



Appendix E. Traffic Impact Analysis

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TRAFFIC IMPACT ANALYSIS
SPRING STREET BUSINESS/INDUSTRIAL PARK

Long Beach, California
December 11, 2019
(Original dated August 23, 2018)

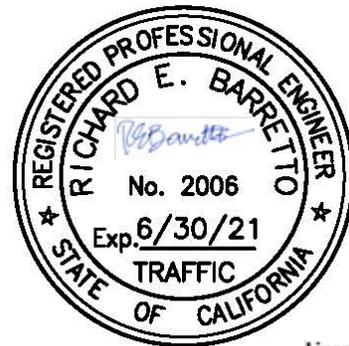
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EXECUTIVE SUMMARY

Project Description

- The project site is a 7.8 acre vacant parcel of land located on the southwest corner of Orange Avenue at Spring Street and addressed at 2851 Orange Avenue in the City of Long Beach, California. The project site is bounded by Spring Street on the north, Willow Springs Park on the south, Orange Avenue on the east, and undeveloped property on the west; the City of Signal Hill jurisdiction is located east of the Project site.

The proposed Project consists of the development of a business park with a total of 160,673 square-feet (SF) of floor area within three (3) concrete “tilt-up” buildings. The anticipated mix of land uses includes manufacturing and warehousing. Building 1 of the project site is 39,812 SF, inclusive of 3,000 SF of mezzanine. Building 2 is 48,745 SF, inclusive of 3,000 SF of mezzanine. Building 3 is 72,116 SF, inclusive of 4,000 SF mezzanine. The project is proposing to provide 162 standard surface lot spaces, 8 trailer spaces, and 18 loading docks.

- The proposed Project is forecast to generate approximately 757 daily trips, with 120 trips (93 inbound, 27 outbound) produced in the AM peak hour and 130 trips (40 inbound, 90 outbound) produced in the PM peak hour on a “typical” weekday. Of the total trips generated by the Project, truck trips related to the manufacturing component after applying a passenger car equivalency (PCE) factor of 2.0 is anticipated to generate 252 daily trips, with 40 trips produced in the AM peak hour and 44 trips produced in the PM peak hour.

Study Area

- Fifteen (15) key study intersections have been identified for evaluation in collaboration with City of Long Beach staff as well as the City of Signal Hill staff. The fifteen (15) intersections listed below provide regional and local access to the study area and define the extent of the boundaries for this traffic impact investigation, as well as identifies the applicable jurisdiction.

Key Intersection	Jurisdiction		
	Caltrans	City of Long Beach	City of Signal Hill
1. Orange Avenue at 32 nd Street	--	--	Signal Hill
2. I-405 NB Ramps at 32 nd Street	Caltrans		
3. Orange Avenue at I-405 SB Ramps	Caltrans	--	--
4. Atlantic Avenue at Spring Street	--	Long Beach	Signal Hill
5. Olive Avenue at Spring Street	--	--	Signal Hill
6. California Avenue at Spring Street	--	Long Beach	Signal Hill
7. Orange Avenue at Spring Street	--	Long Beach	Signal Hill

Key Intersection	Jurisdiction		
	Caltrans	City of Long Beach	City of Signal Hill
8. Walnut Avenue at Spring Street	--	Long Beach	Signal Hill
9. Cherry Avenue at Spring Street	--	Long Beach	Signal Hill
10. I-405 SB Off-Ramp at Spring Street	Caltrans	--	--
11. Orange Avenue at 29 th Street	--	Long Beach	Signal Hill
12. California Avenue at Willow Street	--	Long Beach	Signal Hill
13. Orange Avenue at Willow Street	--	Long Beach	Signal Hill
14. Walnut Avenue at Willow Street	--	--	Signal Hill
15. Cherry Avenue at Willow Street	--	--	Signal Hill

Related Projects Description

- Twenty-seven (27) cumulative projects are expected to generate a combined total of 31,290 daily trips, 2,326 AM peak hour trips (1,272 inbound and 1,054 outbound) and 2,695 PM peak hour trips (1,282 inbound and 1,413 outbound) on a typical weekday.
- In addition, the City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue, which will span between 70th Street and Pacific Coast Highway. Consistent with the City of Long Beach plans, this protected bikeway is assumed to be part of the cumulative background traffic conditions and is anticipated to be complete by the Project's opening year. As part of the planned improvements, Orange Avenue will be reduced from a four-lane roadway to a two-lane roadway.

Traffic Impact Analysis

Existing Traffic Conditions

- The intersection of Orange Avenue/I-405 SB Ramps currently operates at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour. The remaining fourteen (14) key study intersections currently operate at LOS D or better during the weekday AM and PM peak hours.

Existing With Project Traffic Conditions

- The intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour with the addition of project traffic. The remaining fourteen (14) study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours, with the addition of project traffic.

Although the intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour, the intersection is

not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report. Since the study intersection currently operates at an adverse LOS under existing traffic conditions, the Project's impact is not considered to be a significant impact.

Year 2021 Cumulative Traffic Conditions

- the addition of ambient traffic growth and cumulative project traffic will cumulatively impact two (2) of the key study intersections, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the AM and PM peak hours. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	0.905	E
4. Atlantic Avenue at Spring Street	--	--	0.906	E

Year 2021 Cumulative Plus Project Traffic Conditions

- Two (2) of the key study intersections are forecast to operate adversely with the addition of project traffic, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours with the addition of project traffic. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	0.929	E
4. Atlantic Avenue at Spring Street	--	--	0.906	E

One (1) of the two intersections operating adversely are considered significantly impacted, which is Orange Avenue/32nd Street. The implementation of improvements at the intersection will help offset the project's impact.

Additionally, although the intersection of Atlantic Avenue/Spring Street is forecast to operate adversely, the project increment adds less than 0.020 to the ICU value and hence the Project's impact is considered insignificant based on the City's LOS standards and significance criteria.

- An alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and

without implementation of Long Beach’s planned bikeway improvements along Orange Avenue.

With the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic.

Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Without the Orange Avenue bikeway improvements, two (2) of the three study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic.

Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Year 2038 Buildout Traffic Conditions

- The addition of ambient traffic growth and cumulative project traffic will cumulatively impact three (3) of the key study intersections, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the AM and PM peak hours. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	1.034	F
4. Atlantic Avenue at Spring Street	0.908	E	1.030	F
15. Cherry Avenue at Willow Street	--	--	0.996	E

Year 2038 Buildout Plus Project Traffic Conditions

- Three (3) of the key study intersections are forecast to operate adversely with the addition of project traffic, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours with the addition of project traffic. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	1.058	F
4. Atlantic Avenue at Spring Street	0.908	E	1.030	F
15. Cherry Avenue at Willow Street	--	--	0.998	E

One (1) of the three intersections operating adversely are considered significantly impacted, which is Orange Avenue/32nd Street. Review of Column 5 indicates that the implementation of improvements at the intersection will help offset the project's impact.

Additionally, although the intersections of Atlantic Avenue/Spring Street and Cherry Avenue/Willow Street are forecast to operate adversely, the project increment adds less than 0.020 to the ICU value and hence the Project's impact is considered insignificant based on the City's LOS standards and significance criteria.

- An alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

With the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic.

The intersection of Orange Avenue/Spring Street is considered significantly impacted. Implementation of improvements at the intersection will help offset the project's impact.

Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Without the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic.

The intersection of Orange Avenue/Spring Street is considered significantly impacted. Implementation of improvements at the intersection will help offset the project's impact.

Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

State of California (Caltrans) Analysis

Existing Plus Project Traffic Conditions

- The intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

The intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 4 indicates that implementation of improvements at the intersection will help offset the Project's impact.

Year 2021 Cumulative Plus Project Traffic Conditions

- The intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

The intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the significant impact criteria defined in this report, however, implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Year 2038 Cumulative Plus Project Traffic Conditions

- The intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

The intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the significant impact criteria defined in this report, however, implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Intersection Left-Turn Vehicle Queuing Analysis

Existing Plus Project Traffic Conditions

- Eight (8) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining four (4) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at seven (7) of the eight study intersections with storage deficiencies, and thus does not contribute to additional vehicle queuing beyond that previously reported under existing conditions. However, project traffic does contribute additional left-turn queuing to the intersection of Orange Avenue/32nd Street on approaches with pre-existing storage deficiencies.

Year 2021 Cumulative Plus Project Traffic Conditions

- Seven (7) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at seven (7) of the study intersections with storage deficiencies, and thus does not contribute to additional vehicle queuing beyond that previously reported under existing conditions.

- An alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Orange Avenue at Spring Street with implementation of Long Beach's planned bikeway improvements along Orange Avenue has left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2021 cumulative traffic conditions. The remaining study intersection has queues that are adequately accommodated by the storage space.

However, project traffic does contribute additional left-turn queuing to the intersection of Orange Avenue/32nd Street on approaches with pre-existing storage deficiencies.

As it relates to the without bikeway improvements both intersections are forecast to have queues that are adequately accommodated by the storage space.

Year 2038 Cumulative Plus Project Traffic Conditions

- Seven (7) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at the seven (7) of the study intersections with storage deficiencies, and thus does not contribute to additional vehicle queueing beyond that previously reported under existing conditions.

- An alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Orange Avenue at Spring Street and Orange Avenue at Willow Street with implementation of Long Beach's planned bikeway improvements along Orange Avenue has left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions.

However, project traffic does contribute additional left-turn queueing to the intersection of Orange Avenue/Spring Street on approaches with pre-existing storage deficiencies.

As it relates to the without bikeway improvements both intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions. However, Project traffic does not contribute to additional vehicle queueing beyond that previously reported under 2038 cumulative traffic conditions.

Planned Improvements

- The City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue, which will span between 70th Street and Pacific Coast Highway. This protected bikeway is assumed to be part of the cumulative background traffic conditions and is anticipated to be complete by the Project's opening year; for the assessment without this planned bikeway improvement, existing condition would remain in place. As part of the planned improvements, a road diet along Orange Avenue will also be implemented which

will reduce Orange Avenue from a four-lane roadway to a two-lane roadway. The improvements to include the following:

Intersection 1 – Orange Avenue at 32nd Street

With Orange Avenue Bikeway Improvements: No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, south of 32nd Street would be striped with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

Intersection 3 – Orange Avenue at I-405 SB Ramps:

With Orange Avenue Bikeway Improvements: Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

Intersection 7 – Orange Avenue at Spring Street:

With Orange Avenue Bikeway Improvements: Modify and restripe the northbound and southbound approaches to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, this study intersection would be designed to include protected bike lanes (i.e. on-street bike lanes and a median buffer to separate bicycle traffic from vehicular traffic).

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

Intersection 11 – Orange Avenue at 29th Street:

With Orange Avenue Bikeway Improvements: No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, from Spring Street south to Willow Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic; where possible, on-street parking will be maintained/provided.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

Intersection 13 – Orange Avenue at Willow Street:

With Orange Avenue Bikeway Improvements: Restripe the southbound approach to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the existing southbound right-turn lane would be removed to allow for the

installation of on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

Recommended Improvements

Existing Plus Project Traffic Conditions

- The proposed Project will not impact any of the key study intersections under the “Existing Plus Project” traffic scenario. Given that there are no significant project impacts, no improvements are required under this traffic scenario.

Year 2021 Cumulative Plus Project Traffic Conditions

- The proposed Project will significantly impact two (2) key study intersections under the “Year 2021 Cumulative Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

Intersection 1 – Orange Avenue at 32nd Street:

With Orange Avenue Bikeway Improvements: Restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Without Orange Avenue Bikeway Improvements: Same as above, restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Intersection 7 – Orange Avenue at Spring Street:

With Orange Avenue Bikeway Improvements: Construct an exclusive right-turn lane for the northbound and southbound approaches. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill and will need to consider the City of Long Beach’s planned Class IV (Protected Bike Lane) bikeway design/layout for this intersection.

Without Orange Avenue Bikeway Improvements: Restripe the northbound approach to provide dual left-turn lanes, a through lane and a shared through-right turn lane. Restripe the southbound right-turn lane into a shared through-right turn lane. Modify the traffic signal form a two phase signal to a five phase signal with protected north-south left turn lanes. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill.

Year 2038 Cumulative Plus Project Traffic Conditions

- The proposed Project will significantly impact two (2) key study intersections under the “Year 2038 Buildout Plus Project” traffic scenario. The recommended improvements, both

with and without the planned bikeway improvements of the City of Long Beach, are as follows:

Intersection 1 – Orange Avenue at 32nd Street:

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions, restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Intersection 7 – Orange Avenue at Spring Street:

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Construct an exclusive right-turn lane for the northbound and southbound approaches. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill and will need to consider the City of Long Beach’s planned Class IV (Protected Bike Lane) bikeway design/layout for this intersection.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Restripe the northbound approach to provide dual left-turn lanes, a through lane and a shared through-right turn lane. Restripe the southbound right-turn lane into a shared through-right turn lane. Modify the traffic signal from a two phase signal to a five phase signal with protected north-south left turn lanes. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill.

Caltrans Recommended Improvements

Existing Plus Project Traffic Conditions

- The proposed Project will significantly impact one (1) key study intersection under the “Existing Plus Project” traffic scenario based on the Caltrans impact criteria defined in this report. The recommended improvements are as follows:

Intersection 3 – Orange Avenue at I-405 SB Ramps: Install a three-phase traffic signal. These improvements are subject to the approval of Caltrans.

Year 2021 Cumulative Plus Project Traffic Conditions

- The proposed Project will significantly impact one (1) key study intersection under the “Year 2021 Cumulative Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

Intersection 3 – Orange Avenue at I-405 SB Ramps

With Orange Avenue Bikeway Improvements: Install a three-phase traffic signal. Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic. Restripe the northbound left-turn lane to 225 feet. These improvements are subject to the approval of Caltrans.

Without Orange Avenue Bikeway Improvements: Install a three-phase traffic signal; maintain existing intersection lane configuration. These improvements are subject to the approval of Caltrans.

Year 2038 Cumulative Plus Project Traffic Conditions

- The proposed Project will significantly impact one (1) key study intersection under the “Year 2038 Buildout Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

Intersection 3 – Orange Avenue at I-405 SB Ramps:

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Install a three-phase traffic signal. Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic. Restripe the northbound left-turn lane to 225 feet. These improvements are subject to the approval of Caltrans.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Install a three-phase traffic signal. These improvements are subject to the approval of Caltrans.

Project-Specific Improvements

- Subject to the review and approval of the City of Long Beach and Signal Hill Engineering Division, the following improvements are recommended in conjunction with the development of the proposed Project to ensure that adequate ingress and egress to the project site is provided. Intersection modifications include the following:

Intersection A – Project Driveway 1 at Spring Street: Install an unsignalized driveway located approximately 200 feet to the west of Orange Avenue. To restrict illegal left-turns out of this driveway it is recommended that the installation of a raised curbed diverter island be installed to prohibit left-turns and restrict movements to right-turn in and right-turn out only. These improvements are subject to the approval of the City of Long Beach.

Intersection B – Orange Avenue at Project Driveway 2:

With Orange Avenue Bikeway Improvements: To provide full access to the project site install a two phase traffic signal with permissive phasing for the northbound left turn lane. The signal is proposed approximately 260 feet south of Spring Street along Orange Avenue. Modify the northbound approach to accommodate a 100-foot left-turn lane and one through lane. For the eastbound approach, install a shared left/right turn lane. These improvements are subject to the approval of the City of Long Beach and/or City of Signal Hill.

Without Orange Avenue Bikeway Improvements: To provide full access to the project site install a two phase traffic signal with permissive phasing for the northbound left turn lane. Modify the northbound approach to accommodate a 100-foot left-turn lane and two through lanes. For the eastbound approach, install a shared left/right turn lane. These improvements are subject to the approval of the City of Long Beach and/or City of Signal Hill.

Project-Related Fair Share Contribution

- Project's traffic percentage at the intersection of Orange Avenue/32nd Street totals 8.16% and at the intersection of Orange Avenue/I-405 SB Ramps totals 12.43% under Year 2038 buildout traffic conditions. The Project is expected to pay for the mitigation measures identified at the intersection of Orange Avenue/Spring Street.

Transportation Improvement Fee

- Based on the Project development of 160,673 SF of manufacturing space, the proposed Project can be expected to pay up to **\$176,740.30** in Transportation Improvement Fees. The precise fee will be determined by the City upon issuance of project building permits.

Site Access Evaluation

- The proposed driveways are forecast to operate at acceptable LOS C or better during both the AM and PM peak hours.

Congestion Management Program Compliance Assessment

- Based on the proposed Project's trip generation potential, trip distribution and trip assignment, the Project will not add more than 50 at the identified CMP intersections during the weekday AM peak hour or PM peak hour. Therefore, a CMP intersection traffic impact analysis is not required and impacts would be less than significant.

Based on the project's trip generation potential and distribution pattern, the proposed Project will not add more than 150 trips during the AM or PM peak hour at this CMP mainline freeway-monitoring location. Therefore, a CMP freeway traffic impact analysis is not required.

Transit Impact Review

- The proposed Project is forecast to generate 12 transit trips (9 inbound and 3 outbound) during the AM peak hour and 13 transit trips (4 inbound and 9 outbound) during the PM peak hour. Over a 24-hour period the proposed Project is forecasted to generate 74 daily weekday transit trips.

Caltrans Freeway Analysis

Existing Plus Project Traffic Conditions

- Four (4) freeway segments/ramps will operate adversely with the addition of project traffic. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Although no density values are report the Project's contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Year 2021 Cumulative Plus Project Traffic Conditions

- Four (4) freeway segments/ramps will operate adversely with the addition of project traffic. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Although no density values are report the Project's contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Year 2038 Cumulative Plus Project Traffic Conditions

- Four (4) freeway segments/ramps will operate adversely with the addition of project traffic. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Although no density values are report the Project’s contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Alternative Analysis

- Under long-term buildout traffic conditions, the I-405 NB ramps at 32nd Street (Intersection #2) is planned to be removed, however, exact details are still unknown at this time. Therefore, an alternative analysis has been prepared to analyze the effects of the ramp removal on the fifteen (15) study intersections. This alternative analysis includes shifts in long-term buildout volumes from the ramps on 32nd Street to the ramps on either Cherry Avenue or Atlantic Avenue.

The Alternative analysis yields similar results to the main analysis with the exception that the impacted intersection of Orange Avenue at 32nd Street is no longer impacted.

TRAFFIC IMPACT ANALYSIS
SPRING STREET BUSINESS//INDUSTRIAL PARK

Long Beach, California
December 11, 2019
(Original dated August 23, 2018)

1.0 INTRODUCTION

This Traffic Impact Analysis report addresses the potential traffic impacts and circulation needs associated with the Spring Street Business//Industrial Park Project (hereinafter referred to as Project). The Project site is located in the southwest corner of Orange Avenue and Spring Street at 2851 Orange Avenue in the City of Long Beach, California. The Project includes the development of a business park comprised of three (3) buildings with a total floor area of 160,673 square-feet (SF) of manufacturing/warehousing/office land uses.

1.1 Scope of Work

This report documents the findings and recommendations of a traffic impact analysis, conducted by Linscott, Law & Greenspan, Engineers (LLG) to determine the potential impacts associated with the proposed Project. The traffic analysis evaluates the existing operating conditions at fifteen (15) key study intersections within the project vicinity, estimates the trip generation potential of the proposed Project, and forecasts future operating conditions without and with the Project. Where necessary, intersection improvements/mitigation measures are identified to offset the impact of the proposed Project. *Appendix A* contains the traffic impact analysis Scope of Work, inclusive of the amended scope to address the City of Signal Hill's comments.

This traffic report satisfies the traffic impact study requirements of the City of Long Beach as well as the City of Signal Hill and is consistent with the requirements and procedures outlined in the most current *Congestion Management Program (CMP) for Los Angeles County*. The traffic study also addressed comments received from the State of California Department of Transportation (CALTRANS) on the traffic study scope of work, and now includes a weaving and merge assessment along the I-405 Freeway between Atlantic Avenue and Cherry Avenue.

The Project site has been visited by LLG and an inventory of adjacent area roadways and intersections was performed. Existing peak hour traffic information has been collected at the fifteen (15) key study locations on a "typical" weekday for use in the preparation of intersection level of service calculations. Information concerning cumulative projects (planned and/or approved) in the vicinity of the project has been researched at the Cities of Long Beach and Signal Hill. Based on our research, twenty-seven (27) cumulative projects were considered in the cumulative traffic analysis for this project.

Based on City of Long Beach requirements, this traffic report analyzes existing and future (near-term) weekday AM and PM peak hour traffic conditions for existing and Year 2021 traffic conditions without and with the proposed Project. Peak hour traffic forecasts for the Year 2021

horizon year have been projected by increasing existing traffic volumes by an annual growth rate of one percent (1.0%) per year and adding traffic volumes generated by the twenty-seven (27) cumulative projects.

Although the City of Long Beach does not require a long-term traffic assessment for this Project, the City of Signal Hill has requested an analysis of long-term buildout (Year 2038) traffic conditions. As such, this report also analyzes weekday AM and PM peak hour traffic conditions for future long-term (Year 2038) traffic conditions without and with the proposed Project for all the study intersections. Peak hour forecasts for the Year 2038 buildout year have been projected by the same method used in forecasting near-term traffic conditions.

1.2 Study Area

Fifteen (15) key study intersections have been identified for evaluation in collaboration with City of Long Beach staff as well as the City of Signal Hill staff. The fifteen (15) intersections listed below provide regional and local access to the study area and define the extent of the boundaries for this traffic impact investigation, as well as identifies the applicable jurisdiction.

Key Intersection	Jurisdiction		
	Caltrans	City of Long Beach	City of Signal Hill
1. Orange Avenue at 32 nd Street	--	--	Signal Hill
2. I-405 NB Ramps at 32 nd Street	Caltrans		
3. Orange Avenue at I-405 SB Ramps	Caltrans	--	--
4. Atlantic Avenue at Spring Street	--	Long Beach	Signal Hill
5. Olive Avenue at Spring Street	--	--	Signal Hill
6. California Avenue at Spring Street	--	Long Beach	Signal Hill
7. Orange Avenue at Spring Street	--	Long Beach	Signal Hill
8. Walnut Avenue at Spring Street	--	Long Beach	Signal Hill
9. Cherry Avenue at Spring Street	--	Long Beach	Signal Hill
10. I-405 SB Off-Ramp at Spring Street	Caltrans	--	--
11. Orange Avenue at 29 th Street	--	Long Beach	Signal Hill
12. California Avenue at Willow Street	--	Long Beach	Signal Hill
13. Orange Avenue at Willow Street	--	Long Beach	Signal Hill
14. Walnut Avenue at Willow Street	--	--	Signal Hill
15. Cherry Avenue at Willow Street	--	--	Signal Hill

Figure 1-1 presents a Vicinity Map, which illustrates the general location of the Project and depicts the study locations and surrounding street system. The Volume-Capacity (V/C) and Level of Service (LOS) investigations at these key locations were used to evaluate the potential traffic-related impacts associated with the proposed Project.

1.3 Class IV (Protected Bike Lane) Bikeway Improvements on Orange Avenue

The City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue, which will span between 70th Street and Pacific Coast Highway. This protected bikeway, which is funded and in the planning/design stages of development, is included as part of the cumulative background traffic conditions and is anticipated to be complete by the Project's opening year. As part of the planned improvements, a road diet along Orange Avenue will also be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway. The planned bikeway improvements will directly affect current intersection lane configurations at the study intersections of Orange Avenue/I-405 SB Ramps (Intersection 3), Orange Avenue/Spring Street (Intersection 7) and Orange Avenue/Willow Street (Intersection 13) under near-term and long-term traffic conditions. Although the study intersections of Orange Avenue/32nd Street (Intersection 1) and Orange Avenue/Willow Street (Intersection 13) are within the Orange Avenue bikeway improvement project, the City of Long Beach sponsored-project does not affect the current intersection lane configurations at these two study intersections.

However, in response to the City of Signal Hill's comments, an alternative evaluation has been prepared to assess the Project's potential traffic impacts on the surrounding street system, especially along Orange Avenue, assuming Long Beach's planned bikeway improvements would not be implemented as the City of Signal Hill classifies Orange Avenue as a Class III bikeway facility. Further yet, the City of Signal Hill classifies as Orange Avenue as Principal Arterial, which calls for four lanes of travel and a painted or raised median.

1.4 I-405 NB Ramps at 32nd Street Closure

Based on information provided by the City of Signal Hill, the I-405 NB ramps at 32nd Street (Intersection #2) may be removed under long-term buildout traffic conditions. As such, an alternative level of service analysis has been included in this study, which analyzes the effects of the ramp removal at the study intersections. This alternative analysis includes shifts in long-term buildout volumes within the project vicinity to adjacent intersections as motorists currently using the subject intersection to enter or exit the I-405 Freeway would no longer be able to do so under future condition.

Included in this traffic study report are:

- Existing traffic counts;
- Estimated project traffic generation/distribution/assignment;
- Estimated cumulative project traffic generation/distribution/assignment;
- AM and PM peak hour capacity analyses for existing conditions;
- AM and PM peak hour capacity analyses for existing plus project conditions;
- AM and PM peak hour capacity analyses for future near-term (Year 2021) conditions without and with project traffic with and without the Orange Avenue Bikeway Improvements;

- AM and PM peak hour capacity analyses for future long-term (Year 2038) conditions without and with project traffic, with and without the Orange Avenue Bikeway Improvements;
- Caltrans analysis with and without the Orange Avenue Bikeway Improvements;
- Intersection left-turn vehicle queuing analysis with and without the Orange Avenue Bikeway Improvements;
- Recommended Improvements with and without the Orange Avenue Bikeway Improvements;
- Site Access, Internal Circulation Evaluation and Sight Distance Evaluation with and without the Orange Avenue Bikeway Improvements”;
- Congestion Management Program Compliance Assessment;
- I-405 Freeway Weave/Merge Analysis; and
- Alternative analysis for I-405 NB Ramp Closure at 32nd Street, with and without the Orange Avenue Bikeway Improvements.

As noted above, the Orange Avenue Bikeway Improvement project will affect the intersection lane configuration at the study intersections of Orange Avenue/I-405 SB Ramps (Intersection 3), Orange Avenue/Spring Street (Intersection 7) and Orange Avenue/Willow Street (Intersection 13), as well as the intersection and roadway geometry of Orange Avenue, south of Spring Street, along the Project’s frontage.

For the weaving and/or merge assessment, an evaluation of the following sections along the I-405 Freeway, between Atlantic Avenue and Cherry Avenue has been prepared:

Key Freeway Segment/Ramp

1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp (Weaving)
2. I-405 NB segment, west of 32nd Street On-Ramp (Weaving)
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue (Weaving)
4. I-405 SB segment, between Orange Avenue and Cherry Avenue (Weaving)
5. Cherry Avenue On-ramp, merge to I-405 SB (Merge)

2.0 PROJECT DESCRIPTION

The project site is a 7.8 acre vacant parcel of land located on the southwest corner of Orange Avenue at Spring Street and addressed at 2851 Orange Avenue in the City of Long Beach, California. The project site is bounded by Spring Street on the north, Willow Springs Park on the south, Orange Avenue on the east, and undeveloped property on the west; the City of Signal Hill jurisdiction is located east of the Project site. *Figure 2-1* presents the existing site aerial.

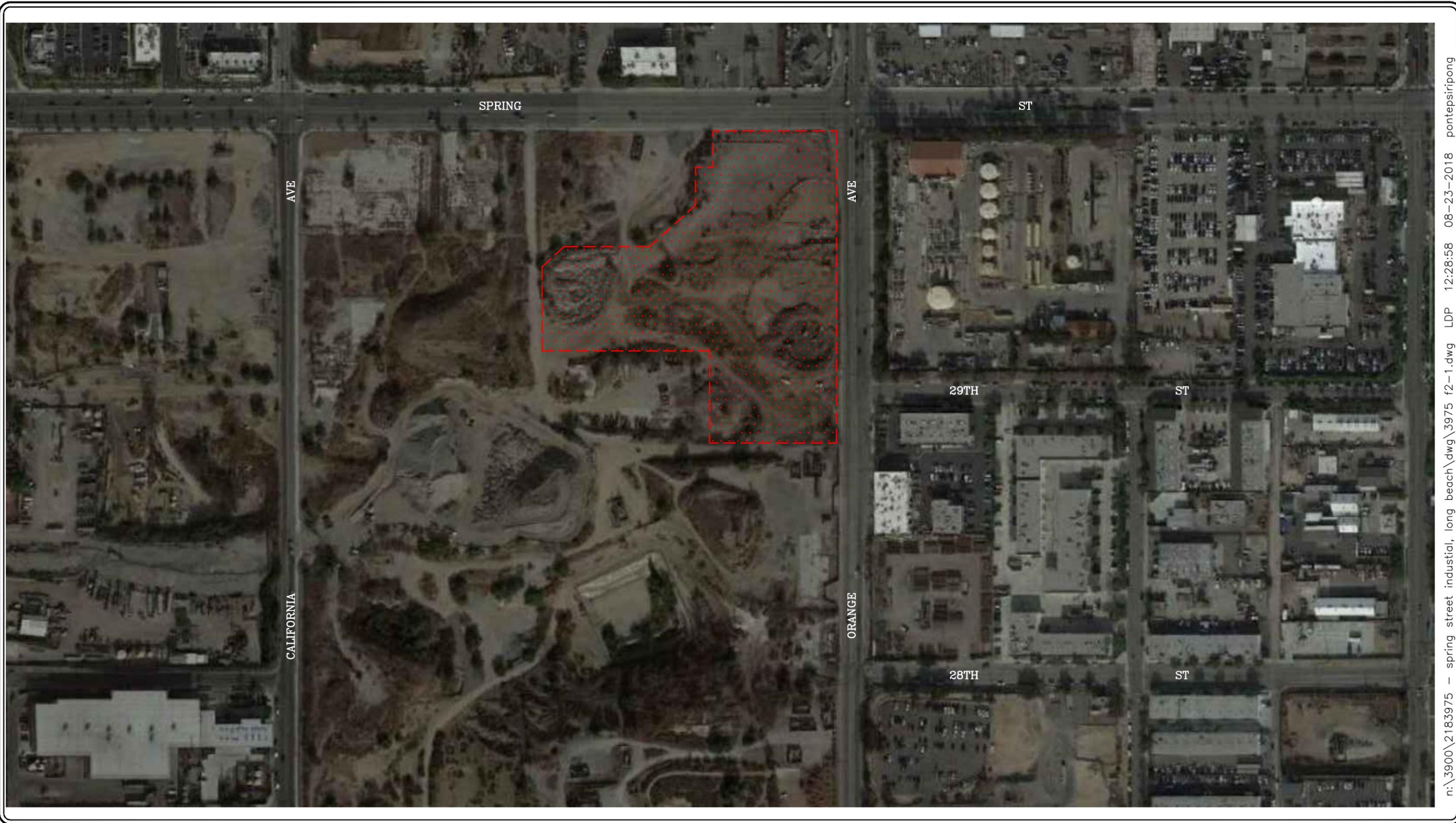
The proposed Project consists of the development of a business park with a total of 160,673 square-foot (SF) of floor area within three (3) concrete “tilt-up” buildings. The anticipated mix of land uses includes manufacturing and warehousing. Building 1 of the project site is 39,812 SF, inclusive of 3,000 SF of mezzanine. Building 2 is 48,745 SF, inclusive of 3,000 SF of mezzanine. Building 3 is 72,116 SF, inclusive of 4,000 SF mezzanine. The project is proposing to provide 162 standard surface lot spaces, 8 trailer spaces, and 18 loading docks. *Figure 2-2* presents the conceptual site plan, prepared by HPA Architecture.

2.1 Site Access

As shown in *Figure 2-2*, vehicular access to the Project site is proposed via one (1) unsignalized right-turn in/out driveway along Spring Street and one (1) full access signalized driveway along Orange Avenue.

Proposed improvements to be completed as a part of the Project along Orange Avenue and Spring Street bordering the subject property, subject to approval by the City of Long Beach and City of Signal Hill, include the following:

- Orange Avenue, from Spring Street south along Project frontage to just south of 29th Street - improve Orange Avenue along project frontage to ultimate half-section improvements. The curb adjacent to the Project along Orange Avenue will be subject to review and approval of the City of Long Beach.
- Spring Street, west of Orange Avenue – with the provision of right-turn in/right-turn out Project driveway on Spring, install diverter and/or appropriate signing and striping improvements to prohibit left-turn inbound movements and restrict turning movements to right-turns only.
- Primary Project Access at Orange Avenue – Install new traffic signal to accommodate new project access and provide a northbound left-turn lane to access site. The Project driveway will provide one inbound lane and a share left/right-turn lane.



n:\3900\2183975 - spring street industrial, long beach\dwg\3975 f2-1.dwg LDP 12:28:58 08-23-2018 pontepsiripong

SOURCE: GOOGLE

KEY

 = PROJECT SITE

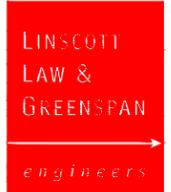
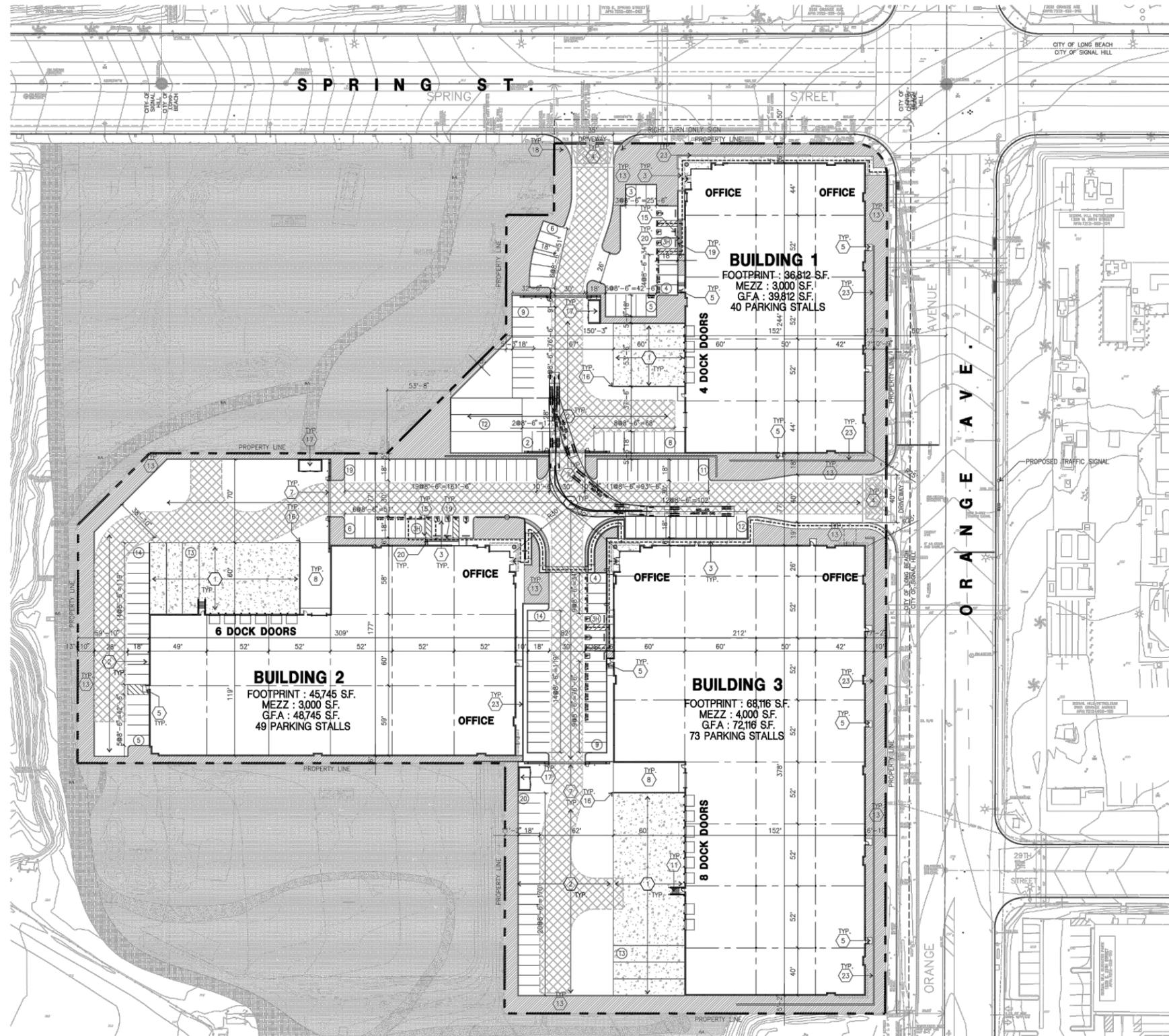


FIGURE 2-1

EXISTING AERIAL PHOTOGRAPH
SPRING STREET INDUSTRIAL, LONG BEACH



SOURCE: HPA ARCHITECTURE

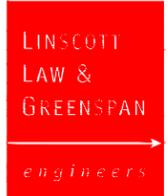


FIGURE 2-2

PROPOSED SITE PLAN
 SPRING STREET INDUSTRIAL, LONG BEACH

2.2 Pedestrian Circulation

The proposed Project is planning to set the curbs to ultimate half-section along Orange Avenue along the project frontage, which will result in the construction of a new sidewalk along Orange Avenue. Pedestrian circulation will be provided via existing public sidewalks along Spring Street and Orange Avenue within the vicinity of the Project frontage, which will connect to a new proposed sidewalk along Orange Avenue. The proposed Project will protect the existing sidewalk along Spring Street and if necessary repair or reconstruct sidewalks along the project frontage per the City's request.

Existing pedestrian facilities within the project area are adequate. Sidewalks are generally provided throughout the City along with crosswalks at most major intersections. In close proximity to the site, Spring Street and Orange Avenue provides pedestrians connectivity via the existing sidewalks linking the project site to the surrounding community. In close proximity to the site, crosswalks are provided at the signalized intersection of Spring Street and Orange Avenue.

3.0 EXISTING CONDITIONS

3.1 Existing Street System

The principal local network of streets serving the project site includes Spring Street, Willow Street, Cherry Avenue, Orange Avenue, and Atlantic Avenue. The following discussion provides a brief synopsis of these key area streets. The descriptions are based on an inventory of existing roadway conditions.

Spring Street is a four-lane, divided roadway oriented in the east-west direction. The posted speed limit is 40 miles per hour (mph). Parking is not permitted on either side of the roadway west of Orange Avenue, but is permitted on both sides of the roadway east of Orange Avenue within the vicinity of the project. Traffic signals control the study intersections of Atlantic Avenue at Spring Street, Olive Avenue at Spring Street, California Avenue at Spring Street, Orange Avenue at Spring Street, Walnut Avenue at Spring Street, Cherry Avenue at Spring Street, and I-405 southbound ramp at Spring Street.

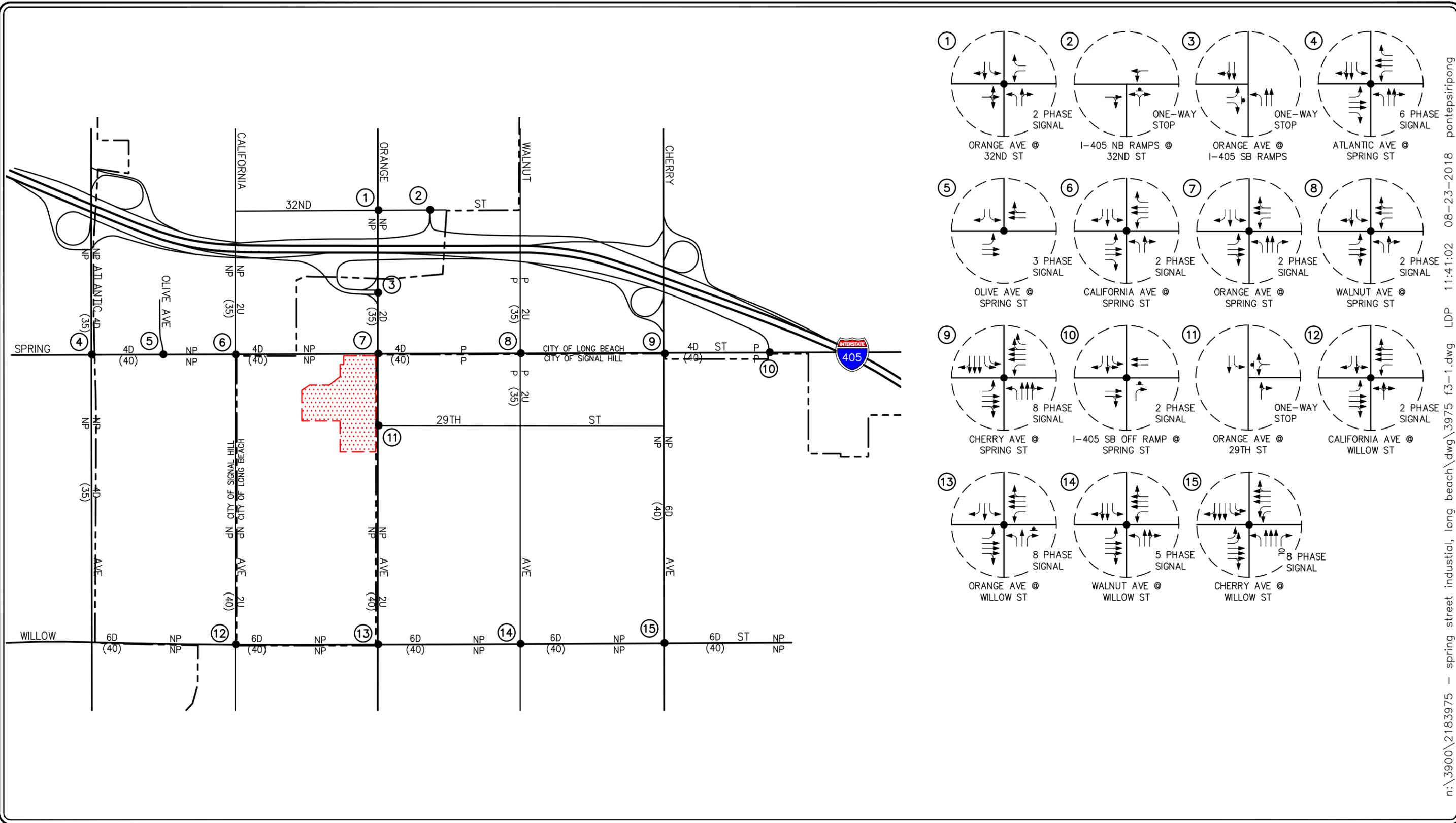
Willow Street is a six-lane, divided roadway oriented in the east-west direction. The posted speed limit is 40 mph. Parking is generally not permitted on either side of the roadway within the vicinity of the project. Traffic signals control the study intersection of California Avenue at Willow Street, Orange Avenue at Willow Street, Walnut Avenue at Willow Street, and Cherry Avenue at Willow Street.

Cherry Avenue is a six-lane divided roadway north-south oriented. The posted speed limit is 40 mph. Parking is generally not permitted on both sides of the roadway within the vicinity of the project. Traffic signals control the study intersections of Cherry Avenue at Spring Street and Willow Street.

Orange Avenue is a two-lane, divided roadway north of Spring Street and a two-lane undivided roadway south of Spring Street. The posted speed limit is 35 mph north of Spring Street and 40 mph south of Spring Street. Parking is generally not permitted on both sides of the roadway within the vicinity of the project. Traffic signals controls the study intersections of Orange Avenue at Spring Street, 32nd Street, and Willow Street. One-way stop signs control the study intersection of Orange Avenue at I-405 southbound ramp and 29th Street.

Atlantic Avenue is a four-lane, divided roadway oriented in the north-south direction. The posted speed limit is 40 mph. Parking is generally not permitted on both sides of the roadway within the vicinity of the project. A traffic signal controls the study intersection of Atlantic Avenue at Spring Street.

Figure 3-1 presents an inventory of the existing roadway conditions for the arterials and intersections evaluated in this report. The number of travel lanes and intersection controls for the key area intersections are identified.



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- KEY**
- ← = APPROACH LANE ASSIGNMENT
 - = TRAFFIC SIGNAL, ▼ = STOP SIGN
 - P = PARKING, NP = NO PARKING
 - U = UNDIVIDED, D = DIVIDED
 - 2 = NUMBER OF TRAVEL LANES
 - (XX) = POSTED SPEED LIMIT (MPH)
 - [Red Hatched Box] = PROJECT SITE

EXISTING ROADWAY CONDITIONS AND INTERSECTION CONTROLS
 SPRING STREET INDUSTRIAL, LONG BEACH

FIGURE 3-1

3.2 Existing Traffic Volumes

Fifteen (15) key study intersections have been identified as the locations at which to evaluate existing and future traffic operating conditions. Some portion of potential project-related traffic will pass through each of these intersections, and their analysis will reveal the expected impact associated with the proposed Project.

Existing weekday peak hour traffic volumes for the fifteen (15) key study intersections evaluated in this report were obtained from manual turning movement counts conducted by The Traffic Solution in March 2018 and National Data and Surveying Services in May 2018. **Figures 3-2** and **3-3** illustrate the existing weekday AM and PM peak hour traffic volumes at the fifteen (15) key study intersections evaluated in this report, respectively. **Appendix B** contains the detailed peak hour count sheets for the key intersections evaluated in this report.

3.3 Existing Public Transit

The Long Beach Transit (LBT) provide public transit services in the vicinity of the proposed Project. In the vicinity of the Project, LBT Route 131 currently serves Spring Street. LBT Routes, 102 and 104 currently serve Willow Street. LBT Routes 21, 22, and 131 currently serve Cherry Avenue. LBT Routes 71 and 72 currently serve Orange Avenue. LBT Routes 61, 101, and 103 currently serve Atlantic Boulevard. **Figure 3-4** graphically illustrates the transit routes of Long Beach Transit within the vicinity of the Project site. **Figure 3-5** identifies the location of the existing bus stops in proximity to the Project site, inclusive of bus stop located on Orange Avenue north of Spring Street, as well as the bus stops located on Orange Avenue, south of 29th Street.

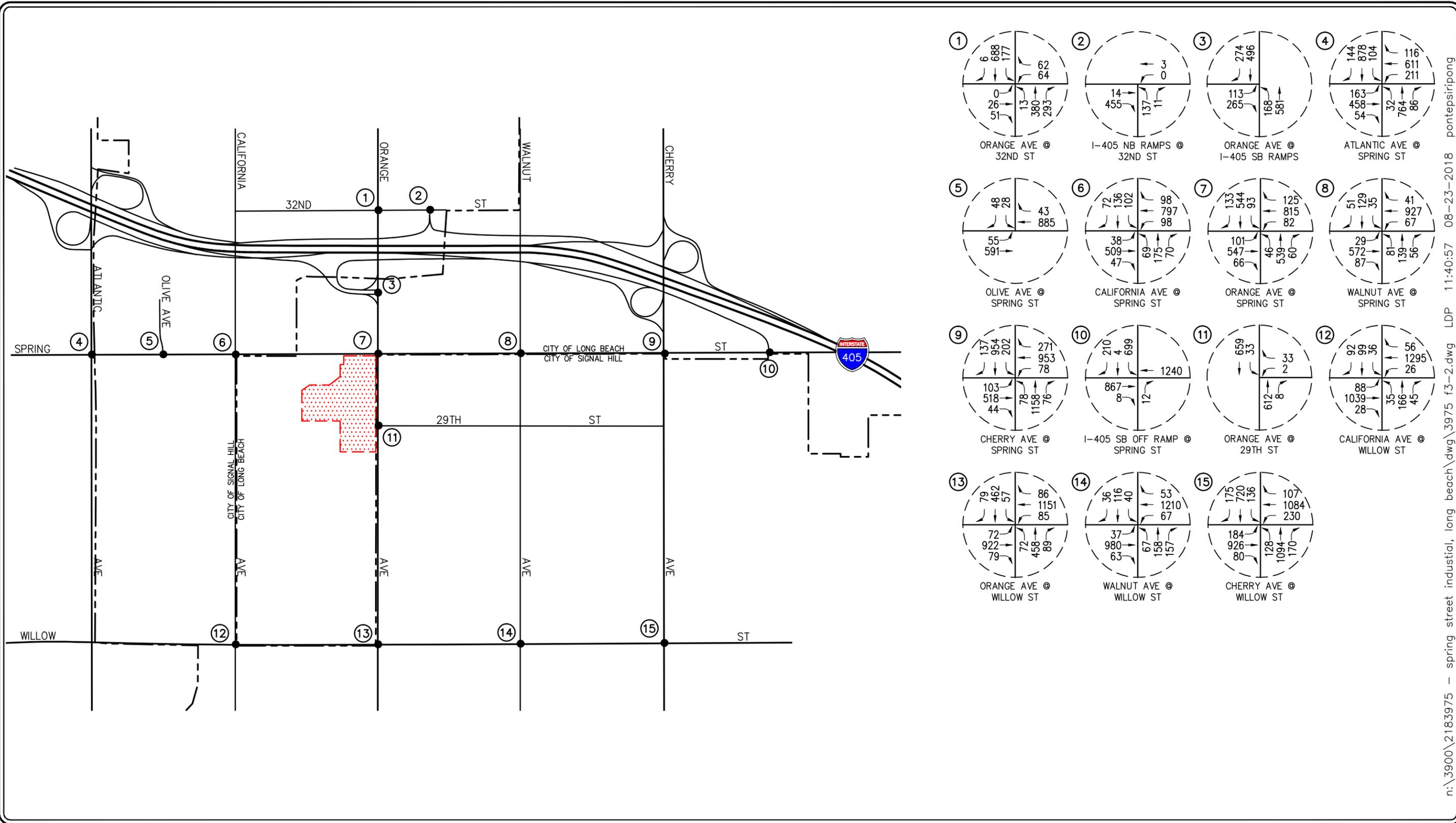
3.4 Existing Bicycle Master Plan

The City of Long Beach promotes bicycling as a means of mobility and a way in which to improve the quality of life within its community. The Bicycle Master Plan recognizes the needs of bicycle users and aims to create a complete and safe bicycle network throughout the City. The City of Long Beach Bicycle Facilities in the vicinity of the Project site (existing and proposed) is shown on **Figure 3-6**. Similarly, the City of Signal Hill Bicycle Master Plan is shown on **Figure 3-7**.

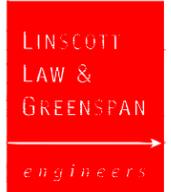
In close proximity to the site a Class II bike lane is provided along the north side and south side of Spring Street, west of the project site. The bikeways in this section of Long Beach as well as Signal Hill are discontinuous, inclusive of the Project frontage. Both the City of Long Beach and City of Signal Hill classify Spring Street and Orange Avenue as Class II and Class III bikeway facilities, respectively, with both roadways identified in the Long Beach Bicycle Master Plan as recommended “8-to-80” bikeways, meaning that it should be designed to comfortably and safely serve cyclists of all ages¹.

Additionally, a Class IV (Protected Bike Lane) bikeway is proposed along Orange Avenue, between 70th Street and Pacific Coast Highway. This proposed bikeway improvements is expected to be

¹ City of Long Beach Draft Bicycle Master Plan, Figure 605, page 73, February 2017.

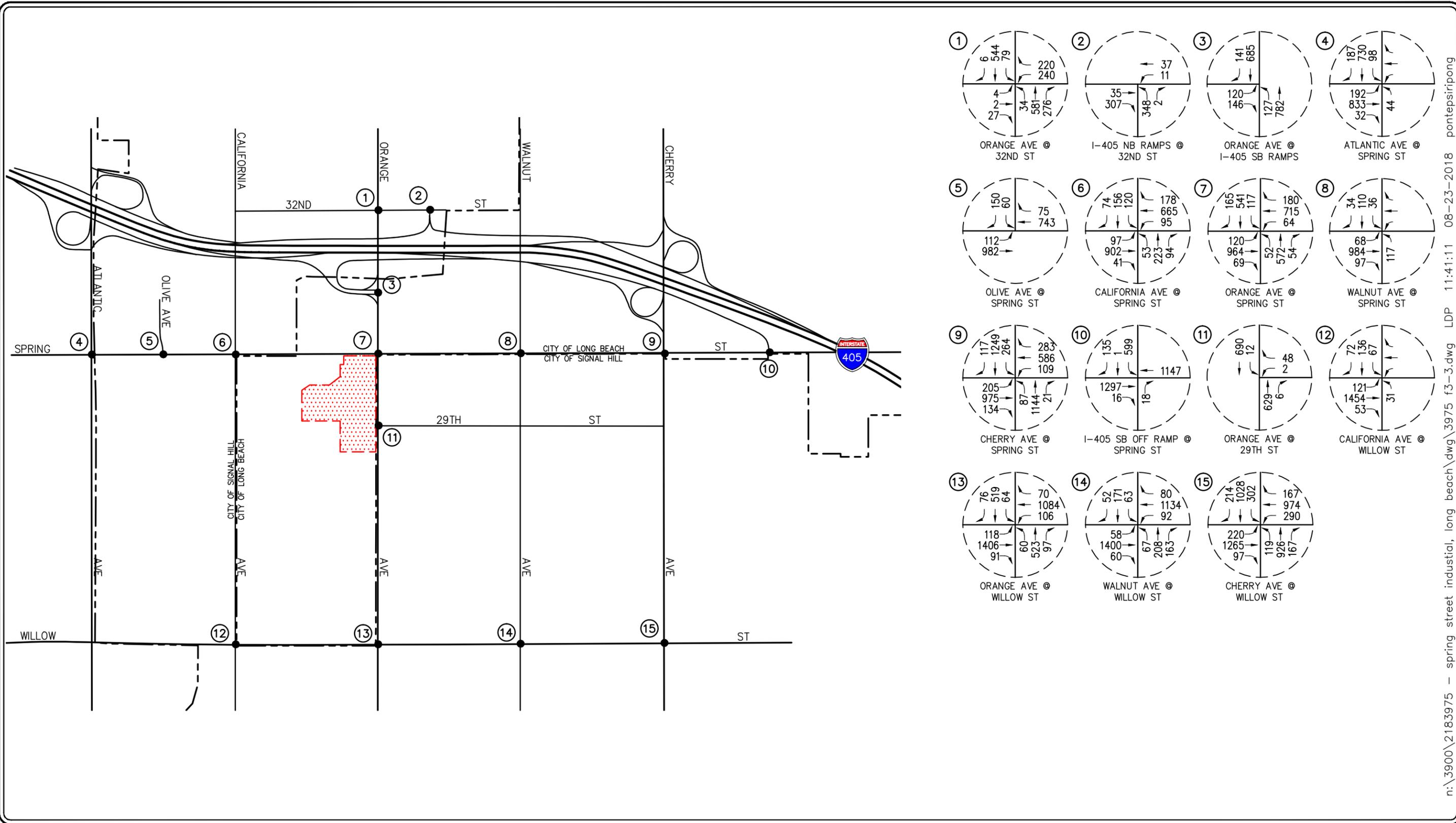


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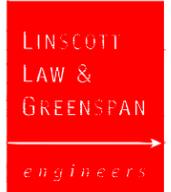


KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 3-2
EXISTING AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



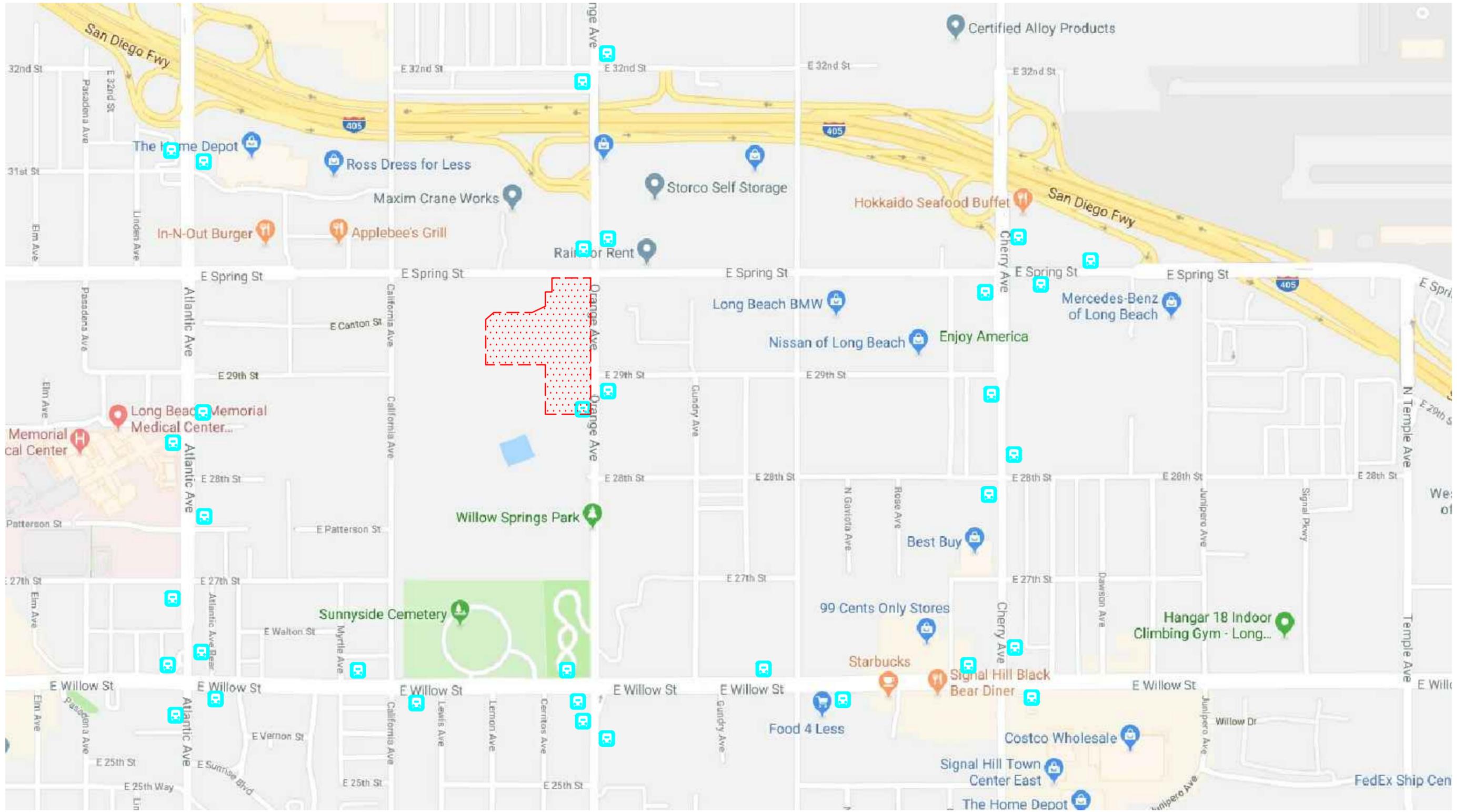
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KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 3-3

EXISTING PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



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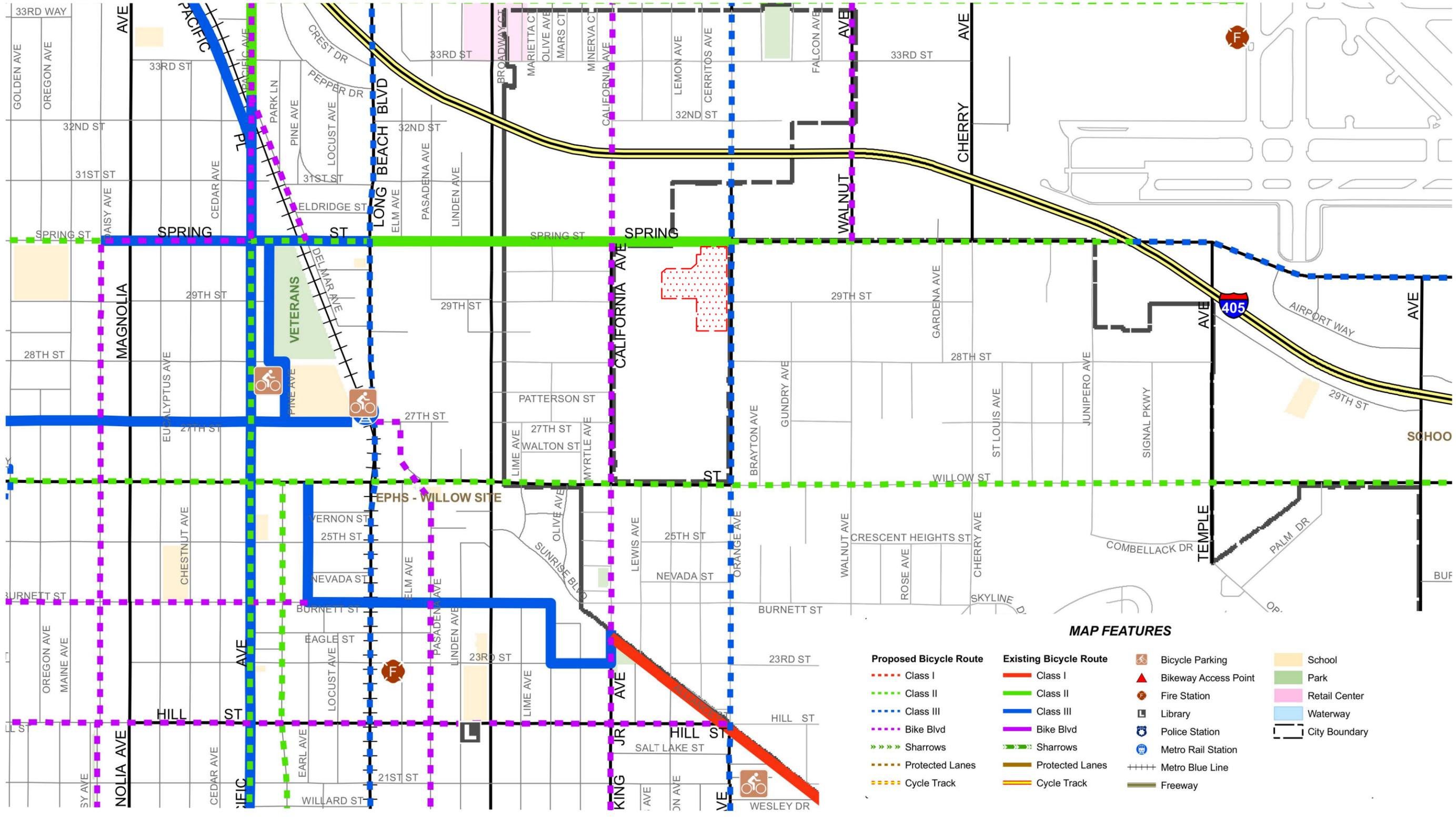


SOURCE: GOOGLE

- KEY**
-  = PROJECT SITE
 -  = TRANSIT STOP

FIGURE 3-5

TRANSIT STOP LOCATIONS
 SPRING STREET INDUSTRIAL, LONG BEACH



MAP FEATURES

Proposed Bicycle Route	Existing Bicycle Route	Bicycle Parking	School
Class I	Class I	Bikeway Access Point	Park
Class II	Class II	Fire Station	Retail Center
Class III	Class III	Library	Waterway
Bike Blvd	Bike Blvd	Police Station	City Boundary
Sharrows	Sharrows	Metro Rail Station	
Protected Lanes	Protected Lanes	Metro Blue Line	
Cycle Track	Cycle Track	Freeway	

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SOURCE: CITY OF LONG BEACH

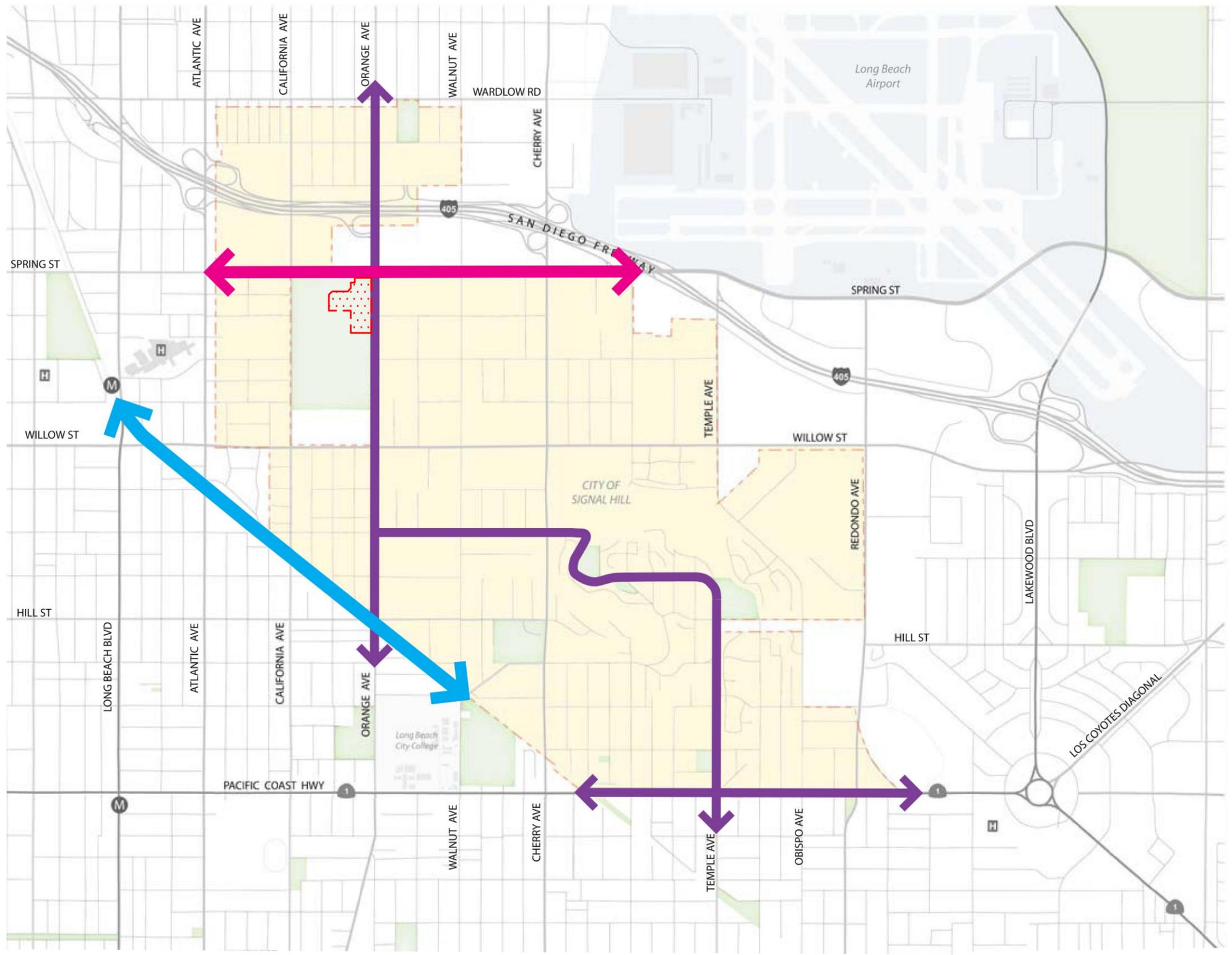
KEY
 = PROJECT SITE

**LINSCOTT
LAW &
GREENSPAN**
engineers

 NO SCALE

FIGURE 3-6

LONG BEACH BIKEWAY FACILITIES
 SPRING STREET INDUSTRIAL, LONG BEACH



- Class I Bike Path
- Class II Bike Lane
- Class III Bike Route
- City of Signal Hill Boundary

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SOURCE: CITY OF SIGNAL HILL

KEY
 = PROJECT SITE

FIGURE 3-7



SIGNAL HILL BICYCLE MASTER PLAN
 SPRING STREET INDUSTRIAL, LONG BEACH

complete by the Project's opening year, and is subject to the review and approval of the City of Signal Hill given a section of Orange Avenue is located within Signal Hill's jurisdiction.

3.5 Existing Intersection Conditions

Pursuant to the City of Long Beach and Signal Hill guidelines, existing AM and PM peak hour operating conditions for the key signalized study intersections were evaluated using the *Intersection Capacity Utilization* (ICU) methodology for signalized intersections and the *Highway Capacity Manual* (HCM) methodology for unsignalized intersections.

3.5.1 Intersection Capacity Utilization (ICU) Method of Analysis

In conformance with City of Long Beach, City of Signal Hill and LA County CMP requirements, existing weekday peak hour operating conditions for the key signalized study intersections were evaluated using the Intersection Capacity Utilization (ICU) method. The ICU technique is intended for signalized intersection analysis and estimates the volume to capacity (V/C) relationship for an intersection based on the individual V/C ratios for key conflicting traffic movements. The ICU numerical value represents the percent signal (green) time, and thus capacity, required by existing and/or future traffic. It should be noted that the ICU methodology assumes uniform traffic distribution per intersection approach lane and optimal signal timing.

Per LA County CMP requirements, the ICU calculations use a lane capacity of 1,600 vehicles per hour (vph) for left-turn, through, and right-turn lanes, and dual left turn capacity of 2,880 vph. A clearance interval is also added to each Level of Service calculation. Per City of Long Beach requirements, a clearance interval of 0.10 is also added to each Level of Service calculation.

The ICU value translates to a Level of Service (LOS) estimate, which is a relative measure of the intersection performance. The six qualitative categories of Level of Service have been defined along with the corresponding ICU value range and are shown in **Table 3-1**. The ICU value is the sum of the critical volume to capacity ratios at an intersection; it is not intended to be indicative of the LOS of each of the individual turning movements.

3.5.1 Highway Capacity Manual (HCM) Method of Analysis (Unsignalized Intersections)

The HCM unsignalized methodology for stop-controlled intersections was utilized for the analysis of the unsignalized intersections. This methodology estimates the average control delay for each of the subject movements and determines the level of service for each movement. For all-way stop controlled intersections, the overall average control delay measured in seconds per vehicle, and level of service is then calculated for the entire intersection. For one-way and two-way stop-controlled (minor street stop-controlled) intersections, this methodology estimates the worst side street delay, measured in seconds per vehicle and determines the level of service for that approach. The HCM control delay value translates to a Level of Service (LOS) estimate, which is a relative measure of the intersection performance. The six qualitative categories of Level of Service have been defined along with the corresponding HCM control delay value range, as shown in **Table 3-2**.

3.5.2 Level of Service Criteria

According to the City of Long Beach and Signal Hill, LOS D is the minimum acceptable condition that should be maintained during the peak commute hours, or the current LOS if the existing LOS is worse than LOS D (i.e. LOS E or F).

3.6 Existing Level of Service Results

Table 3-3 summarizes the existing peak hour service level calculations for the fifteen (15) key study intersections based on existing traffic volumes and current street geometrics. Review of *Table 3-3* indicates that the intersection of Orange Avenue/I-405 SB Ramps currently operates at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour. The remaining fourteen (14) key study intersections currently operate at LOS D or better during the weekday AM and PM peak hours.

Appendix C contains the detailed peak hour level of service worksheets for the key intersections evaluated in this report.

TABLE 3-1
LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS (ICU)²

Level of Service (LOS)	Intersection Capacity Utilization Value (V/C)	Level of Service Description
A	≤ 0.600	EXCELLENT. No vehicle waits longer than one red light, and no approach phase is fully used.
B	0.601 – 0.700	VERY GOOD. An occasional approach phase is fully utilized; many drivers begin to feel somewhat restricted within groups of vehicles.
C	0.701 – 0.800	GOOD. Occasionally drivers may have to wait through more than one red light; backups may develop behind turning vehicles.
D	0.801 – 0.900	FAIR. Delays may be substantial during portions of the rush hours, but enough lower volume periods occur to permit clearing of developing lines, preventing excessive backups.
E	0.901 – 1.000	POOR. Represents the most vehicles intersection approaches can accommodate; may be long lines of waiting vehicles through several signal cycles.
F	> 1.000	FAILURE. Backups from nearby locations or on cross streets may restrict or prevent movement of vehicles out of the intersection approaches. Potentially very long delays with continuously increasing queue lengths.

² Source: *Transportation Research Board Circular 212 - Interim Materials on Highway Capacity.*

TABLE 3-2
LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM)³

Level of Service (LOS)	Highway Capacity Manual Delay Value (sec/veh)	Level of Service Description
A	≤ 10.0	Little or no delay
B	> 10.0 and ≤ 15.0	Short traffic delays
C	> 15.0 and ≤ 25.0	Average traffic delays
D	> 25.0 and ≤ 35.0	Long traffic delays
E	> 35.0 and ≤ 50.0	Very long traffic delays
F	> 50.0	Severe congestion

³ Source: *Highway Capacity Manual 6th Edition*, Chapter 20 (Two-Way Stop Control).

TABLE 3-3
EXISTING (YEAR 2018) PEAK HOUR INTERSECTION CAPACITY ANALYSIS

Key Intersection	Jurisdiction	Time Period	Control Type	ICU/HCM	LOS
1. Orange Avenue at 32 nd Street	Signal Hill	AM	2Ø Traffic Signal	0.719	C
		PM		0.856	D
2. I-405 NB Ramps at 32 nd Street	Signal Hill/ Caltrans	AM	One-Way Stop	11.0 s/v	B
		PM		14.3 s/v	B
3. Orange Avenue at I-405 SB Ramps	Long Beach/ Caltrans	AM	One-Way Stop	44.0 s/v	E
		PM		90.6 s/v	F
4. Atlantic Avenue at Spring Street	Signal Hill/ Long Beach	AM	6Ø Traffic Signal	0.732	C
		PM		0.828	D
5. Olive Avenue at Spring Street	Signal Hill	AM	3Ø Traffic Signal	0.454	A
		PM		0.519	A
6. California Avenue at Spring Street	Signal Hill/ Long Beach	AM	2Ø Traffic Signal	0.590	A
		PM		0.714	C
7. Orange Avenue at Spring Street	Signal Hill/ Long Beach	AM	2Ø Traffic Signal	0.826	D
		PM		0.833	D
8. Walnut Avenue at Spring Street	Signal Hill/ Long Beach	AM	2Ø Traffic Signal	0.584	A
		PM		0.717	C
9. Cherry Avenue at Spring Street	Signal Hill/ Long Beach	AM	8Ø Traffic Signal	0.690	B
		PM		0.738	C
10. I-405 SB Off-Ramp at Spring Street	Signal Hill/ Long Beach/ Caltrans	AM	2Ø Traffic Signal	0.732	C
		PM		0.719	C
11. Orange Avenue at 29 th Street	Signal Hill/ Long Beach	AM	One-Way Stop	13.9 s/v	B
		PM		14.1 s/v	B
12. California Avenue at Willow Street	Signal Hill/ Long Beach	AM	2Ø Traffic Signal	0.613	B
		PM		0.593	A

Notes:

- ICU = Intersection Capacity Utilization
- LOS = Level of Service, please refer to *Table 3-1* and *3-2* for the LOS definitions
- Ø = Phase
- s/v = seconds per vehicle (delay)

TABLE 3-3 (CONTINUED)
EXISTING (YEAR 2018) PEAK HOUR INTERSECTION CAPACITY ANALYSIS

Key Intersection	Jurisdiction	Time Period	Control Type	ICU/HCM	LOS
13. Orange Avenue at Willow Street	Signal Hill/ Long Beach	AM	8Ø Traffic Signal	0.736	C
		PM		0.845	D
14. Walnut Avenue at Willow Street	Signal Hill	AM	5Ø Traffic Signal	0.510	A
		PM		0.617	B
15. Cherry Avenue at Willow Street	Signal Hill	AM	8Ø Traffic Signal	0.687	B
		PM		0.818	D

Notes:

- ICU = Intersection Capacity Utilization
- LOS = Level of Service, please refer to *Table 3-1* and *3-2* for the LOS definitions
- Ø = Phase
- s/v = seconds per vehicle (delay)

4.0 TRAFFIC FORECASTING METHODOLOGY

In order to estimate the traffic impact characteristics of the proposed Project, a multi-step process has been utilized. The first step is traffic generation, which estimates the total arriving and departing traffic on a peak hour and daily basis. The traffic generation potential is forecast by applying the appropriate vehicle trip generation equations or rates to the project development tabulation.

The second step of the forecasting process is traffic distribution, which identifies the origins and destinations of inbound and outbound project traffic. These origins and destinations are typically based on demographics and existing/expected future travel patterns in the study area.

The third step is traffic assignment, which involves the allocation of project traffic to study area streets and intersections. Traffic assignment is typically based on minimization of travel time, which may or may not involve the shortest route, depending on prevailing operating conditions and travel speeds. Traffic distribution patterns are indicated by general percentage orientation, while traffic assignment allocates specific volume forecasts to individual roadway links and intersection turning movements throughout the study area.

With the forecasting process complete and project traffic assignments developed, the impact of the project is isolated by comparing operational (LOS) conditions at selected key intersections using expected future traffic volumes with and without forecast project traffic. The need for site-specific and/or cumulative local area traffic improvements can then be evaluated.

5.0 PROJECT TRAFFIC CHARACTERISTICS

5.1 Project Traffic Generation

Traffic generation is expressed in vehicle trip ends, defined as one-way vehicular movements, either entering or exiting the generating land use. Generation equations and/or rates used in the traffic forecasting procedure are found in the 10th Edition of *Trip Generation*, published by the Institute of Transportation Engineers (ITE) [Washington D.C., 2017].

Trip generation for the proposed Project was completed for two alternatives. The first alternative analyzes the Project utilizing the manufacturing land use. The second alternative analyzes the Project utilizing the warehousing land use.

Table 5-1 summarizes the trip generation rates used in forecasting the vehicular trips generated by Alternative 1 of the proposed Project and also presents the project's forecast peak hour and daily traffic volumes. As shown in the upper portion of *Table 5-1*, ITE Land Use 140: Manufacturing was used to forecast the trip generation potential of the proposed Project.

A review of the lower portion of this table indicates that the proposed Project is forecast to generate approximately 757 daily trips, with 120 trips (93 inbound, 27 outbound) produced in the AM peak hour and 130 trips (40 inbound, 90 outbound) produced in the PM peak hour on a "typical" weekday. Of the total trips generated by the Project, truck trips related to the manufacturing component after applying a passenger car equivalency (PCE) factor of 2.0 is anticipated to generate 252 daily trips, with 40 trips produced in the AM peak hour and 44 trips produced in the PM peak hour.

Table 5-2 summarizes the trip generation rates used in forecasting the vehicular trips generated by Alternative 2 of the proposed Project and also presents the project's forecast peak hour and daily traffic volumes. As shown in the upper portion of *Table 5-2*, ITE Land Use 150: Warehousing was used to forecast the trip generation potential of the proposed Project.

A review of the lower portion of this table indicates that the proposed Project is forecast to generate approximately 335 daily trips, with 32 trips (24 inbound, 8 outbound) produced in the AM peak hour and 38 trips (9 inbound, 29 outbound) produced in the PM peak hour on a "typical" weekday. Of the total trips generated by the Project, truck trips related to the warehousing component after applying a passenger car equivalency (PCE) factor of 2.0 is anticipated to generate 112 daily trips, with 10 trips produced in the AM peak hour and 14 trips produced in the PM peak hour.

To provide a conservative assessment, the trip generation for Alternative 1 has been analyzed in this report.

Truck splits and PCE values are referenced from the *2300 Redondo Avenue TIA*, prepared by Kittelson & Associates in December 2017, which has since been approved. In addition, the percent trucks is consistent with the 3rd Edition of ITE's *Trip Generation Handbook*.

**TABLE 5-1
PROJECT TRIP GENERATION FORECAST – ALTERNATIVE 1⁴**

ITE Land Use Code / Project Description	Daily 2-Way	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
Generation Rates:							
▪ 140: Manufacturing (TE/1000 SF)	3.93	77%	23%	0.62	31%	69%	0.67
Generation Forecasts:							
▪ Building 1 (39,812 SF)							
☐ Passenger Car Traffic	125	15	5	20	6	16	22
☐ Truck PCE Traffic ⁵	<u>62</u>	<u>8</u>	<u>2</u>	<u>10</u>	<u>4</u>	<u>6</u>	<u>10</u>
Building 1 Total	187	23	7	30	10	22	32
▪ Building 2 (48,745 SF)							
☐ Passenger Car Traffic	154	18	6	24	8	18	26
☐ Truck PCE Traffic ⁵	<u>76</u>	<u>10</u>	<u>2</u>	<u>12</u>	<u>4</u>	<u>10</u>	<u>14</u>
Building 2 Total	230	28	8	36	12	28	40
▪ Building 3 (72,116 SF)							
☐ Passenger Car Traffic	226	28	8	36	12	26	38
☐ Truck PCE Traffic ⁵	<u>114</u>	<u>14</u>	<u>4</u>	<u>18</u>	<u>6</u>	<u>14</u>	<u>20</u>
Building 3 Total	340	42	12	54	18	40	58
Total Passenger Car Traffic	505	61	19	80	26	60	86
Total Truck PCE Traffic	<u>252</u>	<u>32</u>	<u>8</u>	<u>40</u>	<u>14</u>	<u>30</u>	<u>44</u>
Total Project Trip Generation	757	93	27	120	40	90	130

Notes:

TE/1000 SF = Trip end per 1,000 SF

⁴ Source: *Trip Generation, 10th Edition, Institute of Transportation Engineers (ITE), Washington, D.C. (2017).*

⁵ Manufacturing truck estimates: 20% trucks, P.C.E. = 2.0 vehicles per truck.

**TABLE 5-2
PROJECT TRIP GENERATION FORECAST – ALTERNATIVE 2⁶**

ITE Land Use Code / Project Description	Daily 2-Way	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
Generation Rates:							
▪ 150: Warehousing (TE/1000 SF)	1.74	77%	23%	0.17	27%	73%	0.19
Generation Forecasts:							
▪ Building 1 (39,812 SF)							
<input type="checkbox"/> Passenger Car Traffic	55	4	2	6	2	4	6
<input type="checkbox"/> Truck PCE Traffic ⁷	<u>28</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>4</u>	<u>4</u>
Building 1 Total	83	6	2	8	2	8	10
▪ Building 2 (48,745 SF)							
<input type="checkbox"/> Passenger Car Traffic	68	5	1	6	2	5	7
<input type="checkbox"/> Truck PCE Traffic ⁷	<u>34</u>	<u>2</u>	<u>2</u>	<u>4</u>	<u>0</u>	<u>4</u>	<u>4</u>
Building 2 Total	102	7	3	10	2	9	11
▪ Building 3 (72,116 SF)							
<input type="checkbox"/> Passenger Car Traffic	100	7	3	10	3	8	11
<input type="checkbox"/> Truck PCE Traffic ⁷	<u>50</u>	<u>4</u>	<u>0</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>6</u>
Building 3 Total	150	11	3	14	5	12	17
Total Passenger Car Traffic	223	16	6	22	7	17	24
Total Truck PCE Traffic	<u>112</u>	<u>8</u>	<u>2</u>	<u>10</u>	<u>2</u>	<u>12</u>	<u>14</u>
Total Project Trip Generation	335	24	8	32	9	29	38

Notes:
TE/1000 SF = Trip end per 1,000 SF

⁶ Source: *Trip Generation, 10th Edition, Institute of Transportation Engineers (ITE), Washington, D.C. (2017).*

⁷ Warehousing truck estimates: 20% trucks, P.C.E. = 2.0 vehicles per truck.

5.2 Project Traffic Distribution and Assignment

Figures 5-1 and *5-2* illustrate the general, directional traffic distribution pattern for the proposed Project for both passenger vehicles and trucks, respectively. Project traffic volumes both entering and exiting the project site have been distributed and assigned to the adjacent street system based on the following considerations:

- location of site access points in relation to the surrounding street system,
- the site's proximity to major traffic carriers and regional access routes,
- physical characteristics of the circulation system such as lane channelization and presence of traffic signals that affect travel patterns,
- City of Long Beach and Signal Hill designated truck routes, and
- ingress/egress availability at the project site, plus parking layout and allocation within the subject property.

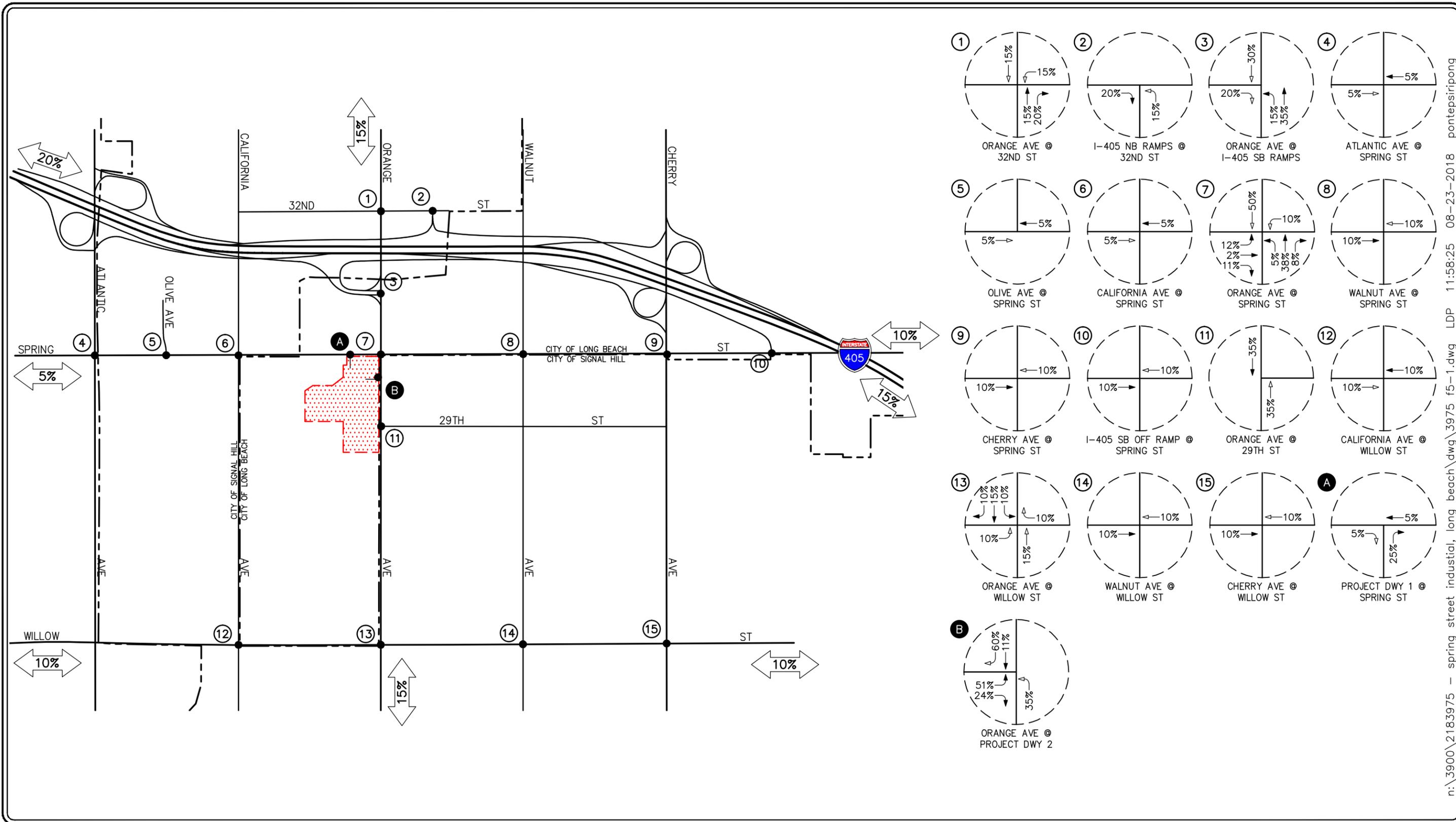
The anticipated AM and PM peak hour traffic volumes associated with the proposed Project are presented in *Figures 5-3* and *5-4*, respectively. The traffic volume assignments presented in *Figures 5-3* and *5-4* reflect the traffic distribution characteristics shown in *Figures 5-1* and *5-2* and the traffic generation forecast presented in the upper portion of *Table 5-1*.

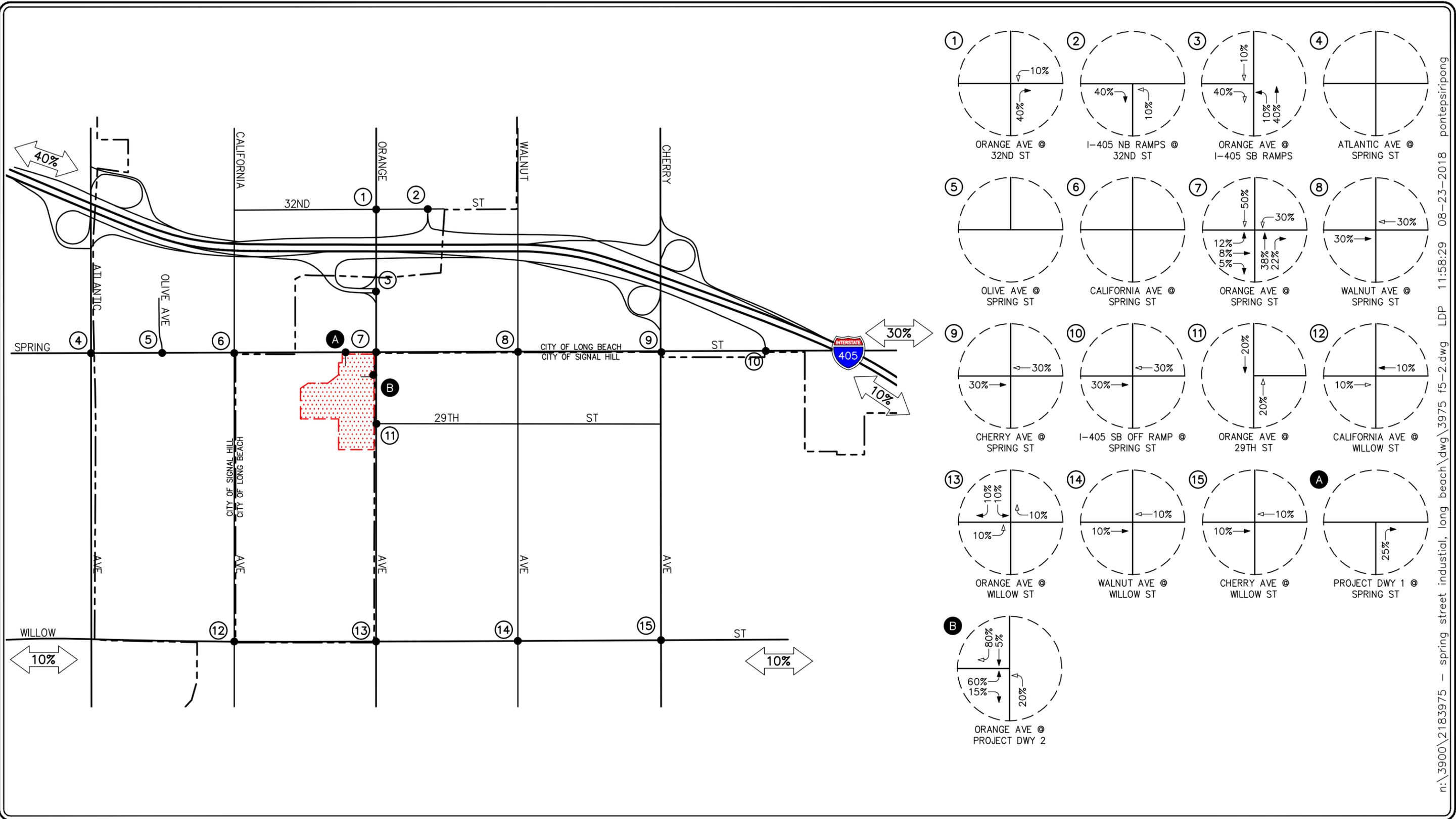
It should be noted that the Project distribution pattern assumes that vehicles/trucks frequenting the site will choose to utilize local streets to minimize travel times rather than taking the most direct route to/from the freeway. It is our understanding that the I-405 Freeway during peak periods has major congestion issues which may alter driver behavior. Spring Street has well timed intersections with good service levels and is designated as a truck route resulting in ideal conditions for alternates to utilizing the freeway. Ultimately vehicles/trucks will use the I-405 but are anticipated to minimize travel along the freeway if possible.

5.3 Existing Plus Project Traffic Conditions

The existing plus project traffic conditions have been generated based upon existing conditions and the estimated project traffic. These forecast traffic conditions have been prepared to assess the potential impacts of a Project upon the circulation system as it currently exists. This traffic volume scenario and the related intersection capacity analyses will identify the roadway improvements necessary to mitigate the direct traffic impacts of the Project, if any.

Figures 5-5 and *5-6* present projected AM and PM peak hour traffic volumes at the fifteen (15) key study intersections with the addition of the trips generated by the proposed Project to existing traffic volumes, respectively.





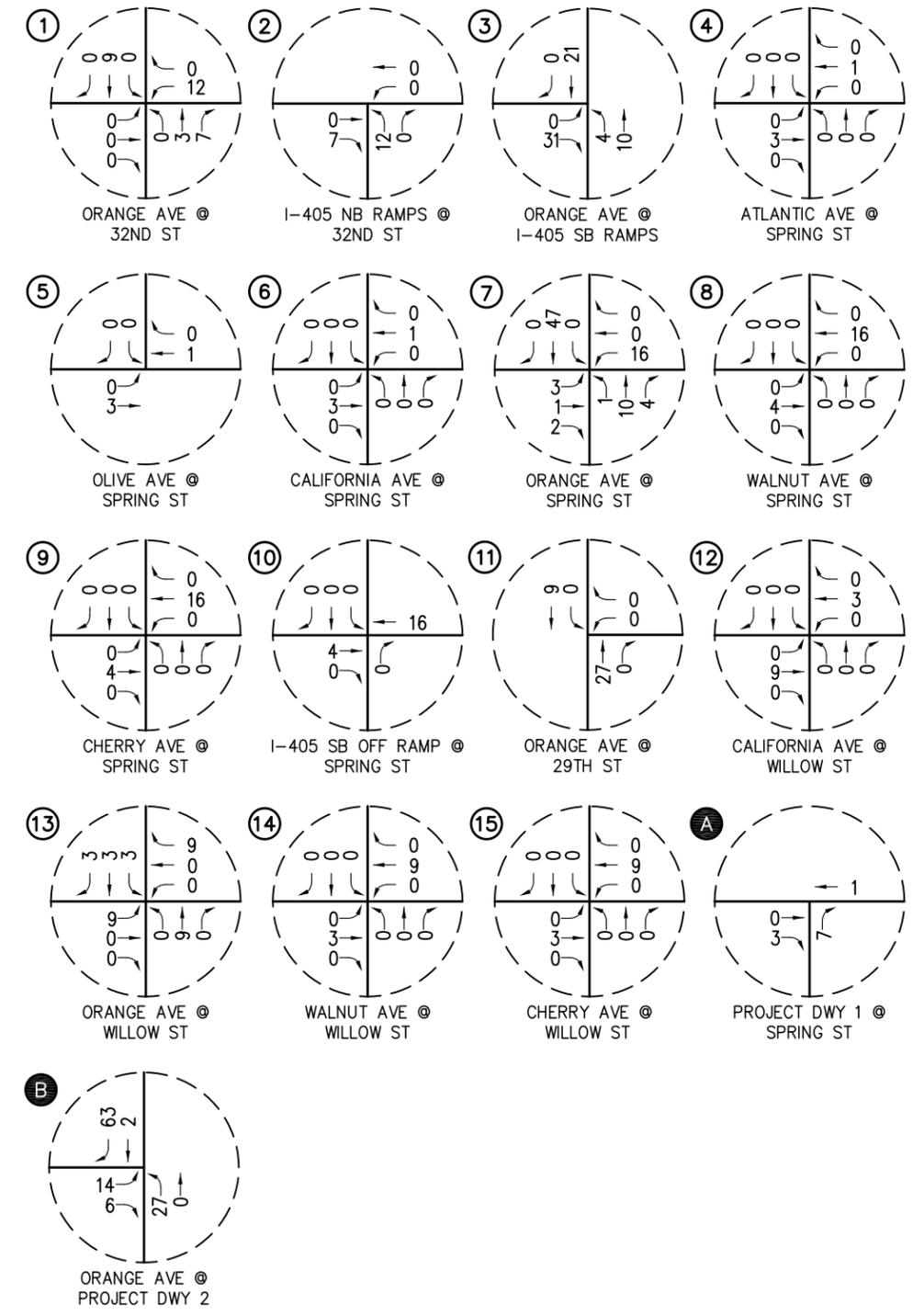
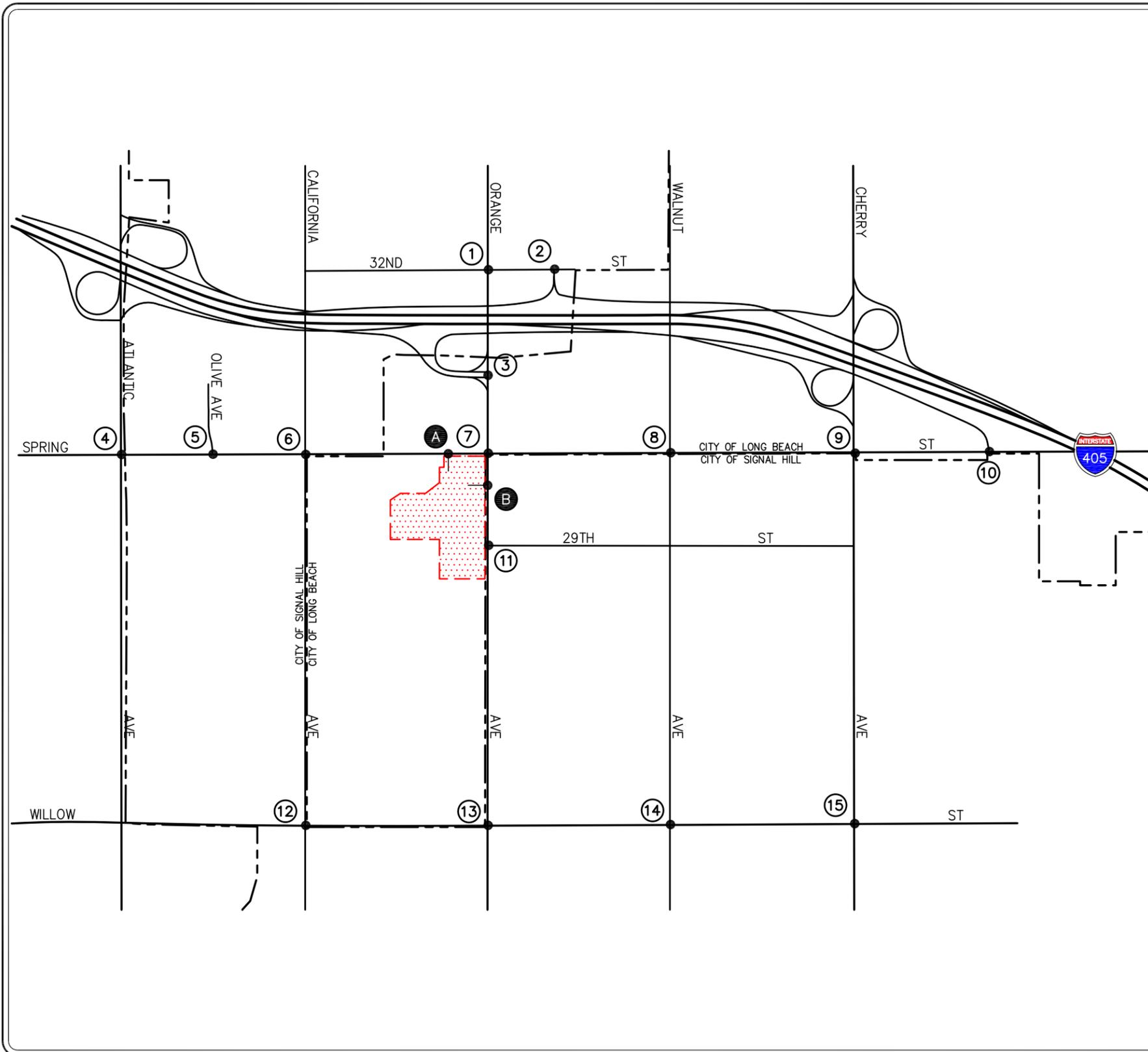
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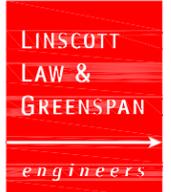
- KEY**
- ⊕ = STUDY INTERSECTION
 - ← = INBOUND PERCENTAGE
 - = OUTBOUND PERCENTAGE
 - ▨ = PROJECT SITE

FIGURE 5-2

PROJECT DISTRIBUTION - TRUCKS
 SPRING STREET INDUSTRIAL, LONG BEACH



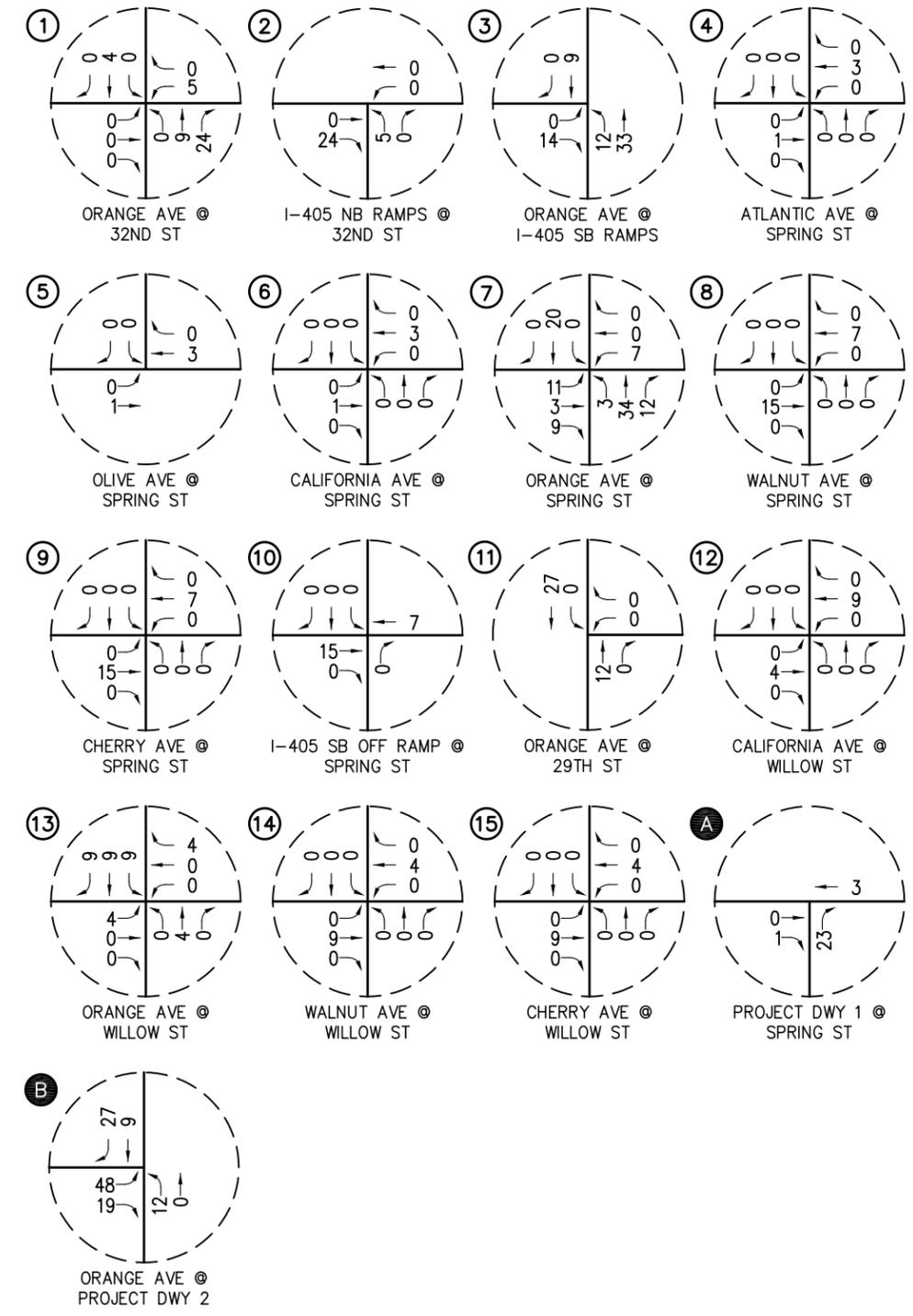
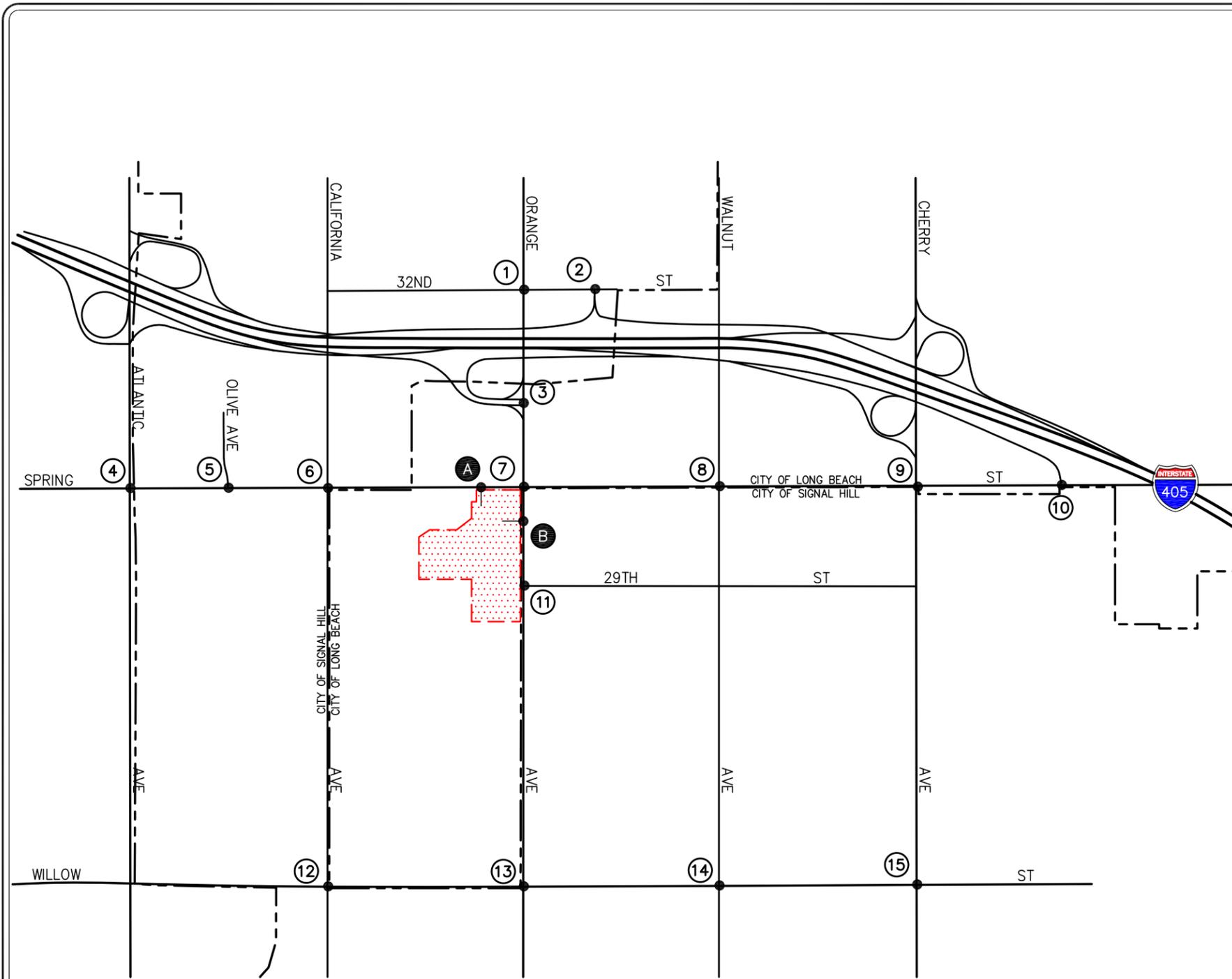
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KEY
 # = STUDY INTERSECTION
 [Red Dotted Box] = PROJECT SITE

FIGURE 5-3

AM PEAK HOUR PROJECT TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



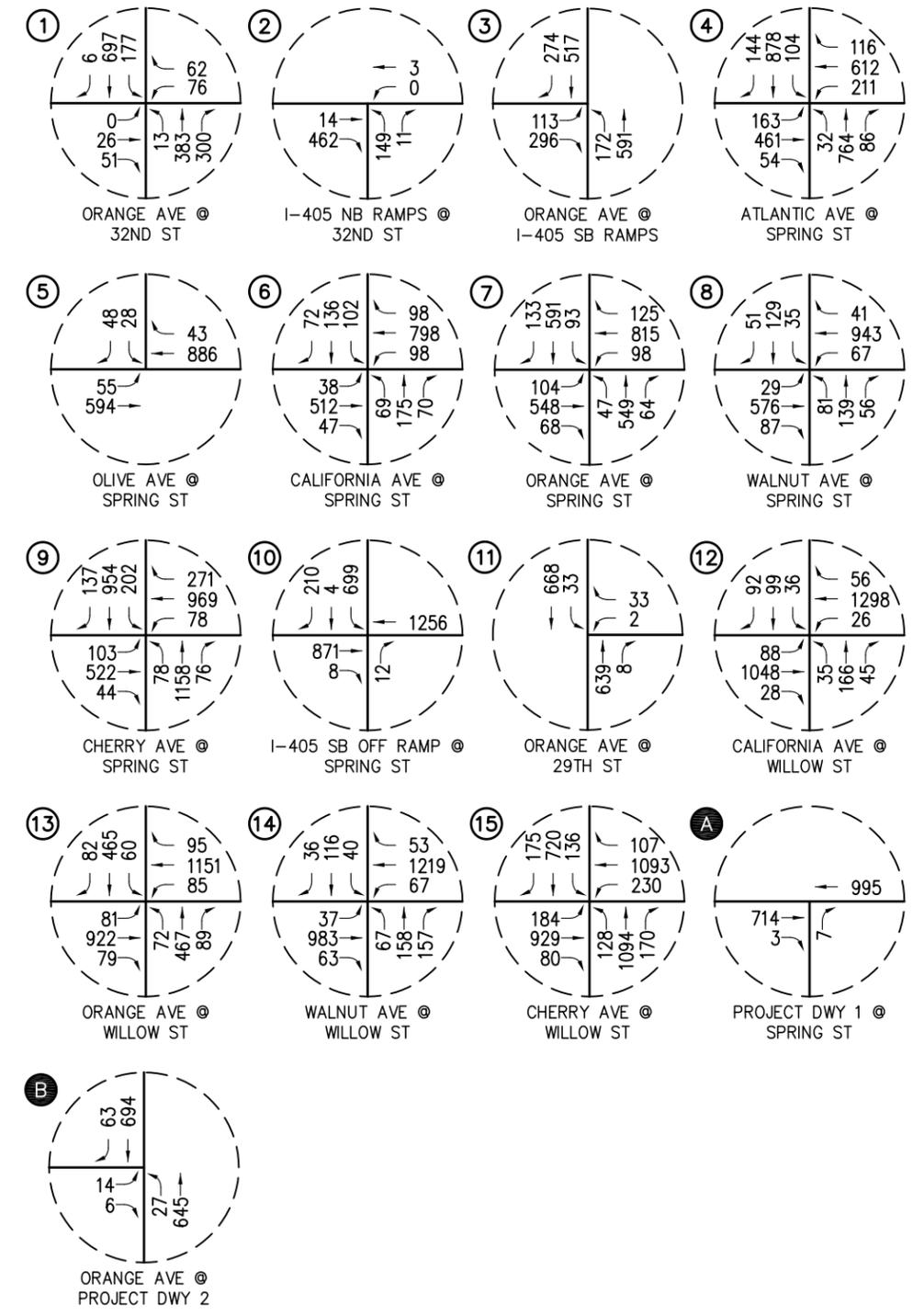
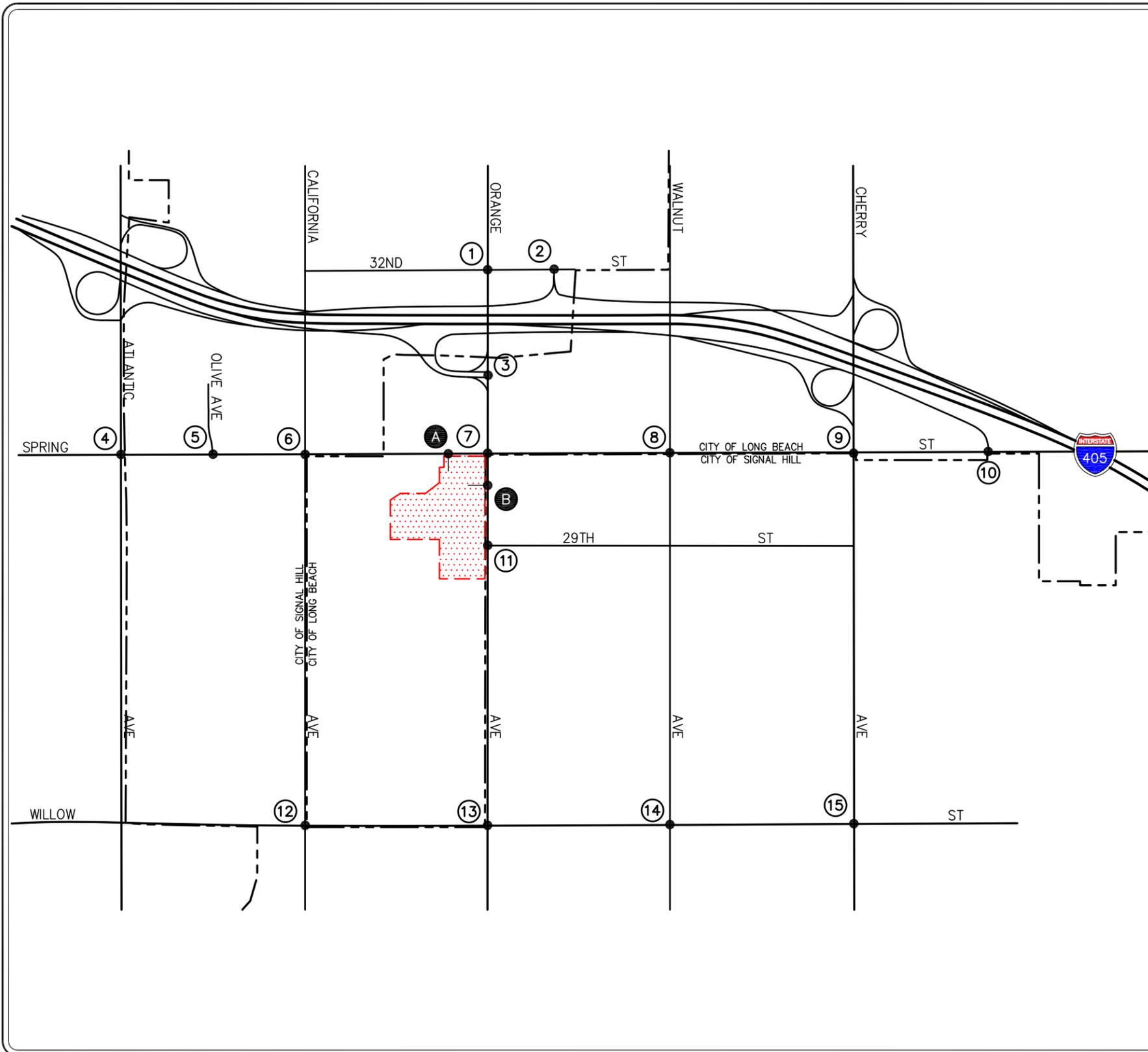
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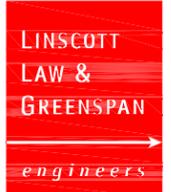
KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 5-4

PM PEAK HOUR PROJECT TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

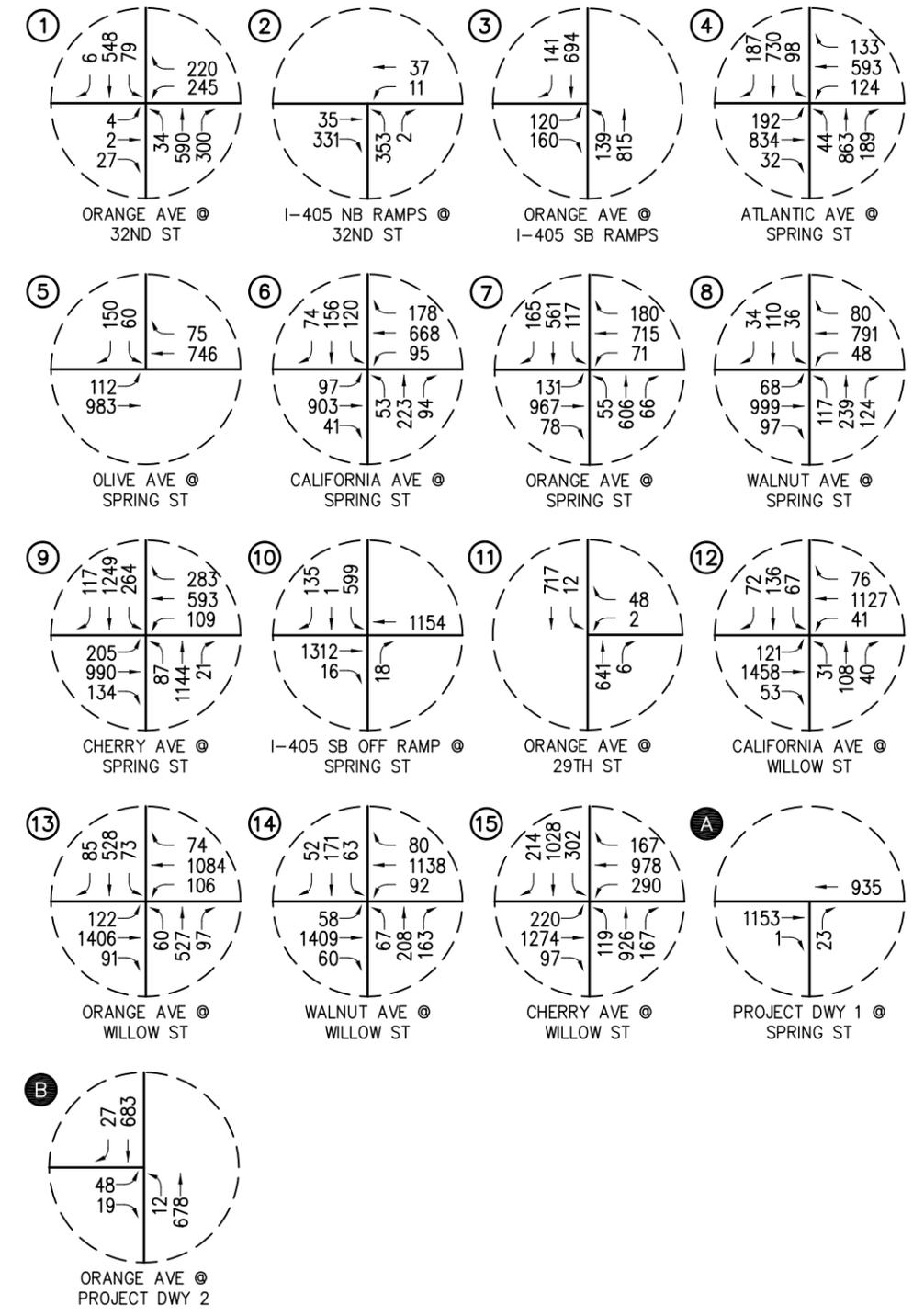
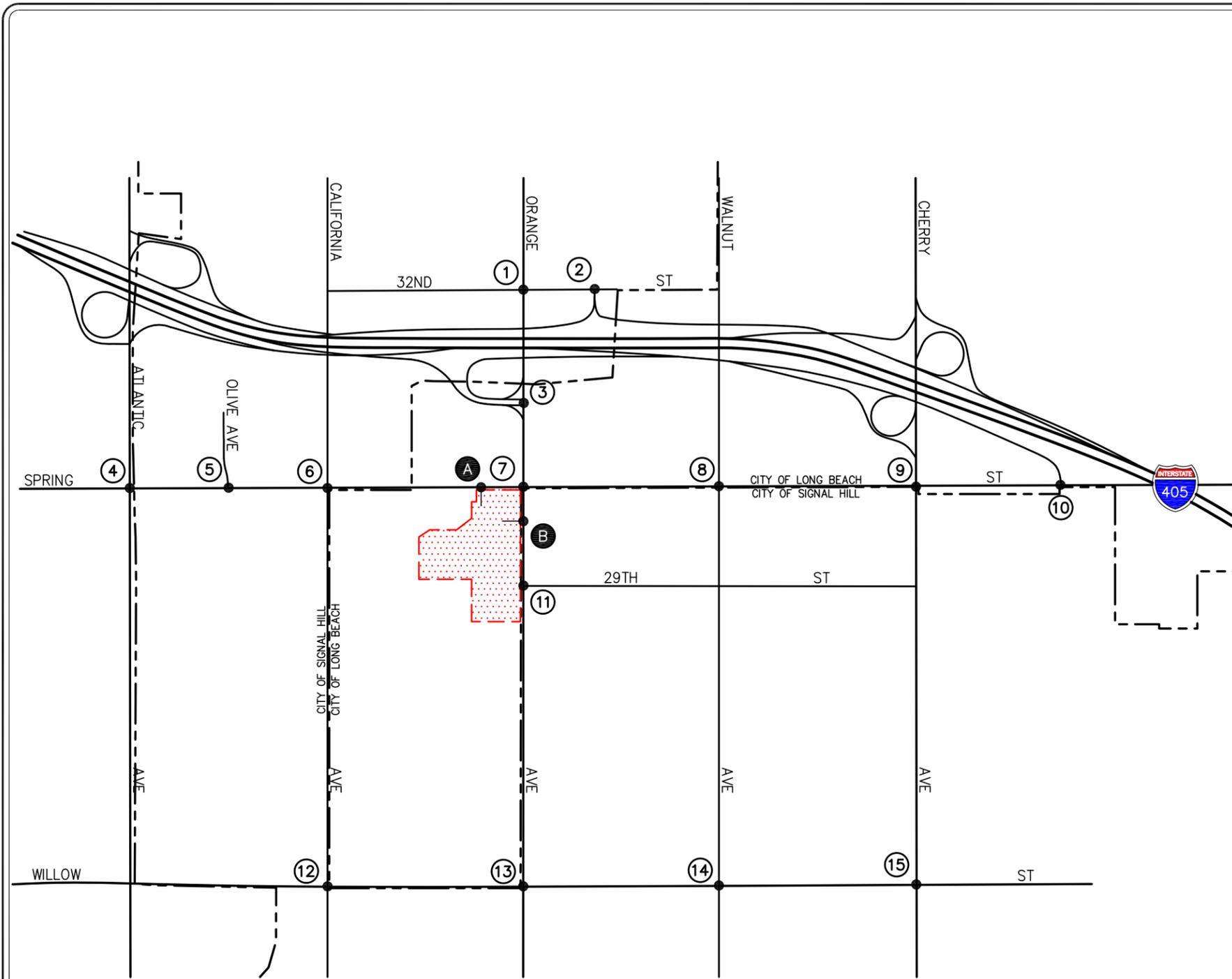


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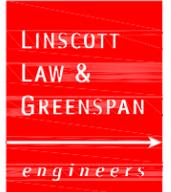


KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 5-5
EXISTING PLUS PROJECT AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



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KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 5-6
EXISTING PLUS PROJECT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

6.0 FUTURE TRAFFIC CONDITIONS

6.1 Ambient Traffic Growth

Cumulative and buildout traffic growth estimates have been calculated using an ambient growth factor. The ambient traffic growth factor is intended to include unknown and future cumulative projects in the study area, as well as account for regular growth in traffic volumes due to the development of projects outside the study area. The future growth in traffic volumes has been calculated at one percent (1%) per year. Applied to existing Year 2018 traffic volumes results in a three percent (3%) increase of growth in existing volumes to near-term horizon Year 2021 and a twenty percent (20%) increase of growth to long-term buildout Year 2038.

Please note that the recommended ambient growth factor is generally consistent with the background traffic growth estimates contained in the most current *Congestion Management Program for Los Angeles County*. It should be further noted that the 1.0% per year ambient growth factor was approved by City of Long Beach staff.

6.2 Cumulative Projects Traffic Characteristics

The City of Long Beach identified twenty-seven (27) cumulative projects within the Project study area. Cumulative projects, as defined by Section 15355 of the CEQA Guidelines, are “closely related past, present and reasonably foreseeable probable future projects”. The Traffic Impact Analysis assumes that all of these cumulative projects will be developed at their proposed size and density and operational when the proposed Project is operational. This is the most conservative, worst-case approach, since the exact timing of each cumulative project is uncertain. In addition, impacts for these cumulative projects would likely be, or have been, subject to mitigation measures and/or reduced in size, which could reduce potential impacts. Under this analysis, however, those mitigation measures and/or reduction are not considered.

With this information, the potential impact of the proposed Project can be evaluated within the context of the cumulative impact of all ongoing development. These twenty-seven (27) cumulative projects have been included as part of the cumulative and buildout background setting. Of the twenty-seven (27) cumulative projects, twenty (20) are located in the City of Long Beach and seven (7) are located in the City of Signal Hill. Although not a development project, the City of Long Beach planned bikeway improvement (Class IV - Protected Bike Lane) project along Orange Avenue within the study area has been considered and is assumed as a part (included) and not a part (not included) of the cumulative background traffic conditions.

Table 6-1 provides the location and a brief description for each of the twenty-seven (27) cumulative projects. *Figure 6-1* graphically illustrates the location of the cumulative projects. These cumulative projects are expected to generate vehicular traffic, which may affect the operating conditions of the key study intersections.

Table 6-2 presents the development totals and resultant trip generation for the twenty-seven (27) cumulative projects. As shown in *Table 6-2*, the twenty-seven (27) cumulative projects are expected to generate a combined total of 31,290 daily trips, 2,326 AM peak hour trips (1,272 inbound and 1,054 outbound) and 2,695 PM peak hour trips (1,282 inbound and 1,413 outbound) on a typical weekday. The AM and PM peak hour traffic volumes associated with the twenty-seven (27) cumulative projects are presented in *Figures 6-2* and *6-3* respectively.

6.3 Year 2021 Traffic Volumes

Figures 6-4 and *6-5* present future AM and PM peak hour near-term cumulative traffic volumes at the fifteen (15) key study intersections for the Year 2021, respectively. Please note that the cumulative traffic volumes represent the accumulation of existing traffic, ambient growth traffic and cumulative projects traffic.

Figures 6-6 and *6-7* illustrate Year 2021 forecast AM and PM peak hour traffic volumes with the inclusion of the trips generated by the proposed Project, respectively.

6.4 Year 2038 Volumes

Figures 6-8 and *6-9* present future AM and PM peak hour long-term buildout traffic volumes at the fifteen (15) key study intersections for the Year 2038, respectively. Please note that the buildout traffic volumes represent the accumulation of existing traffic, ambient growth traffic and cumulative projects traffic.

Figures 6-10 and *6-11* illustrate Year 2038 forecast AM and PM peak hour traffic volumes with the inclusion of the trips generated by the proposed Project, respectively.

**TABLE 6-1
LOCATION AND DESCRIPTION OF CUMULATIVE PROJECTS⁸**

No.	Cumulative Project	Location/Address	Description
<i>City of Long Beach</i>			
1.	Las Ventanas Apartments	1795 Long Beach Boulevard	101 DU apartments and 4,051 SF ground floor retail
2.	Pacific Edge Industrial	2300 Redondo Avenue	410,500 SF warehouse
3.	101 Pacific Coast Highway/ 1814 Pine Avenue	101 Pacific Coast Highway/ 1814 Pine Avenue	26 DU low-rise multifamily residential over 5,499 SF retail
4.	1836-1852 Locust Avenue	1836-1852 Locust Avenue	48 DU affordable housing and 3,600 SF retail
5.	Mendoza Project	201-245 W. Pacific Coast Highway/ 1827 Pacific Avenue	36,000 SF commercial on the ground floor with 154 DU mid-rise multifamily residential
6.	Long Beach Senior Living	2400 & 2450 Long Beach Boulevard/ 2459 Elm Avenue	145 bed assisted living
7.	George Medak	1500 E. Anaheim Street/ 1209 Walnut Avenue	88 DU mid-rise multifamily residential with 18,000 SF medical office building
8.	Salvation Army	3012 Long Beach Boulevard	1 soccer field and 24,608 SF recreational community center
9.	Harbor Freight	530 E. 33 rd Street	15,432 SF commercial building
10.	Starbucks	3602 Atlantic Avenue	1,800 SF coffee shop with drive-through window
11.	1401 Long Beach Boulevard/ 217 East 14 th Street	1401 Long Beach Boulevard/ 217 East 14 th Street	142 DU low-rise multifamily residential and 4,000 SF retail
12.	1320 Atlantic Avenue	1320 Atlantic Avenue	6,470 SF fast food with drive-through and 4,020 SF restaurant
13.	739 East Anaheim Street	739 East Anaheim Street	20,120 SF supermarket and 3,600 SF fast food with drive-through
14.	3435-3459 Long Beach Boulevard/ 3464 Locust Avenue	3435-3459 Long Beach Boulevard/ 3464 Locust Avenue	100,000 SF office and 5 DU low-rise multifamily residential
15.	1900-1940 Long Beach Boulevard	1900-1940 Long Beach Boulevard	95 DU mid-rise multifamily residential and 12,400 SF retail
16.	Long Beach Memorial Medical Center	2801 Atlantic Avenue	80,000 SF medical office building to replace an existing 12,000 SF Ranch House/WIC Medical Center building

Notes:

- SF = Square-feet
- DU = Dwelling units

⁸ Source: City of Long Beach, Signal Hill, and Lakewood Planning Departments.

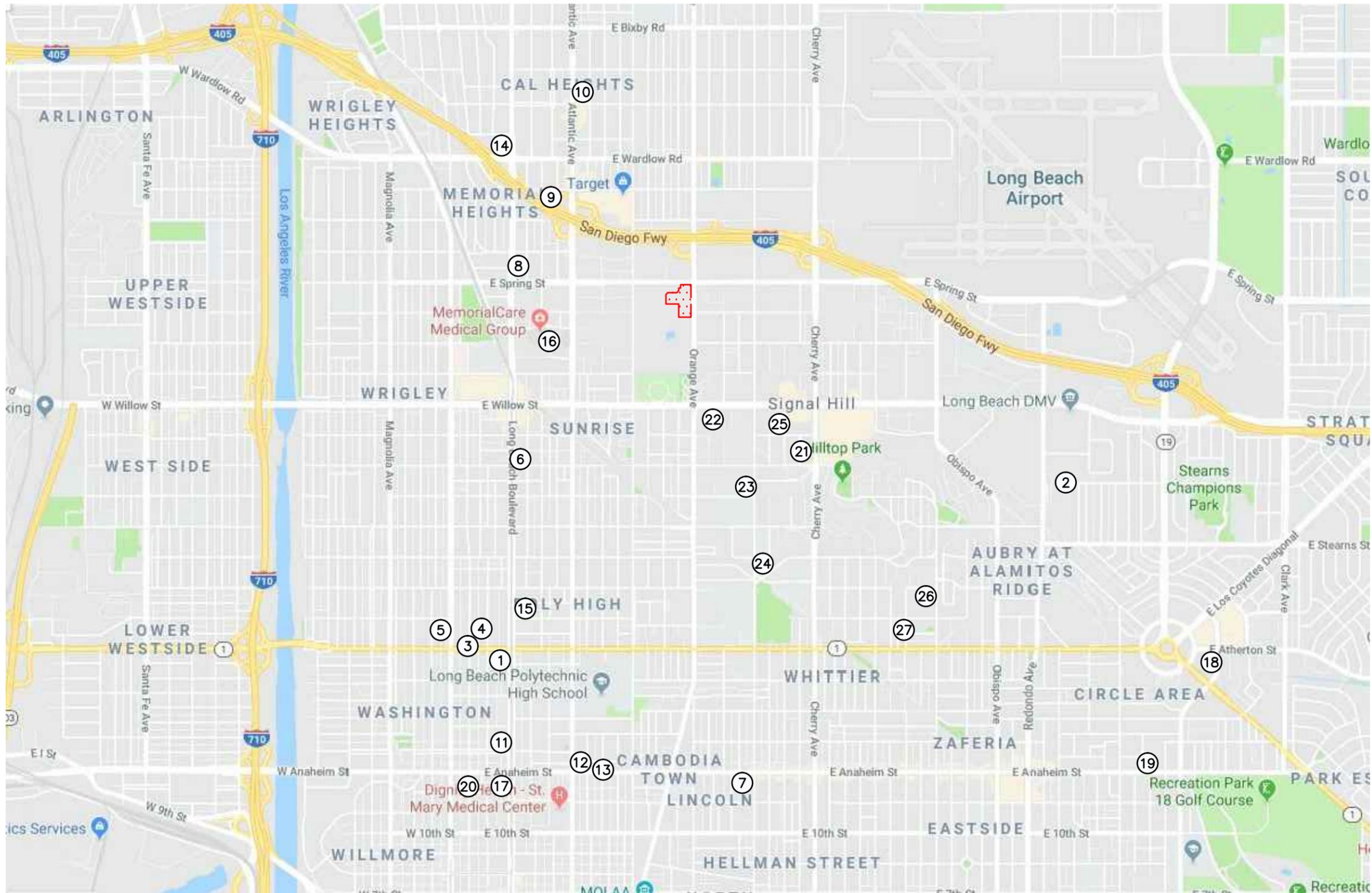
TABLE 6-1 (CONTINUED)
LOCATION AND DESCRIPTION OF CUMULATIVE PROJECTS⁹

No.	Cumulative Project	Location/Address	Description
17.	1101-1105, 1107, 1145 & 1157 Long Beach Boulevard	1101-1105, 1107, 1145 & 1157 Long Beach Boulevard	121 DU mid-rise multifamily residential and 5,000 SF retail
18.	1775 Ximeno Avenue	1775 Ximeno Avenue	10,306 SF fast-food with drive-through window
19.	4223 East Anaheim Street	4223 East Anaheim Street	11,576 SF medical office building
20.	1112 Locust Avenue	1112 Locust Avenue	95 DU mid-rise multifamily residential and 12,400 SF retail
<i>City of Signal Hill</i>			
21.	Signal Hill Heritage Square	West of Cherry Avenue, east of Rose Avenue, south of Crescent Heights Street, and north of Burnett Street.	4 DU single family residential, 199 DU apartments, 10,700 SF retail, 19,500 SF quality restaurant, 5,000 SF high-turnover sit-down restaurant, and 1,600 SF coffee shop with drive-through window
22.	2550 Orange Avenue Industrial	2550 Orange Avenue Industrial	144,919 SF manufacturing/warehouse to replace an existing golf driving range with 21 hitting positions
23.	2351 Walnut Avenue	2351 Walnut Avenue	7,904 SF warehouse and 2,051 SF office
24.	2020 Walnut Avenue	2020 Walnut Avenue	110,300 SF industrial park
25.	Crescent Square	NE corner of Walnut Avenue and Crescent Heights Street	25 DU single family residential
26.	The Courtyard	1939 Temple Avenue	10 DU condominiums
27.	2599 Pacific Coast Highway	2599 Pacific Coast Highway	14 DU low-rise multifamily residential

Notes:

- SF = Square-feet
- DU = Dwelling units

⁹ Source: City of Long Beach, Signal Hill, and Lakewood Planning Departments.



- KEY**
1. LAS VENTANAS APARTMENTS
 2. PACIFIC EDGE INDUSTRIAL
 3. 101 PACIFIC COAST HIGHWAY/
1814 PINE AVENUE
 4. 1836-1852 LOCUST AVE
 5. MENDOZA PROJECT
 6. LONG BEACH SENIOR LIVING
 7. GEORGE MEDAK
 8. SALVATION ARMY
 9. HARBOR FREIGHT
 10. STARBUCKS
 11. 1401 LONG BEACH BOULEVARD/
217 EAST 14TH STREET
 12. 1320 ATLANTIC AVENUE
 13. 739 EAST ANAHEIM STREET
 14. 3435-3459 LONG BEACH BOULEVARD/
3464 LOCUST AVENUE
 15. 1900-1940 LONG BEACH BOULEVARD
 16. LONG BEACH MEMORIAL MEDICAL CENTER
 17. 1101-1105,1107,1145 AND 1157
LONG BEACH BOULEVARD
 18. 1775 XIMENO AVENUE
 19. 4223 EAST ANAHEIM STREET
 20. 1112 LOCUST AVENUE
 21. SIGNAL HILL HERITAGE SQUARE
 22. 2550 ORANGE AVENUE INDUSTRIAL
 23. 2351 WALNUT AVENUE
 24. 2020 WALNUT AVENUE
 25. CRESCENT SQUARE
 26. THE COURTYARD
 27. 2599 PACIFIC COAST HIGHWAY

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SOURCE: GOOGLE

KEY

- # = CUMULATIVE PROJECT LOCATION
- [Red Hatched Box] = PROJECT SITE



FIGURE 6-1

LOCATION OF CUMULATIVE PROJECTS
SPRING STREET INDUSTRIAL, LONG BEACH

**TABLE 6-2
CUMULATIVE PROJECTS TRAFFIC GENERATION FORECAST¹⁰**

Cumulative Project Description	Daily 2-Way	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
1. Las Ventanas Apartments ¹¹	803	11	42	53	46	28	74
2. Pacific Edge Industrial	714	54	16	70	21	57	78
3. 101 Pacific Coast Highway/ 1814 Pine Avenue	398	6	11	17	19	17	36
4. 1836-1852 Locust Avenue	397	6	14	20	20	15	35
5. Mendoza Project	2,061	33	53	86	85	73	158
6. Long Beach Senior Living	600	18	8	26	21	21	42
7. George Medak	1,105	47	35	82	41	60	101
8. Salvation Army Expansion ¹²	903	34	18	52	45	40	85
9. Harbor Freight	583	9	6	15	28	31	59
10. Starbucks	738	41	39	80	19	20	39
11. 1401 Long Beach Boulevard/ 217 East 14 th Street	1,190	17	52	69	57	38	95
12. 1320 Atlantic Avenue	3,498	155	145	300	134	116	250
13. 739 East Anaheim Street	3,843	120	102	222	156	148	304
14. 3435-3459 Long Beach Boulevard/ 3464 Locust Avenue	1,011	100	18	118	20	98	118
15. 1900-1940 Long Beach Boulevard	985	16	30	46	49	40	89
16. Long Beach Memorial Medical Center	2,366	147	42	189	66	169	235
17. 1101-1105, 1107, 1145 & 1157 Long Beach Boulevard	847	14	35	49	41	31	72
18. 1775 Ximeno Avenue	4,854	211	203	414	175	162	337
19. 4223 East Anaheim Street	403	25	7	32	11	29	40
20. 1112 Locust Avenue	528	9	26	35	26	17	43
21. Signal Hill Heritage Square	3,064	75	98	173	144	90	234
22. 2550 Orange Avenue Industrial	385	78	23	101	23	61	84
23. 2351 Walnut Avenue	34	3	0	3	1	3	4

¹⁰ Unless otherwise noted, Source: *Trip Generation*, 10th Edition, Institute of Transportation Engineers (ITE), Washington, D.C. (2017).

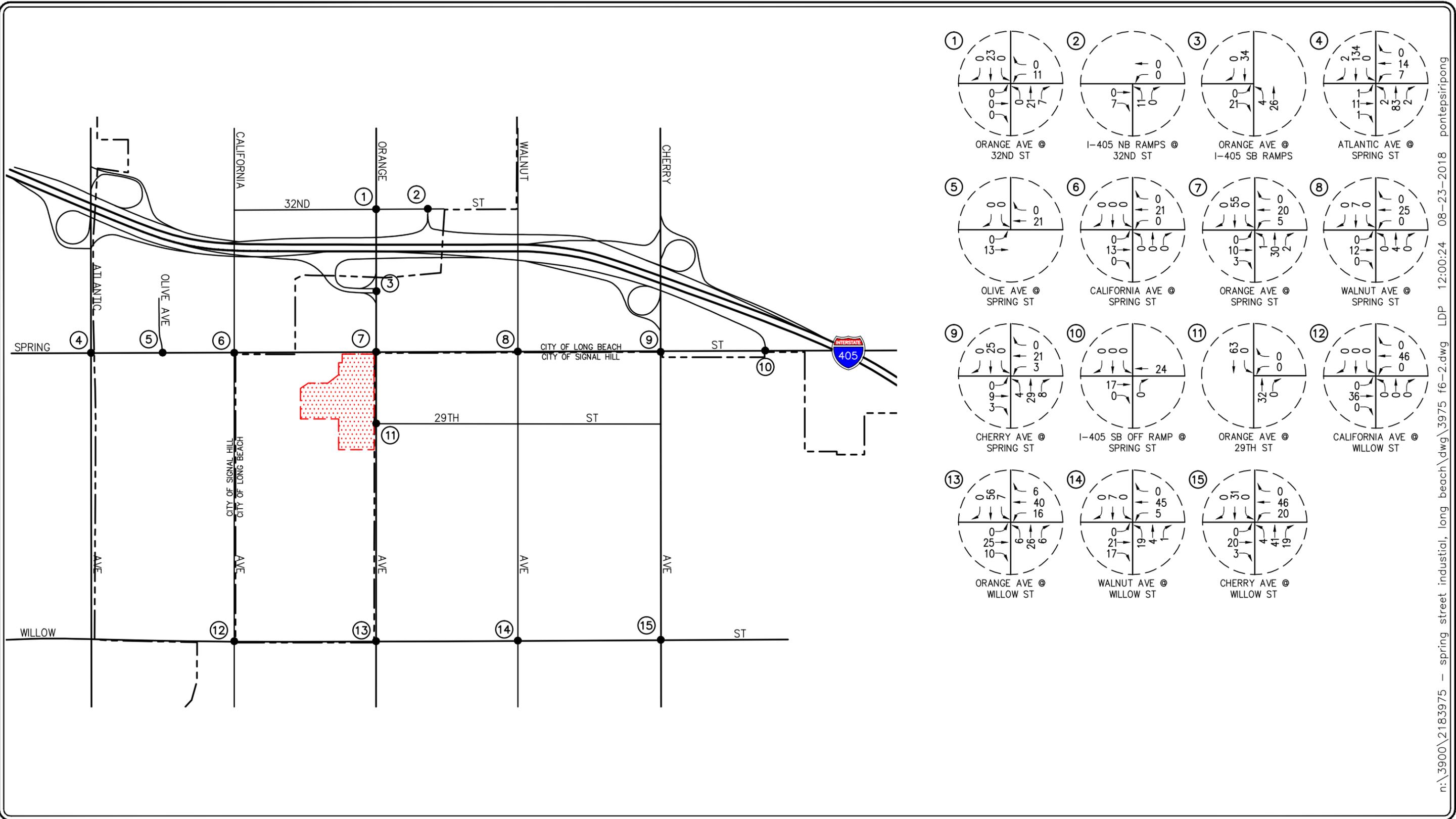
¹¹ Source: *1795 Long Beach Boulevard Mixed-Use Development Project TIA*, prepared by LLG Engineers in June 2017.

¹² Source: *Salvation Army Citadel Expansion TIA*, prepared by LLG Engineers in December 2016.

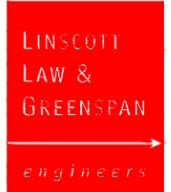
TABLE 6-2 (CONTINUED)
CUMULATIVE PROJECTS TRAFFIC GENERATION FORECAST¹³

Cumulative Project Description	Daily 2-Way	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
24. 2020 Walnut Avenue	372	36	8	44	9	35	44
25. Crescent Square	236	5	14	19	16	9	25
26. The Courtyard	73	1	4	5	4	2	6
27. 2599 Pacific Coast Highway	102	1	5	6	5	3	8
Cumulative Projects Trip Generation Forecast	31,290	1,272	1,054	2,326	1,282	1,413	2,695

¹³ Unless otherwise noted, Source: *Trip Generation*, 10th Edition, Institute of Transportation Engineers (ITE), Washington, D.C. (2017).



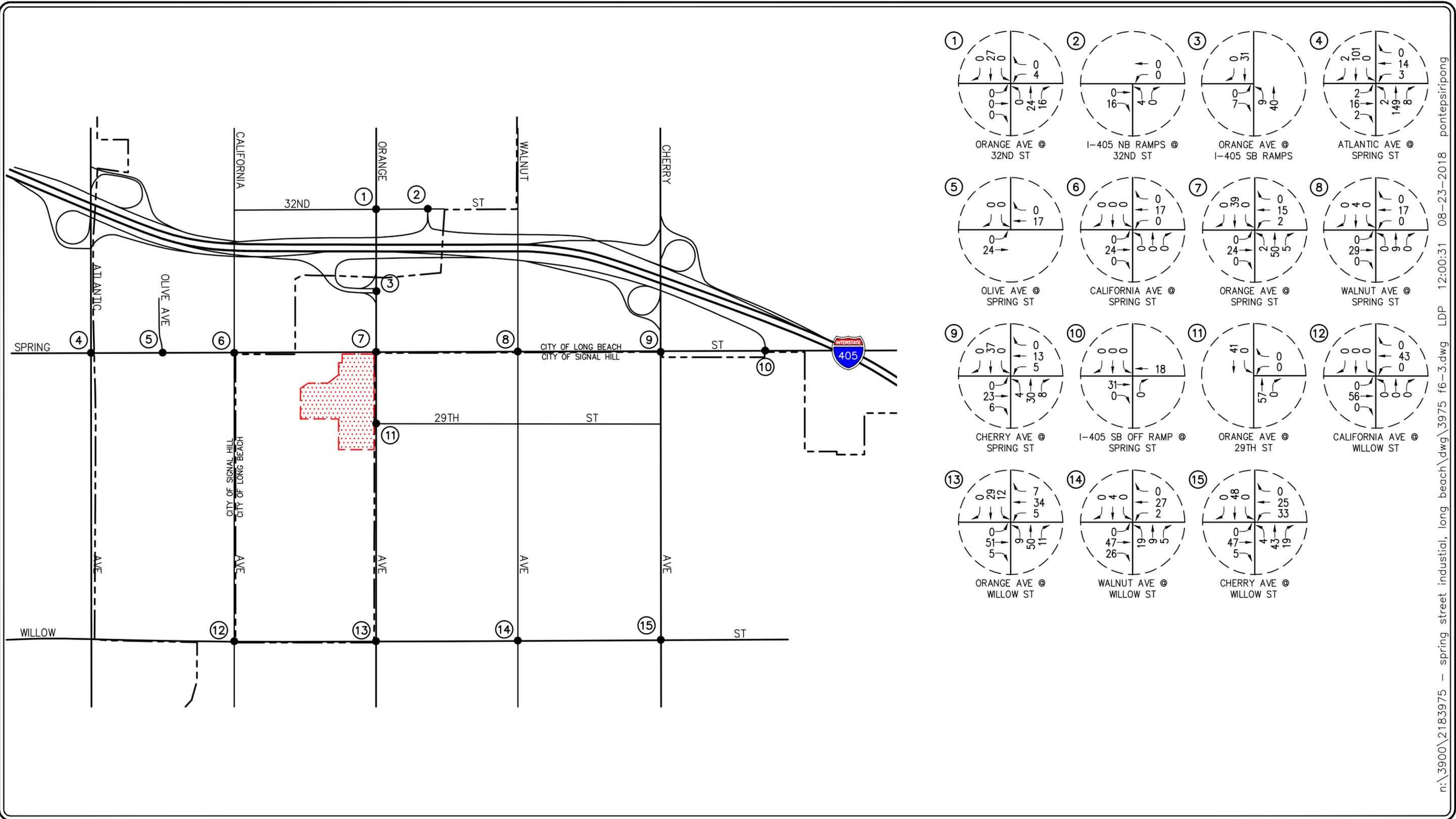
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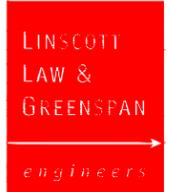
KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 6-2

AM PEAK HOUR CUMULATIVE PROJECT TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



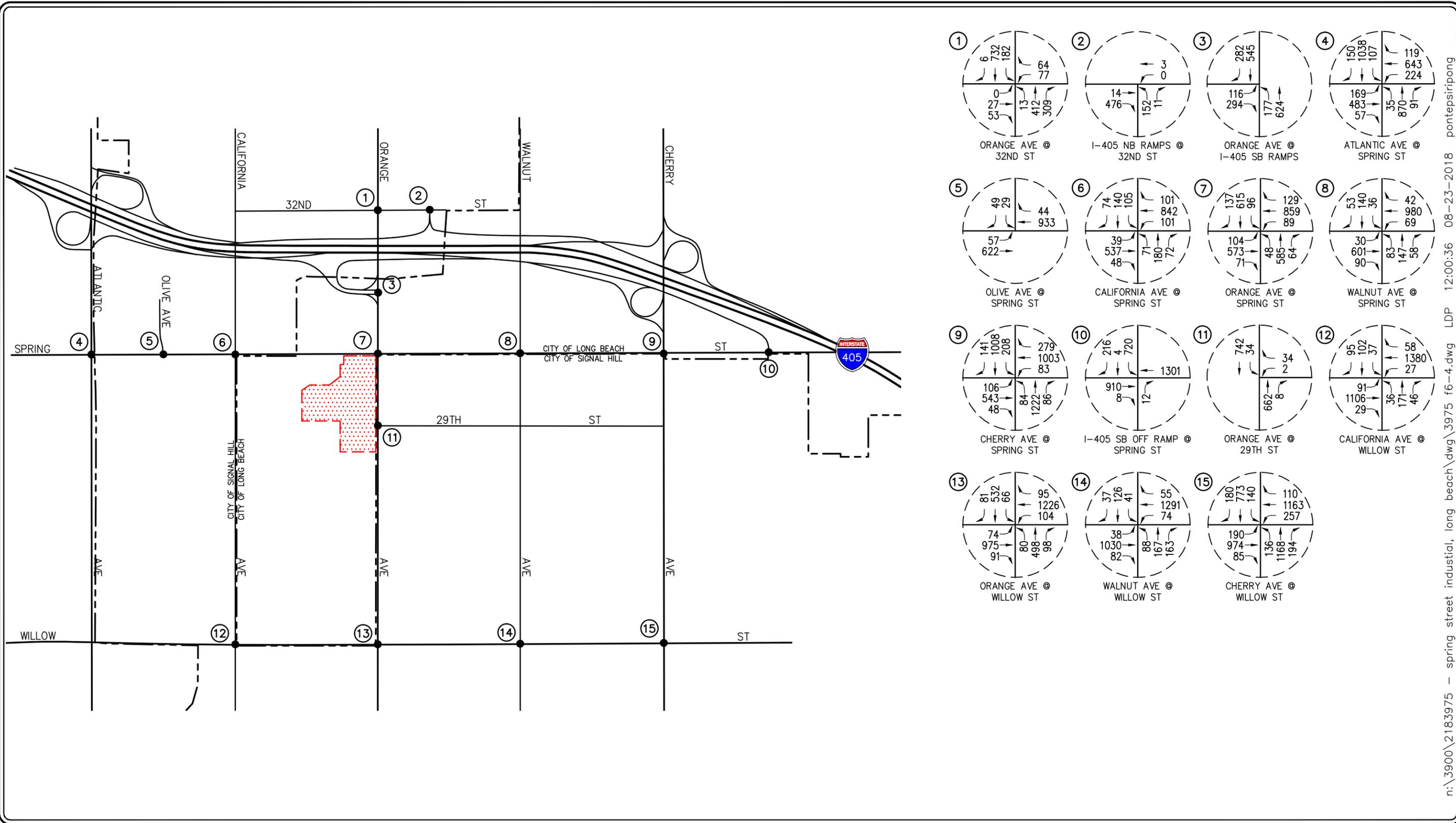
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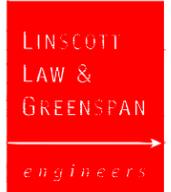
KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 6-3

PM PEAK HOUR CUMULATIVE PROJECT TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

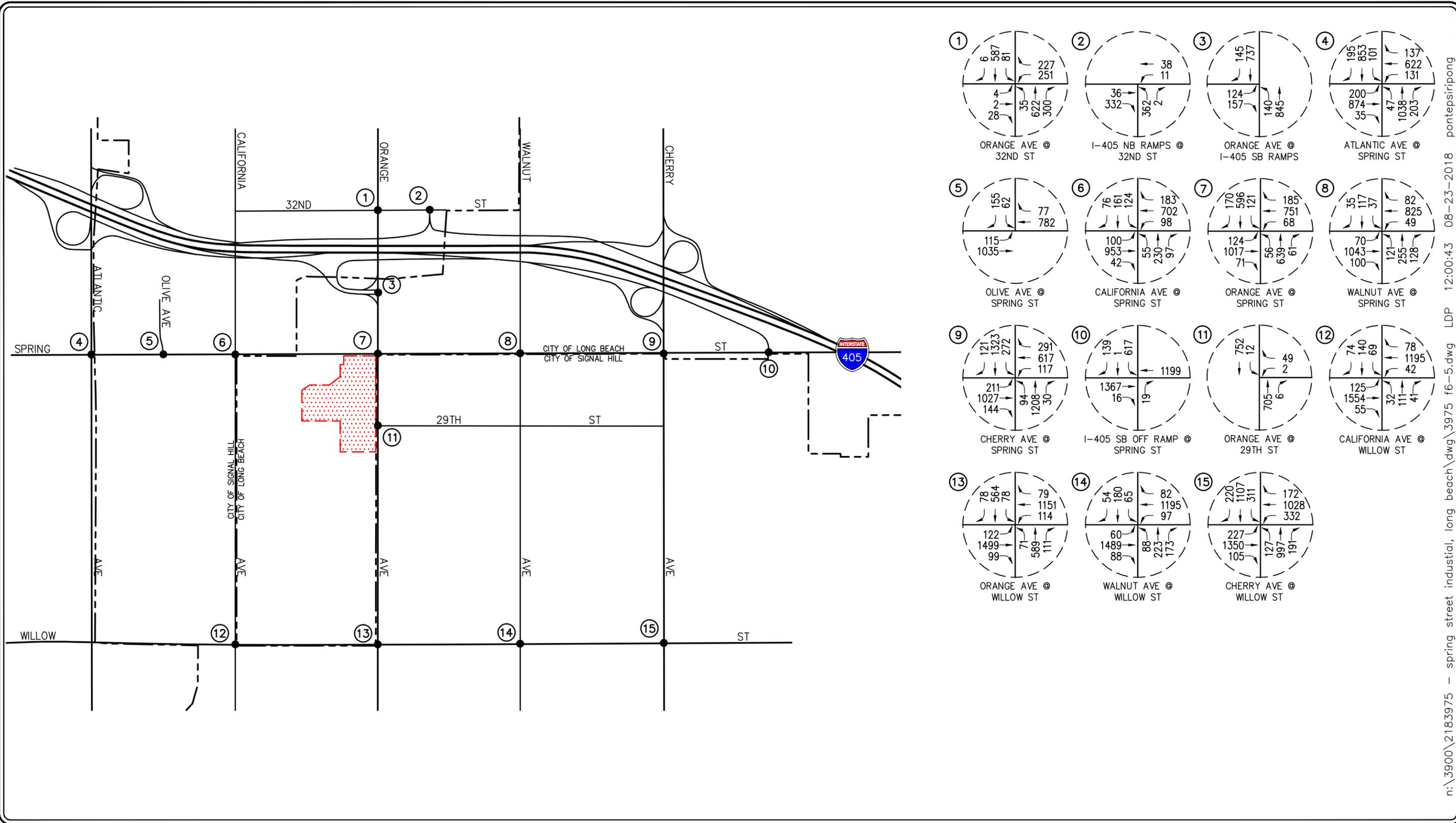


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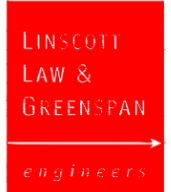


KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 6-4
YEAR 2021 CUMULATIVE AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

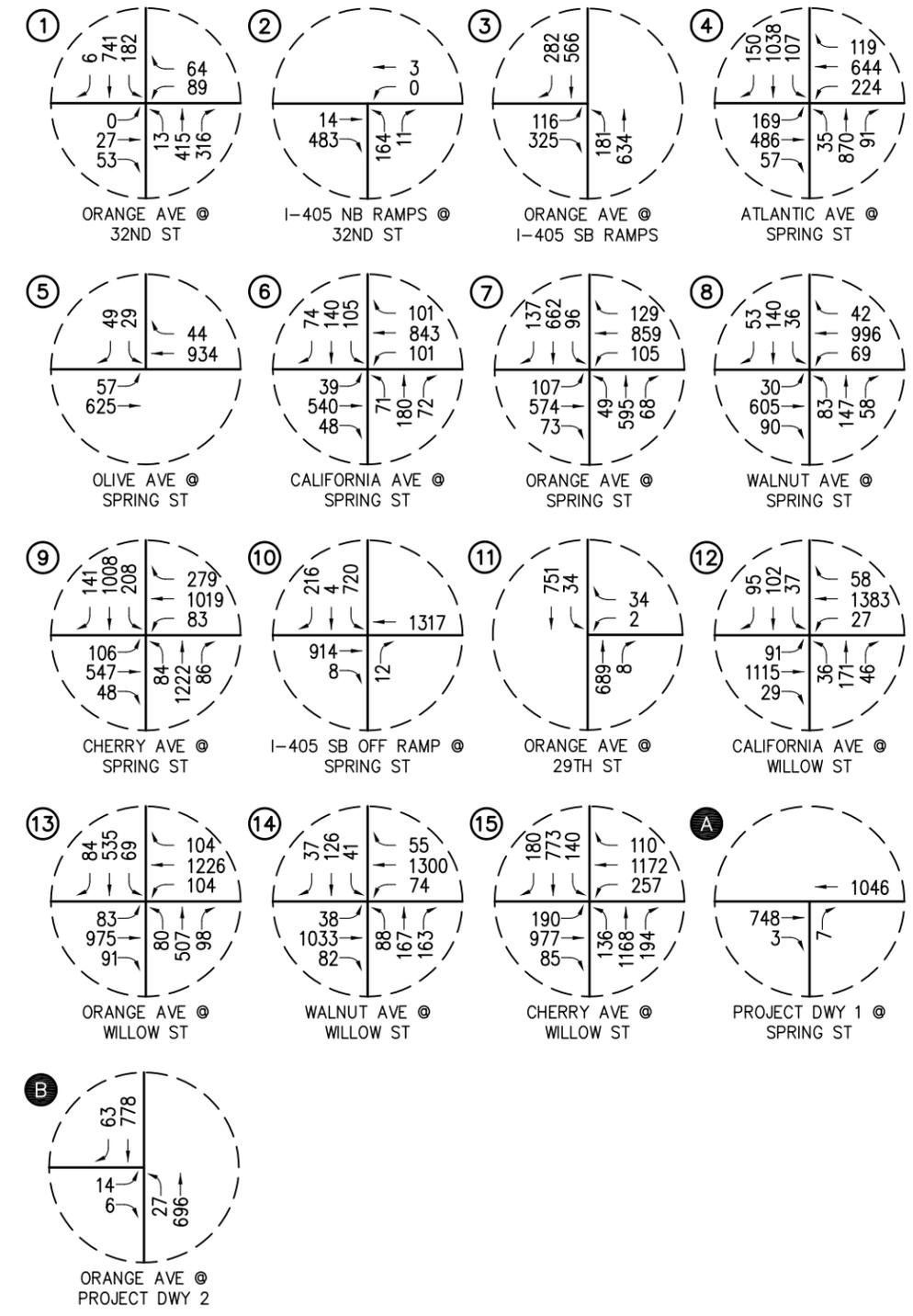
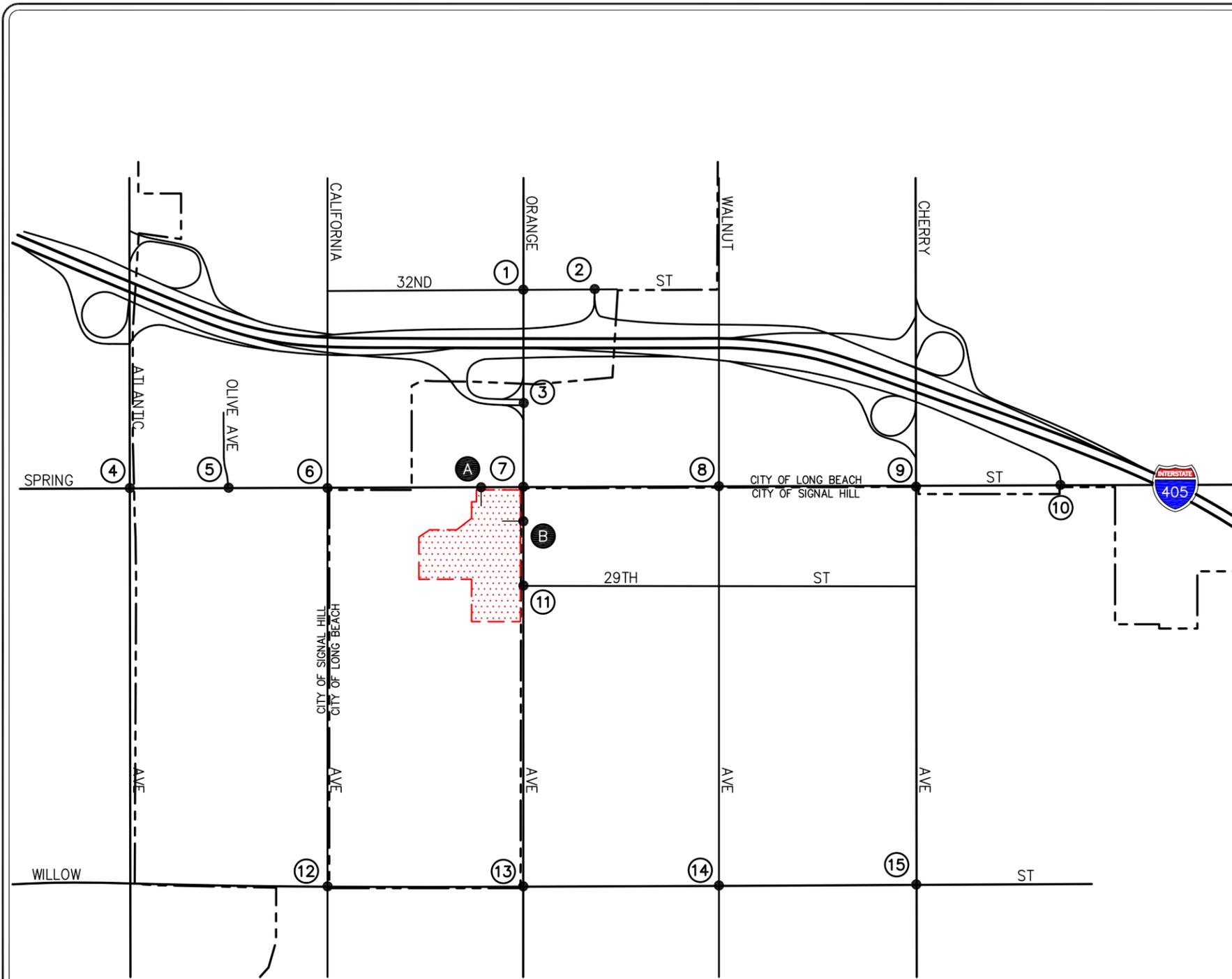


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KEY
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 [Red Hatched Box] = PROJECT SITE

FIGURE 6-5
YEAR 2021 CUMULATIVE PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



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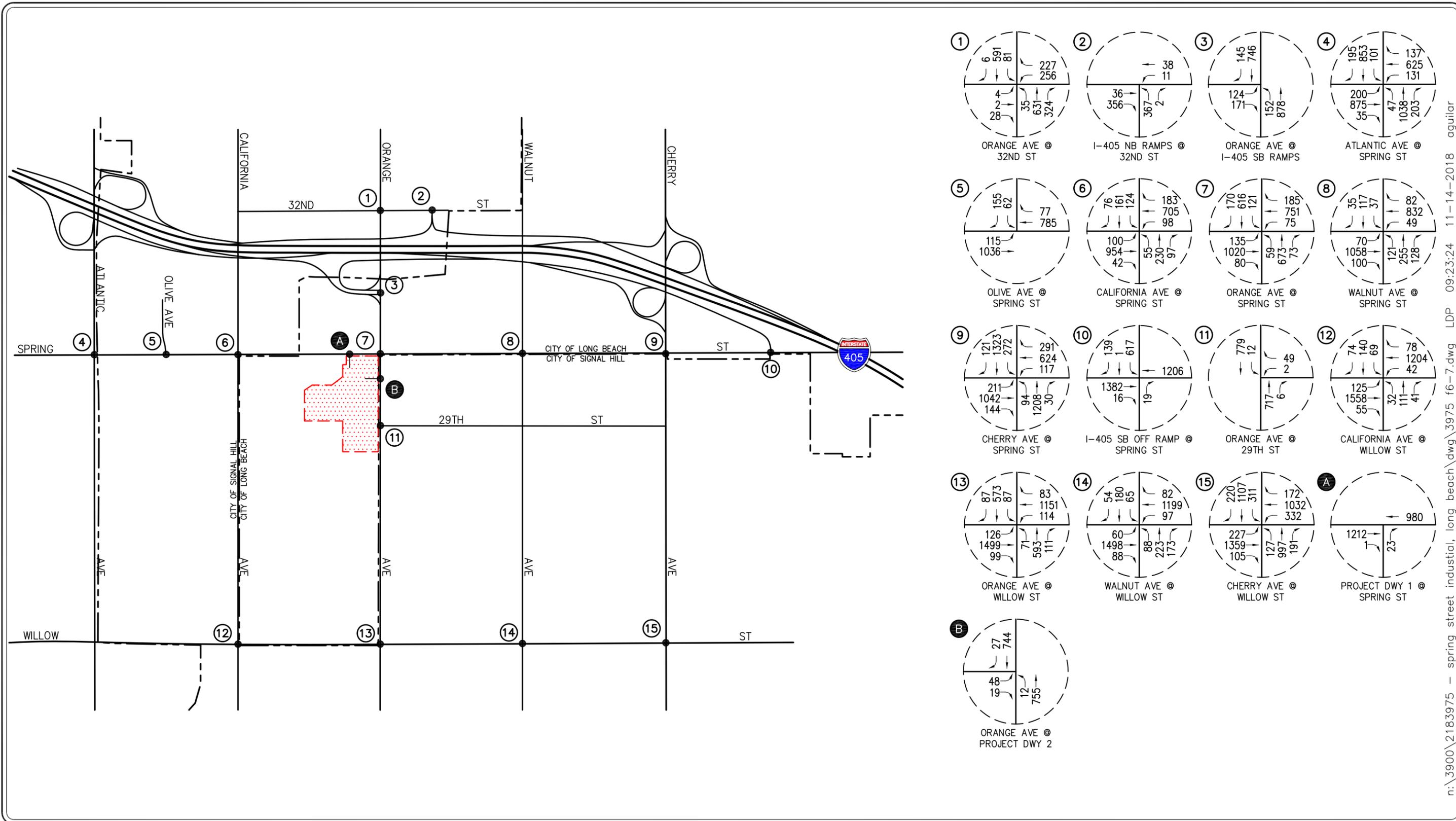


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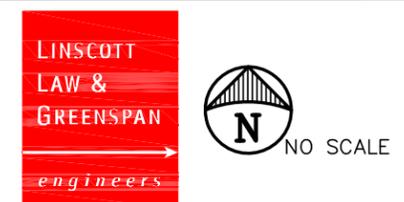
FIGURE 6-6

YEAR 2021 CUMULATIVE PLUS PROJECT AM PEAK HOUR TRAFFIC VOLUMES

SPRING STREET INDUSTRIAL, LONG BEACH



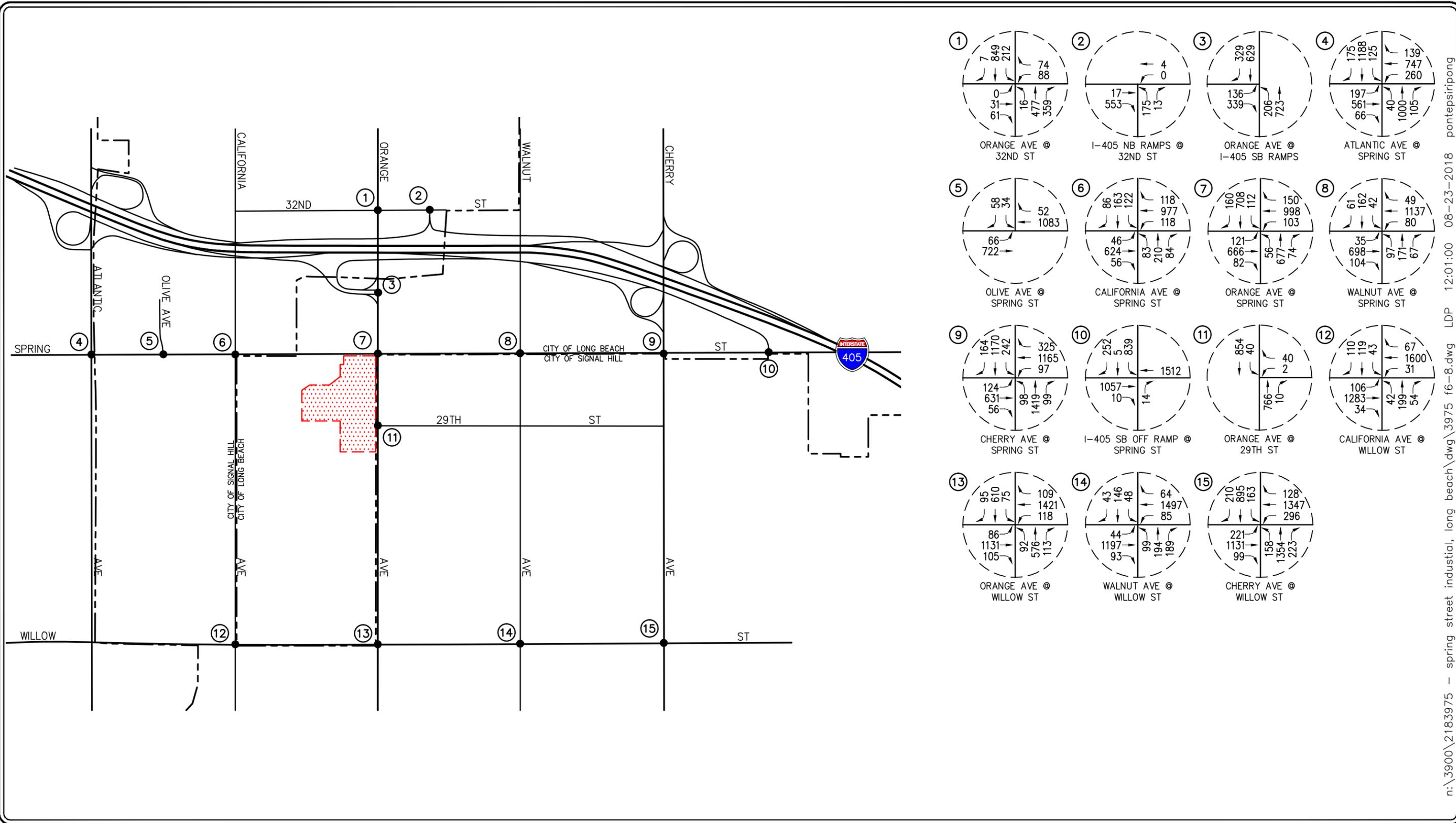
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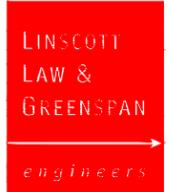
KEY
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 [Red Dotted Box] = PROJECT SITE

FIGURE 6-7

YEAR 2021 CUMULATIVE PLUS PROJECT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



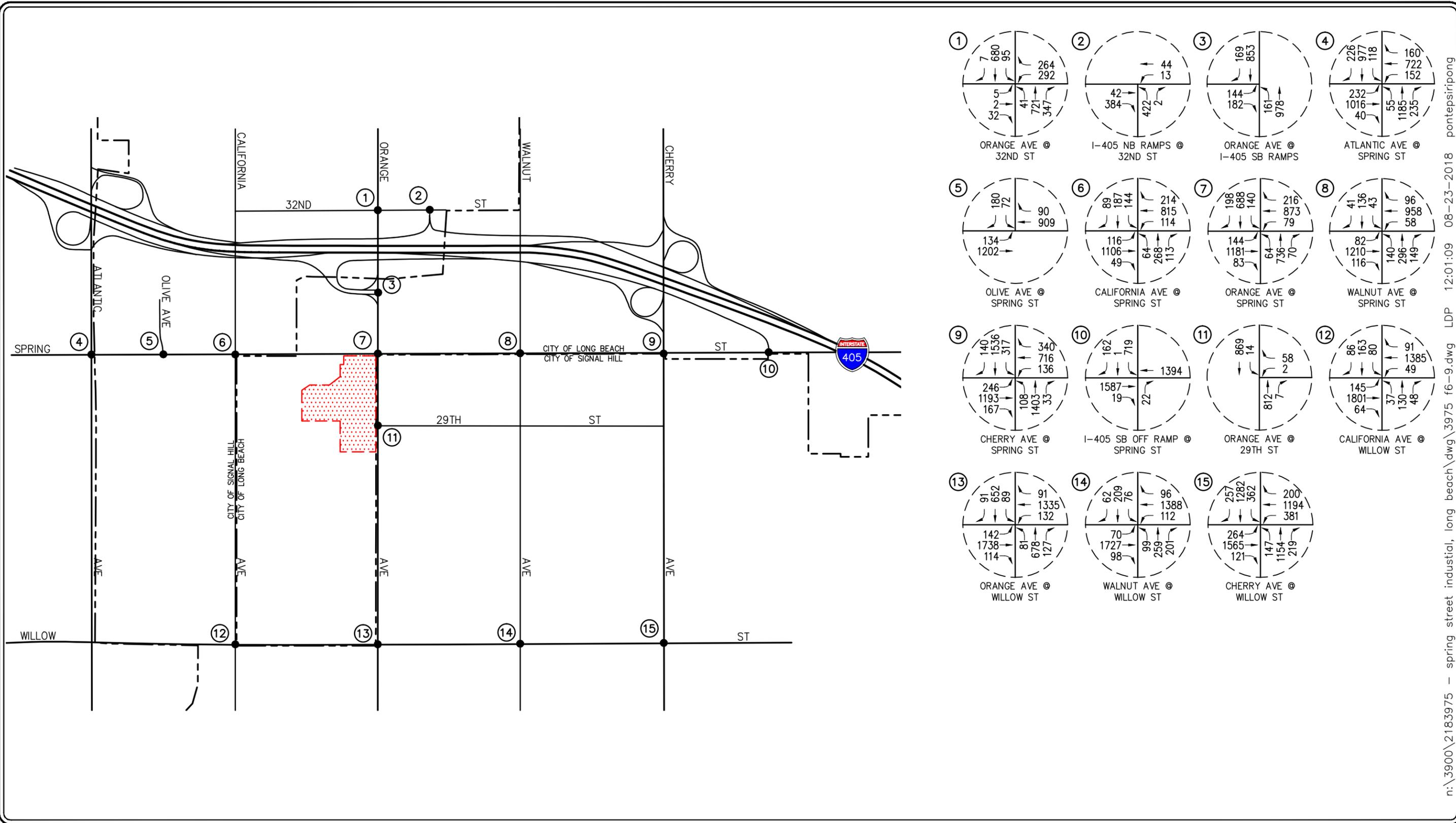
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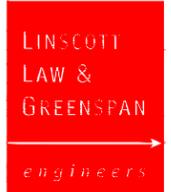
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FIGURE 6-8

YEAR 2038 BUILDOUT AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

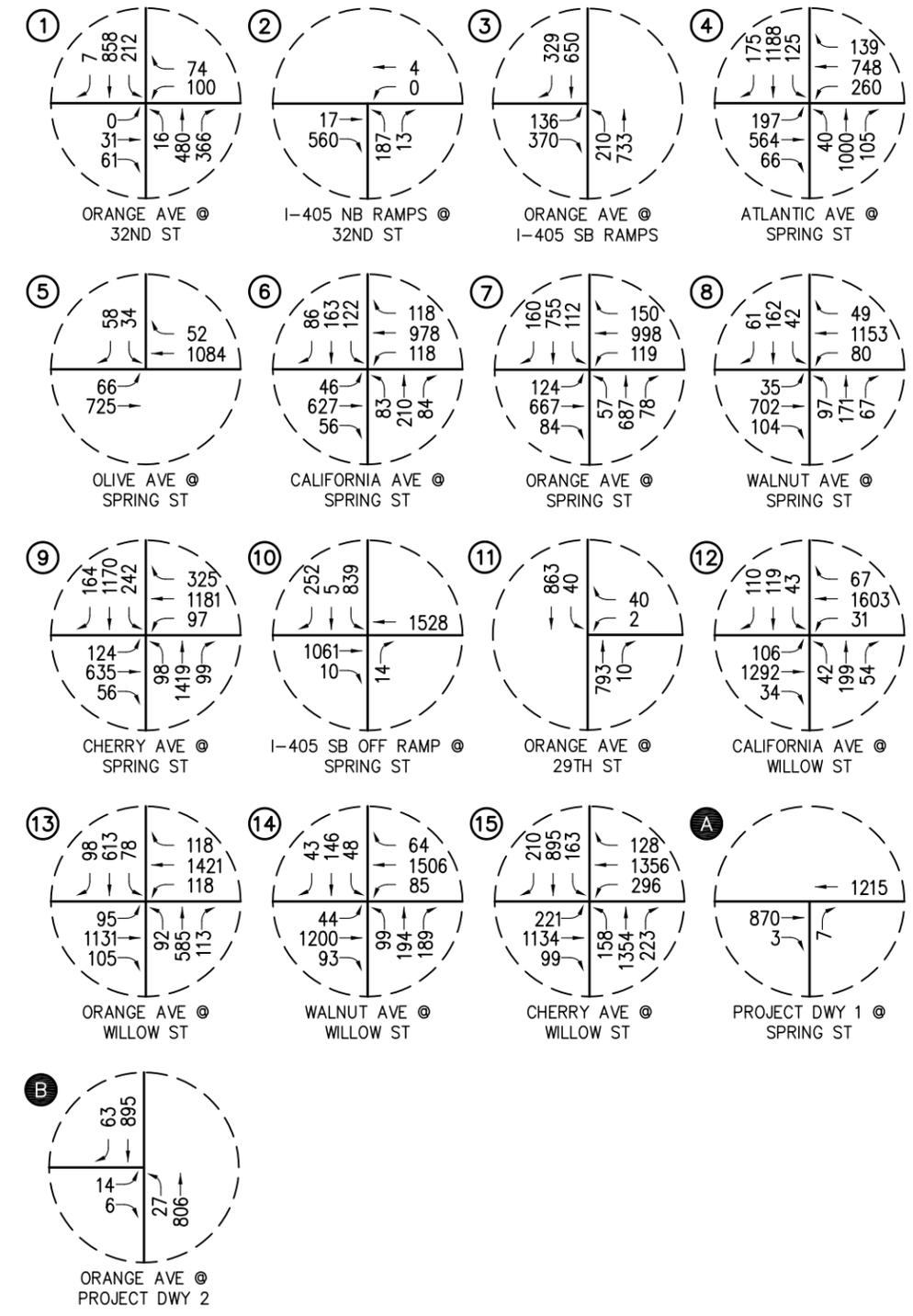
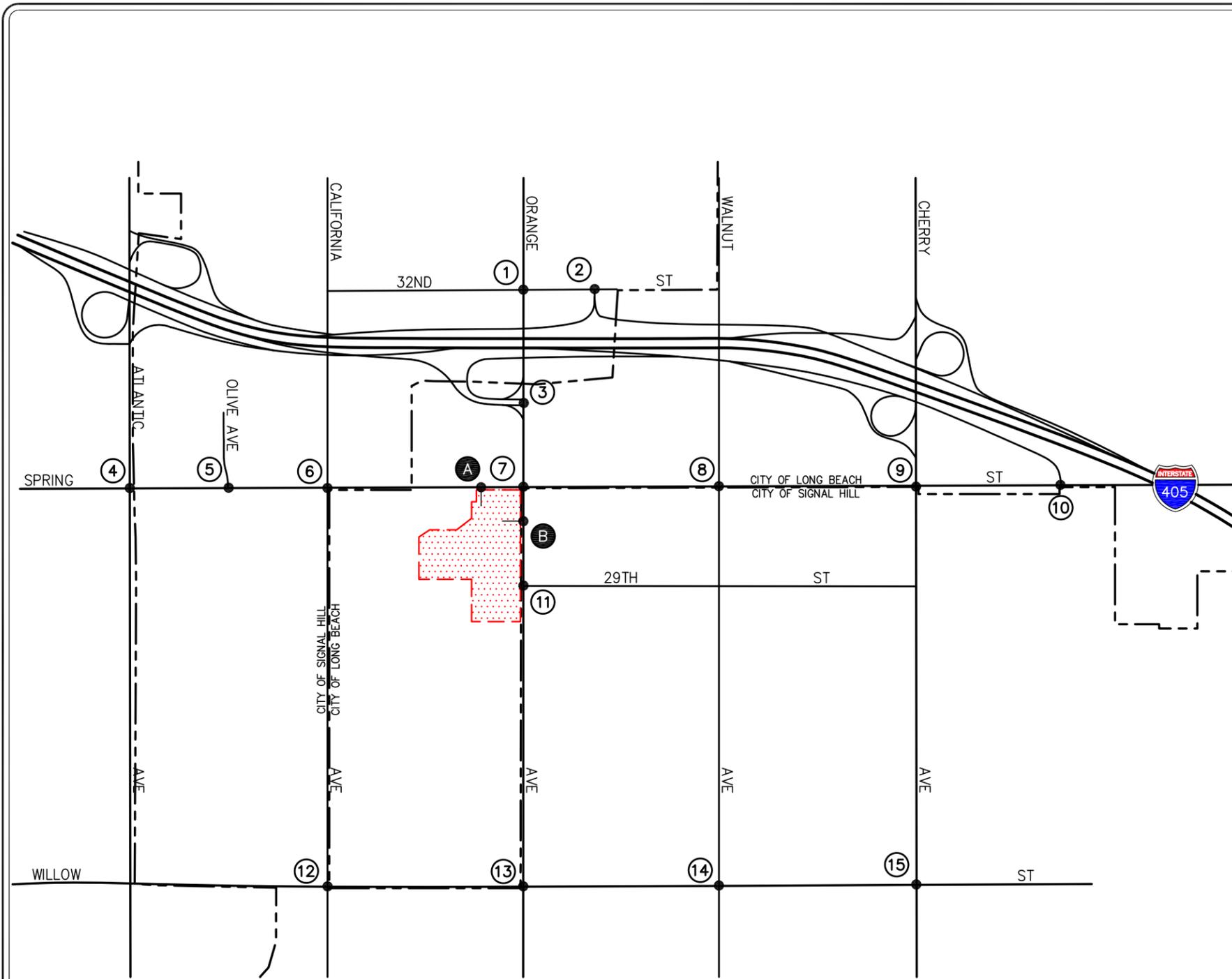


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KEY
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FIGURE 6-9
YEAR 2038 BUILDOUT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



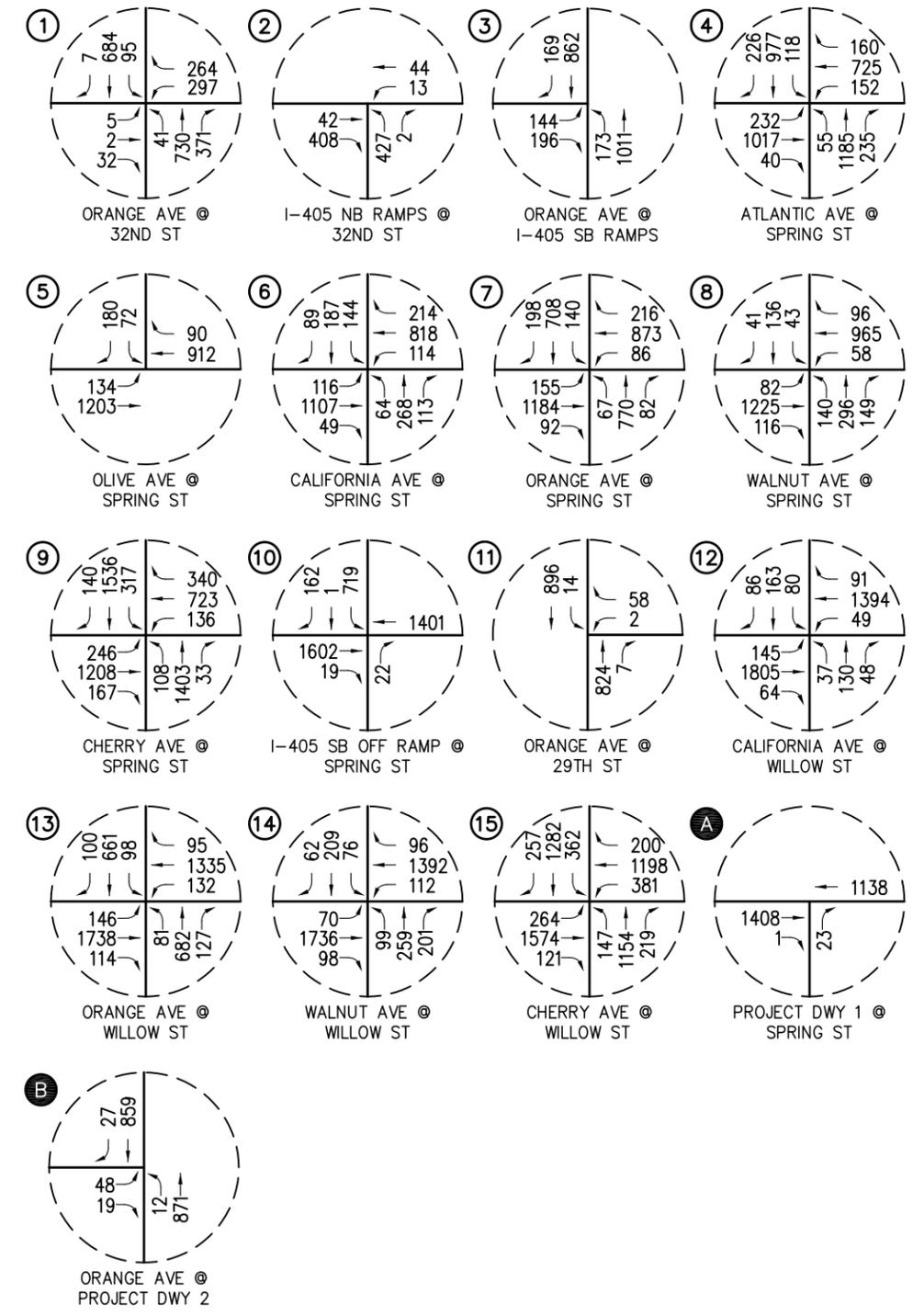
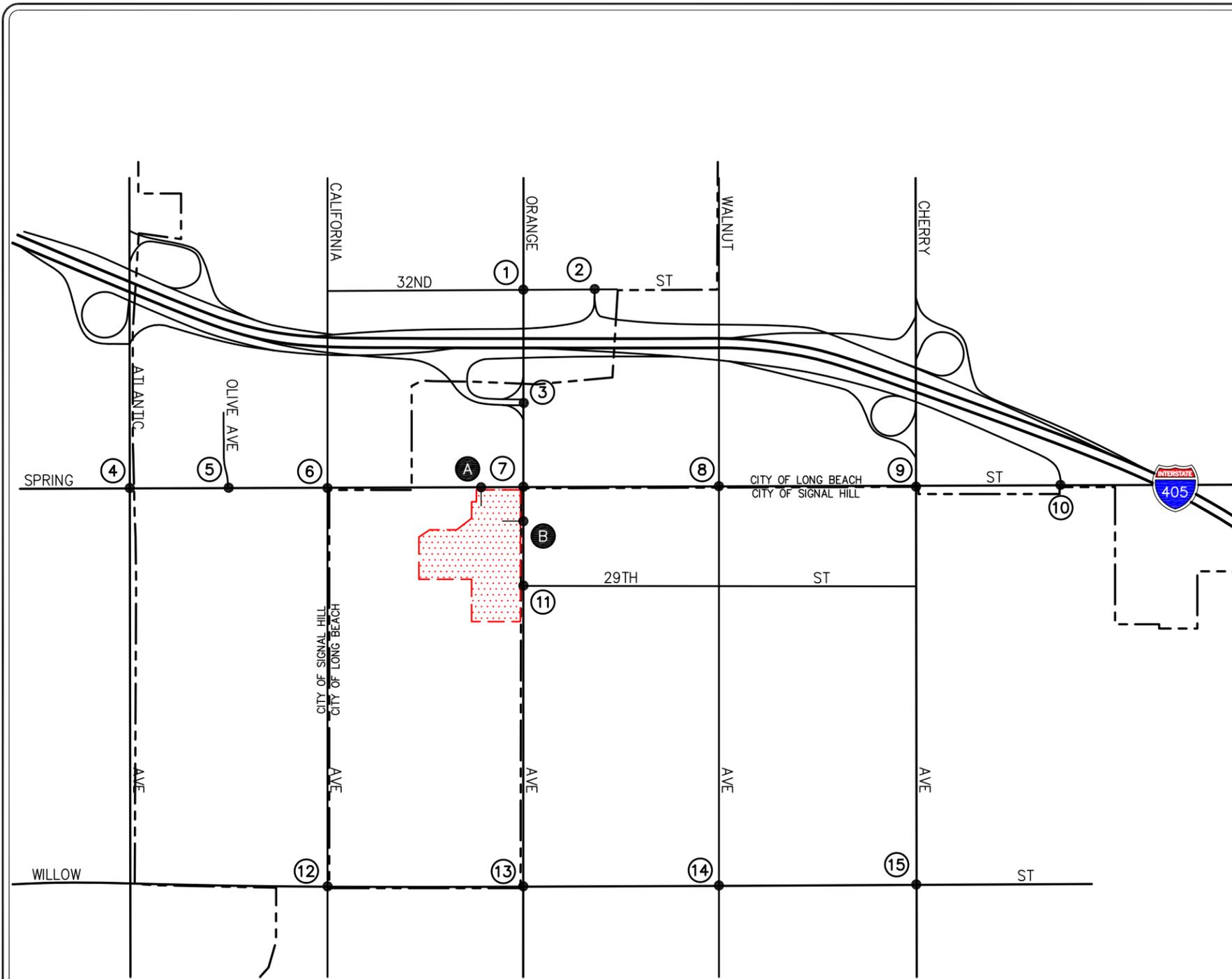
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KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 6-10

YEAR 2038 BUILDOUT PLUS PROJECT AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



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KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 6-11

YEAR 2038 BUILDOUT PLUS PROJECT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

6.5 Class IV (Protected Bike Lane) Bikeway Improvements on Orange Avenue

The City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue, which will span between 70th Street and Pacific Coast Highway. Consistent with the City of Long Beach plans, this protected bikeway is assumed to be part of the cumulative background traffic conditions and is anticipated to be complete by the Project's opening year. As part of the planned improvements, Orange Avenue will be reduced from a four-lane roadway to a two-lane roadway. These improvements will directly affect the study intersections of Orange Avenue/I-405 SB Ramps (Intersection 3), Orange Avenue/Spring Street (Intersection 7) and Orange Avenue/Willow Street (Intersection 13) under near-term and long-term traffic conditions; no change to the lane geometrics are expected at the intersections of Orange Avenue/32nd Street (Intersection 1) and Orange Avenue/29th Street (Intersection 11).

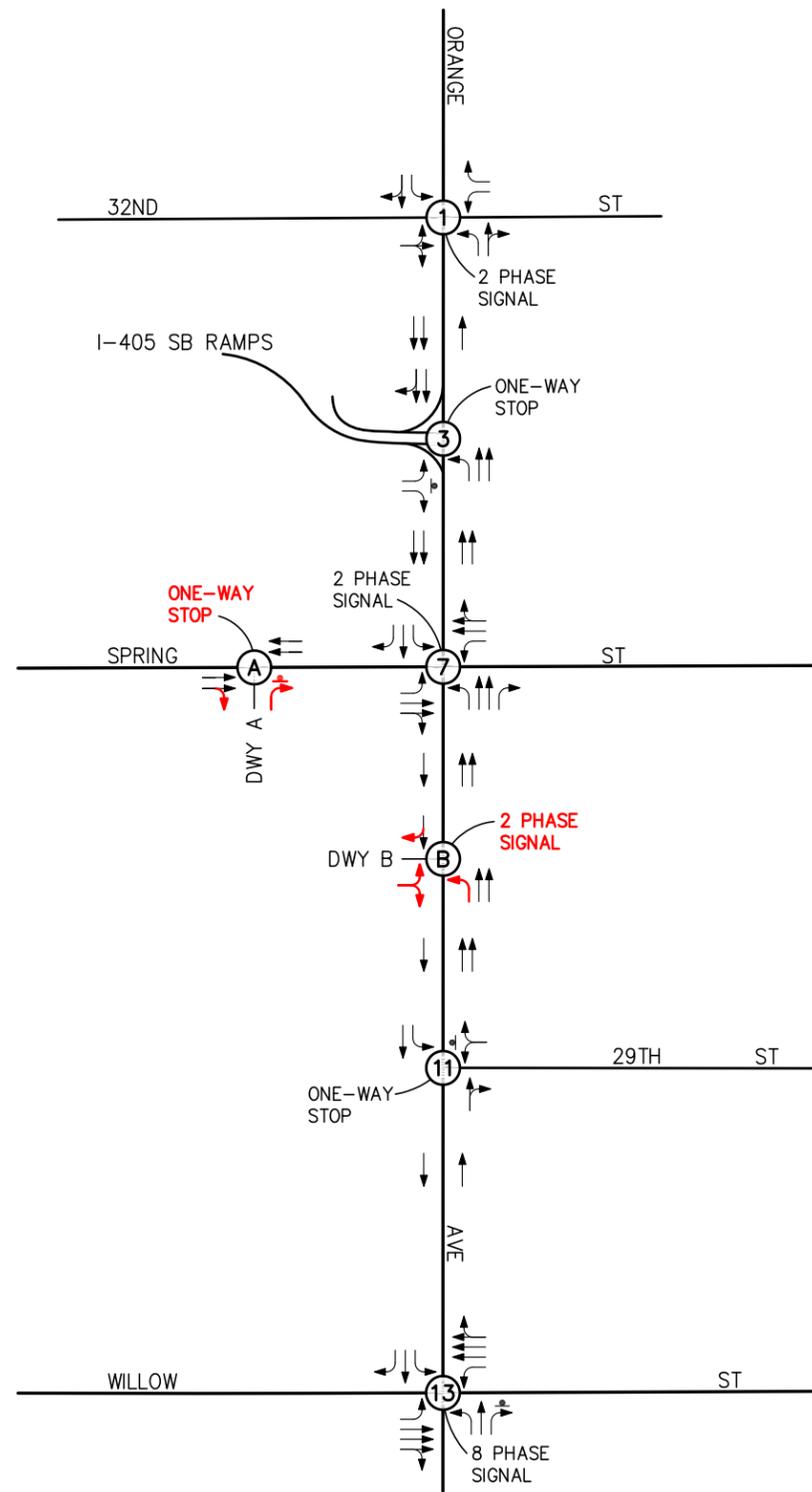
However, since the City of Signal Hill classifies as Orange Avenue as Principal Arterial, which calls for four lanes of travel and a painted or raised median, an alternative evaluation has been prepared to assess the Project's potential traffic impacts at the study intersections along Orange Avenue, assuming Long Beach's planned bikeway improvements would not be implemented.

Based on information provided by the City, the improvements to each intersection include the following:

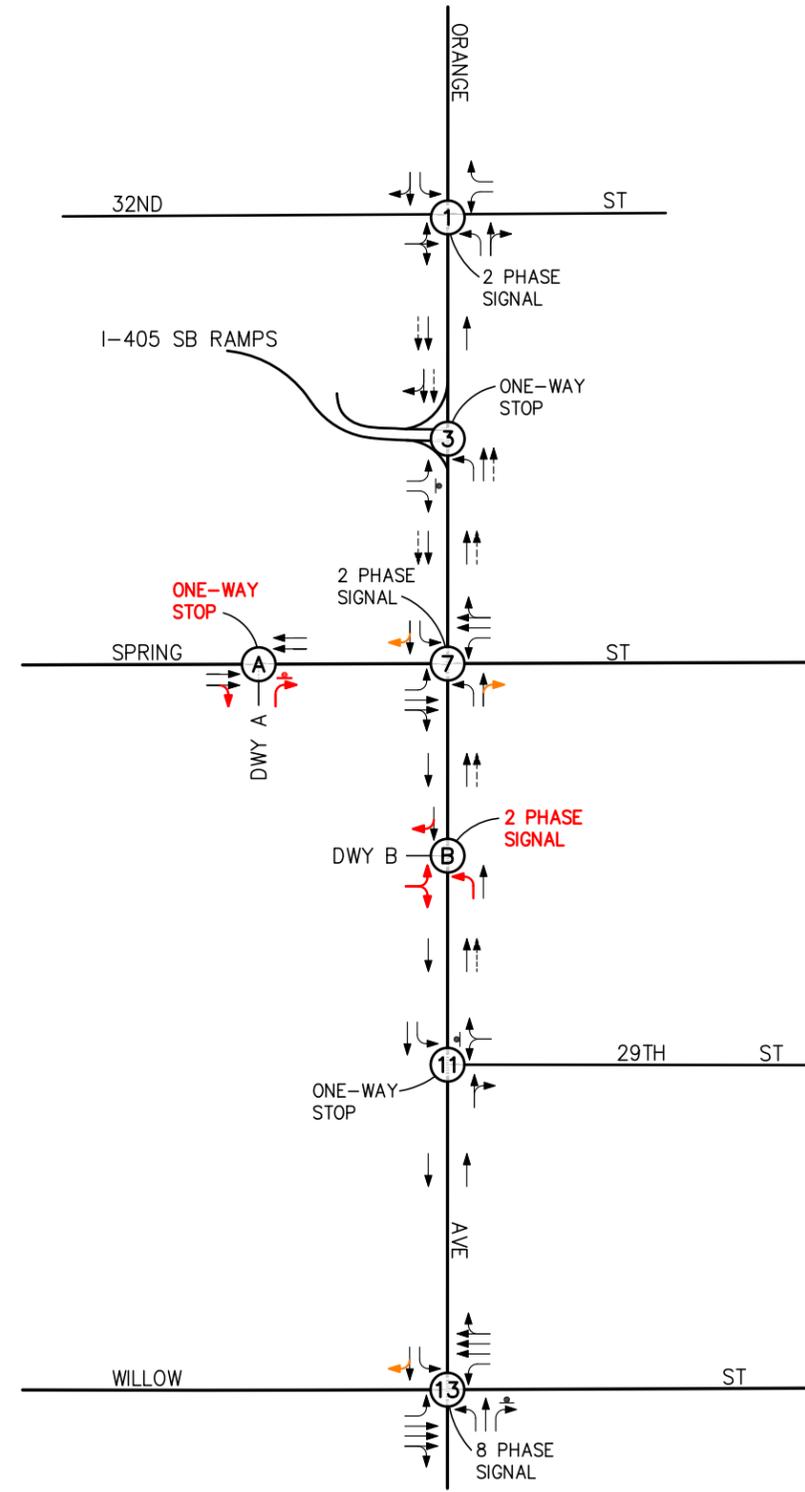
- **Intersection 1 – Orange Avenue at 32nd Street:** No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, south of 32nd Street would be striped with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.
- **Intersection 3 – Orange Avenue at I-405 SB Ramps:** Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.
- **Intersection 7 – Orange Avenue at Spring Street:** Modify and restripe the northbound and southbound approaches to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, this study intersection would be designed to include protected bike lanes (i.e. on-street bike lanes and a median buffer to separate bicycle traffic from vehicular traffic).

- **Intersection 11 – Orange Avenue at 29th Street:** No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, from Spring Street south to Willow Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic; where possible, on-street parking will be maintained/provided.
- **Intersection 13 – Orange Avenue at Willow Street:** Restripe the southbound approach to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the existing southbound right-turn lane would be removed to allow for the installation of on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Figure 6-12 presents the existing roadway and intersection conditions for Orange Avenue and key study intersection mentioned above, and the anticipated conditions with implementation of the Orange Avenue Bikeway Improvements project as planned by the City of Long Beach (i.e. which lanes would be eliminated with bikeway project). This figure also illustrates the planned driveway conditions of the Project’s proposed access points located on Spring Street and Orange Avenue, inclusive of a traffic signal at the driveway (Driveway B) on Orange Avenue.



EXISTING TRAFFIC CONDITIONS



FUTURE TRAFFIC CONDITIONS WITH PLANNED IMPROVEMENTS

KEY

- ← = APPROACH LANE ASSIGNMENT
- = LANE REMOVED
- = PLANNED IMPROVEMENT
- = PROJECT SPECIFIC IMPROVEMENT
- ▨ = PROJECT SITE



FIGURE 6-12

ORANGE AVENUE BIKEWAY IMPROVEMENTS
SPRING STREET INDUSTRIAL, LONG BEACH

7.0 TRAFFIC IMPACT ANALYSIS METHODOLOGY

7.1 Impact Criteria and Thresholds

The potential impact of the added project traffic volumes generated by the proposed Project during the weekday peak hours was evaluated based on analysis of future operating conditions at the fifteen (15) key study intersections, without, then with, the proposed Project. The previously discussed capacity analysis procedures were utilized to investigate the future volume-to-capacity relationships and service level characteristics at each study intersection. The significance of the potential impacts of the project at each key intersection was then evaluated using the following traffic impact criteria.

7.1.1 City of Long Beach and Signal Hill

According to the City of Long Beach and City of Signal Hill significant impact criteria, impacts to local and regional transportation systems are considered significant if:

Signalized Intersections:

- The project causes a study intersection to deteriorate from Level of Service (LOS) D to LOS E or F. The City of Long Beach and Signal Hill considers LOS D (ICU = 0.801 - 0.900) to be the minimum acceptable LOS for all intersections; or
- The project increases traffic demand at the study intersection by 2% of capacity (ICU increase ≥ 0.020), causing or worsening LOS E or F (ICU > 0.901) when an intersection is operating at LOS E or F in the baseline condition.

Unsignalized Intersections:

For unsignalized intersections, an impact is defined to be significant if:

- The project causes an intersection operating at LOS D or better to degrade to LOS E or F, and the traffic signal warrant analysis determines that a traffic signal is justified.

7.2 Traffic Impact Analysis Scenarios

The following scenarios are those for which volume/capacity calculations have been performed using the ICU/HCM methodologies:

- A. Existing Traffic Conditions;
- B. Existing Plus Project Traffic Conditions;
- C. Scenario (B) with Improvements, if necessary;
- D. Year 2021 Cumulative Traffic Conditions;
- E. Year 2021 Cumulative Plus Project Traffic Conditions;
- F. Scenario (E) with Improvements, if necessary;
- G. Year 2038 Buildout Traffic Conditions;
- H. Year 2038 Buildout Plus Project Traffic Conditions; and
- I. Scenario (H) with Improvements, if necessary.

As noted earlier, an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

8.0 PEAK HOUR INTERSECTION CAPACITY ANALYSIS

8.1 Existing Plus Project Traffic Conditions

Table 8-1 summarizes the peak hour Level of Service results at the fifteen (15) key study intersections for existing plus project traffic conditions. The first column (1) of ICU/HCM/LOS values in *Table 8-1* presents a summary of existing AM and PM peak hour traffic conditions (which were also presented in *Table 3-3*). The second column (2) lists existing plus project traffic conditions with current intersection geometry/lane configurations. The third column (3) shows the increase in ICU/HCM value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the significant impact criteria defined in this report. The fourth column (4) indicates the anticipated level of service with improvements, if any.

8.1.1 Existing Traffic Conditions

As previously presented in *Table 3-3*, the intersection of Orange Avenue/I-405 SB Ramps currently operates at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour. The remaining fourteen (14) key study intersections currently operate at LOS D or better during the weekday AM and PM peak hours.

8.1.2 Existing Plus Project Traffic Conditions

Review of columns 2 and 3 of *Table 8-1* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour with the addition of project traffic. The remaining fourteen (14) study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours, with the addition of project traffic.

Although the intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour, the intersection is not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report. Since the study intersection currently operates at an adverse LOS under existing traffic conditions, the Project's impact is not considered to be a significant impact.

Appendix C presents the existing plus project weekday ICU/HCM LOS calculations for the key study intersections.

TABLE 8-1
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions		(3) Significant Impact		(4) Existing Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
1. Orange Avenue at 32 nd Street	AM	0.719	C	0.733	C	0.014	No	--	--
	PM	0.856	D	0.879	D	0.023	No	--	--
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	11.2 s/v	B	0.2 s/v	No	--	--
	PM	14.3 s/v	B	14.7 s/v	B	0.4 s/v	No	--	--
3. Orange Avenue at I-405 SB Ramps	AM	44.0 s/v	E	47.8 s/v	E	--	No ¹⁴	--	--
	PM	90.6 s/v	F	106.4 s/v	F	--	No	--	--
4. Atlantic Avenue at Spring Street	AM	0.732	C	0.733	C	0.001	No	--	--
	PM	0.828	D	0.828	D	0.000	No	--	--
5. Olive Avenue at Spring Street	AM	0.454	A	0.455	A	0.001	No	--	--
	PM	0.519	A	0.520	A	0.001	No	--	--
6. California Avenue at Spring Street	AM	0.590	A	0.590	A	0.000	No	--	--
	PM	0.714	C	0.715	C	0.001	No	--	--
7. Orange Avenue at Spring Street	AM	0.826	D	0.863	D	0.037	No	--	--
	PM	0.833	D	0.855	D	0.022	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹⁴ An unsignalized intersection impact is considered to be significant if the project causes an intersection at LOS D or better to degrade to LOS E or F, and the traffic signal warrant analysis determines that a signal is justified.

TABLE 8-1 (CONTINUED)
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions		(3) Significant Impact		(4) Existing Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
8. Walnut Avenue at Spring Street	AM	0.584	A	0.589	A	0.005	No	--	--
	PM	0.717	C	0.722	C	0.005	No	--	--
9. Cherry Avenue at Spring Street	AM	0.690	B	0.693	B	0.003	No	--	--
	PM	0.738	C	0.741	C	0.003	No	--	--
10. I-405 SB Off-Ramp at Spring Street	AM	0.732	C	0.737	C	0.005	No	--	--
	PM	0.719	C	0.723	C	0.004	No	--	--
11. Orange Avenue at 29 th Street	AM	13.9 s/v	B	14.3 s/v	B	--	No	--	--
	PM	14.1 s/v	B	14.3 s/v	B	--	No	--	--
12. California Avenue at Willow Street	AM	0.613	B	0.613	B	0.000	No	--	--
	PM	0.593	A	0.594	A	0.001	No	--	--
13. Orange Avenue at Willow Street	AM	0.736	C	0.746	C	0.010	No	--	--
	PM	0.845	D	0.853	D	0.008	No	--	--
14. Walnut Avenue at Willow Street	AM	0.510	A	0.512	A	0.002	No	--	--
	PM	0.617	B	0.619	B	0.002	No	--	--
15. Cherry Avenue at Willow Street	AM	0.687	B	0.689	B	0.002	No	--	--
	PM	0.818	D	0.819	D	0.001	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

8.2 Year 2021 Traffic Conditions

Table 8-2 summarizes the peak hour Level of Service results at the fifteen (15) key study intersections for the Year 2021 horizon year. The first column (1) of ICU/HCM/LOS values in **Table 8-2** presents a summary of existing AM and PM peak hour traffic conditions (which were also presented in **Tables 3-3** and **8-1**). The second column (2) lists future Year 2021 cumulative traffic conditions (existing plus ambient growth traffic plus cumulative projects traffic), without any traffic generated by the proposed Project. The third column (3) presents future forecast traffic conditions with the addition of traffic generated by the proposed Project. The fourth column (4) shows the increase in ICU/HCM value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the LOS standards and significant impact criteria defined in this report. The fifth column (5) indicates the anticipated level of service with improvements, if any.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project’s potential traffic impacts with and without implementation of Long Beach’s planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from **Table 8-2** and instead summarized in a comparison table discussed later in this report.

8.2.1 Year 2021 Cumulative Traffic Conditions

Review of Column 2 of **Table 8-2** indicates that the addition of ambient traffic growth and cumulative project traffic will cumulatively impact two (2) of the key study intersections, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the AM and PM peak hours. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	0.905	E
4. Atlantic Avenue at Spring Street	--	--	0.906	E

8.2.2 Year 2021 Cumulative Plus Project Traffic Conditions

Review of column 3 of **Table 8-2** indicates that two (2) of the key study intersections are forecast to operate adversely with the addition of project traffic, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours with the addition of project traffic. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	0.929	E
4. Atlantic Avenue at Spring Street	--	--	0.906	E

Review of column 4 indicates that one (1) of the two intersections operating adversely are considered significantly impacted, which is Orange Avenue/32nd Street. Review of Column 5 indicates that the implementation of improvements at the intersection will help offset the project's impact.

Additionally, although the intersection of Atlantic Avenue/Spring Street is forecast to operate adversely, the project increment adds less than 0.020 to the ICU value and hence the Project's impact is considered insignificant based on the City's LOS standards and significance criteria.

Appendix C presents the Year 2021 ICU/HCM LOS calculations for the key study intersections.

8.2.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. **Table 8-3** summarizes the peak hour Level of Service results with and without the planned bikeway improvements at the three (3) key study intersections for the Year 2021 horizon year. *Table 8-3* is set-up similarly to *Table 8-2*.

Review of column (3) of *Table 8-3* indicates that with the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Review of column (3) of *Table 8-3* indicates that without the Orange Avenue bikeway improvements, two (2) of the three study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

**TABLE 8-2
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY**

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2021 Cumulative Traffic Conditions		(3) Year 2021 Cumulative Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
1. Orange Avenue at 32 nd Street	AM	0.719	C	0.763	C	0.776	C	0.013	No	0.681	B
	PM	0.856	D	0.905	E	0.929	E	0.024	Yes	0.726	C
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	11.3 s/v	B	11.4 s/v	B	0.100	No	--	--
	PM	14.3 s/v	B	15.0 s/v	B	15.5 s/v	C	0.500	No	--	--
3. Orange Avenue at I-405 SB Ramps ¹⁵	AM	44.0 s/v	E	--	--	--	--	--	--	--	--
	PM	90.6 s/v	F	--	--	--	--	--	--	--	--
4. Atlantic Avenue at Spring Street	AM	0.732	C	0.800	C	0.800	C	0.000	No	--	--
	PM	0.828	D	0.906	E	0.906	E	0.000	No	--	--
5. Olive Avenue at Spring Street	AM	0.454	A	0.472	A	0.472	A	0.000	No	--	--
	PM	0.519	A	0.537	A	0.538	A	0.001	No	--	--
6. California Avenue at Spring Street	AM	0.590	A	0.611	B	0.611	B	0.000	No	--	--
	PM	0.714	C	0.741	C	0.741	C	0.000	No	--	--
7. Orange Avenue at Spring Street ¹⁵	AM	0.826	D	--	--	--	--	--	--	--	--
	PM	0.833	D	--	--	--	--	--	--	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹⁵ The City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5. See *Table 8-3*, which identifies the Project's potential impact at this study intersection with and without this planned bikeway improvement assumed in the cumulative background traffic conditions.

TABLE 8-2 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2021 Cumulative Traffic Conditions		(3) Year 2021 Cumulative Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
8. Walnut Avenue at Spring Street	AM	0.584	A	0.611	B	0.616	B	0.005	No	--	--
	PM	0.717	C	0.750	C	0.755	C	0.005	No	--	--
9. Cherry Avenue at Spring Street	AM	0.690	B	0.720	C	0.723	C	0.003	No	--	--
	PM	0.738	C	0.777	C	0.780	C	0.003	No	--	--
10. I-405 SB Off-Ramp at Spring Street	AM	0.732	C	0.758	C	0.763	C	0.005	No	--	--
	PM	0.719	C	0.747	C	0.751	C	0.004	No	--	--
11. Orange Avenue at 29 th Street	AM	13.9 s/v	B	14.8 s/v	B	15.2 s/v	C	--	No	--	--
	PM	14.1 s/v	B	15.3 s/v	C	15.6 s/v	C	--	No	--	--
12. California Avenue at Willow Street	AM	0.613	B	0.638	B	0.638	B	0.000	No	--	--
	PM	0.593	A	0.620	B	0.620	B	0.000	No	--	--
13. Orange Avenue at Willow Street ¹⁶	AM	0.736	C	--	--	--	--	--	--	--	--
	PM	0.845	D	--	--	--	--	--	--	--	--
14. Walnut Avenue at Willow Street	AM	0.510	A	0.533	A	0.535	A	0.002	No	--	--
	PM	0.617	B	0.654	B	0.655	B	0.001	No	--	--
15. Cherry Avenue at Willow Street	AM	0.687	B	0.723	C	0.725	C	0.002	No	--	--
	PM	0.818	D	0.874	D	0.876	D	0.002	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹⁶ The City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5. See *Table 8-3*, which identifies the Project's potential impact at this study intersection with and without this planned bikeway improvement assumed in the cumulative background traffic conditions.

TABLE 8-3
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹⁷

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2021 Cumulative Traffic Conditions		(3) Year 2021 Cumulative Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements		
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS	
3. Orange Avenue at I-405 SB Ramps	<i>With Orange Avenue</i>	AM	44.0 s/v	E	111.4 s/v	F	122.5 s/v	F	--	No ¹⁸	--	--
	<i>Bikeway Improvements</i>											
	<i>Without Orange Avenue</i>	AM	44.0 s/v	E	61.8 s/v	F	67.4 s/v	F	--	No	--	--
	<i>Bikeway Improvement</i>	PM	90.6 s/v	F	142.8 s/v	F	164.4 s/v	F	--	No	--	--
7. Orange Avenue at Spring Street	<i>With Orange Avenue</i>	AM	0.826	D	0.974	E	1.011	F	0.037	Yes	0.926	E
	<i>Bikeway Improvements</i>	PM	0.833	D	0.996	E	1.030	F	0.034	Yes	0.989	E
	<i>Without Orange Avenue</i>	AM	0.826	D	0.888	D	0.926	E	0.038	Yes	0.745	C
	<i>Bikeway Improvement</i>	PM	0.833	D	0.890	D	0.912	E	0.022	Yes	0.797	C
13. Orange Avenue at Willow Street	<i>With Orange Avenue</i>	AM	0.736	C	0.855	D	0.866	D	0.011	No	--	--
	<i>Bikeway Improvements</i>	PM	0.845	D	0.950	E	0.961	E	0.011	No	--	--
	<i>Without Orange Avenue</i>	AM	0.736	C	0.804	D	0.813	D	0.009	No	--	--
	<i>Bikeway Improvement</i>	PM	0.845	D	0.921	E	0.929	E	0.008	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions; s/v = seconds per vehicle (delay)

¹⁷ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹⁸ An unsignalized intersection impact is considered to be significant if the project causes an intersection at LOS D or better to degrade to LOS E or F, and the traffic signal warrant analysis determines that a signal is justified. →

8.3 Year 2038 Traffic Conditions

Table 8-3 summarizes the peak hour Level of Service results at the fifteen (15) key study intersections for the Year 2038 buildout year. The first column (1) of ICU/HCM/LOS values in *Table 8-4* presents a summary of existing AM and PM peak hour traffic conditions (which were also presented in *Tables 3-3, 8-1, and 8-2*). The second column (2) lists future Year 2038 buildout traffic conditions (existing plus ambient growth traffic plus cumulative projects traffic), without any traffic generated by the proposed Project. The third column (3) presents future forecast traffic conditions with the addition of traffic generated by the proposed Project. The fourth column (4) shows the increase in ICU/HCM value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the LOS standards and significant impact criteria defined in this report. The fifth column (5) indicates the anticipated level of service with improvements, if any.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project’s potential traffic impacts with and without implementation of Long Beach’s planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from *Table 8-2* and instead summarized in a comparison table discussed later in this report.

8.3.1 Year 2038 Buildout Traffic Conditions

Review of Column 2 of *Table 8-4* indicates that the addition of ambient traffic growth and cumulative project traffic will cumulatively impact three (3) of the key study intersections, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the AM and PM peak hours. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	1.034	F
4. Atlantic Avenue at Spring Street	0.908	E	1.030	F
15. Cherry Avenue at Willow Street	--	--	0.996	E

8.3.2 Year 2038 Buildout Plus Project Traffic Conditions

Review of column 3 of *Table 8-4* indicates that three (3) of the key study intersections are forecast to operate adversely with the addition of project traffic, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours with the addition of project traffic. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
1. Orange Avenue at 32 nd Street	--	--	1.058	F
4. Atlantic Avenue at Spring Street	0.908	E	1.030	F
15. Cherry Avenue at Willow Street	--	--	0.998	E

Review of column 4 indicates that one (1) of the three intersections operating adversely are considered significantly impacted, which is Orange Avenue/32nd Street. Review of Column 5 indicates that the implementation of improvements at the intersection will help offset the project's impact.

Additionally, although the intersections of Atlantic Avenue/Spring Street and Cherry Avenue/Willow Street are forecast to operate adversely, the project increment adds less than 0.020 to the ICU value and hence the Project's impact is considered insignificant based on the City's LOS standards and significance criteria.

Appendix C presents the Year 2038 ICU/HCM LOS calculations for the key study intersections.

8.3.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 8-5* summarizes the peak hour Level of Service results with and without the planned bikeway improvements at the three (3) key study intersections for the Year 2038 horizon year. *Table 8-5* is set-up similarly to *Table 8-4*.

Review of column (3) of *Table 8-5* indicates that with the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak

hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Review of column (3) of *Table 8-5* indicates that without the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

**TABLE 8-4
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY**

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2038 Buildout Traffic Conditions		(3) Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
1. Orange Avenue at 32 nd Street	AM	0.719	C	0.868	D	0.881	D	0.013	No	0.771	C
	PM	0.856	D	1.034	F	1.058	F	0.024	Yes	0.826	D
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	12.1 s/v	B	12.3 s/v	B	0.2 s/v	No	--	--
	PM	14.3 s/v	B	18.6 s/v	C	19.5 s/v	C	0.9 s/v	No	--	--
3. Orange Avenue at I-405 SB Ramps ¹⁹	AM	44.0 s/v	E	--	--	--	--	--	--	--	--
	PM	90.6 s/v	F	--	--	--	--	--	--	--	--
4. Atlantic Avenue at Spring Street	AM	0.732	C	0.908	E	0.908	E	0.000	No	--	--
	PM	0.828	D	1.030	F	1.030	F	0.000	No	--	--
5. Olive Avenue at Spring Street	AM	0.454	A	0.532	A	0.533	A	0.001	No	--	--
	PM	0.519	A	0.608	B	0.609	B	0.001	No	--	--
6. California Avenue at Spring Street	AM	0.590	A	0.694	B	0.694	B	0.000	No	--	--
	PM	0.714	C	0.845	D	0.845	D	0.000	No	--	--
7. Orange Avenue at Spring Street ¹⁹	AM	0.826	D	--	--	--	--	--	--	--	--
	PM	0.833	D	--	--	--	--	--	--	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹⁹ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

TABLE 8-4 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2038 Buildout Traffic Conditions		(3) Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
8. Walnut Avenue at Spring Street	AM	0.584	A	0.693	B	0.698	B	0.005	No	--	--
	PM	0.717	C	0.856	D	0.860	D	0.004	No	--	--
9. Cherry Avenue at Spring Street	AM	0.690	B	0.820	D	0.824	D	0.004	No	--	--
	PM	0.738	C	0.885	D	0.888	D	0.003	No	--	--
10. I-405 SB Off-Ramp at Spring Street	AM	0.732	C	0.866	D	0.871	D	0.005	No	--	--
	PM	0.719	C	0.852	D	0.857	D	0.005	No	--	--
11. Orange Avenue at 29 th Street	AM	13.9 s/v	B	16.8 s/v	C	17.3 s/v	C	--	No	--	--
	PM	14.1 s/v	B	17.7 s/v	C	18.0 s/v	C	--	No	--	--
12. California Avenue at Willow Street	AM	0.613	B	0.725	C	0.725	C	0.000	No	--	--
	PM	0.593	A	0.704	C	0.704	C	0.000	No	--	--
13. Orange Avenue at Willow Street ²⁰	AM	0.736	C	--	--	--	--	--	--	--	--
	PM	0.845	D	--	--	--	--	--	--	--	--
14. Walnut Avenue at Willow Street	AM	0.510	A	0.602	B	0.604	B	0.002	No	--	--
	PM	0.617	B	0.741	C	0.743	C	0.002	No	--	--
15. Cherry Avenue at Willow Street	AM	0.687	B	0.823	D	0.825	D	0.002	No	--	--
	PM	0.818	D	0.996	E	0.998	E	0.002	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

²⁰ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

**TABLE 8-5
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS²¹**

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2038 Buildout Traffic Conditions		(3) Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Year 2038 Buildout Plus Project Traffic Conditions with Improvements		
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS	
3. Orange Avenue at I-405 SB Ramps	<i>With Orange Avenue</i>	AM	44.0 s/v	E	294.8 s/v	F	322.3 s/v	F	--	No ²²	--	--
	<i>Bikeway Improvements</i>											
	<i>Without Orange Avenue</i>	AM	44.0 s/v	E	170.0 s/v	F	181.1 s/v	F	--	No	--	--
	<i>Bikeway Improvement</i>	PM	90.6 s/v	F	367.8 s/v	F	409.2 s/v	F	--	No	--	--
7. Orange Avenue at Spring Street	<i>With Orange Avenue</i>	AM	0.826	D	1.112	F	1.149	F	0.037	Yes	1.049	F
	<i>Bikeway Improvements</i>	PM	0.833	D	1.138	F	1.170	F	0.032	Yes	1.124	F
	<i>Without Orange Avenue</i>	AM	0.826	D	1.012	F	1.049	F	0.037	Yes	0.845	D ²³
	<i>Bikeway Improvement</i>	PM	0.833	D	1.014	F	1.036	F	0.022	Yes	0.903	E
13. Orange Avenue at Willow Street	<i>With Orange Avenue</i>	AM	0.736	C	0.971	E	0.982	E	0.011	No	--	--
	<i>Bikeway Improvements</i>	PM	0.845	D	1.083	F	1.095	F	0.012	No	--	--
	<i>Without Orange Avenue</i>	AM	0.736	C	0.911	E	0.921	E	0.010	No	--	--
	<i>Bikeway Improvement</i>	PM	0.845	D	1.048	F	1.056	F	0.008	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions; s/v = seconds per vehicle (delay)

²¹ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2038 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

²² An unsignalized intersection impact is considered to be significant if the project causes an intersection at LOS D or better to degrade to LOS E or F, and the traffic signal warrant analysis determines that a signal is justified.

²³ If acceptable level of service is desired at this location, additional improvements will need to be implemented at the intersection. These improvements include the construction of dual southbound left-turn lanes, which would result in the following level of service: AM peak hour – 0.845, LOS D, PM peak hour – 0.865, LOS D

9.0 STATE OF CALIFORNIA (CALTRANS) ANALYSIS

In conformance with the current Caltrans *Guide for the Preparation of Traffic Impact Studies*, dated December 2002, existing and projected peak hour operating conditions at the three (3) state-controlled study intersections within the study area have been evaluated using the *Highway Capacity Manual* operations method of analysis. These state-controlled locations include the following study intersections:

2. I-405 NB Ramps at 32nd Street (City of Signal Hill/Caltrans)
3. Orange Avenue at I-405 SB Ramps (City of Long Beach/Caltrans)
10. I-405 SB Off-Ramp at Spring Street (City of Long Beach/City of Signal Hill/Caltrans)

Caltrans “endeavors to maintain a target LOS at the transition between LOS “C” and LOS “D” on State highway facilities”; it does not require that LOS “D” (shall) be maintained. However, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. For this analysis, LOS D is the target level of service standard and will be utilized to assess the project impacts at the state-controlled study intersections.

The Caltrans *Guide for the Preparation of Traffic Impact Studies*, dated December 2002 states that if an existing State-owned facility operates at less than the target LOS (i.e. LOS D); the existing service level should be maintained. Based on Caltrans Criteria, a Project’s impact is considered significant if the Project causes the LOS to change from an acceptable LOS (i.e., LOS D or better) to a deficient LOS (i.e. LOS E or F); Per Caltrans District 7 staff, if an existing Caltrans facility is operating at less than appropriate target LOS, the existing MOE should be maintained. For intersections, any increase in delay is considered an impact if the existing LOS is E or F.

9.1 Highway Capacity Manual (HCM) Method of Analysis (Signalized Intersections)

Based on the HCM 6th Edition operations method of analysis, level of service for signalized intersections is defined in terms of control delay, which is a measure of driver discomfort, frustration, fuel consumption and lost travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, geometries, traffic and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during ideal conditions: in the absence of traffic control, in the absence of geometric delay, in the absence of any incidents and when there are no other vehicles on the road.

In the HCM, only the portion of total delay attributed to the control facility is quantified. This delay is called *control delay*. Control delay includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay. Specifically, LOS criteria for traffic signals are stated in terms of the average control delay per vehicle. The six qualitative categories of Level of Service that have been defined along with the corresponding HCM control delay value range for signalized intersections are shown in **Table 9-1**.

TABLE 9-1
LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS (HCM)²⁴

Level of Service (LOS)	Control Delay Per Vehicle (seconds/vehicle)	Level of Service Description
A	≤ 10.0	This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
B	> 10.0 and ≤ 20.0	This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.
C	> 20.0 and ≤ 35.0	Average traffic delays. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
D	> 35.0 and ≤ 55.0	Long traffic delays. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	> 55.0 and ≤ 80.0	Very long traffic delays. This level is considered by many agencies (i.e. SANBAG) to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.
F	≥ 80.0	Severe congestion. This level, considered to be unacceptable to most drivers, often occurs with over saturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors to such delay levels.

²⁴ Source: *Highway Capacity Manual* (Signalized Intersections).

9.2 Existing Plus Project Traffic Conditions

Table 9-2 summarizes the peak hour Level of Service results at the three (3) state-controlled study intersections for existing plus project traffic conditions. The first column (1) of HCM/LOS values in *Table 9-2* presents a summary of existing AM and PM peak hour traffic. The second column (2) lists existing plus project traffic conditions with current intersection geometry/lane configurations. The third column (3) shows the increase in delay value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the significant impact criteria defined in this report. The fourth column (4) indicates the anticipated level of service with improvements, if any.

9.2.1 Existing Traffic Conditions

Review of Column 1 of *Table 9-2* indicates that the intersection of Orange Avenue/I-405 SB Ramps currently operates at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour. The remaining two (2) state-controlled study intersections currently operate at LOS C or better during the weekday AM and PM peak hours.

9.2.2 Existing Plus Project Traffic Conditions

Review of columns 2 and 3 of *Table 9-2* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS E in the AM peak hour and LOS F in the PM peak hour with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 3 and 4 of *Table 9-2* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 4 indicates that implementation of improvements at the intersection will help offset the Project's impact.

Appendix D presents the existing plus project HCM/LOS calculations for the state-controlled study intersections.

TABLE 9-2
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY - CALTRANS

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions		(3) Significant Impact	(4) Existing Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	Yes/No	HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	11.2 s/v	B	No	--	--
	PM	14.3 s/v	B	14.7 s/v	B	No	--	--
3. Orange Avenue at I-405 SB Ramps	AM	44.0 s/v	E	47.8 s/v	E	Yes	19.2 s/v	B
	PM	90.6 s/v	F	106.4 s/v	F	Yes	14.0 s/v	B
10. I-405 SB Off-Ramp at Spring Street	AM	21.9 s/v	C	21.8 s/v	C	No	--	--
	PM	24.7 s/v	C	24.6 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

9.3 Year 2021 Traffic Conditions

Table 9-3 summarizes the peak hour Level of Service results at the at the three (3) state-controlled study intersections for the Year 2021 horizon year. The first column (1) of HCM/LOS values in *Table 9-3* presents a summary of existing AM and PM peak hour traffic conditions. The second column (2) lists future Year 2021 cumulative traffic conditions (existing plus ambient growth traffic plus cumulative projects traffic), without any traffic generated by the proposed Project. The third column (3) presents future forecast traffic conditions with the addition of traffic generated by the proposed Project. The fourth column (4) shows the increase in delay value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the LOS standards and significant impact criteria defined in this report. The fifth column (5) indicates the anticipated level of service with improvements, if any.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-3* includes the results for both alternatives.

9.3.1 Year 2021 Cumulative Traffic Conditions

Review of Column 2 of *Table 9-3* indicates that the intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS F in the AM and PM peak hours for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. The remaining two (2) state-controlled study intersections are forecast to operate at LOS C or better during the weekday AM and PM peak hours.

9.3.2 Year 2021 Cumulative Plus Project Traffic Conditions

Review of column 3 of *Table 9-3* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 4 and 5 of *Table 9-3* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 5 indicates that implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Appendix D presents the Year 2021 HCM/LOS calculations for the state-controlled study intersections.

TABLE 9-3
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY - CALTRANS

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2021 Cumulative Traffic Conditions		(3) Year 2021 Cumulative Plus Project Traffic Conditions		(4) Significant Impact Yes/No	(5) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	HCM	LOS		HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	11.3 s/v	B	11.4 s/v	B	No	--	--
	PM	14.3 s/v	B	15.0 s/v	B	15.5 s/v	C	No	--	--
3. Orange Avenue at I-405 SB Ramps ²⁵ <i>With Orange Avenue Bikeway Improvements</i>	AM	44.0 s/v	E	111.4 s/v	F	122.5 s/v	F	Yes	30.6 s/v	C
	PM	90.6 s/v	F	301.5 s/v	F	343.1 s/v	F	Yes	18.4 s/v	B
	AM	44.0 s/v	E	61.8 s/v	F	67.4 s/v	F	Yes	20.7 s/v	C
	PM	90.6 s/v	F	142.8 s/v	F	164.4 s/v	F	Yes	13.8 s/v	B
10. I-405 SB Off-Ramp at Spring Street	AM	21.9 s/v	C	21.6 s/v	C	21.5 s/v	C	No	--	--
	PM	24.7 s/v	C	24.3 s/v	C	24.1 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

²⁵ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

9.4 Year 2038 Traffic Conditions

Table 9-4 summarizes the peak hour Level of Service results at the at the three (3) state-controlled study intersections for the Year 2038 buildout year. The first column (1) of HCM/LOS values in *Table 9-4* presents a summary of existing AM and PM peak hour traffic conditions. The second column (2) lists future Year 2038 buildout traffic conditions (existing plus ambient growth traffic plus cumulative projects traffic), without any traffic generated by the proposed Project. The third column (3) presents future forecast traffic conditions with the addition of traffic generated by the proposed Project. The fourth column (4) shows the increase in delay value due to the added peak hour project trips and indicates whether the traffic associated with the Project will have a significant impact based on the LOS standards and significant impact criteria defined in this report. The fifth column (5) indicates the anticipated level of service with improvements, if any.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-4* includes the results for both alternatives.

9.4.1 Year 2038 Buildout Traffic Conditions

Review of Column 2 of *Table 9-4* indicates that one (1) of the three state-controlled study intersections are forecast to operate adversely. The intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS F in the AM and PM peak hours for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. The remaining two (2) state-controlled study intersections are forecast to operate at LOS C or better during the weekday AM and PM peak hours.

9.4.2 Year 2038 Buildout Plus Project Traffic Conditions

Review of columns 3 and 4 of *Table 9-4* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 4 and 5 of *Table 9-4* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 5 indicates that implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Appendix D presents the Year 2038 HCM/LOS calculations for the state-controlled study intersections.

**TABLE 9-4
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY - CALTRANS**

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2038 Buildout Traffic Conditions		(3) Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact Yes/No	(5) Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	HCM	LOS		HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	12.1 s/v	B	12.3 s/v	B	No	--	--
	PM	14.3 s/v	B	18.6 s/v	C	19.5 s/v	C	No	--	--
3. Orange Avenue at I-405 SB Ramps ²⁶ <i>With Orange Avenue Bikeway Improvements</i>	AM	44.0 s/v	E	294.8 s/v	F	322.3 s/v	F	Yes	49.4 s/v	D
	PM	90.6 s/v	F	724.1 s/v	F	808.6 s/v	F	Yes	25.6 s/v	C
	AM	44.0 s/v	E	170.0 s/v	F	181.1 s/v	F	Yes	22.2 s/v	C
	PM	90.6 s/v	F	367.8 s/v	F	409.2 s/v	F	Yes	14.9 s/v	B
10. I-405 SB Off-Ramp at Spring Street	AM	21.9 s/v	C	21.1 s/v	C	21.0 s/v	C	No	--	--
	PM	24.7 s/v	C	23.6 s/v	C	23.6 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

²⁶ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

9.5 Queueing Analysis

A “turn pocket” queueing evaluation was prepared for the three (3) state-controlled study intersections to determine the adequacy of the existing stacking/storage lengths for all exclusive left-turn lanes and right-turn lanes. This evaluation utilized the HCM methodology using Synchro 10.0 software. The 95th percentile vehicle queue value corresponds to a condition that is generally taken as the maximum queue for the indicated movement and is presented with each turn movement at the key intersections.

9.5.1 Existing Plus Project Traffic Conditions

Table 9-5 presents the queueing analyses results for the three (3) state-controlled study intersections for Existing Plus Project traffic conditions. Column 1 presents the queueing results for Existing traffic conditions. Column 2 presents the results for Existing Plus Project traffic conditions.

Review of Column 1 of *Table 9-5* indicates that the existing queues at the study intersections are adequate. Review of Column 2 of *Table 9-5* indicates that the queues will continue to remain adequate at the study intersections with the addition of the proposed Project. Column 3 of *Table 9-5* presents the anticipated queues with the implementation of recommended improvements, which indicates that the queues will continue to remain adequate.

9.5.2 Year 2021 Cumulative Plus Project Traffic Conditions

Table 9-6 presents the queueing analyses results for the three (3) state-controlled study intersections for Year 2021 Cumulative Plus Project traffic conditions. Column 1 presents the queueing results for Year 2021 Cumulative traffic conditions. Column 2 presents the results for Year 2021 Cumulative Plus Project traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project’s potential traffic impacts with and without implementation of Long Beach’s planned bikeway improvements along Orange Avenue. *Table 9-6* includes the results for both alternatives.

Review of Column 1 of *Table 9-6* indicates that the queues at the study intersections are forecast to be adequate. Review of Column 2 of *Table 9-6* indicates that the queues will continue to remain adequate at the study intersections with the addition of the proposed Project. In addition, both with and without implementation of Long Beach’s planned bikeway improvements along Orange Avenue are forecast to continue to have adequate queues. Year 2038 Buildout Plus Project Traffic Conditions. Column 3 of *Table 9-6* presents the anticipated queues with the implementation of recommended improvements, which indicates that the queues will continue to remain adequate.

9.5.3 Year 2038 Buildout Plus Project Traffic Conditions

Table 9-7 presents the queueing analyses results for the three (3) state-controlled study intersections for Year 2038 Buildout Plus Project traffic conditions. Column 1 presents the queueing results for Year 2038 Buildout traffic conditions. Column 2 presents the results for Year 2038 Buildout Plus Project traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-7* includes the results for both alternatives.

Review of Column 1 of *Table 9-7* indicates that the queues at the study intersections are forecast to be adequate. Review of Column 2 of *Table 9-7* indicates that the queues will continue to remain adequate at the study intersections with the addition of the proposed Project. In addition, both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue are forecast to continue to have adequate queues. Column 3 of *Table 9-7* presents the anticipated queues with the implementation of recommended improvements, which indicates that the queues will continue to remain adequate.

Appendix E presents the HCM queuing worksheets for the signalized study intersections.

**TABLE 9-5
CALTRANS EXISTING PEAK HOUR INTERSECTION QUEUING ANALYSIS²⁷**

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions				(3) Existing Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	25'	Yes	73'	Yes	25'	Yes	78'	Yes	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ²⁸ <i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	140'	Yes	118'	Yes
<i>Eastbound Left-Turn</i>	490'	123'	Yes	198'	Yes	135'	Yes	215'	Yes	145'	Yes	152'	Yes
<i>Eastbound Right-Turn</i>	490'	45'	Yes	25'	Yes	55'	Yes	28'	Yes	83'	Yes	62'	Yes
10. I-405 SB Off-Ramp at Spring Street <i>Southbound Left-Turn</i>	475'	346'	Yes	310'	Yes	346'	Yes	310'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	349'	Yes	311'	Yes	349'	Yes	311'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	164'	Yes	90'	Yes	165'	Yes	90'	Yes	--	--	--	--

²⁷ Queues are based on HCM 95th Percentile.

²⁸ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

**TABLE 9-6
CALTRANS YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS²⁹**

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions				(3) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	25'	Yes	83'	Yes	25'	Yes	88'	Yes	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ³⁰ <i>With Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	162'	Yes ³¹	140'	Yes
<i>Eastbound Left-Turn</i>	490'	218'	Yes	323'	Yes	230'	Yes	340'	Yes	114'	Yes	156'	Yes
<i>Eastbound Right-Turn</i>	490'	98'	Yes	50'	Yes	128'	Yes	58'	Yes	73'	Yes	63'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	155'	Yes ³¹	127'	Yes
<i>Eastbound Left-Turn</i>	490'	160'	Yes	248'	Yes	170'	Yes	268'	Yes	149'	Yes	157'	Yes
<i>Eastbound Right-Turn</i>	490'	55'	Yes	28'	Yes	68'	Yes	30'	Yes	88'	Yes	63'	Yes
10. I-405 SB Off-Ramp at Spring Street													
<i>Southbound Left-Turn</i>	475'	357'	Yes	320'	Yes	357'	Yes	320'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	362'	Yes	322'	Yes	362'	Yes	322'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	174'	Yes	99'	Yes	175'	Yes	100'	Yes	--	--	--	--

²⁹ Queues are based on HCM 95th Percentile.

³⁰ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

³¹ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

**TABLE 9-7
CALTRANS YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS³²**

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions				(3) Year 2038 Buildout Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	30'	Yes	130'	Yes	33'	Yes	138'	Yes	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ³³ <i>With Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	163'	Yes ³⁴	133'	Yes
<i>Eastbound Left-Turn</i>	490'	350'	Yes	445'	Yes	360'	Yes	458'	Yes	165'	Yes	174'	Yes
<i>Eastbound Right-Turn</i>	490'	168'	Yes	83'	Yes	223'	Yes	98'	Yes	90'	Yes	65'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	164'	Yes ³⁴	158'	Yes ³⁴
<i>Eastbound Left-Turn</i>	490'	285'	Yes	380'	Yes	298'	Yes	395'	Yes	165'	Yes	175'	Yes
<i>Eastbound Right-Turn</i>	490'	80'	Yes	38'	Yes	98'	Yes	43'	Yes	90'	Yes	65'	Yes
10. I-405 SB Off-Ramp at Spring Street													
<i>Southbound Left-Turn</i>	475'	431'	Yes	383'	Yes	431'	Yes	383'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	437'	Yes	384'	Yes	437'	Yes	384'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	219'	Yes ³⁵	135'	Yes	219'	Yes ³⁵	136'	Yes	--	--	--	--

³² Queues are based on HCM 95th Percentile.

³³ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

³⁴ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

³⁵ Although the anticipated queue exceeds the provided storage there is adequate storage within the on-ramp to accommodate the spillover queue.

9.6 Caltrans Synchro Assessment

When state highways have saturated flows, Caltrans recommends that existing and projected peak hour operating conditions at the study intersections within the study area be evaluated based on a micro-simulation model. As such, both level of service and queueing analyses have been completed for all three (3) state-controlled study intersections using SimTraffic software. Queues are based on SimTraffic 95th percentile methodology. It should be noted that although only the results for the three study intersection under Caltrans jurisdiction are reported in this section, the Synchro network was developed to include all key study intersections identified in this report (i.e. Orange Avenue from 32nd Street to Willow and Spring Street from Atlantic Avenue to I-405 Ramps).

9.6.1 Existing Plus Project Traffic Conditions Level of Service Analysis

Table 9-8 summarizes the peak hour Level of Service results at the three (3) state-controlled study intersections for existing plus project traffic conditions and is set up similar to *Table 9-2*.

Review of Column 1 of *Table 9-8* indicates that the intersection of Orange Avenue/I-405 SB Ramps currently operates at unacceptable LOS F in the PM peak hour. The remaining two (2) state-controlled study intersections currently operate at LOS C or better during the weekday AM and PM peak hours.

Review of columns 2 and 3 of *Table 9-8* indicates that the intersection of Orange Avenue/I-405 SB Ramps will operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 3 and 4 of *Table 9-8* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 4 indicates that implementation of improvements at the intersection will help offset the Project's impact. These results are consistent with the results summarized in Section 9.2 of this report.

Appendix F presents the existing plus project SimTraffic Worksheets for the state-controlled study intersections.

9.6.2 Year 2021 Traffic Conditions Level of Service Analysis

Table 9-9 summarizes the peak hour Level of Service results at the three (3) state-controlled study intersections for the Year 2021 horizon year and is set up similar to *Table 9-3*. Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-9* includes the results for both alternatives.

Review of Column 2 of *Table 9-9* indicates that the intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS F in the AM and PM peak hours for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. The remaining two (2) state-controlled study intersections are forecast to operate at LOS C or better during the weekday AM and PM peak hours.

Review of column 3 of *Table 9-9* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 4 and 5 of *Table 9-9* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 5 indicates that implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. These results are consistent with the results summarized in Section 9.3 of this report.

Appendix F presents the Year 2021 SimTraffic worksheets for the state-controlled study intersections.

9.6.3 Year 2038 Traffic Conditions Level of Service Analysis

Table 9-10 summarizes the peak hour Level of Service results at the three (3) state-controlled study intersections for the Year 2038 buildout year and is set up similar to *Table 9-4*. Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-10* includes the results for both alternatives.

Review of Column 2 of *Table 9-10* indicates that one (1) of the three state-controlled study intersections are forecast to operate adversely. The intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS F in the AM and PM peak hours for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. The remaining two (2) state-controlled study intersections are forecast to operate at LOS C or better during the weekday AM and PM peak hours.

Review of columns 3 and 4 of *Table 9-10* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining two (2) state-controlled study intersections are forecast to operate at acceptable LOS C or better during the weekday AM and PM peak hours, with the addition of project traffic.

Review of columns 4 and 5 of *Table 9-10* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the Caltrans impact criteria defined in this report. Review of column 5 indicates that implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. These results are consistent with the results summarized in Section 9.4 of this report.

Appendix F presents the Year 2038 SimTraffic worksheets for the state-controlled study intersections.

TABLE 9-8
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY – CALTRANS (SIMTRAFFIC)

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions		(3) Significant Impact	(4) Existing Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	Yes/No	HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	4.6 s/v	A	4.7 s/v	A	No	--	--
	PM	19.4 s/v	C	16.3 s/v	C	No	--	--
3. Orange Avenue at I-405 SB Ramps	AM	31.5 s/v	D	82.5 s/v	F	Yes	23.4 s/v	C
	PM	369.6 s/v	F	442.9 s/v	F	Yes	34.4 s/v	C
10. I-405 SB Off-Ramp at Spring Street	AM	24.3 s/v	C	24.1 s/v	C	No	--	--
	PM	26.3 s/v	C	26.1 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

TABLE 9-9
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY – CALTRANS (SIMTRAFFIC)

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2021 Cumulative Traffic Conditions		(3) Year 2021 Cumulative Plus Project Traffic Conditions		(4) Significant Impact Yes/No	(5) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	HCM	LOS		HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	4.6 s/v	A	4.7 s/v	A	4.8 s/v	A	No	--	--
	PM	19.4 s/v	C	6.9 s/v	A	7.7 s/v	A	No	--	--
3. Orange Avenue at I-405 SB Ramps ³⁶ <i>With Orange Avenue Bikeway Improvements</i>	AM	31.5 s/v	D	315.3 s/v	F	328.5 s/v	F	Yes	46.1 s/v	D
	PM	369.6 s/v	F	556.6 s/v	F	682.4 s/v	F	Yes	36.9 s/v	D
	AM	31.5 s/v	D	46.0 s/v	E	54.6 s/v	F	Yes	25.2 s/v	C
	PM	369.6 s/v	F	313.0 s/v	F	359.9 s/v	F	Yes	19.2 s/v	B
10. I-405 SB Off-Ramp at Spring Street	AM	24.3 s/v	C	24.8 s/v	C	24.2 s/v	C	No	--	--
	PM	26.3 s/v	C	26.3 s/v	C	26.1 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

³⁶ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

TABLE 9-10
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY – CALTRANS (SIMTRAFFIC)

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Year 2038 Buildout Traffic Conditions		(3) Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact Yes/No	(5) Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	HCM	LOS		HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	4.6 s/v	A	5.1 s/v	A	5.1 s/v	A	No	--	--
	PM	19.4 s/v	C	13.0 s/v	B	20.7 s/v	C	No	--	--
3. Orange Avenue at I-405 SB Ramps ³⁷ <i>With Orange Avenue Bikeway Improvements</i>	AM	31.5 s/v	D	493.2 s/v	F	619.0 s/v	F	Yes	48.9 s/v	D
	PM	369.6 s/v	F	745.9 s/v	F	832.1 s/v	F	Yes	40.4 s/v	D
	AM	31.5 s/v	D	206.0 s/v	F	324.3 s/v	F	Yes	39.4 s/v	D
	PM	369.6 s/v	F	591.5 s/v	F	690.6 s/v	F	Yes	30.6 s/v	C
10. I-405 SB Off-Ramp at Spring Street	AM	24.3 s/v	C	30.1 s/v	C	31.4s/v	C	No	--	--
	PM	26.3 s/v	C	28.0 s/v	C	27.2s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

³⁷ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

9.6.4 Existing Plus Project Traffic Conditions Queueing Analysis

Table 9-11 summarizes the queueing analyses results for the three (3) state-controlled study intersections for Existing Plus Project traffic conditions and is set up similar to *Table 9-5*.

Review of Column 1 of *Table 9-11* indicates that the existing queues at the study intersections are adequate with the exception of Orange Avenue at I-405 SB Ramps, in which the queues for the eastbound movements exceed the provides storage.

Review of Column 2 indicates that the eastbound queues are forecast to be inadequate at Orange Avenue/I-405 SB Ramps. The remaining two (2) study intersections are forecast to continue to be adequate with the addition of the proposed Project. Review of Column 3 shows that with the implementation of recommended improvements, the eastbound queues at Orange Avenue/I-405 SB Ramps will improve.

It should be noted that although the northbound left-turn queues at Orange Avenue/I-405 SB Ramps exceed the provided storage with the implementation of improvements, the spillover queue can be accommodated within the transition area.

Appendix F presents the existing plus project SimTraffic queueing worksheets for the state-controlled study intersections.

9.6.5 Year 2021 Traffic Conditions Queueing Analysis

Table 9-12 summarizes the queueing analyses results for the three (3) state-controlled study intersections for Year 2021 Cumulative Plus Project traffic conditions and is set up similar to *Table 9-6*. Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-12* includes the results for both alternatives.

Review of Column 1 of *Table 9-12* indicates that the queues at the study intersections are forecast to be adequate with the exception of Orange Avenue at I-405 SB Ramps, in which the queues for the eastbound movements exceed the provides storage for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Review of Column 2 of *Table 9-12* indicates that the queues will continue to remain inadequate at Orange Avenue/I-405 SB Ramps for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue, and adequate at the remaining two (2) study intersections with the addition of the proposed Project. Review of Column 3 shows that with the implementation of recommended improvements, the eastbound queues at Orange Avenue/I-405 SB Ramps will improve. It should be noted that as part of the improvements, it is recommended to restripe the northbound left-turn pocket to 225 feet in order to accommodate the anticipated queue.

Appendix F presents the Year 2021 SimTraffic queueing worksheet for the state-controlled study intersections.

9.6.6 Year 2038 Traffic Conditions Queueing Analysis

Table 9-13 summarizes the queueing analyses results for the three (3) state-controlled study intersections for Year 2038 Buildout Plus Project traffic conditions and is set up similar to *Table 9-7*. Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 9-13* includes the results for both alternatives.

Review of Column 1 of *Table 9-13* indicates that the queues at the study intersections are forecast to be adequate with the exception of Orange Avenue at I-405 SB Ramps, in which the queues for the eastbound movements exceed the provides storage for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Review of Column 2 of *Table 9-13* indicates that the queues will continue to remain inadequate at Orange Avenue/I-405 SB Ramps for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue, and adequate at the remaining two (2) study intersections with the addition of the proposed Project. It should be noted that although the queue for the southbound right-turn at I-405 SB Off-Ramp/Spring Street exceeds the provided storage, the spillover queue can be accommodated within the transition area.

Review of Column 3 shows that with the implementation of recommended improvements, the eastbound queues at Orange Avenue/I-405 SB Ramps will improve. It should be noted that as part of the improvements, it is recommended to restripe the northbound left-turn pocket to 225 feet in order to accommodate the anticipated queue.

Appendix F presents the Year 2038 SimTraffic queueing worksheet for the state-controlled study intersections.

TABLE 9-11

CALTRANS EXISTING PEAK HOUR INTERSECTION QUEUING ANALYSIS (SIMTRAFFIC)³⁸

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions				(3) Existing Plus Project Traffic Conditions with Improvements				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	60'	Yes	199'	Yes	68'	Yes	187'	Yes	--	--	--	--	
3. Orange Avenue at I-405 SB Ramps	<i>Northbound Left-Turn</i>	140'	107'	Yes	120'	Yes	105'	Yes	157'	Yes ³⁹	188'	Yes ³⁹	182'	Yes ³⁹
	<i>Eastbound Left-Turn</i>	490'	153'	Yes	726'	No	427'	Yes	808'	No	137'	Yes	302'	Yes
	<i>Eastbound Right-Turn</i>	490'	240'	Yes	811'	No	555'	No	857'	No	424'	Yes	508'	Yes ⁴⁰
10. I-405 SB Off-Ramp at Spring Street	<i>Southbound Left-Turn</i>	475'	331'	Yes	298'	Yes	313'	Yes	309'	Yes	--	--	--	--
	<i>Southbound Through/Left-turn</i>	475'	269'	Yes	237'	Yes	256'	Yes	258'	Yes	--	--	--	--
	<i>Southbound Right-Turn</i>	175'	114'	Yes	61'	Yes	108'	Yes	53'	Yes	--	--	--	--

³⁸ Queues are based on SimTraffic 95th percentile methodology.

³⁹ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

⁴⁰ Although the anticipated queue exceeds the provided storage, the off-ramp provides enough storage to accommodate the spillover queue.

TABLE 9-12

CALTRANS YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS (SIMTRAFFIC)⁴¹

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions				(3) Year 2021 Cumulative Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	63'	Yes	104'	Yes	70'	Yes	129'	Yes	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ⁴² <i>With Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	137'	Yes	108'	Yes	137'	Yes	117'	Yes	213'	No ⁴³	195'	No ⁴³
<i>Eastbound Left-Turn</i>	490'	889'	No	884'	No	917'	No	882'	No	315'	Yes	147'	Yes
<i>Eastbound Right-Turn</i>	490'	892'	No	872'	No	876'	No	888'	No	517'	Yes	194'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	102'	Yes	96'	Yes	107'	Yes	99'	Yes	204'	No ⁴³	184'	Yes ⁴⁴
<i>Eastbound Left-Turn</i>	490'	313'	Yes	798'	No	272'	Yes	826'	No	171'	Yes	168'	Yes
<i>Eastbound Right-Turn</i>	490'	177'	Yes	723'	No	356'	Yes	863'	No	411'	Yes	118'	Yes
10. I-405 SB Off-Ramp at Spring Street													
<i>Southbound Left-Turn</i>	475'	317'	Yes	304'	Yes	329'	Yes	307'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	277'	Yes	248'	Yes	270'	Yes	257'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	137'	Yes	53'	Yes	125'	Yes	71'	Yes	--	--	--	--

⁴¹ Queues are based on SimTraffic 95th percentile methodology.

⁴² The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

⁴³ It is recommended to modify the median and restripe the northbound left-turn pocket to 225 feet as part of the recommended improvements in order to accommodate the queues.

⁴⁴ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

TABLE 9-13

CALTRANS YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS (SIMTRAFFIC)⁴⁵

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions				(3) Year 2038 Buildout Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	280'	74'	Yes	193'	Yes	72'	Yes	228'	Yes	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ⁴⁶ <i>With Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	137'	Yes	109'	Yes	143'	Yes ⁴⁷	107'	Yes	224'	No ⁴⁸	197'	No ⁴⁸
<i>Eastbound Left-Turn</i>	490'	899'	No	893'	No	898'	No	877'	No	291'	Yes	168'	Yes
<i>Eastbound Right-Turn</i>	490'	835'	No	863'	No	827'	No	849'	No	471'	Yes	206'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	146'	Yes ⁴⁷	132'	Yes	150'	Yes ⁴⁷	137'	Yes	219'	No ⁴⁸	213'	No ⁴⁸
<i>Eastbound Left-Turn</i>	490'	801'	No	824'	No	856'	No	816'	No	210'	Yes	189'	Yes
<i>Eastbound Right-Turn</i>	490'	819'	No	865'	No	874'	No	880'	No	439'	Yes	193'	Yes
10. I-405 SB Off-Ramp at Spring Street													
<i>Southbound Left-Turn</i>	475'	331'	Yes	329'	Yes	334'	Yes	327'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	308'	Yes	283'	Yes	291'	Yes	281'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	175'	Yes	86'	Yes	194'	Yes ⁴⁷	100'	Yes	--	--	--	--

⁴⁵ Queues are based on SimTraffic 95th percentile methodology.

⁴⁶ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

⁴⁷ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

⁴⁸ It is recommended to restripe the northbound left-turn pocket to 225 feet as part of the recommended improvements in order to accommodate the queues.

10.0 INTERSECTION LEFT-TURN VEHICLE QUEUEING ANALYSIS

Per the request of the City of Signal Hill, a left-turn vehicle queueing analysis was conducted at each signalized study intersection in addition to the intersection level of service analyses. Excessive left-turn vehicle queueing which extends into and/or blocks adjacent through travel lanes may have detrimental effects on intersection operations and the roadway network as a whole in ways not otherwise accounted for by the ICU methodology. Therefore, left-turn vehicle queueing at the signalized study intersections was evaluated for existing conditions, existing with project conditions, and future years 2021 and 2038 conditions, without and with the proposed project, in order to identify the effects of project traffic on left-turn queueing at the signalized study intersections.

The left-turn vehicle queueing analysis was prepared utilizing the HCM methodology for signalized intersections using Synchro 10.0 software. The HCM methodology considers traffic volume data, lane configurations, and traffic signal phasing in order to calculate the 85th percentile queues for the respective traffic movements. The 85th percentile queue represents the maximum back of vehicle queue with 85th percentile traffic volumes (i.e., actual traffic volumes will exceed the 85th percentile volumes 15 percent of the time) and is commonly used for design purposes.

The left-turn vehicle queueing analysis was based on the forecast weekday AM and PM intersection turning movement volumes utilized in the level of service analyses. The existing left-turn lane configurations and storage lengths were determined based on a review of aerial maps of the subject intersections obtained from Google Earth and on field reviews conducted by LLG Engineers. An average vehicle length of 25 feet is assumed for purposes of this analysis. Traffic signal phasing and timing data for the signalized intersections were obtained from the City of Signal Hill.

10.1 Existing Plus Project Traffic Conditions

Table 10-1 presents the left-turn queueing analyses results for the twelve (12) signalized study intersections. Column 1 presents the queueing results for existing traffic conditions. Column 2 presents the results for existing plus project traffic conditions.

10.1.1 Existing Traffic Conditions

Review of Column 1 of *Table 10-1* indicates that eight (8) of the twelve signalized study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under existing traffic conditions. The remaining four (4) study intersections have queues that are adequately accommodated by the existing storage space. The intersections/approaches with storage deficiencies include the following:

- Intersection 1: Orange Avenue at 32nd Street
 - Westbound left-turn – PM peak hour
- Intersection 4: Atlantic Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 6: California Avenue at Spring Street
 - Southbound left-turn – AM peak hour & PM peak hour
- Intersection 7: Orange Avenue at Spring Street
 - Southbound left-turn – PM peak hour
- Intersection 8: Walnut Avenue at Spring Street
 - Northbound left-turn – PM peak hour
- Intersection 9: Cherry Avenue at Spring Street
 - Eastbound left-turn – PM peak hour
- Intersection 12: California Avenue at Willow Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 15: Cherry Avenue at Willow Street
 - Westbound left-turn – PM peak hour

10.1.2 Existing Plus Project Traffic Conditions

Review of Column 2 of *Table 10-1* indicates that same eight (8) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining four (4) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at seven (7) of the eight study intersections with storage deficiencies, and thus does not contribute to additional vehicle queuing beyond that previously reported under existing conditions. However, project traffic does contribute additional left-turn queuing to the intersection of Orange Avenue/32nd Street on approaches with pre-existing storage deficiencies.

Appendix E presents the existing plus project HCM queuing worksheets for the signalized study intersections.

**TABLE 10-1
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁴⁹**

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
1. Orange Avenue at 32 nd Street ⁵⁰									
<i>Northbound Left-Turn</i>	100'	25'	Yes	32'	Yes	25'	Yes	25'	Yes
<i>Southbound Left-Turn</i>	160'	67'	Yes	63'	Yes	75'	Yes	67'	Yes
<i>Eastbound Left/Through/Right-Turn</i>	1,240'	66'	Yes	29'	Yes	65'	Yes	29'	Yes
<i>Westbound Left-Turn</i>	240' ⁵¹	95'	Yes	271'	No	109'	Yes	278'	No
4. Atlantic Avenue at Spring Street									
<i>Northbound Left-Turn</i>	85'	45'	Yes	55'	Yes	45'	Yes	55'	Yes
<i>Southbound Left-Turn</i>	355'	90'	Yes	83'	Yes	90'	Yes	83'	Yes
<i>Eastbound Left-Turn</i>	100'	110'	No	133'	No	110'	No	133'	No
<i>Westbound Left-Turn</i>	220'	145'	Yes	98'	Yes	145'	Yes	98'	Yes
5. Olive Avenue at Spring Street ⁵⁰									
<i>Southbound Left-Turn</i>	125'	45'	Yes	79'	Yes	45'	Yes	79'	Yes
<i>Eastbound Left-Turn</i>	180'	74'	Yes	84'	Yes	73'	Yes	84'	Yes

⁴⁹ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁵⁰ HCM 6th Edition methodology does not support intersections with shared lanes. Therefore, queues for this intersection are based on HCM 2000 95th Percentile methodology.

⁵¹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

TABLE 10-1 (CONTINUED)
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁵²

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
6. California Avenue at Spring Street	<i>Northbound Left-Turn</i>	100'	90'	Yes	70'	Yes	90'	Yes	70'	Yes
	<i>Southbound Left-Turn</i>	110'	118'	No	150'	No	118'	No	150'	No
	<i>Eastbound Left-Turn</i>	160' ⁵⁵	35'	Yes	25'	Yes	35'	Yes	25'	Yes
	<i>Westbound Left-Turn</i>	160' ⁵⁵	85'	Yes	75'	Yes	85'	Yes	75'	Yes
7. Orange Avenue at Spring Street	<i>Northbound Left-Turn</i>	305' ⁵³ /210' ⁵⁴	70'	Yes	88'	Yes	80'	Yes	93'	Yes
	<i>Southbound Left-Turn</i>	135' ⁵⁵	108'	Yes	145'	No	110'	Yes	148'	No
	<i>Eastbound Left-Turn</i>	366' ⁵³	115'	Yes	125'	Yes	123'	Yes	148'	Yes
	<i>Westbound Left-Turn</i>	200'	78'	Yes	73'	Yes	95'	Yes	88'	Yes
8. Walnut Avenue at Spring Street	<i>Northbound Left-Turn</i>	100'	95'	Yes	115'	No	95'	Yes	115'	No
	<i>Southbound Left-Turn</i>	100'	43'	Yes	45'	Yes	43'	Yes	45'	Yes
	<i>Eastbound Left-Turn</i>	185' ⁵³	25'	Yes	73'	Yes	25'	Yes	73'	Yes
	<i>Westbound Left-Turn</i>	100' ⁵³	53'	Yes	58'	Yes	53'	Yes	58'	Yes

⁵² Queues are based on HCM 85th Percentile, unless otherwise noted.

⁵³ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

⁵⁴ The installation of Project Driveway 2 will eliminate the existing TWLT along Orange Avenue and therefore the northbound left-turn no longer includes the extra storage under Project traffic conditions.

⁵⁵ Existing storage capacity includes the striped turn pocket as well as the transition area.

TABLE 10-1 (CONTINUED)
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁵⁶

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
9. Cherry Avenue at Spring Street									
<i>Northbound Left-Turn</i>	241 ⁵⁷	75'	Yes	93'	Yes	75'	Yes	93'	Yes
<i>Southbound Left-Turn</i>	500 ⁵⁸	256'	Yes	330'	Yes	256'	Yes	330'	Yes
<i>Eastbound Left-Turn</i>	147'	140'	Yes	420'	No	140'	Yes	420'	No
<i>Westbound Left-Turn</i>	292 ⁵⁷	108'	Yes	150'	Yes	108'	Yes	150'	Yes
10. I-405 SB Off-Ramp at Spring Street									
<i>Southbound Left-Turn</i>	475'	293'	Yes	265'	Yes	293'	Yes	265'	Yes
12. California Avenue at Willow Street									
<i>Northbound Left/Through/Right-Turn</i>	220'	163'	Yes	120'	Yes	163'	Yes	120'	Yes
<i>Southbound Left/Through</i>	605'	145'	Yes	50'	Yes	145'	Yes	50'	Yes
<i>Eastbound Left-Turn</i>	100'	155'	No	210'	No	155'	No	213'	No
<i>Westbound Left-Turn</i>	115'	40'	Yes	68'	Yes	40'	Yes	68'	Yes

⁵⁶ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁵⁷ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁵⁸ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 10-1 (CONTINUED)
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁵⁹

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
13. Orange Avenue at Willow Street	<i>Northbound Left-Turn</i>	126 ⁶⁰	73'	Yes	53'	Yes	73'	Yes	53'	Yes
	<i>Southbound Left-Turn</i>	209 ⁶¹	55'	Yes	58'	Yes	60'	Yes	65'	Yes
	<i>Eastbound Left-Turn</i>	185 ⁶²	110'	Yes	180'	Yes	120'	Yes	170'	Yes
	<i>Westbound Left-Turn</i>	234'	123'	Yes	175'	Yes	123'	Yes	175'	Yes
14. Walnut Avenue at Willow Street	<i>Northbound Left-Turn</i>	138 ⁶⁰	80'	Yes	78'	Yes	80'	Yes	78'	Yes
	<i>Southbound Left-Turn</i>	160 ⁶¹	48'	Yes	73'	Yes	48'	Yes	73'	Yes
	<i>Eastbound Left-Turn</i>	204'	25'	Yes	63'	Yes	25'	Yes	63'	Yes
	<i>Westbound Left-Turn</i>	208'	28'	Yes	65'	Yes	28'	Yes	65'	Yes

⁵⁹ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁶⁰ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁶¹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

⁶² Existing storage capacity includes the striped turn pocket as well as the transition area.

TABLE 10-1 (CONTINUED)
EXISTING PLUS PROJECT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁶³

Key Study Intersection	Storage Provided (feet)	(1) Existing Traffic Conditions				(2) Existing Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
15. Cherry Avenue at Willow Street									
<i>Northbound Left-Turn</i>	230 ⁶⁴	170'	Yes	150'	Yes	170'	Yes	150'	Yes
<i>Southbound Left-Turn</i>	440 ⁶⁵	180'	Yes	340'	Yes	180'	Yes	340'	Yes
<i>Eastbound Left-Turn</i>	490 ⁶⁶	246'	Yes	270'	Yes	246'	Yes	270'	Yes
<i>Westbound Left-Turn</i>	410 ⁶⁶	286'	Yes	446'	No	286'	Yes	446'	No

⁶³ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁶⁴ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁶⁵ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes. The existing storage also includes the transition area.

⁶⁶ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

10.2 Year 2021 Traffic Conditions

Table 10-2 presents the left-turn queueing analyses results for the ten (10) signalized study intersections. Column 1 presents the queueing results for Year 2021 cumulative traffic conditions. Column 2 presents the results for Year 2021 cumulative plus project traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from *Table 10-2* and instead summarized in a comparison table discussed later in this report.

10.2.1 Year 2021 Cumulative Traffic Conditions

Review of Column 1 of *Table 10-2* indicates that seven (7) of the ten signalized study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2021 cumulative traffic conditions, not including Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space. The intersections/approaches with storage deficiencies include the following:

- Intersection 1: Orange Avenue at 32nd Street
 - Westbound left-turn – PM peak hour
- Intersection 4: Atlantic Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 6: California Avenue at Spring Street
 - Southbound left-turn – AM peak hour & PM peak hour
- Intersection 8: Walnut Avenue at Spring Street
 - Northbound left-turn – PM peak hour
- Intersection 9: Cherry Avenue at Spring Street
 - Eastbound left-turn – PM peak hour
- Intersection 12: California Avenue at Willow Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 15: Cherry Avenue at Willow Street
 - Westbound left-turn – PM peak hour

10.2.2 Year 2021 Cumulative Plus Project Traffic Conditions

Review of Column 2 of *Table 10-2* indicates that same seven (7) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at seven (7) of the study intersections with storage deficiencies, and thus does not contribute to additional vehicle queueing beyond that previously reported under existing conditions.

Appendix E presents the Year 2021 cumulative HCM queueing worksheets for the signalized study intersections.

10.2.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 10-3* presents the left-turn queueing analyses results with and without the planned bikeway improvements at the two (2) key study intersections for the Year 2021 horizon year. *Table 10-3* is set-up similarly to *Table 10-2*.

Review of columns (1) and (2) of *Table 10-3* indicates that the Orange Avenue at Spring Street with implementation of Long Beach's planned bikeway improvements along Orange Avenue has left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2021 cumulative traffic conditions. The remaining study intersection has queues that are adequately accommodated by the storage space.

However, project traffic does contribute additional left-turn queueing to the intersection of Orange Avenue/32nd Street on approaches with pre-existing storage deficiencies.

As it relates to the without bikeway improvements both intersections are forecast to have queues that are adequately accommodated by the storage space.

TABLE 10-2
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁶⁷

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
1. Orange Avenue at 32 nd Street ⁶⁸	<i>Northbound Left-Turn</i>	100'	25'	Yes	25'	Yes	25'	Yes	25'	Yes
	<i>Southbound Left-Turn</i>	160'	82'	Yes	77'	Yes	90'	Yes	89'	Yes
	<i>Eastbound Left/Through/Right-Turn</i>	1,240'	66'	Yes	29'	Yes	65'	Yes	29'	Yes
	<i>Westbound Left-Turn</i>	240' ⁶⁹	109'	Yes	284'	No	122'	Yes	291'	No
4. Atlantic Avenue at Spring Street	<i>Northbound Left-Turn</i>	85'	50'	Yes	63'	Yes	50'	Yes	63'	Yes
	<i>Southbound Left-Turn</i>	355'	88'	Yes	85'	Yes	88'	Yes	85'	Yes
	<i>Eastbound Left-Turn</i>	100'	125'	No	143'	No	125'	No	143'	No
	<i>Westbound Left-Turn</i>	220'	165'	Yes	103'	Yes	165'	Yes	103'	Yes
5. Olive Avenue at Spring Street ⁶⁸	<i>Southbound Left-Turn</i>	125'	47'	Yes	81'	Yes	47'	Yes	81'	Yes
	<i>Eastbound Left-Turn</i>	180'	72'	Yes	76'	Yes	71'	Yes	76'	Yes

⁶⁷ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁶⁸ HCM 6th Edition methodology does not support intersections with shared lanes. Therefore, queues for this intersection are based on HCM 2000 95th Percentile methodology.

⁶⁹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

TABLE 10-2 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁷⁰

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
6. California Avenue at Spring Street									
<i>Northbound Left-Turn</i>	100'	90'	Yes	70'	Yes	90'	Yes	68'	Yes
<i>Southbound Left-Turn</i>	110'	120'	No	158'	No	120'	No	158'	No
<i>Eastbound Left-Turn</i>	160' ⁷³	38'	Yes	25'	Yes	38'	Yes	25'	Yes
<i>Westbound Left-Turn</i>	160' ⁷³	88'	Yes	78'	Yes	88'	Yes	78'	Yes
7. Orange Avenue at Spring Street ⁷¹									
<i>Northbound Left-Turn</i>	210' ⁷²	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	135' ⁷³	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	366' ⁷⁴	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	200'	--	--	--	--	--	--	--	--

⁷⁰ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁷¹ The City has plans to implement a Class IV bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

⁷² The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

⁷³ Existing storage capacity includes the striped turn pocket as well as the transition area.

⁷⁴ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 10-2 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁷⁵

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
8. Walnut Avenue at Spring Street	<i>Northbound Left-Turn</i>	100'	98'	Yes	120'	No	98'	Yes	120'	No
	<i>Southbound Left-Turn</i>	100'	43'	Yes	48'	Yes	43'	Yes	48'	Yes
	<i>Eastbound Left-Turn</i>	185' ⁷⁶	28'	Yes	75'	Yes	28'	Yes	78'	Yes
	<i>Westbound Left-Turn</i>	100' ⁷⁶	55'	Yes	63'	Yes	55'	Yes	63'	Yes
9. Cherry Avenue at Spring Street	<i>Northbound Left-Turn</i>	241' ⁷⁶	80'	Yes	100'	Yes	80'	Yes	100'	Yes
	<i>Southbound Left-Turn</i>	500' ⁷⁷	266'	Yes	340'	Yes	266'	Yes	340'	Yes
	<i>Eastbound Left-Turn</i>	147'	145'	Yes	443'	No	145'	Yes	443'	No
	<i>Westbound Left-Turn</i>	292' ⁷⁶	113'	Yes	163'	Yes	113'	Yes	163'	Yes
10. I-405 SB Off-Ramp at Spring Street	<i>Southbound Left-Turn</i>	475'	303'	Yes	273'	Yes	303'	Yes	273'	Yes

⁷⁵ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁷⁶ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

⁷⁷ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 10-2 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁷⁸

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
12. California Avenue at Willow Street									
<i>Northbound Left/Through/Right-Turn</i>	220'	165'	Yes	123'	Yes	165'	Yes	123'	Yes
<i>Southbound Left/Through</i>	605'	150'	Yes	50'	Yes	150'	Yes	50'	Yes
<i>Eastbound Left-Turn</i>	100'	175'	No	245'	No	175'	No	250'	No
<i>Westbound Left-Turn</i>	115'	40'	Yes	68'	Yes	40'	Yes	65'	Yes
13. Orange Avenue at Willow Street ⁷⁹									
<i>Northbound Left-Turn</i>	126' ⁸⁰	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	209' ⁸¹	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	185' ⁸²	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	234'	--	--	--	--	--	--	--	--

⁷⁸ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁷⁹ The City has plans to implement a Class IV bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

⁸⁰ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁸¹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

⁸² Existing storage capacity includes the striped turn pocket as well as the transition area.

TABLE 10-2 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁸³

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
14. Walnut Avenue at Willow Street	<i>Northbound Left-Turn</i>	138 ^{*84}	100'	Yes	98'	Yes	100'	Yes	98'	Yes
	<i>Southbound Left-Turn</i>	160 ^{*85}	50'	Yes	75'	Yes	50'	Yes	75'	Yes
	<i>Eastbound Left-Turn</i>	204'	25'	Yes	63'	Yes	25'	Yes	63'	Yes
	<i>Westbound Left-Turn</i>	208'	33'	Yes	83'	Yes	33'	Yes	85'	Yes
15. Cherry Avenue at Willow Street	<i>Northbound Left-Turn</i>	230 ^{*84}	180'	Yes	158'	Yes	180'	Yes	158'	Yes
	<i>Southbound Left-Turn</i>	440 ^{*86}	180'	Yes	346'	Yes	180'	Yes	346'	Yes
	<i>Eastbound Left-Turn</i>	490 ^{*87}	250'	Yes	286'	Yes	250'	Yes	286'	Yes
	<i>Westbound Left-Turn</i>	410 ^{*87}	320'	Yes	580'	No	320'	Yes	580'	No

⁸³ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁸⁴ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁸⁵ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

⁸⁶ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes. The existing storage also includes the transition area.

⁸⁷ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 10-3
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁸⁸
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS⁸⁹

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
7. Orange Avenue at Spring Street									
<i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	210 ⁹⁰	85'	Yes	98'	Yes	103'	Yes	98'	Yes
<i>Southbound Left-Turn</i>	135 ⁹¹	135'	Yes	185'	No	155'	No	215'	No
<i>Eastbound Left-Turn</i>	366 ⁹²	148'	Yes	188'	Yes	155'	Yes	220'	Yes
<i>Westbound Left-Turn</i>	200'	100'	Yes	108'	Yes	118'	Yes	128'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	305 ⁹² /250'	68'	Yes	75'	Yes	83'	Yes	90'	Yes
<i>Southbound Left-Turn</i>	135 ⁹¹	98'	Yes	123'	Yes	105'	Yes	133'	Yes
<i>Eastbound Left-Turn</i>	366 ⁹²	148'	Yes	188'	Yes	155'	Yes	220'	Yes
<i>Westbound Left-Turn</i>	200'	100'	Yes	108'	Yes	118'	Yes	128'	Yes

⁸⁸ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁸⁹ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

⁹⁰ The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

⁹¹ Existing storage capacity includes the striped turn pocket as well as the transition area.

⁹² Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 10-3 (CONTINUED)
YEAR 2021 CUMULATIVE PEAK HOUR INTERSECTION QUEUING ANALYSIS⁹³
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS⁹⁴

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Traffic Conditions				(2) Year 2021 Cumulative Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
13. Orange Avenue at Willow Street									
<i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126 ⁹⁵	68'	Yes	60'	Yes	65'	Yes	60'	Yes
<i>Southbound Left-Turn</i>	209 ⁹⁶	53'	Yes	65'	Yes	55'	Yes	70'	Yes
<i>Eastbound Left-Turn</i>	185 ⁹⁷	118'	Yes	155'	Yes	125'	Yes	160'	Yes
<i>Westbound Left-Turn</i>	234'	150'	Yes	198'	Yes	150'	Yes	198'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126 ⁹⁵	73'	Yes	63'	Yes	70'	Yes	60'	Yes
<i>Southbound Left-Turn</i>	209 ⁹⁶	58'	Yes	70'	Yes	60'	Yes	75'	Yes
<i>Eastbound Left-Turn</i>	185 ⁹⁷	118'	Yes	155'	Yes	125'	Yes	160'	Yes
<i>Westbound Left-Turn</i>	234'	150'	Yes	198'	Yes	150'	Yes	198'	Yes

⁹³ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁹⁴ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

⁹⁵ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

⁹⁶ Existing storage capacity includes the striped turn turn pocket as well as storage space upstream of the turn lane.

⁹⁷ Existing storage capacity includes the striped turn pocket as well as the transition area.

10.3 Year 2038 Traffic Conditions

Table 10-4 presents the left-turn queuing analyses results for the ten (10) signalized study intersections. Column 1 presents the queuing results for Year 2038 buildout traffic conditions. Column 2 presents the results for Year 2038 buildout plus project traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from *Table 10-4* and instead summarized in a comparison table discussed later in this report.

10.3.1 Year 2038 Buildout Traffic Conditions

Review of Column 1 of *Table 10-4* indicates that seven (7) of the ten (10) signalized study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 buildout traffic conditions, not including Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space. The intersections/approaches with storage deficiencies include the following:

- Intersection 1: Orange Avenue at 32nd Street
 - Southbound left-turn – PM peak hour
 - Westbound left-turn – PM peak hour
- Intersection 4: Atlantic Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 6: California Avenue at Spring Street
 - Southbound left-turn – AM peak hour & PM peak hour
- Intersection 8: Walnut Avenue at Spring Street
 - Northbound left-turn – AM peak hour & PM peak hour
- Intersection 9: Cherry Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 12: California Avenue at Willow Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 15: Cherry Avenue at Willow Street
 - Westbound left-turn – PM peak hour

10.3.2 Year 2038 Buildout Plus Project Traffic Conditions

Review of Column 2 of *Table 10-4* indicates that same seven (7) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining three (3) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at the seven (7) of the study intersections with storage deficiencies, and thus does not contribute to additional vehicle queueing beyond that previously reported under existing conditions.

Appendix E presents the Year 2038 buildout HCM queueing worksheets for the signalized study intersections.

10.3.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 10-5* presents the left-turn queueing analyses results with and without the planned bikeway improvements at the two (2) key study intersections for the Year 2038 horizon year. *Table 10-5* is set-up similarly to *Table 10-4*.

Review of columns (1) and (2) of *Table 10-5* indicates that the Orange Avenue at Spring Street and Orange Avenue at Willow Street with implementation of Long Beach's planned bikeway improvements along Orange Avenue has left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions.

However, project traffic does contribute additional left-turn queueing to the intersection of Orange Avenue/Spring Street on approaches with pre-existing storage deficiencies.

As it relates to the without bikeway improvements both intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions. However, with the Project traffic does not contribute to additional vehicle queueing beyond that previously reported under 2038 cumulative traffic conditions.

TABLE 10-4
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS⁹⁸

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
1. Orange Avenue at 32 nd Street ⁹⁹	<i>Northbound Left-Turn</i>	100'	25'	Yes	25'	Yes	25'	Yes	25'	Yes
	<i>Southbound Left-Turn</i>	160'	149'	Yes	164'	No	154'	Yes	183'	No
	<i>Eastbound Left/Through/Right-Turn</i>	1,240'	71'	Yes	32'	Yes	72'	Yes	32'	Yes
	<i>Westbound Left-Turn</i>	240' ¹⁰⁰	122'	Yes	374'	No	135'	Yes	384'	No
4. Atlantic Avenue at Spring Street	<i>Northbound Left-Turn</i>	85'	63'	Yes	83'	Yes	63'	Yes	83'	Yes
	<i>Southbound Left-Turn</i>	355'	95'	Yes	95'	Yes	95'	Yes	95'	Yes
	<i>Eastbound Left-Turn</i>	100'	160'	No	180'	No	160'	No	180'	No
	<i>Westbound Left-Turn</i>	220'	213'	Yes	120'	Yes	213'	Yes	120'	Yes
5. Olive Avenue at Spring Street ⁹⁹	<i>Southbound Left-Turn</i>	125'	52'	Yes	92'	Yes	52'	Yes	92'	Yes
	<i>Eastbound Left-Turn</i>	180'	69'	Yes	76'	Yes	68'	Yes	76'	Yes

⁹⁸ Queues are based on HCM 85th Percentile, unless otherwise noted.

⁹⁹ HCM 6th Edition methodology does not support intersections with shared lanes. Therefore, queues for this intersection are based on HCM 2000 95th Percentile methodology.

¹⁰⁰ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

TABLE 10-4 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁰¹

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
6. California Avenue at Spring Street									
<i>Northbound Left-Turn</i>	100'	100'	Yes	60'	Yes	100'	Yes	60'	Yes
<i>Southbound Left-Turn</i>	110'	145'	No	205'	No	145'	No	205'	No
<i>Eastbound Left-Turn</i>	160' ¹⁰⁴	50'	Yes	40'	Yes	50'	Yes	40'	Yes
<i>Westbound Left-Turn</i>	160' ¹⁰⁴	108'	Yes	95'	Yes	108'	Yes	95'	Yes
7. Orange Avenue at Spring Street ¹⁰²									
<i>Northbound Left-Turn</i>	210' ¹⁰³	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	135' ¹⁰⁴	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	366' ¹⁰⁵	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	200'	--	--	--	--	--	--	--	--

¹⁰¹ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁰² The City has plans to implement a Class IV bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

¹⁰³ The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

¹⁰⁴ Existing storage capacity includes the striped turn pocket as well as the transition area.

¹⁰⁵ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 10-4 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁰⁶

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
8. Walnut Avenue at Spring Street	<i>Northbound Left-Turn</i>	100'	115'	No	140'	No	115'	No	140'	No
	<i>Southbound Left-Turn</i>	100'	53'	Yes	60'	Yes	53'	Yes	60'	Yes
	<i>Eastbound Left-Turn</i>	185' ¹⁰⁷	35'	Yes	98'	Yes	35'	Yes	98'	Yes
	<i>Westbound Left-Turn</i>	100' ¹⁰⁷	70'	Yes	85'	Yes	70'	Yes	88'	Yes
9. Cherry Avenue at Spring Street	<i>Northbound Left-Turn</i>	241' ¹⁰⁷	98'	Yes	113'	Yes	98'	Yes	113'	Yes
	<i>Southbound Left-Turn</i>	500' ¹⁰⁸	310'	Yes	406'	Yes	310'	Yes	406'	Yes
	<i>Eastbound Left-Turn</i>	147'	175'	No	598'	No	175'	No	598'	No
	<i>Westbound Left-Turn</i>	292' ¹⁰⁷	130'	Yes	193'	Yes	130'	Yes	193'	Yes
10. I-405 SB Off-Ramp at Spring Street	<i>Southbound Left-Turn</i>	475'	363'	Yes	325'	Yes	363'	Yes	325'	Yes

¹⁰⁶ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁰⁷ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹⁰⁸ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 10-4 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁰⁹

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
12. California Avenue at Willow Street									
<i>Northbound Left/Through/Right-Turn</i>	220'	193'	Yes	143'	Yes	193'	Yes	143'	Yes
<i>Southbound Left/Through</i>	605'	175'	Yes	60'	Yes	175'	Yes	60'	Yes
<i>Eastbound Left-Turn</i>	100'	300'	No	430'	No	303'	No	435'	No
<i>Westbound Left-Turn</i>	115'	38'	Yes	73'	Yes	38'	Yes	73'	Yes
13. Orange Avenue at Willow Street ¹¹⁰									
<i>Northbound Left-Turn</i>	126' ¹¹¹	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	209' ¹¹²	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	185' ¹¹³	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	234'	--	--	--	--	--	--	--	--

¹⁰⁹ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹¹⁰ The City has plans to implement a Class IV bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

¹¹¹ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹¹² Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

¹¹³ Existing storage capacity includes the striped turn pocket as well as the transition area.

TABLE 10-4 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹¹⁴

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
14. Walnut Avenue at Willow Street	<i>Northbound Left-Turn</i>	138' ¹¹⁵	108'	Yes	105'	Yes	108'	Yes	105'	Yes
	<i>Southbound Left-Turn</i>	160' ¹¹⁶	58'	Yes	85'	Yes	58'	Yes	85'	Yes
	<i>Eastbound Left-Turn</i>	204'	25'	Yes	63'	Yes	25'	Yes	63'	Yes
	<i>Westbound Left-Turn</i>	208'	35'	Yes	115'	Yes	35'	Yes	113'	Yes
15. Cherry Avenue at Willow Street	<i>Northbound Left-Turn</i>	230' ¹¹⁵	213'	Yes	175'	Yes	213'	Yes	175'	Yes
	<i>Southbound Left-Turn</i>	440' ¹¹⁷	186'	Yes	346'	Yes	186'	Yes	346'	Yes
	<i>Eastbound Left-Turn</i>	490' ¹¹⁸	286'	Yes	346'	Yes	286'	Yes	346'	Yes
	<i>Westbound Left-Turn</i>	410' ¹¹⁸	370'	Yes	780'	No	370'	Yes	780'	No

¹¹⁴ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹¹⁵ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹¹⁶ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

¹¹⁷ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes. The existing storage also includes the transition area.

¹¹⁸ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 10-5
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹¹⁹
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹²⁰

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
7. Orange Avenue at Spring Street <i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	210' ¹²¹	140'	Yes	175'	Yes	140'	Yes	183'	Yes
<i>Southbound Left-Turn</i>	135' ¹²²	198'	No	468'	No	240'	No	570'	No
<i>Eastbound Left-Turn</i>	366' ¹²³	250'	Yes	298'	Yes	265'	Yes	363'	Yes
<i>Westbound Left-Turn</i>	200'	125'	Yes	150'	Yes	148'	Yes	183'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	305' ¹²³ /250'	85'	Yes	95'	Yes	98'	Yes	108'	Yes
<i>Southbound Left-Turn</i>	135' ¹²²	118'	Yes	158'	No	128'	Yes	178'	No
<i>Eastbound Left-Turn</i>	366' ¹²³	250'	Yes	298'	Yes	265'	Yes	363'	Yes
<i>Westbound Left-Turn</i>	200'	125'	Yes	150'	Yes	148'	Yes	183'	Yes

¹¹⁹ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹²⁰ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹²¹ The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

¹²² Existing storage capacity includes the striped turn pocket as well as the transition area.

¹²³ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 10-5 (CONTINUED)
YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹²⁴
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹²⁵

Key Study Intersection	Storage Provided (feet)	(1) Year 2038 Buildout Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
13. Orange Avenue at Willow Street <i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126 ¹²⁶	78'	Yes	73'	Yes	80'	Yes	73'	Yes
<i>Southbound Left-Turn</i>	209 ¹²⁷	55'	Yes	83'	Yes	58'	Yes	93'	Yes
<i>Eastbound Left-Turn</i>	185 ¹²⁸	140'	Yes	160'	Yes	168'	Yes	170'	Yes
<i>Westbound Left-Turn</i>	234'	170'	Yes	323'	No	170'	Yes	323'	No
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126 ¹²⁶	78'	Yes	68'	Yes	78'	Yes	68'	Yes
<i>Southbound Left-Turn</i>	209 ¹²⁷	60'	Yes	83'	Yes	63'	Yes	93'	Yes
<i>Eastbound Left-Turn</i>	185 ⁹⁷¹²⁸	140'	Yes	160'	Yes	168'	Yes	170'	Yes
<i>Westbound Left-Turn</i>	234'	170'	Yes	323'	No	170'	Yes	323'	No

¹²⁴ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹²⁵ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹²⁶ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹²⁷ Existing storage capacity includes the striped turn turn pocket as well as storage space upstream of the turn lane.

¹²⁸ Existing storage capacity includes the striped turn pocket as well as the transition area.

11.0 TRAFFIC SIGNAL WARRANT ANALYSIS

The level of service analysis at the unsignalized intersection of Orange Avenue at I-405 SB Ramps is supplemented with an assessment of the need for signalization of the intersection. This assessment is made on the basis of signal warrant criteria adopted by Caltrans. For this study, the need for signalization is assessed on the basis of the peak-hour traffic signal warrant as described in the *California Manual on Uniform Traffic Control Devices (MUTCD)*.

Warrant #3 has two parts:

- (1) *Part A* evaluates peak hour vehicle delay for traffic on the minor street approach with the highest delay, and
- (2) *Part B* evaluates peak-hour traffic volumes on the major and minor streets.

This method provides an indication of whether peak-hour traffic conditions or peak-hour traffic volume levels are, or would be, sufficient to justify installation of a traffic signal.

The decision to install a traffic signal should not be based purely on the warrants alone. Instead, the installation of a signal should be considered and further analysis performed when one or more of the warrants are met. Additionally, engineering judgment is exercised on a case-by-case basis to evaluate the effect a traffic signal will have on certain types of accidents and traffic conditions at the subject intersection as well as at adjacent intersections.

11.1 Existing Plus Project Traffic Signal Warrant Analysis

The results of the peak-hour traffic signal warrant analysis (Warrant #3) for Existing and Existing Plus Project traffic are summarized in **Table 11-1**. The results indicate that the key unsignalized intersection of Orange Avenue/I-405 SB Ramps satisfies the criteria for a traffic signal under Existing and Existing Plus Project traffic conditions. As such, a traffic signal could be installed at this location if desired.

Appendix G presents the signal warrant worksheets for the unsignalized study intersections for existing traffic conditions.

11.2 Year 2021 Cumulative Traffic Signal Warrant Analysis

The results of the peak-hour traffic signal warrant analysis (Warrant #3) for Year 2021 Cumulative and Year 2021 Cumulative Plus Project traffic are summarized in **Table 11-2**. The results indicate that the key unsignalized intersection of Orange Avenue/I-405 SB Ramps satisfies the criteria for a traffic signal under Year 2021 Cumulative and Year 2021 Cumulative Plus Project traffic conditions. As such, a traffic signal could be installed at this location if desired.

Appendix G presents the signal warrant worksheets for the unsignalized study intersections for Year 2021 buildout traffic conditions.

11.3 Year 2038 Buildout Traffic Signal Warrant Analysis

The results of the peak-hour traffic signal warrant analysis (Warrant #3) for Year 2038 Buildout and Year 2038 Buildout Plus Project traffic are summarized in **Table 11-3**. The results indicate that the key unsignalized intersection of Orange Avenue/I-405 SB Ramps satisfies the criteria for a traffic signal under Year 2038 Buildout and Year 2038 Buildout Plus Project traffic conditions. As such, a traffic signal could be installed at this location if desired.

Appendix G presents the signal warrant worksheets for the unsignalized study intersections for Year 2038 buildout traffic conditions.

TABLE 11-1
EXISTING TRAFFIC SIGNAL WARRANT ANALYSIS SUMMARY¹²⁹

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions	
		Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?	Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?
3. Orange Avenue at I-405 SB Ramps	AM	Yes	Yes	Yes	Yes
	PM	Yes	Yes	Yes	Yes

¹²⁹ Signal warrant checks based on Warrant 3, Part A - Peak-Hour Delay Warrant and Part B - Peak-Hour Volume Warrant are contained in the California MUTCD.

TABLE 11-2
YEAR 2021 CUMULATIVE TRAFFIC SIGNAL WARRANT ANALYSIS SUMMARY¹³⁰

Key Intersection	Time Period	(1) Year 2021 Cumulative Traffic Conditions		(2) Year 2021 Cumulative Plus Project Traffic Conditions	
		Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?	Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?
3. Orange Avenue at I-405 SB Ramps	AM	Yes	Yes	Yes	Yes
	PM	Yes	Yes	Yes	Yes

¹³⁰ Signal warrant checks based on Warrant 3, Part A - Peak-Hour Delay Warrant and Part B - Peak-Hour Volume Warrant are contained in the California MUTCD.

TABLE 11-3
YEAR 2038 BUILDOUT TRAFFIC SIGNAL WARRANT ANALYSIS SUMMARY¹³¹

Key Intersection	Time Period	(1) Year 2038 Buildout Traffic Conditions		(2) Year 2038 Buildout Plus Project Traffic Conditions	
		Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?	Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?
3. Orange Avenue at I-405 SB Ramps	AM	Yes	Yes	Yes	Yes
	PM	Yes	Yes	Yes	Yes

¹³¹ Signal warrant checks based on Warrant 3, Part A - Peak-Hour Delay Warrant and Part B - Peak-Hour Volume Warrant are contained in the California MUTCD.

12.0 AREA-WIDE TRAFFIC IMPROVEMENTS

12.1 Planned Improvements

As previously discussed, the City of Long Beach has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue, which will span between 70th Street and Pacific Coast Highway. This protected bikeway is assumed to be part of the cumulative background traffic conditions and is anticipated to be complete by the Project's opening year; for the assessment without this planned bikeway improvement, existing condition would remain in place. As part of the planned improvements, a road diet along Orange Avenue will also be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway. The improvements to include the following:

➤ **Intersection 1 – Orange Avenue at 32nd Street**

With Orange Avenue Bikeway Improvements: No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, south of 32nd Street would be striped with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

➤ **Intersection 3 – Orange Avenue at I-405 SB Ramps:**

With Orange Avenue Bikeway Improvements: Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

➤ **Intersection 7 – Orange Avenue at Spring Street:**

With Orange Avenue Bikeway Improvements: Modify and restripe the northbound and southbound approaches to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, this study intersection would be designed to include protected bike lanes (i.e. on-street bike lanes and a median buffer to separate bicycle traffic from vehicular traffic).

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

➤ **Intersection 11 – Orange Avenue at 29th Street:**

With Orange Avenue Bikeway Improvements: No change in intersection lane configurations/assignment; existing lanes will be maintained, although Orange Avenue, from Spring Street south to Willow Street, would be striped as a two-lane divided roadway, with

on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic; where possible, on-street parking will be maintained/provided.

➤ ***Without Orange Avenue Bikeway Improvements:*** Same as existing lane configurations.

➤ **Intersection 13 – Orange Avenue at Willow Street:**

With Orange Avenue Bikeway Improvements: Restripe the southbound approach to include a left-turn lane and a shared through-right turn lane. Modify the existing traffic signal accordingly. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the existing southbound right-turn lane would be removed to allow for the installation of on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic.

Without Orange Avenue Bikeway Improvements: Same as existing lane configurations.

12.2 Recommended Improvements

For those intersections where projected traffic volumes are expected to result in poor operating conditions, this report identifies roadway improvements that are expected to:

- Mitigate the impact of existing traffic, Project traffic and future non-project (ambient growth and cumulative project) traffic; and
- Improve Levels of Service to an acceptable range and/or to pre-project conditions.

12.2.1 Existing Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Table 8-1* shows that the proposed Project will not impact any of the key study intersections under the “Existing Plus Project” traffic scenario. Given that there are no significant project impacts, no improvements are required under this traffic scenario.

12.2.2 Year 2021 Cumulative Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Tables 8-2* and *8-3* shows that the proposed Project will significantly impact two (2) key study intersections under the “Year 2021 Cumulative Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

➤ **Intersection 1 – Orange Avenue at 32nd Street:**

With Orange Avenue Bikeway Improvements: Restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Without Orange Avenue Bikeway Improvements: Same as above, restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

➤ **Intersection 7 – Orange Avenue at Spring Street:**

With Orange Avenue Bikeway Improvements: Construct an exclusive right-turn lane for the northbound and southbound approaches. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill and will need to consider the City of Long Beach’s planned Class IV (Protected Bike Lane) bikeway design/layout for this intersection.

Without Orange Avenue Bikeway Improvements: Restripe the northbound approach to provide dual left-turn lanes, a through lane and a shared through-right turn lane. Restripe the southbound right-turn lane into a shared through-right turn lane. Modify the traffic signal form a two phase signal to a five phase signal with protected north-south left turn lanes. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill.

12.2.3 Year 2038 Buildout Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Table 8-4* and *8-5* shows that the proposed Project will significantly impact two (2) key study intersections under the “Year 2038 Buildout Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

➤ **Intersection 1 – Orange Avenue at 32nd Street:**

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions, restripe the northbound approach for an exclusive right-turn lane. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Signal Hill.

➤ **Intersection 7 – Orange Avenue at Spring Street:**

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Construct an exclusive right-turn lane for the northbound and southbound approaches. Modify the existing traffic signal as necessary. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill and will need to consider the City of Long Beach’s planned Class IV (Protected Bike Lane) bikeway design/layout for this intersection.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Restripe the northbound approach to provide dual left-turn lanes, a through lane and a shared through-right turn lane. Restripe the southbound right-turn lane into a shared through-right turn lane. Modify the traffic signal form a two phase signal to a five phase signal with protected north-south left turn lanes. These improvements are subject to the approval of the City of Long Beach and City of Signal Hill.

12.3 Caltrans Recommended Improvements

For those intersections under Caltrans jurisdiction where projected traffic volumes are expected to result in poor operating conditions, this report identifies roadway improvements that are expected to:

- Mitigate the impact of existing traffic, Project traffic and future non-project (ambient growth and cumulative project) traffic; and
- Improve Levels of Service to an acceptable range and/or to pre-project conditions.

12.3.1 Existing Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Tables 9-2 and 9-11* show that the proposed Project will significantly impact one (1) key study intersection under the “Existing Plus Project” traffic scenario based on the Caltrans impact criteria defined in this report. The recommended improvements are as follows:

- **Intersection 3 – Orange Avenue at I-405 SB Ramps:** Install a three-phase traffic signal. These improvements are subject to the approval of Caltrans.

12.3.2 Year 2021 Cumulative Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Tables 9-3 and 9-12* show that the proposed Project will significantly impact one (1) key study intersection under the “Year 2021 Cumulative Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

- **Intersection 3 – Orange Avenue at I-405 SB Ramps**
With Orange Avenue Bikeway Improvements: Install a three-phase traffic signal. Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic. Restripe the northbound left-turn lane to 225 feet. These improvements are subject to the approval of Caltrans.
Without Orange Avenue Bikeway Improvements: Install a three-phase traffic signal; maintain existing intersection lane configuration. These improvements are subject to the approval of Caltrans.

12.3.3 Year 2038 Buildout Plus Project Traffic Conditions

The results of the intersection capacity analysis presented previously in *Tables 9-4 and 9-13* show that the proposed Project will significantly impact one (1) key study intersection under the “Year 2038 Buildout Plus Project” traffic scenario. The recommended improvements, both with and without the planned bikeway improvements of the City of Long Beach, are as follows:

➤ **Intersection 3 – Orange Avenue at I-405 SB Ramps:**

With Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Install a three-phase traffic signal. Remove one (1) through lane from the northbound and southbound directions on Orange Avenue. With implementation of improvements associated with the Orange Avenue Class IV Bikeway, the section of Orange Avenue, from 32nd Street south of Spring Street, would be striped as a two-lane divided roadway, with on-street bike lanes and a buffer to separate bicycle traffic from vehicular traffic. Modify the median and restripe the northbound left-turn lane to 225 feet. These improvements are subject to the approval of Caltrans.

Without Orange Avenue Bikeway Improvements: Same as recommended improvements for Year 2021 conditions. Install a three-phase traffic signal. These improvements are subject to the approval of Caltrans.

12.4 Project-Specific Improvements

Subject to the review and approval of the City of Long Beach and City of Signal Hill Engineering Divisions, the following improvements are recommended in conjunction with the development of the proposed Project to ensure that adequate ingress and egress to the project site is provided. Intersection modifications include the following:

➤ **Intersection A – Project Driveway 1 at Spring Street:** Install an unsignalized driveway located approximately 200 feet to the west of Orange Avenue. To restrict illegal left-turns out of this driveway it is recommended that the installation of a raised curbed diverter island be installed to prohibit left-turns and restrict movements to right-turn in and right-turn out only. These improvements are subject to the approval of the City of Long Beach.

➤ **Intersection B – Orange Avenue at Project Driveway 2:**

With Orange Avenue Bikeway Improvements: To provided full access to the project site install a two-phase traffic signal with permissive phasing for the northbound left turn lane. The signal is proposed approximately 260 feet south of Spring Street along Orange Avenue. Modify the northbound approach to accommodate a 100-foot left-turn lane and one through lane. For the eastbound approach, install a shared left/right turn lane. These improvements are subject to the approval of the City of Long Beach and/or City of Signal Hill.

Without Orange Avenue Bikeway Improvements: To provided full access to the project site install a two-phase traffic signal with permissive phasing for the northbound left turn lane. Modify the northbound approach to accommodate a 100-foot left-turn lane and two through lane. For the eastbound approach, install a shared left/right turn lane. These improvements are subject to the approval of the City of Long Beach and/or City of Signal Hill.

Figure 12-1 graphically illustrates the planned and recommended improvements as summarized in Section 12.1 through 12.4, above.

Figure 12-2 presents a conceptual improvement plan which details the project specific improvements along Orange Avenue and Spring Street, plus the Project driveways, assuming implementation of the Orange Avenue Bikeway Improvements, and recommended improvements.

Figure 12-3 presents a conceptual improvement plan which details the project specific improvements along Orange Avenue and Spring Street, plus the Project driveways, without the Orange Avenue Bikeway Improvements. Under this option, this plan illustrates the striping improvements associated with installation of dual northbound left-turn lane at Spring Street.

12.5 Project-Related Fair Share Contribution

The transportation impacts associated with the development of the Project were determined based on the Existing Plus Project, Year 2021 and Year 2038 traffic analyses. As summarized in *Section 12*, the development of the Project is anticipated to have an impact at three (3) locations in the Year 2038. However, the Project is expected to pay for the mitigation measures identified at the intersection of Orange Avenue/Spring Street. As such, the Project can be expected to pay its fair share of the improvement costs for two (2) of the three impacted intersections to offset the Project's incremental traffic impact. Please note that the Year 2021 Plus Project recommended improvements are included in the Year 2038 Plus Project recommended improvements. Therefore, only a Year 2038 fair-share contribution has been calculated.

12.5.1 Year 2038 Buildout Project-Related Fair Share Contribution

Table 12-1 presents the PM peak hour percentage of net traffic impact at the study intersections (Intersection #1 and Intersection #3) impacted by the proposed Project for Year 2038 buildout traffic conditions. As presented in this table, the first column (1) presents a total of all intersection peak hour movements for existing traffic conditions. The second column (2) presents project only traffic conditions. The third column (3) presents future Year 2038 buildout traffic conditions with project traffic. The fourth column (4) represents what percentage of total intersection peak hour traffic is project-related traffic.

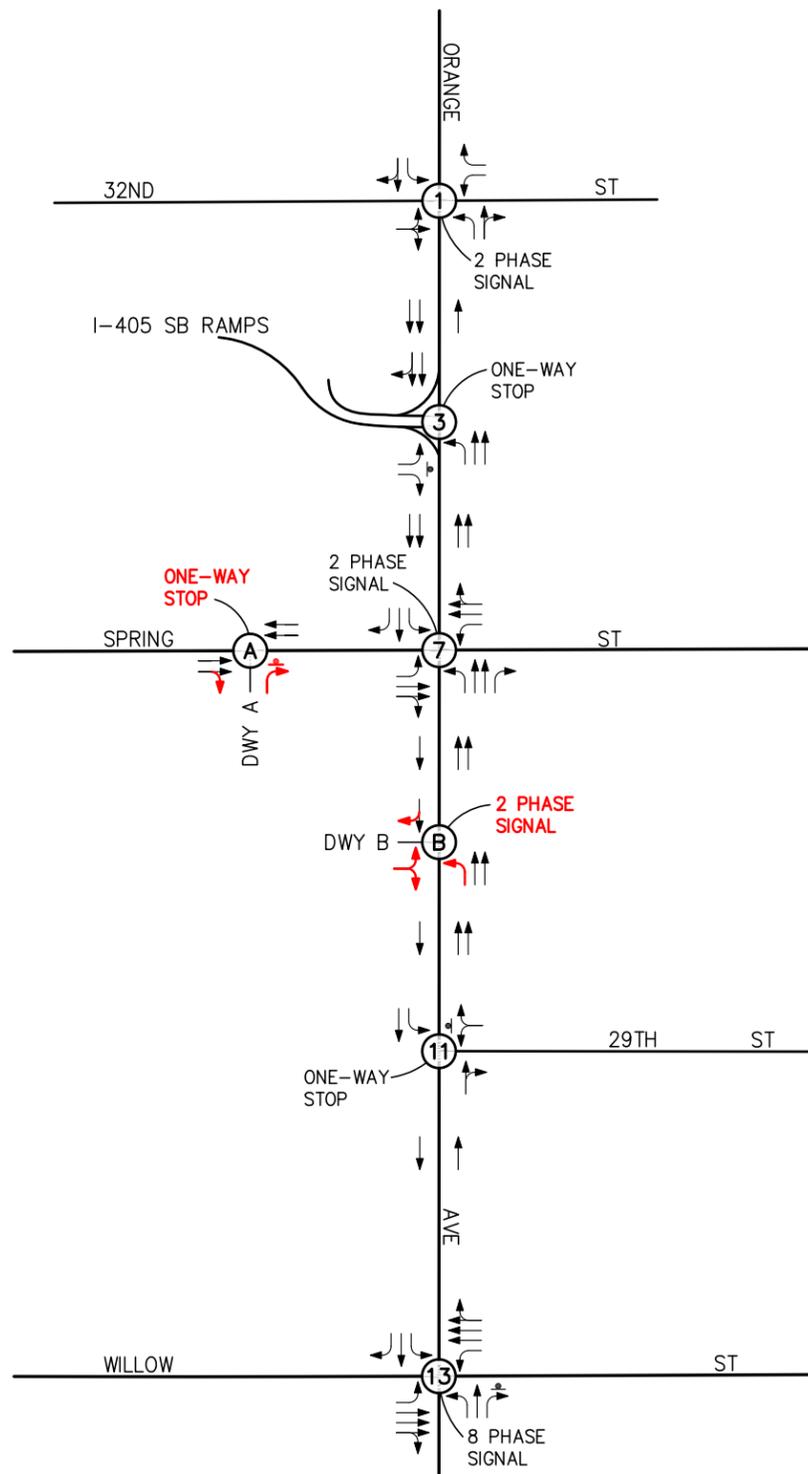
Review of *Table 12-1* shows that the Project's traffic percentage at the intersection of Orange Avenue/32nd Street totals 8.16% and at the intersection of Orange Avenue/I-405 SB Ramps totals 12.43% under Year 2038 buildout traffic conditions. The Project is expected to pay for the mitigation measures identified at the intersection of Orange Avenue/Spring Street.

12.6 Transportation Improvement Fee

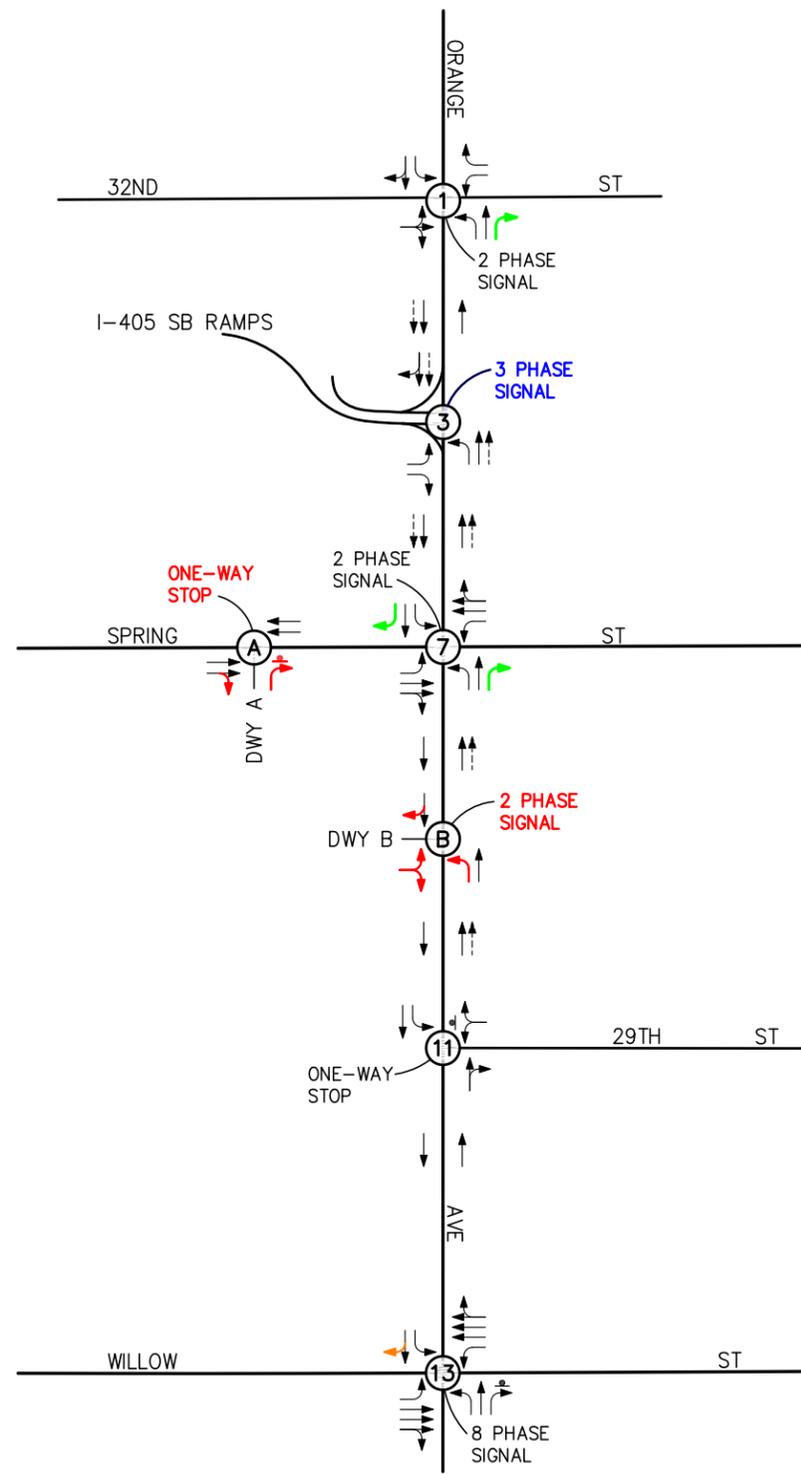
Pursuant to the requirements of the City of Long Beach Municipal Code, Transportation Improvement Fees will be required of the Project. The Transportation Improvement Fee, based on the size of all new commercial development in the City of Long Beach, is assessed as shown below:

- Commercial/Industrial (City-wide): \$1.10 per square-foot

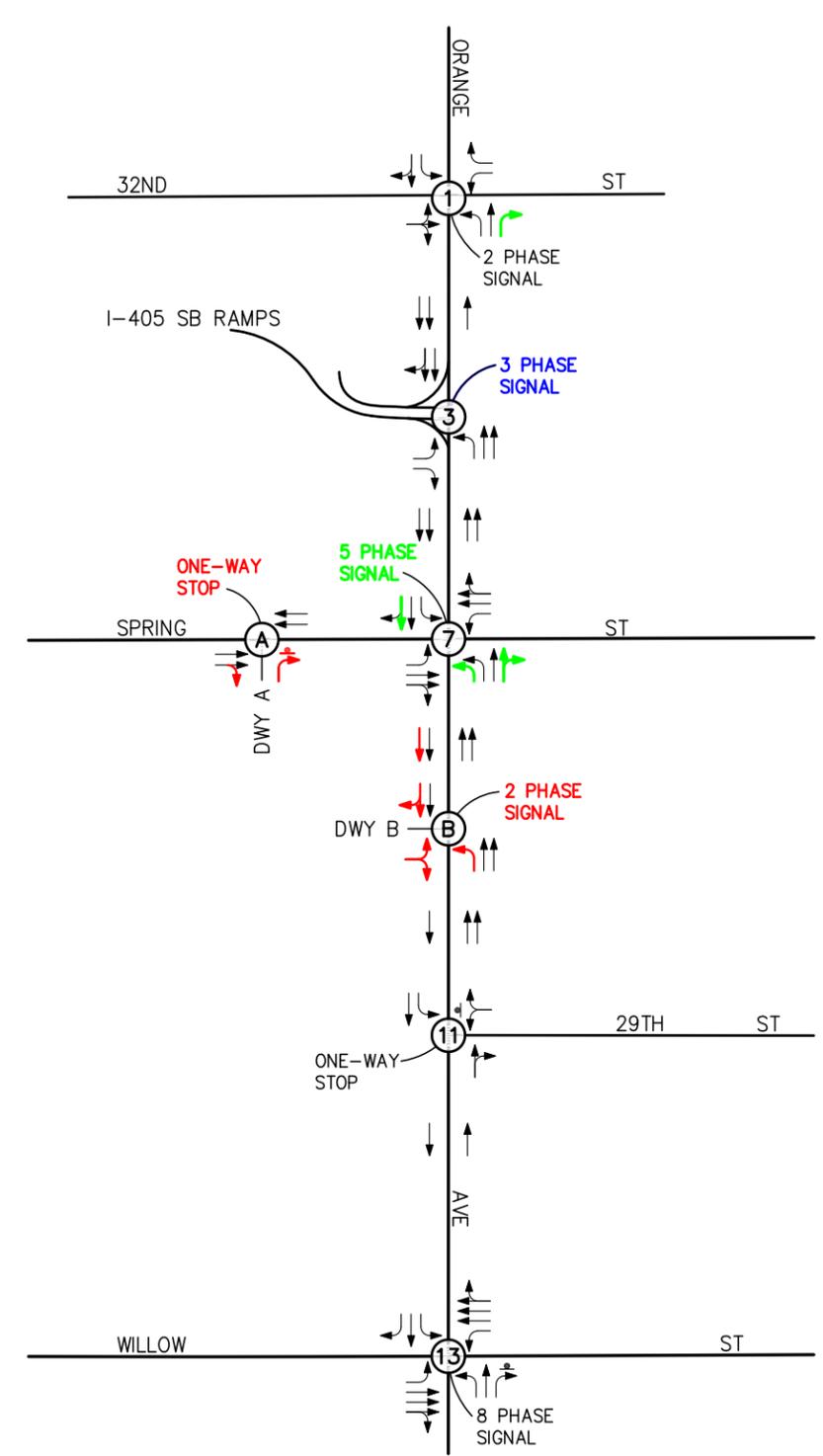
Based on the Project development of 160,673 SF of manufacturing space, the proposed Project can be expected to pay up to **\$176,740.30** in Transportation Improvement Fees. The precise fee will be determined by the City upon issuance of project building permits.



EXISTING TRAFFIC CONDITIONS



FUTURE TRAFFIC CONDITIONS WITH PLANNED AND RECOMMENDED IMPROVEMENTS (WITH ORANGE AVENUE BIKEWAY IMPROVEMENTS)



FUTURE TRAFFIC CONDITIONS WITH PLANNED AND RECOMMENDED IMPROVEMENTS (WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS)

KEY

- = APPROACH LANE ASSIGNMENT
- = LANE REMOVED
- = RECOMMENDED IMPROVEMENT
- = CALTRANS RECOMMENDED IMPROVEMENT
- = PROJECT SPECIFIC IMPROVEMENT
- = PROJECT SITE

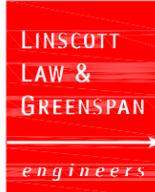
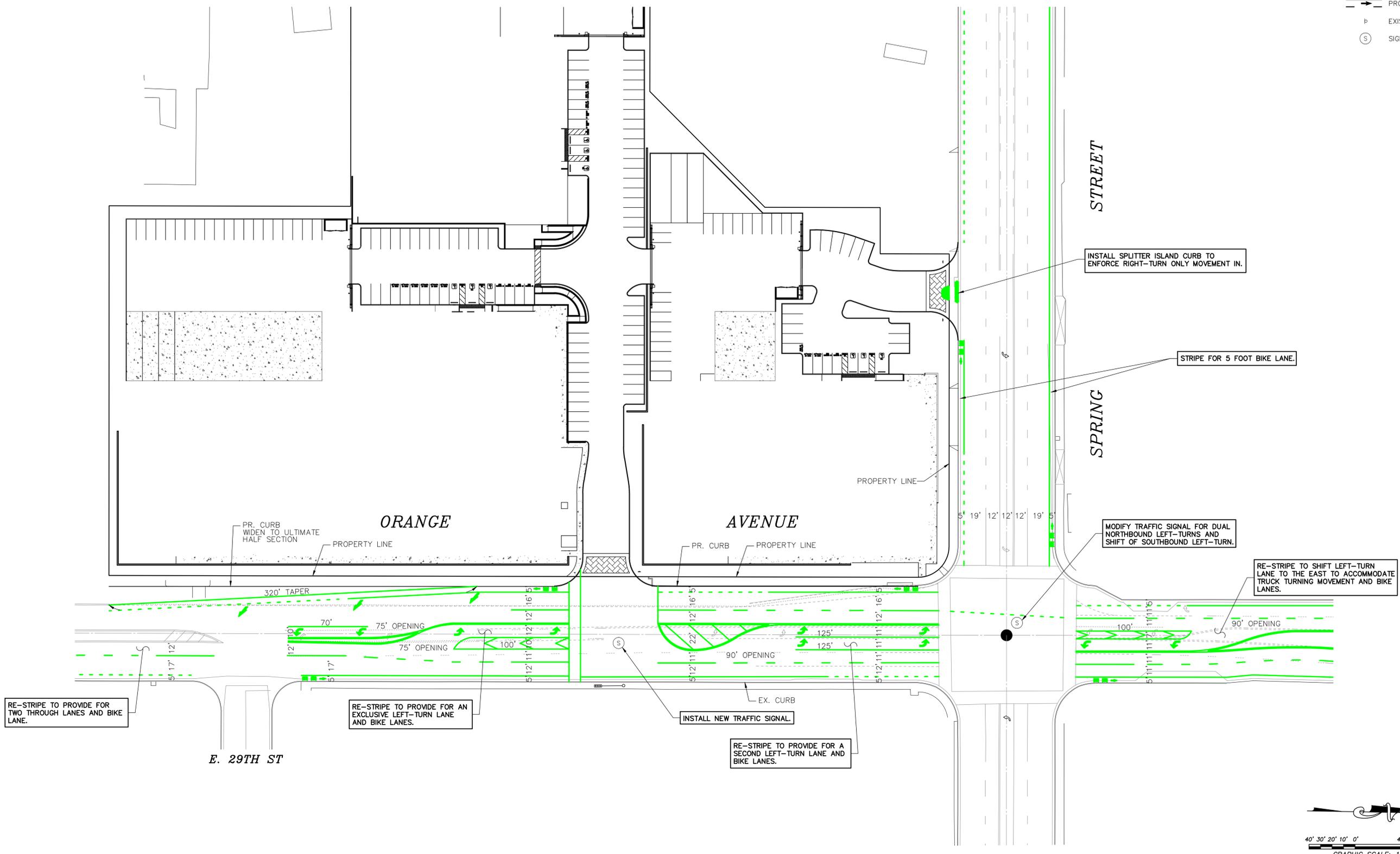


FIGURE 12-1

PLANNED AND RECOMMENDED IMPROVEMENTS
SPRING STREET INDUSTRIAL, LONG BEACH

LEGEND

	EXISTING STRIPING & MARKINGS TO REMAIN.
	EXISTING STRIPING & MARKINGS TO BE REMOVED.
	PROPOSED STRIPING & MARKINGS.
	EXISTING SIGN TO REMAIN.
	SIGNALIZED INTERSECTION.



RE-STRIPE TO PROVIDE FOR TWO THROUGH LANES AND BIKE LANE.

RE-STRIPE TO PROVIDE FOR AN EXCLUSIVE LEFT-TURN LANE AND BIKE LANES.

INSTALL NEW TRAFFIC SIGNAL.

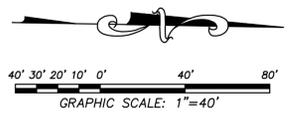
RE-STRIPE TO PROVIDE FOR A SECOND LEFT-TURN LANE AND BIKE LANES.

INSTALL SPLITTER ISLAND CURB TO ENFORCE RIGHT-TURN ONLY MOVEMENT IN.

STRIPE FOR 5 FOOT BIKE LANE.

MODIFY TRAFFIC SIGNAL FOR DUAL NORTHBOUND LEFT-TURNS AND SHIFT OF SOUTHBOUND LEFT-TURN.

RE-STRIPE TO SHIFT LEFT-TURN LANE TO THE EAST TO ACCOMMODATE TRUCK TURNING MOVEMENT AND BIKE LANES.



PREPARED BY:

LINSOTT LAW & GREENSPAN ENGINEERS

TRANSPORTATION PLANNING - TRAFFIC ENGINEERING - PARKING

600 South Lake Avenue, Suite 500, Pasadena CA 91106 (626) 796-2322
 2 Executive Circle, Suite 250, Irvine CA 92614 (714) 641-1587
 4542 Ruffner Street, Suite 100, San Diego, CA 92111 (658) 300-8800

REVISIONS					
No.	DATE	BY	DESCRIPTION	APP'D BY	DATE

BENCH MARK:

APPROVALS		
DIVISION	BY	DATE
DESIGN		
TRAFFIC		
RIGHT OF WAY		
UTILITIES		
PROJECT MANAGER		
APPROVED		
CHIEF ENGINEER	RCE #	DATE

FIGURE 12-2

CONCEPTUAL IMPROVEMENT PLAN

ORANGE AVE AND SPRING ST

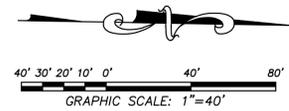
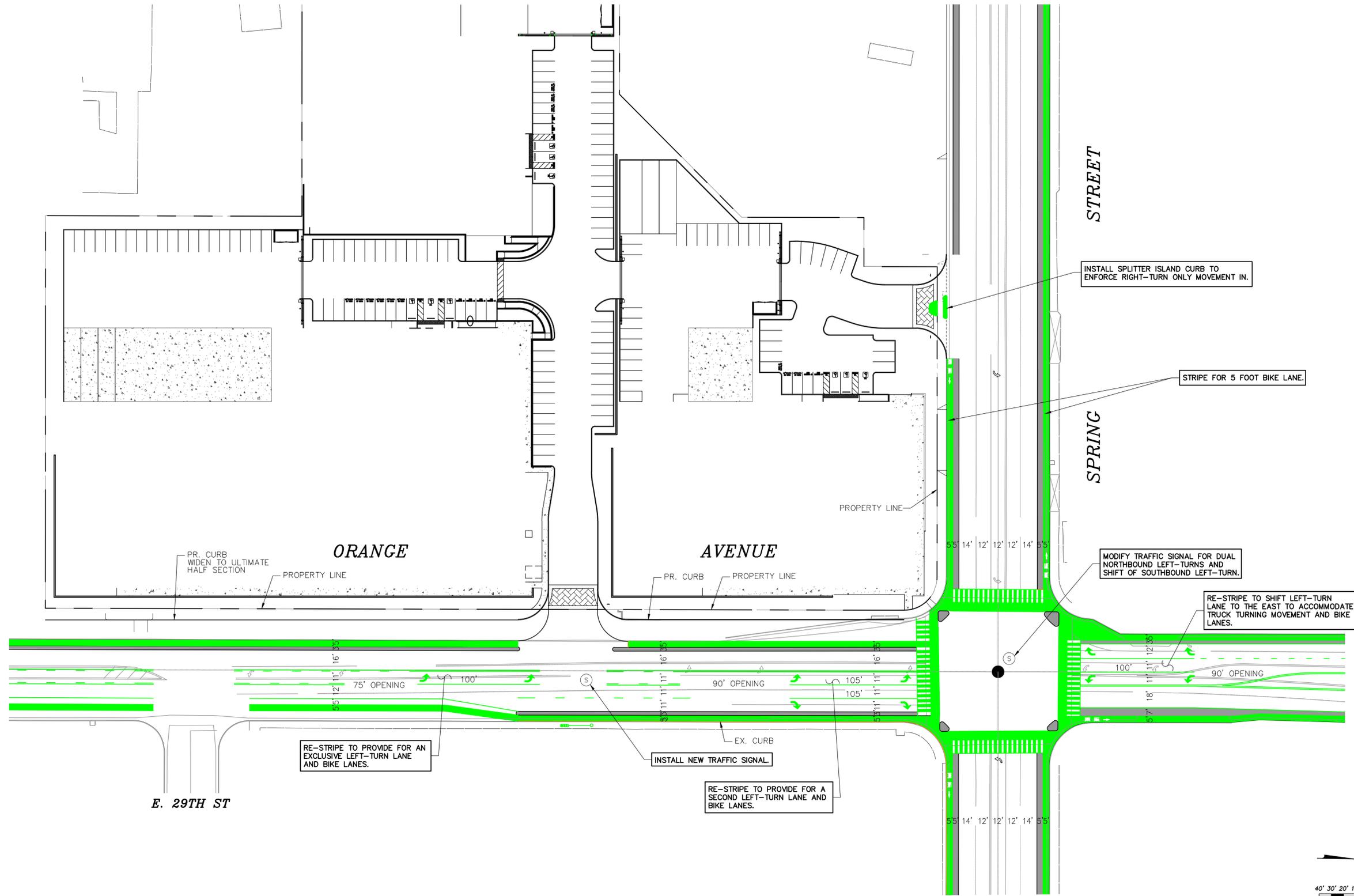
WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENT

PROJECT NO.	DWG	SHEET	OF
-------------	-----	-------	----

N:\3900\2183975 - Spring Street Industrial, Long Beach\DWG\CONCEPT DESIGN\3975 STRIPING ORANGE STREET AT 2.dwg 12/11/19 1:54pm

LEGEND

-  EXISTING STRIPING & MARKINGS TO REMAIN.
-  EXISTING STRIPING & MARKINGS TO BE REMOVED.
-  PROPOSED STRIPING & MARKINGS.
-  EXISTING SIGN TO REMAIN.
-  SIGNALIZED INTERSECTION.



E. 29TH ST

PREPARED BY:



LINSCOTT, LAW & GREENSPAN, ENGINEERS
 TRANSPORTATION PLANNING - TRAFFIC ENGINEERING - PARKING
 □ 600 South Lake Avenue, Suite 500, Pasadena CA 91106 (626) 796-2322
 ■ 2 Executive Circle, Suite 250, Irvine CA 92614 (714) 641-1587
 □ 4542 Ruffner Street, Suite 100, San Diego, CA 92111 (658) 300-8800

REVISIONS					
No.	DATE	BY	DESCRIPTION	APP'D BY	DATE

BENCH MARK:

APPROVALS		
DIVISION	BY	DATE
DESIGN		
TRAFFIC		
RIGHT OF WAY		
UTILITIES		
PROJECT MANAGER		
APPROVED		
CHIEF ENGINEER	RCE #	DATE

FIGURE 12-3
CONCEPTUAL IMPROVEMENT PLAN
ORANGE AVE AND SPRING ST
WITH ORANGE AVENUE BIKEWAY IMPROVEMENT

N:\3900\2183975 - Spring Street Industrial, Long Beach\DWG\CONCEPT DESIGN\3975 STRIPING ORANGE STREET ROAD DIET 2 updated.dwg 12/11/19 1:55pm

**TABLE 12-1
YEAR 2038 BUILDOUT PROJECT FAIR SHARE CONTRIBUTION**

Key Intersections	Impacted Time Period	(1) Existing Traffic	(2) Project Only Traffic	(3) Year 2038 Buildout Plus Project Traffic	(4) Net Project Percent Increase
1. Orange Avenue at 32 nd Street	PM	2,013	42	2,528	8.16%
3. Orange Avenue at I-405 SB Ramps	AM	1,897	66	2,428	12.43%
	PM	2,001	68	2,555	12.27%

Notes:
 Net Project Percent Increase (4) = [Column (2)] / [Column (3) – Column (1)]

13.0 SITE ACCESS EVALUATION

13.1 Site Access

As described in further detail in Section 12, vehicular access to the Project site is proposed via one (1) unsignalized right-turn only driveway along Spring Street and one (1) full access signalized driveway along Orange Avenue.

13.1.1 Project Driveway 2 Traffic Signal Warrant Analysis

A traffic signal warrant assessment has been completed for the Project Driveway 2 at Orange Avenue. The need for signalization is assessed on the basis of the peak-hour traffic signal warrant (Warrant #3) described in the *CA MUTCD*. Warrant #3 has two parts: 1) Part A evaluates peak hour vehicle delay for traffic on the minor street approach with the highest delay and 2) Part B evaluates peak-hour traffic volumes on the major and minor streets. This method provides an indication of whether peak-hour traffic conditions or peak-hour traffic volume levels are, or would be, sufficient to justify installation of a traffic signal.

Table 13-1 summarizes the results of the peak-hour traffic signal warrant analysis conducted for Project Driveway 2 under Year 2021 Cumulative Plus Project and Year 2038 buildout Plus Project traffic conditions. Review of *Table 13-1* indicates that Project Driveway 2 does not meet the traffic signal warrant criteria for both traffic conditions. However, a traffic signal is recommended at this location to help facilitate ingress and egress of large trucks to avoid congestion along Orange Avenue.

Appendix H presents the signal warrant analysis worksheets for the proposed Project driveways.

13.1.2 Level of Service Analysis

Table 13-2 summarizes the intersection operations at the proposed driveways for Year 2021 Cumulative plus Project traffic conditions and Year 2038 buildout plus Project traffic conditions upon completion and full occupancy of the proposed Project. Please note that *Table 13-2* includes an alternative analysis for Orange Avenue at Project Driveway 2 which assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. Review of *Table 13-2* indicates that the proposed driveways are forecast to operate at acceptable LOS C or better during both the AM and PM peak hours. Therefore, project site access is considered adequate.

Appendix I presents the level of service calculation worksheets for the proposed Project driveways.

13.1.3 Project Driveway 2 Queueing Analysis

Table 13-3 summarizes the queueing results for the northbound left-turn lane at Project Driveway 2/Orange Avenue for Year 2021 cumulative plus Project and Year 2038 Buildout Plus Project traffic conditions. Please note that *Table 13-3* includes an alternative analysis for Orange Avenue at Project Driveway 2 which assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. Review of *Table 13-3*

indicates that the northbound left-turn pocket is anticipated to have a queue of one (1) vehicle. As such, providing storage of 100-feet for the northbound left-turn pocket is sufficient.

Appendix E presents the HCM queueing worksheets for the proposed Project driveways.

13.2 Sight Distance Evaluation

At intersections and/or project driveways, a substantially clear line of sight should be maintained between the driver of a vehicle waiting at the crossroad and the driver of an approaching vehicle. Adequate time must be provided for the waiting vehicle to either cross all lanes of through traffic, cross the near lanes and turn left, or turn right, without requiring through traffic to radically alter their speed. Review of the proposed site plan indicates that the sight lines at the proposed Project driveways are expected to be adequate.

Nevertheless, to ensure adequate sight distance is provided at the Project driveways upon completion of the Project, landscaping and/or hardscape on either side of the driveways should be designed such that a driver's clear line of sight is not obstructed and does not threaten vehicular or pedestrian safety, as determined by the City of Long Beach Traffic Engineer.

13.3 Internal Circulation

The on-site circulation was evaluated in terms of vehicle-pedestrian conflicts. Based on our review of the preliminary site plan, the overall layout does not create any unsafe vehicle-pedestrian conflict points and the driveway throating is sufficient such that access to parking spaces is not impacted by internal vehicle queuing/stacking. Curb return radii have been confirmed and are adequate for fire trucks, small service/delivery trucks (i.e. UPS, FedEx, and trash trucks), large delivery trucks (WB-65), and passenger vehicles.

However, given the design of Orange Avenue, from Spring Street south along Project frontage to just south of 29th Street, has not been determined and will need to be consistent with the Orange Avenue Bikeway Improvements project, it is recommended that access from Orange Avenue at the Project's signalized driveway be reviewed prior to finalization of the site plan to ensure that Project-related truck traffic can enter and exit the site adequately, subject to review and approval of the City of Long Beach Traffic Engineer.

The on-site circulation is very good based on our review of the proposed site plan, whereas the alignment, spacing, and throating of the Project driveways is adequate. The circulation around the buildings is adequate with sufficient sight distance along the drive aisles.

TABLE 13-1
PROJECT DRIVEWAY TRAFFIC SIGNAL WARRANT ANALYSIS SUMMARY¹³²

Key Intersection	Time Period	(1) Year 2021 Cumulative Plus Project Traffic Conditions		(2) Year 2038 Buildout Plus Project Traffic Conditions	
		Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?	Part A of Warrant 3 Satisfied?	Part B of Warrant 3 Satisfied?
B. Orange Avenue at Project Driveway 2	AM	No	No	No	No
	PM	No	No	No	No

¹³² Signal warrant checks based on Warrant 3, Part A - Peak-Hour Delay Warrant and Part B - Peak-Hour Volume Warrant are contained in the California MUTCD.

TABLE 13-2
PROJECT DRIVEWAY PEAK HOUR INTERSECTION CAPACITY ANALYSIS

Project Driveway	Time Period	Intersection Control	(1) Year 2021 Cumulative Plus Project Traffic Conditions		(2) Year 2038 Buildout Plus Project Traffic Conditions	
			ICU/HCM	LOS	ICU/HCM	LOS
			A. Project Driveway 1 at Spring Street	AM PM	One-Way Stop	10.9 s/v 13.6 s/v
B. Orange Avenue at Project Driveway 2						
<i>With Orange Avenue Bikeway Improvements</i>	AM PM	2Ø Traffic Signal	0.655 0.631	B B	0.728 0.703	C C
<i>Without Orange Avenue Bikeway Improvement</i>	AM PM	2Ø Traffic Signal	0.392 0.390	A A	0.429 0.426	A A

Notes:

- s/v = seconds per vehicle (delay)
- LOS = Level of Service, please refer to *Table 3-2* for the LOS definitions

TABLE 13-3
PROJECT DRIVEWAY 2 PEAK HOUR INTERSECTION QUEUING ANALYSIS¹³³

Key Study Intersection	Storage Provided (feet)	(1) Year 2021 Cumulative Plus Project Traffic Conditions				(2) Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
B. Orange Avenue at Project Driveway 2 <i>With Orange Avenue Bikeway Improvements</i> Northbound Left-Turn	100'	38'	Yes	25'	Yes	38'	Yes	28'	Yes
<i>Without Orange Avenue Bikeway Improvements</i> Northbound Left-Turn	100'	25'	Yes	25'	Yes	25'	Yes	25'	Yes

¹³³ Queues are based on HCM 85th Percentile, unless otherwise noted.

14.0 CONGESTION MANAGEMENT PROGRAM COMPLIANCE ASSESSMENT

The Congestion Management Program (CMP) was created statewide as a result of Proposition 111 and has been implemented locally by the Los Angeles County Metropolitan Transportation Authority (LACMTA). The CMP for Los Angeles County requires that the traffic impact of individual development projects of potential regional significance be analyzed. A specific system of arterial roadways plus all freeways comprise the CMP system.

For purposes of the CMP, a significant impact occurs when the proposed Project increases traffic demand on a CMP facility by two percent of capacity ($V/C \geq 0.02$), causing LOS F ($V/C > 1.00$). If the facility is already at LOS F, a significant impact occurs when the proposed Project increases traffic demand on a CMP facility by two percent of capacity ($V/C \geq 0.02$).

14.1 Traffic Impact Review

As required by the current *Congestion Management Program for Los Angeles County*, a review has been made of designated monitoring locations on the CMP highway system for potential impact analysis. Per CMP TIA criteria, the geographic area examined in the TIA must include the following, at a minimum:

- All CMP arterial monitoring intersections, including freeway on and off-ramp intersections, where the project will add 50 or more trips during either the AM or PM weekday peak hours.
- Mainline freeway-monitoring stations where the project will add 150 or more trips, in either direction, during the AM or PM weekday peak hours.

14.1.1 Intersections

The following CMP intersection monitoring locations in the project vicinity have been identified:

<u>CMP Station</u>	<u>Intersection/Jurisdiction</u>
No. 35	Lakewood Boulevard at Willow Street

As stated earlier, the CMP guidelines require that arterial monitoring intersection locations must be examined if the proposed Project will add 50 or more trips during either the AM or PM weekday peak hours (of adjacent street traffic) at CMP monitoring intersections. Based on the proposed Project's trip generation potential, trip distribution and trip assignment, the Project will not add more than 50 at the identified CMP intersections during the weekday AM peak hour or PM peak hour. Therefore, a CMP intersection traffic impact analysis is not required.

14.1.2 Freeways

The following CMP freeway monitoring locations in the project vicinity have been identified:

<u>CMP Station</u>	<u>Intersection/Jurisdiction</u>
No. 1078	SR-710, north of Willow Street

As stated earlier, the CMP TIA guidelines require that freeway monitoring locations must be examined if the proposed Project will add 150 or more trips (in either direction) during either the AM or PM weekday peak periods. Based on the project's trip generation potential and distribution pattern, the proposed Project will not add more than 150 trips during the AM or PM peak hour at this CMP mainline freeway-monitoring location. Therefore, a CMP freeway traffic impact analysis is not required.

14.2 Transit Impact Review

As required by the current *Congestion Management Program for Los Angeles County*, a review has been made of the potential impacts of the project on transit service. As previously discussed and shown in *Figure 3-4*, a number of transit services exist in the project area, necessitating the following transit impact review.

The project trip generation, as shown in *Table 5-1*, was adjusted by values set forth in the CMP (i.e. person trips equal 1.4 times vehicle trips, and transit trips equal 7 percent of the total person trips) to estimate project-related transit trip generation. Pursuant to the CMP guidelines, the proposed Project is forecast to generate 12 transit trips (9 inbound and 3 outbound) during the AM peak hour and 13 transit trips (4 inbound and 9 outbound) during the PM peak hour. Over a 24-hour period the proposed Project is forecasted to generate 74 daily weekday transit trips.

It is anticipated that the existing transit service in the project area would be able to accommodate the project generated transit trips. Therefore, given the number of transit trips generated by the project and the existing transit routes in the project vicinity, it is concluded that the existing public transit system would not be significantly impacted by the proposed Project.

15.0 CALTRANS FREEWAY ANALYSIS

In response to Caltrans requirements, a freeway weaving and/or merge analysis for five (5) segments/ramps between Atlantic Avenue and Cherry Avenue have been prepared using the methods provided in the *Highway Capacity Manual (HCM)*. The following five (5) segments were analyzed based on existing, Year 2021 and Year 2038 traffic conditions with and without the proposed Project:

Key Freeway Segment/Ramp

6. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp (Weaving)
7. I-405 NB segment, west of 32nd Street On-Ramp (Weaving)
8. I-405 SB segment, between Atlantic Avenue and Orange Avenue (Weaving)
9. I-405 SB segment, between Orange Avenue and Cherry Avenue (Weaving)
10. Cherry Avenue On-ramp, merge to I-405 SB (Merge)

Figures 15-1 through *15-3* present the locations of the key freeway segments/ramps.

Caltrans “endeavors to maintain a target LOS at the transition between LOS “C” and LOS “D” on State highway facilities”; it does not require that LOS “D” (shall) be maintained. However, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. For this analysis, LOS D is the target level of service standard and will be utilized to assess the Project impacts at the state-controlled study freeway segments. Based on Caltrans criteria, a Project’s impact is considered significant if the Project causes the LOS to change from an acceptable LOS (i.e., LOS D or better) to a deficient LOS (i.e. LOS E or F). If the existing Caltrans facility is operating at less than appropriate target LOS, the existing MOE should be maintained. For freeways, any increase in density (pc/mi/ln) is considered an impact if the existing LOS is E or F.

15.1 Volume Development

The freeway peak-hour traffic volume forecast was developed based on existing Caltrans traffic counts and existing counts at the study intersections. Volumes for Year 2021 and Year 2038 were developed based on the same methodology as described in Section 6.0 of this report. *Figures 15-4* and *15-5* presents Existing, Year 2021 and Year 2038 AM and PM peak hour traffic volumes, with and without the proposed Project, for Segments 1 through 3. *Figures 15-6* and *15-7* presents Existing, Year 2021 and Year 2038 AM and PM peak hour traffic volumes, with and without the proposed Project, for Segment 4. *Figures 15-8* and *15-9* presents Existing, Year 2021 and Year 2038 AM and PM peak hour traffic volumes, with and without the proposed Project, for Segment 5.



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KEY
 = WEAVING ASSESSMENT

FIGURE 15-1

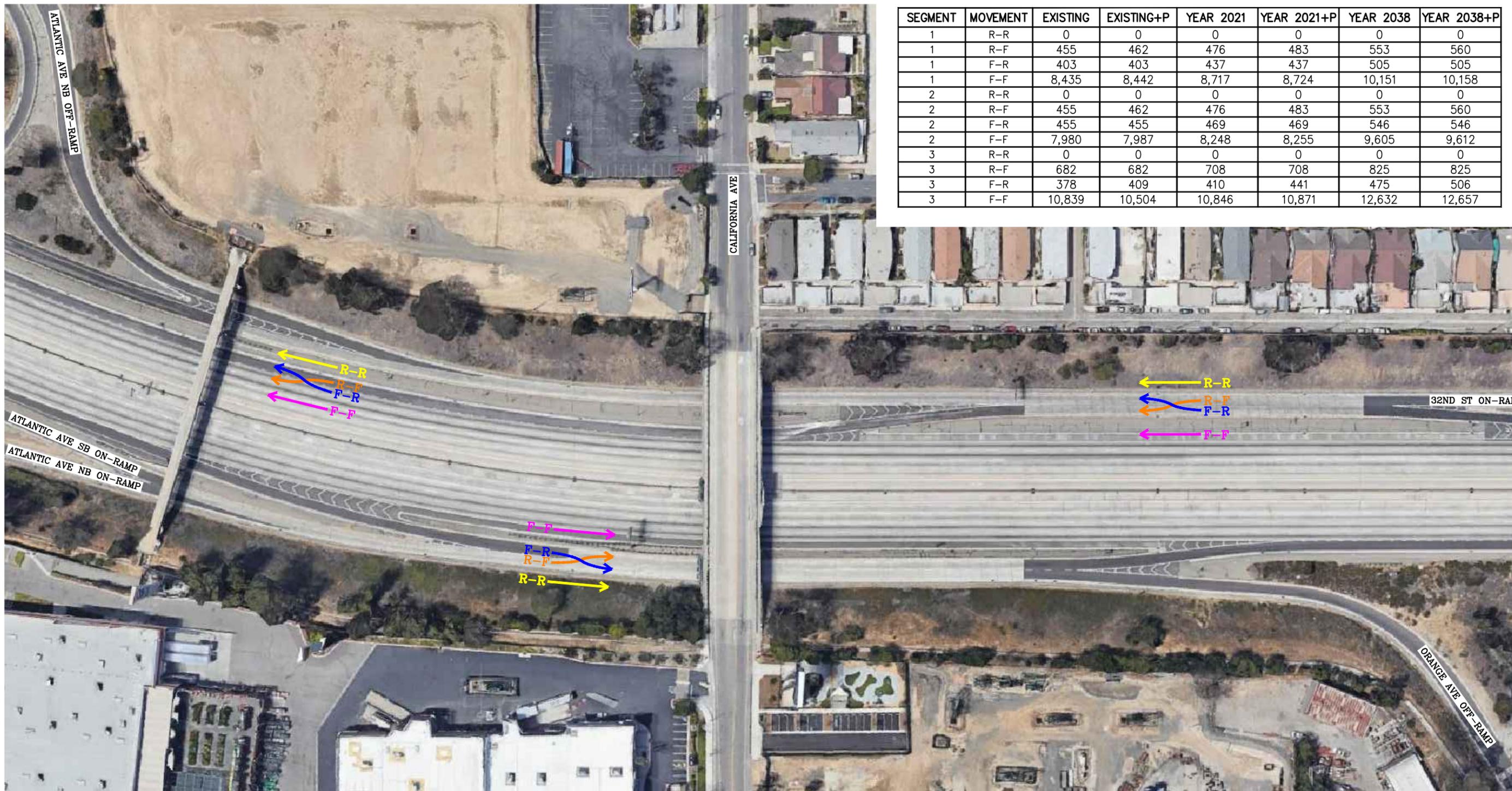
FREWAY ANALYSIS LOCATIONS FOR SEGMENTS 1 THROUGH 3
 SPRING STREET INDUSTRIAL, LONG BEACH



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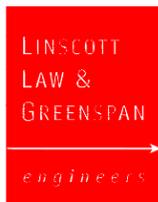


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SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
1	R-R	0	0	0	0	0	0
1	R-F	455	462	476	483	553	560
1	F-R	403	403	437	437	505	505
1	F-F	8,435	8,442	8,717	8,724	10,151	10,158
2	R-R	0	0	0	0	0	0
2	R-F	455	462	476	483	553	560
2	F-R	455	455	469	469	546	546
2	F-F	7,980	7,987	8,248	8,255	9,605	9,612
3	R-R	0	0	0	0	0	0
3	R-F	682	682	708	708	825	825
3	F-R	378	409	410	441	475	506
3	F-F	10,839	10,504	10,846	10,871	12,632	12,657

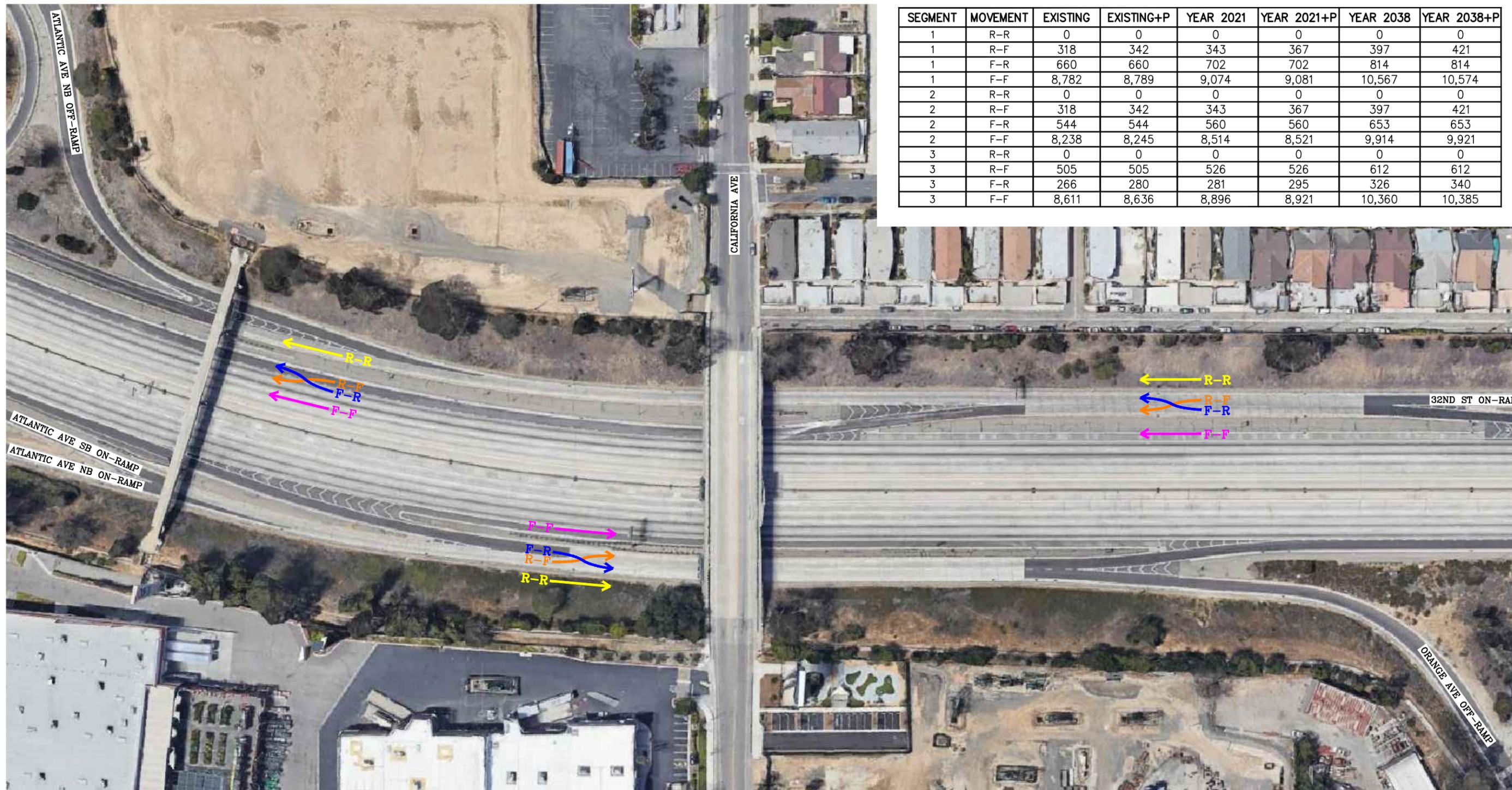
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KEY

→	R-R = RAMP TO RAMP
→	R-F = RAMP TO FREEWAY
→	F-R = FREEWAY TO RAMP
→	F-F = FREEWAY TO FREEWAY

FIGURE 15-4
AM PEAK HOUR TRAFFIC VOLUMES
FOR FREEWAY SEGMENTS 1 THROUGH 3
 SPRING STREET INDUSTRIAL, LONG BEACH



SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
1	R-R	0	0	0	0	0	0
1	R-F	318	342	343	367	397	421
1	F-R	660	660	702	702	814	814
1	F-F	8,782	8,789	9,074	9,081	10,567	10,574
2	R-R	0	0	0	0	0	0
2	R-F	318	342	343	367	397	421
2	F-R	544	544	560	560	653	653
2	F-F	8,238	8,245	8,514	8,521	9,914	9,921
3	R-R	0	0	0	0	0	0
3	R-F	505	505	526	526	612	612
3	F-R	266	280	281	295	326	340
3	F-F	8,611	8,636	8,896	8,921	10,360	10,385

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KEY

—	R-R = RAMP TO RAMP
—	R-F = RAMP TO FREEWAY
—	F-R = FREEWAY TO RAMP
—	F-F = FREEWAY TO FREEWAY

FIGURE 15-5
PM PEAK HOUR TRAFFIC VOLUMES
FOR FREEWAY SEGMENTS 1 THROUGH 3
 SPRING STREET INDUSTRIAL, LONG BEACH

SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
4	R-R	0	0	0	0	0	0
4	R-F	442	446	459	463	535	539
4	F-R	347	347	357	357	416	416
4	F-F	10,839	10,864	11,197	11,222	13,041	13,066



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KEY

—	R-R = RAMP TO RAMP
—	R-F = RAMP TO FREEWAY
—	F-R = FREEWAY TO RAMP
—	F-F = FREEWAY TO FREEWAY

FIGURE 15-6
AM PEAK HOUR TRAFFIC VOLUMES
FOR FREEWAY SEGMENT 4
 SPRING STREET INDUSTRIAL, LONG BEACH

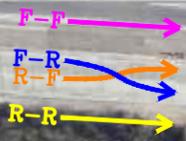
SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
4	R-R	0	0	0	0	0	0
4	R-F	268	280	285	297	330	342
4	F-R	544	544	560	560	653	653
4	F-F	8,572	8,597	8,862	8,887	10,319	10,344



ORANGE AVE ON-RAMP

WALNUT AVE

CHERRY AVE OFF-RAMP



KEY

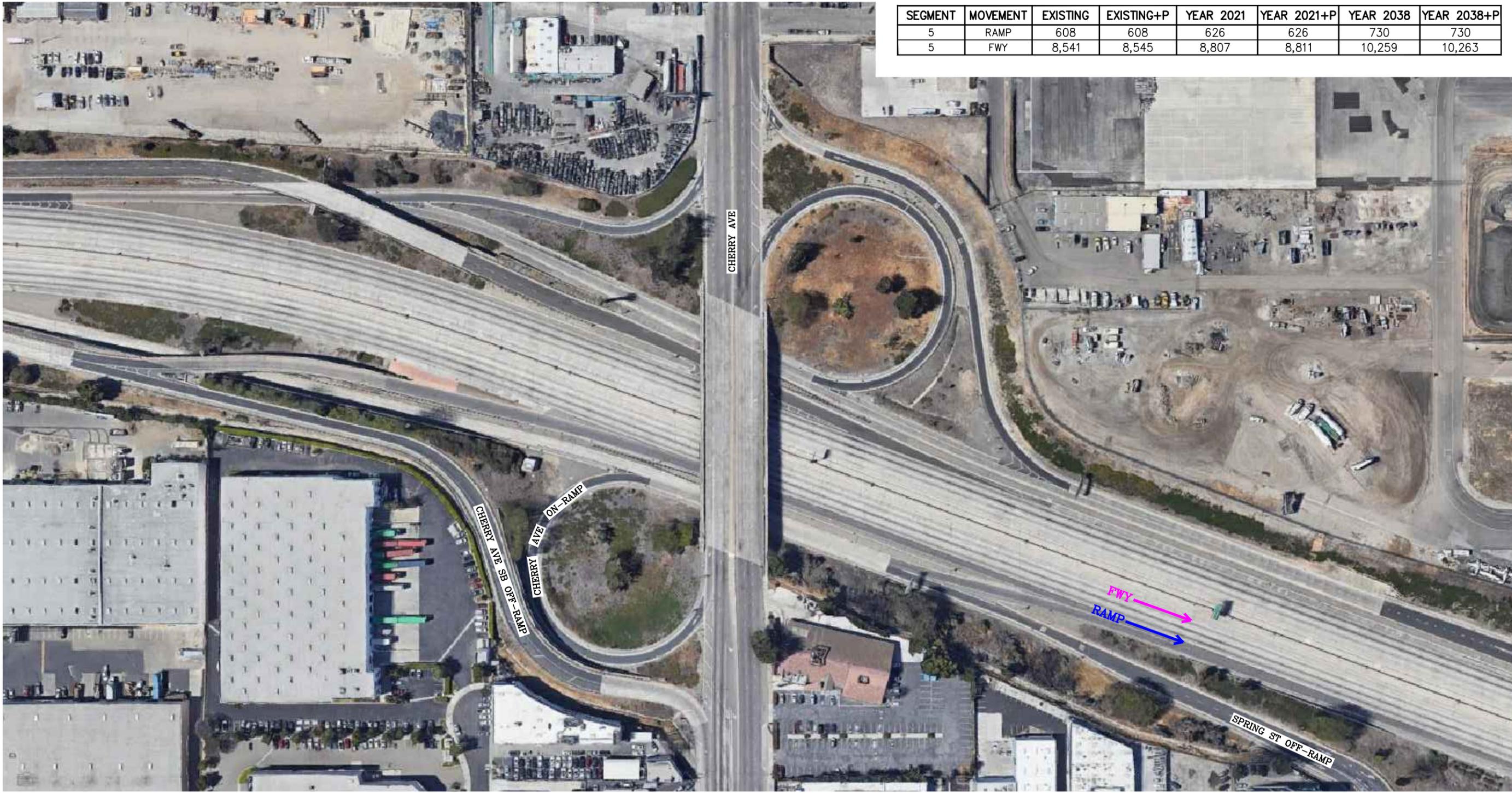
- R-R = RAMP TO RAMP
- R-F = RAMP TO FREEWAY
- F-R = FREEWAY TO RAMP
- F-F = FREEWAY TO FREEWAY

LINSCOTT
LAW &
GREENSPAN
engineers



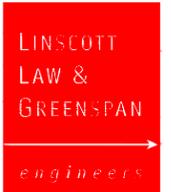
FIGURE 15-7

PM PEAK HOUR TRAFFIC VOLUMES
FOR FREEWAY SEGMENT 4
SPRING STREET INDUSTRIAL, LONG BEACH



SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
5	RAMP	608	608	626	626	730	730
5	FWY	8,541	8,545	8,807	8,811	10,259	10,263

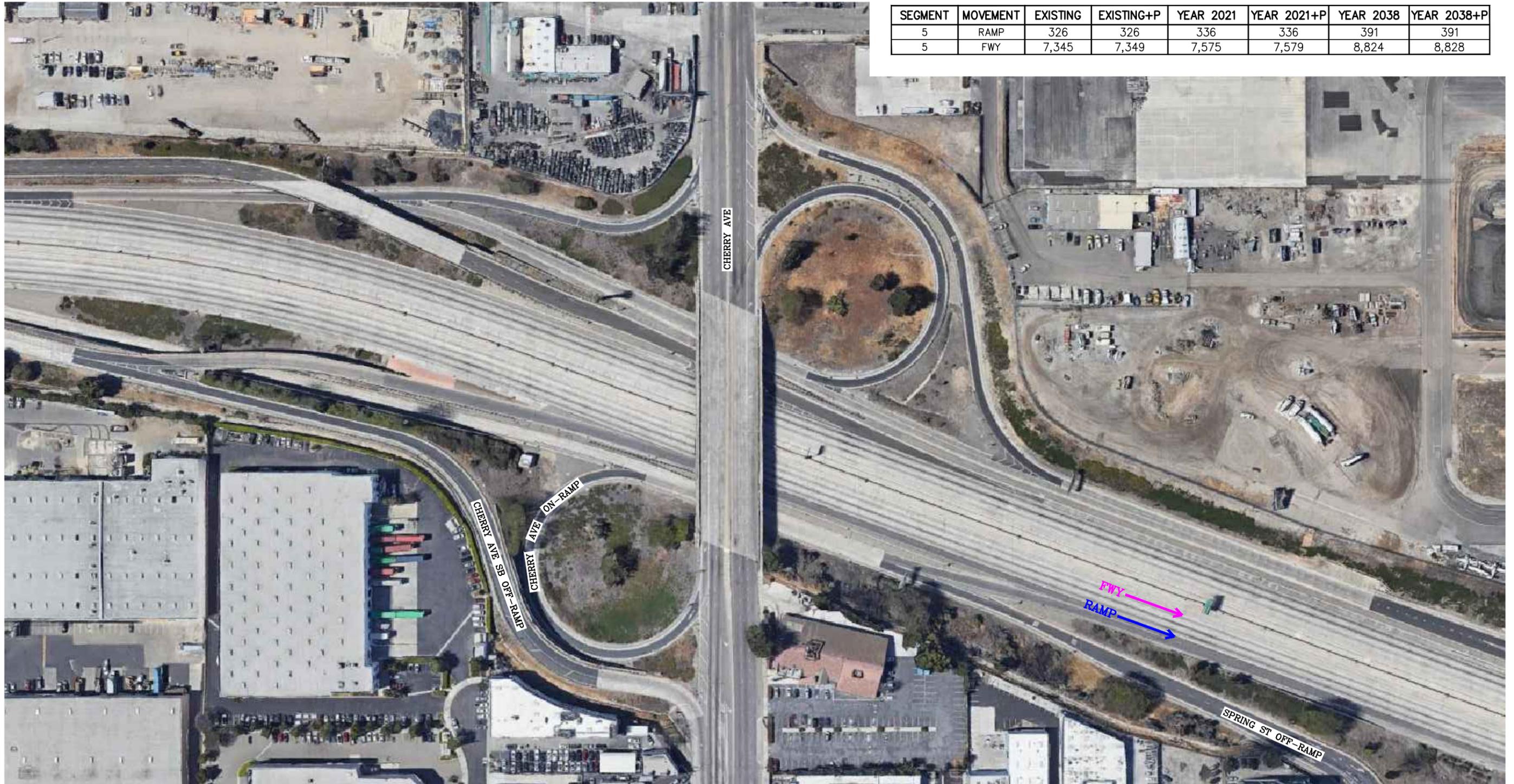
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KEY
 FWY = FREEWAY
 RAMP = RAMP

FIGURE 15-8
AM PEAK HOUR TRAFFIC VOLUMES
FOR FREEWAY SEGMENT 5
 SPRING STREET INDUSTRIAL, LONG BEACH

SEGMENT	MOVEMENT	EXISTING	EXISTING+P	YEAR 2021	YEAR 2021+P	YEAR 2038	YEAR 2038+P
5	RAMP	326	326	336	336	391	391
5	FWY	7,345	7,349	7,575	7,579	8,824	8,828



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KEY
 FWY = FREEWAY
 RAMP = RAMP

FIGURE 15-9

PM PEAK HOUR TRAFFIC VOLUMES FOR FREEWAY SEGMENT 5
 SPRING STREET INDUSTRIAL, LONG BEACH

15.2 Existing Plus Project Traffic Conditions

Table 15-1 summarizes the peak hour Level of Service results at the five (5) key freeway segments/ramps for existing plus project traffic conditions. The first column (1) of *Table 15-1* presents a summary of existing AM and PM peak hour traffic conditions. The second column (2) lists existing plus project traffic conditions. The third column (3) indicates whether the traffic associated with the Project will have a significant impact based on the Caltrans impact criteria defined in this report.

15.2.1 Existing Traffic Conditions

Review of Column 1 of *Table 15-1* indicates that four (4) of the five freeway segments/ramps currently operate at unacceptable LOS F in both the AM and PM peak hours. The remaining segment/ramp currently operates at LOS C during the weekday AM and PM peak hours. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

15.2.2 Existing Plus Project Traffic Conditions

Review of Column 2 of *Table 15-1* indicates that the same four (4) freeway segments/ramps will continue to operate adversely with the addition of project traffic. Although no density values are report the Project's contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Appendix J presents the existing and existing plus project HCS/LOS worksheets.

15.3 Year 2021 Traffic Conditions

Table 15-2 summarizes the peak hour Level of Service results at the five (5) key freeway segments/ramps for Year 2021 traffic conditions. The first column (1) of *Table 15-2* presents a summary of Year 2021 cumulative AM and PM peak hour traffic conditions. The second column (2) lists Year 2021 cumulative plus project traffic conditions. The third column (3) indicates whether the traffic associated with the Project will have a significant impact based on the significant impact criteria defined in this report.

15.3.1 Year 2021 Cumulative Traffic Conditions

Review of Column 1 of *Table 15-2* indicates that four (4) of the five freeway segments/ramps are forecast to operate at unacceptable LOS F in both the AM and PM peak hours. The remaining segment/ramp currently operates at LOS C during the weekday AM and PM peak hours. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

15.3.2 Year 2021 Cumulative Plus Project Traffic Conditions

Review of Column 2 of *Table 15-2* indicates that the same four (4) freeway segments/ramps will continue to operate adversely with the addition of project traffic. Although no density values are report the Project's contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Appendix J presents the Year 2021 HCS/LOS worksheets.

15.4 Year 2038 Traffic Conditions

Table 15-3 summarizes the peak hour Level of Service results at the five (5) key freeway segments/ramps for Year 2038 traffic conditions. The first column (1) of *Table 15-3* presents a summary of Year 2038 cumulative AM and PM peak hour traffic conditions. The second column (2) lists Year 2038 cumulative plus project traffic conditions. The third column (3) indicates whether the traffic associated with the Project will have a significant impact based on the significant impact criteria defined in this report.

15.4.1 Year 2038 Buildout Traffic Conditions

Review of Column 1 of *Table 15-3* indicates that four (4) of the five freeway segments/ramps are forecast to operate at unacceptable LOS F in both the AM and PM peak hours. The remaining segment/ramp currently operates at LOS D or better during the weekday AM and PM peak hours. The segments/ramps operating adversely include the following:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>Density</u>	<u>LOS</u>	<u>Density</u>	<u>LOS</u>
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	--	F	--	F
2. I-405 NB segment, west of 32 nd Street On-Ramp	--	F	--	F
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	--	F	--	F
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	--	F	--	F

Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

15.4.2 Year 2038 Buildout Plus Project Traffic Conditions

Review of Column 2 of *Table 15-3* indicates that the same four (4) freeway segments/ramps will continue to operate adversely with the addition of project traffic. Although no density values are report the Project's contribution to the freeway system can be considered significantly impacted at the four locations operating at LOS F.

Appendix J presents the Year 2038 HCS/LOS worksheets.

15.4.3 Freeway Traffic Improvements

A review of the density calculations summarized in *Tables 15-1* through *15-3* indicates that the development of the Project is anticipated to significantly contribute to the impacted locations. However, the I-405 Freeway is controlled exclusively by the State and there is no mechanism by which the lead agency (City of Long Beach) can construct or guarantee the construction of any improvements to these freeways segments. Therefore, the proposed Project's incremental impacts on freeway study segments assessed in the report are considered unmitigatable as there are no feasible mitigation measures that will reduce cumulative mainline impacts to below significance thresholds or achieve acceptable service level goals.

**TABLE 15-1
EXISTING PLUS PROJECT PEAK HOUR FREEWAY CAPACITY ANALYSIS SUMMARY**

Key Freeway Segment/Ramp	Analysis Type	Time Period	(1) Existing Traffic Conditions		(2) Existing Plus Project Traffic Conditions		(3) Impact
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Yes/No
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	Weaving	AM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
		PM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
2. I-405 NB segment, west of 32 nd Street On-Ramp	Weaving	AM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
		PM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	Weaving	AM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
		PM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	Weaving	AM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
		PM	-- ¹³⁴	F	-- ¹³⁴	F	Yes
5. Cherry Avenue On-Ramp, merge to I-405 SB	Merge	AM	31.6	C	31.6	C	No
		PM	25.9	C	25.9	C	No

Note:

- **Bold Delay/LOS values** indicate adverse service levels based on the LOS standards mentioned in this report

¹³⁴ Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

**TABLE 15-2
YEAR 2021 CUMULATIVE PEAK HOUR FREEWAY CAPACITY ANALYSIS SUMMARY**

Key Freeway Segment	Analysis Type	Time Period	(1) Year 2021 Cumulative Traffic Conditions		(2) Year 2021 Cumulative Plus Project Traffic Conditions		(3) Impact
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Yes/No
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	Weaving	AM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
		PM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
2. I-405 NB segment, west of 32 nd Street On-Ramp	Weaving	AM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
		PM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	Weaving	AM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
		PM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	Weaving	AM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
		PM	-- ¹³⁵	F	-- ¹³⁵	F	Yes
5. Cherry Avenue On-Ramp, merge to I-405 SB	Merge	AM	32.8	C	32.8	C	No
		PM	26.8	C	26.8	C	No

Note:

- **Bold Delay/LOS values** indicate adverse service levels based on the LOS standards mentioned in this report

¹³⁵ Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

TABLE 15-3
YEAR 2038 BUILDOUT PEAK HOUR FREEWAY CAPACITY ANALYSIS SUMMARY

Key Freeway Segment	Analysis Type	Time Period	(1) Year 2038 Buildout Traffic Conditions		(2) Year 2038 Buildout Plus Project Traffic Conditions		(3) Impact
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Yes/No
1. I-405 NB segment, east of Atlantic Avenue NB Off-Ramp	Weaving	AM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
		PM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
2. I-405 NB segment, west of 32 nd Street On-Ramp	Weaving	AM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
		PM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
3. I-405 SB segment, between Atlantic Avenue and Orange Avenue	Weaving	AM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
		PM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
4. I-405 SB segment, between Orange Avenue and Cherry Avenue	Weaving	AM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
		PM	-- ¹³⁶	F	-- ¹³⁶	F	Yes
5. Cherry Avenue On-Ramp, merge to I-405 SB	Merge	AM	40.2	D	40.2	D	No
		PM	31.8	C	31.8	C	No

Note:

- **Bold Delay/LOS values** indicate adverse service levels based on the LOS standards mentioned in this report

¹³⁶ Based on Chapter 13 of the HCM, density (pc/mi/ln) values are not reported when weaving segment volumes exceed the capacity. Therefore, when the v/c value exceeds 1.0 the service level that is reported is LOS F.

16.0 ALTERNATIVE ANALYSIS FOR I-405 NB RAMP CLOSURE AT 32ND STREET

Based on information provided by the City of Signal Hill, the I-405 NB ramps at 32nd Street (Intersection #2) may be removed under long-term buildout traffic conditions, however, exact details are still unknown at this time. Therefore, an alternative analysis has been prepared to analyze the effects of the ramp removal on the fifteen (15) study intersections. This alternative analysis includes shifts in long-term buildout volumes from the ramps on 32nd Street to the ramps on either Cherry Avenue or Atlantic Avenue.

16.1 Alternative Project Traffic Distribution and Assignment

Figures 16-1 and *16-2* illustrate the general, directional traffic distribution pattern for the proposed Project for both passenger vehicles and trucks, respectively, with the removal of I-405 NB Ramps/32nd Street. Project traffic volumes both entering and exiting the project site have been distributed and assigned to the adjacent street system based on the following considerations:

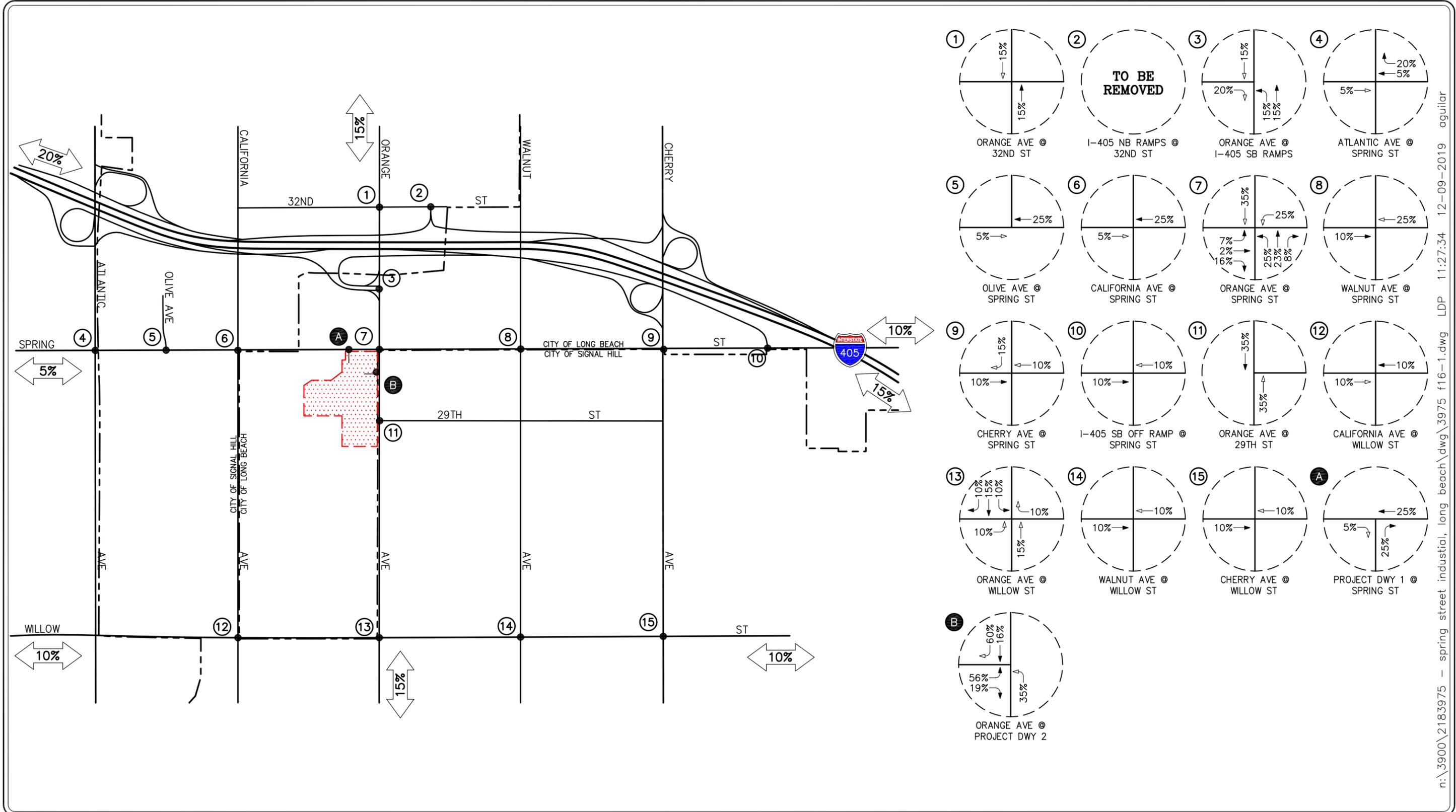
- Removal of I-405 NB ramps at 32nd Street,
- location of site access points in relation to the surrounding street system,
- the site's proximity to major traffic carriers and regional access routes,
- physical characteristics of the circulation system such as lane channelization and presence of traffic signals that affect travel patterns,
- City of Long Beach and Signal Hill designated truck routes, and
- ingress/egress availability at the project site, plus parking layout and allocation within the subject property.

The anticipated AM and PM peak hour traffic volumes associated with the proposed Project are presented in *Figures 16-3* and *16-4*, respectively. The traffic volume assignments presented in *Figures 16-3* and *16-4* reflect the traffic distribution characteristics shown in *Figures 16-1* and *16-2* and the traffic generation forecast presented in the upper portion of *Table 5-1*.

16.2 Alternative Year 2038 Volumes

Figures 16-5 and *16-6* present future AM and PM peak hour long-term buildout traffic volumes at the fifteen (15) key study intersections for the Year 2038, respectively, with shifts in volumes to account for the ramp closure. Please note that the buildout traffic volumes represent the accumulation of existing traffic, ambient growth traffic and cumulative projects traffic.

Figures 16-7 and *16-8* illustrate Year 2038 forecast AM and PM peak hour traffic volumes with the inclusion of the trips generated by the proposed Project, respectively.

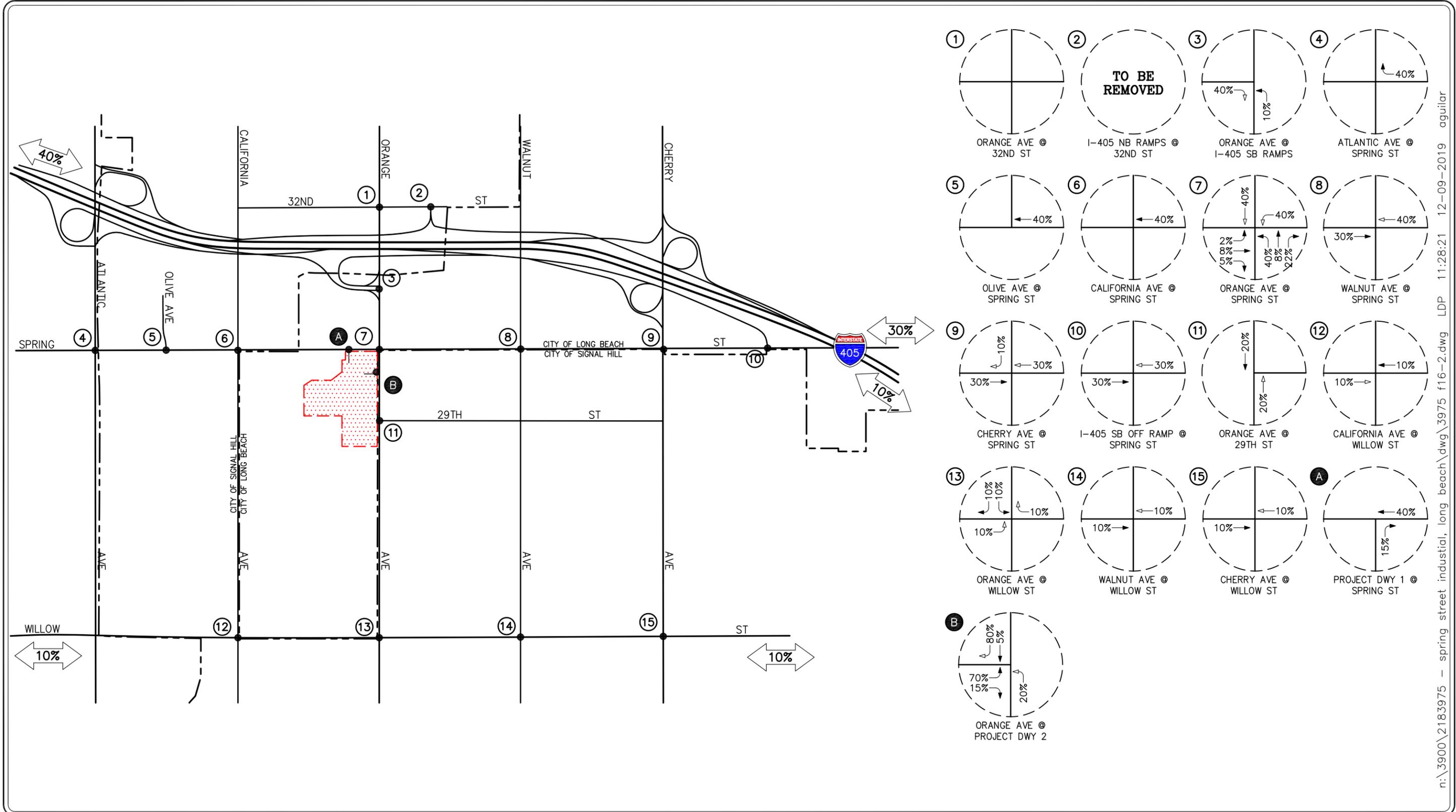


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- KEY**
- ⊕ = STUDY INTERSECTION
 - ← = INBOUND PERCENTAGE
 - = OUTBOUND PERCENTAGE
 - ▨ = PROJECT SITE

FIGURE 16-1
ALTERNATIVE PROJECT DISTRIBUTION PATTERN – PASSENGER VEHICLES
 SPRING STREET INDUSTRIAL, LONG BEACH

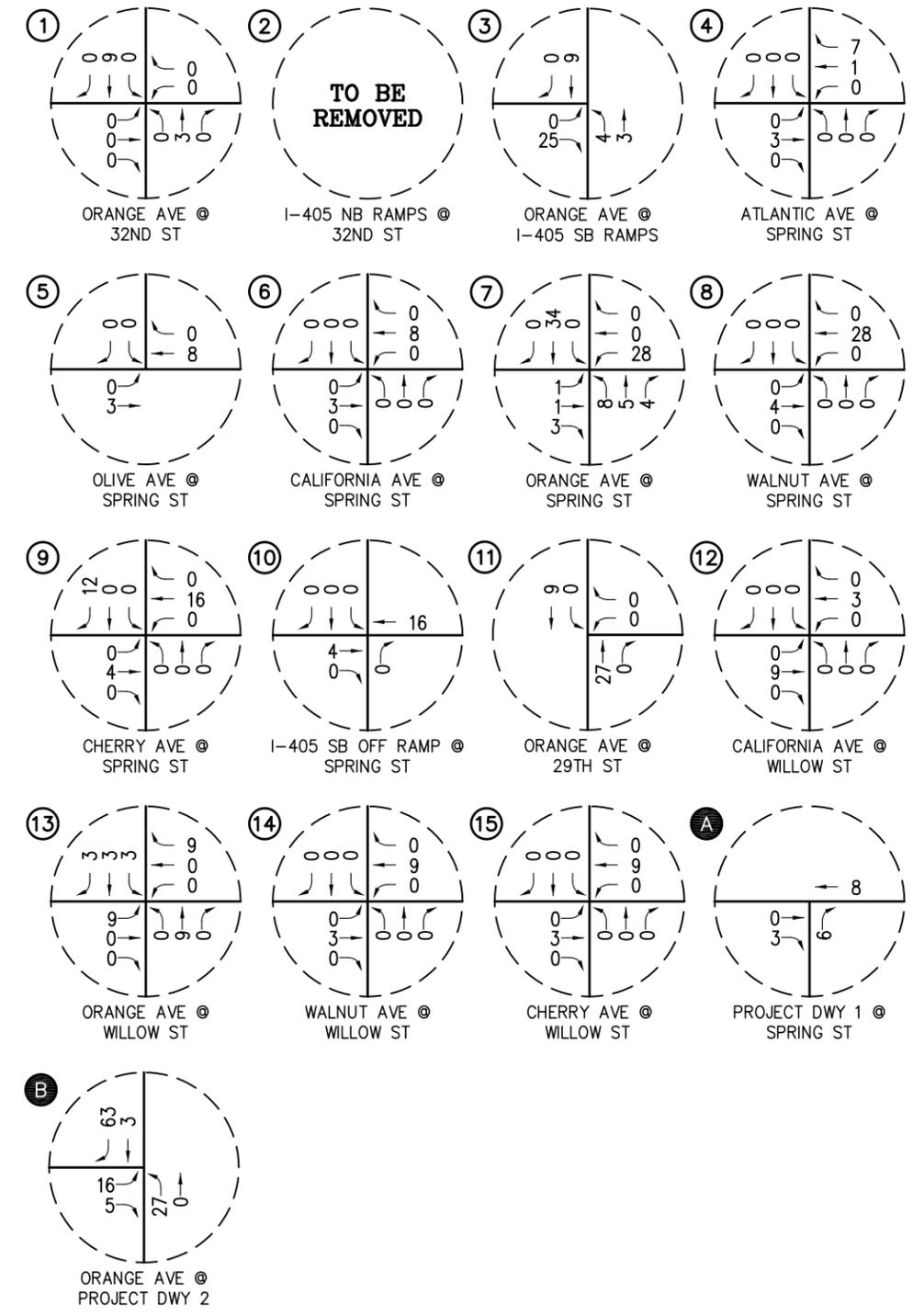
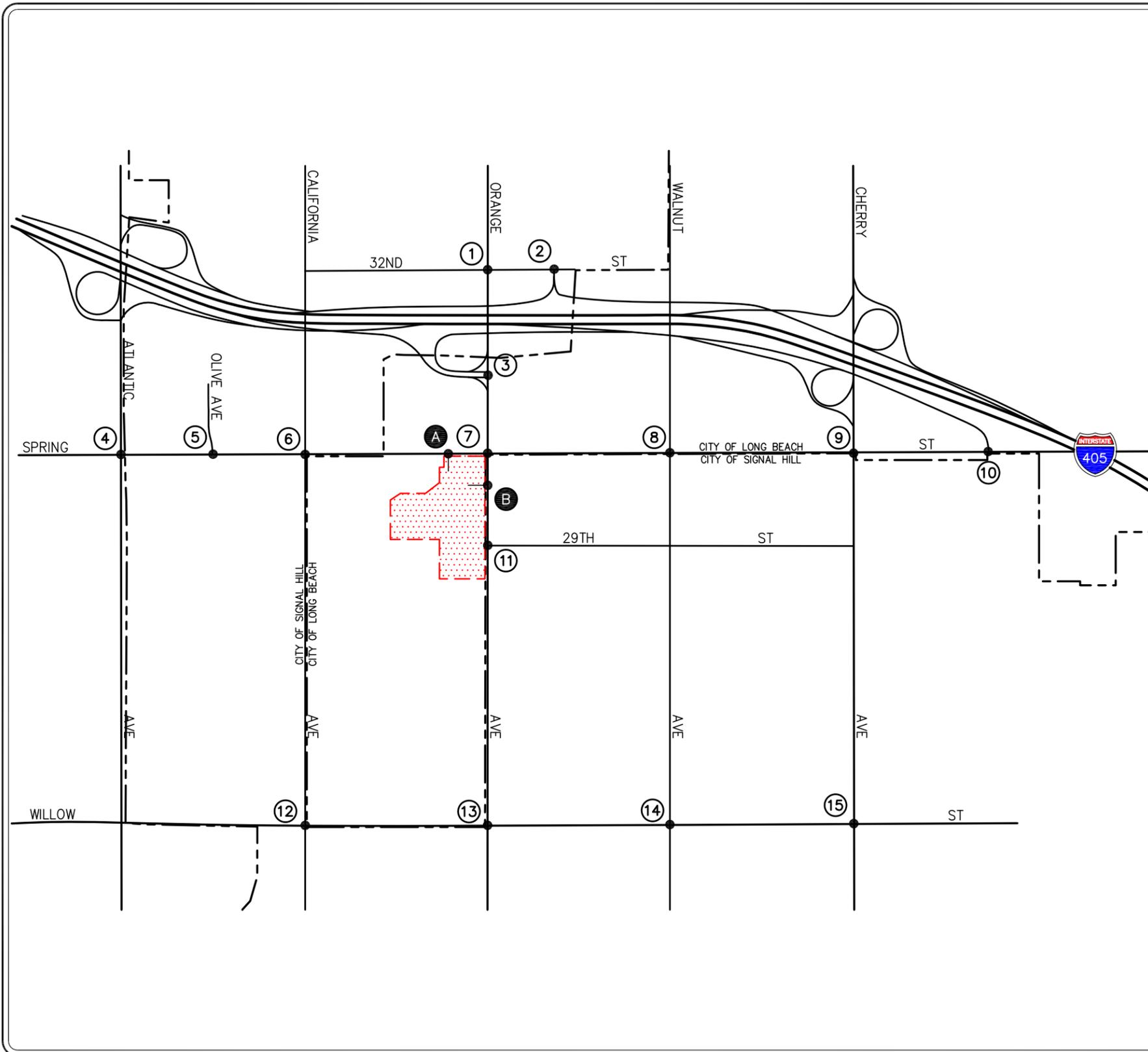


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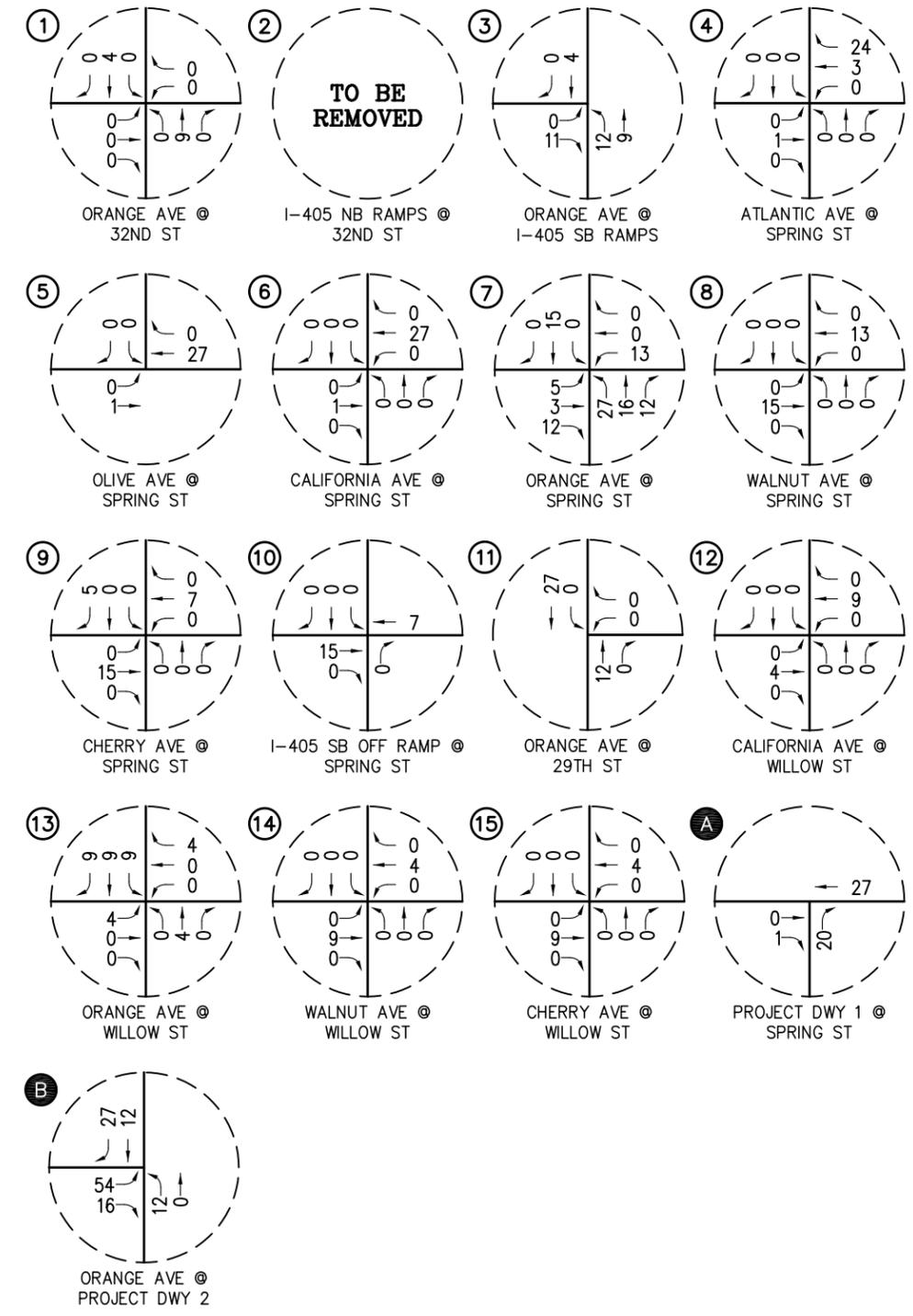
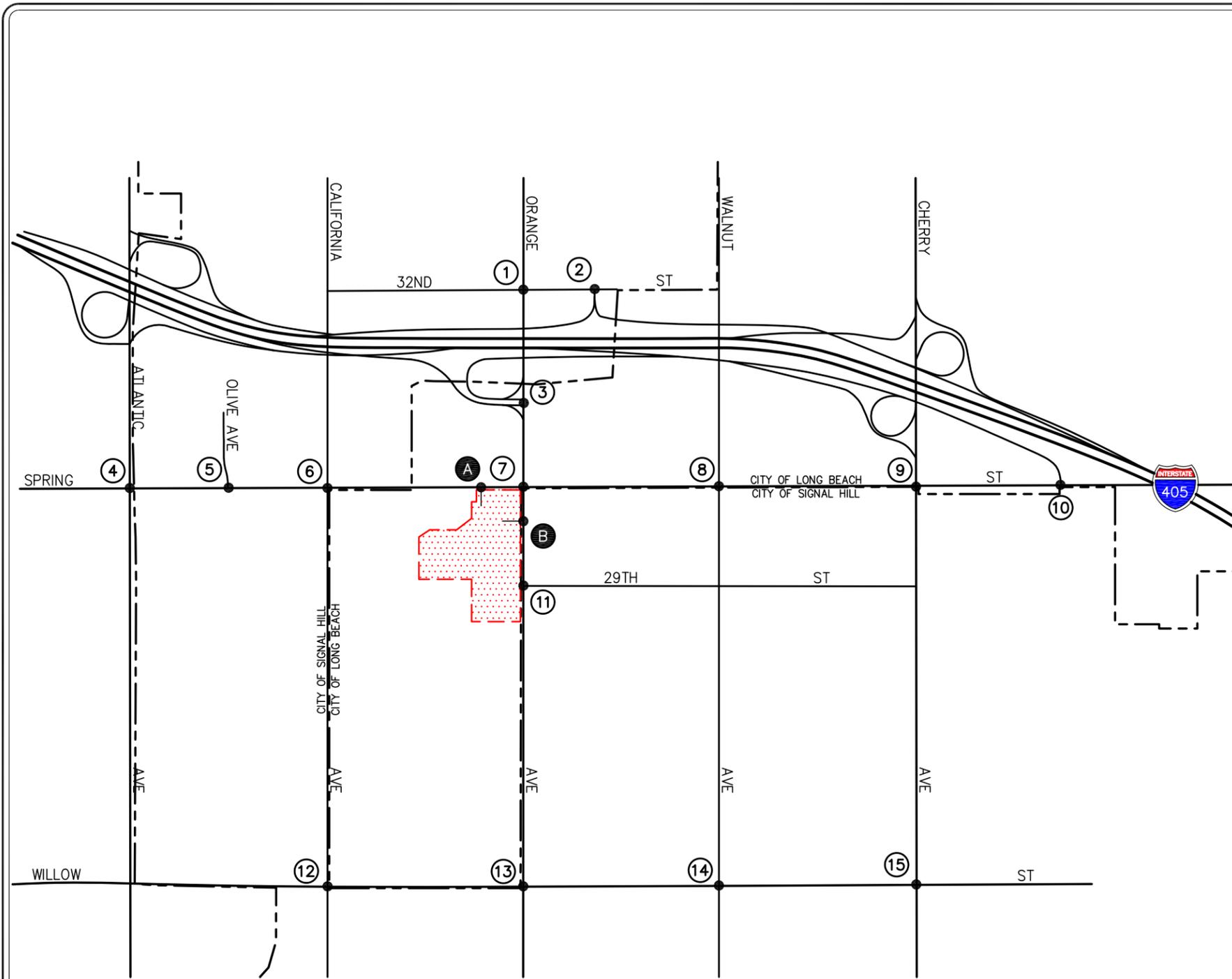


- KEY**
- ⊕ = STUDY INTERSECTION
 - ← = INBOUND PERCENTAGE
 - = OUTBOUND PERCENTAGE
 - ▨ = PROJECT SITE

FIGURE 16-2
ALTERNATIVE PROJECT DISTRIBUTION PATTERN - TRUCKS
 SPRING STREET INDUSTRIAL, LONG BEACH



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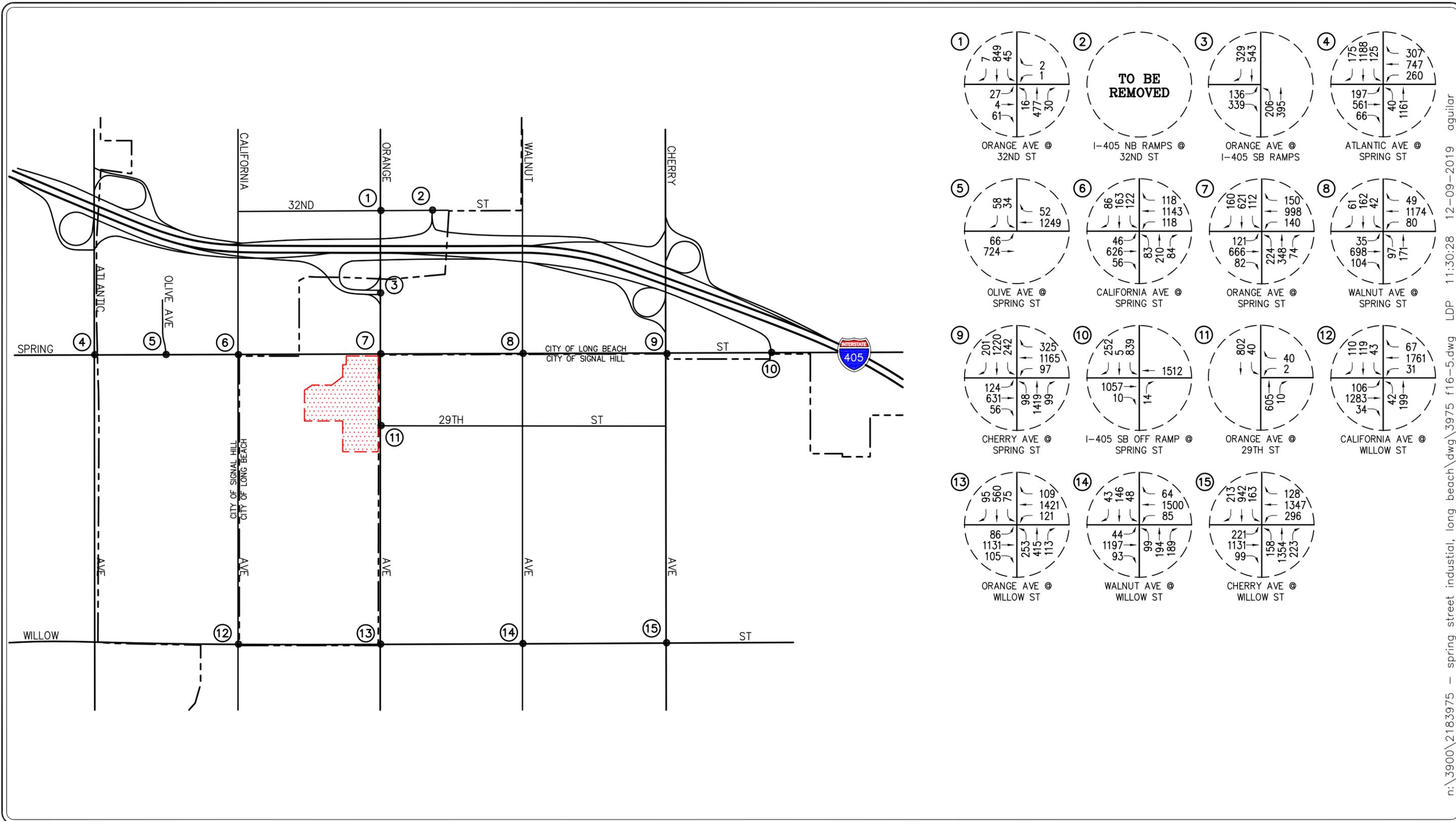
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KEY
 # = STUDY INTERSECTION
 [Red Dotted Box] = PROJECT SITE

FIGURE 16-4

ALTERNATIVE PM PEAK HOUR PROJECT TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

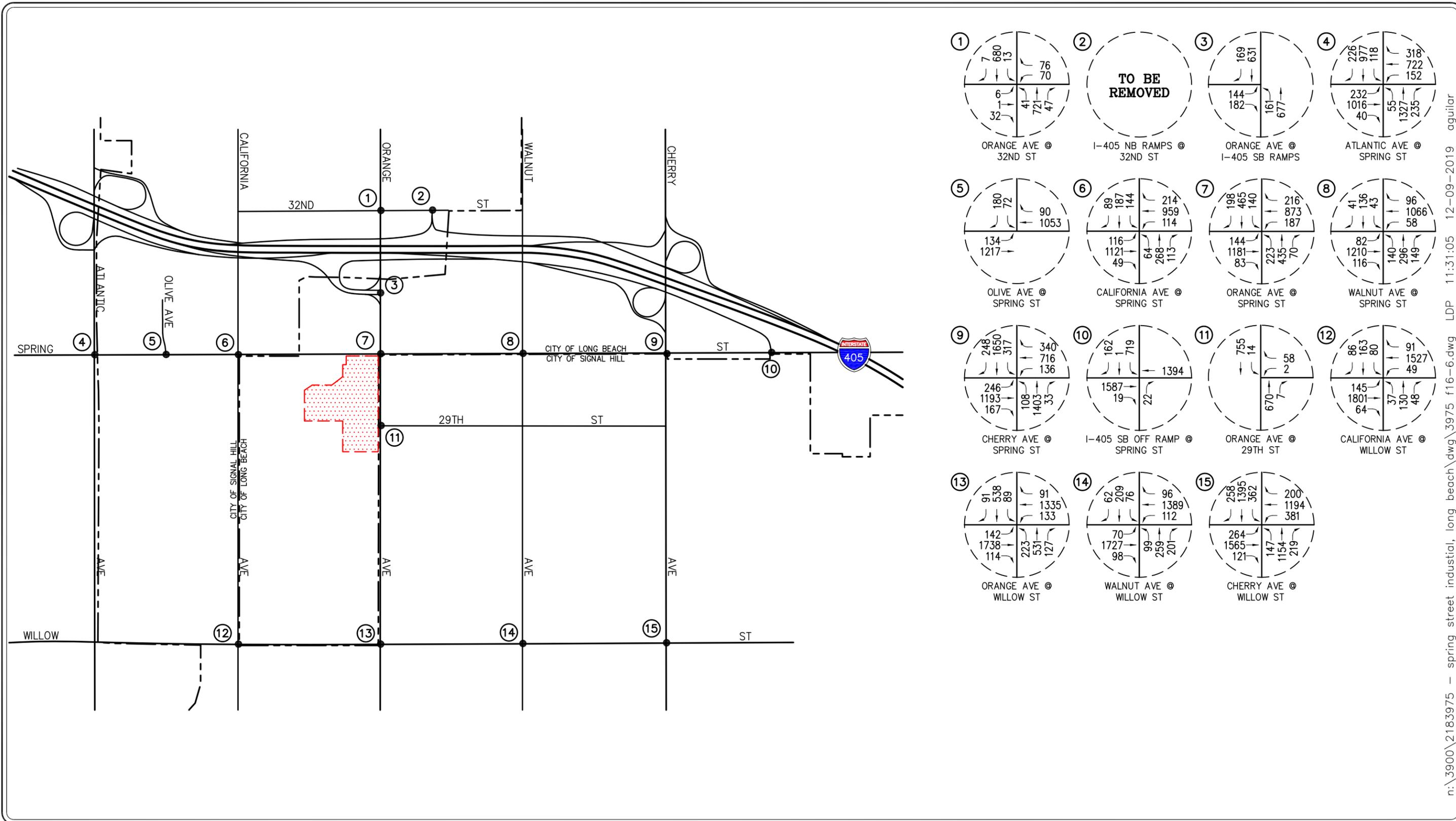


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KEY
 # = STUDY INTERSECTION
 [Red Dotted Box] = PROJECT SITE

FIGURE 16-5
 ALTERNATIVE YEAR 2038 BUILDOUT AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



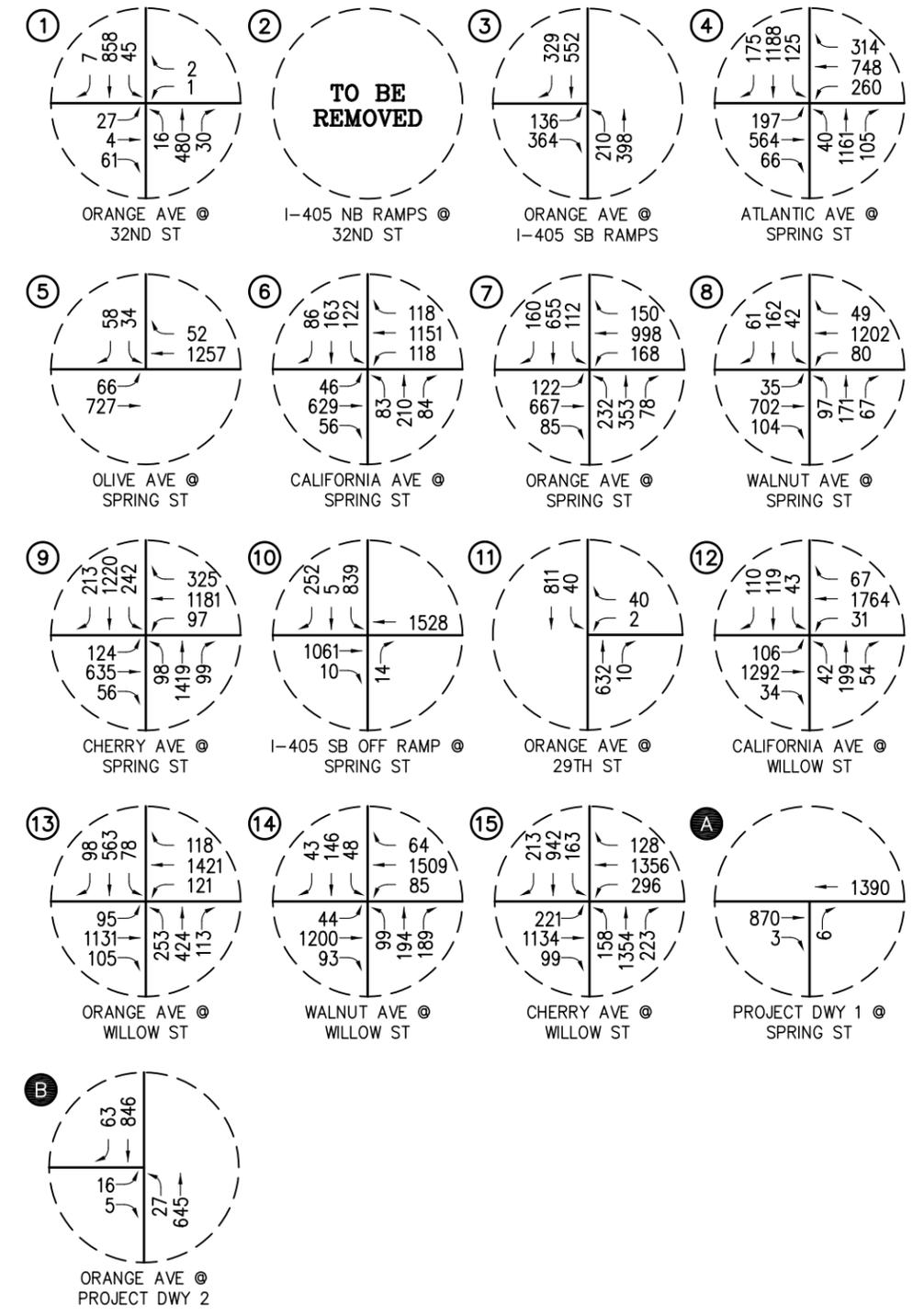
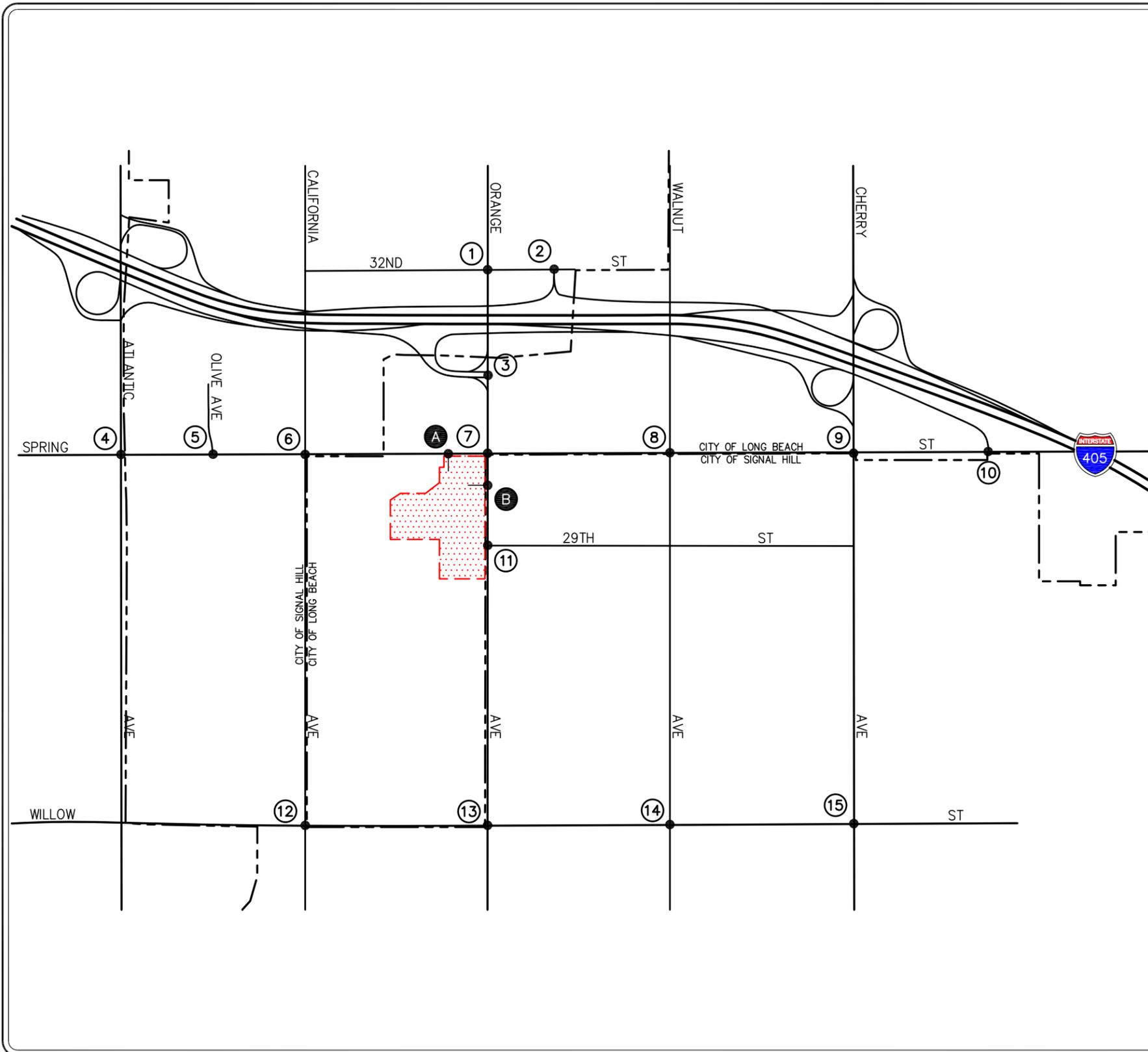
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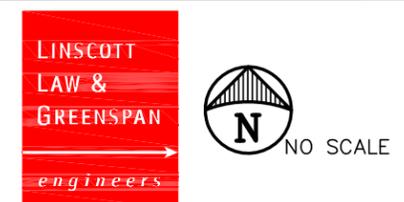
KEY
 # = STUDY INTERSECTION
 [Red Hatched Box] = PROJECT SITE

FIGURE 16-6

ALTERNATIVE YEAR 2038 BUILDOUT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

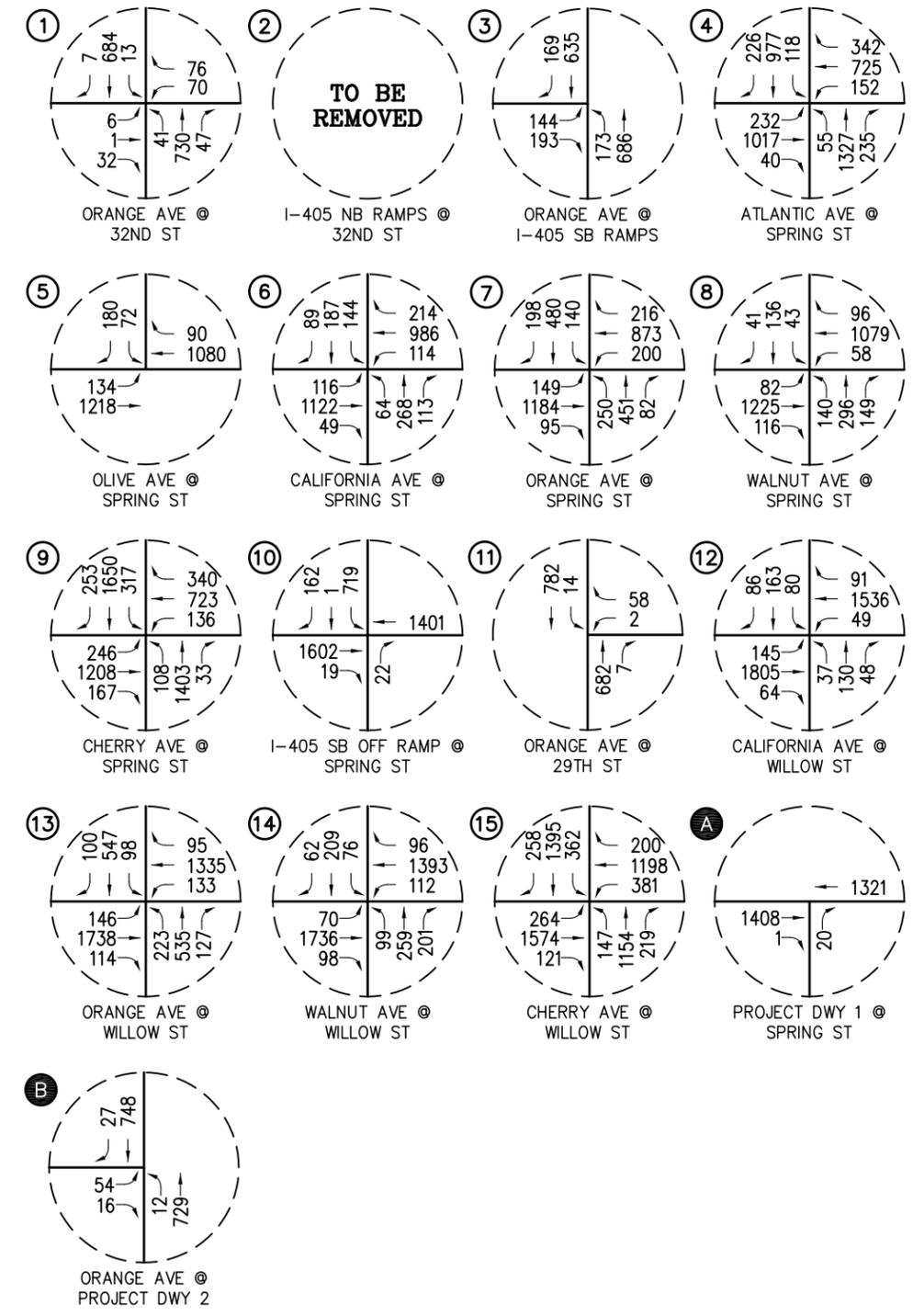
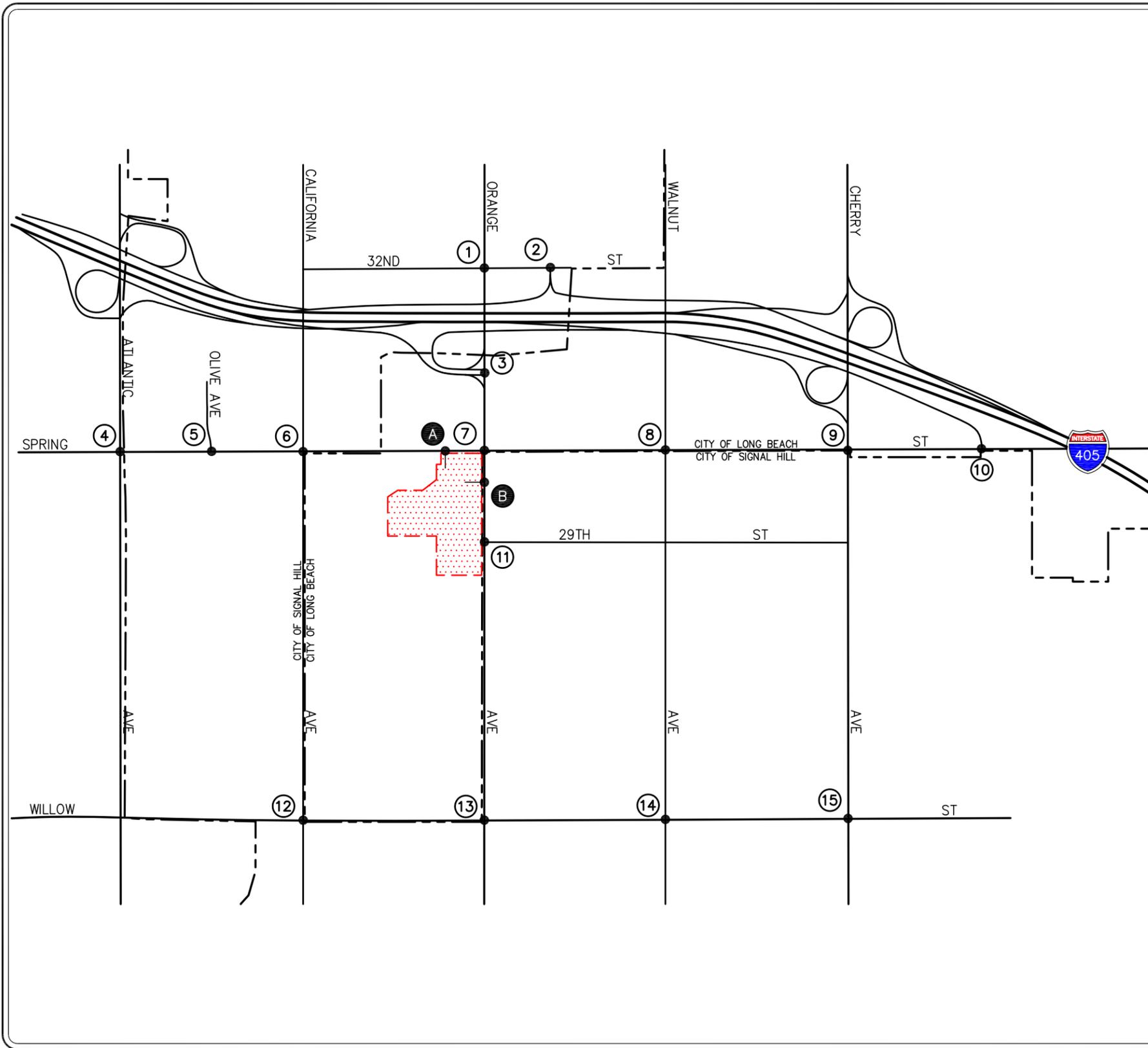


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KEY
 # = STUDY INTERSECTION
 [Red Dotted Box] = PROJECT SITE

FIGURE 16-7
 ALTERNATIVE YEAR 2038 BUILDOUT PLUS PROJECT AM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH



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KEY
 # = STUDY INTERSECTION
 [Red Dotted Box] = PROJECT SITE

FIGURE 16-8
 ALTERNATIVE YEAR 2038 BUILDOUT PLUS PROJECT PM PEAK HOUR TRAFFIC VOLUMES
 SPRING STREET INDUSTRIAL, LONG BEACH

16.3 Alternative Year 2038 Peak Hour Intersection Capacity Analysis

Table 16-1 is setup similar to that of *Table 8-3* with the exception that it included volumes pertaining to the reroute related to the ramp closure. Please note that the intersection of I-405 NB Ramps/32nd Street (Intersection #2) is permanently removed under these traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project’s potential traffic impacts with and without implementation of Long Beach’s planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from *Table 16-1* and instead summarized in a comparison table discussed later in this report.

16.3.1 Alternative Year 2038 Buildout Traffic Conditions

Review of Column 2 of *Table 16-1* indicates that the addition of ambient traffic growth and cumulative project traffic will cumulatively impact three (3) of the key study intersections, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the AM and PM peak hours. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
4. Atlantic Avenue at Spring Street	0.930	E	1.074	F
9. Cherry Avenue at Spring Street	--	--	0.931	E
15. Cherry Avenue at Willow Street	--	--	1.020	F

16.3.2 Alternative Year 2038 Buildout Plus Project Traffic Conditions

Review of column 3 of *Table 16-1* indicates that three (3) of the key study intersections are forecast to operate adversely with the addition of project traffic, not including Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining study intersections are forecast to operate at acceptable LOS D or better during the weekday AM and PM peak hours with the addition of project traffic. The intersections operating adversely are as follows:

<u>Key Intersection</u>	<u>AM Peak Hour</u>		<u>PM Peak Hour</u>	
	<u>ICU/HCM</u>	<u>LOS</u>	<u>ICU/HCM</u>	<u>LOS</u>
4. Atlantic Avenue at Spring Street	0.931	E	1.075	F
9. Cherry Avenue at Spring Street	--	--	0.935	E
15. Cherry Avenue at Willow Street	--	--	1.022	F

Review of column 4 indicates that all three intersections operating adversely are not considered significantly impacted when compared to the impact criteria identified in this report.

Appendix K presents the Alternative Year 2038 ICU/HCM LOS calculations for the key study intersections.

16.3.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3), Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 16-2* summarizes the peak hour Level of Service results with and without the planned bikeway improvements at the three (3) key study intersections for the Year 2038 horizon year. *Table 16-2* is set-up similarly to *Table 16-1*.

Review of column (2) of *Table 16-2* indicates that with the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

Review of column (3) of *Table 16-2* indicates that without the Orange Avenue bikeway improvements, all three (3) study intersections are forecast to operate at unacceptable LOS E or F during either the AM and/or PM peak hours with the addition of project traffic. Review of column (4) indicates that the intersection of Orange Avenue/Spring Street is considered significantly impacted. Review of column (5) indicates that the implementation of improvements at the intersection will help offset the project's impact. Although the intersections of Orange Avenue/I-405 SB Ramps and Orange Avenue/Willow Street is forecast to operate at unacceptable LOS E or F in the AM and/or PM peak hours, the intersections are not considered significantly impacted when compared to the LOS standards and significant impact criteria specified in this report.

TABLE 16-1
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Alternative Year 2038 Buildout Traffic Conditions		(3) Alternative Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Alternative Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
1. Orange Avenue at 32 nd Street	AM	0.719	C	0.703	C	0.709	C	0.006	No	--	--
	PM	0.856	D	0.656	B	0.662	B	0.006	No	--	--
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	--	--	--	--	--	--	--	--
	PM	14.3 s/v	B	--	--	--	--	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ¹³⁷	AM	44.0 s/v	E	--	--	--	--	--	--	--	--
	PM	90.6 s/v	F	--	--	--	--	--	--	--	--
4. Atlantic Avenue at Spring Street	AM	0.732	C	0.930	E	0.931	E	0.001	No	--	--
	PM	0.828	D	1.074	F	1.075	F	0.001	No	--	--
5. Olive Avenue at Spring Street	AM	0.454	A	0.584	A	0.587	A	0.003	No	--	--
	PM	0.519	A	0.653	B	0.662	B	0.009	No	--	--
6. California Avenue at Spring Street	AM	0.590	A	0.746	C	0.748	C	0.002	No	--	--
	PM	0.714	C	0.850	D	0.850	D	0.000	No	--	--
7. Orange Avenue at Spring Street ¹³⁷	AM	0.826	D	--	--	--	--	--	--	--	--
	PM	0.833	D	--	--	--	--	--	--	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹³⁷ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

TABLE 16-1 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Alternative Year 2038 Buildout Traffic Conditions		(3) Alternative Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Alternative Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS
8. Walnut Avenue at Spring Street	AM	0.584	A	0.704	C	0.713	C	0.009	No	--	--
	PM	0.717	C	0.856	D	0.860	D	0.004	No	--	--
9. Cherry Avenue at Spring Street	AM	0.690	B	0.820	D	0.824	D	0.004	No	--	--
	PM	0.738	C	0.931	E	0.935	E	0.004	No	--	--
10. I-405 SB Off-Ramp at Spring Street	AM	0.732	C	0.866	D	0.871	D	0.005	No	--	--
	PM	0.719	C	0.852	D	0.857	D	0.005	No	--	--
11. Orange Avenue at 29 th Street	AM	13.9 s/v	B	14.1 s/v	B	14.5 s/v	B	0.4 s/v	No	--	--
	PM	14.1 s/v	B	14.9 s/v	B	15.1 s/v	C	0.2 s/v	No	--	--
12. California Avenue at Willow Street	AM	0.613	B	0.758	C	0.759	C	0.001	No	--	--
	PM	0.593	A	0.712	C	0.714	C	0.002	No	--	--
13. Orange Avenue at Willow Street ¹³⁸	AM	0.736	C	--	--	--	--	--	--	--	--
	PM	0.845	D	--	--	--	--	--	--	--	--
14. Walnut Avenue at Willow Street	AM	0.510	A	0.603	B	0.605	B	0.002	No	--	--
	PM	0.617	B	0.741	C	0.743	C	0.002	No	--	--
15. Cherry Avenue at Willow Street	AM	0.687	B	0.823	D	0.825	D	0.002	No	--	--
	PM	0.818	D	1.020	F	1.022	F	0.002	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹³⁸ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

TABLE 16-2
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹³⁹

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Alternative Year 2038 Buildout Traffic Conditions		(3) Alternative Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact		(5) Alternative Year 2038 Buildout Plus Project Traffic Conditions with Improvements		
		ICU/HCM	LOS	ICU/HCM	LOS	ICU/HCM	LOS	Increase	Yes/No	ICU/HCM	LOS	
3. Orange Avenue at I-405 SB Ramps <i>With Orange Avenue Bikeway Improvements</i>	AM	44.0 s/v	E	116.0 s/v	F	124.9 s/v	F	--	No ¹⁴⁰	--	--	
	PM	90.6 s/v	F	229.5 s/v	F	250.9 s/v	F	--	No	--	--	
	<i>Without Orange Avenue Bikeway Improvement</i>	AM	44.0 s/v	E	83.4 s/v	F	87.5 s/v	F	--	No ¹⁴⁰	--	--
		PM	90.6 s/v	F	124.9 s/v	F	139.6 s/v	F	--	No	--	--
7. Orange Avenue at Spring Street <i>With Orange Avenue Bikeway Improvements</i>	AM	0.826	D	1.163	F	1.189	F	0.026	Yes	1.089	F	
	PM	0.833	D	1.166	F	1.205	F	0.039	Yes	1.081	F	
	<i>Without Orange Avenue Bikeway Improvement</i>	AM	0.826	D	1.063	F	1.089	F	0.026	Yes	0.870	D ¹⁴¹
		PM	0.833	D	1.042	F	1.081	F	0.039	Yes	0.923	E
13. Orange Avenue at Willow Street <i>With Orange Avenue Bikeway Improvements</i>	AM	0.736	C	1.040	F	1.051	E	0.011	No	--	--	
	PM	0.845	D	1.101	F	1.113	F	0.012	No	--	--	
	<i>Without Orange Avenue Bikeway Improvement</i>	AM	0.736	C	0.981	E	0.990	E	0.009	No	--	--
		PM	0.845	D	1.045	F	1.050	F	0.005	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 3-1 and 3-2* for the LOS definitions; s/v = seconds per vehicle (delay)

¹³⁹ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2038 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹⁴⁰ An unsignalized intersection impact is considered to be significant if the project causes an intersection at LOS D or better to degrade to LOS E or F, and the traffic signal warrant analysis determines that a signal is justified.

¹⁴¹ If acceptable level of service is desired at this location, additional improvements will need to be implemented at the intersection. These improvements include the construction of dual southbound left-turn lanes and restriping the eastbound approach to include an exclusive right-turn lane.

16.4 Alternative Year 2038 Caltrans Analysis

Table 16-3 is setup similar to that of *Table 16-3* with the exception that it included volumes pertaining to the reroute related to the ramp closure. Please note that the intersection of I-405 NB Ramps/32nd Street (Intersection #2) is permanently removed under these traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 16-3* includes the results for both alternatives.

16.4.1 Alternative Year 2038 Buildout Traffic Conditions

Review of Column 2 of *Table 16-3* indicates that the one (1) state-controlled study intersection is forecast to operate adversely. The intersection of Orange Avenue/I-405 SB Ramps is forecast to operate at unacceptable LOS F in the AM and PM peak hours for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. The remaining state-controlled study intersection is forecast to operate at LOS C during the weekday AM and PM peak hours.

16.4.2 Alternative Year 2038 Buildout Plus Project Traffic Conditions

Review of column 3 of *Table 16-3* indicates that the intersection of Orange Avenue/I-405 SB Ramps will continue to operate at unacceptable LOS F in the AM and PM peak hours with the addition of project traffic. The remaining state-controlled study intersection is forecast to continue to operate at LOS C during the weekday AM and PM peak hours.

Review of columns 4 and 5 of *Table 16-3* indicates that the intersection of Orange Avenue/I-405 SB ramps is considered significantly impacted when compared to the significant impact criteria defined in this report. Review of column 5 indicates that implementation of improvements at the intersection will help offset the Project's impact for both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue.

Appendix L presents the Alternative Year 2038 HCM/LOS calculations for the state-controlled study intersections.

**TABLE 16-3
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION CAPACITY ANALYSIS SUMMARY - CALTRANS**

Key Intersection	Time Period	(1) Existing Traffic Conditions		(2) Alternative Year 2038 Buildout Traffic Conditions		(3) Alternative Year 2038 Buildout Plus Project Traffic Conditions		(4) Significant Impact Yes/No	(5) Alternative Year 2038 Buildout Plus Project Traffic Conditions with Improvements	
		HCM	LOS	HCM	LOS	HCM	LOS		HCM	LOS
2. I-405 NB Ramps at 32 nd Street	AM	11.0 s/v	B	--	--	--	--	--	--	--
	PM	14.3 s/v	B	--	--	--	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ¹⁴² <i>With Orange Avenue Bikeway Improvements</i>	AM	44.0 s/v	E	116.0 s/v	F	124.9 s/v	F	Yes	44.8 s/v	D
	PM	90.6 s/v	F	229.5 s/v	F	250.9 s/v	F	Yes	19.8 s/v	B
	AM	44.0 s/v	E	83.4 s/v	F	87.5 s/v	F	Yes	15.5 s/v	B
	PM	90.6 s/v	F	124.9 s/v	F	139.6 s/v	F	Yes	10.5 s/v	B
10. I-405 SB Off-Ramp at Spring Street	AM	21.9 s/v	C	21.1 s/v	C	21.0 s/v	C	No	--	--
	PM	24.7 s/v	C	23.6 s/v	C	23.6 s/v	C	No	--	--

Notes:

- LOS = Level of Service, please refer to *Tables 9-1 and 3-2* for the LOS definitions
- s/v = seconds per vehicle (delay)

¹⁴² The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

16.4.3 Queueing Analysis

Table 16-4 is setup similar to that of *Table 9-7* with the exception that it included volumes pertaining to the reroute related to the ramp closure. Please note that the intersection of I-405 NB Ramps/32nd Street (Intersection #2) is permanently removed under these traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at I-405 SB Ramps (Intersection 3) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 16-4* includes the results for both alternatives.

Review of Column 1 of *Table 16-4* indicates that the queues at the study intersections are forecast to be adequate. Review of Column 2 of *Table 16-4* indicates that the queues will continue to remain adequate at the study intersections with the addition of the proposed Project. In addition, both with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue are forecast to continue to have adequate queues. Column 3 of *Table 16-4* presents the anticipated queues with the implementation of recommended improvements, which indicates that the queues will continue to remain adequate.

Appendix M presents the queueing calculation worksheets for the state-controlled study intersections.

TABLE 16-4
ALTERNATIVE CALTRANS YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁴³

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions with Improvements			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/Min. Storage Required	Adequate Storage (Yes/No)
2. I-405 NB Ramps at 32 nd Street <i>Northbound Left/Right-Turn</i>	--	--	--	--	--	--	--	--	--	--	--	--	--
3. Orange Avenue at I-405 SB Ramps ¹⁴⁴ <i>With Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	167'	Yes ¹⁴⁵	175'	Yes ¹⁴⁵
<i>Eastbound Left-Turn</i>	490'	228'	Yes	328'	Yes	235'	Yes	343'	Yes	165'	Yes	175'	Yes
<i>Eastbound Right-Turn</i>	490'	130'	Yes	50'	Yes	158'	Yes	55'	Yes	89'	Yes	65'	Yes
<i>Without Orange Avenue Bikeway Improvements</i>													
<i>Northbound Left-Turn</i>	140'	25'	Yes	25'	Yes	25'	Yes	25'	Yes	138'	Yes	165'	Yes ¹⁴⁵
<i>Eastbound Left-Turn</i>	490'	195'	Yes	255'	Yes	203'	Yes	270'	Yes	165'	Yes	175'	Yes
<i>Eastbound Right-Turn</i>	490'	70'	Yes	30'	Yes	83'	Yes	33'	Yes	89'	Yes	64'	Yes
10. I-405 SB Off-Ramp at Spring Street													
<i>Southbound Left-Turn</i>	475'	431'	Yes	383'	Yes	431'	Yes	383'	Yes	--	--	--	--
<i>Southbound Through/Left-turn</i>	475'	437'	Yes	384'	Yes	437'	Yes	384'	Yes	--	--	--	--
<i>Southbound Right-Turn</i>	175'	219'	Yes ¹⁴⁶	135'	Yes	219'	Yes ¹⁴⁶	136'	Yes	--	--	--	--

¹⁴³ Queues are based on HCM 95th Percentile.

¹⁴⁴ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

¹⁴⁵ Although the anticipated queue exceeds the provided storage there is adequate storage within the transition area to accommodate the spillover queue.

¹⁴⁶ Although the anticipated queue exceeds the provided storage there is adequate storage within the on-ramp to accommodate the spillover queue.

16.5 Alternative Intersection Left-Turn Vehicle Queueing Analysis

Table 16-5 presents the left-turn queueing analyses results for the ten (10) signalized study intersections. Column 1 presents the queueing results for Year 2038 buildout traffic conditions. Column 2 presents the results for Year 2038 buildout plus project traffic conditions.

Please note that an alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. As such, these intersections are excluded from *Table 16-5* and instead summarized in a comparison table discussed later in this report.

16.5.1 Year 2038 Buildout Traffic Conditions

Review of Column 1 of *Table 16-5* indicates that six (6) of the ten signalized study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 buildout traffic conditions, not including Orange Avenue at Spring Street (Intersection 7) or Orange Avenue at Willow Street (Intersection 13). The remaining four (4) study intersections have queues that are adequately accommodated by the existing storage space. The intersections/approaches with storage deficiencies include the following:

- Intersection 4: Atlantic Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 6: California Avenue at Spring Street
 - Southbound left-turn – AM peak hour & PM peak hour
- Intersection 8: Walnut Avenue at Spring Street
 - Northbound left-turn – AM peak hour & PM peak hour
- Intersection 9: Cherry Avenue at Spring Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 12: California Avenue at Willow Street
 - Eastbound left-turn – AM peak hour & PM peak hour
- Intersection 15: Cherry Avenue at Willow Street
 - Westbound left-turn – PM peak hour

16.5.2 Year 2038 Buildout Plus Project Traffic Conditions

Review of Column 2 of *Table 16-5* indicates that same six (6) study intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach with the addition of project traffic. The remaining four (4) study intersections have queues that are adequately accommodated by the existing storage space.

It should be noted that the addition of project traffic does not contribute to the left-turn movements at the six (6) of study intersections with storage deficiencies, and thus does not contribute to additional vehicle queuing beyond that previously reported under existing conditions.

Appendix M presents the alternative Year 2038 buildout HCM queuing worksheets for the signalized study intersections.

16.5.3 Orange Avenue Bikeway Improvements Comparison

An alternative analysis has been prepared for Orange Avenue at Spring Street (Intersection 7) and Orange Avenue at Willow Street (Intersection 13) to assess the Project's potential traffic impacts with and without implementation of Long Beach's planned bikeway improvements along Orange Avenue. *Table 16-6* presents the left-turn queuing analyses results with and without the planned bikeway improvements at the two (2) key study intersections for the Year 2038 horizon year. *Table 16-6* is set-up similarly to *Table 16-5*.

Review of columns (1) and (2) of *Table 16-6* indicates that the Orange Avenue at Spring Street and Orange Avenue at Willow Street with implementation of Long Beach's planned bikeway improvements along Orange Avenue has left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions.

However, project traffic does contribute additional left-turn queuing to the intersection of Orange Avenue/Spring Street.

As it relates to the without bikeway improvements both intersections have left-turn queues which exceed the existing storage capacity for one or more intersection approach under Year 2038 cumulative traffic conditions. However, with the Project traffic does not contribute to additional vehicle queuing beyond that previously reported under 2038 cumulative traffic conditions.

TABLE 16-5
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁴⁷

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
1. Orange Avenue at 32 nd Street ¹⁴⁸ <i>Northbound Left-Turn</i> <i>Southbound Left-Turn</i> <i>Eastbound Left/Through/Right-Turn</i> <i>Westbound Left-Turn</i>	100'	25'	Yes	25'	Yes	25'	Yes	25'	Yes
	160'	25'	Yes	25'	Yes	25'	Yes	25'	Yes
	1,240'	77'	Yes	38'	Yes	77'	Yes	38'	Yes
	240' ¹⁴⁹	25'	Yes	101'	Yes	25'	Yes	101'	Yes
4. Atlantic Avenue at Spring Street <i>Northbound Left-Turn</i> <i>Southbound Left-Turn</i> <i>Eastbound Left-Turn</i> <i>Westbound Left-Turn</i>	85'	63'	Yes	83'	Yes	63'	Yes	83'	Yes
	355'	100'	Yes	95'	Yes	100'	Yes	95'	Yes
	100'	163'	No	185'	No	163'	No	188'	No
	220'	208'	Yes	118'	Yes	208'	Yes	118'	Yes
5. Olive Avenue at Spring Street ¹⁴⁸ <i>Southbound Left-Turn</i> <i>Eastbound Left-Turn</i>	125'	52'	Yes	92'	Yes	52'	Yes	92'	Yes
	180'	66'	Yes	75'	Yes	65'	Yes	75'	Yes

¹⁴⁷ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁴⁸ HCM 6th Edition methodology does not support intersections with shared lanes. Therefore, queues for this intersection are based on HCM 2000 95th Percentile methodology.

¹⁴⁹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

TABLE 16-5 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁵⁰

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
6. California Avenue at Spring Street									
<i>Northbound Left-Turn</i>	100'	100'	Yes	60'	Yes	100'	Yes	60'	Yes
<i>Southbound Left-Turn</i>	110'	145'	No	205'	No	145'	No	205'	No
<i>Eastbound Left-Turn</i>	160' ¹⁵³	55'	Yes	70'	Yes	65'	Yes	78'	Yes
<i>Westbound Left-Turn</i>	160' ¹⁵³	108'	Yes	98'	Yes	113'	Yes	98'	Yes
7. Orange Avenue at Spring Street ¹⁵¹									
<i>Northbound Left-Turn</i>	210' ¹⁵²	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	135' ¹⁵³	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	366' ¹⁵⁴	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	200'	--	--	--	--	--	--	--	--

¹⁵⁰ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁵¹ The City has plans to implement a Class IV (Protected BikeLane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/1-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

¹⁵² The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

¹⁵³ Existing storage capacity includes the striped turn pocket as well as the transition area.

¹⁵⁴ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 16-5 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁵⁵

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
8. Walnut Avenue at Spring Street	<i>Northbound Left-Turn</i>	100'	115'	No	140'	No	115'	No	140'	No
	<i>Southbound Left-Turn</i>	100'	53'	Yes	60'	Yes	53'	Yes	60'	Yes
	<i>Eastbound Left-Turn</i>	185' ¹⁵⁶	35'	Yes	105'	Yes	38'	Yes	105'	Yes
	<i>Westbound Left-Turn</i>	100' ¹⁵⁶	70'	Yes	85'	Yes	70'	Yes	88'	Yes
9. Cherry Avenue at Spring Street	<i>Northbound Left-Turn</i>	241' ¹⁵⁶	98'	Yes	113'	Yes	98'	Yes	113'	Yes
	<i>Southbound Left-Turn</i>	500' ¹⁵⁷	310'	Yes	406'	Yes	310'	Yes	406'	Yes
	<i>Eastbound Left-Turn</i>	147'	175'	No	598'	No	175'	No	598'	No
	<i>Westbound Left-Turn</i>	292' ¹⁵⁶	130'	Yes	193'	Yes	130'	Yes	193'	Yes
10. I-405 SB Off-Ramp at Spring Street	<i>Southbound Left-Turn</i>	475'	363'	Yes	325'	Yes	363'	Yes	325'	Yes

¹⁵⁵ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁵⁶ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹⁵⁷ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 16-5 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁵⁸

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
12. California Avenue at Willow Street									
<i>Northbound Left/Through/Right-Turn</i>	220'	193'	Yes	143'	Yes	193'	Yes	143'	Yes
<i>Southbound Left/Through</i>	605'	175'	Yes	60'	Yes	175'	Yes	60'	Yes
<i>Eastbound Left-Turn</i>	100'	348'	No	490'	No	348'	No	495'	No
<i>Westbound Left-Turn</i>	115'	35'	Yes	78'	Yes	35'	Yes	70'	Yes
13. Orange Avenue at Willow Street ¹⁵⁹									
<i>Northbound Left-Turn</i>	126' ¹⁶⁰	--	--	--	--	--	--	--	--
<i>Southbound Left-Turn</i>	209' ¹⁶¹	--	--	--	--	--	--	--	--
<i>Eastbound Left-Turn</i>	185' ¹⁶²	--	--	--	--	--	--	--	--
<i>Westbound Left-Turn</i>	234'	--	--	--	--	--	--	--	--

¹⁵⁸ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁵⁹ The City has plans to implement a Class IV (Protected Bike Lane) bikeway along Orange Avenue between 70th Street and Pacific Coast Highway. This protected bikeway, which has already been funded and approved, is assumed to be part of the cumulative background traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street. These improvements are described in more detail in Section 6.5.

¹⁶⁰ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹⁶¹ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

¹⁶² Existing storage capacity includes the striped turn pocket as well as the transition area.

TABLE 16-5 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁶³

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions				
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	
14. Walnut Avenue at Willow Street	<i>Northbound Left-Turn</i>	138 ^{*164}	108'	Yes	105'	Yes	108'	Yes	105'	Yes
	<i>Southbound Left-Turn</i>	160 ^{*165}	58'	Yes	85'	Yes	58'	Yes	85'	Yes
	<i>Eastbound Left-Turn</i>	204'	25'	Yes	63'	Yes	25'	Yes	65'	Yes
	<i>Westbound Left-Turn</i>	208'	35'	Yes	115'	Yes	33'	Yes	113'	Yes
15. Cherry Avenue at Willow Street	<i>Northbound Left-Turn</i>	230 ^{*164}	213'	Yes	175'	Yes	213'	Yes	175'	Yes
	<i>Southbound Left-Turn</i>	440 ^{*166}	180'	Yes	346'	Yes	180'	Yes	346'	Yes
	<i>Eastbound Left-Turn</i>	490 ^{*167}	286'	Yes	346'	Yes	286'	Yes	346'	Yes
	<i>Westbound Left-Turn</i>	410 ^{*167}	370'	Yes	780'	No	370'	Yes	780'	No

¹⁶³ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁶⁴ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹⁶⁵ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

¹⁶⁶ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes. The existing storage also includes the transition area.

¹⁶⁷ Dual left-turn lanes. Reported storage and 85th percentile queues for the approach represent the summation of both turn lanes.

TABLE 16-6
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁶⁸
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹⁶⁹

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
7. Orange Avenue at Spring Street									
<i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	210 ¹⁷⁰	725'	No	730'	No	913'	No	830'	No
<i>Southbound Left-Turn</i>	135 ¹⁷¹	110'	Yes	175'	No	125'	Yes	195'	No
<i>Eastbound Left-Turn</i>	366 ¹⁷²	303'	Yes	245'	Yes	288'	Yes	283'	Yes
<i>Westbound Left-Turn</i>	200'	190'	Yes	568'	No	240'	No	700'	No
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	305 ¹⁷² /250'	373'	No	335'	No	498'	No	413'	No
<i>Southbound Left-Turn</i>	135 ¹⁷¹	93'	Yes	138'	No	100'	Yes	143'	No
<i>Eastbound Left-Turn</i>	366 ¹⁷²	303'	Yes	245'	Yes	288'	Yes	283'	Yes
<i>Westbound Left-Turn</i>	200'	190'	Yes	568'	No	240'	No	700'	No

¹⁶⁸ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁶⁹ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹⁷⁰ The installation of the planned improvements will eliminate the existing TWLT along Orange Avenue and therefore with the northbound left-turn no longer includes the extra storage.

¹⁷¹ Existing storage capacity includes the striped turn pocket as well as the transition area.

¹⁷² Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity

TABLE 16-6 (CONTINUED)
ALTERNATIVE YEAR 2038 BUILDOUT PEAK HOUR INTERSECTION QUEUING ANALYSIS¹⁷³
WITH AND WITHOUT ORANGE AVENUE BIKEWAY IMPROVEMENTS¹⁷⁴

Key Study Intersection	Storage Provided (feet)	(1) Alternative Year 2038 Buildout Traffic Conditions				(2) Alternative Year 2038 Buildout Plus Project Traffic Conditions			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
		Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)	Max. Queue/ Min. Storage Required	Adequate Storage (Yes/No)
13. Orange Avenue at Willow Street									
<i>With Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126' ¹⁷⁵	383'	No	275'	No	275'	No	330'	No
<i>Southbound Left-Turn</i>	209' ¹⁷⁶	58'	Yes	83'	Yes	65'	Yes	85'	Yes
<i>Eastbound Left-Turn</i>	185' ¹⁷⁷	140'	Yes	150'	Yes	168'	Yes	170'	Yes
<i>Westbound Left-Turn</i>	234'	205'	Yes	255'	No	205'	Yes	288'	No
<i>Without Orange Avenue Bikeway Improvements</i>									
<i>Northbound Left-Turn</i>	126' ¹⁷⁵	238'	No	275'	No	245'	No	285'	No
<i>Southbound Left-Turn</i>	209' ¹⁷⁶	63'	Yes	83'	Yes	68'	Yes	88'	Yes
<i>Eastbound Left-Turn</i>	185' ¹⁷⁷	140'	Yes	150'	Yes	168'	Yes	170'	Yes
<i>Westbound Left-Turn</i>	234'	205'	Yes	255'	No	205'	Yes	288'	No

¹⁷³ Queues are based on HCM 85th Percentile, unless otherwise noted.

¹⁷⁴ This table identifies the Project's potential impact at these three study intersection with and without this planned bikeway improvement assumed in the Year 2021 cumulative background and cumulative plus project traffic conditions. As part of the planned improvements, a road diet along Orange Avenue will be implemented which will reduce Orange Avenue from a four-lane roadway to a two-lane roadway and will directly affect the study intersections of Orange Avenue/I-405 SB Ramps, Orange Avenue/Spring Street and Orange Avenue/Willow Street.

¹⁷⁵ Approach contains a TWLT lane upstream of the intersection. It is assumed that queuing vehicles will utilize portions of the TWLT should the queue exceed the length of the striped turn lane. Therefore, existing storage capacity is assumed to consist of the length of the striped turn lane plus one half the length from the end of the turn lane striping to the nearest upstream driveway. Utilizing one-half of the distance from the end of the turn lane to the nearest upstream driveway preserves the TWLT for access to and from the driveway, thereby providing a conservative estimate of available storage capacity.

¹⁷⁶ Existing storage capacity includes the striped turn pocket as well as storage space upstream of the turn lane.

¹⁷⁷ Existing storage capacity includes the striped turn pocket as well as the transition area.

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