62	62	62	60	60	56	56	59	61	58	59	62	60	60	59	59	62	54
7:30 AM	60	61	52	58	58	59	61	54	60	62	62	62	62	63	62	62	62	60	60	55	53	57	59	52	57	61	58	59	58	58	63	52
7:45 AM	59	61	51	54	52	49	48	42	58	62	62	62	62	63	61	62	62	61	59	53	54	58	59	52	57	62	59	58	56	57	59	35
8:00 AM	57	50	41	48	45	42	41	39	58	62	61	62	62	62	61	62	62	60	58	52	51	53	54	51	57	62	60	60	58	57	54	29
8:15 AM	55	44	45	53	50	46	47	46	58	62	62	62	62	63	62	62	62	61	59	50	48	51	52	48	57	61	56	55	51	44	35	20
8:30 AM	58	55	50	57	57	55	54	54	60	62	62	62	62	63	62	62	62	61	61	55	52	55	54	50	54	54	47	44	38	32	25	21
8:45 AM	61	60	57	60	61	61	62	60	62	63	63	63	63	63	62	63	63	62	62	60	59	61	61	57	55	49	42	43	40	36	28	27
9:00 AM	62	63	61	62	62	62	62	62	63	63	62	63	63	63	63	63	63	62	63	61	61	62	62	61	61	61	56	58	56	56	54	46
9:15 AM	62	63	62	62	62	62	63	62	63	63	62	63	63	63	63	63	63	62	63	62	62	62	63	62	62	63	61	62	62	62	63	61
9:30 AM	62	63	61	62	62	62	62	62	63	63	62	63	63	63	63	63	63	62	63	62	62	62	63	62	62	63	61	62	62	62	63	63
9:45 AM	62	63	62	62	62	62	63	62	63	64	62	63	63	63	63	63	63	62	63	62	62	63	63	62	62	63	61	62	62	62	64	63

Northgate Blvd On · Truxel Rd Off · Truxel Rd NB On · Truxel Rd SB On · I-5 Off · I-5 NB On · I-5 SB On · W El Camino Ave Off · W El Camino Ave WB On · W El Camino Ave EB On · Reed Ave Off · Reed Ave On · US 50 Off

I-80 Westbound — PM Peak Period

Direction of Travel →

3:00 PM	62	63	61	62	62	62	63	62	63	64	62	63	64	64	63	63	63	62	63	63	63	62	63	63	60	63	57	60	61	60	62	58
3:15 PM	62	63	62	62	62	62	63	62	63	64	63	63	64	64	63	64	64	62	63	62	63	62	63	63	60	63	57	61	62	60	63	58
3:30 PM	62	62	60	61	62	62	62	61	63	64	62	63	63	63	63	63	63	62	63	62	62	62	62	62	58	62	55	58	60	55	61	54
3:45 PM	62	63	61	61	62	62	62	61	63	64	62	63	63	64	63	63	63	62	62	62	62	61	62	62	59	63	58	61	61	59	61	53
4:00 PM	61	62	59	61	62	62	62	61	63	64	62	63	63	63	63	63	63	61	62	62	62	61	62	62	55	62	56	59	61	56	61	55
4:15 PM	62	62	60	61	62	62	63	61	63	64	62	63	63	63	63	63	63	61	62	62	62	61	62	62	53	62	56	58	60	54	61	54
4:30 PM	62	62	61	62	62	62	63	61	63	64	62	63	63	63	63	63	63	61	62	62	62	61	62	62	56	62	54	54	54	44	60	56
4:45 PM	62	63	61	62	62	62	63	62	64	64	62	63	64	64	63	63	63	61	62	62	62	62	62	62	57	62	57	57	54	51	60	52
5:00 PM	62	62	60	61	62	62	63	61	63	64	62	63	63	63	63	63	63	61	62	62	62	61	62	62	55	62	56	59	60	51	61	59
5:15 PM	61	62	60	61	62	62	63	61	63	64	62	63	63	63	63	63	63	61	62	62	62	61	62	62	55	62	58	60	58	54	58	52
5:30 PM	62	62	61	62	62	62	63	62	63	64	62	63	64	64	63	63	63	61	63	62	63	62	63	62	59	63	58	61	62	55	52	43
5:45 PM	62	62	61	62	62	62	63	62	63	64	62	63	64	64	63	63	63	62	63	63	63	62	63	62	58	63	59	62	62	56	52	50
6:00 PM	62	63	61	62	63	62	63	62	64	64	63	63	64	64	64	64	64	62	63	63	63	63	63	63	62	63	60	62	63	62	62	56
6:15 PM	62	63	62	62	63	62	63	62	64	64	63	63	64	64	64	64	64	62	63	63	63	63	63	63	62	64	60	63	63	62	63	62
6:30 PM	63	63	62	63	63	62	63	63	64	64	63	64	64	64	64	64	64	62	63	63	63	63	63	63	62	64	60	63	63	63	64	62
6:45 PM	63	63	63	63	63	63	63	63	64	64	63	64	64	64	64	64	64	62	63	63	63	63	64	63	63	64	60	63	63	63	64	63

Northgate Blvd SB On · Truxel Rd Off · Truxel Rd NB On · Truxel Rd SB On · I-5 Off · I-5 NB On · I-5 SB On · W El Camino Ave Off · W El Camino Ave WB On · W El Camino Ave EB On · Reed Ave Off · Reed Ave On · US 50 Off

Figure 7

Westbound Speed from I-80 at Northgate Boulevard to US 50 - Existing Conditions

Peak hour travel time from the operations model is reported in **Table 10**. The table includes the free flow travel time at the posted speed of 65 mph. During the AM peak hour, congested conditions affect eastbound travel times the most for eastbound US 50 from I-80 to SR 51/SR 99, which has an average travel time 46 percent greater, an additional 2.3 minutes, than the uncongested travel time. For westbound travel times, I-80 from US 50 to Kidwell Road has an average travel time about 40 percent greater, an additional 4.8 minutes, than the uncongested travel time.

Table 10: Travel Time – Existing Conditions

Path	Free Flow	AM Peak Hour	PM Peak Hour
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	12.2	13.1	22.9
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	5.0	7.3	12.1
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	5.2	5.5	7.5
US 50/I-80 Westbound: I-80 EB Off-ramp to Kidwell Rd Off-ramp	12.2	17.0	12.9
US 50 Westbound: SR 51 On-ramp to I-80 Off-ramp	4.1	4.5	7.6
I-80 Westbound: Truxel Rd SB On-ramp to US 50	5.3	5.8	5.3

Notes: Travel time is reported in minutes. Free Flow is the travel time at the posted speed of 65 mph. The peak hours are 7:00 to 8:00 AM and 4:00 to 5:00 PM.

During the PM peak hour, average eastbound travel time is 88 percent greater than free flow for I-80 from Kidwell Road to US 50 and 142 percent greater for US 50 from I-80 to SR 51/SR 99. Westbound travel time is worst for US 50 from SR 51 to I-80 where the congested travel time is 85 percent greater than free flow, about 3.5 additional minutes.

Table 11 and **Table** 12 show the peak hour (7:00 to 8:00 AM and 4:00 to 5:00 PM) LOS and average density at selected eastbound and westbound ramp junctions and mainline sections under existing conditions. See **Appendix B** for results for all study locations in each hour of the peak periods (6:00 to 10:00 AM and 3:00 to 7:00 PM).

Table 11: Selected Eastbound Freeway Operations – Existing Conditions

		LOS/Density[1]	LOS/Density[1]
Freeway Segment	**Facility Type**	**AM Peak Hour**	**PM Peak Hour**
I-80 EB: Old Davis Rd to Richards Blvd	Basic	C / 26	**F / 66**
I-80 EB: Richards Blvd to Mace Blvd	Basic	C / 26	**F / 66**
I-80 EB: Mace Blvd SB On-ramp	Merge	**F / 49**	**F / 73**
I-80 EB: Mace Blvd to County Rd 32B	Basic	D / 28	E / 40
I-80 EB: County Rd 32B On-ramp	Merge	D / 30	**F / 52**
I-80 EB: County Rd 32B to Enterprise Blvd	Basic	D / 31	D / 29
I-80 EB: Enterprise Blvd to US 50	Weave	B / 16	B / 17
US 50 EB: I-80 to Harbor Blvd	Weave	**F / 49**	**F / 66**
US 50 EB: Harbor Blvd to Jefferson Blvd	Weave	**F / 44**	**F / 58**
US 50 EB: Jefferson Blvd On-ramp	Basic	**F / 60**	**F / 51**
US 50 EB: I-5 to 15th St	Weave	E / 38	**F / 56**
I-80 EB: US 50 to Reed Ave	Basic	C / 18	**F / 62**
I-80 EB: W El Camino Ave to I-5	Basic	B / 16	D / 28
I-80 EB: I-5 SB On-ramp	Merge	D / 32	**F / 73**
I-80 EB: I-5 to Truxel Rd	Weave	D / 31	E / 41
I-80 EB: Truxel Rd to Northgate Blvd	Basic	D / 28	**F / 57**

Notes: Bold and underline font indicate LOS F conditions. The peak hours are 7:00 to 8:00 AM and 4:00 to 5:00 PM.
1. Density is reported in vehicles per lane per mile.

For the eastbound direction, AM peak hour LOS F congested conditions occur on US 50 from the I-80 on-ramp in West Sacramento to the I-5 on-ramp in Sacramento. LOS F also occurs on I-80 at Mace Boulevard, but the segments on either side of the interchange operate at LOS D or better. During the PM peak hour, LOS F conditions exist on I-80 from Old Davis Road to County Road 32B in Davis, on US 50 from Harbor Boulevard to the I-5 off-ramp, and on US 50 from the I-5 on-ramp past the SR 51/SR 99 off-ramp. LOS F also occurs on I-80 between US 50 and Reed Avenue, at I-5, and from Truxel Road to east of Northgate Boulevard.

For the westbound direction, AM peak hour LOS F congested conditions occur on from the I-80/US 50 interchange through the West Capitol Avenue interchange. During the PM peak hour, LOS F conditions exist on US 50 from east of SR 51/SR 99 to the 15th Street on-ramp. The Yolo Causeway bottleneck forms after the peak hour, so LOS F conditions occur after 5:00 PM at this location.

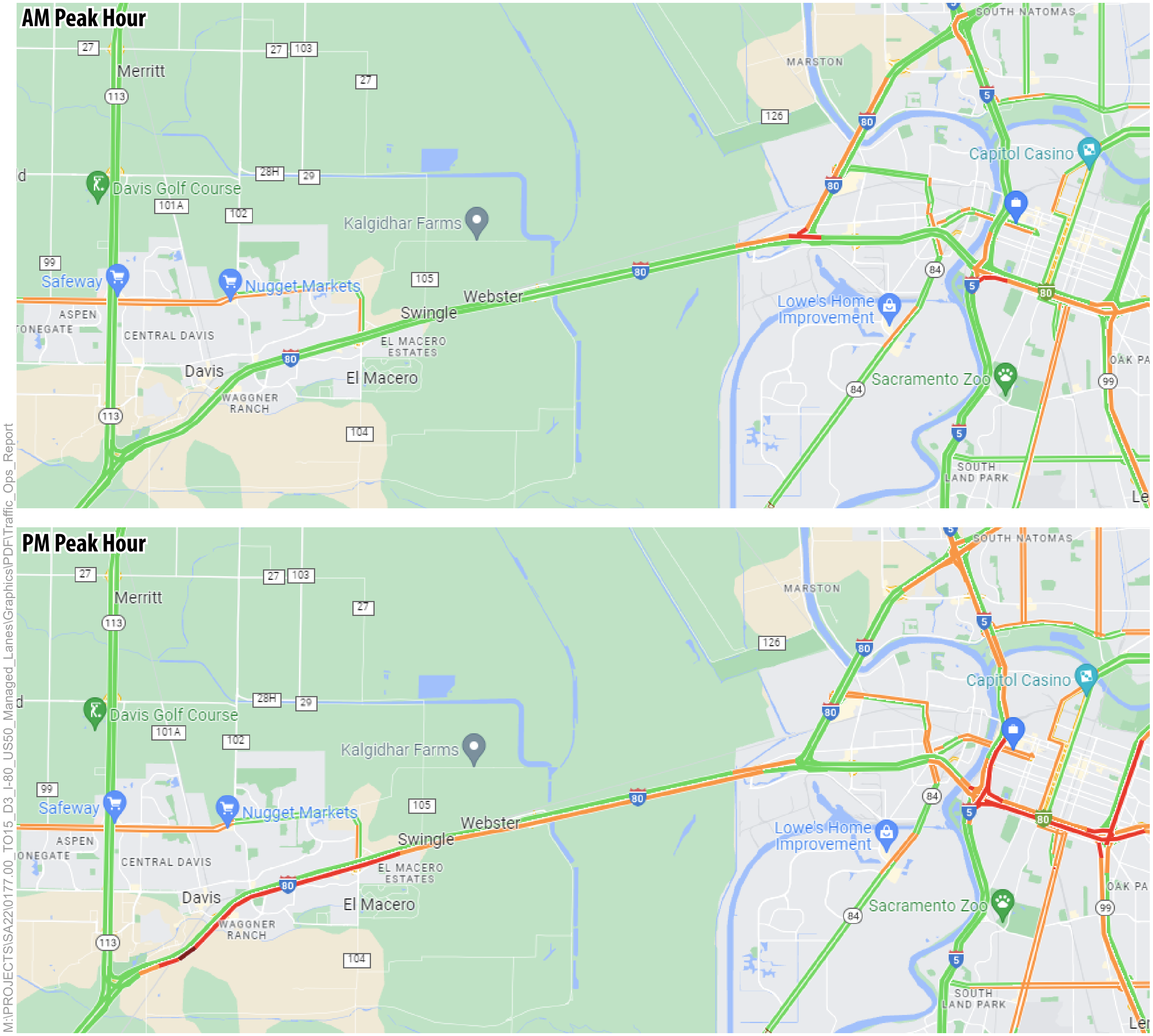
Table 12: Selected Westbound Freeway Operations – Existing Conditions

		LOS/Density[1]	LOS/Density[1]
Freeway Segment	**Facility Type**	**AM Peak Hour**	**PM Peak Hour**
US 50 WB: SR 51 to 16th St	Weave	E / 39	**F / 87**
US 50 WB: 15th St to I-5	Weave	B / 20	**F / 45**
US 50 WB: I-5 On-ramp	Merge	C / 24	C / 27
US 50 WB: Jefferson Blvd to Harbor Blvd	Basic	C / 20	B / 18
US 50 WB: I-80 Off-ramp	Diverge	C / 23	B / 15
I-80 WB: US 50 to W Capitol Ave	Weave	**F / 73**	B / 15
I-80 WB: W Capitol Ave WB On-ramp	Merge	**F / 51**	D / 33
I-80 WB: County Rd 32A to Mace Blvd	Basic	D / 31	C / 24
I-80 WB: Mace Blvd to Olive Dr	Basic	D / 29	C / 20
I-80 WB: Richards Blvd to Old Davis Rd	Basic	C / 21	B / 16
I-80 WB: Old Davis Rd On-ramp to SR 113 On-ramp	Basic	B / 18	B / 13
I-80 WB: Truxel Rd to I-5	Weave	D / 35	B / 20
I-80 WB: I-5 to W El Camino Ave	Weave	C / 21	B / 17
I-80 WB: W El Camino Ave to Reed Ave	Basic	E / 35	C / 25
I-80 WB: Reed Ave to US 50	Basic	C / 27	D / 28

Notes: Bold and underline font indicate LOS F conditions. The peak hours are 7:00 to 8:00 AM and 4:00 to 5:00 PM.
1. Density is reported in vehicles per lane per mile.

4.3 March 2023 Conditions

Although the COVID-19 pandemic has continued to affect travel patterns in 2023, traffic volumes have increased, and peak period congestion has returned compared with conditions during the COVID-19 pandemic in 2020. **Figure 8** shows traffic conditions for the study area from Google Maps for a typical Thursday (accessed on March 21, 2023). The AM peak hour figure is from 8:25 AM, and the PM peak hour figure is from 4:45 PM.



Source: Google Maps Typical Traffic accessed March 21, 2023.

M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\PDF\Traffic_Ops_Report

Figure 8

AM and PM Peak Hour Typical Conditions – March 2023

4.4 Roadway Safety

The Traffic Accident Surveillance and Analysis System (TASAS) was queried to generate the collision history for I-80 and US 50 in the project area for a five-year period from January 2015 to December 2019. **Table 13** summarizes the number of collisions by severity and compares the collision rate to statewide averages.

Table 13: Collision History – Freeway Segments

					Actual Collision Rate	Actual Collision Rate	Actual Collision Rate	Average Collision Rate	Average Collision Rate	Average Collision Rate
Segment	**Direction**	**Total Collisions**	**Total Fatality Collisions**	**Fatal & Injury Collisions**	**F**	**F&I**	**Total**	**F**	**F&I**	**Total**
I-80 from Solano Co. Line to US 50 (YOL 0.0 to R9.6)	EB	857	4	325	0.003	**<u>0.27</u>**	**<u>0.70</u>**	0.006	0.22	0.67
	WB	647	6	219	0.005	0.18	0.53	0.006	0.22	0.67
I-80 from US 50 to HOV Lane (YOL R9.6 to R11.7, SAC M0.0 to M1.4)	EB	137	1	47	0.003	0.15	0.44	0.005	0.27	0.81
	WB	402	2	138	**<u>0.006</u>**	**<u>0.44</u>**	**<u>1.29</u>**	0.005	0.27	0.81
US 50 from I-80 to I-5 (YOL 0.0 to 3.2, SAC L0.0 to L0.6)	EB	410	4	152	**<u>0.009</u>**	**<u>0.35</u>**	**<u>0.94</u>**	0.003	0.27	0.84
	WB	458	8	195	**<u>0.018</u>**	**<u>0.45</u>**	**<u>1.05</u>**	0.003	0.27	0.84

Notes: Collision rate is in collisions per million vehicle miles. "F" refers to the fatality collision rate, and "F&I" refers to the fatality and injury collision rate. Bold and underline font indicate an actual collision rate that exceeds the average collision rate.
Source: TASAS Table B Summary from January 2015 to December 2019, Caltrans (2021)

For the I-80 segment from the Solano County line to US 50, 1,504 collisions were recorded in the five-year period from 2015 to 2019 including 10 fatality-related collisions. For the eastbound direction, the fatal and injury and total collision rates are higher than the statewide average, but the fatality rate is below. The actual collision rate was less than the statewide average in the westbound direction. Collisions are most frequent at Richards Boulevard and Mace Boulevard in the eastbound direction. In the westbound direction, collision rates are highest at the Enterprise Boulevard/West Capitol Avenue interchange, which is also the bottleneck location at the start of the Yolo Causeway.

For I-80 from US 50 to the start of the HOV lane, 75 percent of the 539 collisions occurred in the westbound direction, and 3 collisions involved a fatality. The eastbound collision rate is less than the statewide average, but the westbound collision rate is higher for all three categories. The most frequent collision locations in the eastbound direction are at Reed Avenue and at the downstream end of the Bryte Bend Bridge. In the westbound direction, collisions are most frequent on the connector ramp that merges with westbound US 50.

For the US 50 segment, 868 collisions were measured in the five-year period with about the same number in each direction. Four fatality-related collisions occurred in the eastbound direction and eight in the westbound direction. Both directions had actual collision rates higher than the statewide rate for all three categories. In the eastbound direction, the locations with the most frequent collisions are the Jefferson Boulevard off-ramp and the I-5 off-ramp. In the westbound direction, collisions are most frequent at US 50.

Table 14 lists the collision type for freeway segments in the study area. The most common collision type is rear end collisions, which is more than 60 percent of all collisions. Hit object and sideswipe are the next most common collision types. Rear end and sideswipe collisions are associated with congested conditions. During the AM peak period, 81 percent of collisions are rear end and sideswipe collisions. During the PM peak period, 92 percent are rear end and sideswipe collisions.

Table 14: Collision Type – Freeway Segments

Segment	Head-on	Side-swipe	Rear End	Broad-side	Hit Object	Over-turn	Auto Ped	Other	Total
I-80 from Solano Co. Line to US 50 (YOL 0.0 to R9.6)	2 (0.1%)	323 (21.5%)	915 (60.8%)	26 (1.7%)	210 (14.0%)	19 (1.3%)	2 (0.1%)	7 (0.7%)	1,504
I-80 from US 50 to HOV Lane (YOL R9.6 to R11.7, SAC M0.0 to M1.4)	1 (0.2%)	9 (17.3%)	346 (64.2%)	4 (0.7%)	86 (16.0%)	6 (1.1%)	0 (0%)	3 (0.6%)	539
US 50 from I-80 to I-5 (YOL 0.0 to 3.2, SAC L0.0 to L0.6)	3 (0.3%)	151 (17.4%)	524 (60.4%)	14 (1.6%)	152 (17.5%)	11)(1.3%)	5 (0.6%)	8 (0.9%)	868

Notes: Collision rate is in collisions per million vehicle miles. "F" refers to the fatality collision rate, and "F&I" refers to the fatality and injury collision rate. Bold and underline font indicate an actual collision rate that exceeds the average collision rate.
Source: TASAS Table B Summary from January 2015 to December 2019, Caltrans (2021)

Table 15 summarizes the collision history at ramps where ramp meters would be installed under the build alternatives. The table also lists collision history for the connector ramps at the I-80/US 50 interchange. Three ramps recorded no collisions in the five-year period. The most collisions, 12, occurred at the westbound US 50 to eastbound I-80 connector ramp. Four ramps had actual collision rates higher than the statewide averages. The SR 113 on-ramp to eastbound I-80 had a higher fatality collision rate due to one fatality-related collision. The Richards Boulevard on-ramp to eastbound I-80 had a higher fatality and injury collision rate. The westbound I-80 to eastbound US 50 connector ramp had both a higher fatality and injury and a higher total collision rate. Also, the westbound US 50 to eastbound I-80 connector ramp had a higher total collision rate.

Table 15: Collision History – Ramps

				Actual Collision Rate[1]	Actual Collision Rate[1]	Actual Collision Rate[1]	Average Collision Rate[1]	Average Collision Rate[1]	Average Collision Rate[1]
Ramp	**Total Collisions**	**Total Fatality Collisions**	**Fatal & Injury Collisions**	**F**	**F&I**	**Total**	**F**	**F&I**	**Total**
SR 113 On-ramp to WB I-80 (SR 113 PM SOL R21.9 to R22.0)	1	0	1	0.000	0.22	0.22	0.009	0.16	0.47
Old Davis Rd On-ramp to WB I-80 (PM SOL R43.2)	0	0	0	0.000	0.00	0.00	0.017	0.24	0.64
SR 113 On-ramp to EB I-80 (PM SOL R43.4)	4	1	1	**<u>0.105</u>**	0.11	0.42	0.020	0.24	0.53
Old Davis Rd On-ramp to EB I-80 (PM SOL R43.8)	0	0	0	0.000	0.00	0.00	0.017	0.24	0.64
Richards Blvd On-ramp to EB I-80 (PM YOL 0.5)	6	0	3	0.000	**<u>0.28</u>**	0.56	0.002	0.23	0.63
Mace Blvd On-ramp to WB I-80 (PM YOL 2.5)	2	0	2	0.000	0.19	0.19	0.002	0.23	0.63
County Rd 32A On-ramp to WB I-80 (PM YOL 2.5)	0	0	0	0.000	0.00	0.00	0.005	0.27	0.88
WB I-80 to EB US 50 Connector ramp (US 50 PM YOL 0.7)	7	0	5	0.000	**<u>0.47</u>**	**<u>0.65</u>**	0.005	0.15	0.48
WB US 50 to EB I-80 Connector ramp (US 50 PM YOL 0.6)	12	0	2	0.000	0.10	**<u>0.57</u>**	0.003	0.14	0.43

Notes: Collision rate is in collisions per million vehicle miles. "F" refers to the fatality collision rate, and "F&I" refers to the fatality and injury collision rate. Bold and underline font indicate an actual collision rate that exceeds the average collision rate.
Source: TASAS Table B Summary from January 2015 to December 2019, Caltrans (2021)

Of the four collisions on the SR 113 on-ramp to eastbound I-80, three were hit object collisions. Two of the six collisions for the Richards Boulevard on-ramp were also hit object collisions, and another two collisions were broadside. Hit object collisions are also common at the I-80/US 50 interchange with three of seven collisions for the westbound I-80 to eastbound US 50 connector ramp, and eight of the 12 collisions for the westbound US 50 to eastbound I-80 connector ramp.

4.5 Multimodal Facilities

4.5.1 Transit System

Existing transit service on the corridor is provided by the Amtrak Capitol Corridor regional commuter rail, by Fairfield and Suisun Transit (FAST) express bus service, by Yolo County Transportation District's Yolobus service, and by the Causeway Connection which is operated by Yolobus and Sacramento Regional Transit. Except where noted, the service descriptions below reflect October 2019 conditions: that is, before service changes associated with the COVID-19 pandemic.

FAST operates the Blue Line express bus that provides weekday service between downtown Sacramento and Walnut Creek with a UC Davis stop in the project area. Effective August 2021, service is provided four times each during the AM and PM peak periods.

The Capitol Corridor operates daily train service between San Jose and Auburn. On weekdays, 11 trains travel between Davis and Sacramento in each direction. Some of the trains terminate in Sacramento or Roseville rather than Auburn. Train service is approximately hourly during the AM and PM peak periods with longer headways during the middle of the day. The Sacramento and Davis stations are located in the study area. The nearest station to the west is Fairfield-Vacaville, and the nearest station to the east is Roseville.

Yolobus operates eight routes on I-80 in the study area. On weekdays, two routes provide intercity service throughout the day, and the other six are commuter routes between Davis and Sacramento. The intercity routes have stops adjacent to the park-and-ride lots at West Capitol Avenue and Mace Boulevard. The routes are described below.

- Routes 42A and 42B provide intercity service between Davis, Sacramento, and Woodland throughout the day. Route 42A travels in a clockwise direction, and Route 42B travels in a counterclockwise direction. In the study area, Route 42A travels westbound along I-80 from West Capitol Avenue to Mace Boulevard, and Route 42B travels eastbound from Mace Boulevard to Enterprise Boulevard. Service is provided hourly between 6:00 AM and 11:00 PM.
- Route 43 provides commuter service between UC Davis and downtown Sacramento. Route 43 has five peak direction trips during each peak period (towards Sacramento in the morning and towards Davis in the afternoon). Route 43 travels between I-80 at Mace Boulevard and US 50 at Tower Bridge Gateway.
- Routes 43R provide commuters service between UC Davis and downtown Sacramento. Route 43R has one off-peak direction trip during each peak period (towards Davis in the morning and towards Sacramento in the afternoon). Route 43R travels between I-80 at Richards Boulevard and US 50 at 5th Street in Sacramento.
- Route 44 provides commuter service between south Davis and downtown Sacramento. Route 44 has three peak direction trips during each peak period (towards Sacramento in the morning and towards Davis in the afternoon). Like Route 43, Route 44 travels between I-80 at Mace Boulevard and US 50 at Tower Bridge Gateway.
- Routes 230, 231, and 232 provide commuter service between Davis and downtown Sacramento similar to Route 43. Route 230 has three peak direction trips during each peak period (towards Sacramento in the morning and towards Davis in the afternoon) and travels between I-80 at SR 113 and US 50 at Tower Bridge Gateway. Route 232 has one peak direction trip during each peak period (towards Sacramento in the morning and towards Davis in the afternoon) and travels

between I-80 at Mace Boulevard and US 50 at Tower Bridge Gateway. Route 231 is an additional route that is scheduled late in the PM peak period that picks up passengers that may have missed an earlier Route 230 or 232 bus.

The Causeway Connection (Route 138) provides daily service between UC Davis and the UC Davis Medical Center in Sacramento. On weekdays, 15 buses travel in each direction and hourly service is provided between 6:00 AM and 8:00 PM. In the study area, the route travels between I-80 at Old Davis Road and US 50 at Stockton Boulevard, which is just east of the SR 51/SR 99 interchange.

In addition to these transit services, other organizations provide bus service along I-80. Commercial bus carriers include Greyhound, Megabus, and FlixBus. Recreational tour companies provide bus service to casinos and other recreational destinations in the Reno and Tahoe region.

4.5.2 Bicycle System

This section describes the bicycle facilities in and adjacent to the project area.

A three-mile Class I bicycle/pedestrian path runs between I-80 on the south and the Union Pacific Railroad on the north from Olive Drive at the I-80 westbound off-ramp to County Road 32A at County Road 105. Connections are provided to both the east and west sides of Mace Boulevard by paths along the westbound on- and off-ramps. In May 2022, a connection to the west side of Pole Line Road was opened.

A 3.6-mile Class IV bicycle/pedestrian path runs along the north side of the Yolo Causeway on I-80. Connections are provided via a levee road to County Road 32A in the west and to West Capitol Avenue at the I-80 westbound on-ramp and at about 400 feet east of the I-80 Westbound Ramps intersection.

These two bicycle/pedestrian paths are connected by a two-mile long section of County Road 32A that has Class II on-street bicycle lanes. Parallel local streets in Davis, including Olive Drive, Research Park Drive, Cowell Boulevard, Chiles Road, and 2nd Street, provide Class II on-street bicycle lanes. County Road 32B, the frontage road south of I-80 and east of Davis, does not have bicycle facilities.

In West Sacramento, buffer-separated Class II bicycle lanes were recently installed on West Capitol Avenue from I-80 to Jefferson Boulevard. Class II bicycle lanes exist on West Capitol Avenue from Jefferson Boulevard to Tower Bridge Gateway. These lanes continue east along Tower Bridge Gateway across the Sacramento River into downtown Sacramento. Industrial Boulevard, the parallel arterial street south of US 50 in West Sacramento, also includes Class II bicycle lanes. Harbor Boulevard, which parallels I-80 to the east, has Class II bicycle lanes only from West Capitol Avenue to Reed Avenue. No bicycle crossing is provided at or near the I-80 crossing of the Sacramento River.

The I-80 and US 50 crossings are listed below along with their bicycle facilities, if any.

- I-80 at Putah Creek Trail – Class I bicycle/pedestrian path
- I-80 at Richards Boulevard – Class II bicycle lanes

- I-80 at Pole Line Road – Class I bicycle/pedestrian path on west side and Class II on-street bicycle lanes
- I-80 at Dave Pelz Pedestrian Overcrossing – Class I bicycle/pedestrian path
- I-80 at Mace Boulevard – Class II on-street bicycle lanes
- I-80 at County Road 32A/32B – no facilities
- I-80 at West Capitol Avenue/Enterprise Boulevard – no facilities
- I-80 at West Capitol Avenue – Class II buffered on-street bicycle lanes
- I-80 at Reed Avenue – no facilities
- I-80 at Garden Highway – no facilities
- US 50 at Harbor Boulevard – Class II on-street bicycle lanes
- US 50 at Westacre Road – no facilities
- US 50 at Jefferson Boulevard – no facilities
- US 50 at Drever Street – no facilities
- US 50 at South River Road – no facilities
- US 50 at Sacramento River Bicycle Trail – Class I bicycle/pedestrian path
- US 50 at Front Street – Class II on-street bicycle lanes
- US 50 at 3rd Street – no facilities
- US 50 at 5th Street – Class II on-street bicycle lane

4.5.3 Pedestrian System

This section describes the pedestrian facilities in and adjacent to the project area.

A three-mile Class I bicycle/pedestrian path runs between I-80 on the south and the Union Pacific Railroad on the north from Olive Drive at the I-80 westbound off-ramp to County Road 32A at County Road 105. Connections are provided to both the east and west sides of Mace Boulevard by paths along the westbound on- and off-ramps. In May 2022, a connection to the west side of Pole Line Road was opened.

A 3.6-mile Class I bicycle/pedestrian path runs along the north side of the Yolo Causeway on I-80. Connections are provided via a levee road to County Road 32A in the west and to West Capitol Avenue at the I-80 westbound on-ramp and at about 400 feet east of the I-80 Eastbound Ramps intersection.

Although the two-mile long section of County Road 32A that connects these two bicycle/pedestrian paths has Class II on-street bicycle lanes, no facilities are provided specifically for pedestrians. The parallel local streets in Davis, including Olive Drive, Research Park Drive, Cowell Boulevard, Chiles Road, and 2nd Street, generally provide a sidewalk for at least one side of the street. The side adjacent to the freeway or the railroad typically does not have a sidewalk. Also, 2nd Street has a 1,600-foot gap in the sidewalk between

Faraday Avenue and Fermi Place, and Chiles Road has a 1,730-foot gap between Cowell Boulevard and La Vida Way. County Road 32B, the frontage road south of I-80 and east of Davis, does not have pedestrian facilities.

In West Sacramento, sidewalks were recently refurbished and installed on West Capitol Avenue from I-80 to Jefferson Boulevard. The project included new ADA ramps and mid-block crossing treatments. Sidewalks exist on both sides of West Capitol Avenue from Jefferson Boulevard to Tower Bridge Gateway. Similar pedestrian facilities continue east along Tower Bridge Gateway across the Sacramento River into downtown Sacramento. Evergreen Avenue, a local street located between West Capitol Avenue and US 50, has several gaps in the sidewalk between Pine Avenue and Sycamore Avenue. Industrial Boulevard, the parallel arterial street south of US 50 in West Sacramento, has a sidewalk on the north side of the street. Harbor Boulevard, which parallels I-80 to the east, has sidewalks on both sides of the street from US 50 to Reed Avenue. No pedestrian crossing is provided at or near the I-80 crossing of the Sacramento River.

The I-80 and US 50 crossings are listed below along with their pedestrian facilities, if any.

- I-80 at Putah Creek Trail – Class I bicycle/pedestrian path
- I-80 at Richards Boulevard – Sidewalk on west side
- I-80 at Pole Line Road – Class I bicycle/pedestrian path on west side
- I-80 at Dave Pelz Pedestrian Overcrossing – Class I bicycle/pedestrian path
- I-80 at Mace Boulevard – Sidewalk on east side
- I-80 at County Road 32A/32B – no facilities
- I-80 at West Capitol Avenue/Enterprise Boulevard – Sidewalk on west side
- I-80 at West Capitol Avenue – Sidewalks on both sides
- I-80 at Reed Avenue – Sidewalks on both sides
- I-80 at Garden Highway – no facilities
- US 50 at Harbor Boulevard – Sidewalks on both sides
- US 50 at Westacre Road – Sidewalks on both sides
- US 50 at Jefferson Boulevard – Sidewalks on both sides
- US 50 at Drever Street – no facilities
- US 50 at South River Road – no facilities
- US 50 at Sacramento River Bicycle Trail – Class I bicycle/pedestrian path
- US 50 at Front Street – Sidewalk on east side
- US 50 at 3rd Street – Sidewalk on west side
- US 50 at 5th Street – Sidewalk on east side

4.5.4 Freight System

I-80 and US 50 serve as important regional connections for freight distribution. Regional and interstate trucks use these freeways to deliver goods within the Sacramento metropolitan area and to adjoining metropolitan areas and beyond. West Sacramento is an important freight hub with warehouse and manufacturing land uses adjacent to I-80 between the Yolo Bypass and the Sacramento River and along US 50 from I-80 to Harbor Boulevard. The Port of West Sacramento located south of US 50 is accessed via the US 50/Harbor Boulevard interchange. This seaport primarily provides for the import and export of agricultural goods and raw materials via the Sacramento River Deep Water Ship Canal. Davis also has warehouse and manufacturing land uses along I-80 between Richards Boulevard and Mace Boulevard that focus on agricultural and industrial research. In the study area, I-80 and US 50 are National Network Surface Transportation Assistance Act (STAA) routes, which are designed to accommodate trucks with STAA dimensions.

Under existing conditions, truck percentages for I-80 and US 50 range from 5 to 9 percent during the AM and PM peak periods (see **Table 4**). **Table 16** shows existing peak hour heavy vehicle volumes at the I-80/US 50 interchange. Heavy vehicles include single unit trucks, tractor-trailers, and buses. Existing heavy vehicle volumes for all study area locations are shown in **Appendix E**.

Table 16: Heavy Vehicle Volumes – Existing Conditions

Freeway Segment	Direction	AM Peak Hour	PM Peak Hour
I-80: Enterprise Blvd/W Capitol Ave to US 50	Eastbound	399	305
	Westbound	405	245
US 50: I-80 to Harbor Blvd	Eastbound	373	277
	Westbound	327	190
I-80: US 50 to Reed Ave	Eastbound	228	210
	Westbound	302	255

Note: The peak hours are 7:00 to 8:00 AM and 4:00 to 5:00 PM.

5. Travel Demand Forecasts

5.1 Performance Measures

The performance measures from the base year 2016, opening year 2029, and horizon year 2049 models are reported in this chapter. All performance measures reported from the modified SACSIM19 model are based on one run per alternative. Since the modeling was completed, SACOG has shared advice on performing multiple runs and changing random number seeds for the activity portion of the model. Runs would then be averaged to better isolate project alternative effects. This approach is recommended for future applications.

Appendix D provides tables of the network performance measures (VMT, Congested VMT, VMT per capita, VHT, VHD, PMT, and PMT per lane-mile) and tables for VMT by 5-mph speed bin. The performance measures are listed by alternative and analysis year for daily, AM peak, and PM peak periods. Except for VMT per capita, the performance measures are reported on both a regional and corridor basis. **Appendix D** also provides the average speed for the three freeway segments at the I-80/US 50 interchange that combines both the off-peak average speed from the forecast model and the peak period speeds from the traffic operations model.

5.1.1 VHT

Table 17 presents the regional daily VHT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Regional VHT is expected to grow by 10 percent in 2029 and 50 percent in 2049 under Alternative 1. In 2029, Alternative 1 would have the lowest regional VHT, but as network delay increases, Alternative 1 would have the highest regional VHT by 2049. Regional VHT in 2049 would be similar across the build alternatives, with Alternatives 6 and 7 having the highest VHT.

Table 18 presents the corridor daily VHT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor VHT is expected to grow by 7 percent in 2029 and 56 percent in 2049 under Alternative 1. In 2029, Alternatives 4 through 7 would have higher corridor VHT than Alternative 1, but the other build alternatives would have lower corridor VHT. Corridor VHT in 2049 would be highest for Alternative 1, 6, and 7, which would have more corridor delay than the other alternatives. Alternatives 6 and 7 include minor widening, which would reduce travel time compared to Alternative 1.

Table 17: Regional Daily VHT

Alternative	2016	2029	2049
1 (No Build)	1,686,900 (Base Year)	1,851,200	2,522,700
2 (Add HOV)	1,686,900 (Base Year)	1,923,800	2,351,500
3 (Add HOT2+)	1,686,900 (Base Year)	1,923,000	2,357,900
4 (Add HOT3+)	1,686,900 (Base Year)	1,921,900	2,360,300
5 (Add Toll)	1,686,900 (Base Year)	1,926,000	2,363,900
6 (Add Transit)	1,686,900 (Base Year)	1,917,500	2,396,700
7 (Convert HOV)	1,686,900 (Base Year)	1,928,200	2,373,400
8 (Add HOV with Median Ramps)	1,686,900 (Base Year)	1,925,000	2,354,900
9 (Add HOV without Enterprise Crossing)	1,686,900 (Base Year)	1,929,200	2,357,300

Table 18: Corridor Daily VHT

Alternative	2016	2029	2049
1 (No Build)	75,700 (Base Year)	81,100	117,000
2 (Add HOV)	75,700 (Base Year)	80,600	94,800
3 (Add HOT2+)	75,700 (Base Year)	80,300	94,900
4 (Add HOT3+)	75,700 (Base Year)	81,200	96,200
5 (Add Toll)	75,700 (Base Year)	82,500	96,800
6 (Add Transit)	75,700 (Base Year)	84,600	107,400
7 (Convert HOV)	75,700 (Base Year)	83,900	102,600
8 (Add HOV with Median Ramps)	75,700 (Base Year)	80,700	94,700
9 (Add HOV without Enterprise Crossing)	75,700 (Base Year)	80,200	94,000

5.1.2 VHD

Table 19 presents the regional daily VHD by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Regional VHD is expected to grow by 16 percent in 2029 and 132 percent in 2049 under Alternative 1. Similar to the VHT results, Alternative 1 would have the lowest regional VHD in 2029, but as network delay increases, Alternative 1 would have the highest regional VHD by 2049. Regional VHD in 2049 would be similar across the build alternatives, with Alternatives 6 and 7 having the highest VHD, which matches the VHT results.

Table 20 presents the corridor daily VHD by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor VHD is expected to grow by 22 percent in 2029 and 200 percent in 2049 under Alternative 1. In 2029, Alternatives 6 and 7 would have higher corridor VHD than Alternative 1, and the other build alternatives would have lower corridor VHD. Corridor VHD in 2049 would be highest for Alternatives 1, 6, and 7. Alternatives 6 and 7 include minor widening, which would reduce travel time compared to Alternative 1. The corridor VHD for the other build alternatives would be less than half the Alternative 1 corridor VHD.

Table 19: Regional Daily VHD

Alternative	2016	2029	2049
1 (No Build)	230,600 (Base Year)	266,800	533,200
2 (Add HOV)	230,600 (Base Year)	292,900	431,500
3 (Add HOT2+)	230,600 (Base Year)	292,500	434,700
4 (Add HOT3+)	230,600 (Base Year)	292,800	439,100
5 (Add Toll)	230,600 (Base Year)	295,400	443,100
6 (Add Transit)	230,600 (Base Year)	296,500	465,200
7 (Convert HOV)	230,600 (Base Year)	302,100	452,100
8 (Add HOV with Median Ramps)	230,600 (Base Year)	293,500	432,700
9 (Add HOV without Enterprise Crossing)	230,600 (Base Year)	296,000	434,900

Table 20: Corridor Daily VHD

Alternative	2016	2029	2049
1 (No Build)	15,100 (Base Year)	18,300	44,300
2 (Add HOV)	15,100 (Base Year)	12,500	19,600
3 (Add HOT2+)	15,100 (Base Year)	12,100	19,600
4 (Add HOT3+)	15,100 (Base Year)	13,500	21,900
5 (Add Toll)	15,100 (Base Year)	15,200	23,00
6 (Add Transit)	15,100 (Base Year)	20,600	36,500
7 (Convert HOV)	15,100 (Base Year)	21,700	33,900
8 (Add HOV with Median Ramps)	15,100 (Base Year)	12,500	19,400
9 (Add HOV without Enterprise Crossing)	15,100 (Base Year)	12,400	19,100

5.1.3 VMT

Table 21 presents the regional daily VMT by alternative under opening year 2029 and horizon year 2049 based on the modified SACSIM19 model output. These results are compared to the base year 2016 model output and do not fully account for induced VMT effects. Separate induced VMT forecasts using the NCST calculator are provided in **Section 5.2**. Regional VMT is expected to grow by 8 percent in 2029 and 35 percent in 2049 under Alternative 1. Similar to the VHT results, Alternative 1 would have the lowest regional VMT in 2029, but as network delay increases, Alternative 1 would have the highest regional VMT by 2049 as travelers shift to longer routes to reduce overall travel time. Regional VMT in 2049 would be similar across the build alternatives, with Alternative 6 having the highest VMT. While transit use may be higher in this alternative, passenger travel to train stations and park-and-ride lots would likely be higher than other build alternatives.

Table 22 presents the corridor daily VMT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor VMT is expected to grow by 4 percent in 2029 and 20 percent in 2049 under Alternative 1. In 2029, all build alternatives except Alternative 7 would have higher corridor VMT than Alternative 1. Corridor VMT in 2049 would be highest for Alternative 3 and lowest for Alternatives 6 and 7. These two alternatives would also be the only alternatives with a lower corridor VMT than Alternative 1.

Table 21: Regional Daily VMT

Alternative	2016	2029	2049
1 (No Build)	63,097,900 (Base Year)	67,803,500	85,249,400
2 (Add HOV)	63,097,900 (Base Year)	69,891,500	82,246,400
3 (Add HOT2+)	63,097,900 (Base Year)	69,869,900	82,366,100
4 (Add HOT3+)	63,097,900 (Base Year)	69,788,500	82,220,400
5 (Add Toll)	63,097,900 (Base Year)	69,839,100	82,154,200
6 (Add Transit)	63,097,900 (Base Year)	69,378,300	82,651,100
7 (Convert HOV)	63,097,900 (Base Year)	69,590,700	82,199,000
8 (Add HOV with Median Ramps)	63,097,900 (Base Year)	69,923,800	82,339,500
9 (Add HOV without Enterprise Crossing)	63,097,900 (Base Year)	69,981,600	82,330,400

Table 22: Corridor Daily VMT

Alternative	2016	2029	2049
1 (No Build)	3,741,100 (Base Year)	3,881,000	4,495,700
2 (Add HOV)	3,741,100 (Base Year)	4,237,700	4,683,100
3 (Add HOT2+)	3,741,100 (Base Year)	4,240,200	4,686,500
4 (Add HOT3+)	3,741,100 (Base Year)	4,200,700	4,616,200
5 (Add Toll)	3,741,100 (Base Year)	4,170,900	4,582,700
6 (Add Transit)	3,741,100 (Base Year)	3,953,600	4,381,600
7 (Convert HOV)	3,741,100 (Base Year)	3,867,200	4,276,800
8 (Add HOV with Median Ramps)	3,741,100 (Base Year)	4,241,900	4,683,700
9 (Add HOV without Enterprise Crossing)	3,741,100 (Base Year)	4,216,200	4,662,500

5.1.4 Congested VMT

Table 23 presents the regional daily congested VMT (VMT on links where the v/c ratio is greater than 1) by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Regional congested VMT is expected to grow by 14 percent in 2029 and 168 percent in 2049 under Alternative 1. Similar to the VMT results, Alternative 1 would have the lowest regional congested VMT in 2029, but as network delay increases, Alternative 1 would have the highest regional congested VMT by 2049. Regional congested VMT in 2049 would be similar across the build alternatives, with Alternatives 6 and 7 having the highest congested VMT. Compared to the alternatives with the highest total VMT, Alternative 6 is on both lists, but Alternative 7 is not.

Table 23: Regional Daily Congested VMT

Alternative	2016	2029	2049
1 (No Build)	3,704,300 (Base Year)	4,223,000	9,920,500
2 (Add HOV)	3,704,300 (Base Year)	4,787,300	7,672,900
3 (Add HOT2+)	3,704,300 (Base Year)	4,825,200	7,746,300
4 (Add HOT3+)	3,704,300 (Base Year)	4,814,400	7,959,100
5 (Add Toll)	3,704,300 (Base Year)	5,024,500	8,145,200
6 (Add Transit)	3,704,300 (Base Year)	4,865,200	8,522,700
7 (Convert HOV)	3,704,300 (Base Year)	5,017,300	8,326,000
8 (Add HOV with Median Ramps)	3,704,300 (Base Year)	4,795,700	7,717,500
9 (Add HOV without Enterprise Crossing)	3,704,300 (Base Year)	4,844,100	7,719,800

Table 24 presents the corridor daily congested VMT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor congested VMT is expected to grow by 30 percent in 2029 and 182 percent in 2049 under Alternative 1. In 2029, Alternatives 5, 6, and 7 would have higher corridor congested VMT than Alternative 1, and the other build alternatives would have lower corridor congested VMT. Corridor congested VMT in 2049 would be highest for Alternatives 1, 6, and 7. The corridor congested VMT for the other build alternatives would be about half the Alternative 1 corridor congested VMT.

Table 24: Corridor Daily Congested VMT

Alternative	2016	2029	2049
1 (No Build)	381,600 (Base Year)	496,900	1,074,800
2 (Add HOV)	381,600 (Base Year)	308,400	524,800
3 (Add HOT2+)	381,600 (Base Year)	335,800	542,100
4 (Add HOT3+)	381,600 (Base Year)	368,600	588,300
5 (Add Toll)	381,600 (Base Year)	580,300	632,900
6 (Add Transit)	381,600 (Base Year)	561,700	984,700
7 (Convert HOV)	381,600 (Base Year)	509,400	963,500
8 (Add HOV with Median Ramps)	381,600 (Base Year)	309,700	551,500
9 (Add HOV without Enterprise Crossing)	381,600 (Base Year)	311,200	521,900

5.1.5 VMT Per Capita

Table 25 presents the daily VMT per capita (total VMT divided by total population) by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Due to the change in population, the VMT per capita is expected to decrease by 6 percent in 2029. The increase in VMT by 2049 will overcome the population growth so that the VMT per capita will increase by 1 percent for Alternative 1. The relationship of VMT per capita among the project alternatives is the same as the total VMT since the resident population is the same for all alternatives for a given analysis year. VMT per capita is reported only for a regional scale since the corridor does not have a corresponding resident population.

Table 25: Regional Daily VMT Per Capita

Alternative	2016	2029	2049
1 (No Build)	26.55 (Base Year)	24.93	26.93
2 (Add HOV)	26.55 (Base Year)	25.70	25.98
3 (Add HOT2+)	26.55 (Base Year)	25.69	26.02
4 (Add HOT3+)	26.55 (Base Year)	25.66	25.97
5 (Add Toll)	26.55 (Base Year)	25.68	25.95
6 (Add Transit)	26.55 (Base Year)	25.51	26.11
7 (Convert HOV)	26.55 (Base Year)	25.59	25.97
8 (Add HOV with Median Ramps)	26.55 (Base Year)	25.71	26.01
9 (Add HOV without Enterprise Crossing)	26.55 (Base Year)	25.73	26.01

5.1.6 PMT

Table 26 presents the regional daily PMT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Regional PMT is expected to grow at a similar rate as VMT: by 8 percent in 2029 and 34 percent in 2049 under Alternative 1. Similar to the VMT results, Alternative 1 would have the lowest regional PMT in 2029, but as network delay increases, Alternative 1 would have the highest regional PMT by 2049. Regional PMT in 2049 would be similar across the build alternatives, with Alternative 6 having the highest PMT.

Table 26: Regional Daily PMT

Alternative	2016	2029	2049
1 (No Build)	84,592,400 (Base Year)	91,261,400	113,647,000
2 (Add HOV)	84,592,400 (Base Year)	94,338,200	111,658,600
3 (Add HOT2+)	84,592,400 (Base Year)	94,312,300	111,802,300
4 (Add HOT3+)	84,592,400 (Base Year)	94,242,500	111,742,900
5 (Add Toll)	84,592,400 (Base Year)	94,234,000	111,497,100
6 (Add Transit)	84,592,400 (Base Year)	93,585,200	111,804,800
7 (Convert HOV)	84,592,400 (Base Year)	94,009,300	111,508,600
8 (Add HOV with Median Ramps)	84,592,400 (Base Year)	94,378,800	111,691,000
9 (Add HOV without Enterprise Crossing)	84,592,400 (Base Year)	94,453,800	111,679,000

Table 27 presents the corridor daily PMT by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor PMT is expected to grow at a similar rate as VMT: by 4 percent in 2029 and 20 percent in 2049 under Alternative 1. In 2029, all build alternatives would have higher corridor PMT than Alternative 1. Corridor PMT in 2049 would be highest for Alternatives 3 and 8 and lowest for Alternatives 6 and 7. These two alternatives would also be the only alternatives with a lower corridor PMT than Alternative 1.

Table 27: Corridor Daily PMT

Alternative	2016	2029	2049
1 (No Build)	4,943,700 (Base Year)	5,162,000	5,936,900
2 (Add HOV)	4,943,700 (Base Year)	5,666,100	6,330,000
3 (Add HOT2+)	4,943,700 (Base Year)	5,666,900	6,355,000
4 (Add HOT3+)	4,943,700 (Base Year)	5,622,400	6,295,800
5 (Add Toll)	4,943,700 (Base Year)	5,545,700	6,162,800
6 (Add Transit)	4,943,700 (Base Year)	5,268,400	5,868,700
7 (Convert HOV)	4,943,700 (Base Year)	5,277,400	5,903,300
8 (Add HOV with Median Ramps)	4,943,700 (Base Year)	5,673,400	6,333,900
9 (Add HOV without Enterprise Crossing)	4,943,700 (Base Year)	5,635,900	6,295,600

5.1.7 PMT per Lane-Mile

PMT per lane-mile is a measure of efficiency of the transportation network to move people. On a regional basis, the distribution of PMT per lane among the project alternatives is similar to PMT since the lane-miles added by the project are small compared to the overall lane-miles in the region. The bus lane in Alternative 6 is not counted towards the lane-miles in the corridor. The results on a corridor basis show more differences.

Table 28 presents the corridor daily PMT per lane-mile by alternative under opening year 2029 and horizon year 2049 based on the model output. These results are compared to the base year 2016 model output. Corridor PMT per lane-mile is expected to grow by 3 percent in 2029 and 18 percent in 2049 under Alternative 1. In 2029, only Alternatives 6 and 7 would have higher corridor PMT per lane-mile than Alternative 1. Corridor PMT per lane-mile in 2049 would be highest for Alternative 1, followed by Alternatives 6 and 7. PMT per lane-mile would be lower for the other alternatives since they add lane-miles to the corridor.

Table 28: Corridor Daily PMT Per Lane Mile

Alternative	2016	2029	2049
1 (No Build)	50,500 (Base Year)	51,800	59,400
2 (Add HOV)	50,500 (Base Year)	49,000	54,600
3 (Add HOT2+)	50,500 (Base Year)	49,000	54,800
4 (Add HOT3+)	50,500 (Base Year)	48,600	54,300
5 (Add Toll)	50,500 (Base Year)	48,000	53,100
6 (Add Transit)	50,500 (Base Year)	52,900	58,800
7 (Convert HOV)	50,500 (Base Year)	53,000	59,100
8 (Add HOV with Median Ramps)	50,500 (Base Year)	48,800	54,300
9 (Add HOV without Enterprise Crossing)	50,500 (Base Year)	47,900	53,400

5.2 Induced Travel

Induced VMT forecasts attributable to the project were prepared using the modified SACSIM19 model and the NCST calculator (https://travelcalculator.ncst.ucdavis.edu). The advantages and disadvantages of these methods are described below. This information can be used to comply with CEQA requirements for transportation impact analysis based on the project's effect on VMT.

Induced travel is the increase in the potential demand for travel due to the economic effect of reducing travel time and therefore travel costs. The build alternatives will widen I-80 and US 50 to provide additional travel lanes in the study area which will reduce travel times for passenger and commercial vehicles. Typically, lower vehicle travel costs generate increases in vehicle travel demand due to the following causes.

Short-term responses

- New vehicle trips that would otherwise not be made
- Longer vehicle trips to more distant destinations
- Shifts from other travel modes to driving
- Shifts from one driving route to another

Longer-term responses

- Changes in land use development patterns (these are often more dispersed, low density patterns that are automobile-dependent)
- Changes in overall growth

The modified SACSIM19 model has proven generally sensitive to short-term induced vehicle travel effects but lacks sensitivity to potential changes in vehicle trip generation rates, land use patterns, and population growth that may occur over the long-term. According to SACOG, the SACSIM19 land use forecasts represent population and employment growth allocations based on planned land use supply in local general plans and the proposed network modifications contained in the MTP/SCS project list. As such, the land use forecasts best represent conditions for the build alternatives for the I-80/US 50 Managed Lanes project. As noted in **Section 3.1.2**, Caltrans directed that the model land uses be maintained without changes from the MTP/SCS versions for all alternatives, including the no build alternative. A potential limitation of this approach is that the forecasts may not capture the full difference between no build and build alternatives. The potential risk of this approach is that the forecasts for the no build alternative are not fully sensitive to the different population and employment growth allocations that could occur without the corridor capacity expansion.

Another limitation of the SACSIM19 model is the use of static assignment rather than dynamic assignment of vehicle trips. With congested conditions, static assignment can result in volumes that exceed capacity for the analysis period. With dynamic assignment, trips are rerouted or shifted in time so that capacity is met. If dynamic assignment were used, VMT could be lower if trips are shifted in time to more direct routes or if trips are shifted to different destinations due to congested conditions. VMT could also be higher if longer routes must be used to avoid congested links.

As recommended in the TAF, this study also applied the NCST calculator. This tool uses research-based elasticities to forecast long-term induced VMT from current regional VMT and the lane-miles associated with those alternatives adding GP, HOV, or HOT lanes. The elasticity method in the NCST calculator forecasts long-term VMT changes while controlling for variables such as population and employment growth, income changes, etc., because the method is focused on isolating the effect of just adding lane-miles. Since it relies solely on the addition of lane-miles, the context of the project is not fully considered. For example, the method does not directly account for the severity of existing congestion, presence of alternative travel modes, or the availability of alternative routes to list a few.

The NCST tool guidance recommends that the long-term elasticity not be applied for a toll lane addition because the toll is dynamically adjusted based on demand so that the managed lane does not become congested. Since the SACSIM model forecast volumes for the managed lane were similar among the HOV, HOT, and toll alternatives, the toll lane is likely to have a similar VMT effect as those alternatives. The NCST calculator is not applicable for transit-only lanes. For this project alternative, the potential induced VMT is likely to be less than that for GP, HOV, HOT, and toll lane additions.

Table 29 presents the estimated short-term induced travel using the modified SACSIM19 travel demand model under 2029 and 2049 conditions plus the long-term induced travel based on the NCST calculator. For the SACSIM19 model, induced VMT is the difference between the build and no build alternatives. For the NCST calculator, the estimate is based on the lane-miles that would be constructed. Alternative 1 would not construct new lanes, so no induced VMT would occur. For Alternatives 2 and 9, the project would construct about 28.4 lane-miles of new freeway lanes (HOV and auxiliary lanes). A portion of the project would convert existing GP to managed lanes on US 50 between I-80 and Jefferson Boulevard, so the total lane addition is less than the project length. Alternative 7 would have minor lane additions totaling about 0.7 miles. With the median ramps at I-80/US 50, Alternative 8 would construct about 29.6 lane-miles in total. The calculator does not estimate the induced VMT for transit-only lane alternatives (Alternative 6).

Table 29: Daily VMT Change and Induced VMT

	SACSIM19 Daily VMT Change	SACSIM19 Daily VMT Change	
Alternative	**2029**	**2049**	**NCST Long-Term Induced Daily VMT**
1 (No Build)	-	-	-
2 (Add HOV)	+2,088,000	-3,003,000	+495,300
3 (Add HOT2+)	+2,066,400	-2,883,300	+495,300
4 (Add HOT3+)	+1,985,000	-3,029,000	+495,300
5 (Add Toll)	+2,035,600	-3,095,200	+495,300
6 (Add Transit)	+1,574,800	-2,598,300	-
7 (Convert HOV)	+1,787,200	-3,050,400	+12,300
8 (Add HOV with Median Ramps)	+2,120,300	-2,909,900	+516,000
9 (Add HOV without Enterprise Crossing)	+2,178,100	-2,919,000	+495,300

Notes: The SACSIM19 model includes two additional counties (Sutter and Yuba). Annual VMT converted to daily VMT using a factor of 300 to account for less travel on weekends and holidays. Long-term induced daily VMT estimated with an elasticity of 1.0 using NCST calculator based on 2019 VMT in the four-county MSA (El Dorado, Placer, Sacramento, and Yolo).

While the modified SACIM19 forecasts may not be fully sensitive to the long-term induced vehicle travel effects, the model is sensitive to the network effects of the project. Essentially, the project expands the capacity of critical bridge link in the regional network between the Bay Area and Sacramento (plus destinations beyond). Additionally, the forecasting model's pricing module accounts for dynamic tolling of the managed lane under the priced lane alternatives (Alternatives 3, 4, and 5) and iteratively adjusts the toll based on demand to maintain uncongested travel speeds. For further details on the pricing module application, please see the *I-80/US 50 Managed Lanes Traffic and Revenue Report*.

In the SACSIM model, the travel time savings under 2029 build conditions are sufficient to induce new vehicle trips and increase regional VMT. Under 2049 conditions, much higher levels of congestion exist under no build conditions such that traffic re-routes long distances during peak periods. The build alternatives improve travel times and allow this traffic to remain on the most direct freeway routes causing a reduction in regional VMT. The 2049 demand forecasts were produced through linear extrapolation of the 2040 forecasts. While this approach minimizes the potential to underestimate future volumes, it may contribute to less reasonable induced VMT forecasts under 2049 conditions especially considering the model's limited sensitivity to congestion due to static assignment. Therefore, the 2029 results offer a more reasonable assessment of short-term induced travel effects.

As noted previously, the VMT estimated for Alternative 1 is likely higher than would occur since some portion of the land use growth would likely not occur if the additional capacity were not provided. As a result, the predicted VMT reduction with the build alternatives would likely be lower.

The NCST elasticity method produces a net increase in VMT. However, the method is not sensitive to the network effects noted above. The elasticity method only produces an increase in VMT if lane-miles increase. Given this limitation, the elasticity method results may overstate the long-term VMT increase for this project type and location.

Although the TAF was published after project initiation, the checklist for evaluating adequacy of the travel demand model was applied (see **Appendix D** for the completed checklist). The section below assesses the project's SACSIM travel demand forecasting model according to the following five criteria.

1. Land use values are constant across project alternatives. As a result, the model process does not pass the first criterion since the future land use is not sensitive to network changes.
2. The travel demand model is sensitive to network travel times and costs when choosing the trip mode (Part 2a of the checklist). Travel times and costs are fed back into the mode choice, destination choice, and route choice modules. However, the trip frequency models are not updated based on congestion levels. Instead, travel activity is calibrated to base year conditions (Part 2b). The model does reflect the heterogeneity and complexity of traveler responses to the project changes. Since Part 2b is not met, the model does not pass the second criterion.
3. The model network is sufficiently detailed for roadway and transit networks (Part 3a). The model VMT is adjusted to account for travel beyond the model boundary (Part 3b). Since it passes both parts, the model passes the third criterion.
4. The model assignment convergence was evaluated as described in **Section 3.1.1**, so the model passes the fourth criterion.
5. The model was calibrated and validated as described in **Section 3.1.1**, so the model passes the fifth criterion.

Since the travel demand model does not satisfy all five checks, Caltrans has directed that the NCST calculator be used to report VMT for the project alternatives.

5.3 Truck VMT

The SACSIM model was used to estimate truck VMT for the region and for the study corridor. Although the SACSIM model did not provide a reasonable estimate of changes to peak period truck volumes in the study area as described in **Section 3.1.4.3**, the change in regional daily truck volume is likely to be reasonable. Using the SACSIM model, the regional VMT was divided among vehicle modes. The percentages of these modes are listed in **Table 30**. The percentages vary due to differences in the project alternatives. The No Build Alternative has the highest SOV percentage in the horizon year 2049.

Table 30: Travel Mode Percentages

	Analysis Year	
Mode	**2029**	**2049**
Single occupant vehicles (SOV)	57-58%	58-61%
Two passenger vehicles (HOV2)	15%	14-15%
Three or more passenger vehicles (HOV3)	8-9%	8-9%
Heavy vehicles with 2 axles	15%	13-14%
Heavy vehicles with 3 or more axles	4%	4%

Table 31 and **Table** 32 show regional VMT for all vehicles and for heavy vehicles under the opening year 2029 and horizon year 2049.

Table 31: Daily Regional Network Performance – Opening Year 2029

Alternative	Total VMT	Truck VMT	Truck VMT %
1 (No Build)	67,803,500	13,219,200	19.5%
2 (Add HOV)	69,891,500	13,266,100	19.0%
3 (Add HOT2+)	69,875,700	13,250,300	19.0%
4 (Add HOT3+)	69,779,500	13,233,500	19.0%
5 (Add Toll)	69,826,300	13,233,200	19.0%
6 (Add Transit)	69,378,300	13,220,300	19.1%
7 (Convert HOV)	69,590,700	13,233,900	19.0%
8 (Add HOV with Median Ramps)	69,923,800	13,267,800	19.0%
9 (Add HOV without Enterprise Crossing)	69,981,600	13,270,600	19.0%

Table 32: Daily Regional Network Performance – Horizon Year 2049

Alternative	Total VMT	Truck VMT	Truck VMT %
1 (No Build)	85,249,400	14,394,400	16.9%
2 (Add HOV)	82,246,400	14,461,900	17.6%
3 (Add HOT2+)	82,366,100	14,436,000	17.5%
4 (Add HOT3+)	82,220,400	14,419,800	17.5%
5 (Add Toll)	82,154,200	14,423,600	17.6%
6 (Add Transit)	82,651,100	14,395,600	17.4%
7 (Convert HOV)	82,199,000	14,400,900	17.5%
8 (Add HOV with Median Ramps)	82,339,500	14,455,400	17.6%
9 (Add HOV without Enterprise Crossing)	82,330,400	14,465,800	17.6%

Corridor VMT was estimated using the model links for the study area. To estimate truck VMT for these links, the existing truck percentage was applied as reported for I-80 east of the US 50 junction by the Caltrans traffic census office. The reported daily truck percentage from the 2019 database is 7.4 percent.

As described in **Section 3.1.4.3**, the SACSIM model did not provide a reasonable estimate of changes to peak period truck volumes in the study area. Therefore, the traffic volume forecasts use the existing truck percentages for all analysis years. This same approach was used to estimate daily corridor VMT for trucks.

Table 33 and **Table** 34 show corridor VMT for all vehicles and for heavy vehicles under the opening year 2029 and horizon year 2049.

Table 33: Daily Corridor Network Performance – Opening Year 2029

Alternative	Total VMT	Truck VMT	Truck VMT %
1 (No Build)	1,956,900	144,200	7.4%
2 (Add HOV)	2,138,400	157,600	7.4%
3 (Add HOT2+)	2,139,600	157,700	7.4%
4 (Add HOT3+)	2,113,300	155,800	7.4%
5 (Add Toll)	2,102,200	154,900	7.4%
6 (Add Transit)	1,993,300	146,900	7.4%
7 (Convert HOV)	1,954,800	144,100	7.4%
8 (Add HOV with Median Ramps)	2,141,100	157,800	7.4%
9 (Add HOV without Enterprise Crossing)	2,127,300	156,800	7.4%

Note: Truck percentage comes from traffic census data rather than the SACSIM model due to poor matching of observed truck percentage in the base year model.

Table 34: Daily Corridor Network Performance – Horizon Year 2049

Alternative	Total VMT	Truck VMT	Truck VMT %
1 (No Build)	2,265,100	166,900	7.4%
2 (Add HOV)	2,361,100	174,000	7.4%
3 (Add HOT2+)	2,365,100	174,300	7.4%
4 (Add HOT3+)	2,326,600	171,500	7.4%
5 (Add Toll)	2,305,800	169,900	7.4%
6 (Add Transit)	2,207,100	162,700	7.4%
7 (Convert HOV)	2,157,000	159,000	7.4%
8 (Add HOV with Median Ramps)	2,361,800	174,100	7.4%
9 (Add HOV without Enterprise Crossing)	2,349,500	173,200	7.4%

Note: Truck percentage comes from traffic census data rather than the SACSIM model due to poor matching of observed truck percentage in the base year model.

The NCST calculator relies on elasticities based on total VMT, so the portion of VMT related to truck travel can also be estimated. Based on a review of the supporting research behind the calculator, changes in commercial driving were estimated as 19 to 29 percent of the total induced VMT. **Table 35** provides the truck VMT estimate from the NCST calculator.

Table 35: NSCT Long-Term Induced VMT

Alternative	Total VMT	Truck VMT	Truck VMT %
1 (No Build)	-	-	-
2 (Add HOV)	495,300	143,600	29%
3 (Add HOT2+)	495,300	143,600	29%
4 (Add HOT3+)	495,300	143,600	29%
5 (Add Toll)	495,300	143,600	29%
6 (Add Transit)	-	-	-
7 (Convert HOV)	12,300	3,600	29%
8 (Add HOV with Median Ramps)	516,000	149,600	29%
9 (Add HOV without Enterprise Crossing)	495,300	143,600	29%

5.4 Demand Volume Forecasts

This chapter presents the peak hour forecasts for Alternatives 1 through 9 under the opening year 2029 and horizon year 2049. **Appendixes E** and **F** contain the full set of traffic forecasts for all alternatives under the opening year 2029 and horizon year 2049. The following information is provided.

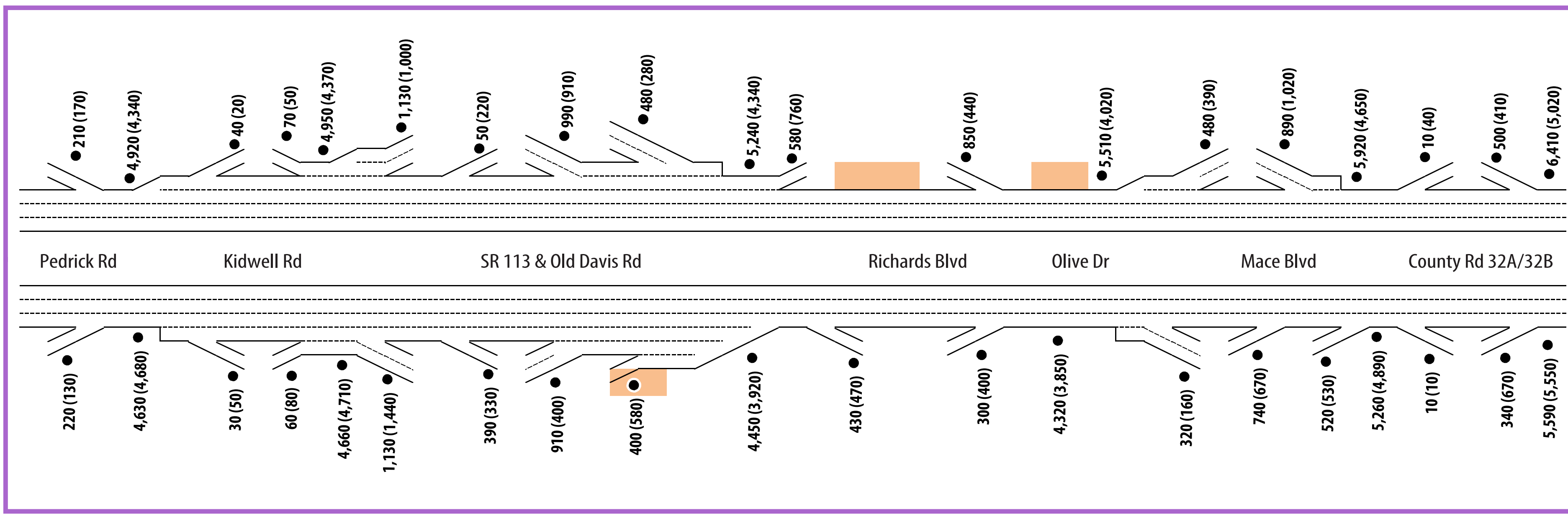
- Stick diragrams showing the AM peak hour, AM peak period, PM peak hour, PM peak period, and daily total volumes for the freeway mainline and ramps
- A table listing the AM peak hour, AM peak period, PM peak hour, PM peak period, and daily total volumes for the freeway mainline and ramps
- A table listing the AM peak hour, AM peak period, PM peak hour, and PM peak period managed lane volumes for the freeway mainline between interchanges
- A table listing the AM peak hour, AM peak period, PM peak hour, PM peak period, and daily truck volumes for the freeway mainline and ramps

5.4.1 Opening Year 2029

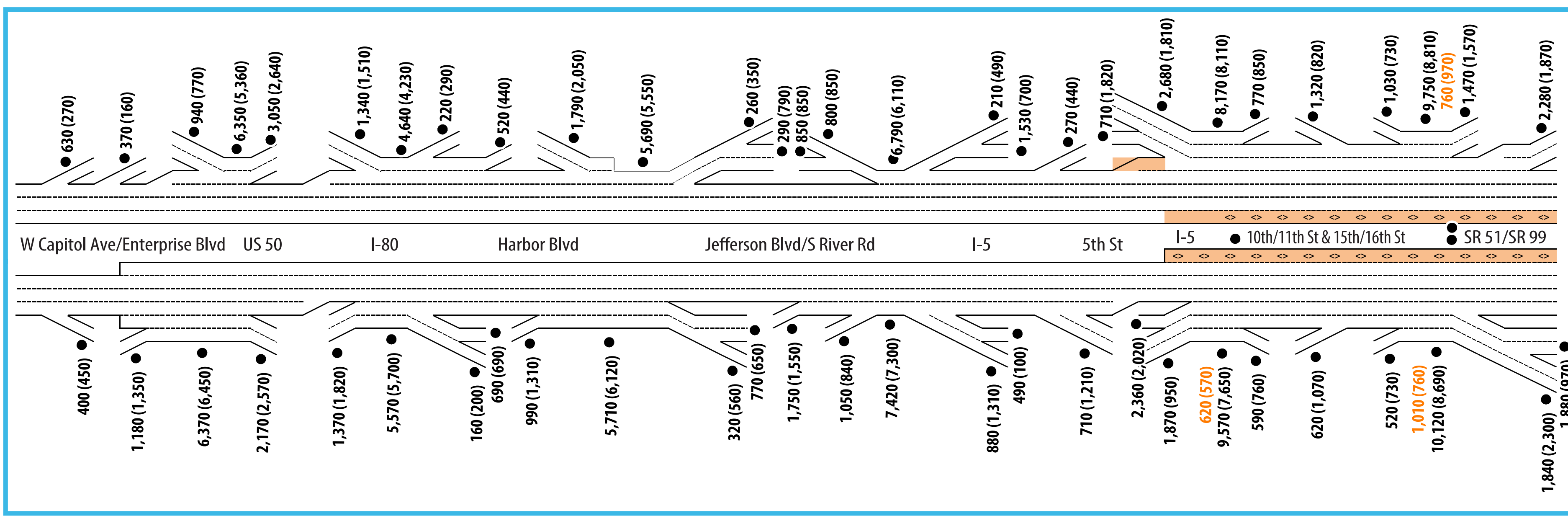
The AM and PM peak hour freeway volumes for the project alternatives under the opening year of 2029 are shown in **Figure 9** through **Figure** 17. The figures show the mainline, ramp, and managed lane volumes. The mainline volume is the sum of the volume in the GP and managed lanes. The roadway changes associated with planned separate projects and the project alternative are highlighted on the lane configuration diagrams.

Table 36 and **Table** 37 present the opening year 2029 PM peak hour mainline demand volumes under the project alternatives at three locations: I-80 at the Yolo Causeway (County Road 32A/32B to Enterprise Boulevard/West Capitol Avenue), US 50 at the Sacramento River (Jefferson Boulevard/South River Road to I-5), and I-80 at the Sacramento River (Reed Avenue to West El Camino Avenue). The weekday PM peak hour volume is typically the highest hourly volume.

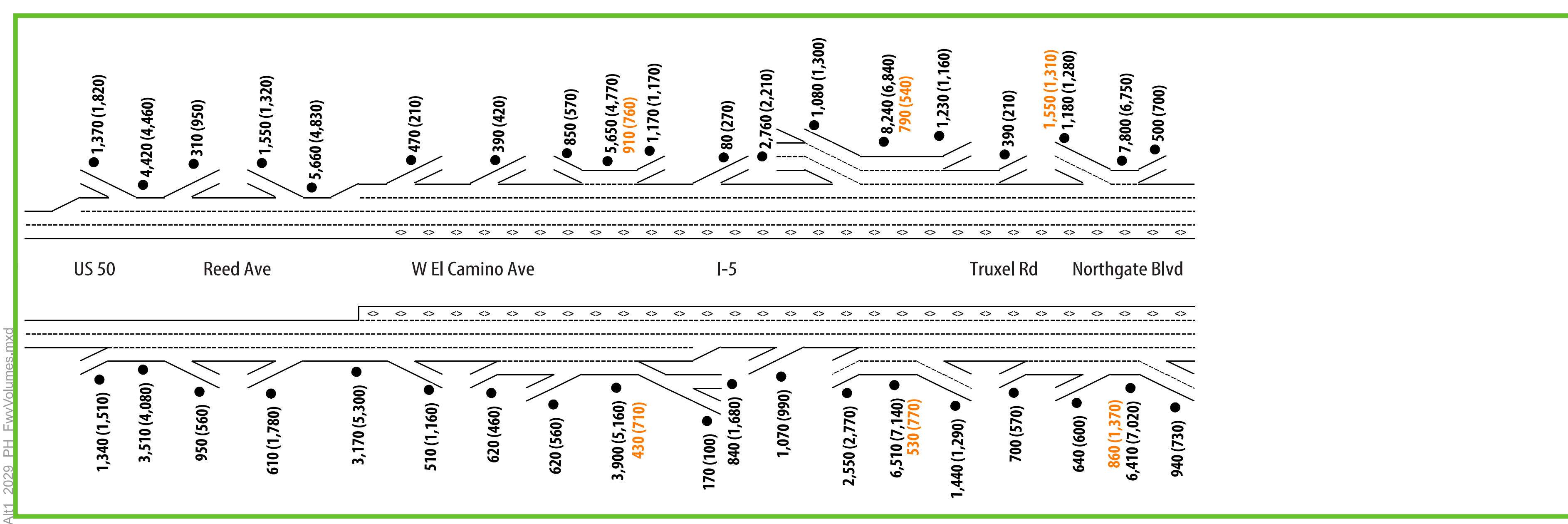
Section A



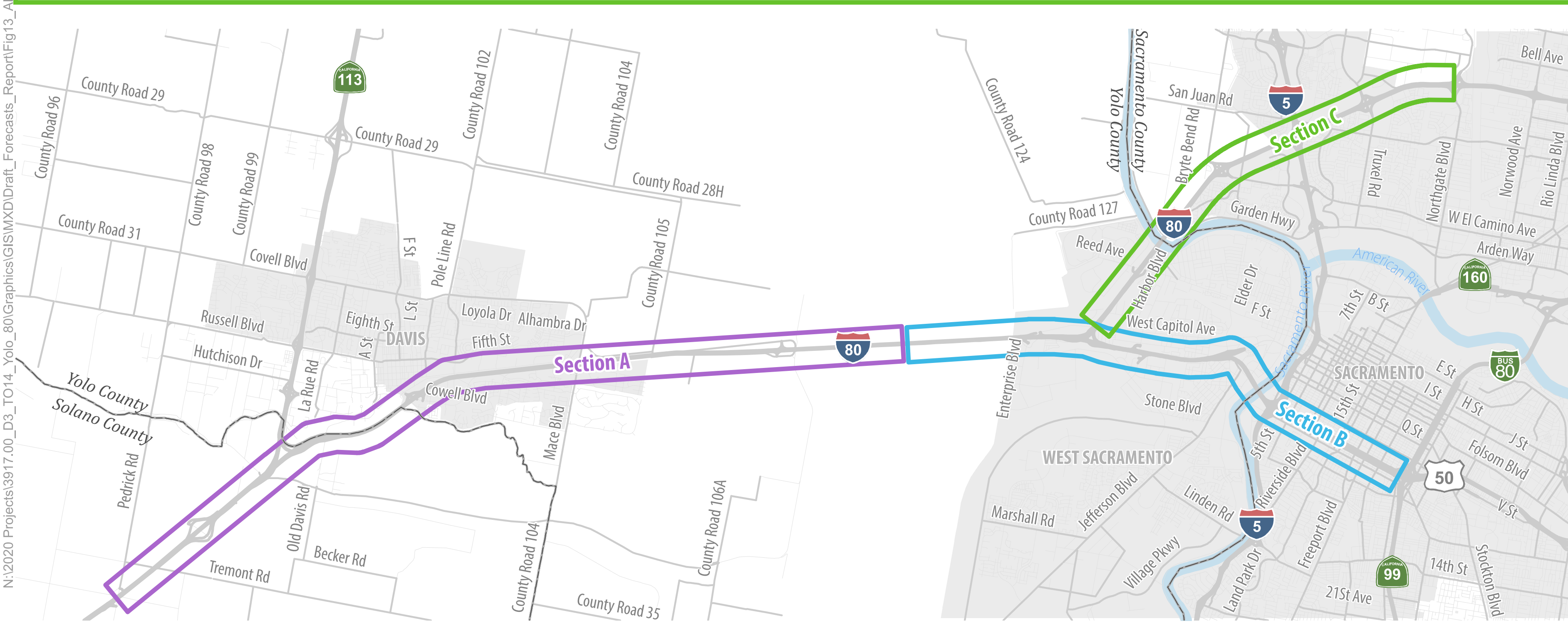
Section B



Section C



N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig13_Alt1_2029_PM_FwyVolumes.mxd



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

◇ Managed Lane

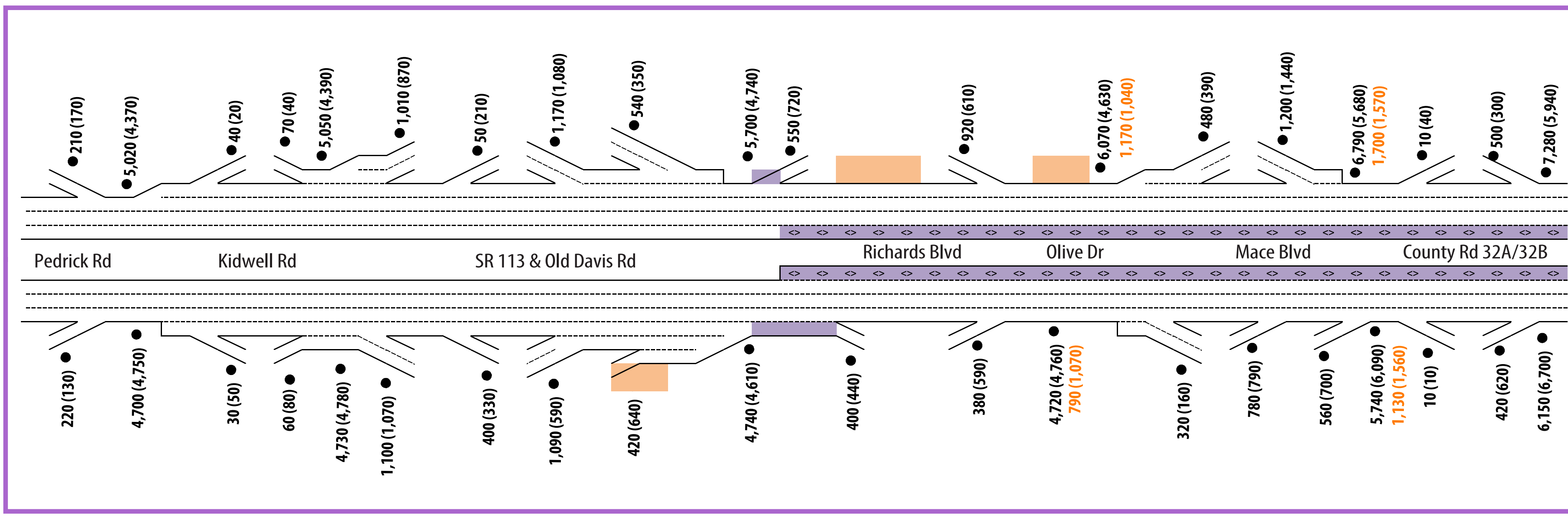
N

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

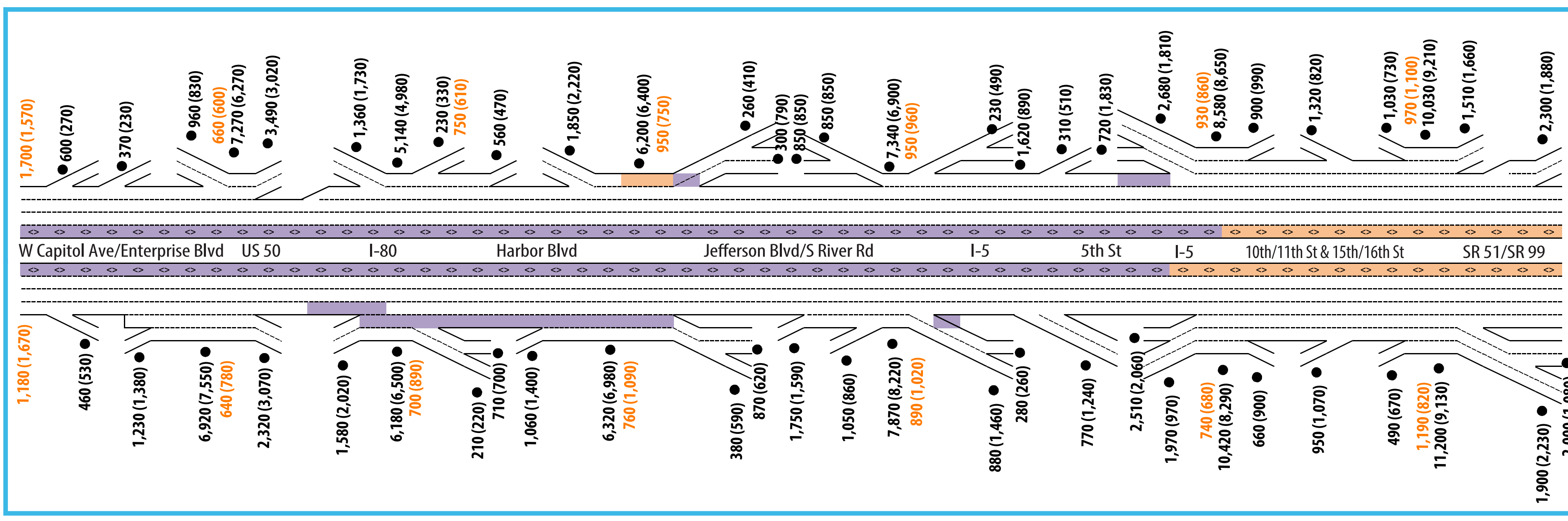
Figure 9

2029 Alternative 1 (No Build)
AM & PM Peak Hour Freeway Volumes

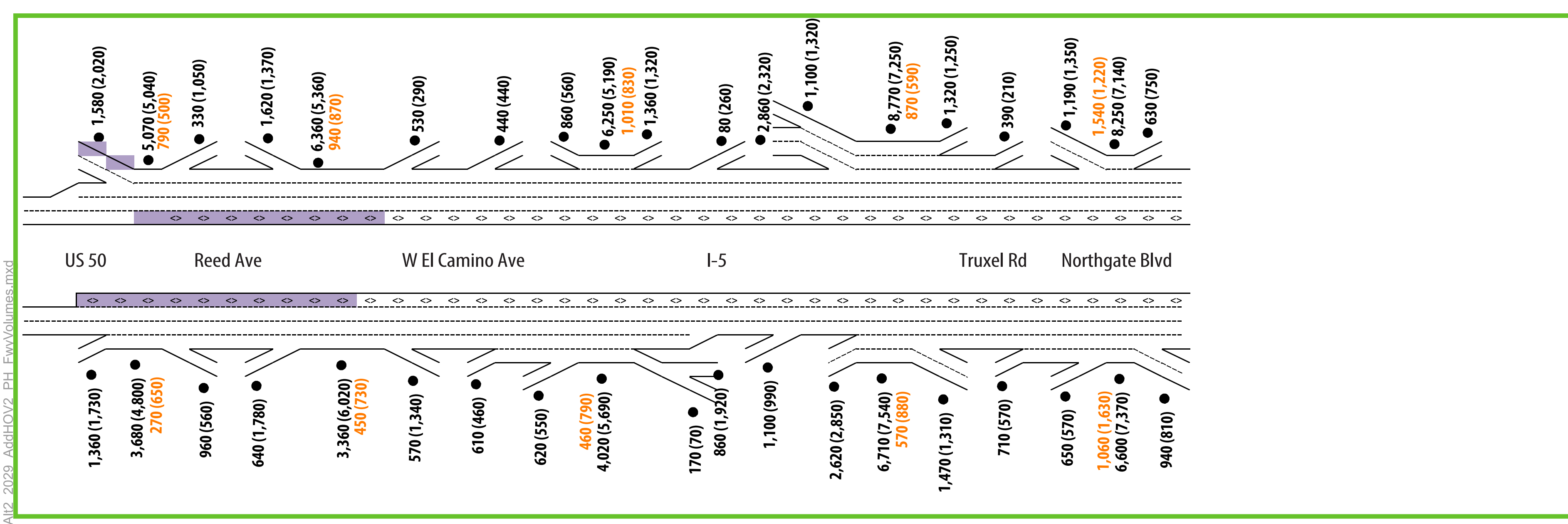
Section A

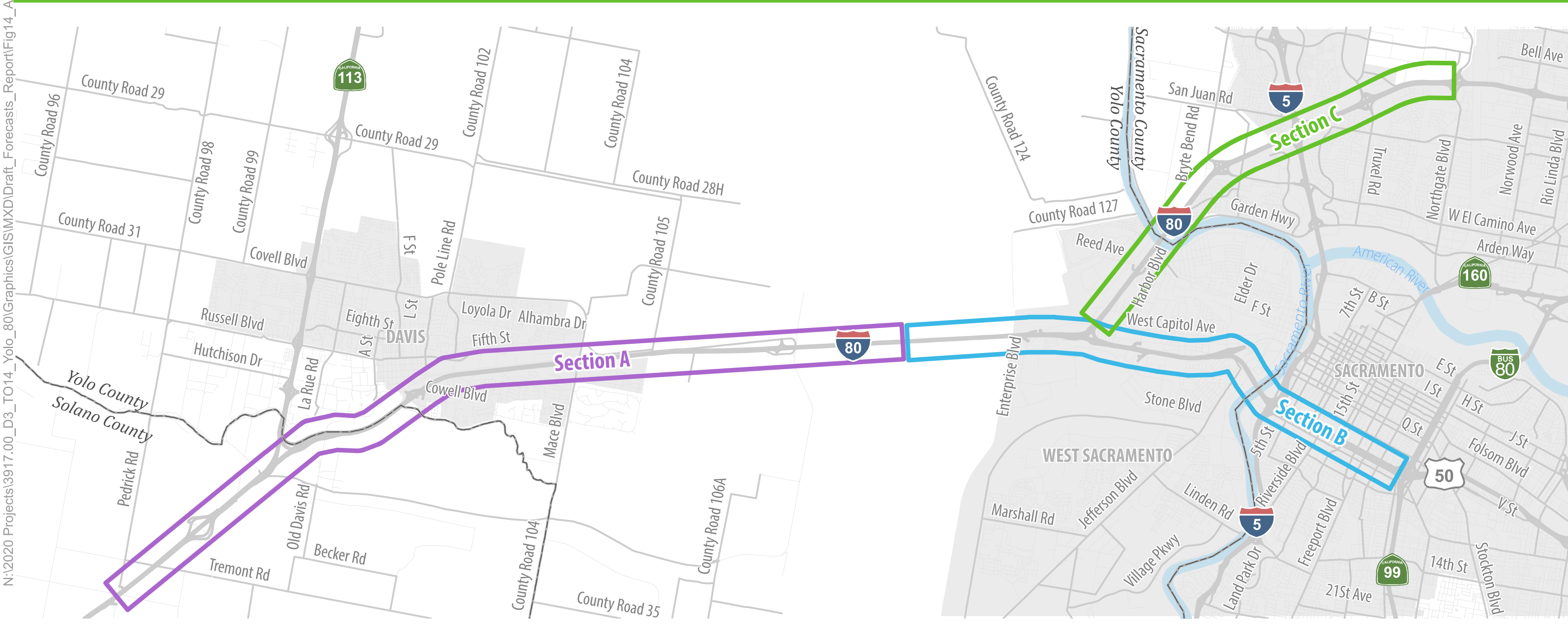


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 2

◇ Managed Lane

N

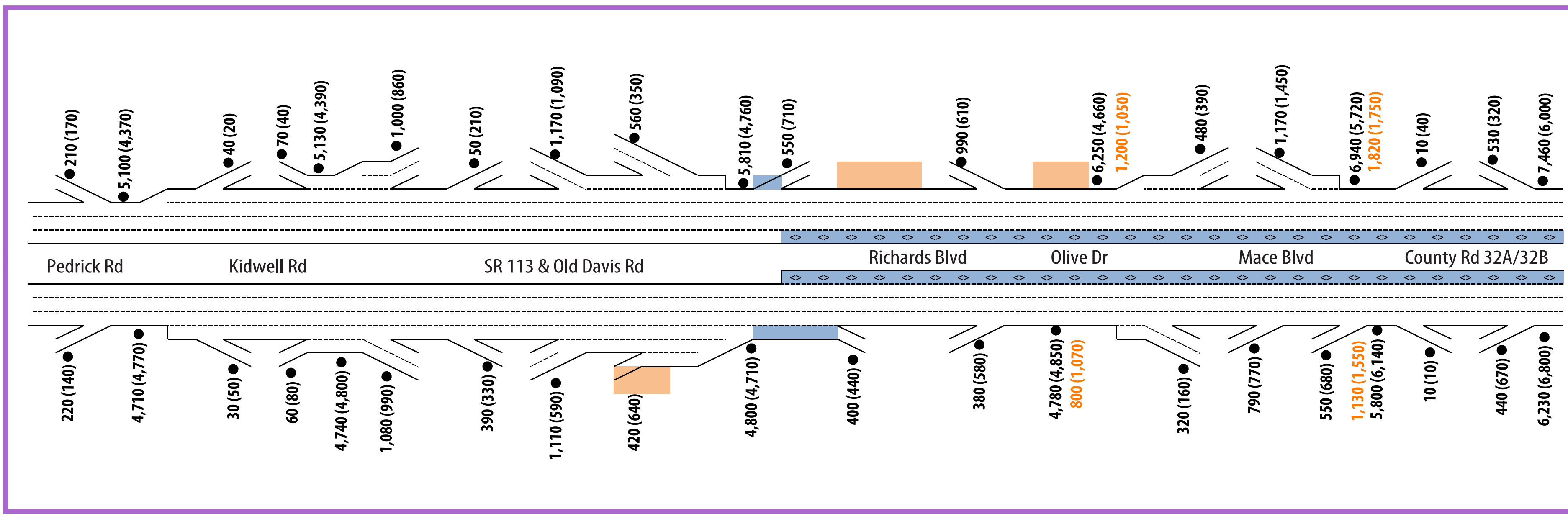
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 10

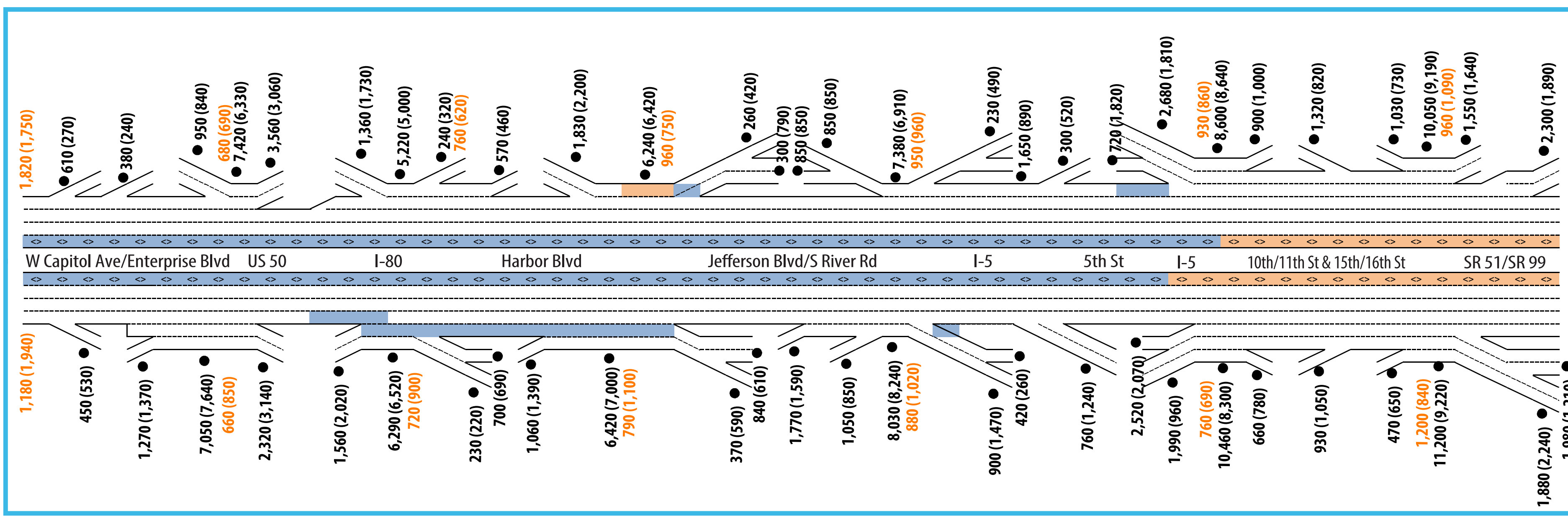
2029 Alternative 2 (Add HOV2+ Lane)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig14_Alt2_2029_AddHOV2_PH_FwyVolumes.mxd

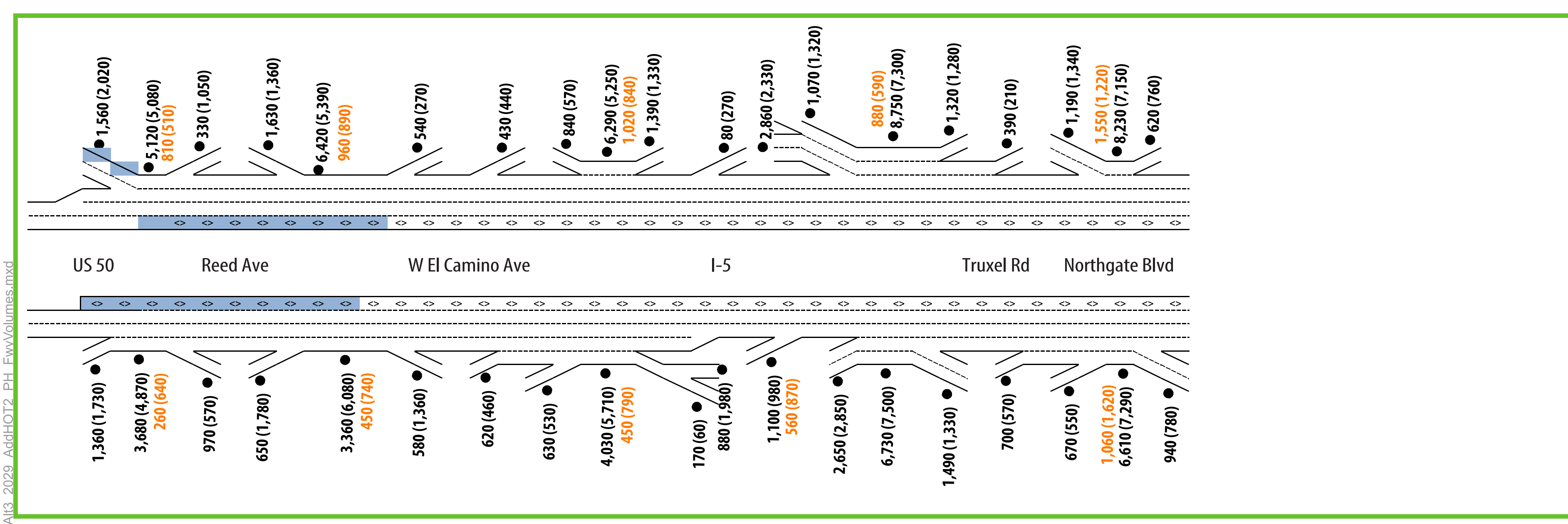
Section A

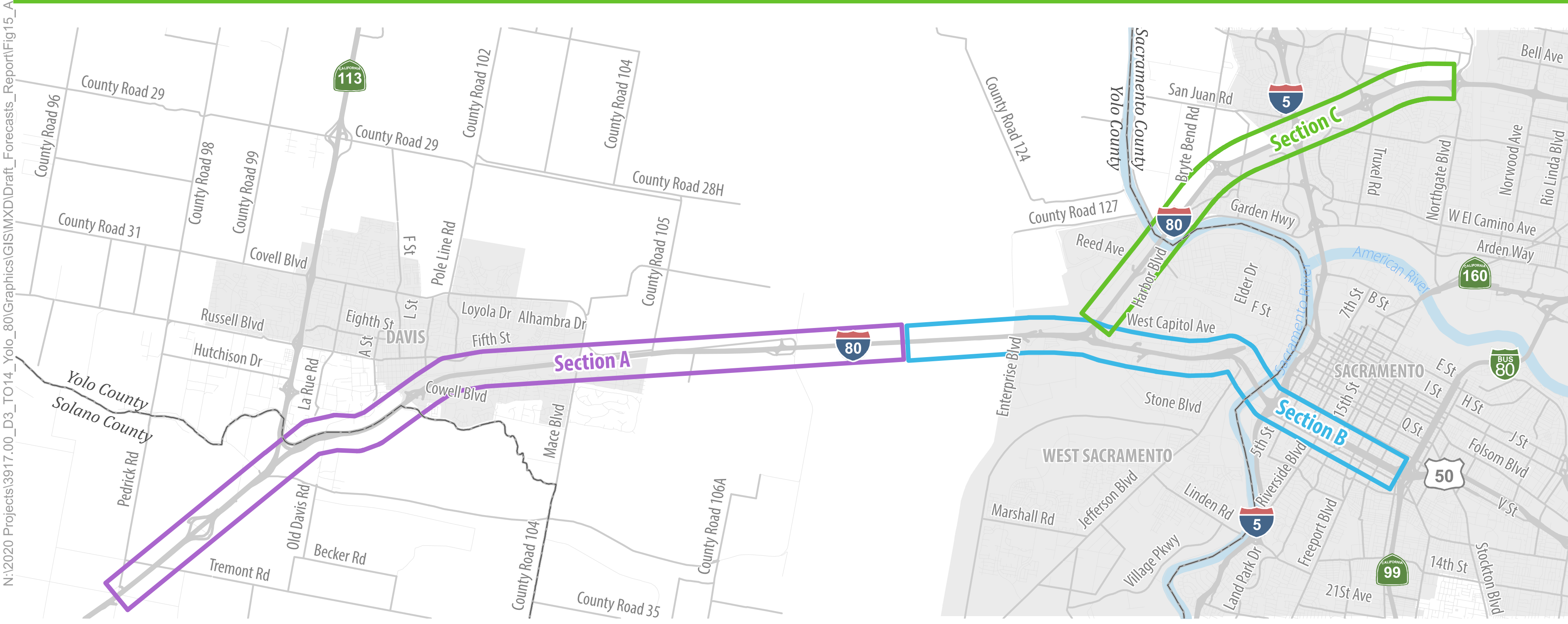


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 3

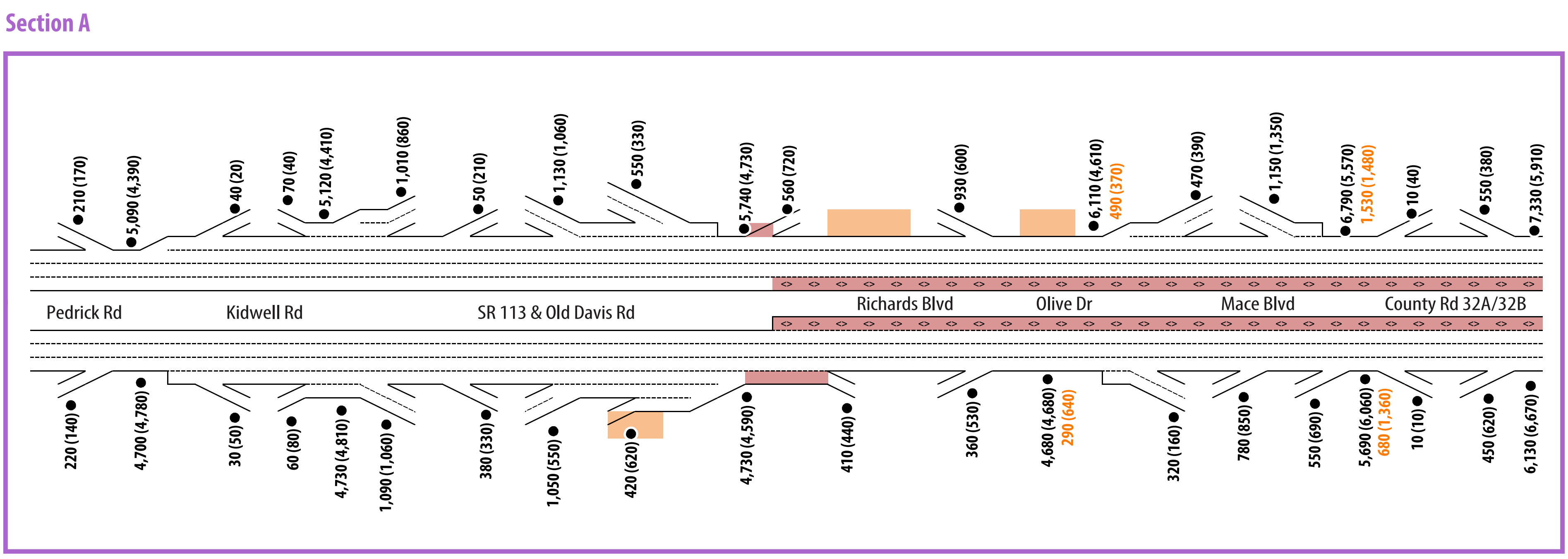
Managed Lane

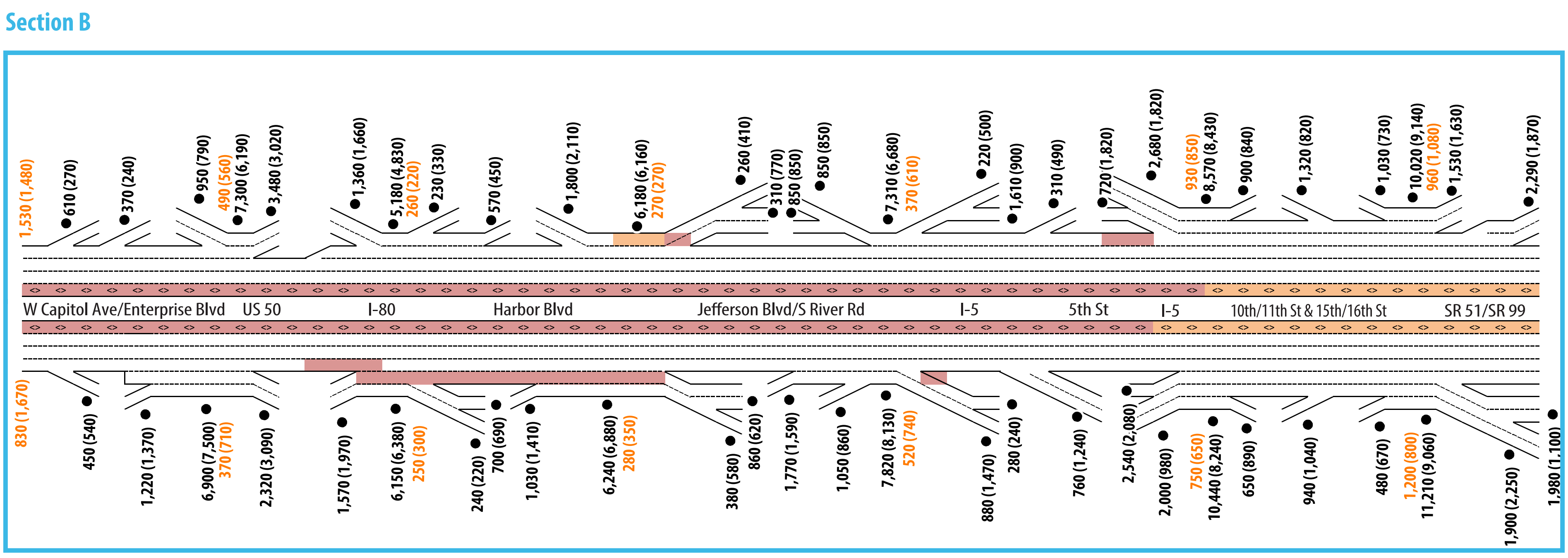
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

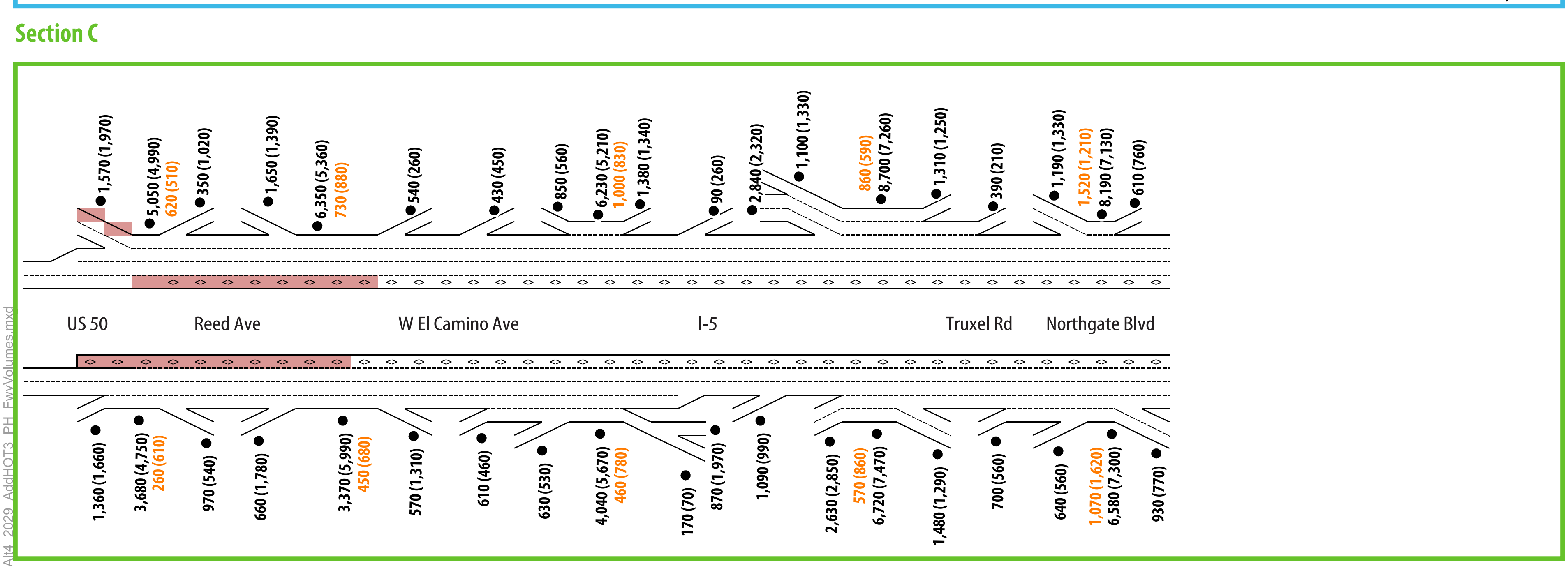
Figure 11

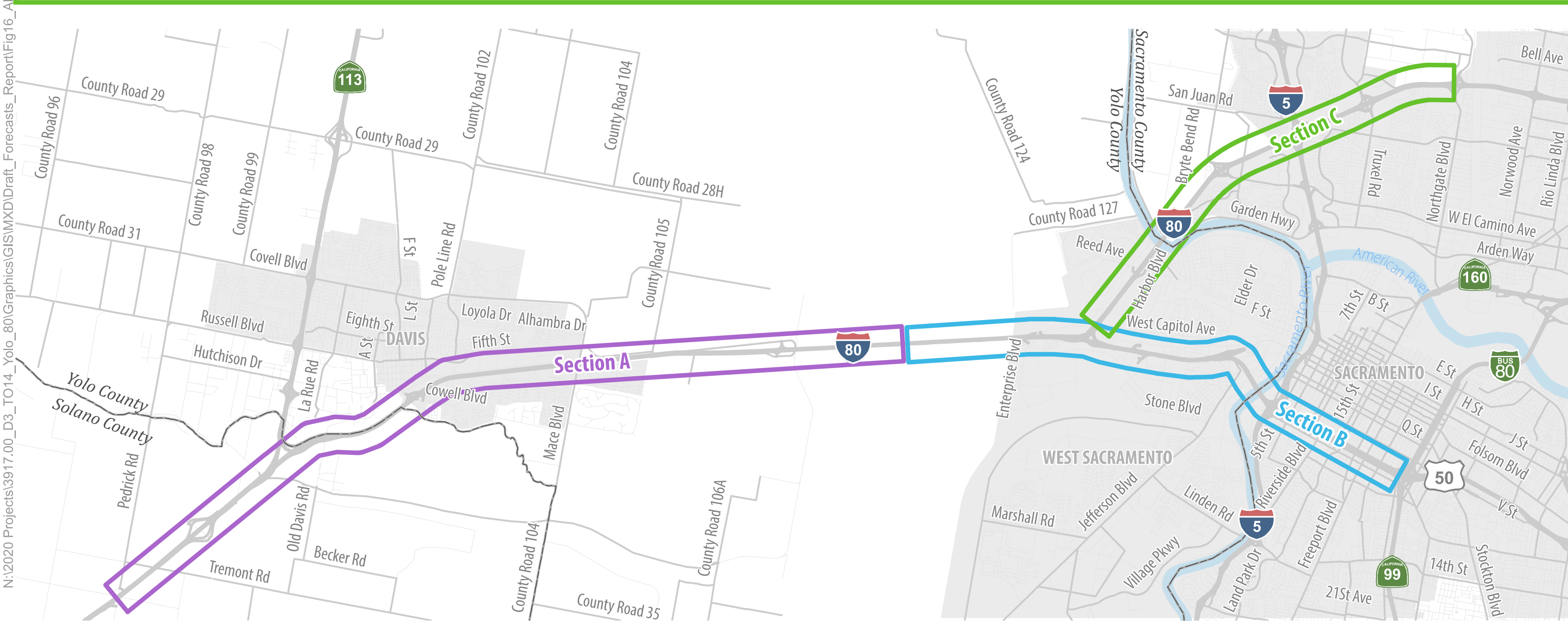
2029 Alternative 3 (Add HOT2+)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig15_Alt3_2029_AddHOT2_PH_FwyVolumes.mxd









x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 4

Managed Lane

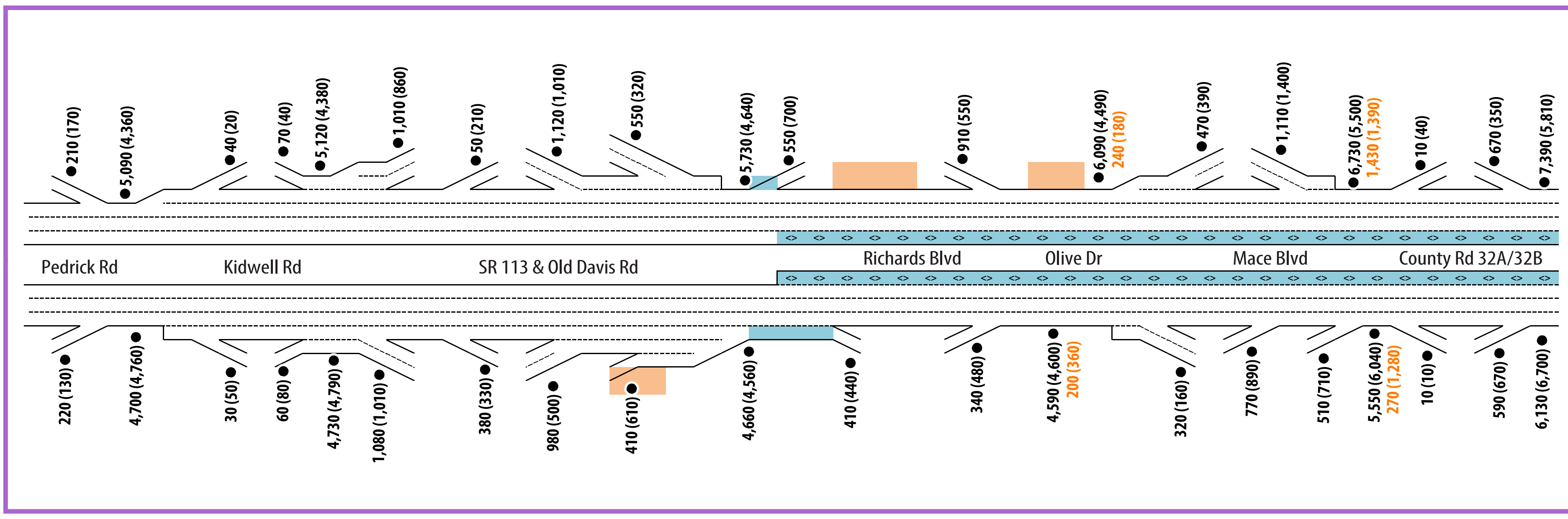
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 12

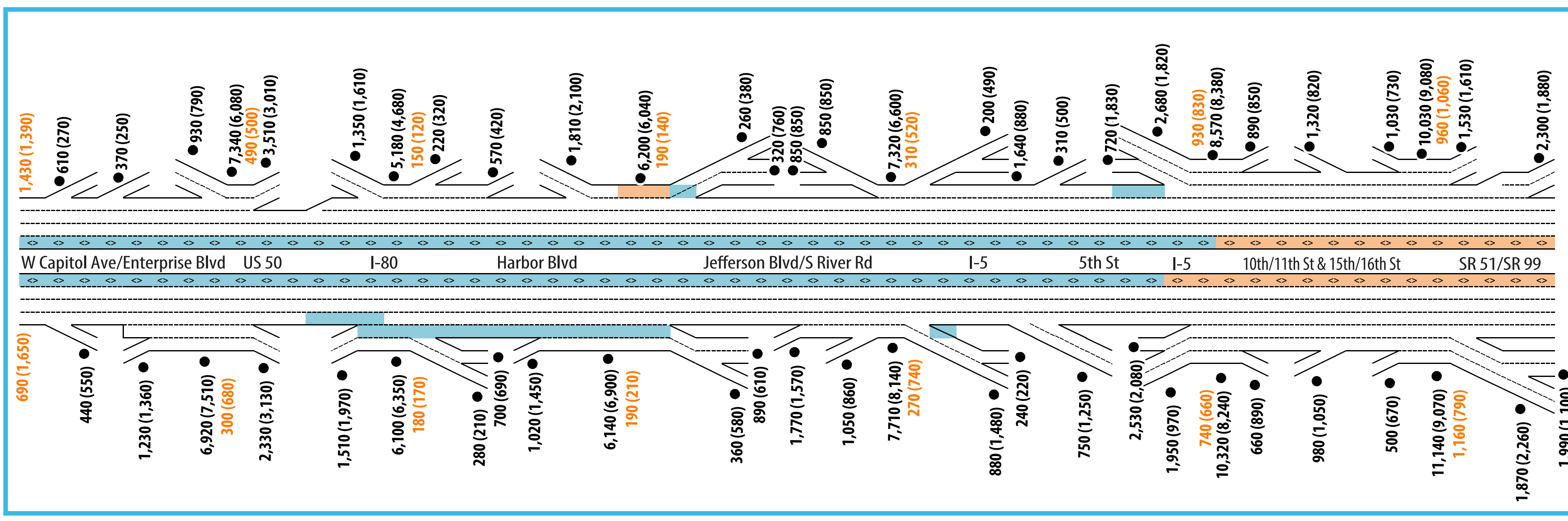
2029 Alternative 4 (Add HOT3+) AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig16_Alt4_2029_AddHOT3_PM_FwyVolumes.mxd

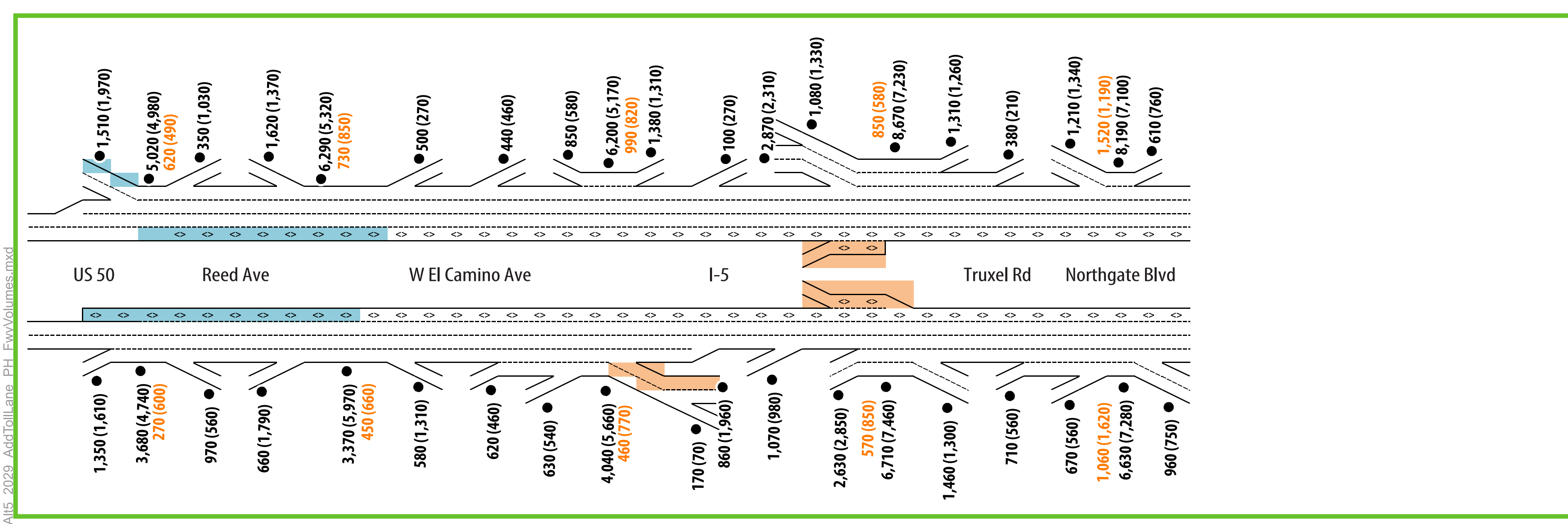
Section A

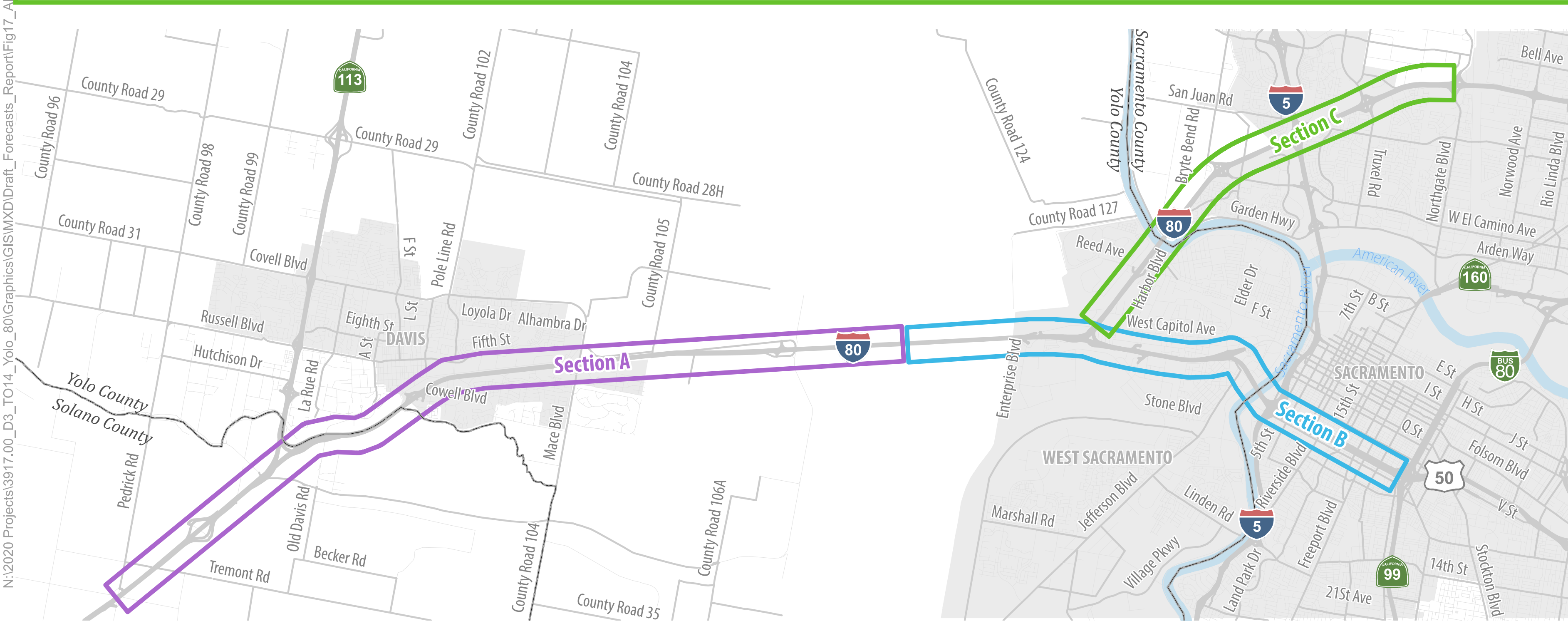


Section B



Section C





N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig17_Alt5_2029_AddTollLane_PH_FwyVolumes.mxd

x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 5

Managed Lane

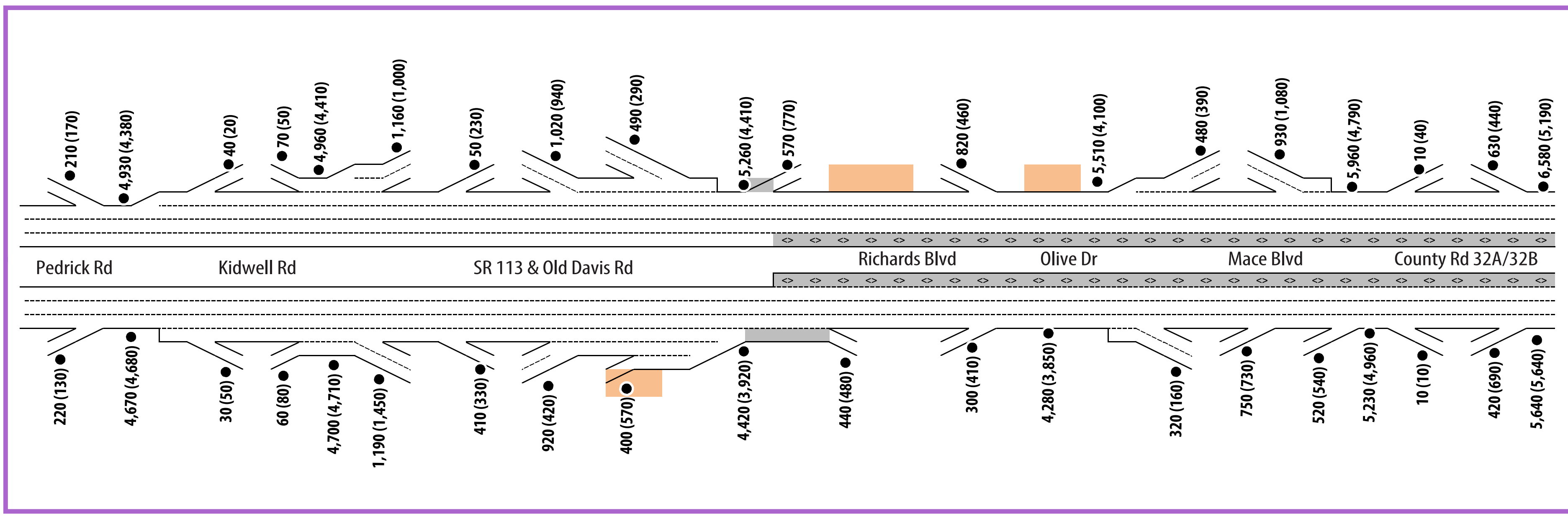
N

Figure 13

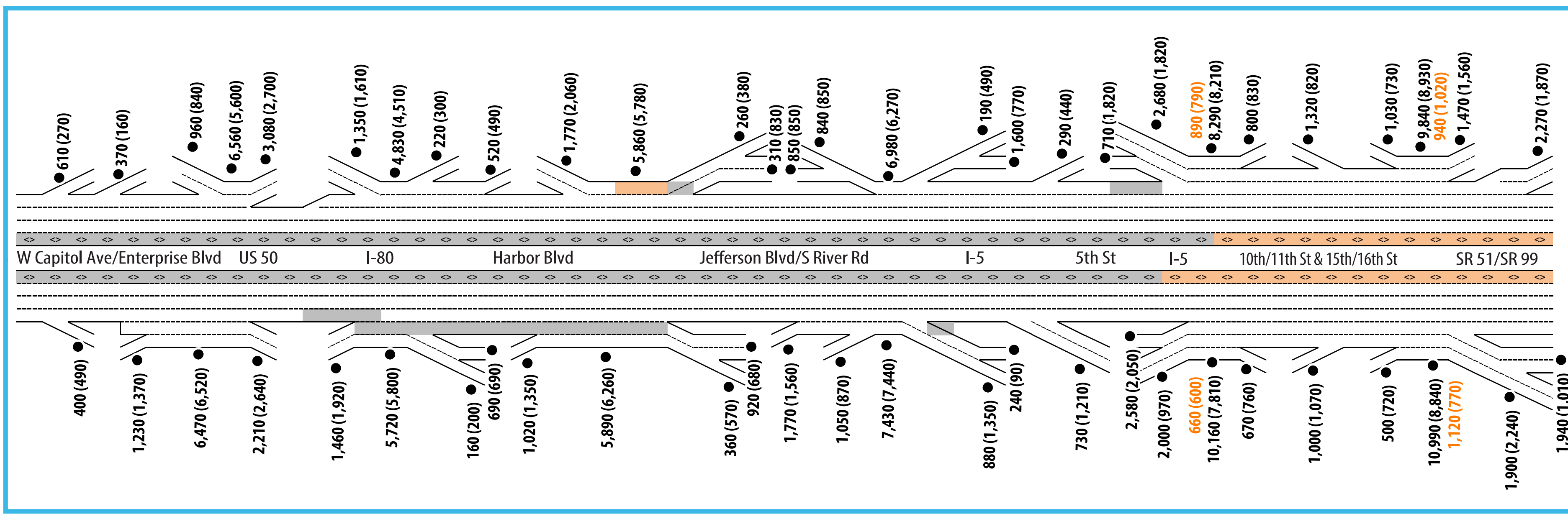
2029 Alternative 5 (Add Toll)
AM & PM Peak Hour Freeway Volumes

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

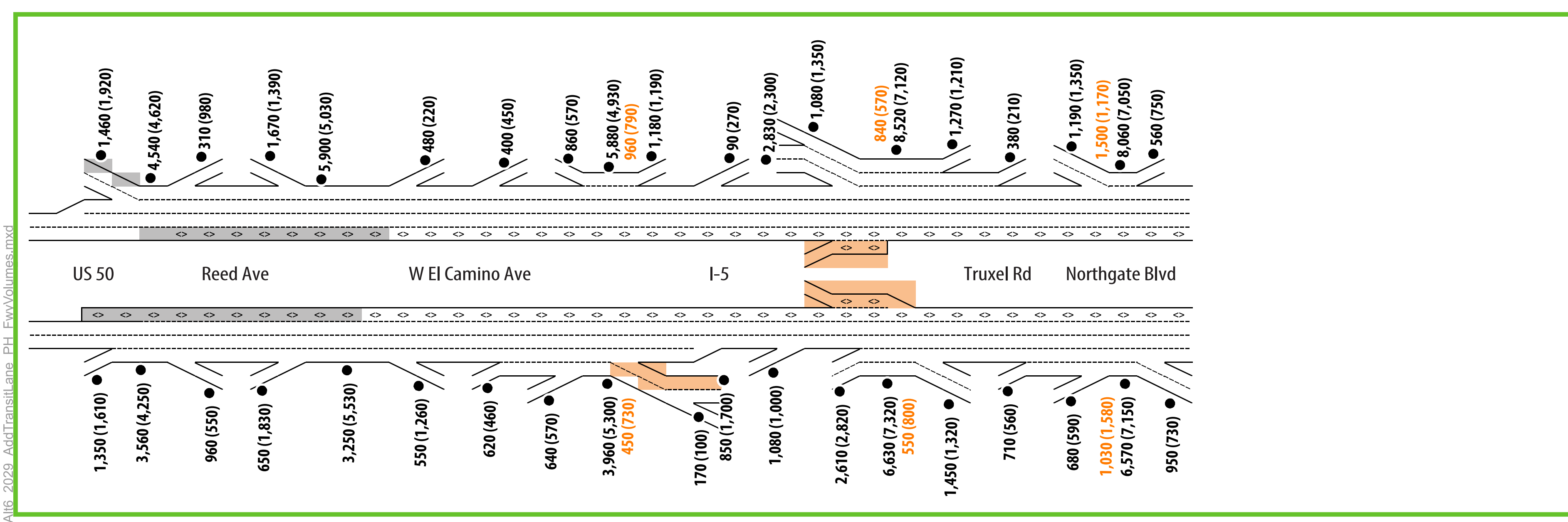
Section A

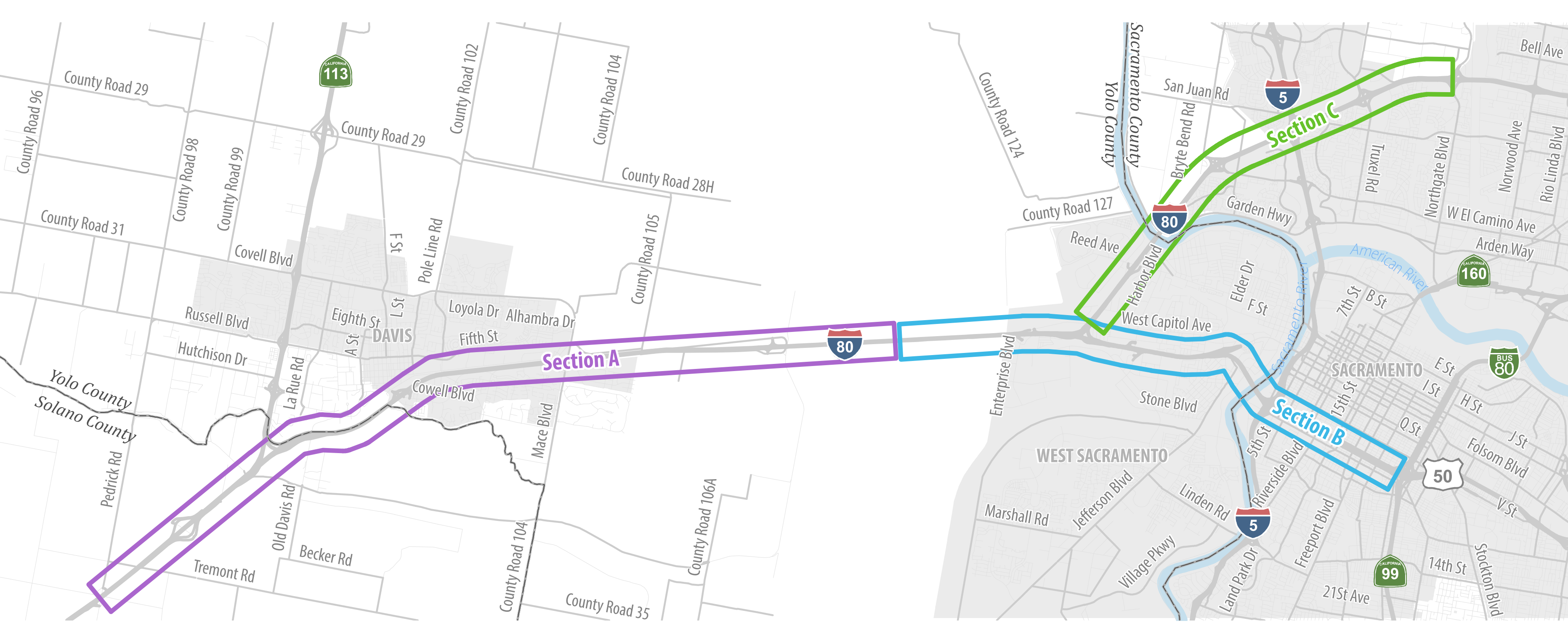


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 6

Managed Lane

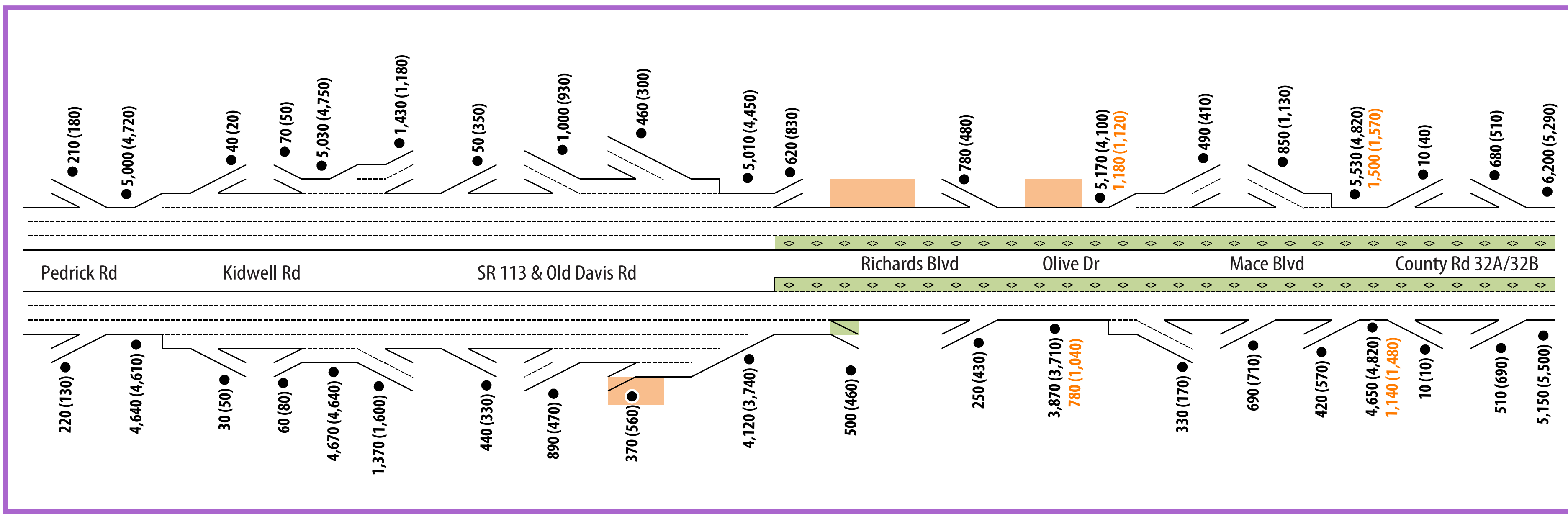
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 14

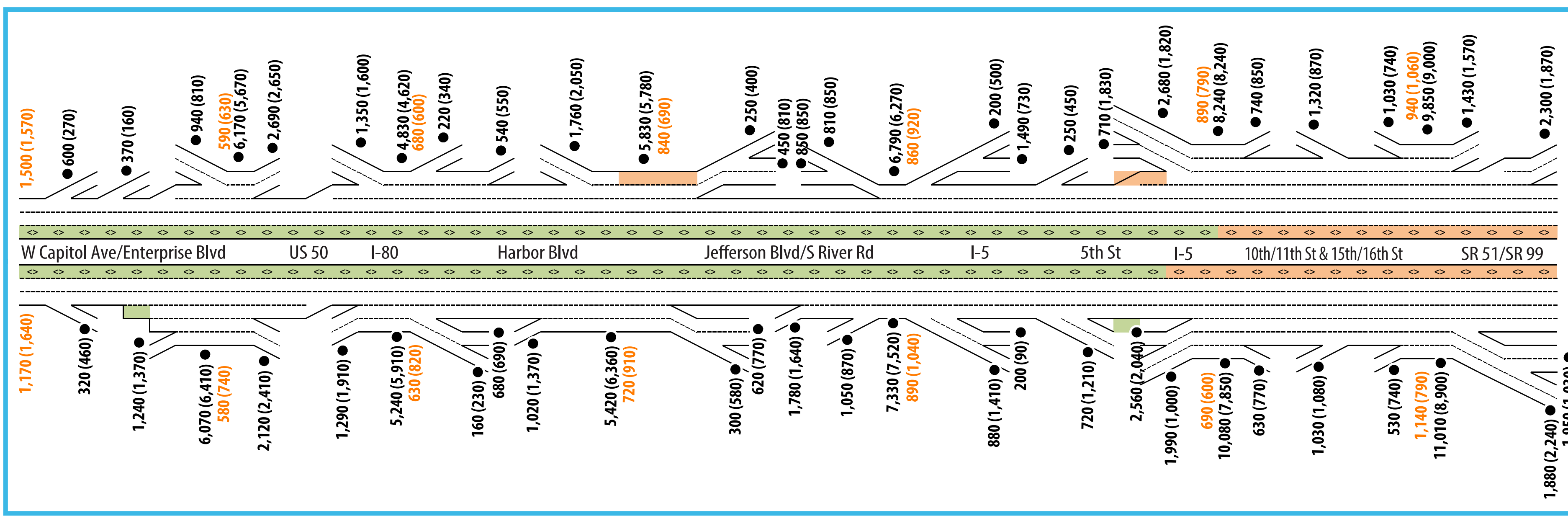
2029 Alternative 6 (Add Transit)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig18_Alt6_2029_AddTransit_Lane_PH_FwyVolumes.mxd

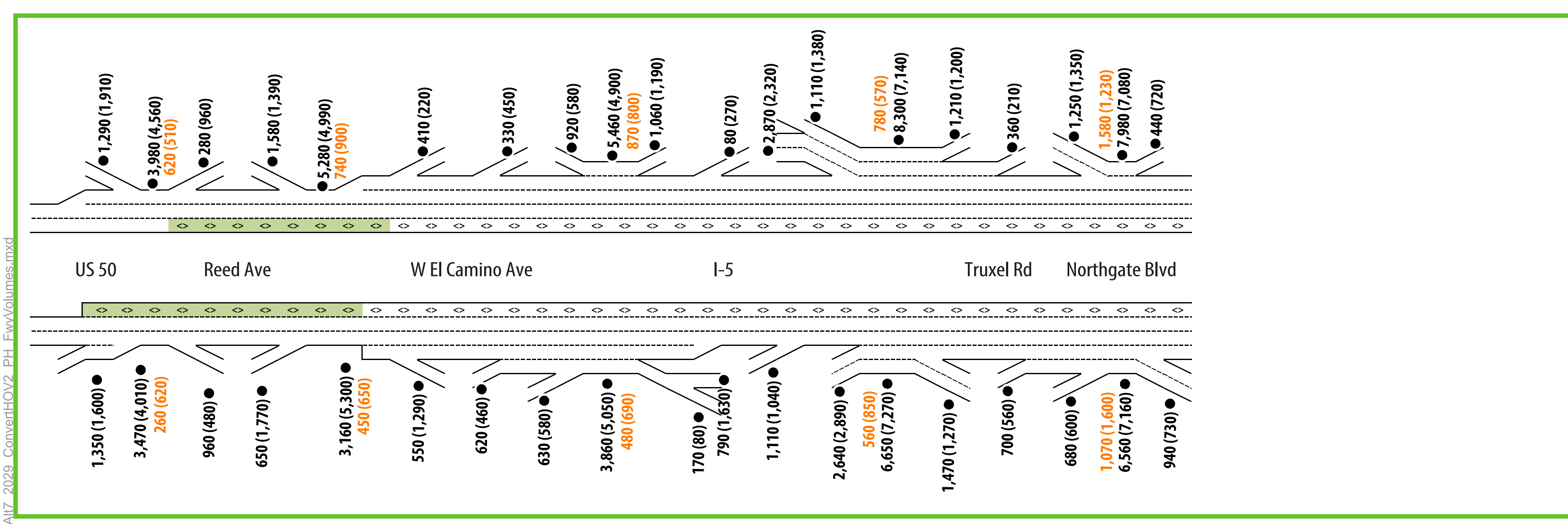
Section A

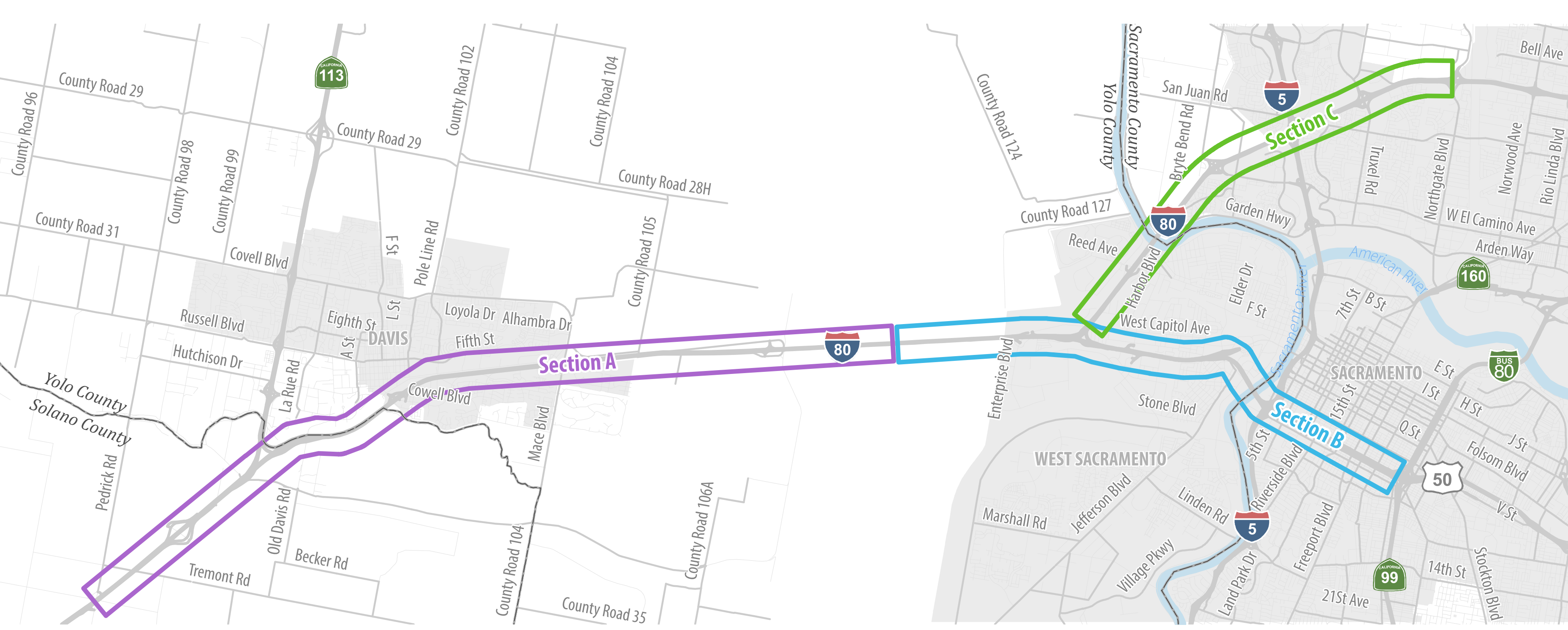


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 7

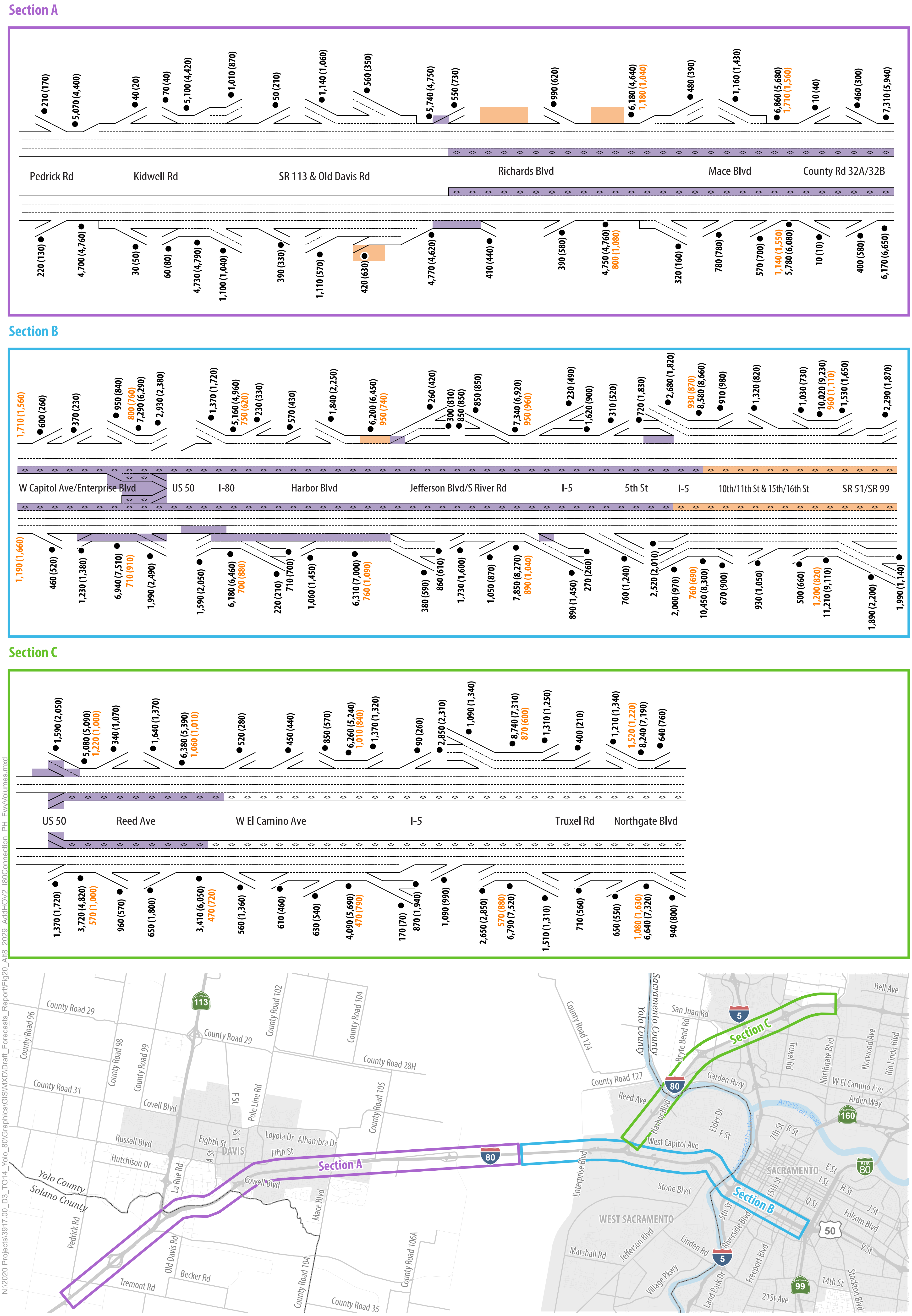
Managed Lane

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 15

2029 Alternative 7 (Convert HOV)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig19_Alt7_2029_ConvertHOV2_PH_FwyVolumes.mxd



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 8

Managed Lane

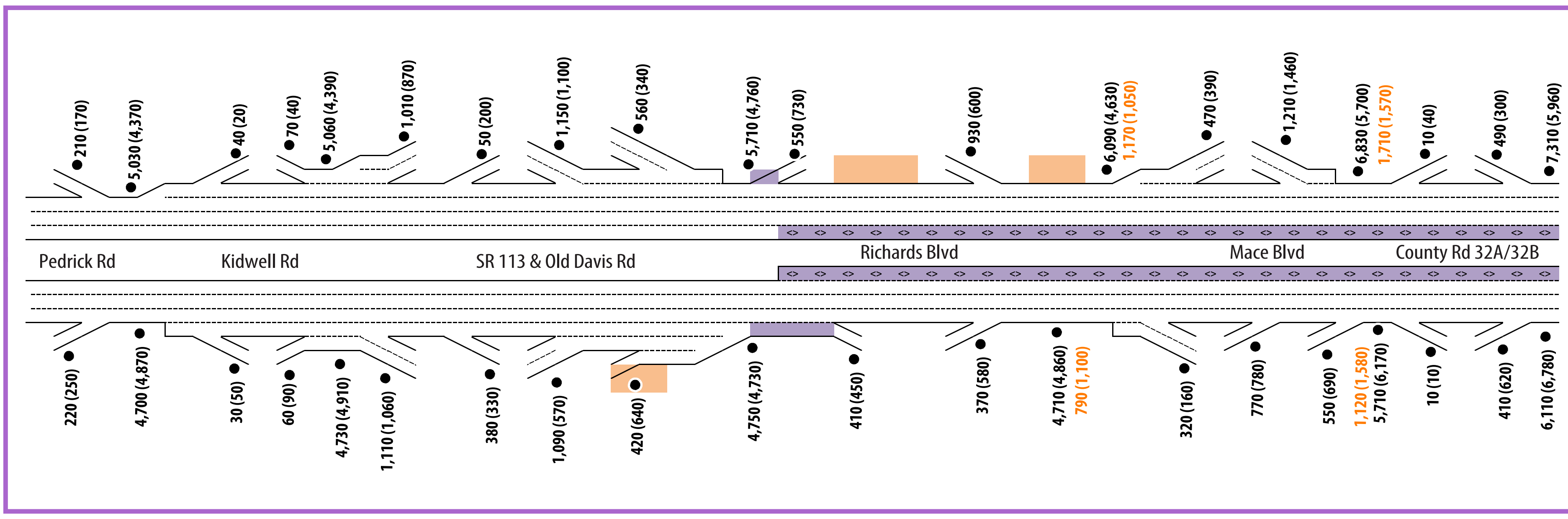
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 16

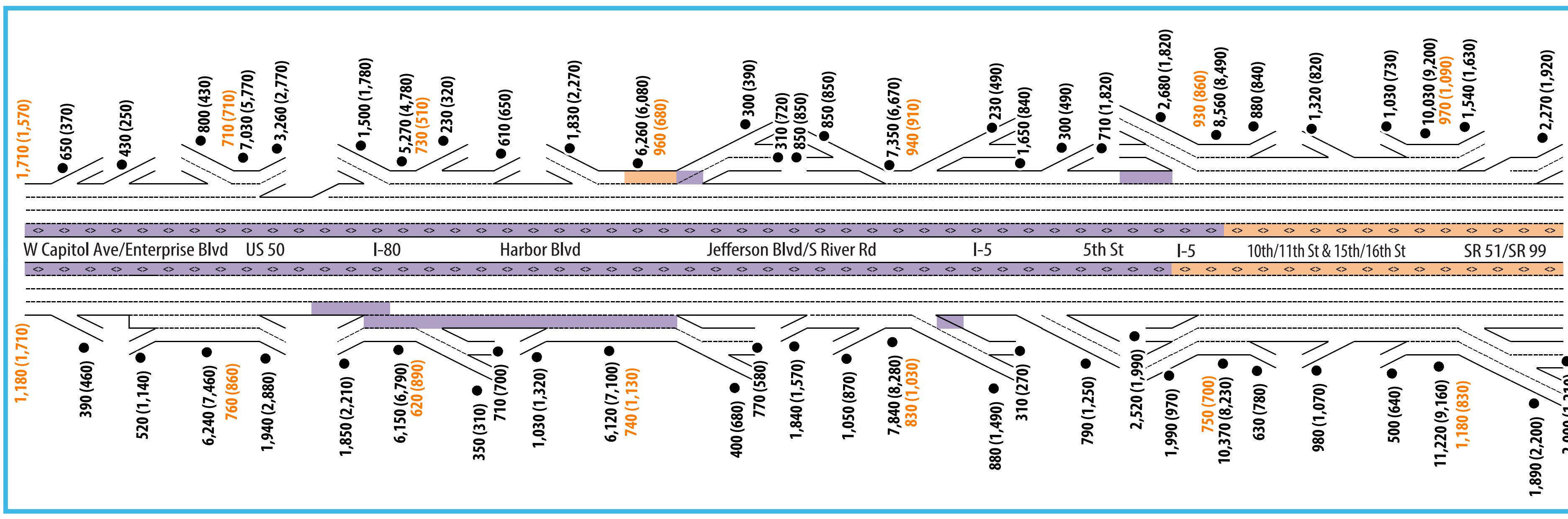
2029 Alternative 8 (Add HOV with Median Ramps)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig20_Alt8_2029_AddHOV2_I80Connection_PH_FwyVolumes.mxd

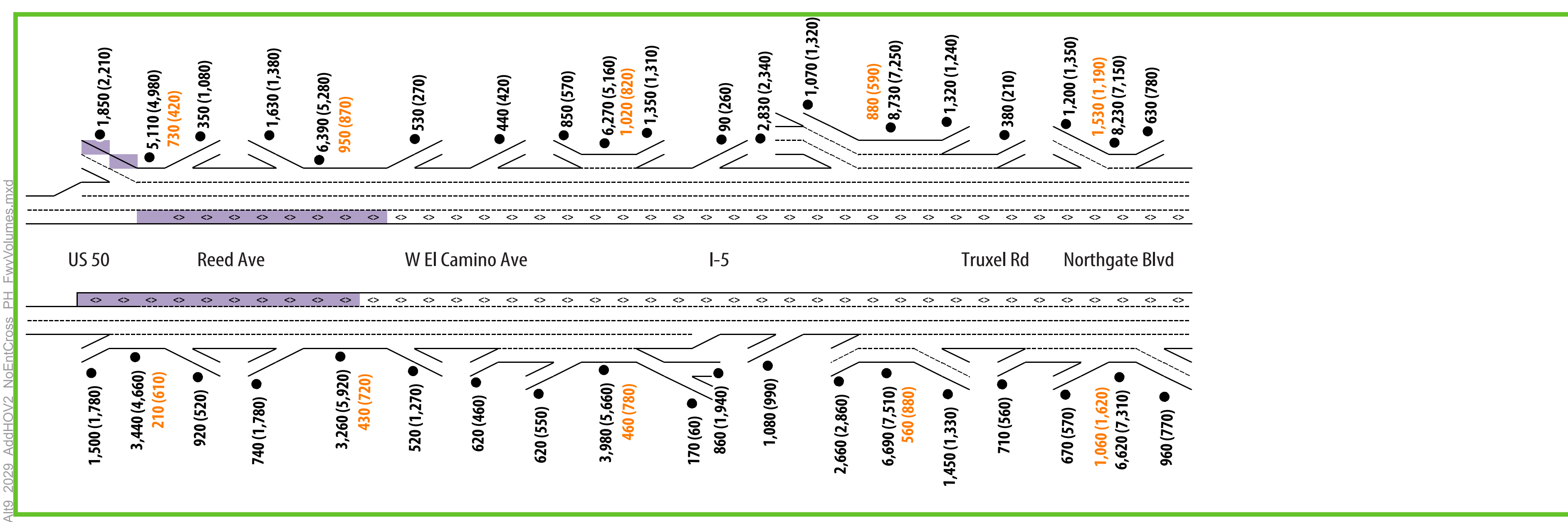
Section A

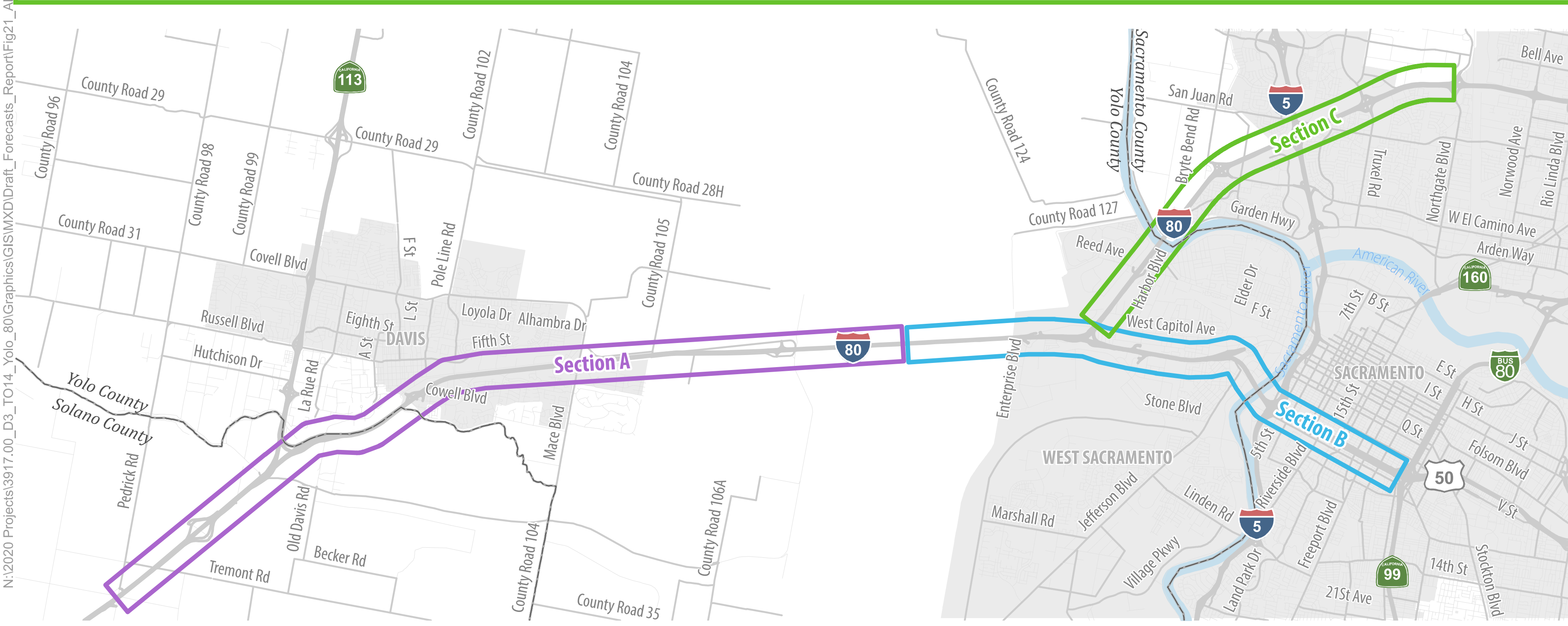


Section B



Section C





N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig21_Alt9_2029_AddHOV2_NoEntCross_PM_FwyVolumes.mxd

x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 9

Managed Lane

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 17

2029 Alternative 9 (Add HOV without Enterprise Crossing)
AM & PM Peak Hour Freeway Volumes

Table 36: Eastbound PM Peak Hour Mainline Demand Volumes – Opening Year 2029

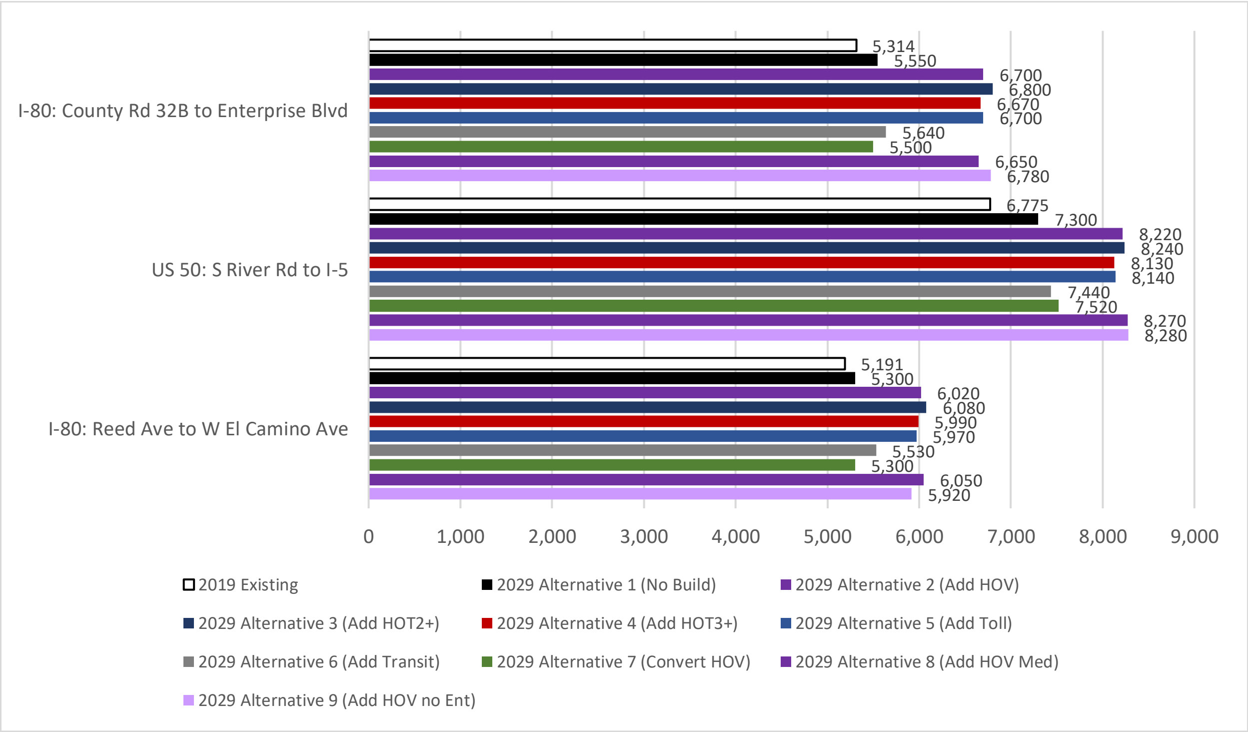
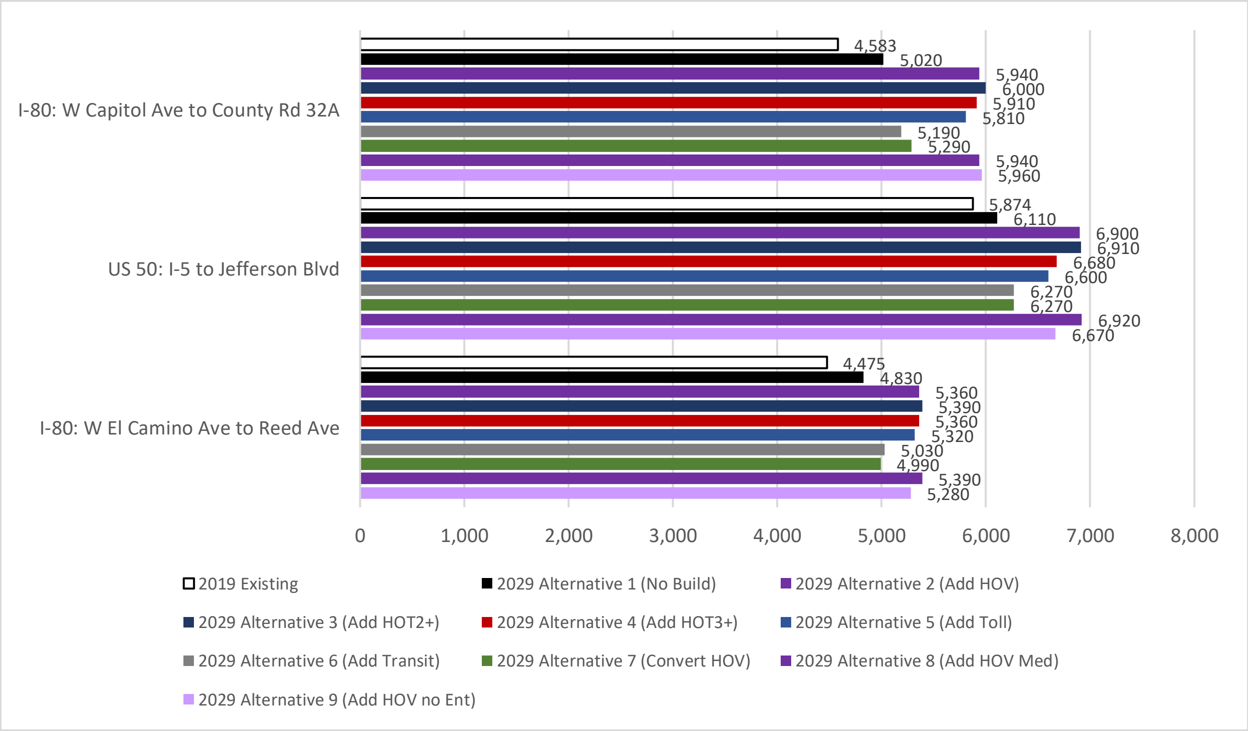


Table 37: Westbound PM Peak Hour Mainline Demand Volumes – Opening Year 2029



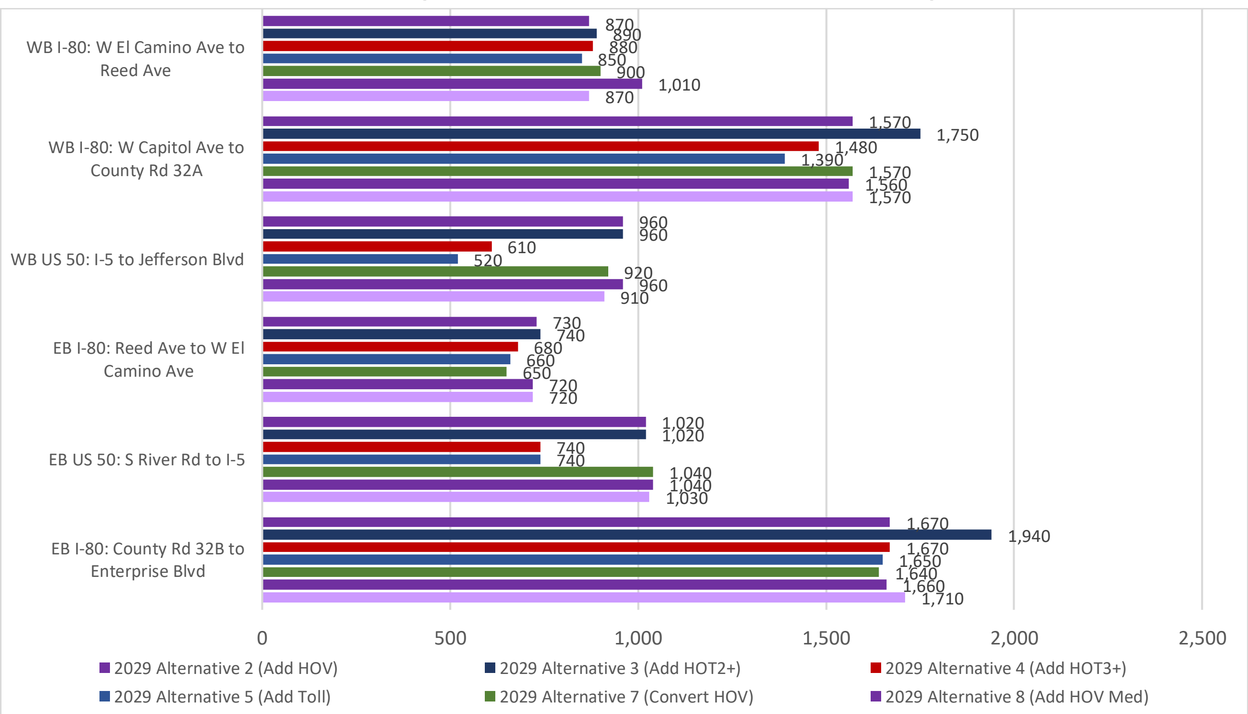
Under Alternative 1, the mainline volumes are expected to grow by 3 to 10 percent compared to existing conditions. The I-80 at the Yolo Causeway has the highest growth rate westbound, and US 50 at the Sacramento River has the highest growth rate eastbound. Alternatives 1, 6, and 7 have similar mainline volumes since they would have significant congestion at the Yolo Causeway during the PM peak hour since the demand volume (about 1,850 vph per lane in the eastbound direction) would be higher than the measured capacity of less than 1,500 vph per lane.

With the lane addition on I-80 and US 50 under Alternatives 2 through 5, the PM peak hour demand volume would increase by 1,000 vph or more in the eastbound direction at the Yolo Causeway compared to Alternative 1. Despite the added capacity, peak hour congested conditions would still be expected in both directions since the PM peak hour demand would be about 1,700 vph per lane (including the managed lane), which is more than the observed capacity of less than 1,500 vph per lane.

Alternative 6 would restrict the added lane to transit vehicles, which would reduce the vehicle demand volume as shown in **Table 36** and **Table** 37. However, this alternative has the potential to serve more people. Alternative 8, which provides median ramps at the I-80/US 50 interchange, and Alternative 9, which removes the Enterprise Boulevard bridge at the deep-water ship channel, would have similar freeway demand volumes at the Yolo Causeway as Alternatives 2 through 5.

Table 38 shows the opening year 2029 PM peak hour demand volumes for the managed lane under the build alternatives.

Table 38: PM Peak Hour Managed Lane Demand Volumes – Opening Year 2029



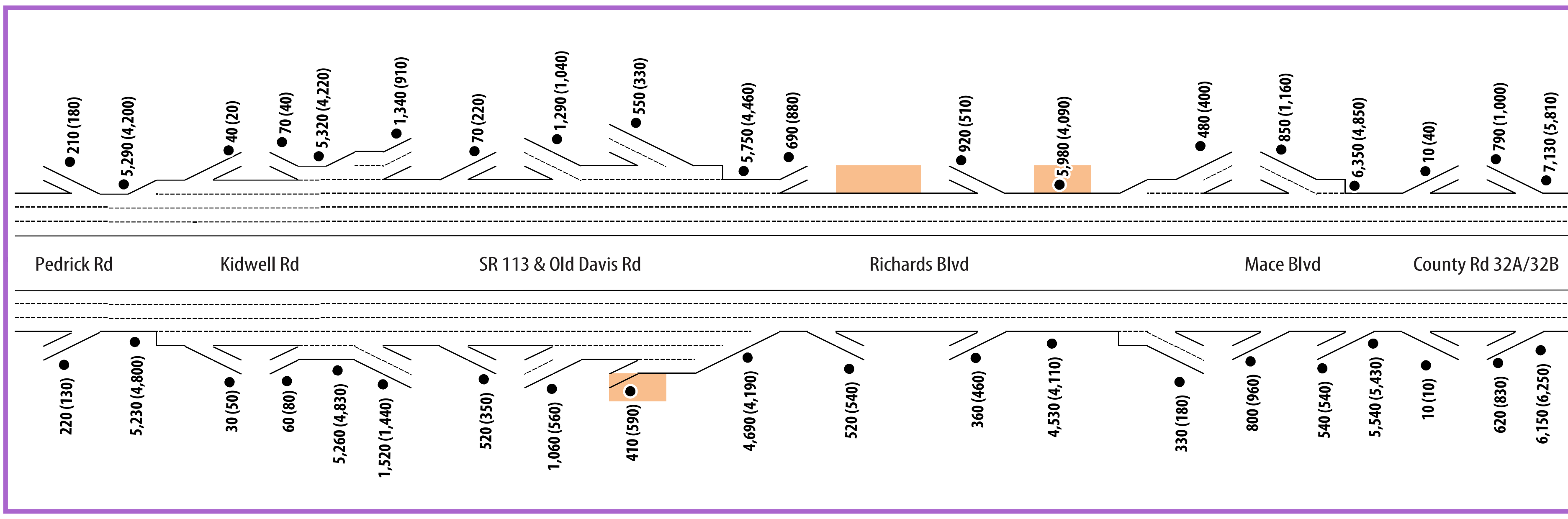
The managed lane volume is near the suggested operating volume for a managed lane (1,650 vph) at the Yolo Causeway in both directions for most alternatives. Allowing tolled vehicles to use the lane (Alternative 3) increases the eastbound demand volume to almost 2,000 vph, which is higher than the effective lane capacity. The priced lane alternatives (Alternatives 4 and 5) would discourage some drivers so that the lane would have lower demand. The managed lane volumes are lower on US 50 at the Sacramento River since the ramp volumes to and from the adjacent I-5 interchange are high. On I-80 at the Sacramento River, the westbound managed lane volume would be higher for Alternative 8 due to the median HOV direct ramp from I-80 west of US 50, but the same effect would not occur for the eastbound direction.

5.4.2 Horizon Year 2049

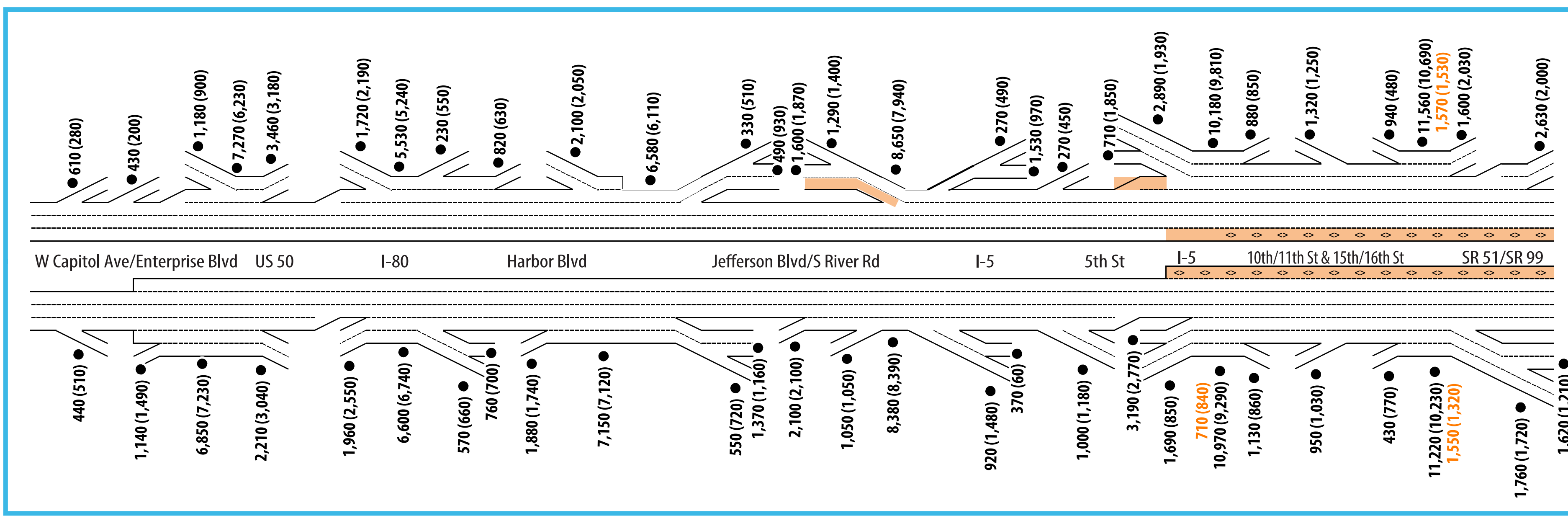
The AM and PM peak hour freeway volumes for the project alternatives under the horizon year of 2049 are shown in **Figure 18** through **Figure** 26. The figures show the mainline, ramp, and managed lane volumes. The mainline volume is the sum of the volume in the GP and managed lanes. The roadway changes associated with planned separate projects and the project alternative are highlighted on the lane configuration diagrams.

Table 39 and **Table** 40 present the horizon year 2049 PM peak hour mainline demand volumes under the project alternatives at three locations: I-80 at the Yolo Causeway (County Road 32A/32B to Enterprise Boulevard/West Capitol Avenue), US 50 at the Sacramento River (Jefferson Boulevard/South River Road to I-5), and I-80 at the Sacramento River (Reed Avenue to West El Camino Avenue). The weekday PM peak hour volume is typically the highest hourly volume.

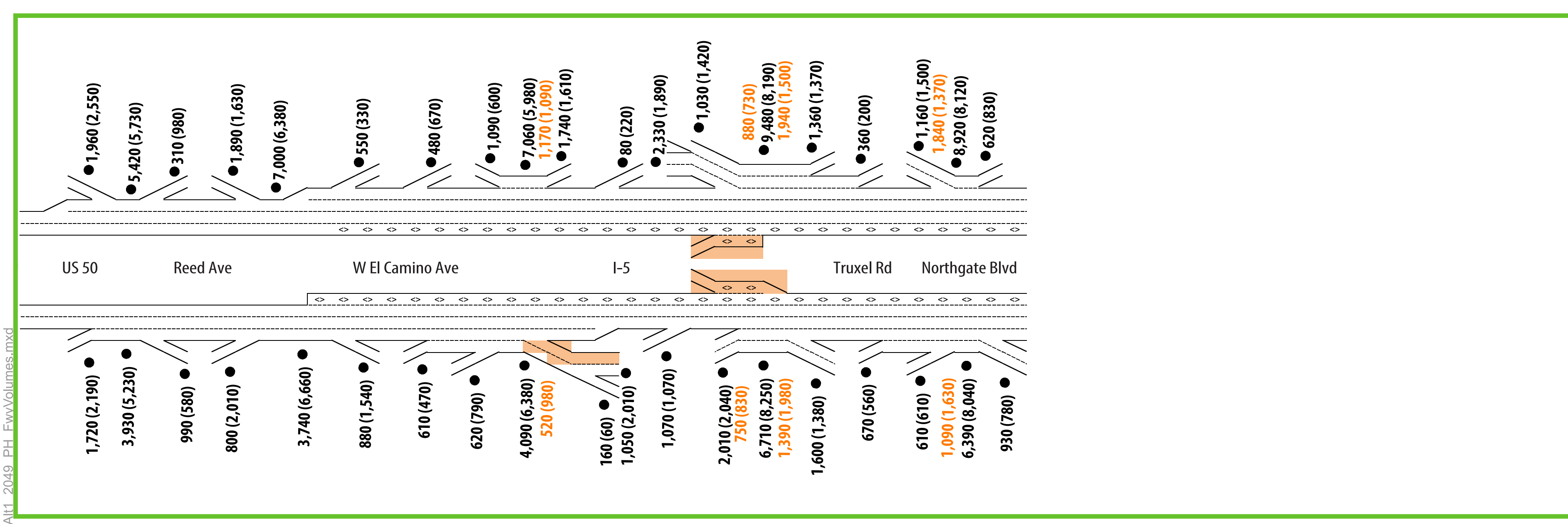
Section A

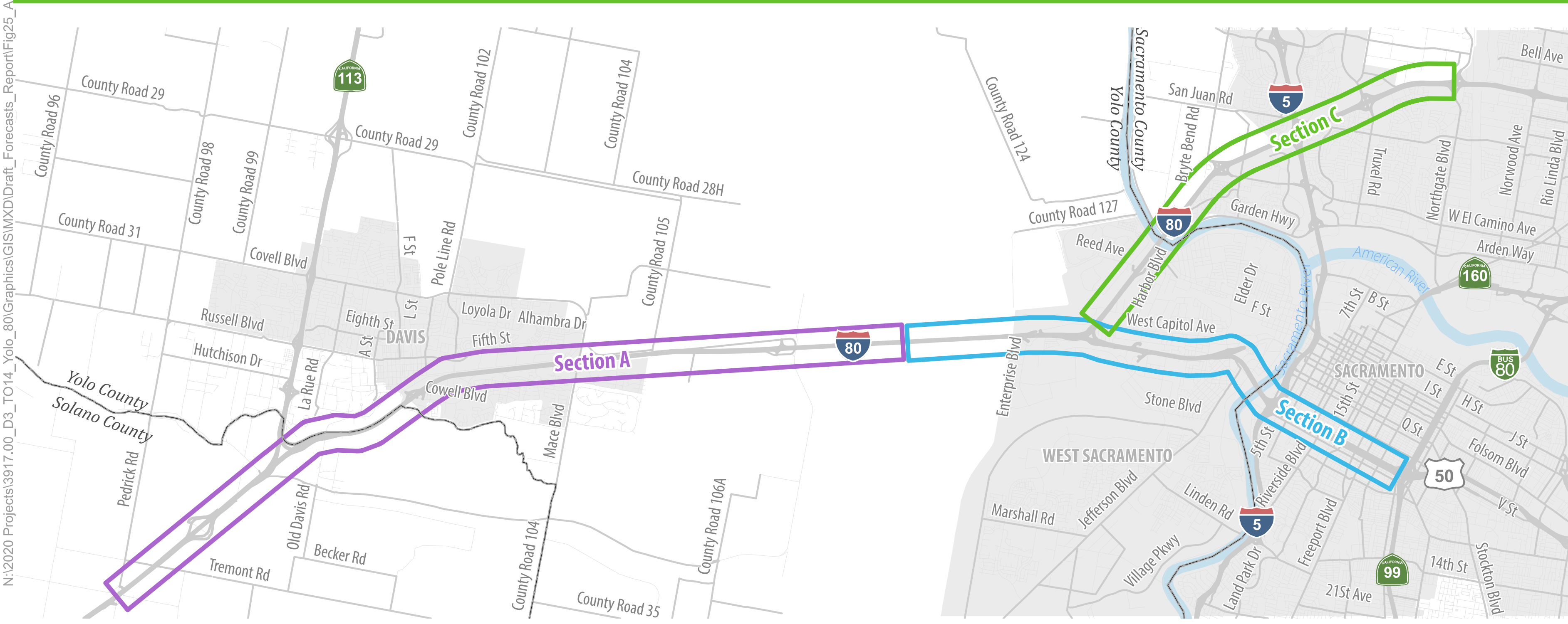


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

◇ Managed Lane

x,xxx (x,xxx) Managed Lane
AM Peak Hour Volume (PM Peak Hour Volume)

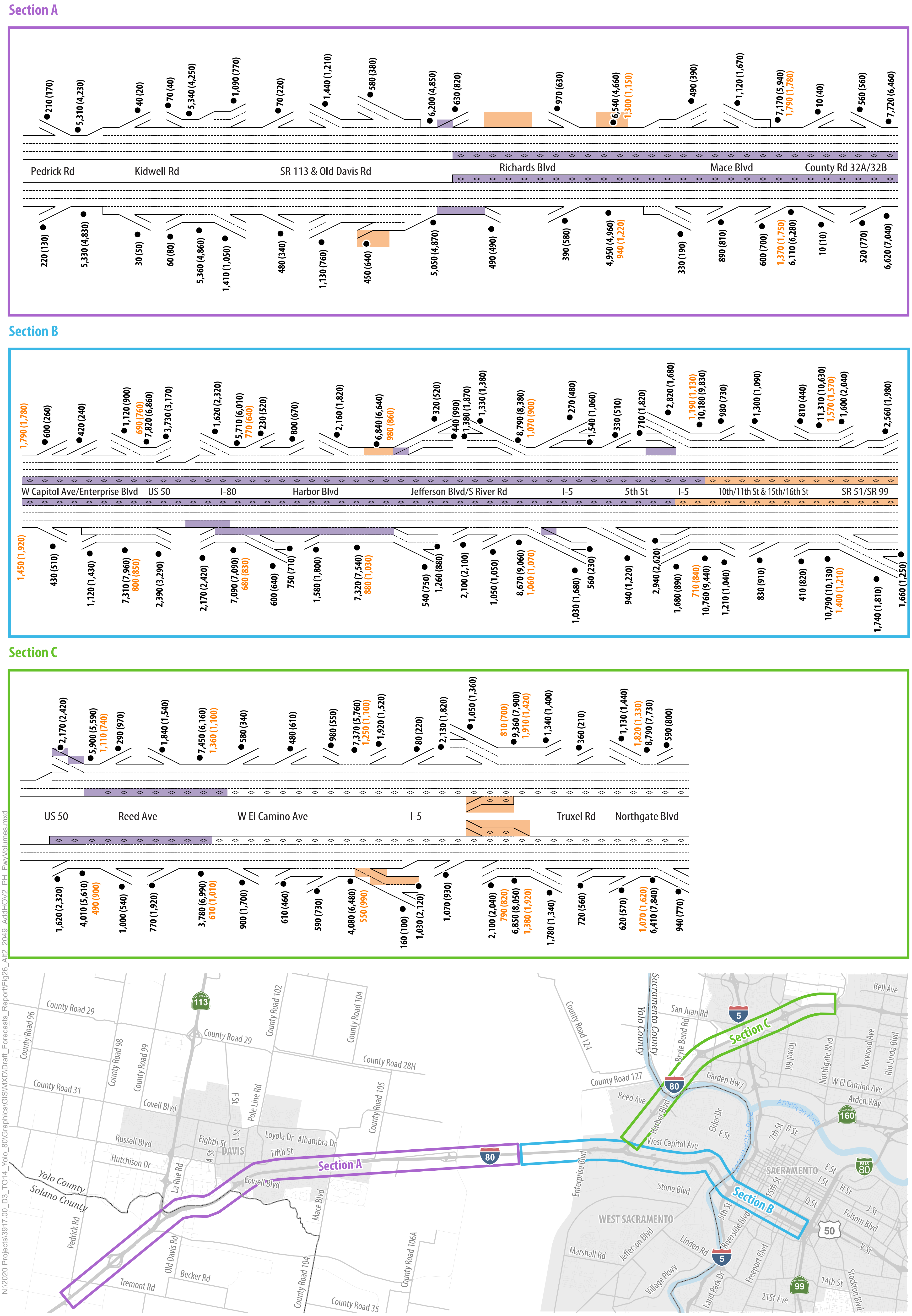
N

Figure 18

2049 Alternative 1 (No Build)
AM & PM Peak Hour Freeway Volumes

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig25_Alt1_2049_PM_FwyVolumes.mxd



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 2

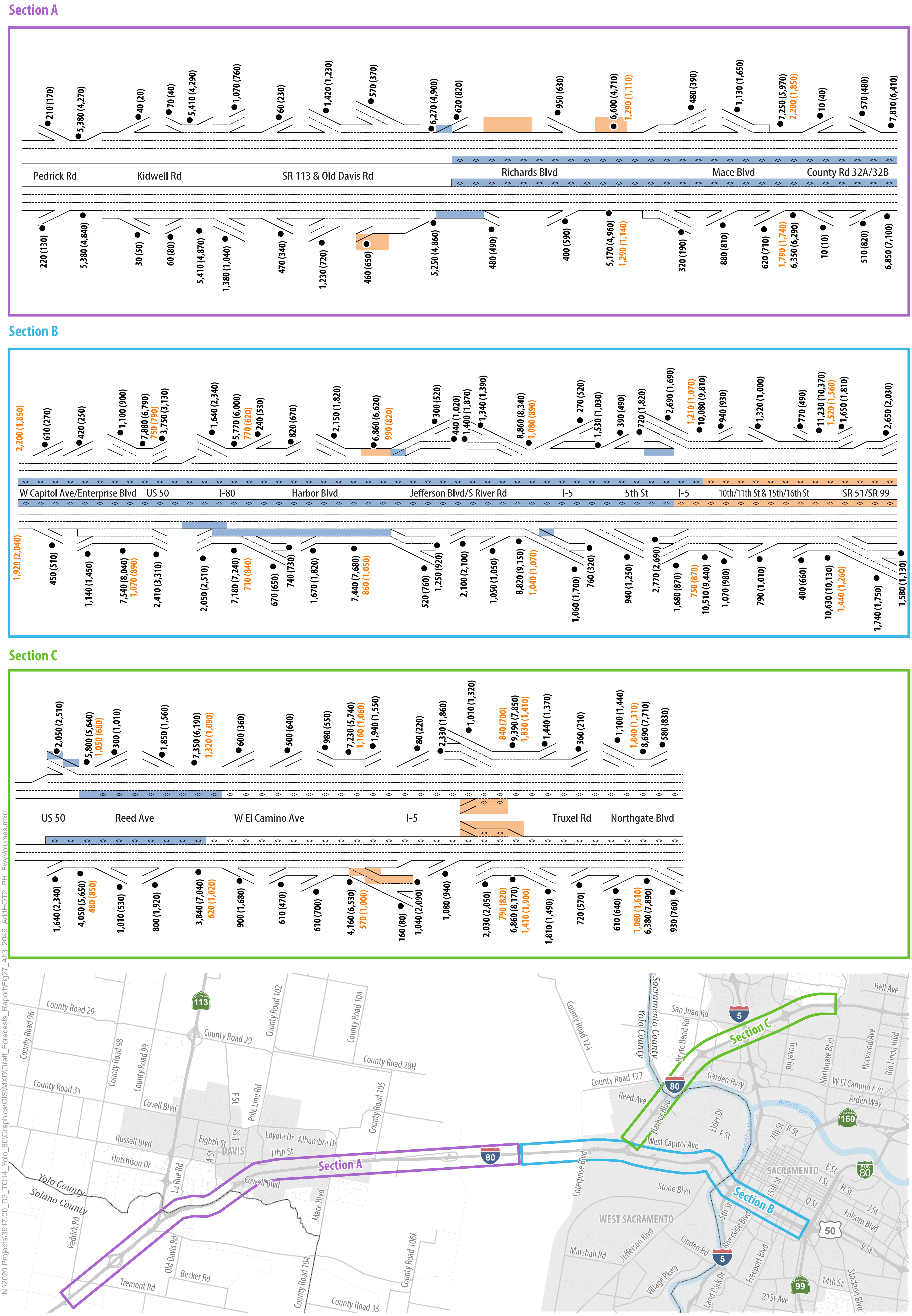
Managed Lane

Figure 19

2049 Alternative 2 (Add HOV2+ Lane)
AM & PM Peak Hour Freeway Volumes

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig26_Alt2_2049_AddHOV2_PH_FwyVolumes.mxd



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 3

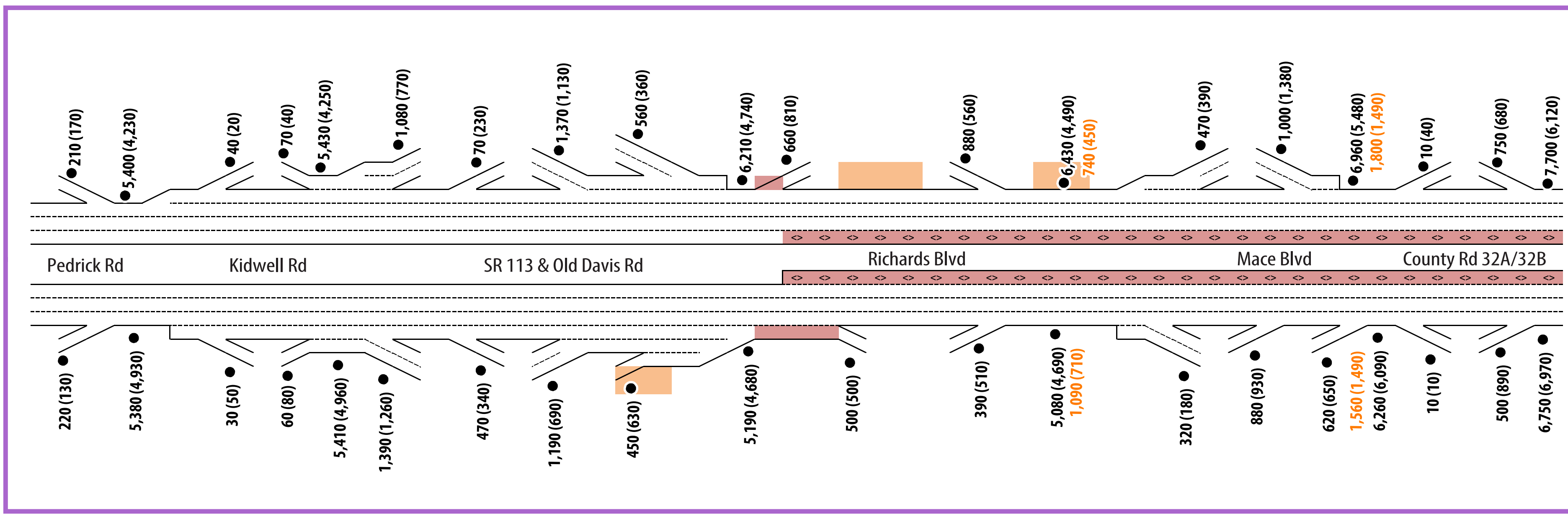
Managed Lane

Figure 20

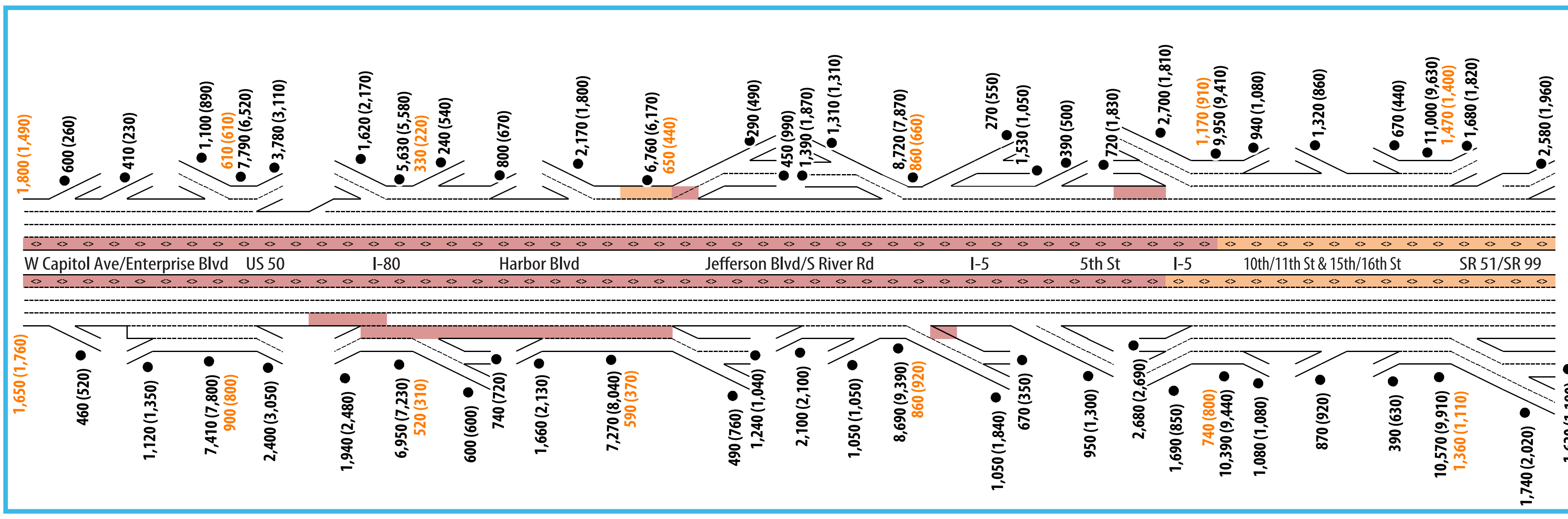
2049 Alternative 3 (Add HOT) AM & PM Peak Hour Freeway Volumes

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

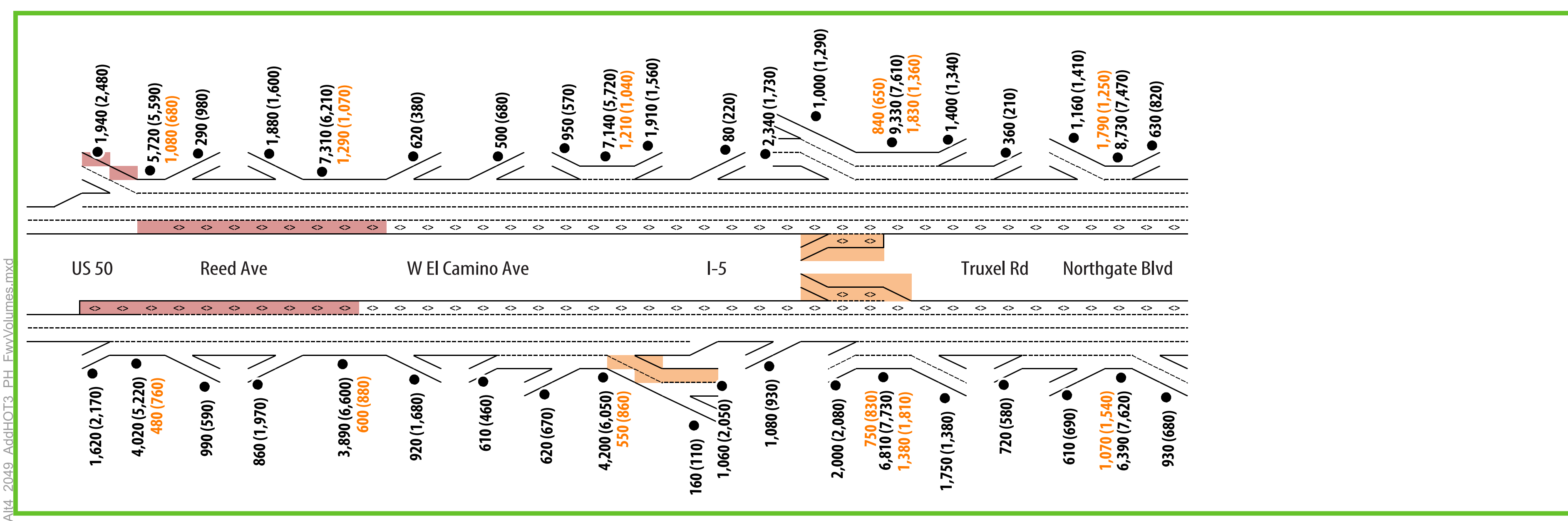
Section A

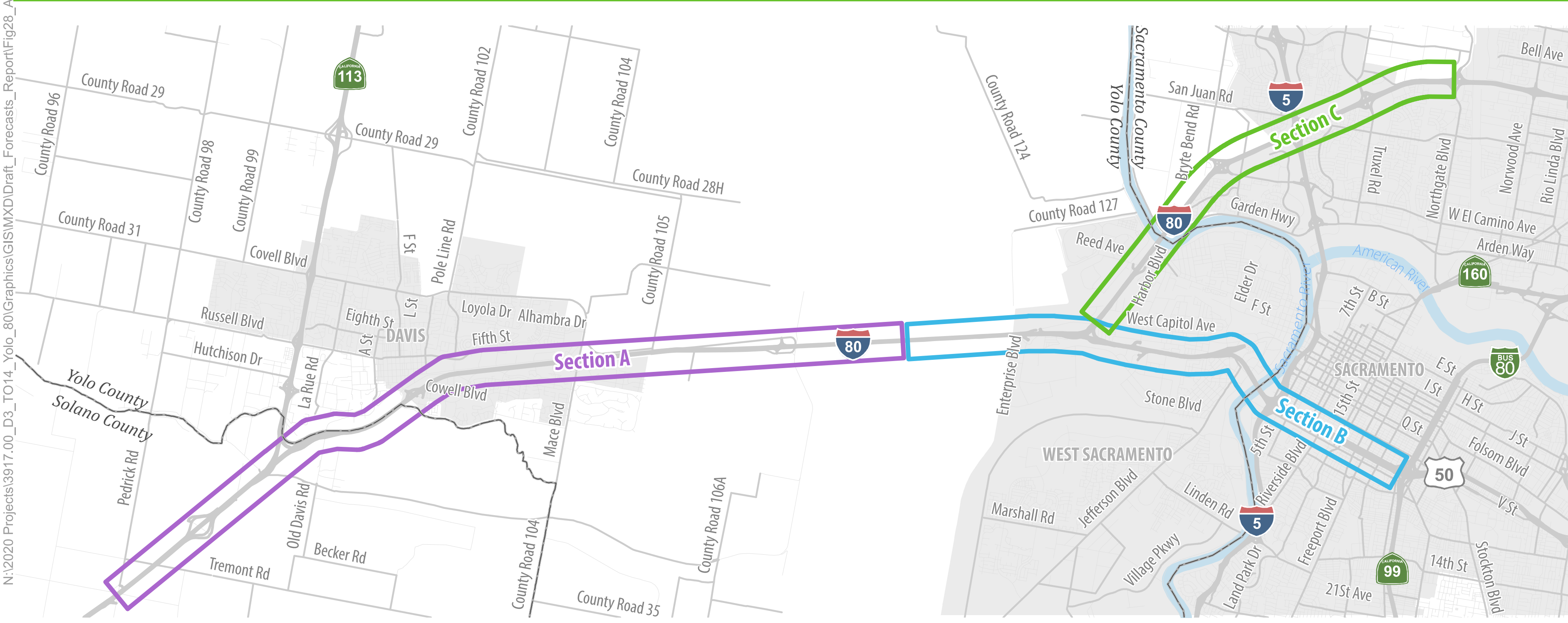


Section B



Section C





N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig28_Alt4_2049_AddHOT3_PH_FwyVolumes.mxd

x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 4

Managed Lane

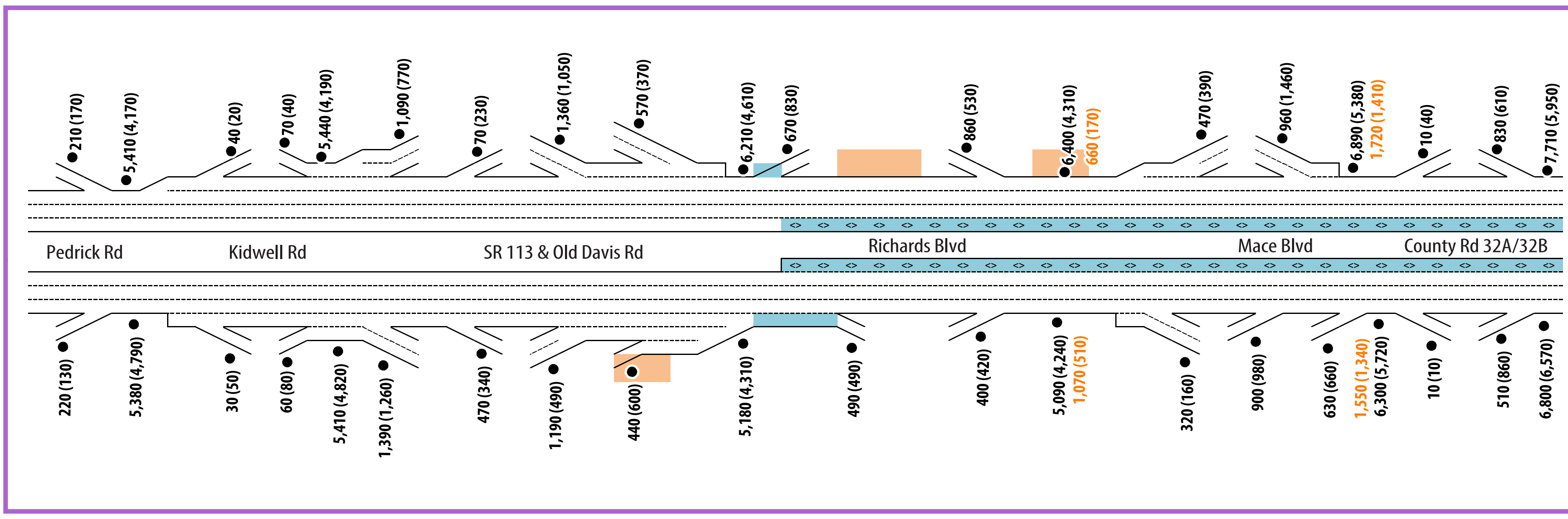
N

Figure 21

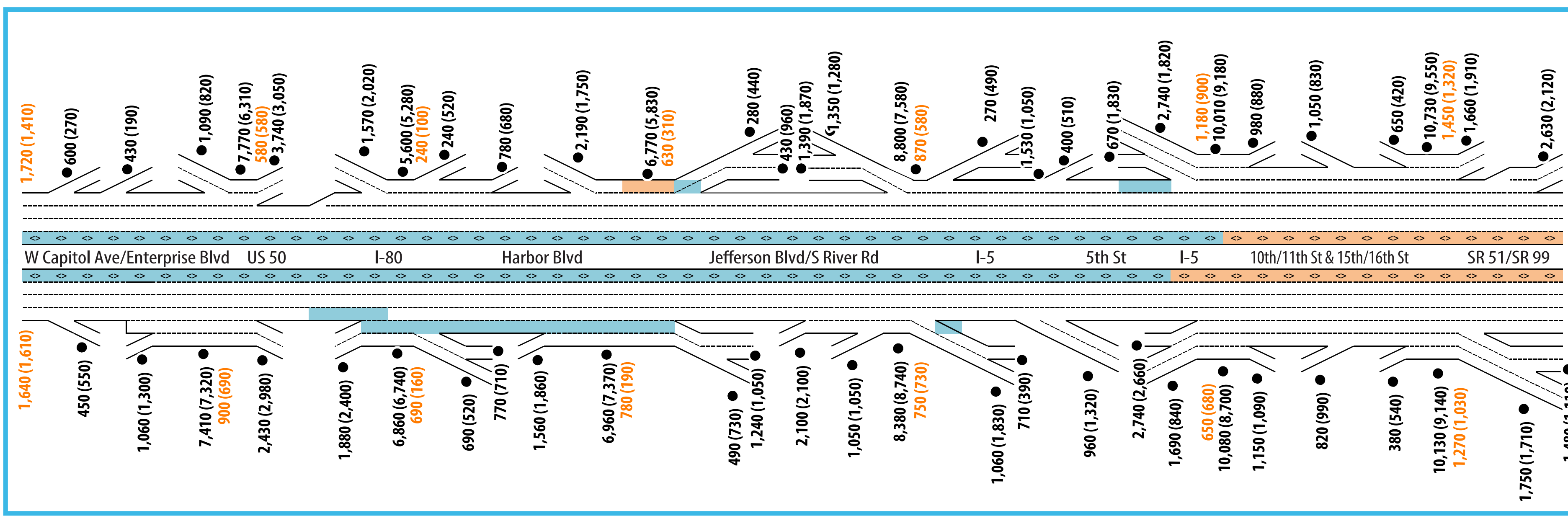
2049 Alternative 4 (Add HOT3+)
AM & PM Peak Hour Freeway Volumes

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

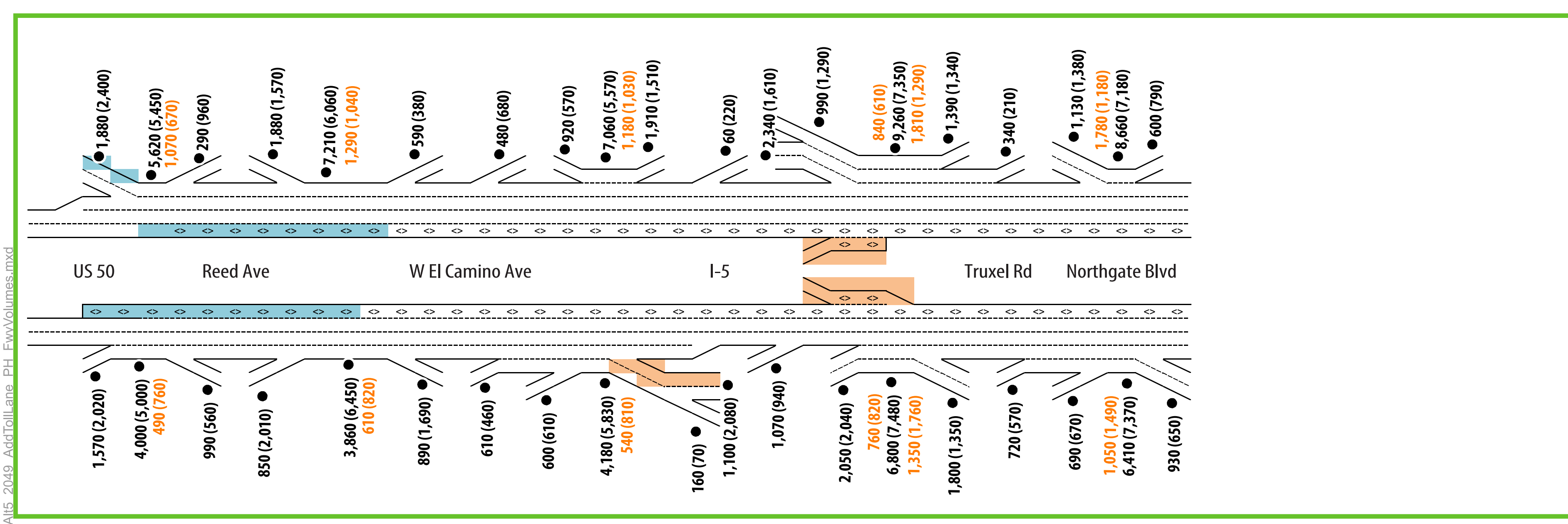
Section A

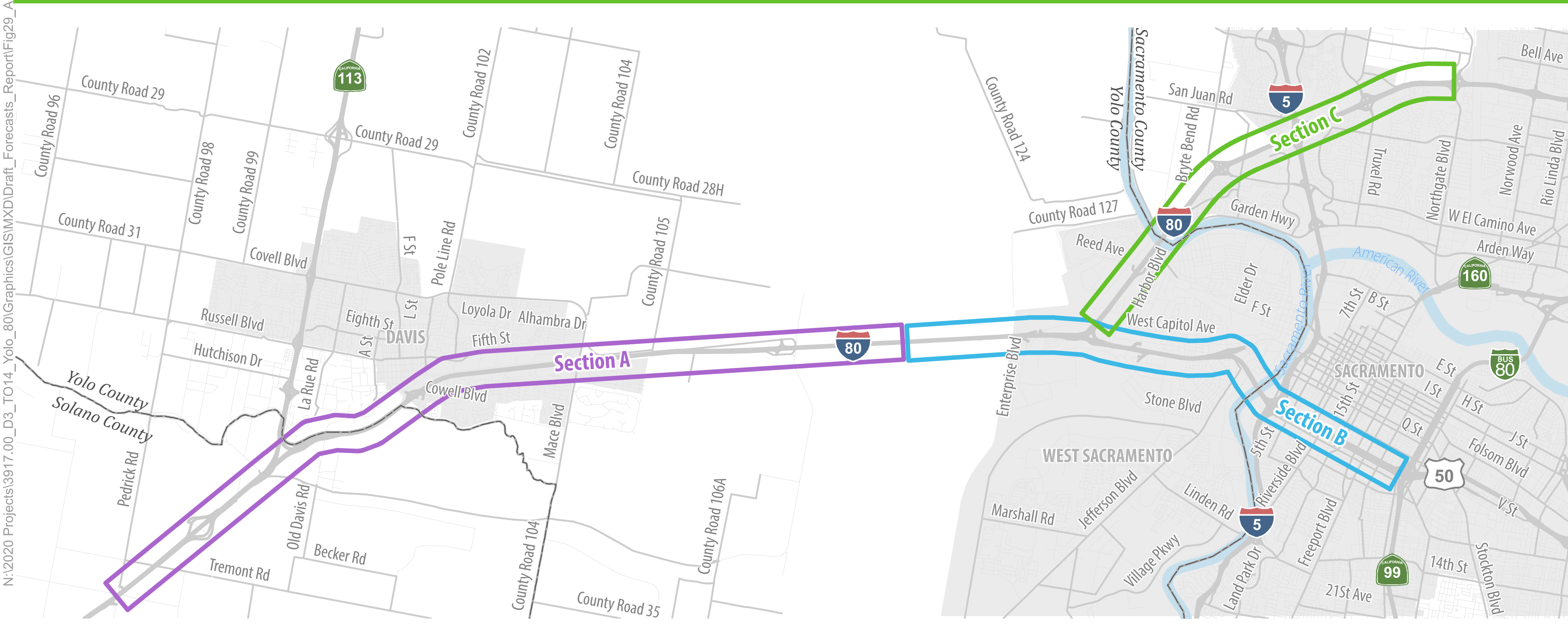


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane
AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 5

Managed Lane

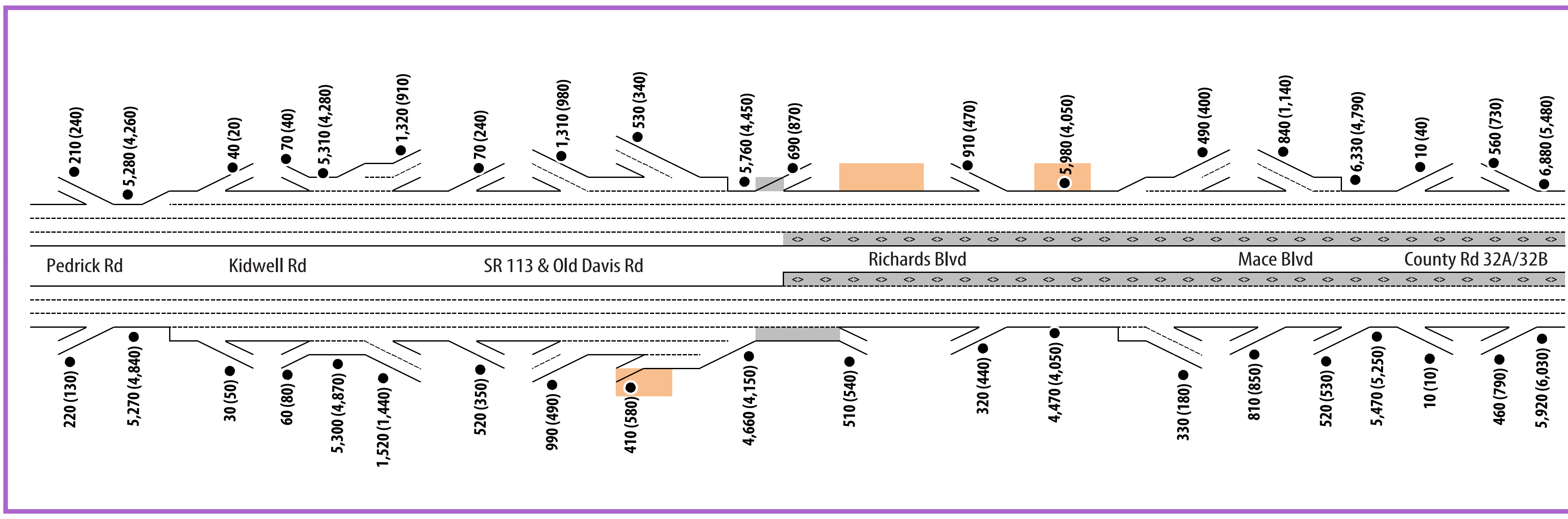
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 22

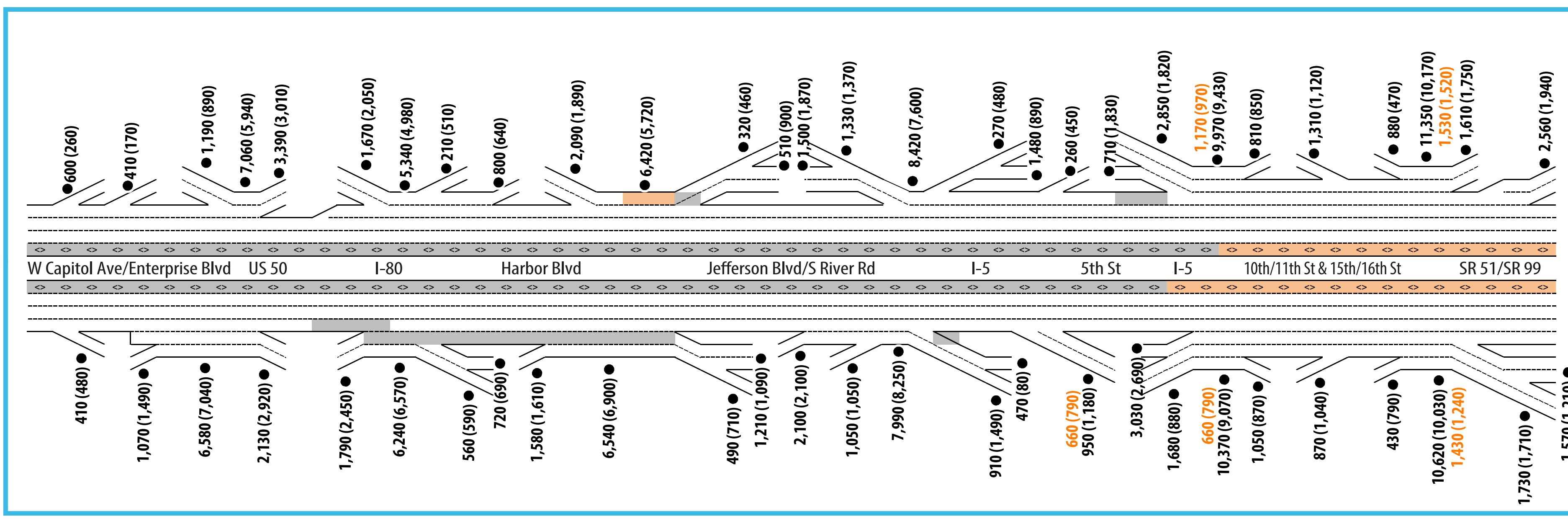
2049 Alternative 5 (Add Toll)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig29_Alt5_2049_AddTollLane_PH_FwyVolumes.mxd

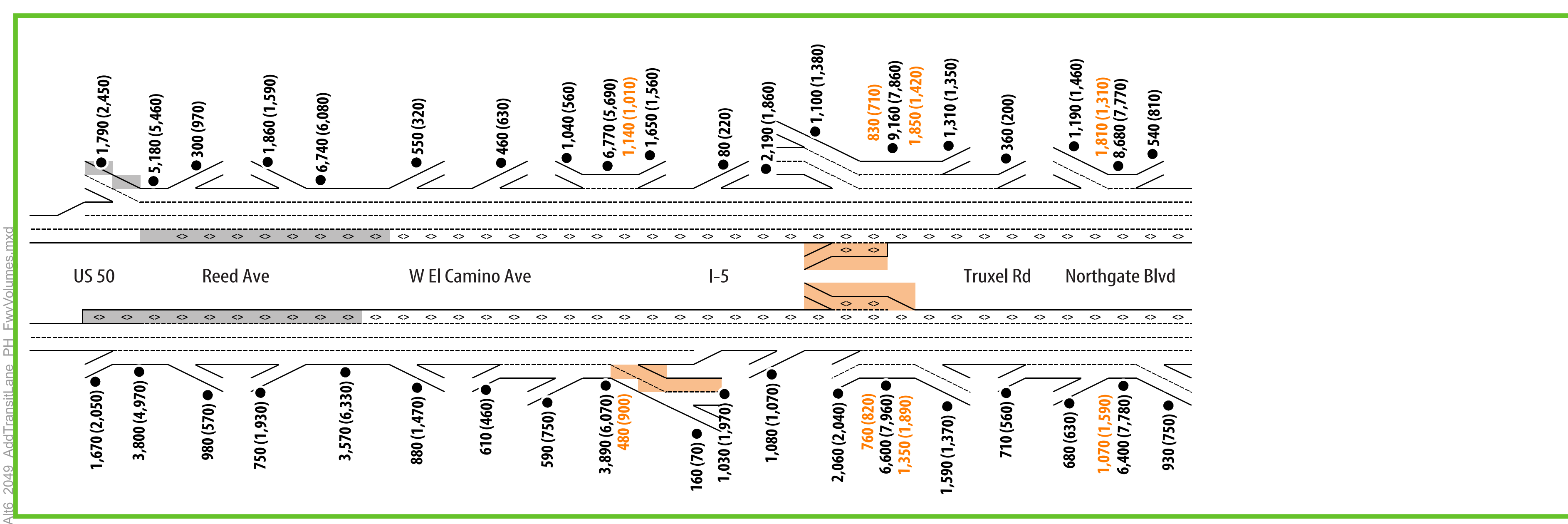
Section A

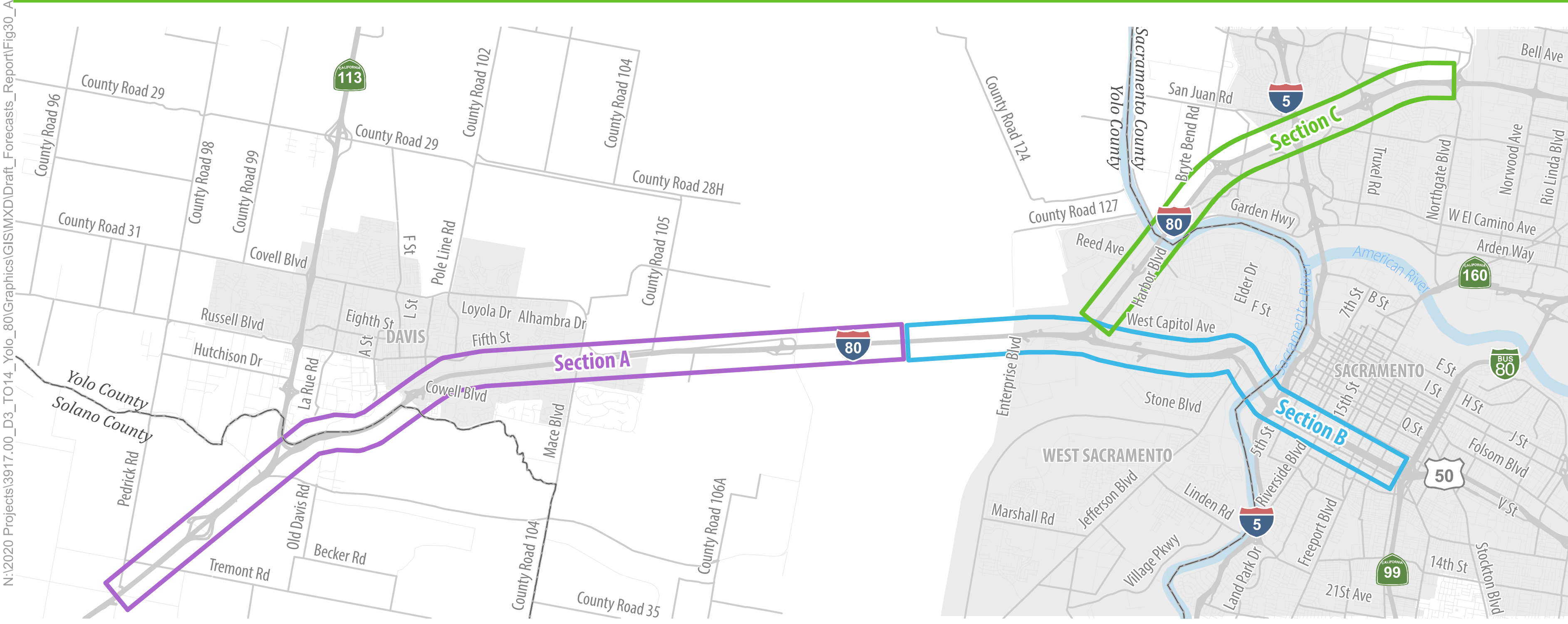


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 6

◇ Managed Lane

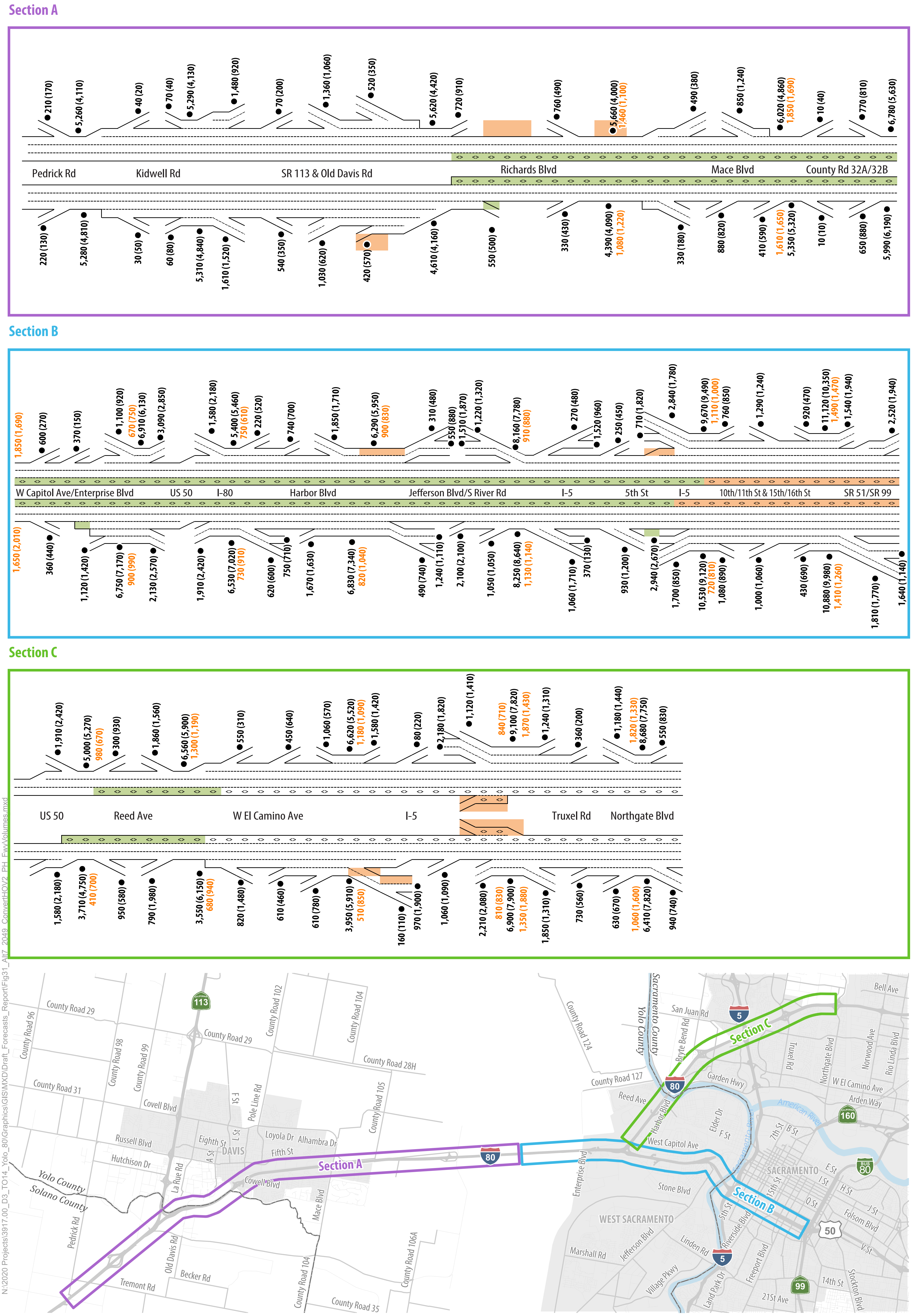
N

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 23

2049 Alternative 6 (Add Transit) AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig30_Alt6_2049_AddTransitLane_PH_FwyVolumes.mxd



x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 7

Managed Lane

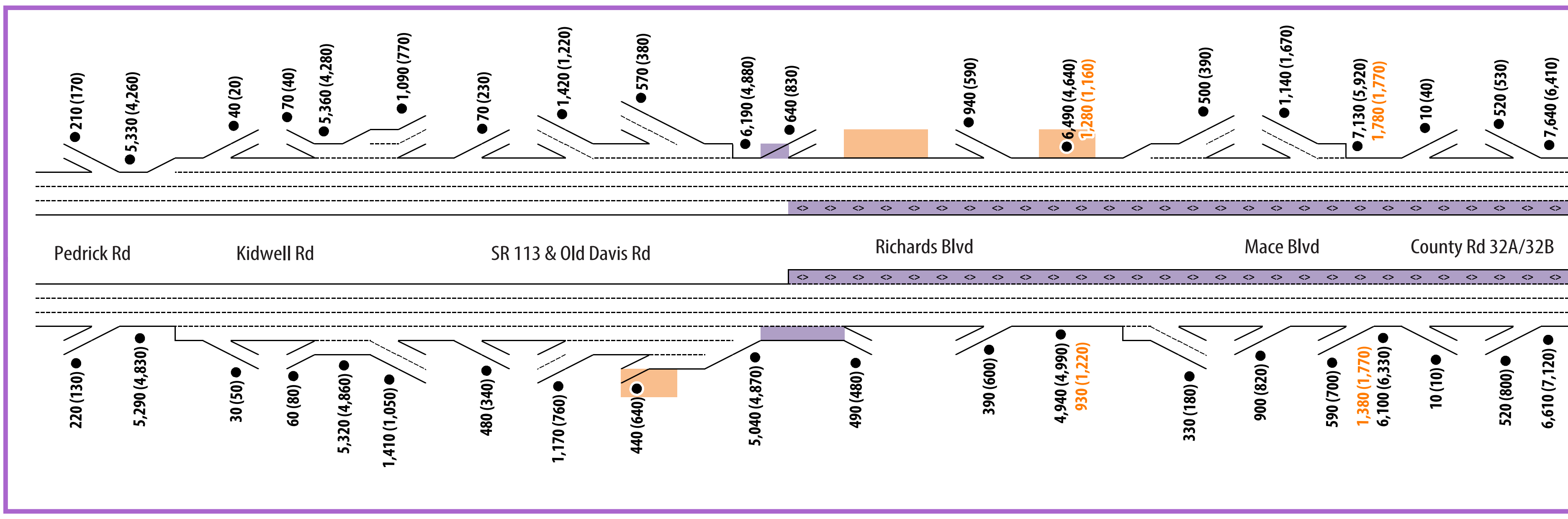
Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 24

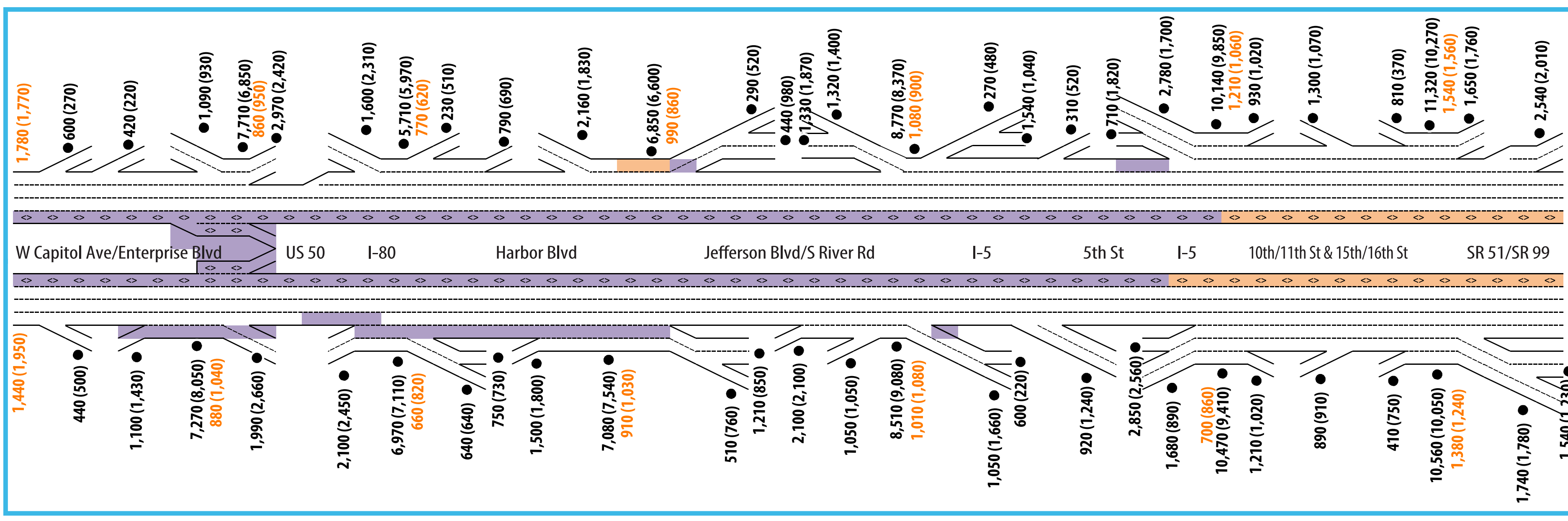
2049 Alternative 7 (Convert HOV)
AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig31_Alt7_2049_ConvertHOV2_PH_FwyVolumes.mxd

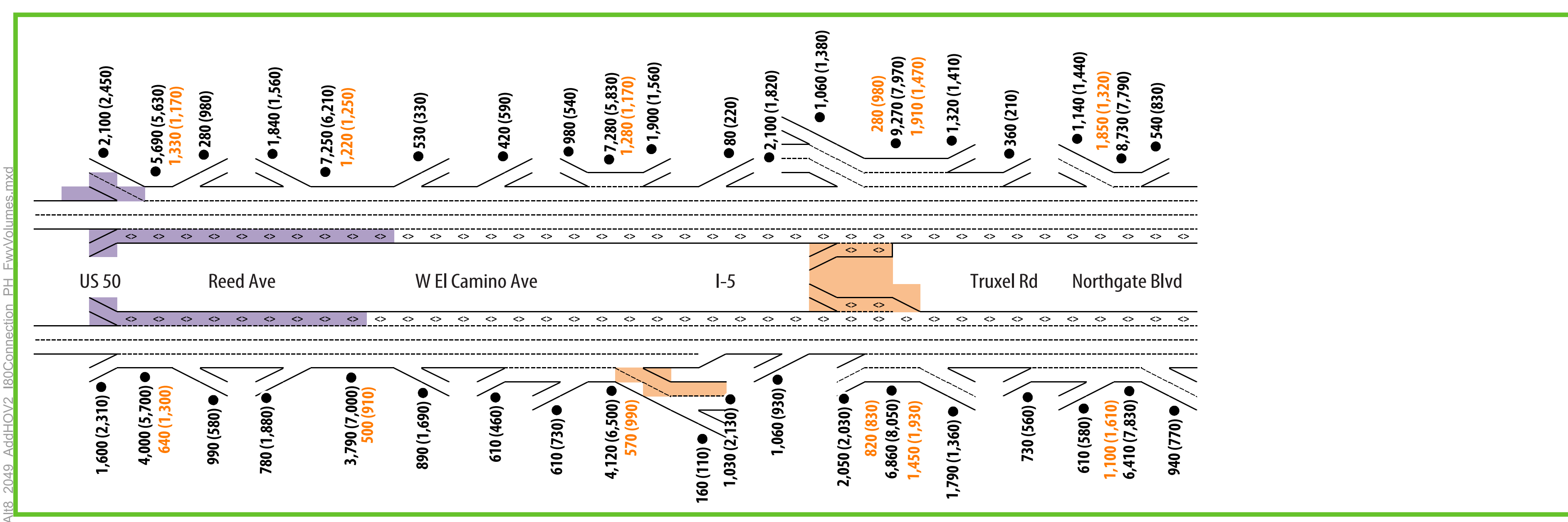
Section A

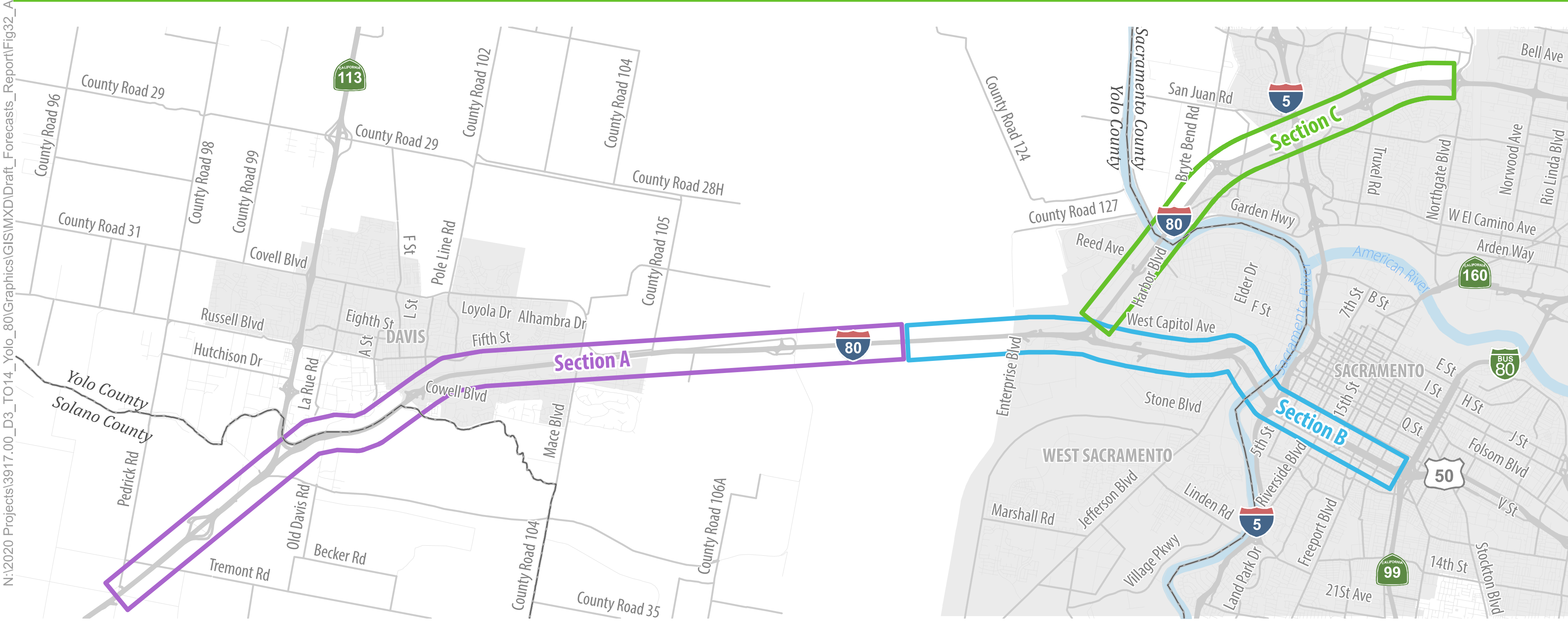


Section B



Section C





N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig32_Alt8_2049_AddHOV2_I80Connection_PH_FwyVolumes.mxd

x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 8

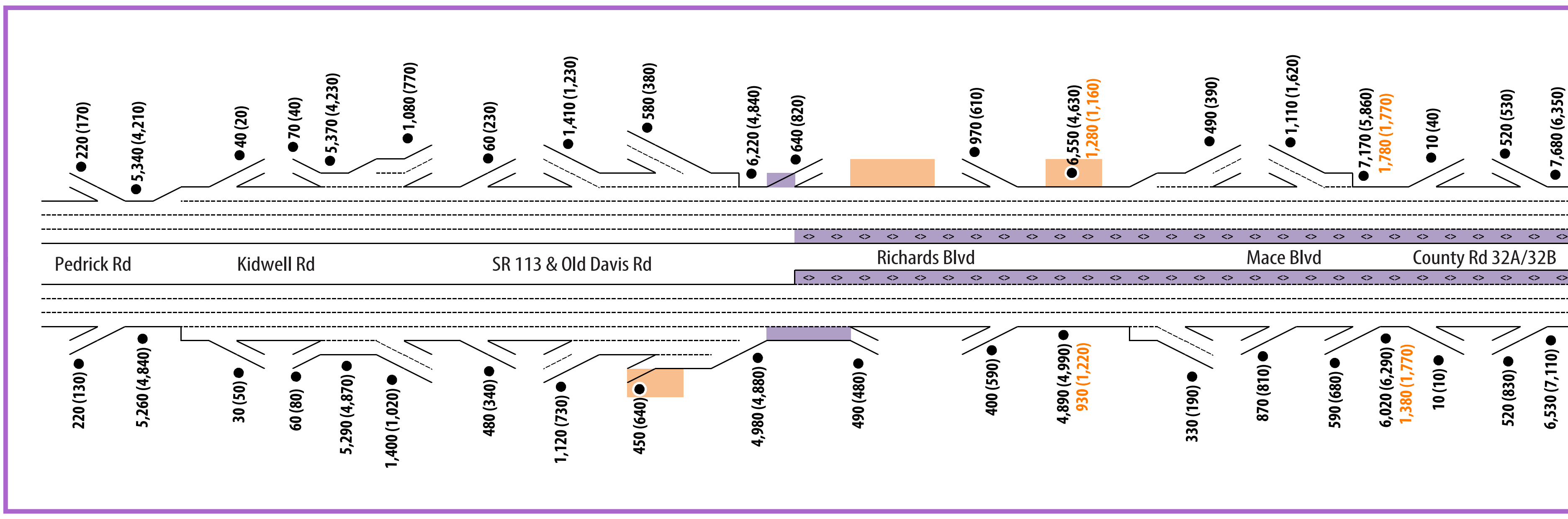
Managed Lane

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

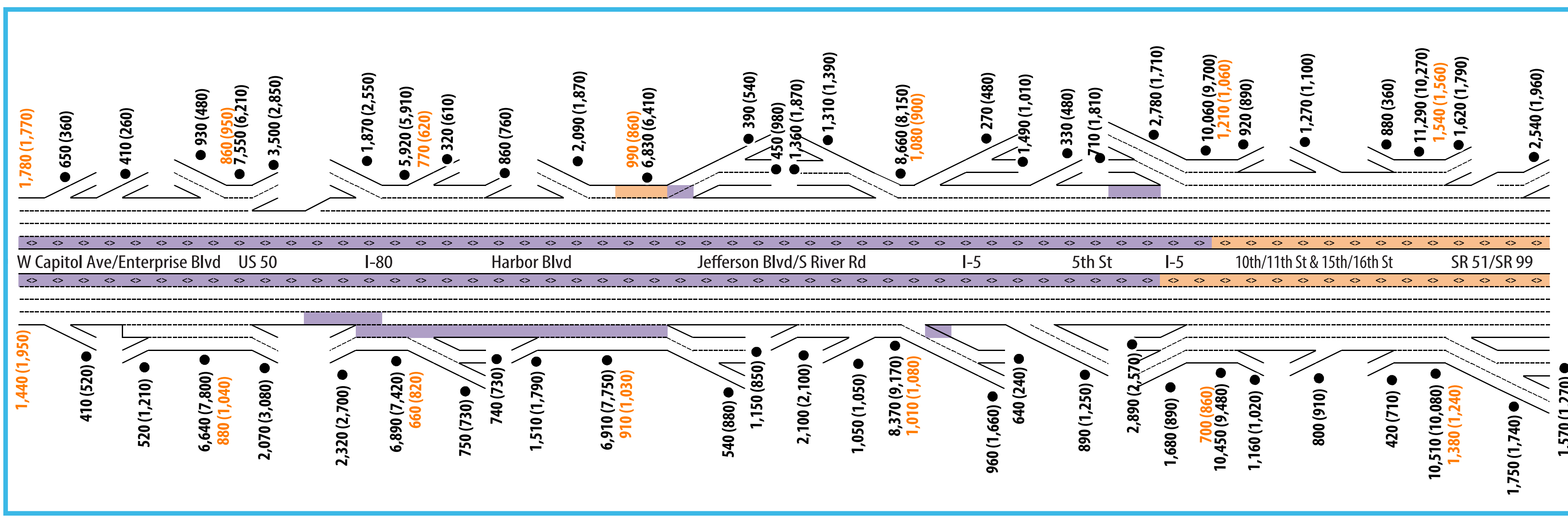
Figure 25

2049 Alternative 8 (Add HOV2 with Median Ramps)
AM & PM Peak Hour Freeway Volumes

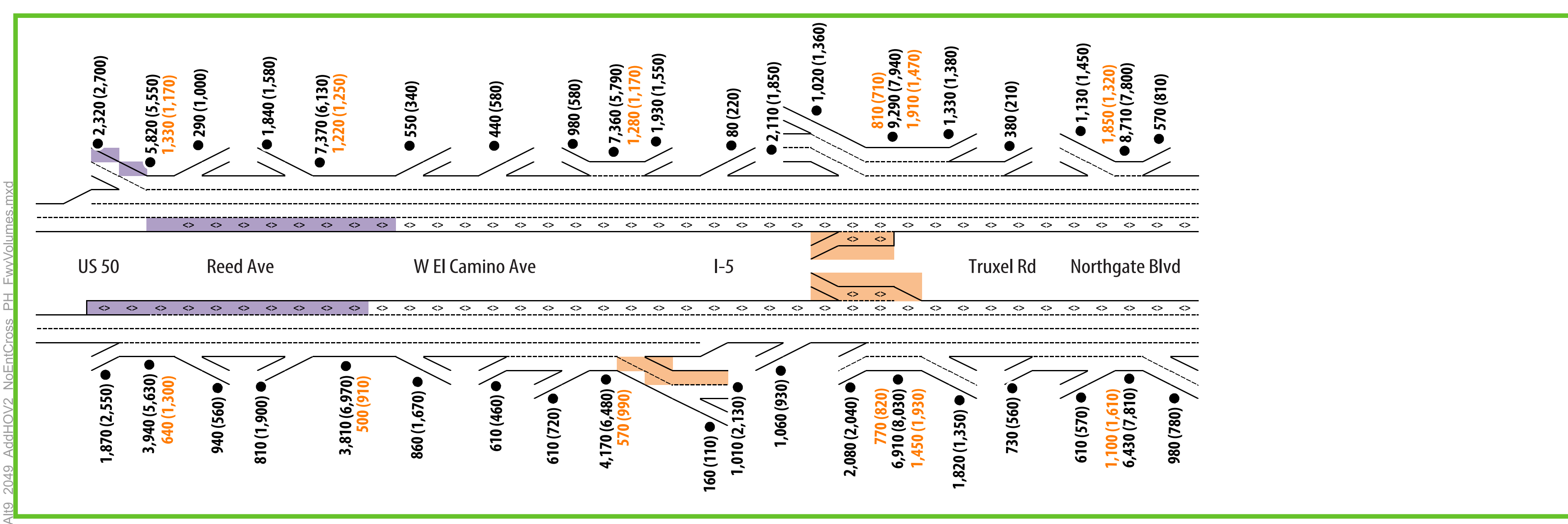
Section A

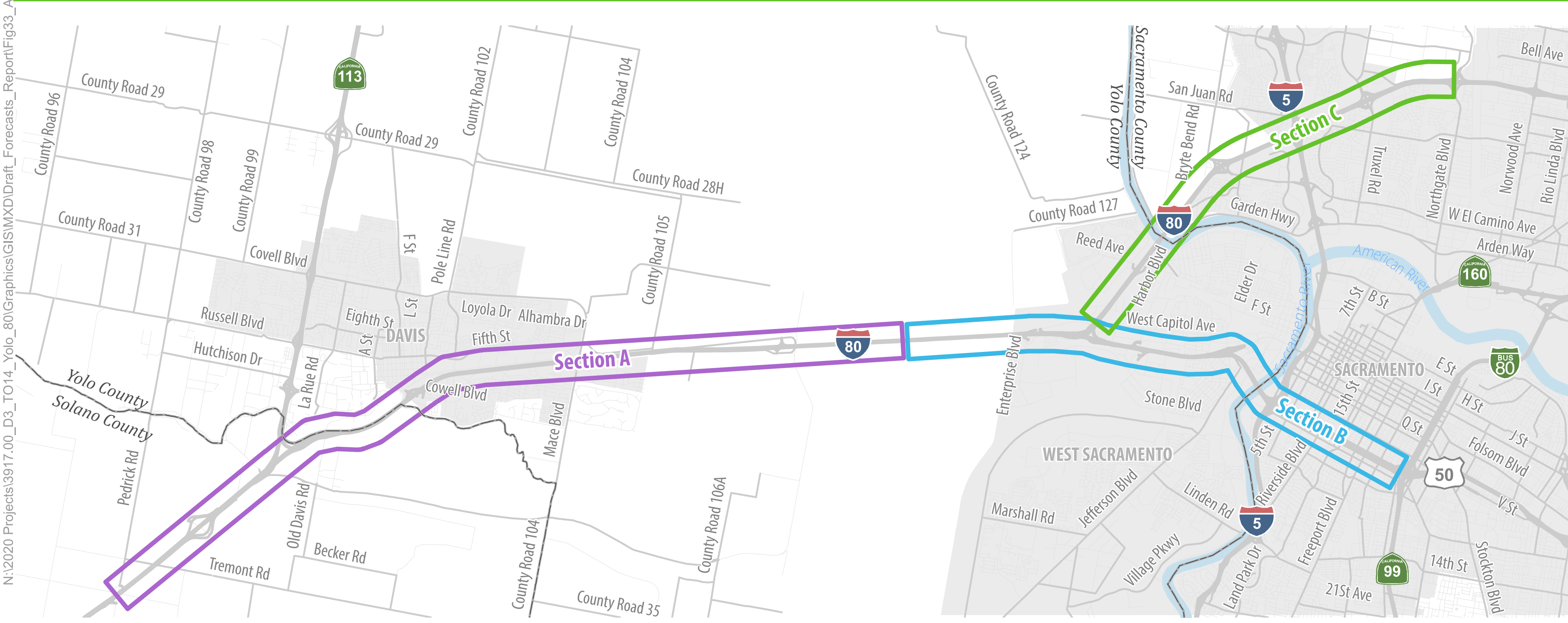


Section B



Section C





x,xxx (x,xxx) AM Peak Hour Volume (PM Peak Hour Volume)

x,xxx (x,xxx) Managed Lane AM Peak Hour Volume (PM Peak Hour Volume)

Separate Planned Projects

Alternative 9

Managed Lane

N

Note: Weekday peak hours are 7-8 AM & 4-5 PM.

Figure 26

2049 Alternative 9 (Add HOV without Enterprise Crossing) AM & PM Peak Hour Freeway Volumes

N:\2020 Projects\3917.00_D3_TO14_Yolo_80\Graphics\GIS\MXD\Draft_Forecasts_Report\Fig33_Alt9_2049_AddHOV2_NoEntCross_PH_FwyVolumes.mxd

Table 39: Eastbound PM Peak Hour Mainline Demand Volumes – Horizon Year 2049

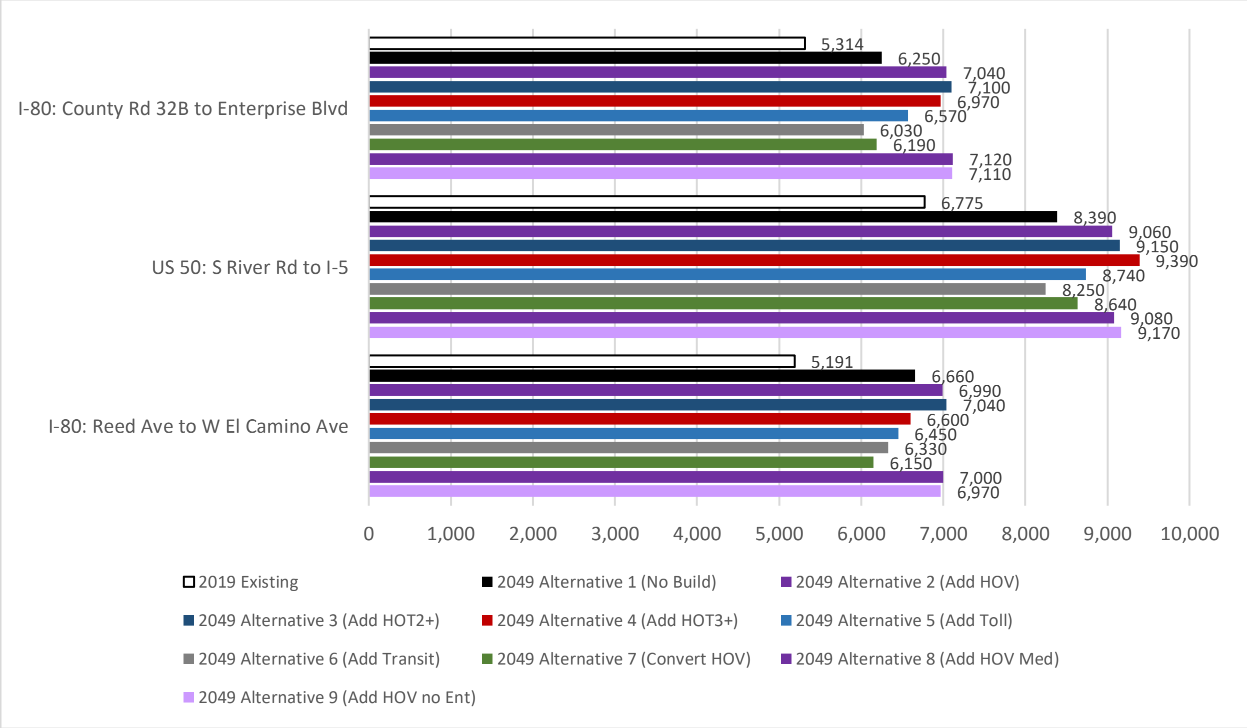
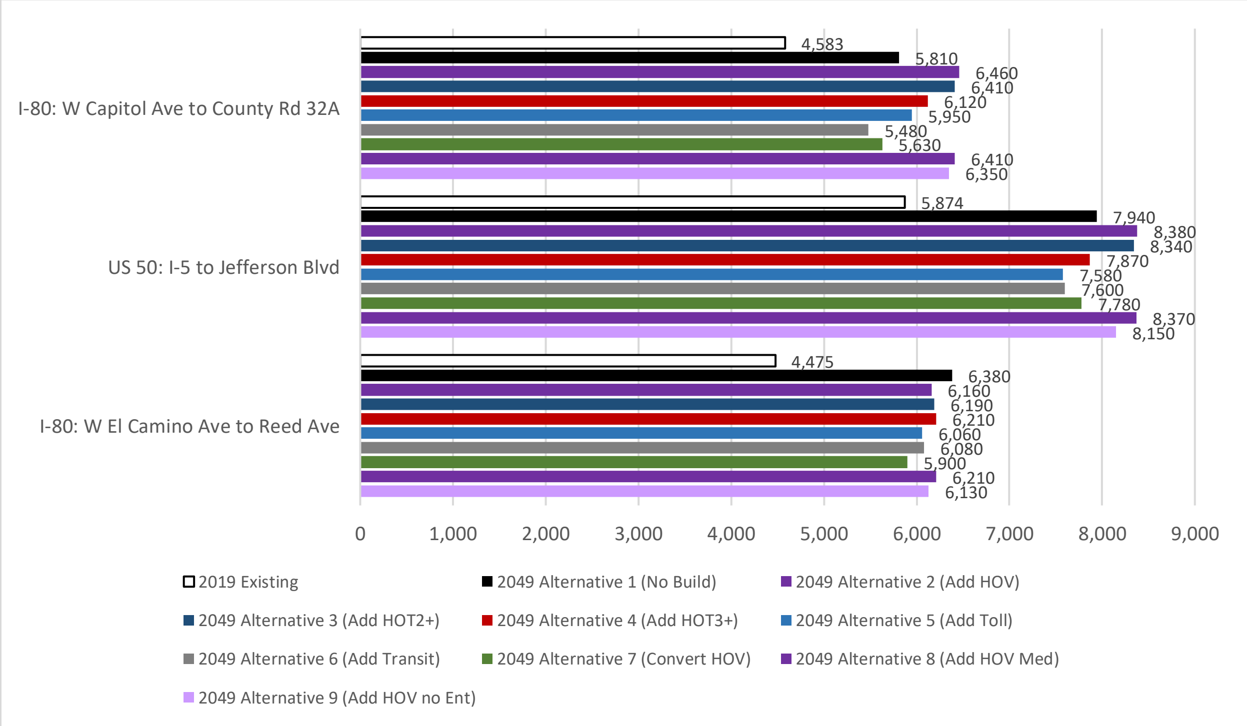


Table 40: Westbound PM Peak Hour Mainline Demand Volumes – Horizon Year 2049



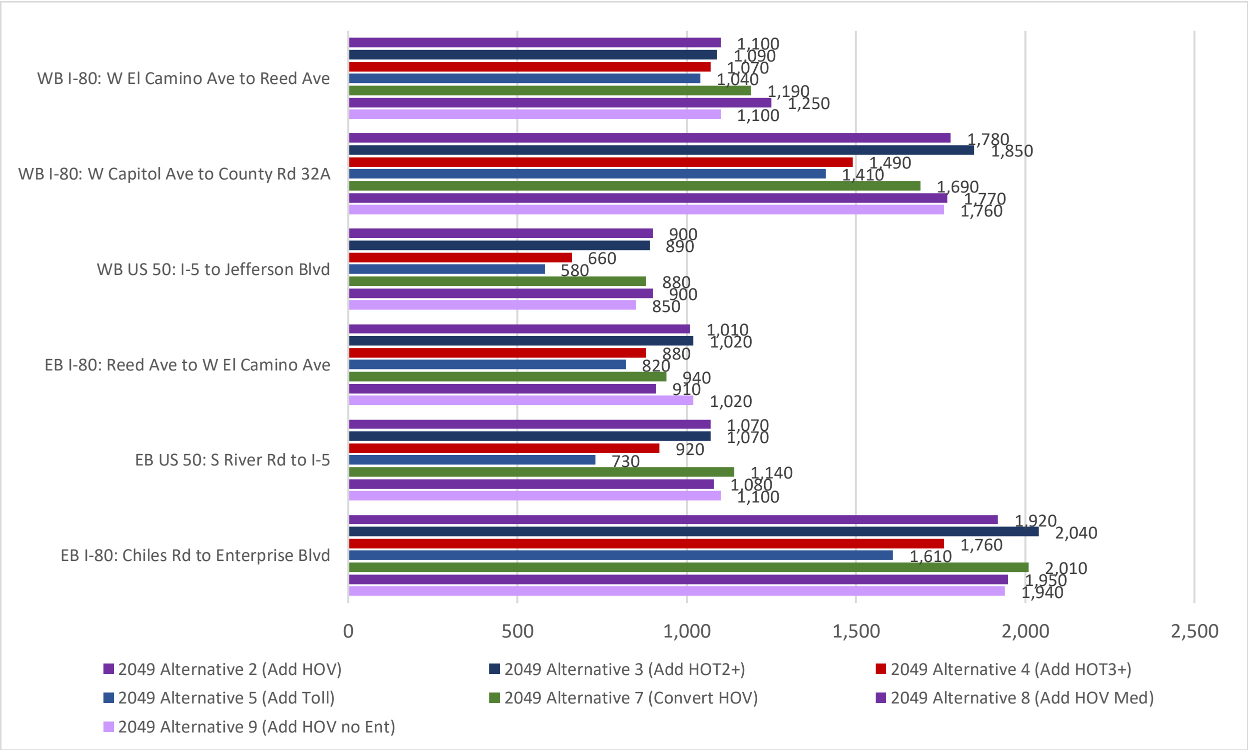
Under Alternative 1, the mainline volumes are expected to grow by 18 to 43 percent compared to existing conditions. The Sacramento River crossings generally have higher growth rates than the Yolo Causeway. Alternatives 1, 6, and 7 have similar mainline volumes for the Yolo Causeway and US 50 at the Sacramento River. These alternatives would have significant congestion at the Yolo Causeway during the PM peak hour since the demand volume (about 2,000 vph per lane) would be higher than the measured capacity of less than 1,500 vph per lane.

With the lane addition under Alternatives 2 through 4, 8, and 9, the PM peak hour demand volume would increase by 720 to 870 vph in the eastbound direction at the Yolo Causeway compared to Alternative 1. Alternative 5 would have a more modest increase of 320 vph. The westbound direction would have somewhat lower increases. Despite the added capacity, congested conditions would still be expected in both directions since the PM peak hour demand would be more than 2,000 vph per lane.

Alternative 6 would restrict the added lane to transit vehicles, which would reduce the vehicle demand volume. However, this alternative has the potential to serve more people. In Alternative 8, the median HOV ramps at the I-80/US 50 interchange would increase demand volumes for eastbound I-80 at the Yolo Causeway and westbound I-80 at the Sacramento River by 70 to 80 vph compared to Alternative 2. Alternative 9, which removes the Enterprise Boulevard bridge at the deep-water ship channel, would reassign traffic at the West Sacramento interchanges, but otherwise have similar freeway volumes at the Yolo Causeway to Alternatives 2 through 4.

Table 41 shows the horizon year 2049 PM peak hour demand volumes for the managed lane under the build alternatives. The eastbound managed lane volume at the Yolo Causeway is at or near the theoretical capacity of freeway lane (2,000 vph) for the alternatives without a majority of tolled vehicles. The westbound demand volumes are lower by about 200 vph, but otherwise like the eastbound volumes. The priced lane alternatives (Alternatives 4 and 5) allow the price to be adjusted so that the lane operates at less than capacity. The managed lane volumes are lower on US 50 at the Sacramento River since the ramp volumes to and from the adjacent I-5 interchange are high. For I-80 at the Sacramento River, the managed lane volumes are lower since the overall freeway volume is lower than the other two locations.

Table 41: PM Peak Hour Managed Lane Demand Volumes – Horizon Year 2049



5.5 Transit Forecasts

5.5.1 Forecast Model

The SACSIM19 regional travel demand model includes both a mode choice model to select transit as a mode and a transit routing model to assign transit vehicles to the network. When preparing the opening year 2029 and horizon year 2049 scenarios, only the vehicle trip tables and roadway network were updated. As a result, transit volume forecasts are available only from the 2027 and 2040 model years.

Table 42 shows the transit routes and headways in the 2027 and 2040 models. The 2027 and 2040 models have the same transit routes and headways since no new transit service is planned in the study area. Additionally, the project alternatives do not propose additional transit service, so all alternatives have the same transit routes and headways.

Table 42: Model Transit Routes and Headways

	Eastbound	Eastbound	Eastbound	Eastbound	Eastbound	Westbound	Westbound	Westbound	Westbound	Westbound
Route	**AM**	**MD**	**PM**	**EV**	**NI**	**AM**	**MD**	**PM**	**EV**	**NI**
Capitol Corridor to Sacramento	120	120	120	120	-	120	120	120	120	-
Capitol Corridor to Auburn	-	-	-	120	-	240	-	-	-	-
Capitol Corridor to Roseville	45	180	45	120	180	45	180	45	120	180
Yolobus Route 42A (WB)/42B (EB)	60	60	60	120	180	60	60	60	120	180
Yolobus Route 43	60	-	-	-	-	-	-	60	-	-
Yolobus Route 43R	-	-	60	-	-	60	-	-	-	-
Yolobus Route 44	90	-	-	-	-	-	-	90	-	-
Yolobus Route 230	20	-	-	-	-	-	-	20	-	-
Yolobus Route 231	-	-	-	-	-	-	-	30	-	-
Yolobus Route 232	30	-	-	-	-	-	-	60	-	-
Causeway Connection (Route 138)	15	30	15	30	-	15	30	15	30	-

Notes: Headways are listed in minutes. The time periods cover approximately the following periods: AM – beginning of service to 10:00 AM, MD – 10:00 AM to 3:00 PM, PM – 3:00 to 6:00 PM, EV – 6:00 to 8:00 PM, and NI – 8:00 PM to end of service.

5.5.2 Bus and Rail Ridership

This section presents the transit ridership forecasts for interim year 2027 and cumulative year 2040.

5.5.2.1 Interim Year 2027

As noted above, the transit trip tables were not adjusted to opening year 2029 conditions. The 2027 model year ridership forecasts presented below can be used to represent the opening year 2029 conditions since the difference is only two years.

Table 43 presents the daily ridership forecasts for the project alternatives under interim year 2027 conditions. **Appendix G** shows the ridership by transit route and time period for each alternative. The ridership includes all trips on the selected transit routes within the SACOG region.

Table 43: Daily Transit Ridership – Interim Year 2027

Alternative	Daily Ridership	Change from Alt 1 (No Build)
1 (No Build)	6,223	-
2 (Add HOV)	6,397	+174 (+2.8%)
3 (Add HOT2+)	6,539	+316 (+5.1%)
4 (Add HOT3+)	6,378	+155 (+2.5%)
5 (Add Toll)	6,564	+341 (+5.5%)
6 (Add Transit)	6,750	+527 (+8.5%)
7 (Convert HOV)	5,934	-289 (-4.6%)
8 (Add HOV with Median Ramps)	6,534	+311 (+5.0%)
9 (Add HOV without Enterprise Crossing)	6,330	+108 (+1.7%)

Most build alternatives show an increase in transit ridership compared to Alternative 1 due to the improved travel time on I-80 and US 50 with the planned improvements. Alternative 6, which provides a transit-only freeway lane, has the highest increase in daily ridership, 8.5 percent, due to the improved transit travel time. The one alternative that has a decrease in transit ridership is Alternative 7. This alternative has increased travel time on the freeway since no lanes are added and both the GP and HOV lanes are congested. Capitol Corridor daily ridership would increase by about 50 percent under Alternative 7, but it is not enough to offset the decrease in bus ridership.

5.5.2.2 Cumulative Year 2040

As noted above, the transit trip tables were not adjusted to horizon year 2049 conditions. The 2040 model year ridership forecasts presented below can be used to approximate the horizon year 2049 conditions although additional increases are likely with the planned land use growth between 2040 and 2049.

Table 44 presents the daily ridership forecasts for the project alternatives under cumulative year 2040 conditions. **Appendix G** shows the ridership by transit route and time period for each alternative.

Table 44: Daily Transit Ridership – Cumulative Year 2040

Alternative	Daily Ridership	Change from Alt 1 (No Build)
1 (No Build)	7,194	-
2 (Add HOV)	7,595	+401 (+5.6%)
3 (Add HOT2+)	7,571	+377 (+5.2%)
4 (Add HOT3+)	7,464	+271 (+3.8%)
5 (Add Toll)	7,359	+165 (+2.3%)
6 (Add Transit)	8,232	+1,038 (+14.4%)
7 (Convert HOV)	6,923	-270 (-3.8%)
8 (Add HOV with Median Ramps)	7,433	+239 (+3.3%)
9 (Add HOV without Enterprise Crossing)	7,493	+299 (+4.2%)

Similar to interim year 2027 conditions, most build alternatives show an increase in transit ridership compared to Alternative 1 due to the improved travel time on I-80 and US 50 with the planned improvements. Alternative 6, which provides a transit-only freeway lane, has the highest increase in daily ridership, 14.4 percent, due to the improved transit travel time. The one alternative that has a decrease in transit ridership is Alternative 7, which would decrease by 3.8 percent.

5.6 Traffic Index

Using the daily volume forecasts for opening year 2029 and horizon year 2049, the traffic index for pavement design was calculated for the project alternatives according to the *Highway Design Manual* procedure. The traffic index is provided for three segments in the study area: I-80 From the Solano County line to US 50, US 50 from I-80 to I-5, and I-80 from US 50 to the Sacramento River. **Table 45**, **Table** 46, and **Table** 47 summarize the recommended 10-year, 20-year, and 40-year mainline traffic indices by build alternative. The reports are provided in **Appendix H**.

Table 45: Traffic Index – I-80 from Solano County Line to US 50

	10 Year	10 Year	10 Year	20 Year	20 Year	20 Year	40 Year	40 Year	40 Year
Alternative	**Median**	**Outside**	**Shoulder**	**Median**	**Outside**	**Shoulder**	**Median**	**Outside**	**Shoulder 1**
2 (Add HOV)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
3 (Add HOT2+)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
4 (Add HOT3+)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
5 (Add Toll)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
6 (Add Transit)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
7 (Convert HOV)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
8 (Add HOV with Median Ramps)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0
9 (Add HOV without Enterprise Crossing)	11.0	13.0	8.5	12.0	14.0	9.0	13.0	15.5	9.0

Note: 1. Maximum TI for shoulder is 9.0 per the *Highway Design Manual* Chapter 610.

Table 46: Traffic Index – US 50 from I-80 to I-5

	10 Year	10 Year	10 Year	20 Year	20 Year	20 Year	40 Year	40 Year	40 Year
Alternative	**Median**	**Outside**	**Shoulder**	**Median**	**Outside**	**Shoulder 1**	**Median**	**Outside**	**Shoulder 1**
2 (Add HOV)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0
3 (Add HOT2+)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0
4 (Add HOT3+)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0
5 (Add Toll)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0
6 (Add Transit)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	15.5	9.0
7 (Convert HOV)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	15.5	9.0
8 (Add HOV with Median Ramps)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0
9 (Add HOV without Enterprise Crossing)	11.5	13.5	8.5	12.5	14.5	9.0	13.5	16.0	9.0

Note: 1. Maximum TI for shoulder is 9.0 per the *Highway Design Manual* Chapter 610.

Table 47: Traffic Index – I-80 from US 50 to Sacramento River

	10 Year	10 Year	10 Year	20 Year	20 Year	20 Year	40 Year	40 Year	40 Year
Alternative	**Median**	**Outside**	**Shoulder**	**Median**	**Outside**	**Shoulder**	**Median**	**Outside**	**Shoulder**
2 (Add HOV)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
3 (Add HOT2+)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
4 (Add HOT3+)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
5 (Add Toll)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
6 (Add Transit)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
7 (Convert HOV)	10.0	12.0	8.0	11.0	13.0	8.5	12.0	14.0	9.0
8 (Add HOV with Median Ramps)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0
9 (Add HOV without Enterprise Crossing)	10.5	12.0	8.0	11.0	13.0	8.5	12.0	14.5	9.0

6. Opening Year (2029)

This chapter presents the freeway operations analysis results under the opening year (2029). Additional details for the operational analysis performance are provided in **Appendix I**.

6.1 Planning Analysis

The HCS analysis identified the following locations with LOS F conditions under Alternative 1 during the AM peak hour under the opening year 2029.

- I-80 eastbound from Mace Boulevard off-ramp to Mace Boulevard northbound on-ramp
- US 50 westbound from SR 99 on-ramp to 16th Street
- US 50 westbound from 15th Street to I-5
- I-80 westbound from West Capitol Avenue off-ramp to County Road 32A on-ramp

The first three areas match the existing conditions findings. For the last area, the segments with LOS F expanded upstream and downstream with the higher demands under opening year 2029 conditions.

Two of the three weaving segments with LOS F according to the Leisch Method continued to have LOS F during the AM peak hour under Alternative 1: US 50 eastbound from I-5 to 15th Street and I-80 eastbound from I-5 to Truxel Road. US 50 westbound from SR 51 to 16th Street improved to LOS E due to the volume changes. However, a new location was identified as LOS F: I-80 westbound from Truxel Road to I-5.

For Alternative 2, new LOS F locations during the AM peak hour are listed below.

- US 50 eastbound from Jefferson Boulevard on-ramp to I-5 off-ramp
- US 50 eastbound from 5th Street off-ramp to 15th Street
- US 50 eastbound from 16th Street to SR 51/SR 99

The eastbound I-80 bottleneck at Mace Boulevard expands upstream by one segment to Richards Boulevard. The congested area on eastbound I-80 at the Yolo Bypass shifts from West Capitol Avenue off-ramp to County Road 32A to US 50 to West Capitol Avenue westbound on-ramp. The Leisch Method for Alternative 2 has a new location with LOS F: westbound I-80 from US 50 to West Capitol Avenue.

Alternatives 3 through 5, 8 and 9 have similar bottleneck locations and congested LOS F segments as Alternative 2. The results for Alternative 6 are also generally similar to Alternative 2 except for westbound I-80 at the Yolo Causeway where the congested area would be the same as Alternative 1. Alternative 7 results would expand the congested area under Alternative 2 at two locations: the eastbound I-80 at Mace Boulevard congested area would extend upstream to the Richards Boulevard off-ramp and the westbound I-80 at the Yolo Bypass congested area would extend from US 50 to Mace Boulevard. Two new congested areas were also identified: westbound I-80 from Northgate Boulevard to I-5 and westbound I-80 at Reed Avenue. The Leisch Method for Alternative 8 identifies a new segment with LOS F: eastbound I-80 from Enterprise Boulevard to US 50. This weaving segment has fewer lanes than the other alternatives so that the median ramps at the I-80/US 50 interchange can be constructed with fewer impacts.

The HCS analysis identified the following locations with LOS F conditions under Alternative 1 during the PM peak hour.

- I-80 eastbound from Mace Boulevard off to on-ramp to Mace Boulevard northbound on-ramp
- I-80 eastbound from County Road 32B off-ramp to County Road 32B on-ramp
- US 50 eastbound from Jefferson Boulevard off-ramp to I-5 off-ramp
- US 50 eastbound from I-5 to SR 51/SR 99
- I-80 eastbound from I-5 southbound on-ramp to Truxel Road
- US 50 westbound from SR 51 to I-5
- US 50 westbound at the Jefferson Boulevard off-ramp
- I-80 westbound at the West Capitol Avenue westbound on-ramp

The first two areas match the existing conditions findings. The next two areas expand the congested areas near downtown Sacramento. The eastbound location between I-5 and Truxel Road is new. In the westbound direction, the downtown Sacramento congested area is expanded, but the other two locations are the same as existing conditions. The location with LOS F under the Leisch Method during the PM peak hour is the same as existing conditions.

For Alternative 2, locations that improve from LOS F during the PM peak hour are listed below.

- US 50 eastbound at Jefferson Boulevard off to on-ramp
- US 50 eastbound at 15th Street off-ramp to 11th Street on-ramp
- I-80 eastbound at I-5 Southbound on-ramp

The eastbound I-80 bottleneck at Mace Boulevard expands upstream by one segment to the Mace Boulevard off-ramp. The congested area on eastbound I-80 at I-5 expands to cover from the I-5 off-ramp to the I-5 southbound on-ramp.

Alternatives 3 through 5, 8, and 9 have similar bottleneck locations and congested LOS F segments as Alternative 2. The results for Alternative 6 are also generally similar to Alternative 2 except for worse conditions for eastbound US 50 at Jefferson Boulevard. Alternative 7 results would expand the congested area under Alternative 2 by one segment at eastbound I-80 at Mace Boulevard, eastbound I-80 at County Road 32B, and eastbound US 50 at I-5. New congested areas would occur on eastbound I-80 from US 50 to West El Camino Avenue and westbound I-80 from Truxel Road to I-5.

As in the AM peak hour, the Leisch Method for Alternative 8 identifies a new segment with LOS F: eastbound I-80 from Enterprise Boulevard to US 50.

6.2 Simulation Analysis

6.2.1 Ramp Meters

In 2020, most existing ramp meters in the Sacramento area were converted from peak period to full time operation. For opening year 2029 conditions, the existing ramp meters (see **Table 9**) are planned to operate continuously based on freeway demand so that the metering can turn on at any time of day. As part of separate projects, meter signals will be installed on existing HOV preferential lanes. **Table 48** lists the ramp meters that are expected to be installed under separate projects for all project alternatives. **Table 49** lists the ramp meters that would be installed under the project. These ramp meters are included only in Alternatives 2 through 9.

Table 48: Additional Ramp Meters – Opening Year 2029

Route and Direction	Location	Lanes	Cars per Green	Hours
I-80 Eastbound	Reed Ave	2 GP	1	24 hours
	Truxel Rd NB	2 GP	1	24 hours
I-80 Westbound	Northgate Blvd SB	1 GP	1	24 hours
	Truxel Rd NB	2 GP	1	24 hours
	Truxel Rd SB	2 GP	1	24 hours
	W El Camino Ave WB	1 GP	1	24 hours
	W El Camino Ave EB	1 GP	1	24 hours
	Reed Ave	2 GP	1	24 hours
	W Capitol Ave EB	1 GP	1	24 hours
	W Capitol Ave WB	1 GP, 1 HOV	1	24 hours
	Richards Blvd	2 GP, 1 HOV	1	24 hours
US 50 Eastbound	Jefferson Blvd	2 GP	2	24 hours
	S River Rd	1 GP	2	24 hours
US 50 Westbound	5th St	2 GP	1	24 hours
	Jefferson Blvd	1 GP	1	24 hours
	Tower Bridge Gateway	2 GP	1	24 hours

Notes: GP – metered GP lane, HOV – metered HOV preferential lane

Table 49: Build Alternative Ramp Meters

Route and Direction	Location	Lanes	Cars per Green	Hours
I-80 Eastbound	SR 113	2 GP	1	24 hours
	Old Davis Rd	1 GP, 1 HOV	1	24 hours
	Richards Blvd	2 GP	1	24 hours
I-80 Westbound	County Rd 32A	1 GP	1	24 hours
	Mace Blvd	2 GP	1	24 hours
	Old Davis Rd	1 GP	1	24 hours
	SR 113	2 GP	1	24 hours

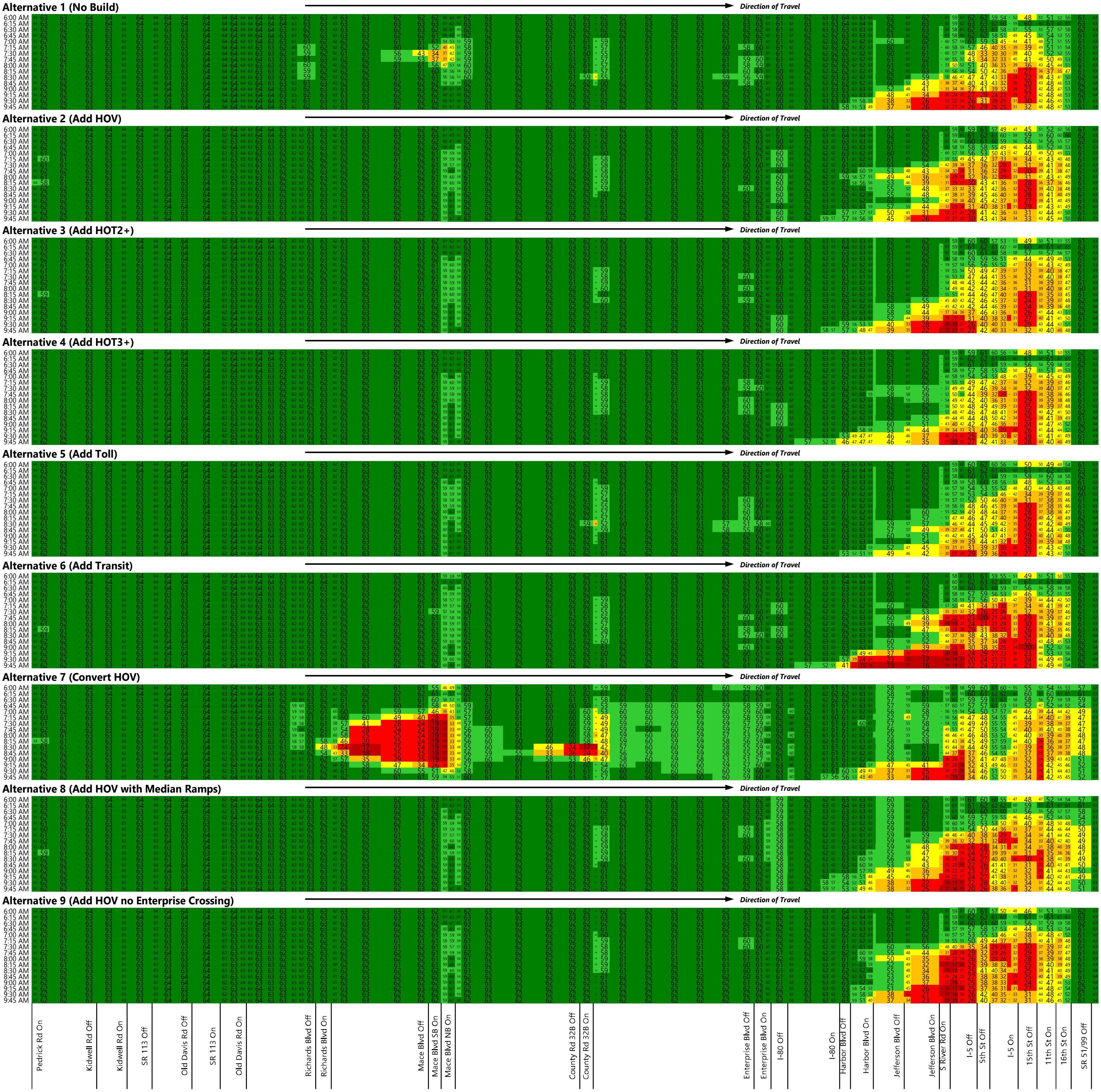
Notes: GP – metered GP lane, HOV – metered HOV preferential lane

Caltrans staff provided the ramp meter timing settings to be used for Alternative 2 under horizon year 2049. The ramp meter timings were adjusted for opening year 2029 conditions only if the on-ramp peak hour demand volume differed from the Alternative 2 horizon year 2049 on-ramp volume by more than 50 vph.

6.2.2 Travel Speed

Speed contour plots were prepared for the eastbound and westbound freeway study corridors: I-80 at Pedrick Road to US 50 at SR 51/SR 99 and I-80 from US 50 to Northgate Boulevard under opening year 2029. The AM and PM peak period speed contour plots for the GP lanes on these corridors are provided in **Figure 27** through **Figure** 30. The speed contour plots for all lanes and for managed lanes are provided in **Appendix I**.

Figure 27 shows the speed contour plots for the AM and PM peak periods for the eastbound corridor from I-80 at Pedrick Road to US 50 at SR 51/SR 99. For the AM peak period, all alternatives show a bottleneck on US 50 in downtown Sacramento that would extend back to Harbor Boulevard by the end of the peak period. Alternative 1 would have a bottleneck of about an hour at Mace Boulevard. The only other alternative with a Mace Boulevard bottleneck is Alternative 7, which would have a three-hour congested period with queues extending to Richards Boulevard. Alternative 7 would also have a bottleneck at County Road 32B and a more severe bottleneck at the I-5 off-ramp since it maintains the existing one-lane off-ramp instead of widening to two lanes as in the other build alternatives.

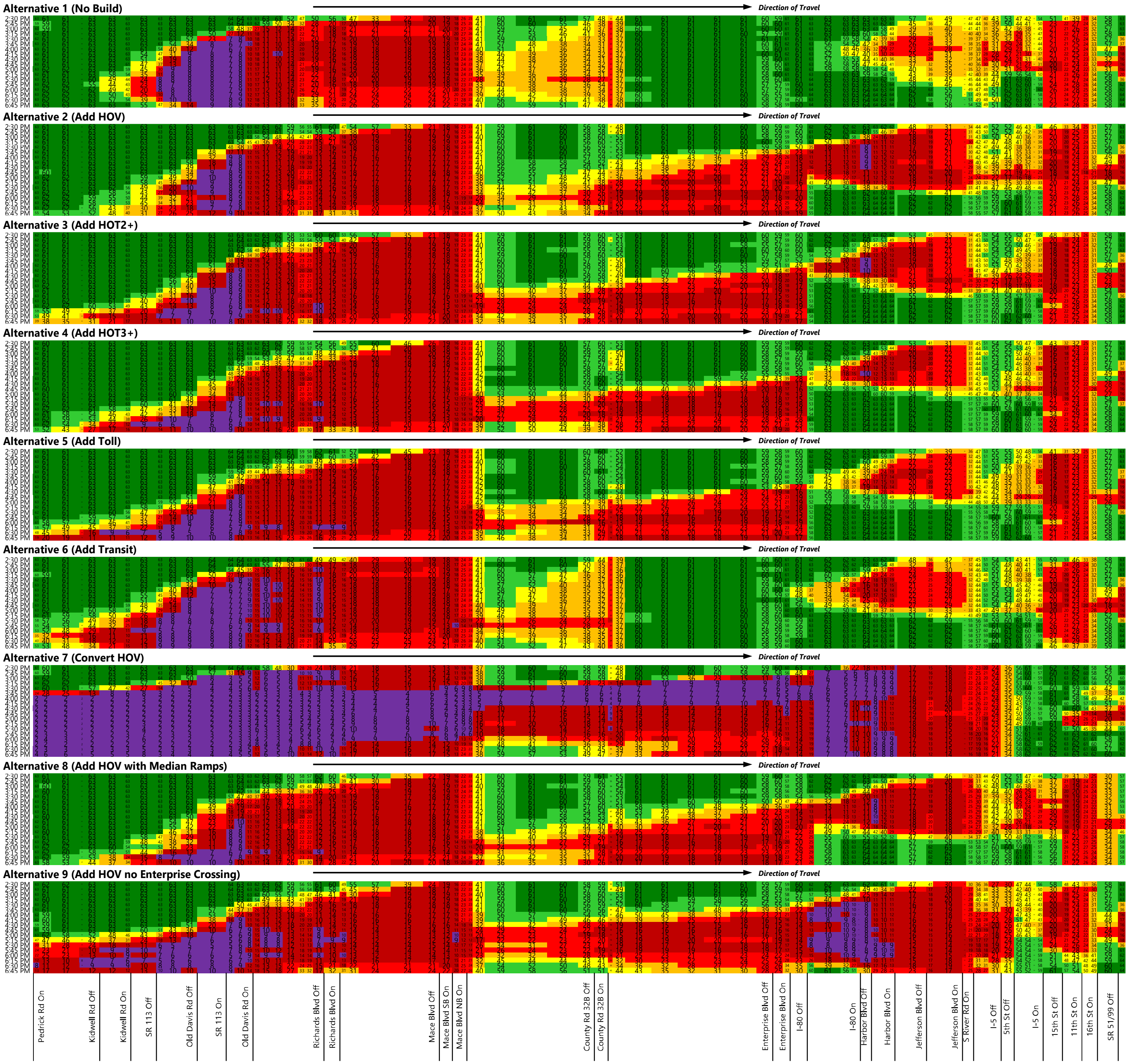


Note: The speed is an average of the GP lanes.

Figure 27a

Eastbound Speed from I-80 at Pedrick Road to US 50 at SR 51/SR 99 Opening Year 2029 - AM Peak Period

M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\AI\Traffic_Ops_Report

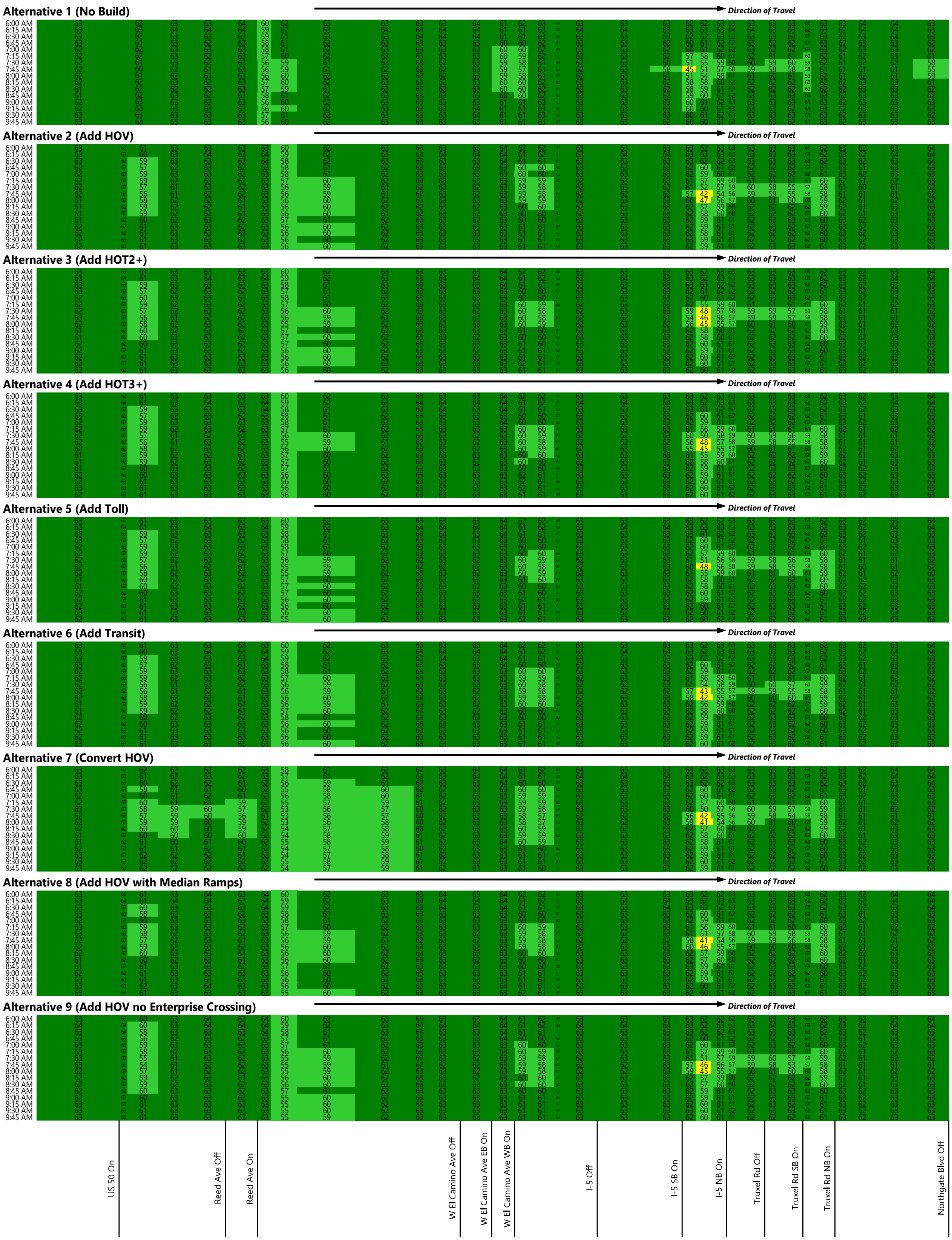


Note: The speed is an average of the GP lanes.

Figure 27b

Eastbound Speed from I-80 at Pedrick Road to US 50 at SR 51/SR 99
Opening Year 2029 - PM Peak Period

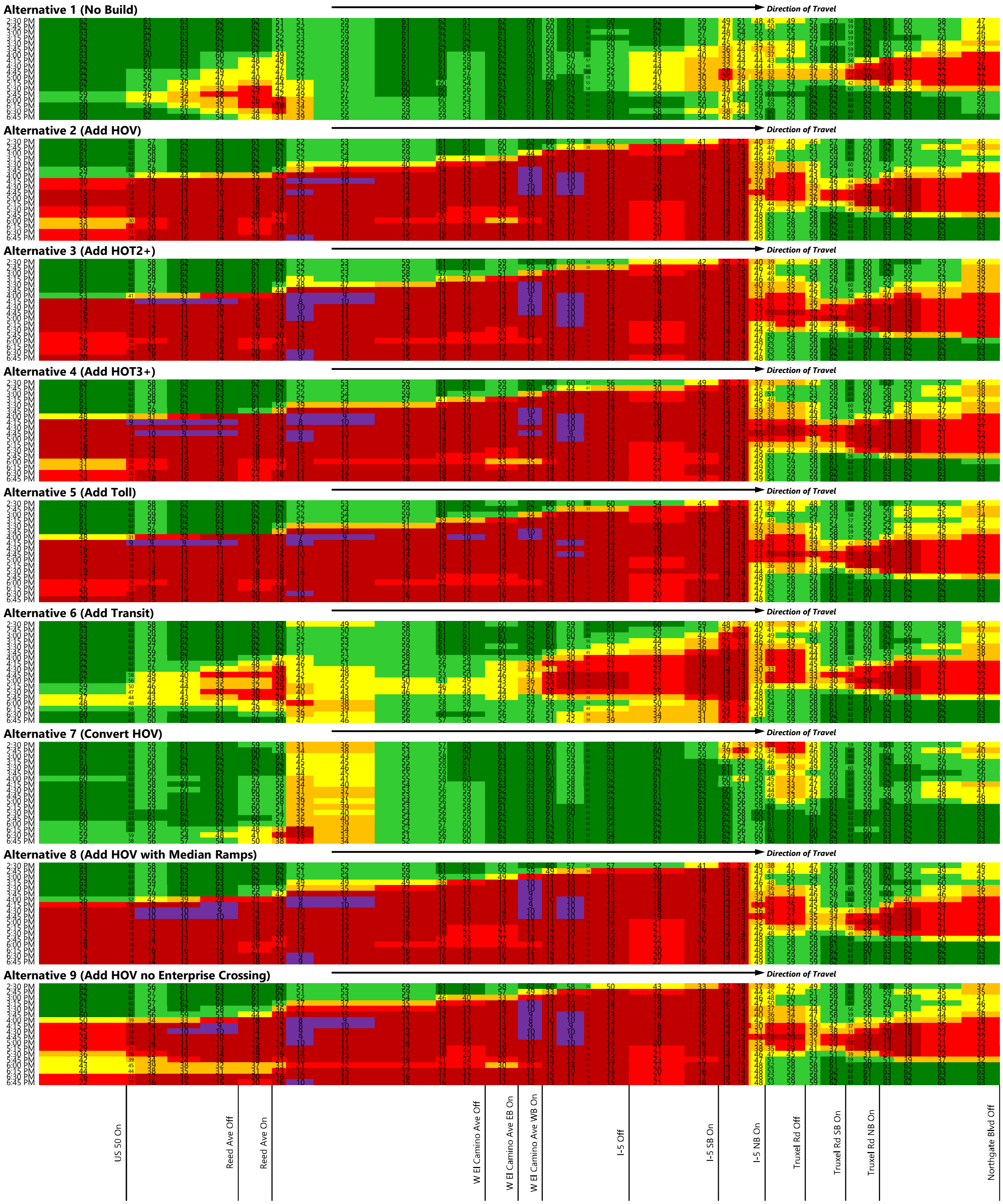
M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\AI\Traffic_Ops_Report



Note: The speed is an average of the GP lanes.

Figure 28a

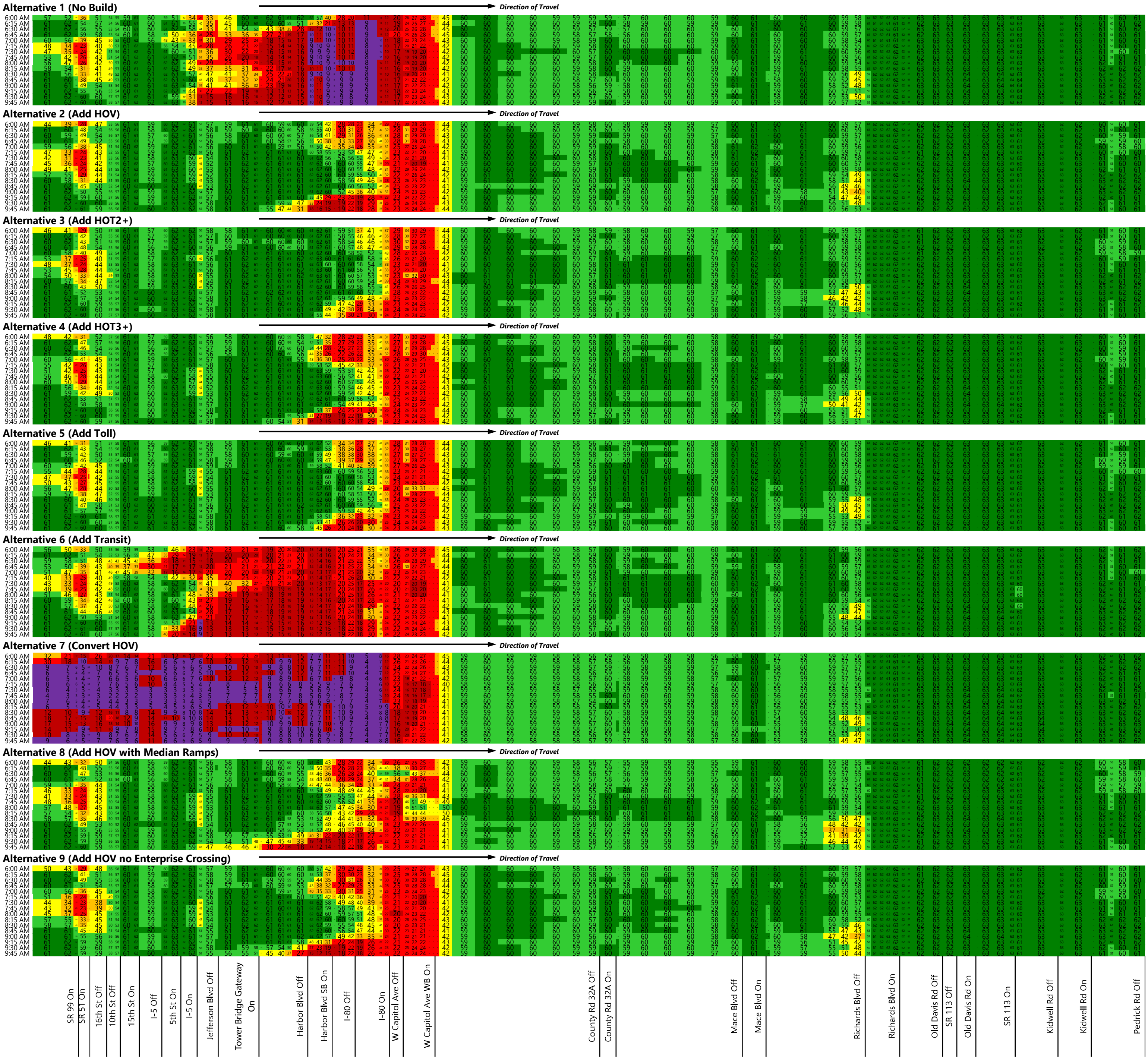
Eastbound Speed from I-80 at US 50 to Northgate Boulevard Opening Year 2029 - AM Peak Period



Note: The speed is an average of the GP lanes.

Figure 28b

Eastbound Speed from I-80 at US 50 to Northgate Boulevard
Opening Year 2029 - PM Peak Period

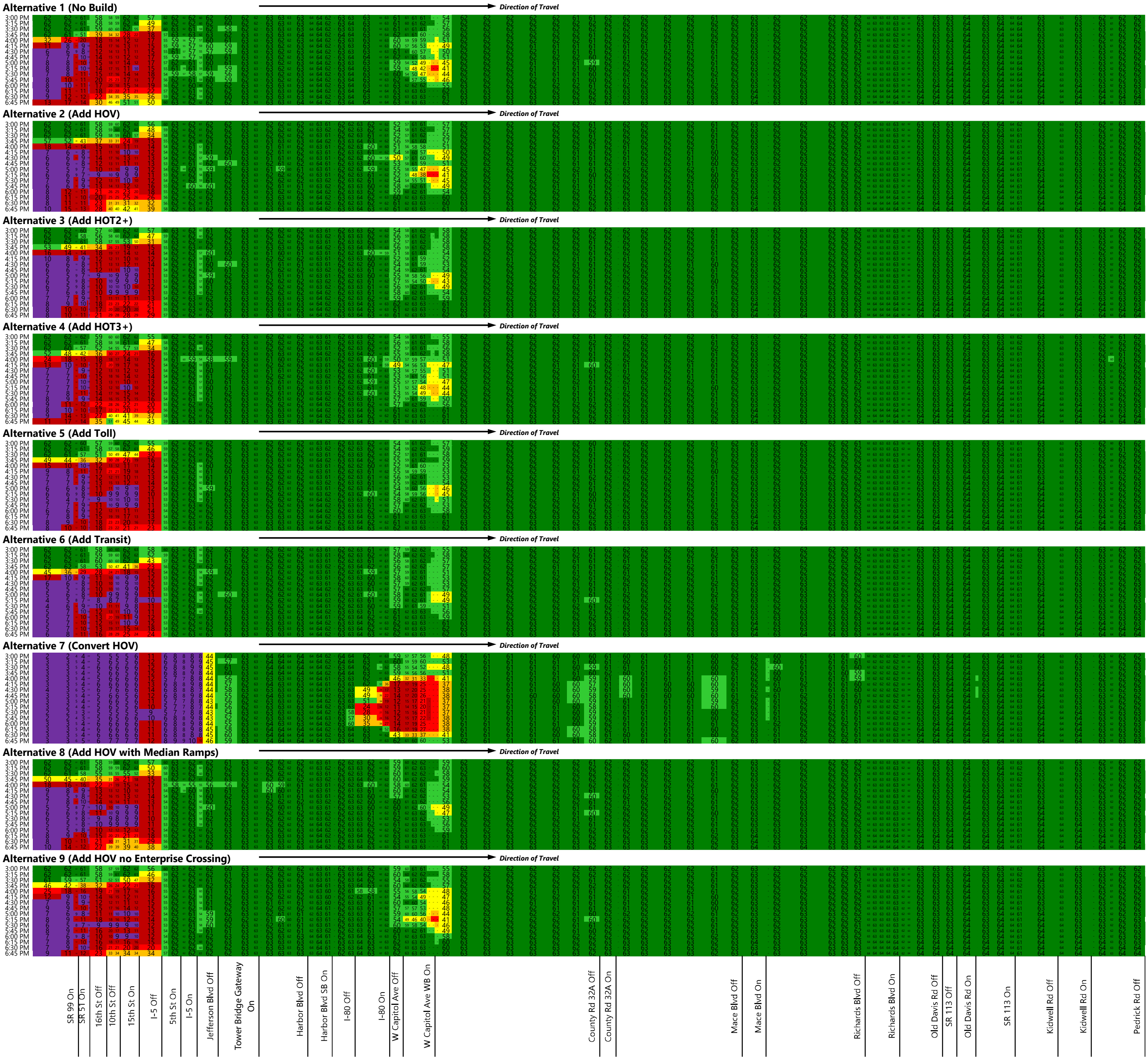


Note: The speed is an average of the GP lanes.

Figure 29a

Westbound Speed from US 50 at SR 51/SR 99 to I-80 at Pedrick Road Opening Year 2029 - AM Peak Period

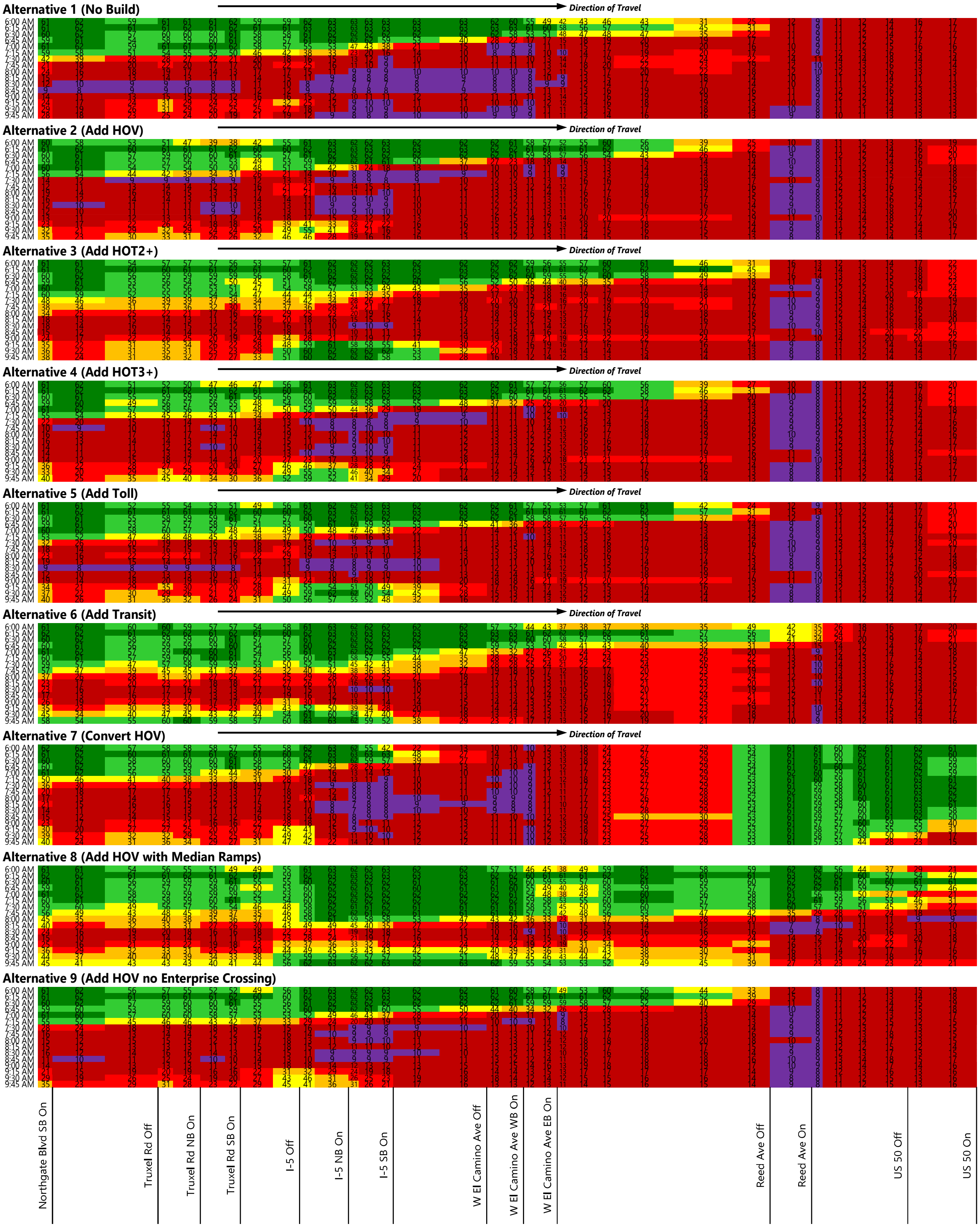
M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\AI\Traffic_Ops_Report



Note: The speed is an average of the GP lanes.

Figure 29b

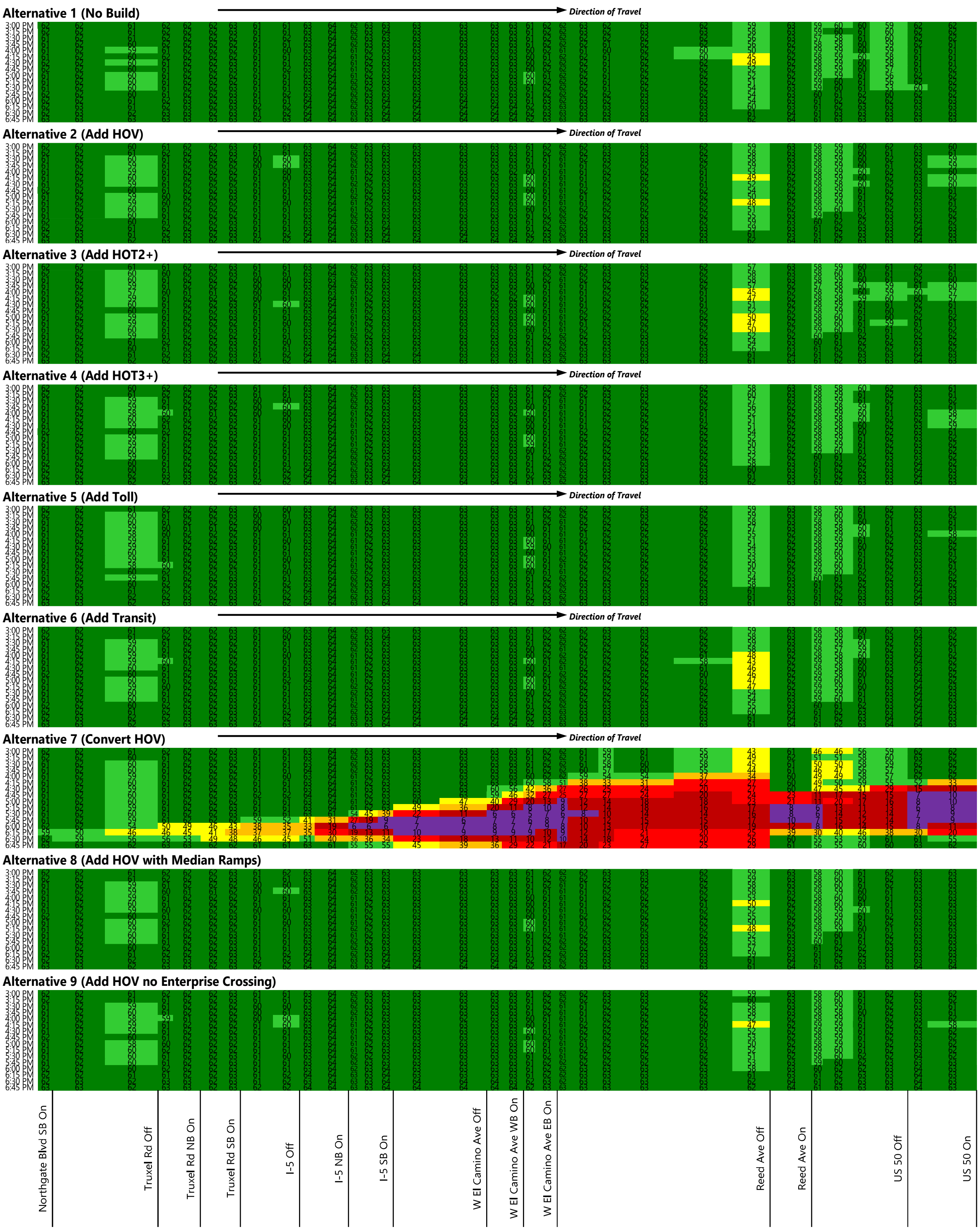
Westbound Speed from US 50 at SR 51/SR 99 to I-80 at Pedrick Road Opening Year 2029 - PM Peak Period



Note: The speed is an average of the GP lanes.

Figure 30a

Westbound Speed from I-80 at Northgate Boulevard to US 50 Opening Year 2029 - AM Peak Period



Note: The speed is an average of the GP lanes.

Figure 30b

Westbound Speed from I-80 at Northgate Boulevard to US 50
Opening Year 2029 - PM Peak Period

For the PM peak period, eastbound I-80 to eastbound US 50 would have congestion for most of the peak period under all alternatives. Alternatives 1 and 6 would have similar congestion patterns with a major bottleneck at Mace Boulevard and minor downstream bottlenecks at County Road 32B and between Jefferson Boulevard and I-5. Alternatives 2 through 5 and 8 would have a less severe bottleneck at Mace Boulevard and would remove the bottleneck at County Road 32B. However, a new bottleneck would occur at the I-80/US 50 interchange due to traffic backing up from a downstream bottleneck on I-80 at I-5 as shown in **Figure 28**. Alternative 7 would be congested for the entire peak period due to major bottlenecks at Mace Boulevard, County Road 32B, Harbor Boulevard, and I-5.

Figure 28 shows the speed contour plots for the AM and PM peak periods for the eastbound corridor on I-80 from US 50 to Northgate Boulevard. For the AM peak period, the I-5 southbound on-ramp would be a minor (15- to 30-minute) bottleneck under most alternatives. For the PM peak period, the southbound I-5 on-ramp would be the primary bottleneck for Alternatives 2 through 5, 8, and 9 causing congestion back onto eastbound I-80 at US 50 by about 4:00 PM. Planned improvements at the I-5/I-80 interchange would partially reduce congestion through an additional lane on the I-5 off-ramp. The Reed Avenue on-ramp and the adjacent Sacramento River bridge would show up as a bottleneck under Alternatives 1, 6, and 7 since these alternatives deliver less volume to this corridor due to upstream bottlenecks.

Figure 29 shows the speed contour plots for the AM and PM peak periods for the westbound corridor from US 50 at SR 51/SR 99 to I-80 at Pedrick Road. All alternatives would have similar congestion on westbound US 50 in downtown Sacramento at the 16th Street off-ramp during the AM peak period. Congestion from the bottleneck on I-80 at the Yolo Causeway would extend back to I-5 under Alternatives 1 and 6. For Alternative 7, the congestion would extend through downtown and last the entire peak period. For most of the other alternatives, the lane drop after the I-80 off-ramp would be a minor bottleneck that would cause a queue to extend to Harbor Boulevard by the end of the peak period.

During the PM peak hour, the I-5 off-ramp bottleneck would constrain entering traffic demand. For Alternative 7, Jefferson Boulevard would be a major bottleneck that would last longer than the peak period. Alternative 7 would also have a two-and-a-half-hour downstream bottleneck at the Yolo Causeway. For the other alternatives, congestion at the Yolo Causeway bottleneck would last an hour or less. Congestion at this location under Alternative 9 would last about two hours due to the travel volume shift from Enterprise Boulevard to Harbor Boulevard without the planned Enterprise Boulevard bridge over the shipping channel.

Figure 30 shows the speed contour plots for the AM and PM peak periods for the westbound corridor on I-80 from Northgate Boulevard to US 50. During the AM peak period, most alternatives would be severely congested, with congested speeds extending upstream to merge with a bottleneck at I-5. Alternatives 2 through 5 would show less congestion than Alternative 1. For Alternative 7, the bottleneck would be the grade at the Sacramento River bridge due to fewer lanes for this alternative. Alternative 8 would have the highest average speeds since more capacity is provided at the I-80/US 50 interchange with the median connector ramp for HOVs. With this alternative, congestion would be reduced to less than two hours between Reed Avenue and US 50.

For the PM peak period, most alternatives would have speeds greater than 50 mph with only minor slowing near the Reed Avenue off-ramp. The exception is Alternative 7, which would have congestion extending upstream from the I-5/I-80 interchange through Reed Avenue. The Reed Avenue off-ramp would be another bottleneck resulting in congestion extending to Truxel Road.

6.2.3 Bottleneck Throughput

Opening year 2029 AM and PM peak period throughput at the primary bottleneck in each direction are reported in **Table 50** and **Table** 51, respectively. **Appendix I** provides the total vehicles served and persons served for mainline freeway segments for each of the four hours in the AM and PM peak periods. In the eastbound direction, the main bottleneck is on I-80 at Mace Boulevard. In the westbound direction, the main bottleneck is on I-80 at the Yolo Causeway.

Table 50: Eastbound Peak Period Throughput: I-80 at Mace Boulevard – Opening Year 2029

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicles served	17,400	**19,200**	**19,200**	18,900	18,500	17,600	15,900	**19,200**	19,100
Persons served	27,400	**29,900**	29,500	28,700	28,600	27,900	25,500	**29,900**	**29,900**
PM Peak Period									
Vehicles served	19,000	**23,400**	23,100	22,600	22,300	19,000	11,800	23,100	22,100
Persons served	29,500	**36,500**	35,100	34,200	34,600	29,900	18,500	35,900	34,200

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

Table 51: Westbound Peak Period Throughput: I-80 at Yolo Causeway – Opening Year 2029

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicles served	23,400	27,300	28,000	27,100	27,400	24,100	18,800	**28,200**	27,200
Persons served	36,900	42,600	42,800	41,300	42,700	38,500	30,100	**44,100**	42,800
PM Peak Period									
Vehicles served	17,900	**21,200**	21,000	21,100	20,700	17,900	16,800	21,000	21,000
Persons served	28,700	**33,800**	33,100	**33,800**	33,400	29,000	27,500	33,700	**33,800**

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

For eastbound I-80 at Mace Boulevard, the AM peak period would have low congestion under the build alternatives, so the vehicle served at the bottleneck would be similar across most alternatives. Alternatives 2, 3, and 8 would serve the most vehicles. Due to differences in average vehicle occupancy, Alternatives 2, 8, and 9 would serve the most people. For the PM peak period, Alternative 2 would serve the most vehicles and people although Alternatives 3 and 8 would serve almost as many. Alternative 7 would serve the fewest vehicles and people during both peak periods.

For westbound I-80 at the Yolo Causeway, the AM peak period would be congested causing queues upstream on both I-80 and US 50. Alternative 8 would serve the most vehicles and people. Alternatives 2 through 5 and 9 would also serve about as many vehicles and people as Alternative 8. During the PM peak period, Alternative 2 would serve the most vehicles, but Alternatives 2, 4, and 9 would serve the most people. Like in the eastbound direction, Alternative 7 would serve the fewest vehicles and people at the main westbound bottleneck.

6.2.4 Corridor Travel Time

Opening year 2029 AM and PM peak hour travel times for the GP and managed lanes are reported in **Table 52** and **Table** 53, respectively. **Appendix I** provides the overall travel time and travel times for the other three hours in the peak periods. The travel time for three corridors is reported: I-80 between Kidwell Road in Solano County and US 50, US 50 between I-80 and SR 51/SR 99, and I-80 between US 50 and Truxel Road. The free-flow travel time is about 12 minutes for the first corridor and about 5 minutes for the other two corridors.

During the AM peak hour, eastbound average travel time in the GP lanes would be highest for Alternative 7 for I-80 from Kidwell Road to US 50 and from US 50 to Truxel Road. Travel times for the managed lane would be highest for Alternative 1 which has the shortest managed lanes. Compared to Alternative 1, the Alternatives 2 through 5, 8, and 9 would have a 30-second savings for I-80 from Kidwell Road to US 50 and three minutes or more for US 50 from I-80 to SR 51/SR 99 in the GP lanes.

In the westbound direction during the AM peak hour, Alternative 8 would have the lowest westbound travel times for all corridors and lanes except for the GP lanes for US 50, where Alternative 3 would be faster by about 40 seconds during the AM peak hour. GP lane travel time savings for Alternative 8 would be 14.5 minutes for I-80 from Truxel Road to US 50 compared to Alternative 1. Westbound travel time would be highest for Alternative 7 for US 50 from SR 51/SR 99 to I-80 at almost an hour for the GP lanes. Alternative 1 would be better with a travel time of about 16 minutes for the same corridor. Alternatives 2 through 5, 8, and 9 would have the best average travel time of about 5 to 6 minutes. West of US 50, GP lane travel times would be similar across alternatives although Alternatives 1 and 7 would be about 30 seconds higher on average.

Table 52: AM Peak Hour Travel Time – Opening Year 2029

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	13.2	12.8	12.8	12.8	12.8	12.8	**14.9**	<u>12.7</u>	12.8
	ML	n/a	<u>12.4</u>	12.5	<u>12.4</u>	<u>12.4</u>	**12.7**	12.6	12.5	<u>12.4</u>
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	**9.9**	6.9	6.2	6.5	<u>6.1</u>	7.1	6.3	6.7	6.8
	ML	**5.7**	<u>5.1</u>	<u>5.1</u>	<u>5.1</u>	<u>5.1</u>	5.2	<u>5.1</u>	<u>5.1</u>	<u>5.1</u>
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	5.5	5.3	5.3	<u>5.2</u>	<u>5.2</u>	5.3	**5.6**	5.5	5.3
	ML	**5.3**	<u>5.2</u>	<u>5.2</u>	<u>5.2</u>	<u>5.2</u>	**5.3**	<u>5.2</u>	**5.3**	<u>5.2</u>
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	22.4	**25.4**	19.1	25.3	23.4	16.6	17.4	<u>7.9</u>	25.2
	ML	14.0	16.9	12.9	12.8	13.2	8.6	7.1	<u>5.3</u>	**17.3**
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	16.4	5.7	<u>5.2</u>	5.9	5.4	11.6	**59.3**	5.9	6.1
	ML	16.2	5.0	<u>4.8</u>	5.1	4.9	8.1	**32.6**	<u>4.8</u>	5.1
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	14.2	13.8	<u>13.7</u>	<u>13.7</u>	<u>13.7</u>	13.8	**14.3**	<u>13.7</u>	13.9
	ML	n/a	12.8	12.8	12.8	12.8	12.9	**13.8**	<u>12.4</u>	12.8

Notes: Average travel time is reported in minutes. The AM peak hour is 7:00 to 8:00 AM. "GP" indicates GP lanes, and "ML" indicates the managed lane. Where no managed lane exists in Alternative 1, "n/a" is shown. The lowest value is underlined, and the highest value is bolded.

Table 53: PM Peak Hour Travel Time – Opening Year 2029

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	34.6	34.6	30.3	<u>28.2</u>	29.1	35.9	**194.8**	31.7	42.0
	ML	n/a	21.3	19.8	<u>17.8</u>	18.7	26.8	**115.6**	19.5	21.7
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	<u>11.6</u>	17.5	15.1	13.2	12.7	12.7	**19.3**	17.3	20.4
	ML	**9.7**	6.5	6.1	6.0	<u>5.9</u>	<u>5.9</u>	7.0	6.4	7.1
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	7.1	23.2	25.1	**25.9**	24.7	11.2	<u>6.1</u>	24.4	24.8
	ML	5.8	8.3	8.9	**9.3**	9.1	6.0	<u>5.3</u>	7.6	8.5
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	5.3	5.3	5.3	5.3	<u>5.2</u>	5.3	**10.2**	<u>5.2</u>	5.3
	ML	5.2	5.1	5.1	5.1	5.1	5.1	**7.3**	<u>5.0</u>	5.1
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	10.0	10.4	10.4	9.6	10.0	10.5	**19.0**	10.2	<u>9.5</u>
	ML	6.3	5.3	5.3	5.2	5.3	5.4	**7.3**	5.3	<u>5.1</u>
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	12.4	12.3	<u>12.2</u>	12.4	<u>12.2</u>	<u>12.2</u>	**14.0**	<u>12.2</u>	12.4
	ML	n/a	12.0	12.0	12.0	12.0	<u>11.9</u>	**12.2**	12.1	12.0

Notes: Average travel time is reported in minutes. The PM peak hour is 4:00 to 5:00 PM. "GP" indicates GP lanes, and "ML" indicates the managed lane. Where no managed lane exists in Alternative 1, "n/a" is shown. The lowest value is underlined, and the highest value is bolded.

Similar to AM peak hour conditions, eastbound PM peak hour average travel time in the GP lanes would be highest for Alternative 7 for I-80 from Kidwell Road to US 50. Due to severe congestion, average GP lane travel time would be more than three hours for Alternative 7. Alternatives 3 through 5 and 8 would have the best travel times of about 30 minutes for the GP lanes and 18 to 20 minutes for the managed lanes. Peak hour travel time would be higher for Alternative 5 due to higher demand from 3:00 to 4:00 PM, which results in more peak hour congestion. Average travel time would increase later in the peak period due to increased congestion. Downstream on US 50, Alternatives 1 and 6 would have low travel times due to upstream capacity constraints, but Alternatives 4 and 5 would also have low travel times without the same constraints due to the capacity provided by the managed lane. Downstream on I-80, average travel time would be lowest for Alternatives 1, 6, and 7 due to upstream bottlenecks that constrain traffic volume from reaching this corridor. Longer travel times for the other alternatives would be caused by the I-5 bottleneck, which is outside the project area.

Westbound PM peak hour travel time for GP lanes would be highest for Alternative 7 for all three corridors. The other alternatives would have similar travel times for all three corridors. For the congested US 50 corridor, the GP lane travel time would be about twice the managed lane travel time.

Travel time reliability was measured using the planning time index, which is the 95th percentile travel time divided by the free-flow travel time. Opening year 2029 AM and PM peak hour planning time index for the GP and managed lanes are reported in **Table 54** and **Table** 55, respectively. **Appendix I** has the overall planning time index and planning time indexes for the other three hours in the peak periods.

Table 54: AM Peak Hour Planning Time Index – Opening Year 2029

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	1.11	1.06	<u>1.05</u>	1.06	1.06	1.06	**1.30**	1.06	<u>1.05</u>
	ML	n/a	<u>1.02</u>	1.03	<u>1.02</u>	<u>1.02</u>	**1.05**	1.04	1.04	<u>1.02</u>
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	**2.05**	1.59	1.32	1.54	<u>1.27</u>	1.55	1.35	1.51	1.57
	ML	**1.23**	1.05	1.03	1.05	<u>1.02</u>	1.06	1.03	1.04	1.04
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	1.07	1.07	**1.11**	1.09	<u>1.06</u>	1.07	1.10	<u>1.06</u>	1.08
	ML	1.03	1.05	1.05	1.05	1.05	**1.08**	<u>1.02</u>	1.03	1.05
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	5.11	5.62	4.41	5.52	5.31	4.26	3.70	<u>2.16</u>	**5.72**
	ML	2.94	3.96	3.02	2.91	3.15	1.84	1.48	<u>1.14</u>	**4.00**
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	3.82	1.41	<u>1.15</u>	1.41	1.23	2.77	**14.80**	1.49	1.48
	ML	3.78	1.16	<u>1.09</u>	1.28	1.13	2.46	**7.78**	1.11	1.30
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	1.22	1.20	<u>1.19</u>	<u>1.19</u>	<u>1.19</u>	1.20	**1.23**	1.20	1.21
	ML	n/a	1.16	1.15	1.15	1.15	**1.19**	1.18	<u>1.07</u>	1.16

Notes: The AM peak hour is 7:00 to 8:00 AM. "GP" indicates GP lanes, and "ML" indicates the managed lane. The lowest value is underlined, and the highest value is bolded.

For the AM peak hour, the eastbound travel time would be more reliable for Alternatives 2 through 6, 8, and 9 on eastbound I-80 from Kidwell Road to US 50 with planning time indexes less than 1.1 for both GP and managed lanes. The congested conditions on US 50 would increase the planning time index to about 1.3 to 1.6 for GP lanes under these alternatives, but the managed lanes would have a value less than 1.1. In the westbound direction, travel time would be most reliable for Alternative 8 for I-80 from Truxel Road to US 50 with an index less than 3 while the other alternatives would have values greater than 4 for the GP lanes. For the downstream corridors, Alternative 3 would have the best reliability and Alternative 7 the worst.

Table 55: PM Peak Hour Planning Time Index – Opening Year 2029

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	3.03	3.26	2.71	2.49	2.65	3.18	**16.02**	3.00	4.51
	ML	n/a	1.89	1.80	1.64	1.74	2.41	**9.66**	1.83	2.07
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	2.94	3.89	3.24	3.14	3.10	3.00	**3.90**	3.72	4.38
	ML	**2.56**	1.37	1.24	1.25	1.22	1.22	1.45	1.36	1.56
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	1.71	4.83	5.34	**5.35**	5.01	2.67	1.23	5.15	5.31
	ML	1.24	1.71	1.85	**1.92**	1.82	1.25	1.03	1.54	1.90
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	1.09	1.08	1.10	1.11	1.08	1.08	**2.33**	1.07	1.09
	ML	1.08	1.03	1.05	1.06	1.04	1.03	**1.62**	1.03	1.04
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	2.37	2.43	2.53	2.23	2.41	2.40	**4.36**	2.43	2.26
	ML	1.43	1.19	1.20	1.17	1.20	1.26	**1.71**	1.24	1.17
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	1.07	1.07	1.06	1.09	1.06	1.05	**1.20**	1.06	1.09
	ML	n/a	1.04	1.04	1.04	1.04	1.03	**1.05**	1.04	1.04

Notes: The PM peak hour is 4:00 to 5:00 PM. "GP" indicates GP lanes, and "ML" indicates the managed lane. The lowest value is underlined, and the highest value is bolded.

For the PM peak hour, GP lane travel times would be more reliable for Alternatives 3 through 5 for eastbound I-80 from Kidwell Road to US 50. The managed lane would provide a more reliable travel time for these alternatives with planning time indexes of 1.6 to 1.8 compared to 2.5 to 2.7 for the GP lanes. The US 50 corridor shows similar good performance for these alternatives and poor performance for Alternative 7. On the downstream I-80 segment, Alternatives 3 through 5 show worse performance since more traffic reaches downstream bottlenecks at I-5 outside the project area compared to Alternatives 1 and 7. In the westbound direction, Alternative 7 has the highest planning time indexes on the three corridors for the GP and managed lanes. The other alternatives generally perform similarly for the I-80 corridors. On US 50, Alternative 4 would have the lowest planning time indexes for both GP and managed lanes, although Alternative 9 would perform similarly.

6.2.5 Network Performance

Using the Vissim operations analysis model, the network performance for the project alternatives under opening year 2029 conditions are provided in **Table 56** for eastbound and **Table 57** for westbound.

Table 56: Eastbound Peak Period Network Performance – Opening Year 2029

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicle hours of delay	2,700	3,300	3,300	3,400	3,100	**3,800**	3,500	3,500	3,300
Vehicle hours of travel	10,800	11,800	11,800	11,800	11,600	11,900	11,400	**12,100**	11,700
Average speed (mph)	**46.4**	45.1	45.1	44.6	45.4	42.1	42.8	44.1	44.9
Vehicles served	98,700	**102,000**	101,800	101,100	100,900	99,200	99,700	**102,000**	100,600
Persons served	149,800	155,400	153,100	150,300	153,600	150,900	153,200	**155,500**	153,000
Unserved entry vehicles	0	0	0	0	0	0	0	0	0
PM Peak Period									
Vehicle hours of delay	11,300	17,600	17,500	16,500	16,900	13,500	**24,400**	17,300	21,300
Vehicle hours of travel	20,800	27,900	27,600	26,600	26,800	23,000	**31,200**	27,500	31,300
Average speed (mph)	**28.0**	22.8	22.7	23.5	22.9	25.6	13.2	23.0	19.7
Vehicles served	115,600	116,600	115,400	116,000	115,000	**118,300**	104,800	116,100	115,100
Persons served	173,600	175,800	171,400	169,000	170,800	**177,600**	159,000	175,000	173,400
Unserved entry vehicles	0	0	0	0	0	0	**11,100**	0	900

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

In the eastbound direction, the AM peak period delay, travel time, and average speed would be best under Alternative 1 although all alternatives would perform similarly. The better performance for Alternative 1 is due to lower demand volumes, which is why it would serve the least vehicles. Alternatives 2 and 8 would serve the most vehicles. The eastbound direction during the PM peak period would have the lowest network delay for Alternative 1 again due to lower demand volumes. Alternatives 2 through 5 and 8 would have similar performance. The network average speed for these five alternatives would be about 23 mph, which reflects the congested conditions on the corridor. The performance for Alternative 9 would be just behind these alternatives with an average speed of 20 mph. Alternative 7 would have the poorest performance with an average speed of about 13 mph. Due to congestion in the study area, the entry demand volume on eastbound I-80 would not be completely served with 11,100 vehicles unserved for Alternative 7.

Table 57: Westbound Peak Period Network Performance – Opening Year 2029

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicle hours of delay	13,300	10,900	8,800	10,200	9,800	11,000	**21,400**	7,300	10,600
Vehicle hours of travel	24,500	23,200	21,500	22,400	22,100	22,500	**30,500**	20,000	22,800
Average speed (mph)	28.2	32.8	36.5	33.9	34.5	31.9	18.6	**39.6**	33.2
Vehicles served	106,700	112,900	115,600	112,900	113,300	111,600	91,900	**116,300**	110,600
Persons served	161,600	171,400	170,900	166,100	170,300	169,800	139,700	**176,700**	168,000
Unserved entry vehicles	1,700	2,700	0	2,300	1,800	0	**10,100**	300	2,700
PM Peak Period									
Vehicle hours of delay	6,500	7,400	7,600	6,900	7,700	7,400	**16,300**	7,600	7,300
Vehicle hours of travel	16,100	17,900	18,000	17,400	17,900	17,000	**24,900**	18,000	17,600
Average speed (mph)	36.9	36.3	35.7	**37.4**	35.4	34.8	21.3	35.6	36.4
Vehicles served	112,000	116,100	114,800	**116,500**	114,000	110,800	100,900	114,500	115,300
Persons served	169,700	**176,500**	170,500	173,100	171,100	168,300	154,700	174,500	175,100
Unserved entry vehicles	600	2,300	**2,900**	1,300	2,700	2,500	**10,600**	2,700	2,100

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

In the westbound direction, Alternative 8 would have the best performance during the AM peak period. The network average speed of about 40 mph would be about 3 mph higher than Alternative 3. Alternatives 2, 4, and 9 would have relatively good performance with average speeds of about 33 mph. Alternatives 1 and 7 would perform the poorest with average speeds of 28 and 19 mph, respectively. Alternatives 3 and 6 would serve their AM peak period entry demand due to higher throughput at the adjacent bottlenecks for Alternative 3 and lower entering demand for Alternative 6, but Alternative 7 would have about 10,000 unserved vehicles.

During the PM peak period in the westbound direction, Alternative 1 would have the lowest delay and total travel time. However, Alternative 4 would have the highest average speed and the most vehicles served. Although Alternatives 2 and 9 would have lower vehicles served, they would have higher persons served due to more HOVs. Alternative 7 would have the worst performance: highest delay, lowest average speed, and lowest vehicles served.

Table 58 summarizes the freeway analysis segments with deficient operations as defined by the evaluation criteria provided in **Section 3.4**. The deficient operations were determined for each of the four hours during the AM and PM peak periods. The total number of analysis segments varies by alternative, so the percentage of deficient analysis segments is also listed.

Table 58: Hourly Segments with Deficient Operations – Opening Year 2029

Peak Period	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM	**163 (29%)**	111 (21%)	97 (19%)	108 (21%)	97 (19%)	144 (28%)	160 (29%)	95 (18%)	114 (22%)
PM	160 (29%)	217 (42%)	215 (41%)	202 (39%)	207 (40%)	176 (34%)	**266 (49%)**	217 (42%)	239 (46%)

Notes: Operations are deficient if LOS E or F west of Mace Boulevard and LOS F east of Mace Boulevard. The lowest value is underlined, and the highest value is bolded.

During the AM peak period, Alternative 1 would have the most deficient segments with 29 percent. Alternative 8 would have the fewest segments, although Alternatives 3 and 5 would have almost the same percentage. During the PM peak period, almost half of the segments would be deficient under Alternative 7. Alternative 1 would have the fewest segments at 29 percent. Both Alternatives 1 and 6 would have significant congestion extending upstream of the analysis area in the westbound direction. The alternatives with higher capacity (Alternatives 2 through 5 and 8) would have 39 to 42 percent deficient segments.

7. Horizon Year (2049)

This chapter presents the freeway operations analysis results under the horizon year (2049). Additional details for the operational analysis performance are provided in **Appendix J**.

7.1 Planning Analysis

The HCS analysis identified the following locations with LOS F conditions under Alternative 1 during the AM peak hour under the horizon year 2049.

- I-80 eastbound from Richards Boulevard to Mace Boulevard northbound on-ramp
- I-80 eastbound at County Road 32B on-ramp
- US 50 eastbound from Harbor Boulevard off-ramp to Jefferson Boulevard
- US 50 eastbound from I-5 to 15th Street
- US 50 eastbound from 16th Street to SR 51/SR 99
- US 50 westbound from SR 99 on-ramp to 16th Street
- US 50 westbound from 15th Street to I-5
- US 50 westbound from I-5 to Jefferson Boulevard
- I-80 westbound from I-5 to West El Camino Avenue
- I-80 westbound from the lane drop west of West El Camino Avenue to Reed Avenue
- I-80 westbound at the US 50 off-ramp
- I-80 westbound from West Capitol Avenue eastbound on-ramp to Mace Boulevard

Compared to opening year 2029, eight additional bottlenecks have been identified, and the congested areas eastbound at Mace Boulevard and westbound at West Capitol Avenue would be expanded.

The four weaving segments with LOS F during the AM peak hour according to the Leisch Method are listed below.

- US 50 eastbound from I-5 to 15th Street
- I-80 eastbound from I-5 to Truxel Road
- I-80 westbound from Truxel Road to I-5
- US 50 westbound from Harbor Boulevard to Jefferson Boulevard

The first three segments also had LOS F under opening year 2029. The last location worsened to LOS F under horizon year 2049.

For Alternative 2, the following congested locations identified in Alternative 1 improve from LOS F conditions:

- I-80 eastbound at County Road 32B on-ramp
- US 50 eastbound at Harbor Boulevard off to on-ramp
- US 50 westbound from I-5 on-ramp to Jefferson Boulevard off-ramp
- I-80 westbound at US 50 off-ramp

Additionally, the westbound bottleneck at the Yolo Bypass would be reduced to only the West Capitol Avenue westbound on-ramp. However, new bottlenecks were identified on I-80 eastbound from the I-5 off-ramp to the I-5 southbound on-ramp, I-80 westbound from Truxel Road off-ramp to I-5, and I-80 westbound from US 50 to West Capitol Avenue.

The Leisch Method results for Alternative 2 show an improvement to LOS E for two locations: US 50 eastbound from Harbor Boulevard to Jefferson Boulevard and I-80 westbound from Northgate Boulevard to Truxel Road. Two new bottlenecks have been identified: I-80 westbound from Truxel Road to I-5 and from US 50 to West Capitol Avenue.

Alternatives 3 through 5, 8, and 9 would have mostly similar bottleneck locations and congested LOS F segments as Alternative 2. One exception is that Alternative 9 would not have a bottleneck on I-80 eastbound from I-5 off-ramp to I-5 southbound on-ramp caused by less served volume upstream at the on-ramp from US 50 eastbound. The results for Alternative 6 are also generally similar to Alternative 2 except for (1) a new bottleneck on eastbound US 50 from Jefferson Boulevard on-ramp to 5th Street off-ramp, (2) congestion on westbound I-80 at the Yolo Causeway like Alternative 1, and (3) no bottlenecks for eastbound I-80 at I-5 and westbound I-80 at US 50 off-ramp. These differences would be caused by higher demands for the GP lanes in Alternative 6 compared to Alternative 2. Alternative 7 results would expand the congested area under Alternative 2 at three eastbound locations – I-80 at Mace Boulevard and County Road 32B and US 50 at Jefferson Boulevard – and two westbound locations – US 50 at Jefferson Boulevard and I-80 at the Yolo Bypass.

The Leisch Method for Alternatives 3, 4, and 7 have LOS F for the US 50 eastbound segment from Harbor Boulevard to Jefferson Boulevard as in Alternative 1. Alternative 7 also has LOS F for US 50 eastbound from I-80 to Harbor Boulevard. Alternatives 6 and 7 do not show LOS F for I-80 westbound from Truxel Road to I-5. As in the opening year 2029, Alternative 8 identifies a new segment with LOS F: I-80 eastbound from Enterprise Boulevard to US 50. This weaving segment has fewer lanes than the other alternatives so that the median ramps at the I-80/US 50 interchange can be constructed with fewer impacts.

The HCS analysis identified the following locations with LOS F conditions under Alternative 1 during the PM peak hour.

- I-80 eastbound from Mace Boulevard off-ramp to Mace Boulevard northbound on-ramp
- I-80 eastbound from County Road 32B off to on-ramp to County Road 32B on-ramp

- US 50 eastbound from Harbor Boulevard to Jefferson Boulevard
- US 50 eastbound from Jefferson Boulevard on-ramp to I-5 off-ramp
- US 50 eastbound from I-5 to 15th Street and 16th Street to SR 51/SR 99
- I-80 eastbound from I-5 off-ramp to Truxel Road
- US 50 westbound from SR 99 to 16th Street and 15th Street to I-5
- US 50 westbound at the Jefferson Boulevard off-ramp
- I-80 westbound from Truxel Road northbound on-ramp to I-5
- I-80 westbound at US 50 off-ramp
- I-80 westbound at the West Capitol Avenue westbound on-ramp

The first two areas expand the congested area under opening year 2029 conditions. The LOS F segments near downtown Sacramento are fewer than in the opening year, likely caused by constrained demand flow from over-capacity segments. New LOS F locations are US 50 eastbound from Harbor Boulevard to Jefferson Boulevard and I-80 westbound at I-5 and at US 50. The Leisch Method shows one new LOS F location: US 50 eastbound from Harbor Boulevard to Jefferson Boulevard.

For Alternative 2, locations that improve from LOS F during the PM peak hour are listed below.

- I-80 eastbound at I-5 off-ramp
- I-80 westbound from Truxel Road northbound on-ramp to I-5
- I-80 westbound at US 50 off-ramp

The eastbound I-80 bottleneck at Mace Boulevard expands upstream by one segment to Richards Boulevard. Otherwise, the LOS F locations are the same as in Alternative 1. The Leisch Method shows the US 50 eastbound segment from Harbor Boulevard to Jefferson Boulevard improving from LOS F in Alternative 1 to E in Alternative 2. The new US 50 westbound weave segment from Tower Bridge Gateway to Harbor Boulevard would have LOS F.

Alternatives 3 through 6, 8, and 9 have similar bottleneck locations and congested LOS F segments as Alternative 2. One exception is that Alternatives 4 and 5 do not have LOS F locations for I-80 eastbound at I-5 due to lower mainline demand volume than the other alternatives. Alternative 7 results would expand the congested area under Alternative 2 by one segment on eastbound I-80 at Mace Boulevard, eastbound I-80 at County Road 32B, and eastbound US 50 at I-5. New congested areas would occur on eastbound I-80 from US 50 to West El Camino Avenue, westbound I-80 from Truxel Road to I-5, and for four segments on westbound I-80 from West El Camino Avenue to US 50 due to fewer GP lanes in the project area and higher demand for the I-5 off-ramps outside the project area.

Unlike Alternative 2, the US 50 eastbound segment from Harbor Boulevard to Jefferson Boulevard would be LOS F for Alternatives 3 through 7 and 9. The US 50 westbound segment from Tower Bridge Gateway would be LOS E for Alternatives 4 through 7 and 9. Similar to the AM peak hour, I-80 eastbound from Enterprise Boulevard to US 50 would be LOS F under Alternative 8 during the PM peak hour.

7.2 Simulation Analysis

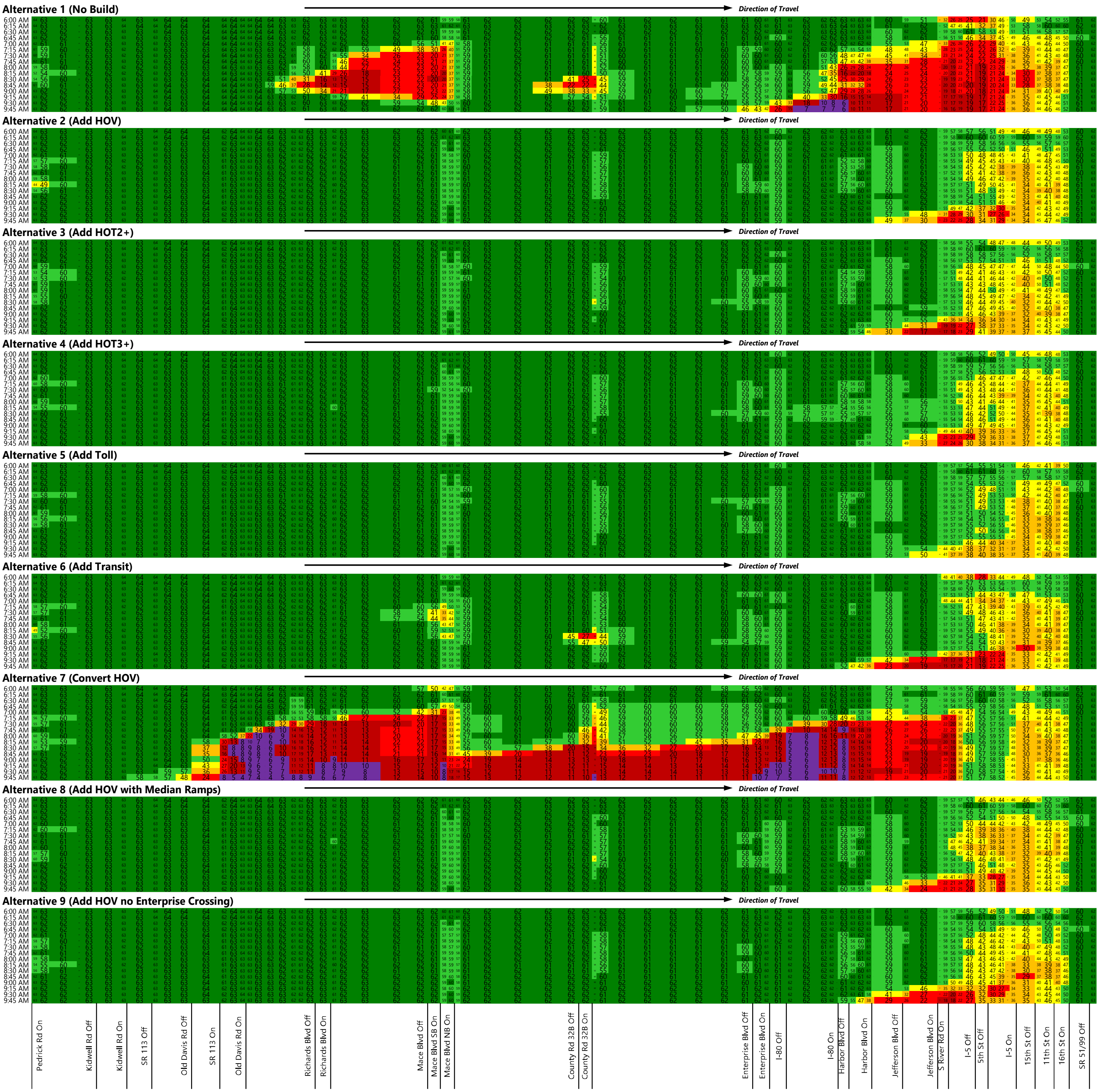
7.2.1 Ramp Meters

For design year 2049 conditions, the ramp meters are planned to operate continuously based on freeway demand so that the metering can turn on at any time of day. As part of separate projects, meter signals will be installed on existing HOV preferential lanes. **Table 9** lists the existing ramp meters, and **Table 48** lists the ramp meters that are expected to be installed under separate projects by 2029. By 2049, an interchange reconstruction project at I-80/West El Camino Avenue will widen all four on-ramps to provide metered HOV preferential lanes. **Table 49** lists the ramp meters that would be installed under the project. These ramp meters are included only in Alternatives 2 through 9.

Caltrans staff provided the ramp meter timing settings used for Alternative 2. The ramp meter timings were adjusted under other alternatives only if the on-ramp peak hour demand volume differed from the Alternative 2 on-ramp volume by more than 50 vph.

7.2.2 Travel Speed

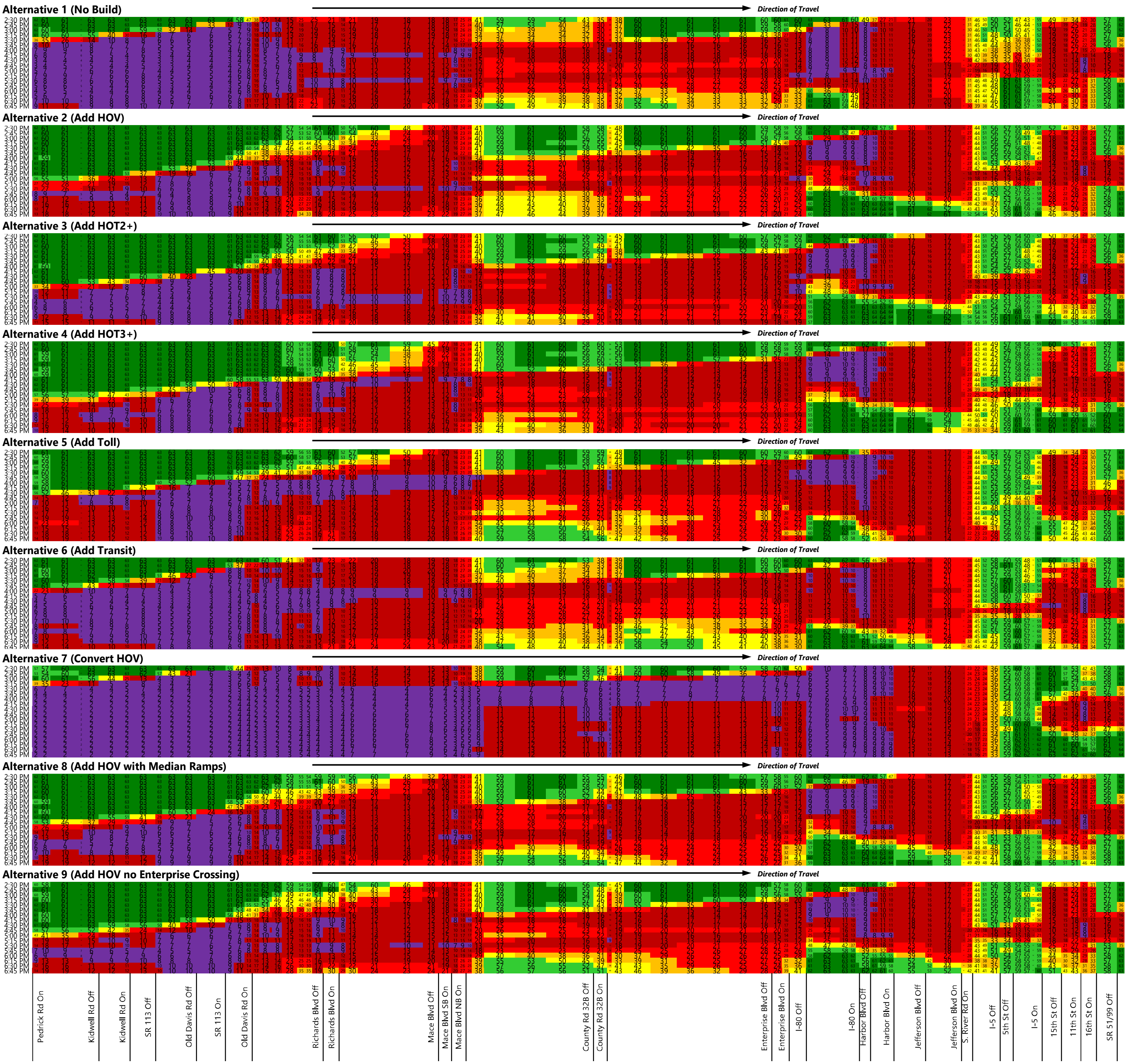
Speed contour plots were prepared for the eastbound and westbound freeway study corridors: I-80 at Pedrick Road to US 50 at SR 51/SR 99 and I-80 from US 50 to Northgate Boulevard under the horizon year 2049. The AM and PM peak period speed contour plots for the GP lanes on these corridors are provided in **Figure 31** through **Figure** 34. The speed contour plots for all lanes and for managed lanes are provided in **Appendix J**.



Note: The speed is an average of the GP lanes.

Figure 31a

Eastbound Speed from I-80 at Pedrick Road to US 50 at SR 51/SR 99
Horizon Year 2049 - AM Peak Period

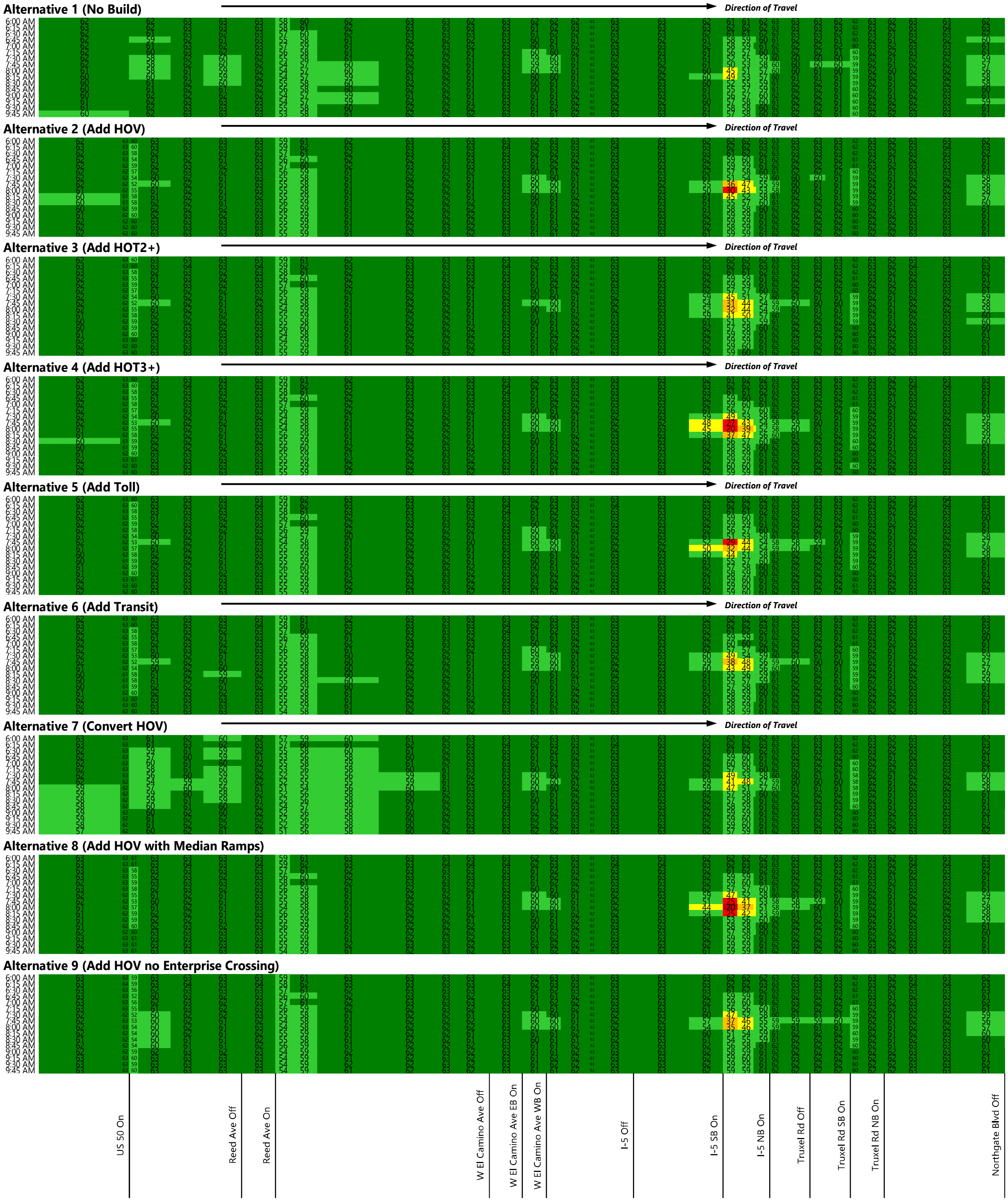


Note: The speed is an average of the GP lanes.

Figure 31b

Eastbound Speed from I-80 at Pedrick Road to US 50 at SR 51/SR 99
Horizon Year 2049 - PM Peak Period

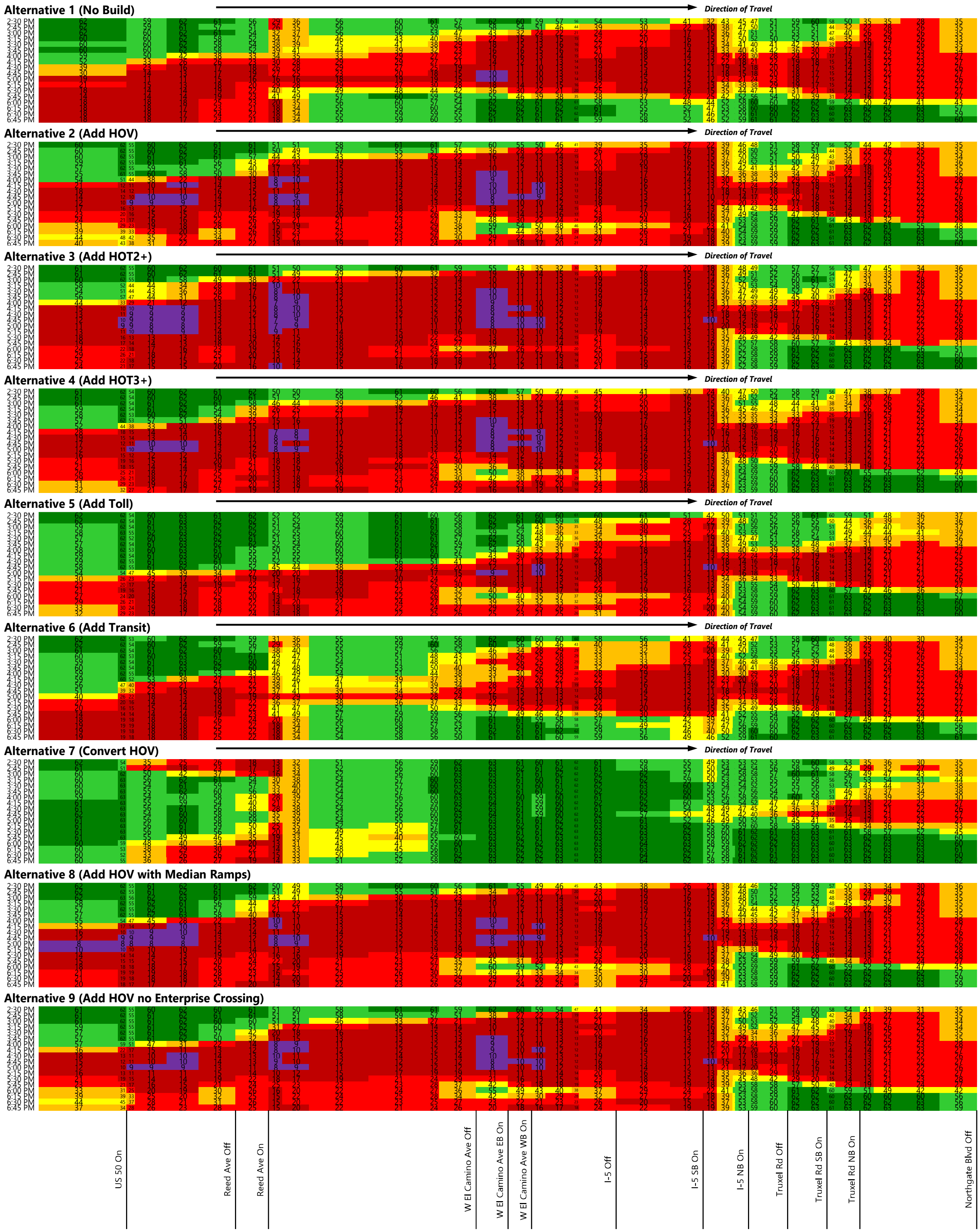
M:\PROJECTS\SA22\0177.00_TO15_D3_I-80_US50_Managed_Lanes\Graphics\AI\Traffic_Ops_Report



Note: The speed is an average of the GP lanes.

Figure 32a

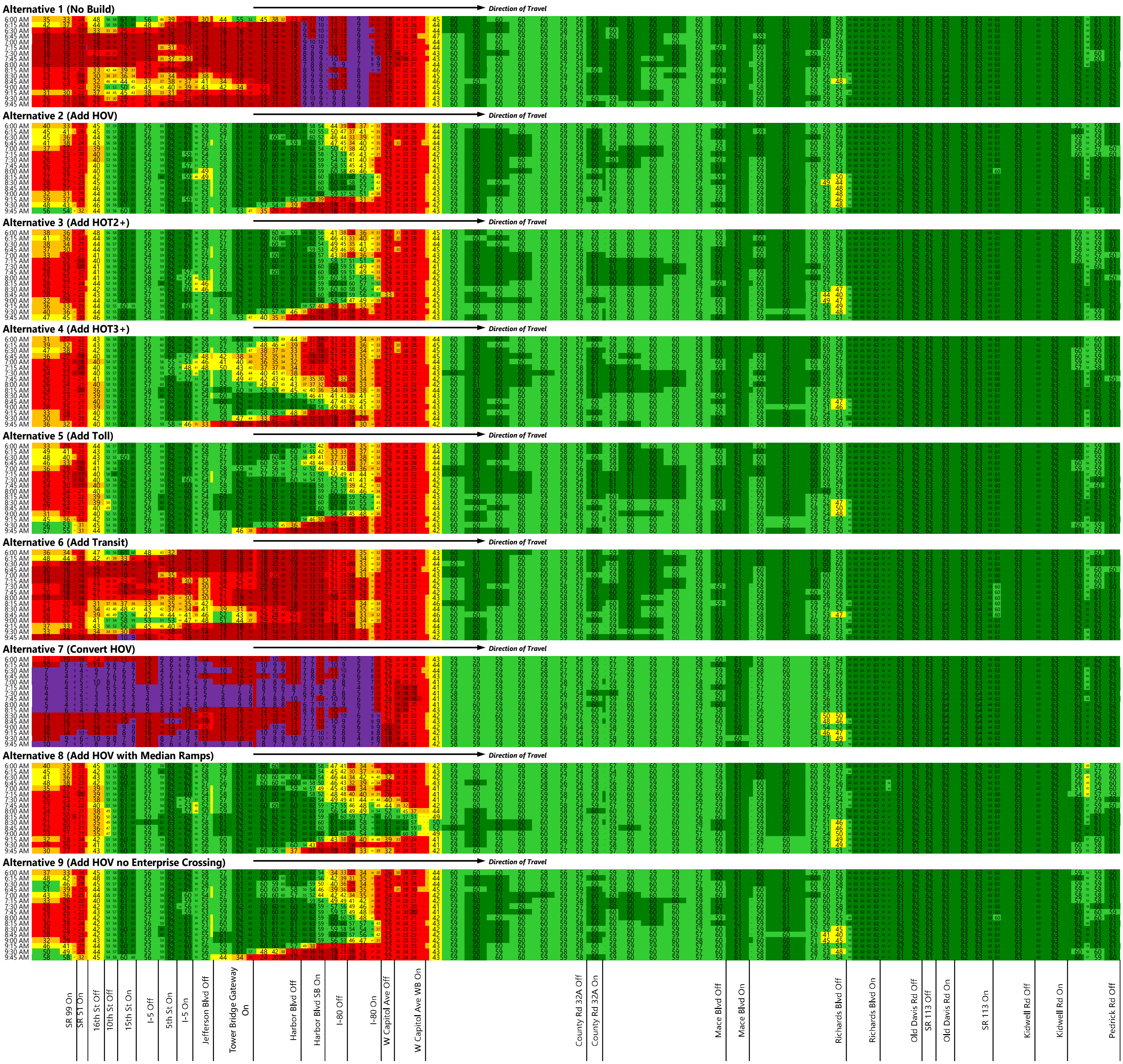
Eastbound Speed from I-80 at US 50 to Northgate Boulevard Horizon Year 2049 - AM Peak Period



Note: The speed is an average of the GP lanes.

Figure 32b

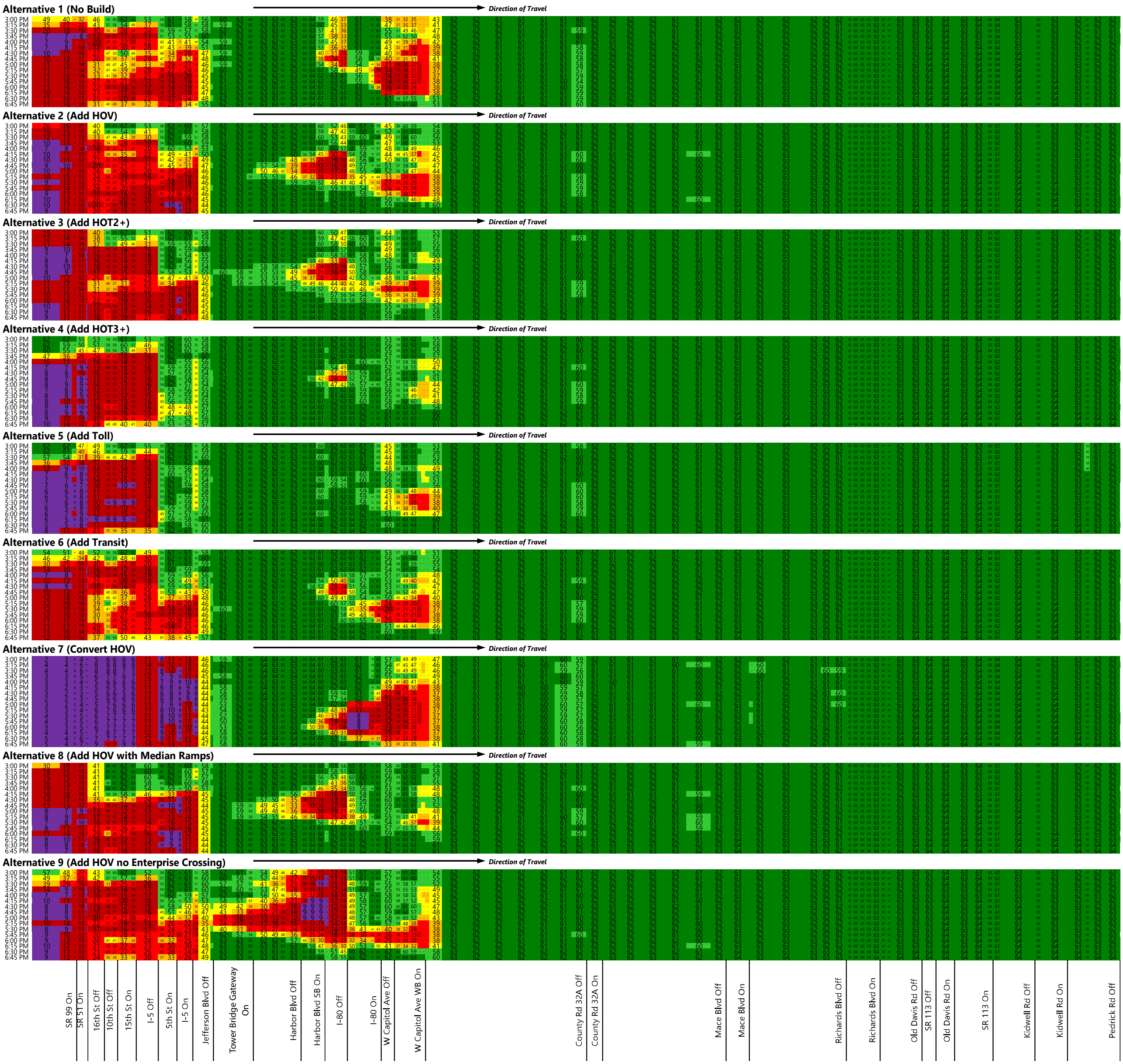
Eastbound Speed from I-80 at US 50 to Northgate Boulevard
Horizon Year 2049 - PM Peak Period



Note: The speed is an average of the GP lanes.

Figure 33a

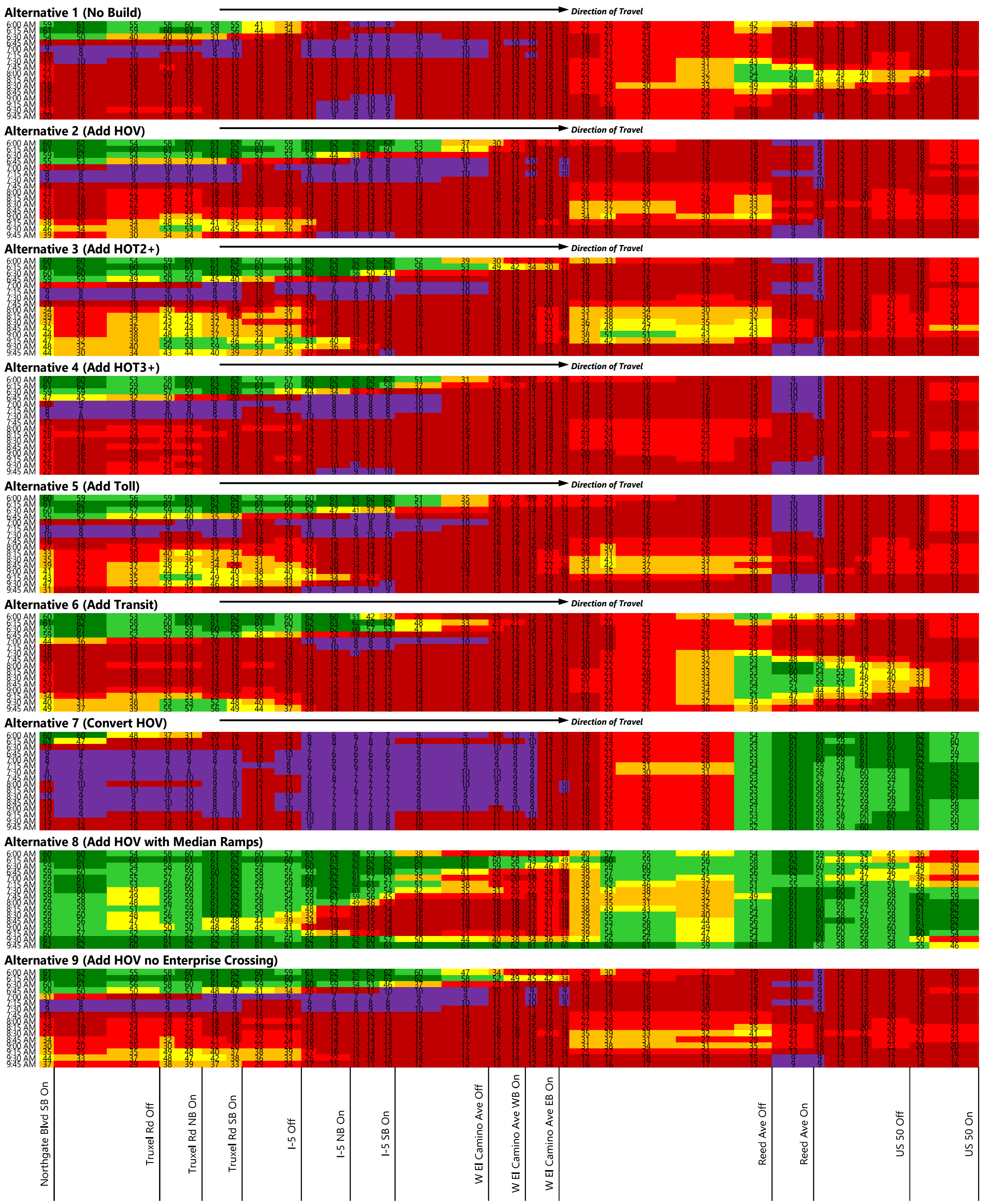
Westbound Speed from US 50 at SR 51/SR 99 to I-80 at Pedrick Road
Horizon Year 2049 - AM Peak Period



Note: The speed is an average of the GP lanes.

Figure 33b

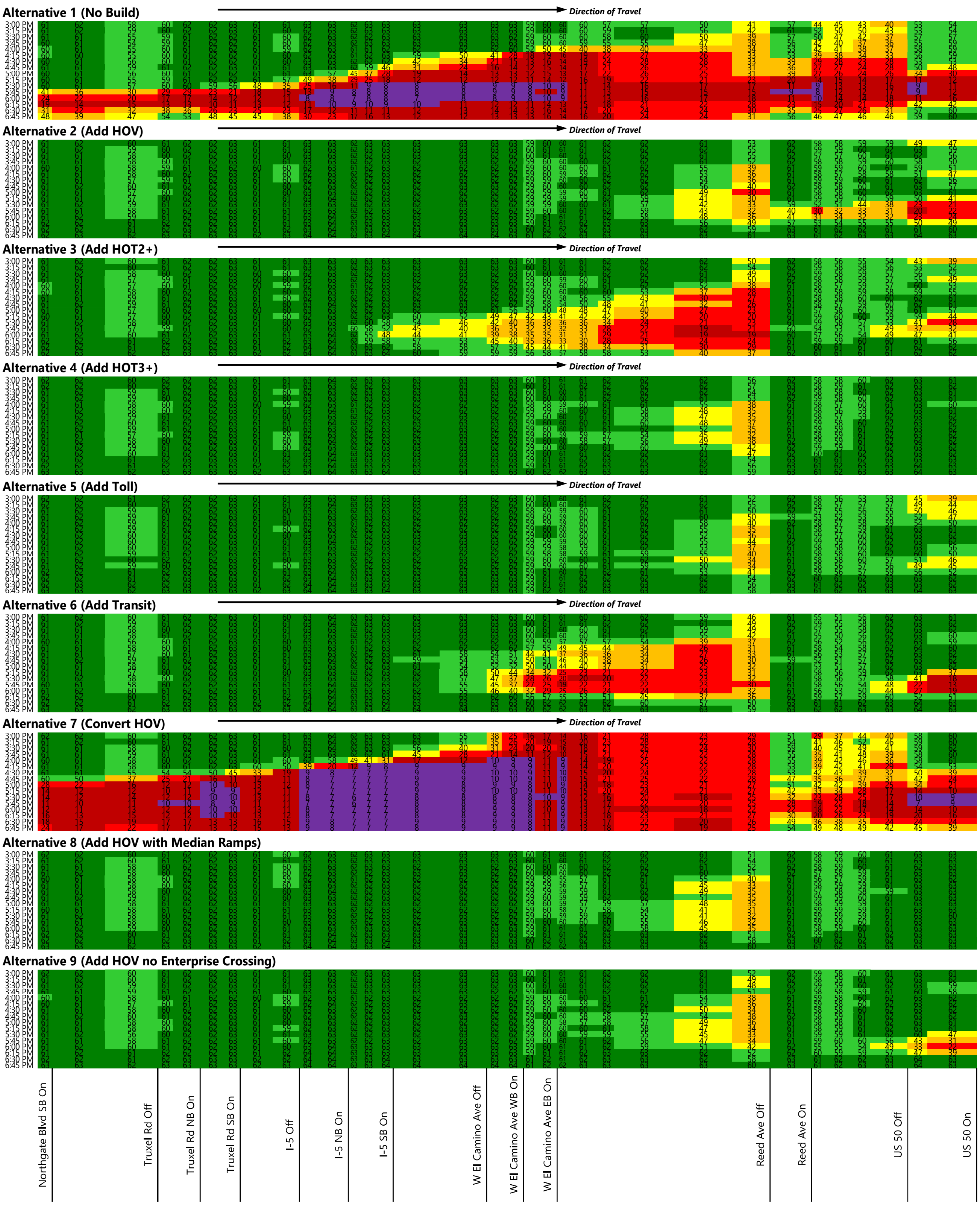
Westbound Speed from US 50 at SR 51/SR 99 to I-80 at Pedrick Road Horizon Year 2049 - PM Peak Period



Note: The speed is an average of the GP lanes.

Figure 34a

Westbound Speed from I-80 at Northgate Boulevard to US 50
Horizon Year 2049 - AM Peak Period



Note: The speed is an average of the GP lanes.

Figure 34b

Westbound Speed from I-80 at Northgate Boulevard to US 50
Horizon Year 2049 - PM Peak Period

Figure 31 shows the speed contour plots for the AM and PM peak periods for the eastbound corridor from I-80 at Pedrick Road to US 50 at SR 51/SR 99. For the AM peak period, all alternatives show a bottleneck on US 50 in downtown Sacramento although the bottleneck is less severe than in opening year 2029. This is likely due to lower demand from northbound I-5 in 2049. Alternative 1 would have more severe congestion at I-5 than the other alternatives due to less capacity approaching I-5. The congested area would extend to the I-80 interchange by the end of the peak period. Also, a bottleneck of about three hours long would occur at Mace Boulevard with a small bottleneck of less than an hour at County Road 32B. These upstream bottlenecks would also occur for Alternative 6 for about 30 minutes each. For Alternative 7, corridor speed would be the lowest of all alternatives with bottlenecks at the I-5 off-ramp, Harbor Boulevard on-ramp, Mace Boulevard, and County Road 32B.

For the PM peak period, eastbound I-80 to eastbound US 50 would be congested for most of the peak period under all alternatives. East of downtown Sacramento, the major bottlenecks would be Mace Boulevard and Jefferson Boulevard on-ramps. The I-80 off-ramp would also constrain eastbound traffic due to congestion from a bottleneck on I-80 to the east extending back onto the Yolo Causeway. County Road 32B would continue to be a minor bottleneck. Alternatives 2 and 8 would have the least congestion. Alternatives 1 and 7 would have the overall lowest speeds for this corridor.

Figure 32 shows the speed contour plots for the AM and PM peak periods for the eastbound corridor on I-80 from US 50 to Northgate Boulevard. For the AM peak period, the I-5 southbound on-ramp would be a minor (15- to 30-minute) bottleneck under most alternatives. For the PM peak period, I-5 would be the primary bottleneck although the Reed Avenue on-ramp and the adjacent Sacramento River bridge would also be bottlenecks. Alternatives 3 and 4 would operate with lower speeds due to turbulence near West El Camino Avenue at the transition from HOT lane to HOV lane when the GP lanes are congested. This would occur to a lesser extent for Alternative 5 because of less congestion in the GP lanes. This section of eastbound I-80 would operate better for Alternatives 6 and 7 due to more severe congestion upstream under these alternatives.

Figure 33 shows the speed contour plots for the AM and PM peak periods for the westbound corridor from US 50 at SR 51/SR 99 to I-80 at Pedrick Road. Westbound US 50 would continue to be congested in downtown Sacramento at the 16th Street off-ramp during the AM peak period. Congestion from the bottleneck on I-80 at the Yolo Causeway would extend back to downtown under Alternatives 1, 6, and 7. For most of the other alternatives, the lane drop after the I-80 off-ramp would be a minor bottleneck that would cause a queue to extend to Tower Bridge Gateway by the end of the peak period. For Alternative 4, the higher demand volumes for the GP lanes would result in congested conditions at I-80 during the first two hours as well.

During the PM peak hour, the I-5 off-ramp bottleneck would constrain entering traffic demand. The lane drop to the Jefferson Boulevard off-ramp would be a bottleneck for the latter three hours of the peak period for most alternatives. Alternatives 4 and 5 would not have a bottleneck here due to lower demand volumes. For Alternative 7, Jefferson Boulevard would be a major bottleneck that would last longer than the peak period. Downstream bottlenecks would also occur at the I-80 off-ramp and the Yolo Causeway, which would last about two hours for most build alternatives. For Alternatives 8 and 9, congestion at the I-80 off-ramp would be larger than at the Yolo Causeway. Congestion at this location under Alternative 9 would last for more than three hours due to the travel volume shift from Enterprise Boulevard to Harbor Boulevard without the planned Enterprise Boulevard bridge over the shipping channel.

Figure 34 shows the speed contour plots for the AM and PM peak periods for the westbound corridor on I-80 from Northgate Boulevard to US 50. During the AM peak period, most alternatives would be severely congested since the two-lane capacity for the connector ramp for westbound I-80 at US 50 would not change. The exception would be Alternative 8, which provides a median connector ramp for HOVs. With this alternative, congestion would be reduced to less than two hours between Reed Avenue and US 50. The upstream bottleneck at West El Camino Avenue would last for about three hours and extend back to I-5.

For the PM peak period, all alternatives would have a bottleneck at the Reed Avenue off-ramp. The congestion at this location would be most severe for Alternative 1 and 7 extending upstream to Northgate Boulevard. For most of the other alternatives, the congestion would be 0.5 mile or less. Most alternatives also show some slowing at the I-80 interchange for about an hour. Alternatives 4 and 8 would have no congestion at I-80. Alternative 4 would have lower peak period demand volume for I-80 at US 50 than Alternatives 2, 3, and 5 although the peak hour volume would be higher than Alternative 5 (see **Appendix F**). The median ramp in Alternative 8 would provide more capacity resulting in less congestion.

7.2.3 Bottleneck Throughput

Horizon year 2049 AM and PM peak period throughput at the primary bottleneck in each direction are reported in **Table 59** and **Table** 60, respectively. **Appendix J** provides the total vehicles served and persons served for mainline freeway segments for each of the four hours in the AM and PM peak periods. In the eastbound direction, the main bottleneck is on I-80 at Mace Boulevard. In the westbound direction, the main bottleneck is on I-80 at the Yolo Causeway.

Table 59: Eastbound Peak Period Throughput: I-80 at Mace Boulevard – Horizon Year 2049

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicles served	19,300	21,000	**21,200**	21,000	21,100	18,800	15,900	21,000	21,100
Persons served	31,000	33,800	33,700	33,400	33,700	30,800	26,200	33,600	**34,000**
PM Peak Period									
Vehicles served	16,400	**22,500**	21,000	21,400	20,800	17,100	9,400	21,600	22,200
Persons served	25,900	**35,800**	33,000	32,900	32,200	27,200	15,800	34,100	35,300

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

Table 60: Westbound Peak Period Throughput: I-80 at Yolo Causeway – Horizon Year 2049

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicles served	23,700	28,400	28,500	27,400	27,800	24,400	<u>19,700</u>	**29,700**	28,200
Persons served	38,000	45,600	43,600	41,900	43,100	39,500	<u>32,100</u>	**47,000**	45,300
PM Peak Period									
Vehicles served	20,400	23,100	**23,500**	21,400	22,300	20,100	<u>17,300</u>	23,100	22,900
Persons served	33,100	**37,800**	36,600	33,800	35,600	32,800	<u>28,700</u>	37,400	36,900

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

For eastbound I-80 at Mace Boulevard, the AM peak period would have low congestion under the build alternatives, so the vehicle served at the bottleneck would be similar across most alternatives. Alternative 3 would serve the most vehicles. Due to differences in average vehicle occupancy and travel patterns, Alternative 9 would serve the most people. For the PM peak period, Alternative 2 would serve the most vehicles and people although Alternative 9 would serve almost as many. Alternative 7 would serve the fewest vehicles and people during both peak periods.

For westbound I-80 at the Yolo Causeway, the AM peak period would be congested causing queues upstream on both I-80 and US 50. Alternative 8 would serve the most vehicles and people. Alternatives 2 through 5 and 9 would also serve about as many vehicles and people as Alternative 8. During the PM peak period, Alternative 3 would serve the most vehicles, but Alternative 2 would serve the most people. Like in the eastbound direction, Alternative 7 would serve the fewest vehicles and people at the main westbound bottleneck.

7.2.4 Corridor Travel Time

Horizon year 2049 AM and PM peak hour travel times for the GP and managed lanes are reported in **Table 61** and **Table** 62, respectively. **Appendix J** provides the overall travel time and travel times for the other three hours in the peak periods. The travel time for three corridors is reported: I-80 between Kidwell Road in Solano County and US 50, US 50 between I-80 and SR 51/SR 99, and I-80 between US 50 and Truxel Road. The free-flow travel time is about 12 minutes for the first corridor and about 5 minutes for the other two corridors.

During the AM peak hour, eastbound average travel time in the GP lanes would be highest for Alternative 7 for I-80 from Kidwell Road to US 50 and on US 50 from I-80 to SR 51/SR 99. Travel times for the managed lane would be highest for Alternative 1 which has the shortest managed lanes. Compared to Alternative 1, the Alternatives 2 through 5, 8, and 9 would have a two-minute savings for each of these corridors for the GP lanes. Eastbound travel time on I-80 from US 50 to Truxel Road would be similar under all alternatives.

Table 61: AM Peak Hour Travel Time – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	14.9	12.8	12.9	12.9	12.9	13.1	**19.3**	12.8	12.8
	ML	n/a	12.5	12.5	12.5	12.5	12.7	**13.8**	12.5	12.5
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	8.4	6.2	6.0	6.2	6.0	6.2	**9.9**	6.4	6.0
	ML	**7.8**	5.1	5.1	5.1	5.1	5.2	5.6	5.1	5.1
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	**5.5**	5.2	5.2	5.2	5.2	5.2	5.4	5.2	5.2
	ML	5.3	5.2	5.2	5.2	5.2	**5.4**	5.1	5.3	5.2
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	20.9	25.2	24.0	24.9	24.5	20.9	20.7	8.6	**25.5**
	ML	11.2	14.2	13.0	10.7	11.8	8.4	7.3	5.3	**14.4**
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	23.6	5.6	5.5	8.7	5.9	15.8	**56.1**	5.8	5.7
	ML	20.8	5.0	5.0	6.5	5.1	10.1	**28.2**	4.8	5.1
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	14.1	13.8	13.7	13.7	13.7	13.8	**14.2**	13.8	13.8
	ML	n/a	12.8	12.8	12.8	12.8	12.9	**13.6**	12.5	12.8

Notes: Average travel time is reported in minutes. The AM peak hour is 7:00 to 8:00 AM. "GP" indicates GP lanes, and "ML" indicates the managed lane. Where no managed lane exists in Alternative 1, "n/a" is shown. The lowest value is underlined, and the highest value is bolded.

Table 62: PM Peak Hour Travel Time – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	73.8	<u>35.8</u>	38.6	37.5	62.7	75.3	**193.3**	55.4	38.4
	ML	n/a	16.8	17.2	<u>14.9</u>	24.6	44.3	**116.8**	28.2	17.6
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	20.1	19.6	19.5	19.8	18.7	<u>18.6</u>	**22.8**	21.6	19.2
	ML	**17.5**	7.2	7.2	7.2	6.6	<u>6.1</u>	7.3	7.5	7.3
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	14.5	20.6	23.4	22.8	9.1	11.3	<u>6.2</u>	**25.5**	21.2
	ML	**14.5**	7.6	8.1	8.1	5.6	6.1	<u>5.2</u>	7.8	7.5
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	10.1	5.6	6.5	5.7	<u>5.5</u>	7.0	**19.5**	5.6	5.6
	ML	**8.2**	5.2	5.3	<u>5.1</u>	<u>5.1</u>	5.3	6.6	<u>5.1</u>	<u>5.1</u>
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	<u>8.1</u>	9.9	9.8	9.6	9.8	8.3	**19.9**	10.6	15.0
	ML	6.7	5.3	<u>5.1</u>	<u>5.1</u>	5.2	<u>5.1</u>	**7.2**	5.3	5.9
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	13.2	12.5	12.3	12.3	<u>12.2</u>	12.4	**13.6**	12.3	12.3
	ML	n/a	12.1	12.1	<u>12.0</u>	<u>12.0</u>	<u>12.0</u>	**12.2**	**12.2**	12.1

Notes: Average travel time is reported in minutes. The PM peak hour is 4:00 to 5:00 PM. "GP" indicates GP lanes, and "ML" indicates the managed lane. Where no managed lane exists in Alternative 1, "n/a" is shown. The lowest value is underlined, and the highest value is bolded.

In the westbound direction, Alternative 8 would have the lowest AM peak hour travel time for I-80 from Truxel Road to US 50 with GP and managed lane travel time less than half that for Alternative 1. Westbound travel time would be highest for Alternative 7 for US 50 from SR 51/SR 99 to I-80 at 56 minutes for the GP lanes. Alternative 1 would be better with about 24 minutes. Alternatives 2, 3, 5, 8, and 9 would have the best average GP lane travel time of about 6 minutes. West of US 50, travel times would be similar across alternatives although Alternatives 1 and 7 would be about 30 seconds higher on average.

Similar to AM peak hour conditions, eastbound PM peak hour average travel time in the GP lanes would be highest for Alternative 7 for I-80 from Kidwell Road to US 50. Due to severe congestion, average GP lane travel time would be more than three hours for Alternative 7 and more than an hour for Alternative 1. Alternatives 2 through 4 and 9 would have the best travel times of 35 to 40 minutes for the GP lanes and 15 to 18 minutes for the managed lanes. Peak hour travel time would be higher for Alternative 5 due to higher demand from 3:00 to 4:00 PM, which results in more peak hour congestion. For Alternative 8, travel time would be higher due to one less GP lane for vehicles to queue in between Enterprise Boulevard and US 50 with the addition of the median ramp. Downstream on US 50, travel time would be similar across alternatives since speeds would be controlled by congestion in downtown Sacramento beyond the project limits. Downstream on I-80, average travel time would be lowest for Alternatives 1, 6, and 7 due to upstream bottlenecks that constrain traffic volume from reaching this corridor. Travel time would be higher for Alternative 8 because more traffic can reach the bottleneck at I-5/I-80 with the median ramp for HOVs at I-80/US 50.

Westbound PM peak hour travel time for GP lanes would be highest for Alternative 7 for all three corridors. Alternatives 2, 4, 5, 8, and 9 would provide a 4.5-minute GP lane travel time savings for I-80 from Truxel Road to US 50 compared to Alternative 1. Alternative 3 would have a longer travel time due to congestion at the Reed Avenue off-ramp. There would be about a three-minute managed lane travel time savings for Alternatives 2 through 6, 8, and 9. For US 50 from SR 51/SR 99 to I-80, Alternative 1 would have the lowest GP lane travel time due to capacity constraints in downtown Sacramento. The build alternatives, except for Alternative 7, would provide about a 1.5-minute travel time savings for the managed lane compared to Alternative 1. Downstream on I-80 west of US 50, congestion is less, but the build alternatives, except for Alternative 7, would still provide about a 1-minute travel time savings over Alternative 1.

Travel time reliability was measured using the planning time index, which is the 95th percentile travel time divided by the free-flow travel time. Horizon year 2049 AM and PM peak hour planning time index for the GP and managed lanes are reported in **Table 63** and **Table** 64, respectively. **Appendix J** has the overall planning time index and planning time indexes for the other three hours in the peak periods.

For the AM peak hour, the eastbound travel time would be more reliable for Alternatives 2 through 5, 8, and 9 on I-80 from Kidwell Road to US 50 with planning time indexes less than 1.1 for both GP and managed lanes. The congested conditions on US 50 would increase the planning time index to about 1.3 for GP lanes under these alternatives, but the managed lanes would have a value less than 1.1. In the westbound direction, travel time would be most reliable for Alternative 8 for I-80 from Truxel Road to US 50 with an index less than 2 while the other alternatives would have values greater than 4 for the GP lanes.

Table 63: AM Peak Hour Planning Time Index – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	1.29	1.06	1.06	1.06	1.06	1.12	**1.67**	1.06	1.06
	ML	n/a	1.03	1.03	1.03	1.03	1.05	**1.17**	1.03	1.03
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	1.93	1.28	1.27	1.32	1.24	1.32	**2.27**	1.36	1.24
	ML	**1.81**	1.04	1.04	1.03	1.03	1.06	1.17	1.04	1.03
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	1.07	1.08	**1.09**	1.08	**1.09**	**1.09**	**1.09**	1.08	1.08
	ML	1.03	1.01	1.01	1.01	1.01	**1.04**	1.02	1.02	1.01
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	4.46	**5.74**	5.46	5.33	5.39	4.48	4.24	1.94	5.57
	ML	2.43	**3.43**	3.13	2.37	2.83	1.75	1.50	1.09	3.33
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	5.31	1.37	1.27	2.45	1.64	3.67	**13.55**	1.47	1.41

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
	ML	4.71	1.20	1.17	2.01	1.18	3.02	**6.61**	1.07	1.21
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	1.21	1.19	1.19	1.19	1.18	1.20	**1.22**	1.21	1.20
	ML	n/a	1.15	1.15	1.15	1.15	**1.18**	1.17	1.08	1.15

Notes: The AM peak hour is 7:00 to 8:00 AM. "GP" indicates GP lanes, and "ML" indicates the managed lane. The lowest value is underlined, and the highest value is bolded.

Table 64: PM Peak Hour Planning Time Index – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80 Eastbound: Kidwell Rd Off-ramp to US 50 Off-ramp	GP	6.73	3.31	3.49	3.65	5.53	6.76	**16.35**	5.20	3.70
	ML	n/a	1.50	1.53	1.29	2.35	3.93	**9.69**	2.77	1.67
US 50 Eastbound: I-80 to SR 51/SR 99 Off-ramp	GP	4.26	4.06	4.04	4.24	3.82	3.85	**4.76**	4.51	3.98
	ML	**3.72**	1.51	1.49	1.48	1.36	1.29	1.56	1.58	1.51
I-80 Eastbound: US 50 Off-ramp to Truxel Rd Off-ramp	GP	3.29	4.81	5.05	5.13	1.91	2.76	1.43	**5.41**	4.73
	ML	**3.29**	1.68	1.69	1.76	1.10	1.28	1.04	1.60	1.63
I-80 Westbound: Truxel Rd SB On-ramp to US 50 On-ramp	GP	2.33	1.21	1.57	1.27	1.18	1.81	**4.62**	1.19	1.23
	ML	**1.79**	1.13	1.10	1.05	1.07	1.11	1.62	1.04	1.05
US 50 Westbound: SR 51 On-ramp to I-80 On-ramp	GP	1.93	2.54	2.35	2.22	2.42	1.95	**4.69**	2.52	4.23
	ML	1.58	1.25	1.16	1.17	1.19	1.19	**1.69**	1.22	1.41
I-80 Westbound: US 50 On-ramp to Kidwell Rd Off-ramp	GP	1.17	1.09	1.07	1.07	1.06	1.08	**1.19**	1.06	1.07
	ML	n/a	1.04	1.04	1.04	1.04	1.04	**1.05**	**1.05**	1.04

Notes: The PM peak hour is 4:00 to 5:00 PM. "GP" indicates GP lanes, and "ML" indicates the managed lane. The lowest value is underlined, and the highest value is bolded.

For the PM peak hour, GP lane travel times would be more reliable for Alternatives 2 through 4 and 9 than the other alternatives for eastbound I-80 from Kidwell Road to US 50. The managed lane would provide a more reliable travel time for these alternatives with planning time indexes of 1.3 to 1.7 compared to 3.3 to 3.7 for the GP lanes. The other two eastbound corridors show similar results although the values for eastbound I-80 from US 50 to Truxel Road are higher. Due to congested conditions, Alternative 7 has the highest planning time indexes for the upstream I-80 and the US 50 segments and the lowest values for the downstream I-80 segment. In the westbound direction, Alternative 7 has the highest planning time indexes for the three corridors for the GP lanes. The managed lane values are higher only for Alternative 1. Alternatives 1 and 6 would have the lowest value for the GP lanes on US 50 due to worse congestion at I-5.

Alternative 8 would provide the lowest managed lane planning time index for the I-80 corridors and would be among the lower values for the US 50 corridor.

7.2.5 Network Performance

Using the Vissim operations analysis model, the network performance for the project alternatives under horizon year 2049 conditions are provided in **Table 65** for eastbound and **Table 66** for westbound.

Table 65: Eastbound Peak Period Network Performance – Horizon Year 2049

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicle hours of delay	5,700	3,200	3,000	3,100	3,000	3,500	**9,000**	3,200	2,900
Vehicle hours of travel	15,000	12,900	12,700	12,700	12,500	12,600	**17,300**	12,900	12,500
Average speed (mph)	38.7	46.7	47.3	47.1	47.4	44.8	29.9	46.5	**47.7**
Vehicles served	116,500	**117,100**	116,300	115,600	115,200	114,800	111,500	116,900	116,000
Persons served	183,500	**186,200**	182,800	179,000	178,900	181,100	177,100	184,000	184,300
Unserved entry vehicles	0	0	0	0	0	0	0	0	0
PM Peak Period									
Vehicle hours of delay	27,500	22,000	24,400	21,600	21,700	24,200	**30,600**	22,900	22,200
Vehicle hours of travel	36,100	32,300	34,200	31,600	31,800	33,200	**37,000**	33,000	32,500
Average speed (mph)	14.6	**19.7**	17.6	19.6	19.5	16.6	10.4	18.9	19.6
Vehicles served	118,100	123,600	120,400	124,000	**125,000**	121,200	107,900	123,500	123,100
Persons served	179,500	**189,900**	181,700	183,000	185,700	184,300	164,000	188,400	189,100
Unserved entry vehicles	7,500	1,200	3,000	1,000	1,600	5,400	**15,400**	2,400	1,700

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

In the eastbound direction, the AM peak period delay, travel time, and average speed would be best under Alternative 9 although Alternatives 2 through 5 and 8 would have similar performance. The network average speed for these alternatives would be within 1.2 mph of each other. The average speed for Alternative 1 would be about 10 mph lower. Alternative 7 would have the poorest performance with an average speed of about 30 mph. Overall, the peak period demand would be served under all alternatives.

Table 66: Westbound Peak Period Network Performance – Horizon Year 2049

Performance Measure	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM Peak Period									
Vehicle hours of delay	19,700	12,400	11,700	14,400	12,000	15,800	**24,500**	<u>7,000</u>	11,800
Vehicle hours of travel	31,000	25,600	24,900	27,000	24,800	27,800	**33,700**	<u>20,700</u>	24,900
Average speed (mph)	22.6	31.9	33.0	28.9	32.0	26.7	<u>16.9</u>	**41.2**	32.8
Vehicles served	112,200	122,500	123,300	117,700	119,900	117,400	<u>93,100</u>	**127,500**	121,000
Persons served	173,100	191,300	183,200	173,100	179,900	182,300	<u>145,600</u>	**196,600**	189,100
Unserved entry vehicles	9,700	2,000	900	4,300	1,900	3,800	**21,300**	<u>0</u>	1,600
PM Peak Period									
Vehicle hours of delay	12,100	9,200	10,100	<u>7,900</u>	8,700	<u>7,900</u>	**20,000**	8,400	10,200
Vehicle hours of travel	23,100	20,700	21,500	<u>18,700</u>	19,600	18,800	**28,900**	19,900	21,500
Average speed (mph)	29.4	34.2	33.0	35.6	34.2	**35.9**	<u>19.1</u>	35.7	32.6
Vehicles served	**128,400**	128,300	127,700	123,200	121,600	128,000	<u>107,500</u>	127,300	126,600
Persons served	196,900	**198,400**	190,300	<u>165,000</u>	181,200	196,600	166,600	196,300	195,500
Unserved entry vehicles	2,300	2,600	3,800	2,700	3,500	<u>1,300</u>	**13,500**	2,300	2,600

Notes: The peak periods are 6:00 to 10:00 AM and 3:00 to 7:00 PM. The lowest value is underlined, and the highest value is bolded.

The eastbound direction during the PM peak period would have the lowest network delay for Alternative 4 although Alternatives 2, 5, and 9 would have similar performance. The network average speed for these four alternatives would be about 20 mph, which reflects the congested conditions on the corridor. The performance for Alternative 8 would be just behind these alternatives with an average speed of 19 mph. Alternative 5 would serve the most vehicles, but Alternative 2 would serve the most people. Alternative 1 average speed would be about 15 mph. Similar to the AM peak period, Alternative 7 would have the poorest performance with an average speed of about 10 mph. Due to congestion in the study area, the entry demand volume on eastbound I-80 would not be completely served with up to 7,500 vehicles unserved for Alternative 1 and 15,400 vehicles unserved for Alternative 7.

In the westbound direction, Alternative 8 would have the best performance during the AM peak period with a little over half the delay of the next best alternative. The network average speed of 41 mph would be about 8 mph higher than Alternatives 3 and 9. Alternatives 2 and 5 would have relatively good performance with average speeds of about 32 mph. Alternatives 1 and 7 would perform the poorest with average speeds of 22 and 17 mph, respectively. Alternative 8 would serve its AM peak period entry demand, but Alternative 1 would have about 10,000 unserved vehicles, and Alternative 7 would have about 21,000 unserved vehicles.

During the PM peak period in the westbound direction, Alternatives 4 and 6 would have the lowest delay and total travel time. Alternatives 5 and 8 would also have low delay. Although Alternative 1 would serve the most vehicles, Alternative 2 would serve the most people due to the priority given to HOVs. Alternative 7 would have the worst performance: highest delay, lowest average speed, and lowest vehicles served.

Table 67 summarizes the freeway analysis segments with deficient operations as defined by the evaluation criteria provided in **Section 3.4**. The deficient operations were determined for each of the four hours during the AM and PM peak periods. The total number of analysis segments varies by alternative, so the percentage of deficient analysis segments is also listed.

During the AM peak period, Alternative 1 would have the most deficient segments with 43 percent. Alternative 8 would have the fewest segments at 13 percent. Alternatives 3, 5, and 9 would be next at about 21 percent for all three alternatives. During the PM peak period, Alternative 1 would again have the most deficient segments at 62 percent. Both Alternatives 4 and 5 would have the fewest deficient segments at about 44 percent.

Table 67: Hourly Segments with Deficient Operations – Horizon Year 2049

Peak Period	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
AM	**241 (43%)**	109 (21%)	109 (21%)	132 (25%)	108 (21%)	160 (31%)	222 (41%)	<u>69 (13%)</u>	108 (21%)
PM	**346 (62%)**	276 (53%)	274 (52%)	236 (45%)	<u>230 (44%)</u>	275 (53%)	314 (57%)	256 (50%)	280 (54%)

Notes: Operations are deficient if LOS E or F west of Mace Boulevard and LOS F east of Mace Boulevard. The lowest value is underlined, and the highest value is bolded.

7.3 Roadway Safety

Under Alternative 1, collision rates would be expected to be the same or higher than existing conditions. With the forecasted increase in traffic volumes, congestion and congestion-related collisions would increase. The freeway segments with higher-than-average collision rates would continue to experience the same collision rates. The freeway segments with increased congestion would be expected to have higher collision rates.

Alternatives 2 through 5, 8, and 9 would reduce congestion compared to Alternative 1. Reducing congestion and increasing the average speed to or near the free-flow speed would reduce congestion-related collision types, such as the most common type in the project area, rear end collision.

The *Highway Safety Manual* (AASHTO, 2014) provides equations to predict the safety performance of freeways. The equations show that having more freeway lanes is associated with lower collision frequency for all types of multi-vehicle collisions and for single-vehicle collisions with property damage only. Single-vehicle fatal and injury collisions have an increase in collision frequency. On an overall basis, Alternatives 2 through 6, 8, and 9 would be expected to lower the collision rate since these alternatives add a lane in most of the study area.

The Crash Modification Factors Clearinghouse online database does not include a crash modification factor for the conversion of a freeway lane to a managed lane. The database does include a four-star rated study that evaluated conversion of an HOV to an HOT lane in Miami, Florida. The study found that the overall collision rate was about the same after the conversion, but the managed lanes had a lower collision rate, and the GP lanes had a higher collision rate.

Alternatives 2 through 9 include the installation of ramp meter signals at five on-ramps. The Crash Modification Factors Clearinghouse provides a four-star rated study that estimates a 0.86 crash modification factor for the freeway when a ramp meter is installed.

Alternatives 2 though 6, 8, and 9 include the addition of westbound auxiliary lane between Tower Bridge Gateway and Harbor Boulevard. The Crash Modification Factors Clearinghouse provides a three-star rated study that estimates a 0.80 crash modification factor for the freeway when an auxiliary lane is added to connect an on-ramp to a downstream off-ramp.

Alternatives 2 through 9 include improvements to the west end of the Class I bicycle/pedestrian path on the Yolo Causeway. A new connection would be constructed along the westbound off-ramp to County Road 32A. This connection would allow eastbound bicyclists and pedestrians to access the path directly from the Class II on-street bicycle lanes on County Road 32A. This change would remove the need to cross County Road 32A at the existing entrance to the Yolo Causeway bicycle/pedestrian path. Removing this conflict point will improve safety for vulnerable users of the transportation system.

7.4 Multimodal Facilities

7.4.1 Transit System

As noted previously, the existing transit service as of October 2019 was carried forward for the opening year 2029 and horizon year 2049 analysis. The forecasted ridership differs by alternative as described in **Section 5.5.2**. Alternative 6 would have the highest ridership since only buses would have the travel time savings provided by the managed lanes. Alternatives 2 through 5, 8, and 9 would have similar transit ridership and an increase over Alternative 1. Alternative 7 would have the lowest ridership and a decrease compared to Alternative 1 due to network congestion.

Bus travel times were measured in the traffic simulation model for the Yolobus routes that travel I-80 and US 50 in the study area. **Table 68** and **Table** 69 show the average bus travel time for the AM and PM peak hours for Routes 42A/B and 138. See **Appendix K** for travel times for all routes and for all hours in the peak periods.

Table 68: AM Peak Hour Bus Travel Time – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
Eastbound: I-80 at Mace Blvd to Enterprise Blvd (Route 42B)	All	**11.3**	9.2	9.9	9.9	10.6	7.6	7.7	9.4	8.8
	Bus	7.5	7.7	**7.8**	7.2	7.0	7.2	7.4	7.7	7.3
Eastbound: I-80 at Old Davis Rd to US 50 at SR 51/SR 99 (Route 138)	All	21.7	16.7	16.8	16.9	16.4	17.2	**29.3**	16.7	16.4
	Bus	**21.0**	16.3	16.2	16.3	16.3	16.2	17.8	16.2	16.3
Westbound: I-80 at W Capitol Ave to Mace Blvd (Route 42A)	All	7.2	7.0	7.2	7.2	7.2	7.1	7.1	**7.3**	7.2
	Bus	7.7	7.5	7.6	7.6	7.7	7.5	**7.9**	7.6	7.5
Westbound: US 50 at Stockton Blvd to I-80 at Old Davis Rd (Route 138)	All	44.7	18.9	18.8	22.4	19.3	32.1	**64.4**	19.1	18.7
	Bus	**41.8**	18.4	18.4	19.0	18.6	19.5	32.3	18.4	18.4

Notes: Average travel time is reported in minutes. The AM peak hour is 7:00 to 8:00 AM. "All" indicates all vehicle types, and "Bus" indicates buses following the indicated route. The lowest value is underlined, and the highest value is bolded.

Table 69: PM Peak Hour Bus Travel Time – Horizon Year 2049

Path	Type	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
Eastbound: I-80 at Mace Blvd to Enterprise Blvd (Route 42B)	All	23.7	19.0	23.4	22.1	23.1	21.0	**37.0**	20.2	19.2
	Bus	25.7	12.2	14.9	15.0	20.0	15.7	**31.4**	14.6	14.2
Eastbound: I-80 at Old Davis Rd to US 50 at SR 51/SR 99 (Route 138)	All	68.3	49.7	53.2	48.0	52.9	62.6	**92.9**	52.2	49.9
	Bus	**81.0**	25.2	25.3	23.6	27.0	25.9	77.0	25.0	25.4
Westbound: I-80 at W Capitol Ave to Mace Blvd (Route 42A)	All	6.7	6.7	6.6	6.5	6.5	6.6	**6.9**	6.6	6.7
	Bus	7.5	7.3	7.4	7.1	7.4	7.4	**8.2**	7.4	7.4
Westbound: US 50 at Stockton Blvd to I-80 at Old Davis Rd (Route 138)	All	21.9	23.0	22.4	23.7	22.6	21.4	**39.4**	22.8	25.7
	Bus	20.5	19.5	18.9	18.9	18.6	18.4	**22.2**	19.0	19.7

Notes: Average travel time is reported in minutes. The PM peak hour is 4:00 to 5:00 PM. "All" indicates all vehicle types, and "Bus" indicates buses following the indicated route. The lowest value is underlined, and the highest value is bolded.

During the AM peak hour, Route 42B buses would have a lower eastbound travel time than other vehicles on the same route since the buses would use both the managed lane and the HOV preferential lane on the on-ramp. Travel time savings for the bus would be about two minutes or more for Alternatives 1 through 5, 8, and 9. Alternatives 6 and 7 would have lower travel time for all vehicles due to the bottleneck at Mace Boulevard constraining the volume. Route 138 eastbound buses would not have much travel time savings for most alternatives due to low congestion on the route. However, Alternatives 6 and 7 would have a lower bus travel time due to a higher average travel time for other vehicles compared to the other alternatives. In the westbound direction, Route 42A travel times would be the same or higher than the average travel time because the route is uncongested and downstream of the bottleneck. On the other hand, Route 138 would have travel time savings of about 30 seconds for Alternatives 2, 3, 5, 8, and 9. Alternatives 4, 6, and 7 would have longer travel times for all vehicles, so the bus travel time savings would be greater: for example, a 50 percent reduction in travel time for Alternative 7.

During the PM peak hour, Route 42B travel time savings would range from about 3 to 9 minutes for alternatives with a managed lane. Alternative 2 would have the lowest travel times for buses and all vehicles, and Alternative 7 would have the highest. The longer Route 138 would also have travel time savings with most build alternatives having a bus travel time of around 25 minutes, which would be about half the overall average travel time. Due to congestion, travel time for both Route 138 and all traffic would be more than an hour for Alternative 7. In the westbound direction, Route 42A is downstream of the bottleneck, so the managed lane does not provide travel time savings. In contrast, Route 138 would have about a four-minute travel time savings for most alternatives.

Alternatives 2 through 9 include the construction of a mobility hub in the southeast quadrant of the I-80/Enterprise Boulevard interchange. The mobility hub would provide 300 parking spaces, e-scooter and e-bike parking, and a transit transfer station. The additional parking spaces would help to meet the park-and-ride demand for this location.

Transit service to the park-and-ride lots could be improved. At Mace Boulevard, the northbound bus stop is located only 200 feet north of the park-and-ride lot. The southbound bus stop is about 750 feet to the north and requires crossing two legs at the Mace Boulevard/Second Street intersection. The existing Enterprise Boulevard location is not served by transit, but the planned mobility hub across the street would include new transit service. The West Capitol Avenue location has adjacent service for eastbound buses. To access westbound buses, riders must cross three legs at the West Capitol Avenue/I-80 Westbound Ramps intersection because the fourth crosswalk is not provided, or risk crossing five lanes of traffic at the park-and-ride lot entrance. Although more direct transit service to the park-and-ride lots could improve transit use, the additional time needed would increase overall route travel time, which would worsen transit performance for other riders.

7.4.2 Bicycle System

A separate project to construct a Class I bicycle/pedestrian path across US 50 in West Sacramento was started in 2023. The project will extend Sycamore Trail from Sycamore Avenue/Evergreen Avenue to

Westmore Oaks Elementary school. A planned third phase of the project will extend the trail south to Stone Boulevard about 800 feet east of Industrial Boulevard.

Alternatives 2 through 9 include improvements to the Class I bicycle/pedestrian path on the Yolo Causeway. The pavement for the east and west connections to local streets will be rehabilitated to improve the riding surface. The barrier height on the causeway would be raised to meet current design standards, and a new fence would be installed on top of the barrier. On the west end, a new connection would be constructed along the westbound off-ramp to County Road 32A. The new connection would eliminate a 90-degree turn on the bike path and provide a more direct connection to County Road 32A. Additionally, the new connection eliminates the need for eastbound bicyclists to cross County Road 32A to access the path. Westbound bicyclists could choose to use the existing connection to avoid crossing County Road 32A or could use the new connection to cross County Road 32A at the I-80 Westbound Ramps intersection where drivers are expecting conflicting traffic.

7.4.3 Pedestrian System

A separate project to construct a Class I bicycle/pedestrian path across US 50 in West Sacramento was started in 2023. The project will extend Sycamore Trail from Sycamore Avenue/Evergreen Avenue to Westmore Oaks Elementary school. A planned third phase of the project will extend the trail south to Stone Boulevard about 800 feet east of Industrial Boulevard.

Alternatives 2 through 9 include improvements to the Class IV bicycle/pedestrian path on the Yolo Causeway. The pavement for the east and west connections to local streets will be rehabilitated to improve the walking surface. The barrier height on the causeway would be raised to meet current design standards, and a new fence would be installed on top of the barrier. On the west end, a new connection would be constructed along the westbound off-ramp to County Road 32A. The new connection would provide a more direct connection to County Road 32A. Additionally, the new connection eliminates the need for eastbound pedestrians to cross County Road 32A to access the path. Westbound pedestrians could choose to use the existing connection to avoid crossing County Road 32A or could use the new connection to cross County Road 32A at the I-80 Westbound Ramps intersection where drivers are expecting conflicting traffic.

7.4.4 Freight System

Future planned lane use development in the study area will increase warehouse and manufacturing activity in West Sacramento and Davis. As discussed in **Section 3.1.4.3**, the travel demand forecast model showed an inconsistent trend for truck volumes under the future analysis years. As a result, the existing heavy vehicle percentages were used to develop heavy vehicle volume forecasts. Horizon year 2049 heavy vehicle peak hour and peak period demand volumes for all study locations are shown in **Appendix F**.

Table 70 and **Table** 71 show AM and PM peak hour truck served volume at the I-80/US 50 interchange from the traffic simulation model. Horizon year 2049 truck served volume for each of the hours in the AM and PM peak periods for all study locations are shown in **Appendix J.**

Table 70: Truck Served Volume – Horizon Year 2049 AM Peak Hour

Path	Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80: Enterprise Blvd/W Capitol Ave to US 50	Eastbound	262	291	**320**	260	263	256	227	286	294
	Westbound	211	303	246	232	213	235	175	**311**	310
US 50: I-80 to Harbor Blvd	Eastbound	282	**298**	296	272	263	282	233	297	254
	Westbound	331	424	344	318	306	360	241	432	**453**
I-80: US 50 to Reed Ave	Eastbound	261	264	261	239	246	262	256	**267**	244
	Westbound	300	296	246	225	221	315	255	**395**	289

Notes: The AM peak hour is 7:00 to 8:00 AM. Volume does not include buses. The lowest value is underlined, and the highest value is bolded.

Table 71: Truck Served Volume – Horizon Year 2049 PM Peak Hour

Path	Direction	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
I-80: Enterprise Blvd/W Capitol Ave to US 50	Eastbound	148	228	219	188	183	165	98	236	**237**
	Westbound	105	**138**	126	120	107	104	107	137	125
US 50: I-80 to Harbor Blvd	Eastbound	168	166	164	144	146	125	90	171	**176**
	Westbound	207	**228**	210	195	178	201	183	217	200
I-80: US 50 to Reed Ave	Eastbound	138	165	156	135	144	155	121	**170**	160
	Westbound	227	253	248	235	221	243	207	**258**	249

Note: The PM peak hour is 4:00 to 5:00 PM. Volume does not include buses. The lowest value is underlined, and the highest value is bolded.

During the AM peak hour, the eastbound direction would be relatively uncongested, so the served truck volumes are similar across alternatives. The congestion in Alternative 7 results in low truck volumes on I-80 and US 50 between Enterprise Boulevard and Harbor Boulevard. For the westbound direction, truck served volume is also lowest for Alternative 7 on US 50 and I-80 between Harbor Boulevard and West Capitol Avenue. With less congestion for Alternative 8, the westbound truck served volume is highest on the I-80 segments.

During the PM peak hour, Alternative 7 would have the lowest truck served volume for the three eastbound segments. Alternatives 8 and 9 would have the highest truck served volume. In the westbound direction, Alternatives 5, 6, and 7 would have the lowest truck served volumes on US 50 and I-80 from Harbor Boulevard to West Capitol Avenue. Alternatives 2 and 8 would have the highest truck served volume.

7.5 Transportation System and Demand Management

The proposed project needs to include or allow for the subsequent installation of the following planned transportation system management devices.

- Roadside weather information systems
- Dynamic message signs
- CCTV cameras
- Traffic monitoring stations
- Census stations
- Ramp metering

Ramp meters are planned to be installed under separate projects at most local street on-ramps in the study area. The proposed project includes installation of ramp meters at the locations shown in **Table 72**. These ramp meters would be constructed under all alternatives except for Alternative 1.

Table 72: Proposed Ramp Meter Installation Locations

Ramp	Configuration	Storage Length for General-purpose Lane(s)
SR 113 to Westbound I-80	2 GP lanes	1,600 ft
Old Davis Rd to Westbound I-80	1 GP lane	1,300 ft
SR 113 to Eastbound I-80	2 GP lanes	5,000 ft
Old Davis Rd to Eastbound I-80	1 GP lane and 1 HOV preferential lane	775 ft
Richards Blvd to Eastbound I-80	2 GP lanes	650 ft
Mace Blvd to Westbound I-80	2 GP lanes	900 ft
County Rd 32A to Westbound I-80	1 GP lane	775 ft

The adequacy of the proposed storage length was evaluated using guidance from the *Ramp Meter Deign Manual* (October 2022). The ramp meter should accommodate storage of 7 percent of the peak hour demand volume assuming an average vehicle length of 29 feet (see **Appendix L**). Under the build alternatives, six of the seven ramps would have adequate storage to accommodate the peak hour demand volume under 2049 conditions. The exception is the Old Davis Road on-ramp to eastbound I-80. The storage in the GP lane would not accommodate the GP demand. The additional storage needed ranges from 82 feet under Alternative 7 to 201 feet under Alternative 3. The required storage could be provided on the local street since a 300-foot left-turn pocket exists at the unsignalized ramp terminal intersection. There appears to be available right-of-way to add a northbound right-turn pocket for additional storage. Alternatively, the ramp meter could be operated with two GP lanes.

Caltrans policy (Deputy Directive 35-R1) requires that HOV preferential lanes be provided when ramp meters are installed. Deviation from this policy requires justification.

Transportation demand management strategies include encouraging ride sharing using carpools and transit. The corridor currently has three park-and-ride lots: on Mace Boulevard north and west of the interchange at I-80, West Capitol Avenue in the westbound loop on-ramp, and Enterprise Boulevard in the eastbound loop on-ramp. Before the COVID-19 pandemic, the West Sacramento two park-and-ride lots were observed to be full or nearly full during the midday period although free public parking was available nearby. Alternatives 2 through 9 include the construction of a mobility hub in the southeast quadrant of the I-80/Enterprise Boulevard interchange. The mobility hub would provide 300 parking spaces, which would help to meet the park-and-ride demand for this location.

8. Alternatives Comparison and Recommendations

This section provides a comparison of the project alternatives across the performance measures reported above. Recommendations for further improvements and additional analysis are provided.

8.1 Alternatives Comparison

Table 73 provides a qualitative assessment of selected performance measures for the horizon year 2049 conditions. The first two performance measures are based on the daily values from the forecasting model. The remaining performance measures come from the operations analysis model and are the average of the AM and PM peak period performance.

Table 73: Alternatives Comparison – Horizon Year 2049

	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative	Alternative
Performance Measure	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Regional VMT	5	2	3	2	1	4	2	3	3
Corridor PMT	5	2	1	3	4	5	5	2	3
Persons served at bottlenecks	3.5	1	2	2.5	2.5	3.5	5	1	1
GP peak hour travel time	3.5	1.5	1.5	2	2	3	5	2	1.5
GP peak hour planning time index	4	2	2	2.5	1.5	3	5	2.5	2.5
Managed lane peak hour travel time	4.5	2	1.5	1.5	1.5	3	5	1.5	2
Vehicle hours of delay	4	2	2.5	2	1.5	2.5	5	1.5	2
Average speed	4	1.5	2.5	2	2	2.5	5	1	2
Total vehicles served	3.5	1.5	2	3	3	3	5	1	2
Total persons served	3	1	2	4	3	2.5	5	1	1.5
Deficient segments	5	2.5	2.5	2	1.5	3	4	1.5	2.5
Average score	4.1	1.7	2.0	2.4	2.1	3.2	4.6	1.6	2.1

Note: The scale is 1 for very good performance and 5 for very poor performance.

Alternatives 2 and 8 have the best overall performance including very good performance in two categories for Alternative 2 and four categories for Alternative 8. Alternative 2 would have at least good performance for all categories, and Alternative 8 would have neutral performance for only regional VMT. These alternatives would increase freeway capacity in the form of a HOV lane so that faster travel time would be available to vehicles eligible for the HOV lane. These alternatives would increase both vehicle and person throughput at the key bottlenecks: eastbound I-80 at Mace Boulevard and westbound I-80 at the Yolo

Bypass. Alternative 8 would perform better than all other alternatives during the AM peak period since the median ramps at I-80/US 50 would provide a travel time advantage to HOVs, but PM peak hour travel time would be worse since fewer GP lanes would be provided on eastbound I-80 between Enterprise Boulevard and US 50. The AM peak period performance leads Alternative 8 to have the best overall average score.

Alternatives 3, 4, and 5 would perform well although not as high as Alternatives 2 and 8. For Alternative 3, performance would be worse because more vehicles would be eligible for the managed lane than in the other alternatives, so congestion would be higher where vehicles are entering and leaving the managed lane. In particular, the transition section from the HOT lane to the existing HOV lane on eastbound I-80 near West El Camino Avenue would have more turbulence than the other alternatives in a location where the GP lanes are congested from a downstream bottleneck at I-5. The additional turbulence would result in longer travel times and lower network average speed. Alternative 4 would also have turbulence at the transition sections. Additionally, Alternative 4 would serve fewer people overall since HOV2s would have to pay to use the managed lane. For Alternative 5, restricting the managed lane to tolled vehicles would restrict vehicles served and persons served since ridesharing would not provide a travel time savings. However, these alternatives would perform better than Alternatives 1 and 7 and would offer better travel time reliability in the managed lane than the HOV lane alternatives.

Alternative 6 would not perform well compared to the other alternatives. While person throughput could be improved if additional bus service were provided, the forecasted passenger vehicle volume would be constrained by the network capacity resulting in performance like Alternative 1 for many performance measures. Alternative 7 would also perform poorly. While the HOV lane would provide lower travel time than in the GP lanes, the GP lanes would be so congested that HOVs would be severely delayed entering and exiting the HOV lane.

Alternative 9 has the same freeway configuration as Alternative 2, but the demand volumes are different due to the missing ship canal bridge on Enterprise Boulevard. The worse performance for Alternative 9 shows the benefit of the planned Enterprise Boulevard bridge. The new bridge would shift demand from the US 50/Harbor Boulevard and I-80/Reed Avenue interchanges to the I-80/Enterprise Boulevard/West Capitol Avenue interchange, thereby improving operations at the I-80/US 50 interchange.

As mentioned in **Section 1.3.10**, traffic operations analysis was not prepared for Alternatives 11 through 15, which add the managed lane median ramps at the I-80/US 50 interchange to Alternatives 3 through 7. Since this is the same change when going from Alternative 2 to 8, the comparison of operational performance of these two alternatives can be extended to Alternatives 11 through 15. As noted previously, the biggest benefit for Alternative 8 would be the reduced westbound AM peak hour travel time due to the proximity of the bottleneck at the Yolo Causeway. The reduction in eastbound GP lanes between Enterprise Boulevard and US 50 results in a higher PM peak hour travel time. As a result, Alternatives 11 through 15 would likely have a better overall score for the horizon year 2049 performance measures than Alternatives 3 through 7.

Importantly, the above findings do not fully account for how induced vehicle travel effects could affect the demand volumes used in the operations analysis. Higher travel speeds could attract more demand than predicted thereby dampening the operational benefits of the alternatives. However, alternatives with managed lanes that include tolling have a greater ability to manage demand and balance the project's multiple purpose and need objectives while minimizing environmental effects associated with induced vehicle travel effects.

8.2 Considerations for Future Improvements

The project alternatives were refined during the traffic operations analysis to better align the travel demand volumes with freeway capacity. The following additional improvements should be considered to address bottlenecks in the study area.

- I-80/Mace Boulevard Interchange – The horizontal curves on I-80 combined with the on-ramps result in a capacity of about 1,310 vph per lane, which is significantly lower than the a typical freeway capacity of about 2,000 vph per lane. Increasing the radius of the horizontal curves, particularly near the on-ramps in the eastbound direction would increase vehicle capacity. Providing longer than standard acceleration lanes should be considered as well. These changes would likely require additional right-of-way south of the current alignment.
- I-80 from Enterprise Boulevard/West Capitol Avenue to US 50 – The Leisch Method analysis identified this weaving segment as over capacity for the AM peak hour under several alternatives. Given the close spacing of the interchanges, braiding the ramps should be considered to improve safety and operations.
- I-80/US 50 Interchange – The westbound US 50 connector ramp to eastbound I-80 becomes a bottleneck in the future years. The two-lane ramp narrows to one lane before joining eastbound I-80. The future year peak hour demand exceeds the capacity of a one-lane resulting in queuing onto westbound US 50. Widening the connector ramp to two full lanes should be considered. This change would likely affect the structure for the West Capitol Avenue undercrossing. Combined with the weaving issues with the adjacent Enterprise Boulevard/West Capitol Avenue interchange, an analysis of the entire interchange could be considered. Reconstructing the interchange so that I-80 is the major route instead of using connector ramps to stay on I-80 could be evaluated.
- US 50/Jefferson Boulevard/South River Road Interchange – Planned improvements for this interchange should consider removing the South River Road ramps so that the weaving section between Jefferson Boulevard and I-5 can be lengthened to improve safety and operations.
- I-5/I-80 Interchange – Planned improvements for this interchange include widening the eastbound off-ramp to two lanes and adding median ramps between I-5 to the south and I-80 to the east. The planned project should consider additional capacity for eastbound I-80 since this analysis showed that the bottleneck at the I-5 southbound on-ramp would result in congestion extending back through the I-80/US 50 interchange under both opening and horizon year conditions.
- I-80 in Solano County – Under future conditions, eastbound I-80 is congested during the PM peak period with the project alternatives, and the congestion would extend upstream of Pedrick Road

under the horizon year. The benefit of the managed lane is limited since the lane starts at the Yolo County line near Richards Boulevard. Further travel time savings and improved operations would result if the managed lane were extended into Solano County.

The proposed alternatives would restrict managed lane access during the weekday AM and PM peak periods. The study area also has congestion during weekends and holidays that would benefit from the lane addition under Alternatives 2 through 6, 8, and 9. Under future conditions, congestion will likely occur on weekends and holidays, so extending the managed lane access restrictions to weekends and holidays would provide an improved travel time for vehicles eligible for the managed lane. The provision of dynamic signs to control managed lane access should be considered to provide operators with more flexibility to handle traffic conditions.

As noted above, Alternatives 3, 4, and 5 would have more congestion due to turbulence where the managed lane connects to existing HOV lanes on I-80 and US 50. The turbulence could be minimized by adding lanes at the connection to minimize lane changing when leaving the upstream managed lane. Alternately, turbulence would be minimized if the managed lane restrictions were the same.

9. References

The references cited in the Transportation Analysis Report are listed below.

- 2017 California Regional Transportation Plan Guidelines for Metropolitan Planning Organizations, https://dot.ca.gov/programs/transportation-planning/regional-planning/federal-state-planning-program/2017-rtp-guidelines-for-mpos, California Transportation Commission, January 2017
- 2020 Metropolitan Transportation Plan, Sustainable Communities Strategy, https://www.sacog.org/2020-metropolitan-transportation-plansustainable-communities-strategy-update, Sacramento Area Council of Governments, 2019
- Annual Average Daily Truck Traffic on the California State Highway System, https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/census/aadt/2019-truck-aadt.xlsx, Caltrans, 2019
- California Induced Travel Calculator, National Center for Sustainable Transportation, https://ncst.ucdavis.edu/research-product/induced-travel-calculator
- Caltrans Performance Measurement System (PeMS), https://pems.dot.ca.gov.
- City of Davis General Plan Transportation Element, http://community-development.cityofdavis.org/Media/Default/Documents/PDF/CDD/Planning/Plans-Documents/GP/004-02-Transportation.pdf, December 2013
- City of West Sacramento General Plan 2035 Policy Document, https://www.cityofwestsacramento.org/home/showpublisheddocument/6446/636445527399300000, November 2016
- Crash Modification Factors Clearinghouse, cmfcleainghouse.org, accessed May 2023
- The Fundamental Law of Road Congestion: Evidence from US Cities, Gilles Duranton and Matthew A. Turner, American Economic Review 101, October 2011. Retrieved from https://www.aeaweb.org/articles?id=10.1257/aer.101.6.2616.
- Highway Capacity Manual Seventh Edition, Transportation Research Board, 2022
- Highway Design Manual, Chapter 610, https://dot.ca.gov/-/media/dot-media/programs/design/documents/chp0610-a11y.pdf, Caltrans, July 2020
- Highway Safety Manual Supplement, American Association of State Highway and Transportation Officials, 2014
- I-80 Transportation Concept Report, Caltrans, 2017

- NCHRP 765 Analytical Travel Demand Forecasting Approaches for Project-Level Planning and Design, Transportation Research Board, 2014
- Ramp Meter Design Manual, Caltrans, October 2022
- Road Expansion, Urban Growth, and Induced Travel – A Path Analysis, Robert Cervero, APA Journal, Spring 2003, Vol. 69, No. 2
- Transportation Analysis Framework, Caltrans, 2020, https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-09-10-1st-edition-taf-fnl-a11y.pdf
- Transportation Analysis under CEQA, Caltrans, 2020, https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-09-10-1st-edition-tac-fnl-a11y.pdf
- Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, FHWA, 2004
- Transportation Concept Report Interstate 80, Caltrans District 3, July 2017
- Transportation Concept Report and Corridor System Management Plan United States Route 50, Caltrans District 3, June 2014
- US 50 Transportation Concept Report, Caltrans, 2014

Appendix

A. 2019 Stick Diagrams

B. Existing Conditions Operations Analysis Results

C. Collision History

D. Forecast Model Performance Measures

E. Opening Year 2029 Forecast Volumes

F. Horizon Year 2049 Forecast Volumes

G. Transit Ridership

H. Traffic Index

I. Opening Year 2029 Operations Analysis Results

J. Horizon Year 2049 Operations Analysis Results

K. Bus Travel Time Comparison

L. Ramp Meter Storage

Appendix A:

2019 Stick Diagrams

Appendix B:

Existing Conditions Operations Analysis Results

Appendix C:

Collision History

Appendix D:

Forecast Model Performance Measures

Appendix E:

Opening Year 2029 Forecast Volumes

Appendix F:

Opening Year 2029 Forecast Volumes

Appendix G:

Transit Ridership

Appendix H:

Traffic Index

Appendix I:

Opening Year 2029
Operations Analysis Results

Appendix J:

Horizon Year 2049
Operations Analysis Results

Appendix K:

Bus Travel Time Comparison

Appendix L:

Ramp Meter Storage