Centinela Avenue Grade Separation Traffic Analysis

DRAFT Report

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Submitted to:

Metro

17J18-0400 | Prepared by **Iteris, Inc.**

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1.0 EXECUTIVE SUMMARY

1.1 Problem Statement

This study analyzes traffic at the Centinela Avenue and Florence Avenue intersection and assesses its performance according to the Metro Grade Crossing Safety Policy. The Metro Grade Crossing Safety Policy was originally approved by the Metro Board on December 4, 2003; it was revised on October 28, 2010.

The intersection of Centinela Avenue and Florence Avenue is a T-intersection, and as a result, it does not contain northbound or southbound through movements. Without a southbound through movement, drivers proceeding south from Centinela Avenue must turn left or right onto Florence Avenue and then turn right onto Prairie Avenue or left onto Hillcrest Boulevard in order to continue south. Drivers traveling north must similarly turn right on Hillcrest Boulevard or left on Prairie Avenue and then turn right or left from Florence Avenue onto Centinela Avenue. Traffic congestion and queuing currently occur at this location.

Recent intensification of development at Hollywood Park, which was planned after construction of the Crenshaw/LAX Line had commenced, will increase the demand for travel through Centinela Avenue/Florence Avenue. Because the intersection is also the site of an at-grade crossing of the Crenshaw/LAX Line, the Metro Board directed staff to consider a grade separation for the train at this location.

1.2 Methodology

While this study is the product of an independent analysis by Metro, it was conducted in coordination with the City of Inglewood. Metro met with the City of Inglewood throughout the study to receive agreement on key assumptions for analysis, including intersection design, signal phasing, base traffic volumes, an annual traffic growth factor, future development in the City of Inglewood and nearby, the use of the Southern California Association of Governments (SCAG) travel demand forecasting model to determine the growth and routing of traffic, and the use of traffic simulation modeling.

This study looks at peak hour travel during three time periods: 2017, before the operation of the Crenshaw/LAX Line; 2019, after the opening of the Crenshaw/LAX Line; and 2040, the future year of the SCAG model, which includes the completion of currently planned development in Hollywood Park. Both at-grade and grade-separated conditions are analyzed for 2019 and 2040.

1.3 Analysis

1.3.1 Signal Phasing

Figure ES-1 and **Table ES-1** show an average signal cycle under existing baseline conditions. Without the LRT, the signal at the Centinela/Florence intersection is currently operating at a 100-second cycle during the peak hours.

When the LRT trains are present, the signal at this location may operate at a longer cycle length between 120 to 140 seconds, depending on the actual train arrival schedules and the background traffic volumes. An average signal cycle of approximately 130 seconds was estimated based on multiple VISSIM simulation runs for the peak hours. About one third of the signal phase is dedicated to the Crenshaw/LAX Line and two thirds of the signal time is dedicated to vehicles and pedestrians. For illustrative purposes, an average signal cycle for Centinela Avenue/Florence Avenue is shown in **Figure ES-2** and **Table ES-2**.

FIGURE ES-1 – Average Signal Phase Time Percent Allocation without LRT

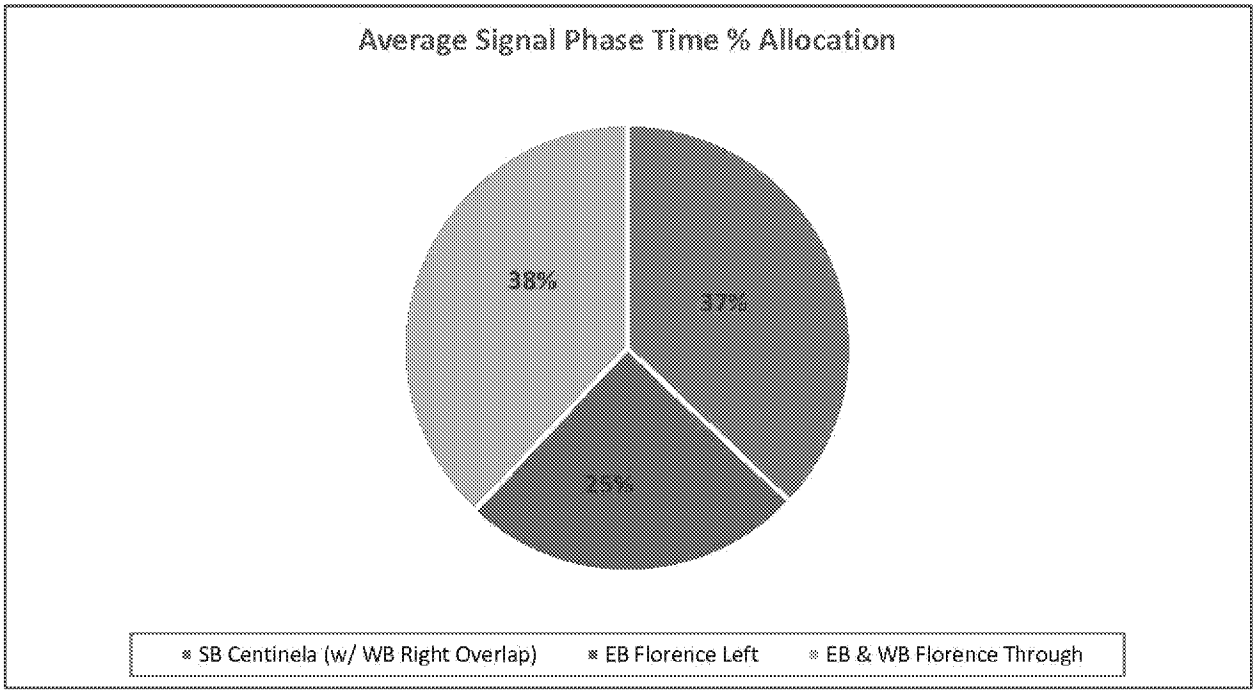
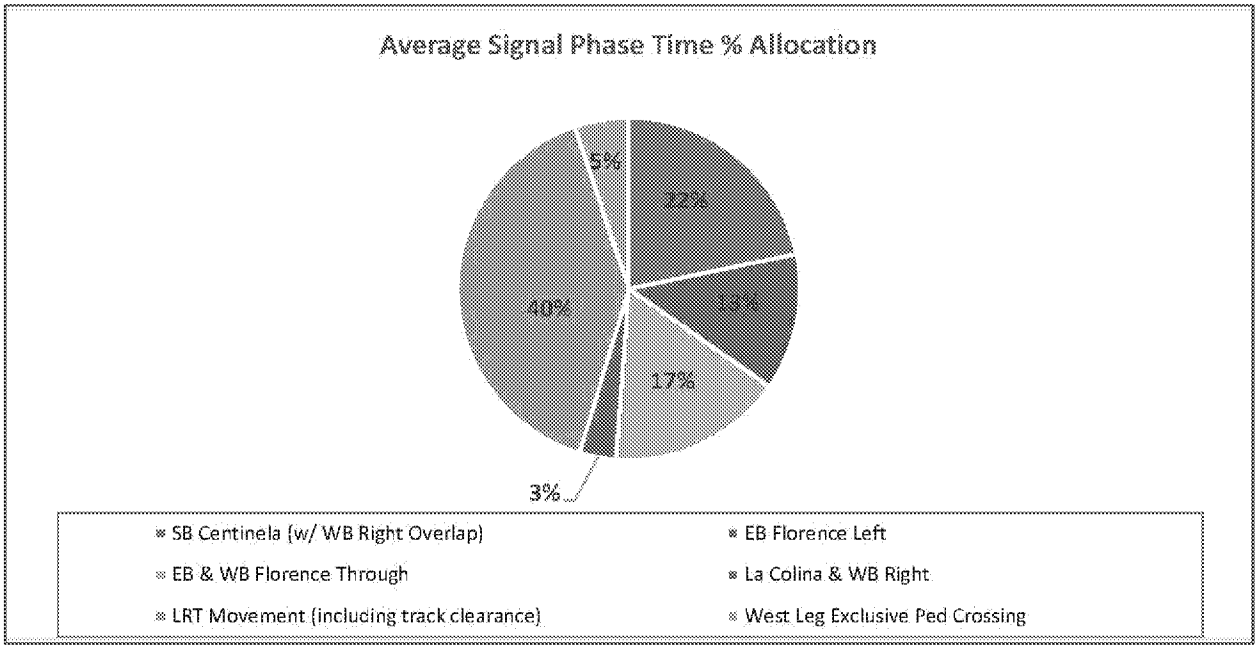


Table ES-1: Signal Phase Time Allocation without LRT

Movement	Average Signal Cycle (seconds)	Percentage share
EB Florence Ave Left-turn	25 sec	25%
EB & WB Florence Ave Through	38 sec	38%
SB Centinela Ave	37 sec	37%
Sum	100 sec	100%

FIGURE ES-2 – Average Signal Phase Time Percent Allocation with LRT



*Note: This pie chart represents the "average" cycle. However, there would not be a true typical cycle given the LRT. La Colina would not be activated every cycle, nor would the West Leg Exclusive Ped Crossing. The percent allocation for these phases would be longer than the amounts shown when activated, but since they are not activated every cycle, the total percentage averages out to the values shown in the chart.

Table ES-2: Signal Phase Time Allocation with LRT

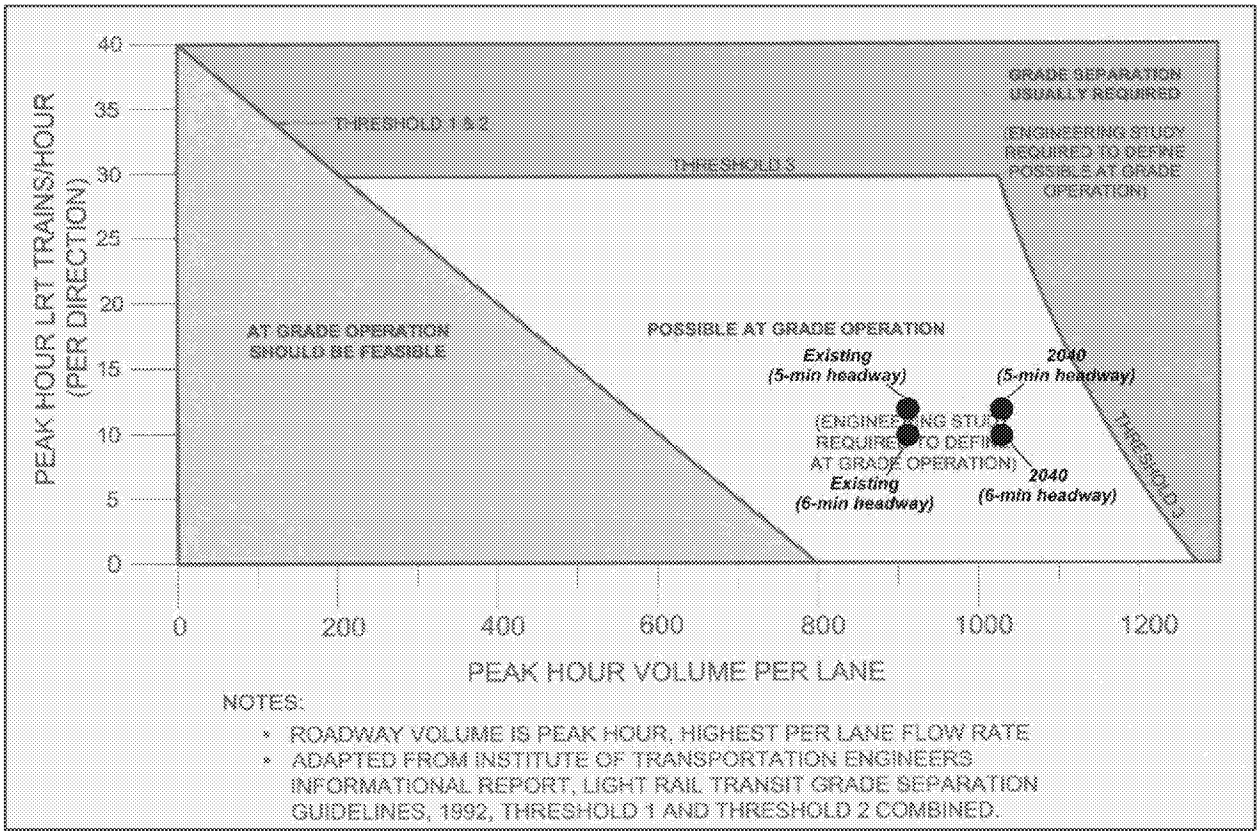
Movement	Average Signal Cycle* (seconds)	Percentage share
EB Florence Ave Left-turn	17 sec	13%
EB & WB Florence Ave Through	21 sec	17%
La Colina & WB Right-turn	4 sec	3%
SB Centinela Ave & WB right turn overlap	29 sec	22%
West Leg Exclusive Pedestrian Crossing	7 sec	5%
LRT Movement (including track clearance)	52 sec	40%
Sum	130 sec	100%

*Note: When the LRT trains are present, the signal at this location would be operating at a longer cycle length between 120 to 140 seconds, depending on the train arrival schedules and the background traffic volumes. An average signal cycle of approximately 130 seconds was estimated based on multiple VISSIM model runs.

1.3.2 Nomograph

The Metro Grade Crossing Safety Policy nomograph for Centinela Avenue/Florence Avenue in 2017 and 2040 is shown in **Figure ES-3**. The two sets of plots on the nomograph illustrate the increased traffic volumes between existing and future years, and the effect of this increase in traffic according the Metro Grade Crossing Safety Policy. Based on traffic volumes and train frequency during the a.m. peak hour (which experiences higher traffic volumes than the p.m. peak hour), the screening categorizes the intersection as having possible at grade train operation. As described on the nomograph, further engineering analysis is required for intersections in this category.

FIGURE ES-3 Nomograph for Initial Screening



1.3.3 Traffic Congestion

From 2017 to 2040, traffic congestion is expected to increase at all four study intersections. As shown in **Table ES-3**, average vehicle delay at Centinela Avenue/Florence Avenue is estimated to increase from 15 seconds to 107 seconds during the a.m. peak hour and from 14 seconds to 98 seconds during the p.m. peak hour. With a grade-separated crossing, average vehicle delay at Centinela Avenue/Florence Avenue is projected to be 32 seconds in the a.m. peak hour and 55 seconds in the p.m. peak hour in year 2040.

Table ES-3: Centinela Ave/Florence Ave Intersection Peak Hour LOS
2017, 2019, 2040 (with and without LRT grade separation)

Scenario	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds) - LOS
Existing Conditions	15.4 – C	14.4 – B
Existing Plus At-Grade Crossing[1]	**107.9 – F**	**97.8 – F**
Opening Year 2019 with At-Grade Crossing[2]	**103.7 – F**	**98.1 – F**
Opening Year 2019 with Grade-SeparatedCrossing[2]	20.1 – C	15.3 – B
Future Year 2040 with At-Grade Crossing[1]	**117.9 –F**	**108.5 – F**
Future Year 2040 with Grade-Separated Crossing[1]	31.7 – C	**55.3 – E**

Note:
1. Three-car trains and 5-minute headways per direction during peak hours
2. Two-car trains and 5-minute headways per direction during peak hours

1.3.4 Queue Lengths

Vehicle queues for all movements at study intersections are expected to increase with the background traffic growth and the opening of the Crenshaw/LAX Line. To understand if an at-grade LRT crossing is feasible from the traffic operations and safety perspectives, two types of vehicle queues were evaluated for the Centinela/Florence crossing per the Metro Grade Crossing Policy, including:

- Influence zone: The area between the light rail tracks or gate and an adjacent intersection where the queue from the adjacent intersection has the potential to back up onto the light rail tracks. An extensive influence zone queue may cause a safety concern. At Centinela/Florence crossing, the influence zone queues are: northbound movement at Centinela Avenue/Warren Lane, westbound movement at Hillcrest Blvd/Florence Avenue, and eastbound movement at Prairie Avenue/Florence Avenue.

- Gate spillback: The area between the light rail tracks or gate and an adjacent intersection where the queue resulting from the gate has the potential to back up to the adjacent intersection. An extensive spillback queue may result in traffic gridlocking in the localized area around an at-grade crossing. At Centinela/Florence crossing, the gate spillback queue are traffic movements that would have direct conflicts with the LRT tracks, including: southbound left turn and right turn movement on Centinela Avenue, westbound right-turn movement from Florence Avenue to Centinela Avenue, and eastbound left turn movement from Florence Avenue to Centinela Avenue.

At the Centinela/Florence intersection, the influence zone and gate spillback queues were estimated for all study scenarios (existing, 2019 opening year, and 2040). The key findings from the queueing analysis are:

- **Existing conditions**: The intersection is operating at LOS C or better in the peak hours and no significant traffic queuing conditions were identified based on field observations.

- **Existing Plus At-Grade Crossing scenario**: If the LRT tracks were in operation with 5-minute headways and 3-car trains with the current background traffic, this intersection LOS would change from LOS C or better to LOS F in both peak hours. Traffic movements in the southbound queue (left turn and right-turn), eastbound left turn queue and westbound right turn queue could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest). Yet, the influence zone queue length is not anticipated to extend from the adjacent intersections to cross the LRT tracks (i.e., no salient safety issue was identified).

- **Opening year 2019 with at-grade crossing scenario**: In the near-term, with 5-minute headways, 2-car trains, and slightly higher background traffic conditions, this intersection LOS would change from existing LOS C or better to LOS F conditions in both the a.m. and p.m. peak hours. The vehicle queues at Centinela/Florence may accumulate and begin to spill back from the LRT tracks to the three adjacent intersections periodically (Warren to the north, Prairie to the east, and Hillcrest to the west). However, no salient safety issue was identified for this at-grade crossing because the influence zone queue from the adjacent intersections is projected to be within the storage capacity on Florence and on Centinela.

- **Opening year 2019 with grade-separated crossing scenario**: The intersection is anticipated to operate at comparable LOS and queuing conditions to the existing conditions.

- **Future Year 2040 with At-Grade Crossing**: Due to the cumulative traffic growth and more frequent 5-minute headway and 3-car train services, this intersection LOS would deteriorate from existing LOS C or better to LOS F in both the a.m. and p.m. peak hours. Traffic movements approaching the at-grade crossings (southbound, eastbound left turn and westbound right-turn) may experience extensive delays and queue lengths and motorists may have to wait for more than one signal cycle before they can safely cross the LRT tracks. These traffic movements could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest) frequently. However, no salient safety issue was identified for this at-grade crossing because the influence zone queue from the adjacent intersections is projected to be within the storage capacity on Florence and on Centinela.

- **Future Year 2040 with Grade-Separated Crossing**: Due to the cumulative traffic growth, this intersection is projected to operate at LOS C in the a.m. peak hour and at border line LOS E in the p.m. peak hour. The average traffic queue for the southbound left turn and right turn queue may be extensive and begin to spill back to Warren Lane to the north. The average eastbound and westbound movement queues can be generally accommodated within one block of the at-grade crossing, but the maximum queue may begin to spill back to Prairie and to Hillcrest periodically.

Figures ES-4 and **ES-5** show a comparison of existing average queue lengths and 2040 with at-grade crossing average queue lengths at the intersection approaches, during the weekday a.m. and p.m. peak

hours respectively. In 2040, the average influence zone traffic queues are not expected to extend from the adjacent intersections to across the Crenshaw/LAX Line tracks at Centinela/Florence intersection. The east/west bound through movements on Florence Avenue may be congested, but are not expected to result in salient safety issues to the at-grade crossing. However, due to the LRT train pre-emption and gate down time, traffic delay and traffic queueing at the southbound movement, eastbound left turn, and westbound right-turn movement will be significant under 2040 conditions.

FIGURE ES-4: Existing and 2040 Average AM Queue Lengths at Centinela/Florence

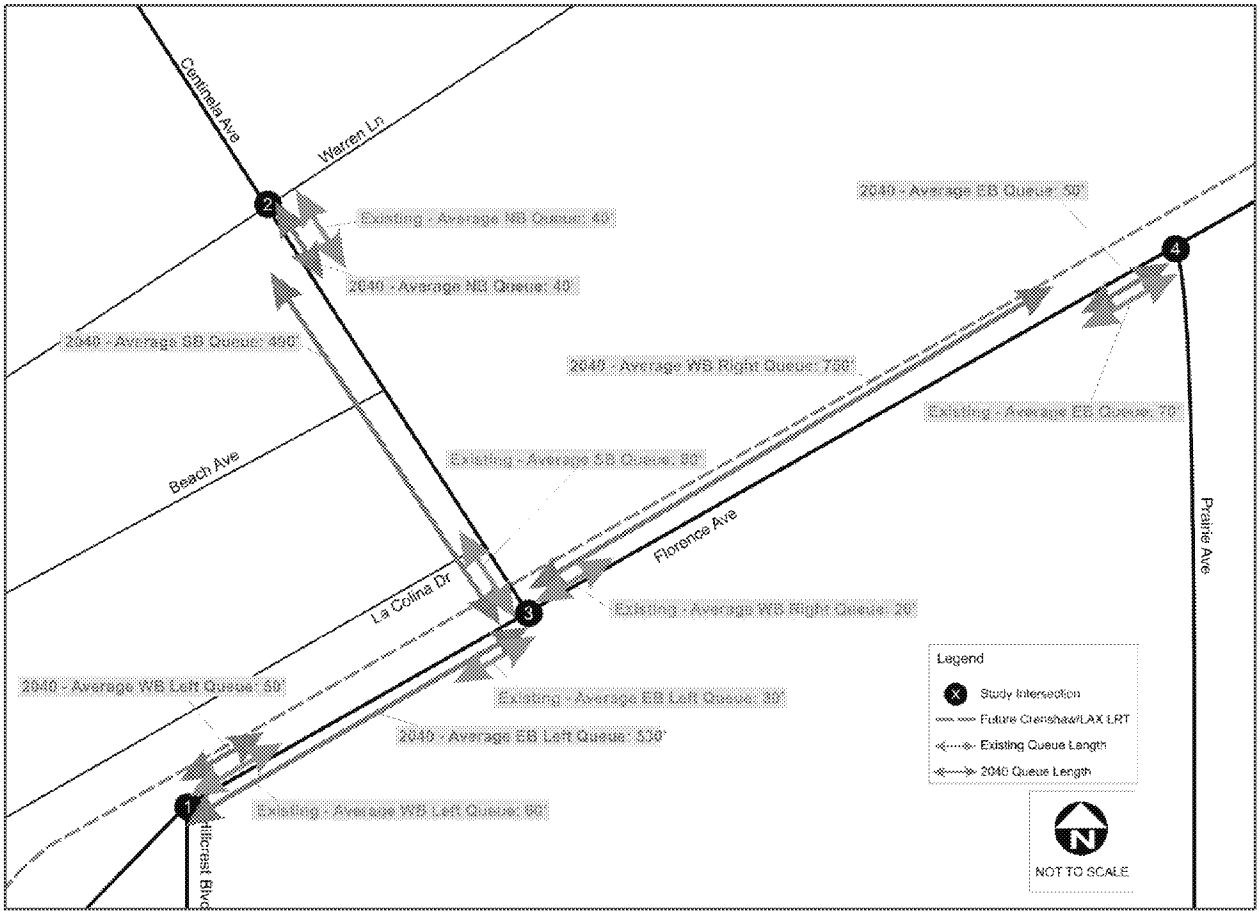
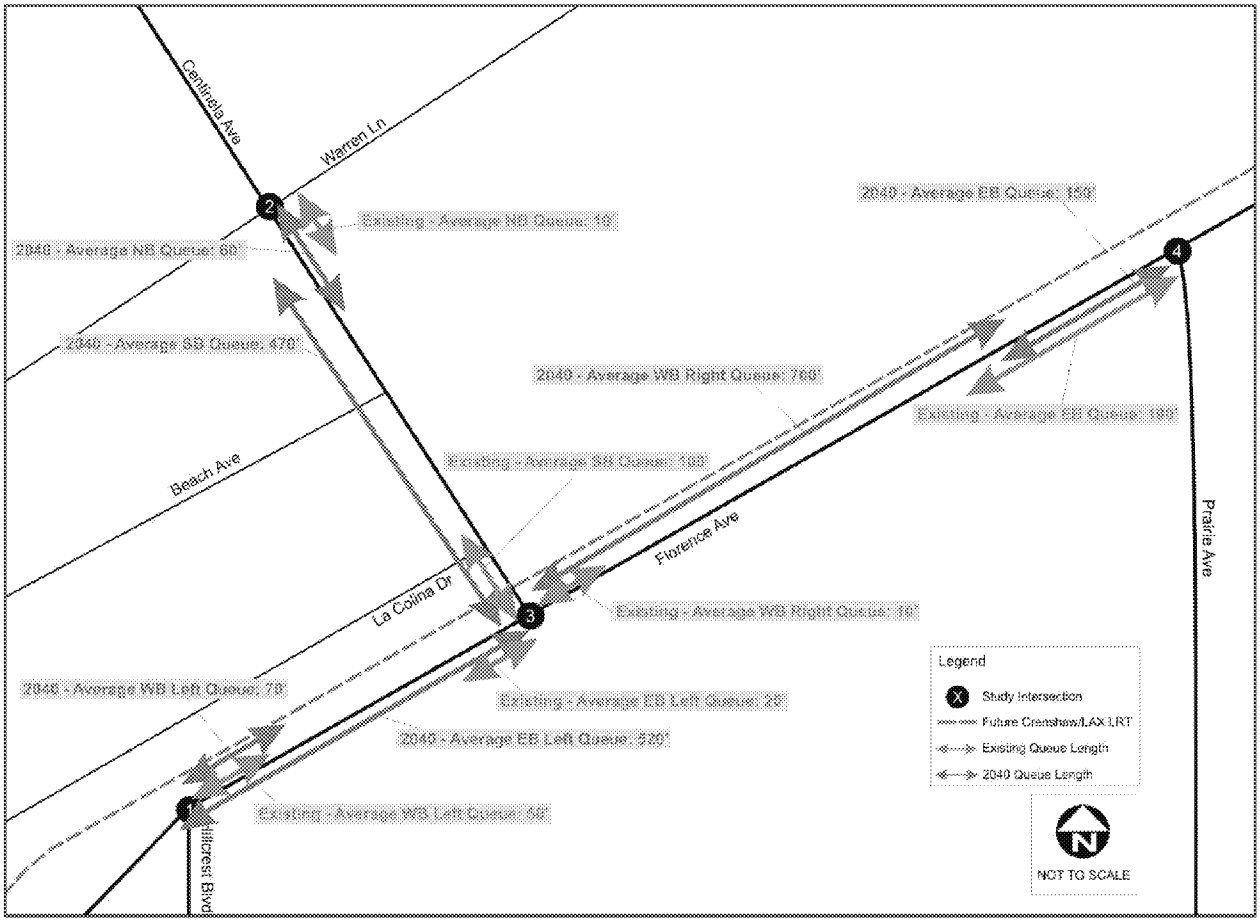


FIGURE ES-5: Existing and 2040 Average PM Queue Lengths at Centinela/Florence



1.4 Safety Analysis

Although potential increases in traffic delays and traffic queues are expected in the future at Centinela Avenue/Florence Avenue, traffic queues for future opening year 2019 with at-grade crossing and future year 2040 with at-grade crossing are not forecast to cross the LRT tracks and would therefore not create an unsafe condition.

2.0 INTRODUCTION

The Crenshaw/LAX Light Rail Transit (LRT) Line will connect the existing Exposition Line and the Green Line, near Los Angeles International Airport. Eight new stations are part of this project, including three stations in the City of Inglewood: Fairview Heights, Downtown Inglewood, and Westchester/Veterans. Iteris has been tasked with evaluating traffic operations at the Centinela Avenue grade crossing of the Crenshaw/LAX Line in the City of Inglewood, which is referred to as the "project" in this report. The Centinela Avenue crossing is currently under construction as an at-grade crossing between the Fairview Heights and Downtown Inglewood stations. This report analyzes existing and future traffic conditions in the vicinity of the at-grade crossing location.

2.1 Study Area

A scoping agreement, dated August 17, 2017, was prepared by Iteris to outline the proposed study area, traffic forecasting, and traffic operations analysis methodologies for the Centinela Grade Separation Study. As noted in the scoping agreement, the study area consists of the following four intersections:

1. Hillcrest Boulevard/Florence Avenue;
2. Centinela Avenue/Warren Lane;
3. Centinela Avenue/Florence Avenue; and
4. Prairie Avenue/Florence Avenue.

The three locations in addition to Centinela Avenue/Florence Avenue were chosen because they represent the next closest signalized intersections in each direction. **Figure 1** shows the location of the Crenshaw/LAX LRT Line in relation to the surrounding street network, as well as the study intersections.

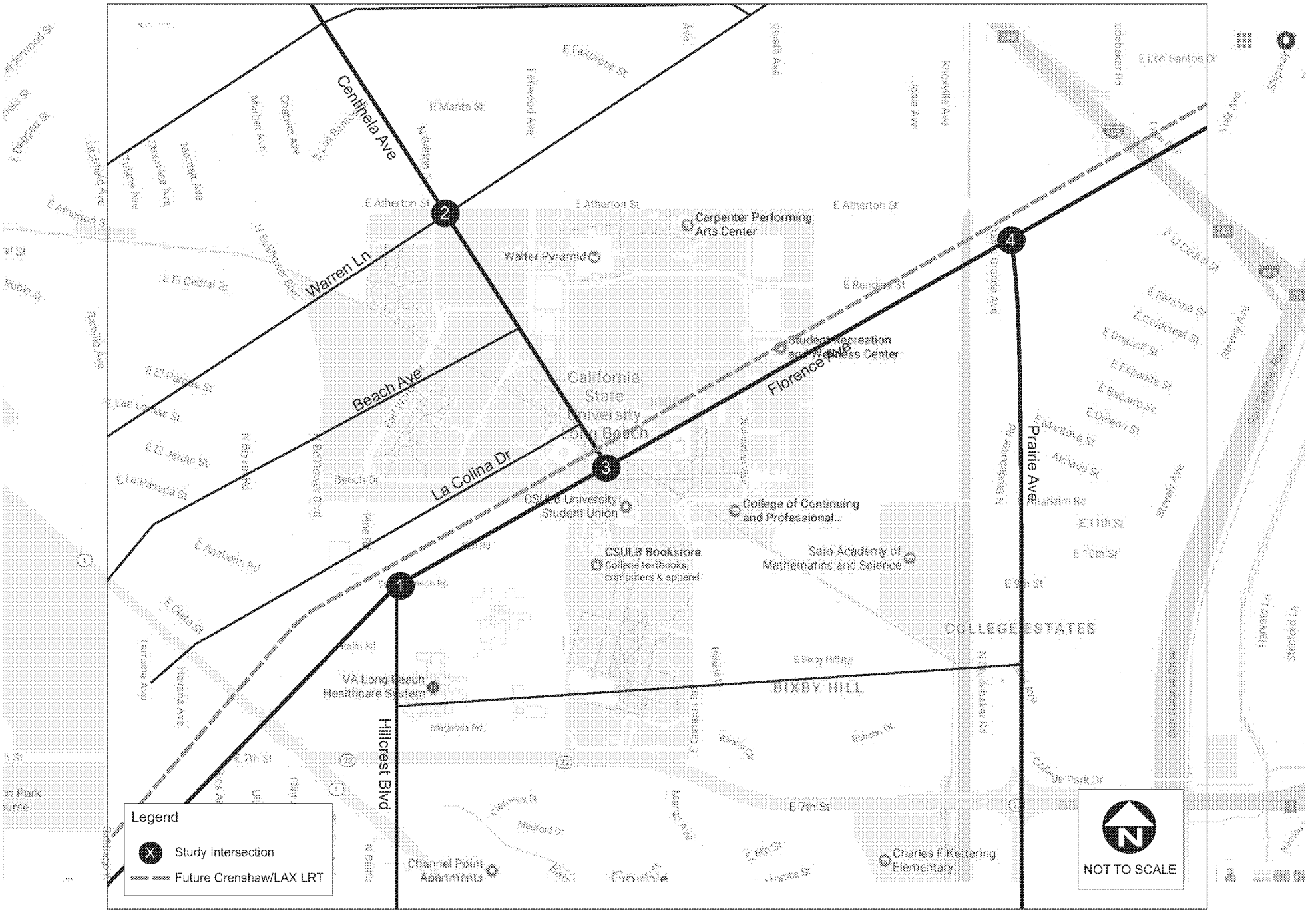
2.2 Study Periods

The following scenarios are analyzed in this report:

- Existing 2017 Conditions;
  - Assumes no Crenshaw/LAX Line
- Existing 2017 with At-grade Crossing Conditions ;
- Opening Year 2019 with At-grade Crossing Conditions;
- Opening Year 2019 with Grade-Separated Crossing Conditions;
- Future Year 2040 with At-grade Crossing Conditions; and
- Future Year 2040 with Grade-Separated Crossing Conditions.

For each scenario, the peak hour time periods were analyzed as follows:

- Typical Weekday a.m. peak hour; and
- Typical Weekday p.m. peak hour.



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Centinela Grade Separation
Traffic Analysis

Figure 1
Study Area

The weekday peak hour time periods are used in this analysis as they represent the periods of highest traffic volumes, consisting of commuter trips. These trips, which occur on a regular daily basis as opposed to trips related to weekend trips or special event traffic, are considered throughout the industry as the most useful data for informing decisions on long-range infrastructure needs. Mid-day and weekend peak hour traffic volumes were observed to be much lower than weekday peak hour volumes.

For the purpose of this analysis, 3-car trains and 5-minute headways per direction during peak hours were assumed for the existing 2017 at-grade crossing scenario and future 2040 with LRT scenarios. For the opening year 2019 with LRT scenarios, the analysis assumed 2-car trains and 5-minute headways per direction during peak hours.

3.0 ENVIRONMENTAL SETTING

This section presents an overview of the existing roadway system within the study area, and the methodology used to determine existing traffic volumes.

3.1 Roadway Configurations

The existing configurations of the significant roadways within the study area are described below:

- ***Centinela Avenue*** has a north-south orientation in the project area beginning at Florence Avenue, and it curves in a northwest direction through La Cienega Boulevard. It is classified as a major arterial in the City's General Plan Circulation Element and has two travel lanes in each direction. There is on-street parking on both sides of the avenue within the project area. The speed limit is established as 40 mph.
- ***Florence Avenue*** runs in an east-west orientation with two travel lanes in each direction and an additional center turn lane between Glasglow Avenue and Hyde Park Boulevard. Florence Avenue is classified as a major arterial in the City's General Plan Circulation Element. Florence Avenue connects to I-405 through the heart of Inglewood and becomes Aviation Boulevard at Manchester Boulevard. Within the project area, the future Crenshaw/LAX Line would run parallel to Florence Avenue on the north side of the street. On-street parking is prohibited within the project area. The speed limit is established as 40 mph.
- ***Hillcrest Boulevard*** runs in a north-south orientation in the project area and it is classified as a collector in the City's General Plan Circulation Element. Within the study area, Hillcrest Boulevard has one travel lane in each direction and has on-street parking on both sides. The speed limit is established as 30 mph.
- ***Prairie Avenue*** lies on the eastern border of the project area beginning north from Florence Avenue down south until Manchester Boulevard. Prairie Avenue consists of two travel lanes in each direction and is designated as a major arterial in the City's General Plan Circulation Element. There is no on-street parking available in the project area. The speed limit in the project area is established as 40 mph.

- ***Warren Lane*** runs in a southwest direction from Park Avenue to Edgewood Street. Warren Lane is designated as a collector in the City's General Plan Circulation Element. The street has one travel lane in each direction, with parking on both sides. The speed limit is established as 25 mph.

The intersection of Centinela Avenue and Florence Avenue is a T-intersection, and as a result, it does not contain northbound or southbound through movements. Without a southbound through movement, drivers proceeding south from Centinela Avenue must turn left or right onto Florence Avenue and then turn right onto Prairie Avenue or left onto Hillcrest Boulevard to continue south. Drivers traveling north must similarly turn right on Hillcrest Boulevard or left on Prairie Avenue and then turn right or left from Florence Avenue onto Centinela Avenue. Traffic congestion and queuing currently occur at this location.

Figure 2 shows an aerial photo of the Centinela Avenue/Florence Avenue intersection before the current construction conditions. **Figure 3** shows the existing intersection lane configurations.

3.2 Existing Traffic Volumes

Peak period intersection count data was collected at the four study intersections on a typical weekday and two weekend days, during the five time periods described. Weekday count data was collected on Thursday, August 31, 2017 (with local schools in session) and weekend count data was collected on Saturday, September 16 and Sunday 17, 2017. The existing counts were reviewed by City of Inglewood staff.

While the traffic counts were collected after the start of the school year (with its associated increase in traffic volumes) and outside of holiday periods (that might result in lower traffic volumes), on-going construction activities for the Crenshaw/LAX Line resulted in the closure of one westbound through lane along Florence Avenue at Centinela Avenue during the count period. As a result, the City of Inglewood provided historical (2015) traffic count data for the a.m. and p.m. peak period at the study intersections. The 2015 counts were then increased by an annual growth rate of 1.34%. This rate was provided by City staff and based on the average growth in traffic volumes at study intersections between 2010 and 2017; this growth rate was approved by Iteris. These City-provided volumes were used for the weekday a.m. and p.m. peak hour analysis of existing conditions in lieu of the August 31st counts. Though the August 31st counts were ultimately not used in the analysis, the counts confirmed the rough magnitude of turning movement volumes. Existing traffic count data is provided in **Appendix A**.

Source: Google Earth 2016

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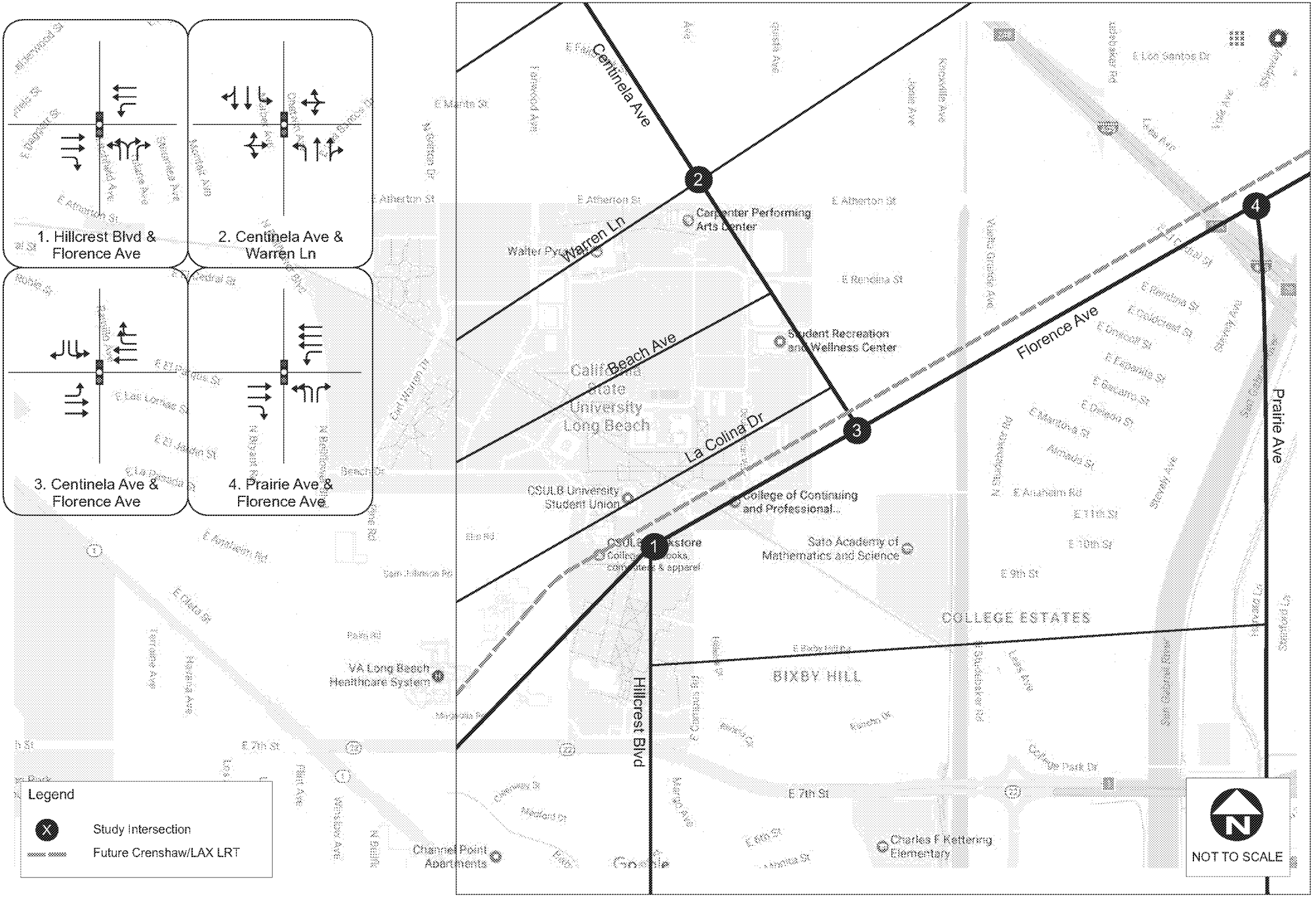
Figure 2
Centinela/Florence Intersection in Pre-Construction Conditions



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Traffic Analysis

Figure 3
Existing Intersection Lane Configurations (Pre-construction)

Figure 4 shows the existing weekday peak hour intersection volumes, which include the mid-day peak hour as well.

4.0 TRAFFIC OPERATIONS ANALYSIS METHODOLOGY

Iteris prepared a computer simulation, using VISSIM, of the operation of the study intersections in the vicinity of the Crenshaw/LAX Line crossing at Centinela Avenue. This section describes the steps taken to develop the VISSIM model for use in the analysis.

4.1 Model Development

The microsimulation platform VISSIM was used to develop the model. The VISSIM model was developed using VISSIM build 6.00-21, and was calibrated for existing year 2017 conditions. The VISSIM model developed for this project includes roadway geometrics, traffic signal parameters, and driver behavior characteristics. Unlike static analyses conducted according to the Highway Capacity Manual (HCM), a simulation model includes "virtual drivers" that travel through the model network, from entry nodes to exit nodes, along network paths that are assigned by the analyst. The model uses random seeds and probability distributions for a number of traffic flow characteristics, such that each model run will produce slightly different outputs. Each seed contains random variables to account for variations in driver behavior and departure time. This model is therefore stochastic; it simulates the random fluctuations that are typically observed in real-time traffic networks. This feature makes the results more robust, given that they are based on the average of multiple observations or model runs, rather than a single calculation.

Data Inputs

To develop data to be used as inputs as well as calibration targets, multiple data resources were used:

- Traffic Volumes – Intersection counts conducted in 2015 and normalized to 2017 conditions.
- Queues – P.M. peak hour queue values at the southbound approach of the Centinela Avenue/Florence Avenue intersection in 2017. These values were used for model calibration as described in the next section. In addition, queue counts were collected in May 2018 (while schools were in session) that confirmed, within a reasonable range, the 2017 values applied in the calibration process. These 2018 queue counts are provided in **Appendix A**.
- Lane Configuration – Confirmed by field survey
- Signal Timing Plan – Provided by City of Inglewood

Error Checking

The error correction process involved software error checking, input coding, and animation review. Input coding included geometry, demand, signal timing, traffic volumes, and route choices. The animation was reviewed to confirm that realistic travel behaviors were being simulated.

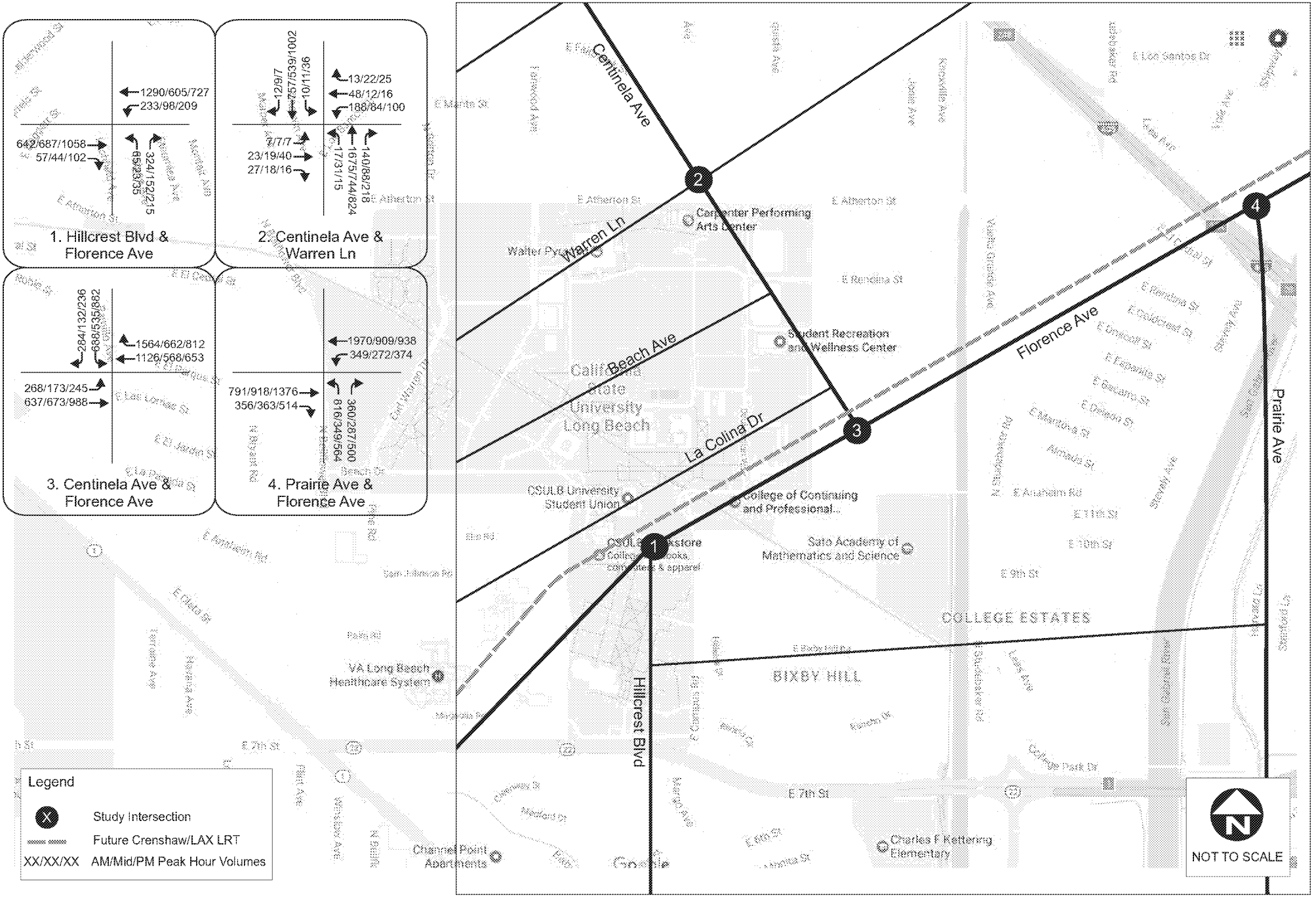

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Figure 4
Existing Weekday Peak Hour Intersection Volumes

4.2 Model Confidence and Calibration

The objectives of model confidence and calibration are to obtain the best match possible between model performance estimates and field measurements of performance. However, at a certain point in the calibration process there are diminishing returns where large investments in effort yield small improvements in accuracy. The Federal Highway Administration (FHWA) has set confidence and calibration procedures and standards for microsimulation models and these were used in the calibration process.

Given the varying results that inherently exist between microsimulation runs (due to the random seed number), the confidence is intended to demonstrate that the average of the model runs falls within a certain range of values which we believe is representative and not skewed towards a statistical outlier. in order to achieve a 95% confidence level that the average model output was accurate to within 50 feet of the southbound queue length measurements, the required number of runs was three and nine, for a.m. and p.m., respectively, utilizing the following formula:

$$N = \left(2 * t_{0.025,N-1} \frac{s}{R} \right)^2$$

R = Confidence Interval for the true mean
$t_{0.025,N-1}$ = Student's t-statistic for two-sided error of 2.5 percent (totals 5 percent) with N-1 degrees of freedom (this is related to a 95% Confidence Level)
s = Standard Deviation about the mean for selected MOE (southbound queues in this case)
N = Number of required simulation runs

The following FHWA calibration target was applied to the traffic volumes:

- GEH Statistic[1] < 5 for Individual Link Flows > 85% of cases

[1] The use of the GEH statistic (named after its developer, Geoffrey E. Havers) "stems from the inability of either the absolute difference or relative difference statistics to cope with flows over a wide range" of values (Scottish Transport Appraisal Guidance, 2002). The GEH statistic is a modified Chi-squared statistic that incorporates both relative and absolute differences to compare modeled and observed characteristics. The form of the GEH statistic allows for greater absolute differences for low volumes while requiring lower relative differences for large volumes. The expression for the GEH statistic is GEH = [square root of 2[(E - V).sup.2] / (E + V)] (2) Where E = model estimated characteristic; V = observed characteristic.

As tabulated in **Appendix B**, the model calibration resulted in 100% of the cases with GEH statistic <5 which exceeds the FHWA calibration target for both AM and PM peak hour models.

5.0 EXISTING CONDITIONS ANALYSIS

This section presents the results of the existing conditions traffic analysis utilizing the VISSIM model, as well as Metro's Grade Crossing Safety Policy Analysis (Initial Screening).

5.1 Initial Grade Crossing Policy Analysis – Existing Conditions

The "Metro Grade Crossing Safety Policy for Light Rail" was originally approved by the Metro Board on December 4, 2003; it was revised on October 28, 2010. The Grade Crossing Safety Policy is intended to provide an official structured process by which street crossings by light rail projects are evaluated to determine whether they should be grade-separated or whether they can safely and efficiently operate as at-grade crossings.

The Metro Grade Crossing Policy includes three steps of review and analysis that may be conducted in order to arrive at a decision. Step 1 uses traffic volumes and train frequencies to categorize the feasibility of an at-grade crossing. Step 2 involves a detailed analysis of crossing design, roadway traffic and train operations. Step 3 is described as additional study (such as traffic simulation modeling) in coordination with the local jurisdiction to arrive at a final recommendation.

The Initial Screening is based upon the highest bi-directional roadway volume per-lane, for the highest peak hour. Roadway volume is compared against number of trains per direction during the peak hour. These values are plotted on a nomograph to determine which category would be appropriate for the crossing. The possible categories are: at-grade operation should be feasible, possible at-grade operation, and grade separation usually required.

Table 1 shows the highest bi-directional cross-street traffic volume per-lane for the a.m. peak hour and p.m. peak hour. The volumes shown are normalized 2017 volumes approved by the City of Inglewood and Metro staff.

Table 1: Cross-Street Traffic Volume per Lane – AM and PM Peak Hour

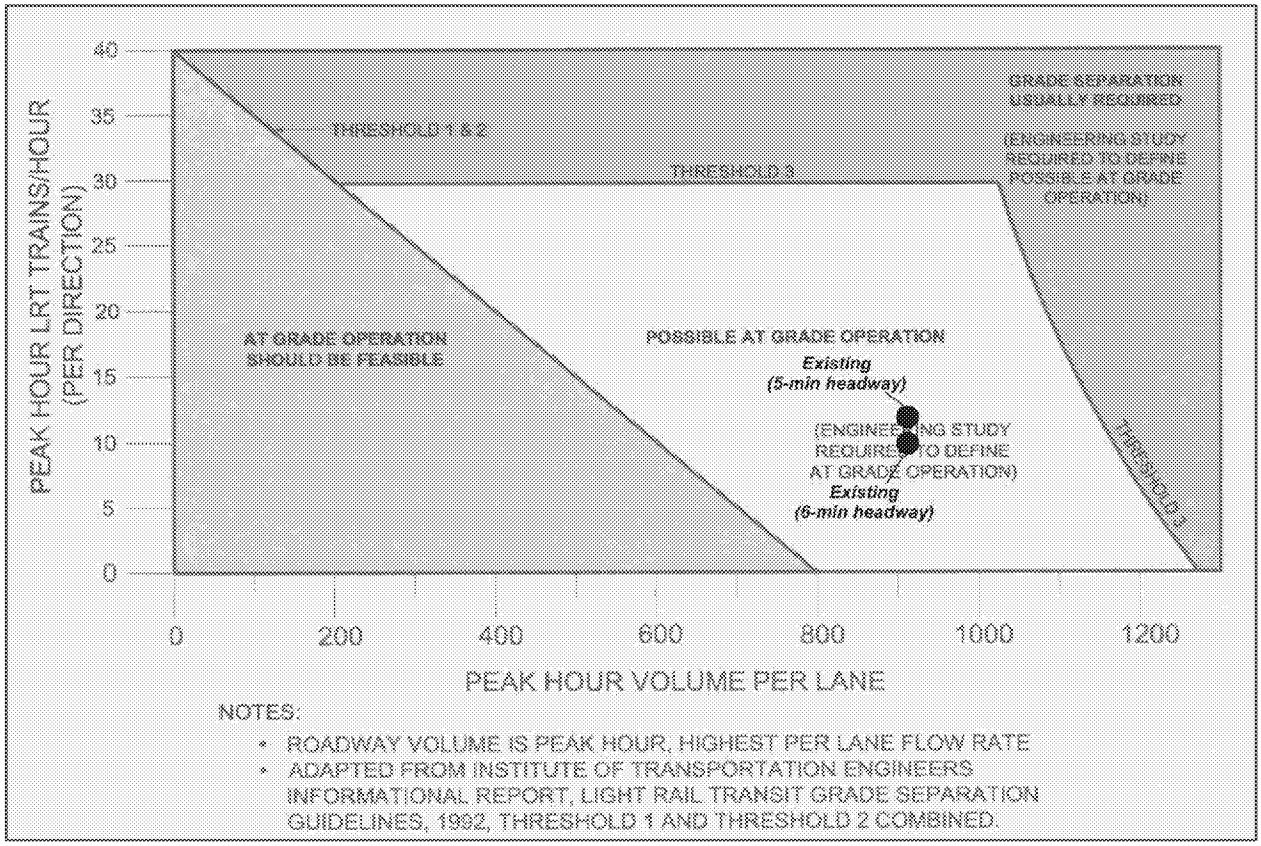
At-Grade Crossing	Cross-Street # of Lanes		Highest Cross-Street Volume/Lane
	NB	SB	Normalized 2017
Centinela Ave (north of Florence Ave)	2	4*	916 vehicles/lane (a.m.) 529 vehicles/lane (p.m.)

* Proposed configuration with at-grade crossing

Peak hour headways of five (5) minutes per direction are anticipated for the Metro Crenshaw Line/LAX

Line (ultimate buildout), as provided by Metro. This frequency equates to 12 trains per hour for the peak hour. **Figure 5** shows the Nomograph for Initial Screening for the a.m. peak hour, which consists of the governing peak hour volume per lane. For comparison purposes, both the 5-minute (12 trains per hour) and 6-minute (10 trains per hour) headway conditions are plotted on the figure.

Figure 5 – Nomograph for Initial Screening – Existing AM Peak Hour



As shown in **Figure 5**, the Centinela Avenue crossing is categorized as "possible at-grade operation", but further engineering study is required to define the operation. More detailed traffic operations/queuing analysis focusing on the Centinela/Florence LRT crossing is described within this report.

5.2 Existing Traffic Operations

A Level of Service (LOS) and queue analysis were conducted using 2017 traffic volumes. LOS is a term that describes the operating performance of an intersection or roadway based on the Highway Capacity Manual (HCM) 2010. Intersection LOS is developed based on a number of factors, including the vehicle volumes per travel lane and the amount of traffic in each direction of a crossing. LOS is measured quantitatively and reported on a scale from A to F, with A representing the least congested conditions and F representing the most congested conditions.

Under existing conditions (**Table 2**), the intersections in the study are currently operating at LOS D or better during the weekday a.m. and p.m. peak hours. Detailed LOS output data is provided in **Appendix C**.

Table 2: Existing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds)- LOS
1. Hillcrest Blvd / Florence Ave	13.3 – B	16.0 – C
2. Centinela Ave / Warren Ln	10.9 – B	7.5 – A
3. Centinela Ave / Florence Ave	15.4 – C	14.4 – B
4. Prairie Ave / Florence Ave	22.1 – C	27.9 – D

Table 3 summarizes the average and maximum queues for the critical intersection movements. The queue tables in this report reference the "influence zone" and the "gate spillback" as described in the Metro Grade Crossing Policy. The influence zone is the area between the light rail tracks or gate and an adjacent intersection where the queue from the adjacent intersection has the potential to back up onto the light rail tracks. The gate spillback is the area between the light rail tracks or gate and an adjacent intersection where the queue resulting from the gate has the potential to back up to the adjacent intersection. As shown in Table 2 and Table 3, the intersection of Florence/Centinela is operating at LOS C or better in the peak hours and no significant traffic queuing conditions was identified based on field observations.

Table 3: Existing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave Queue (ft)	Max Queue (ft)	Ave Queue (ft)	Max Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	60	**270**	50	**230**
	WB Through	475	20	320	10	100
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	600	40	360	10	180
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	600	80	310	100	400
	SB Right-turn (Gate Spillback)	230	50	**270**	20	200
	EB Left-turn	150	30	**240**	20	110
	WB Right-turn	250	20	180	10	120
4. Prairie Ave / Florence Ave	EB Through	940	70	400	190	740
	EB Right-turn	175	30	**250**	70	**570**

Note: Bold font: projected queue length exceeds the storage capacity.

5.3 Existing Plus At-Grade Crossing Traffic Operations

The purpose of this analysis scenario is to evaluate the traffic operations with the at-grade crossing during existing conditions, for potential compliance in an environmental document. The following assumptions from Metro for the operation of the Crenshaw/LAX Line in this scenario are as follows:

- 5-minute headways per direction during peak hours;
- 3-car trains;
- Trains speeds of 35 – 45 mph in the westbound direction and 40 – 50 mph in eastbound direction. (At the Centinela Avenue crossing, eastbound trains are estimated to operate at higher speeds than westbound trains because eastbound trains would be accelerating away from the Downtown Inglewood station and westbound trains would be decelerating at the approach of the Downtown Inglewood station.)

Figure 6 shows the intersection lane configurations with completion of the at-grade crossing. This configuration includes additional turn lanes at the Centinela Avenue/Florence Avenue intersection. **Table 4** summarizes the existing plus at-grade crossing LOS at the study intersections for the weekday peak hours. Detailed LOS output data is provided in **Appendix C**. **Table 5** summarizes the existing plus at-grade crossing average and maximum queues at the critical intersection movements.

As shown in **Table 4**, utilizing the current traffic volumes with the at-grade crossing condition, the study intersections in the study are forecast to operate at LOS E or F during the weekday a.m. and p.m. peak hours. As shown in **Table 5**, at the Centinela Avenue/Florence Avenue intersection, the most extensive traffic queues are generally forecast to occur in the a.m. peak hour, at the westbound right-turn and southbound right-turn movements.

If the LRT tracks were in operation with 5-minute headways and 3-car trains with the current background traffic, this intersection LOS would change from LOS C or better to LOS F in both peak hours. Traffic movements in the southbound queue (left turn and right-turn), eastbound left turn queue and westbound right turn queue could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest). The average gate spillback queue is forecast to be under 500 feet, where the gate spillback area to accommodate this queue is approximately 520 feet.

The distance from the Centinela Avenue/Warren Lane intersection back to the future at-grade crossing (influence zone area) is approximately 560 feet. The estimated influence zone queue length is not anticipated to extend from the adjacent intersections to cross the LRT tracks. Thus, an unsafe influence zone queue condition is not forecast to occur.

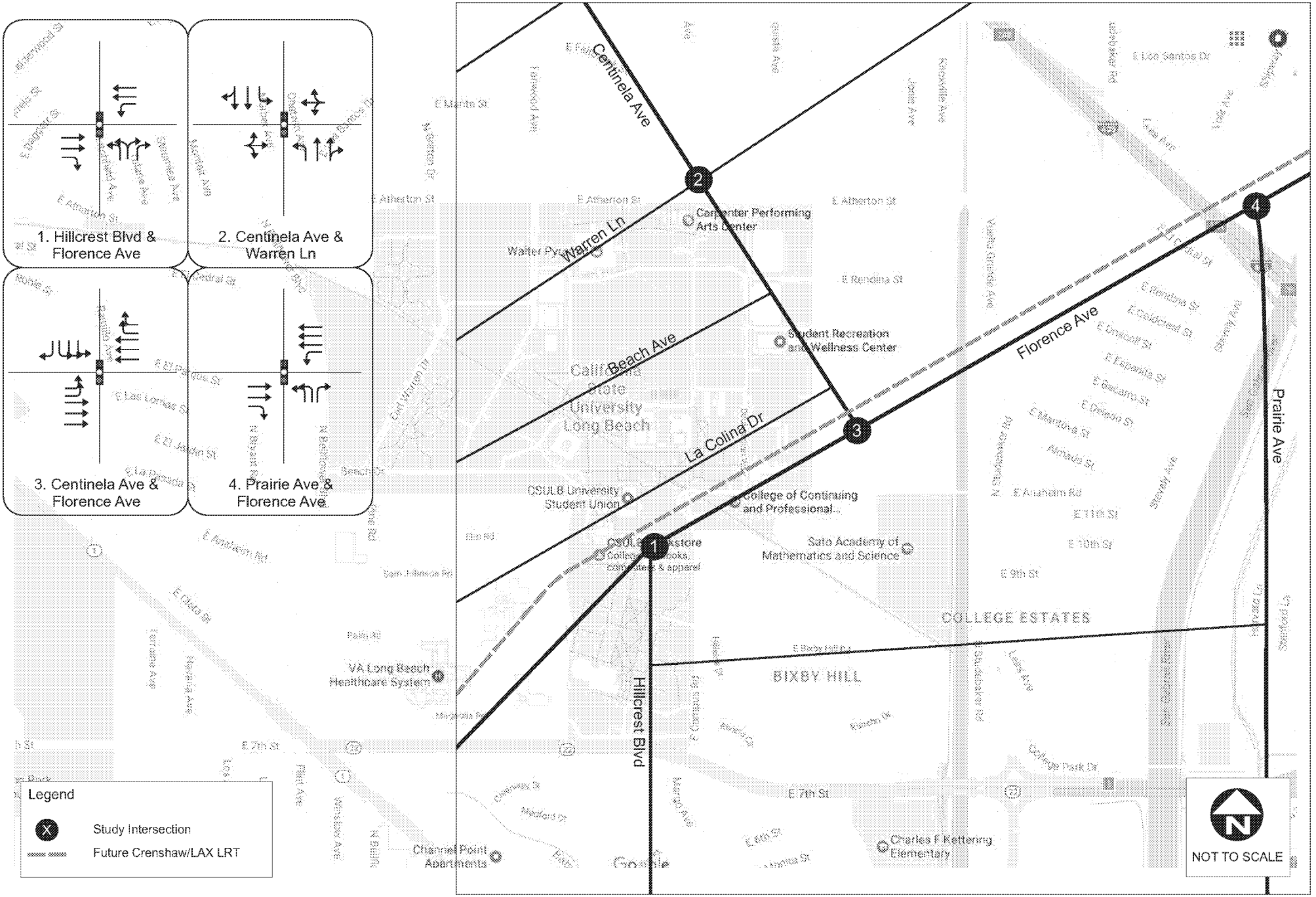
Table 4: Existing Plus At-Grade Crossing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds) - LOS
1. Hillcrest Blvd / Florence Ave	76.8 – E	88.4 – F
2. Centinela Ave / Warren Ln	24.1 – C	27.4 – C
3. Centinela Ave / Florence Ave	**107.9** – F	**97.8** – F
4. Prairie Ave / Florence Ave	78.8 – E	27.6 – C

Table 5: Existing Plus At-Grade Crossing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave. Queue (ft)	Max. Queue (ft)	Ave. Queue (ft)	Max. Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	50	**300**	80	**400**
	WB Through	475	30	**450**	20	420
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	560*	30	380	30	360
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	520*	310	**> 520**	300	**> 520**
	SB Right-turn (Gate Spillback)	230	**330**	**> 520**	**320**	**> 520**
	EB Left-turn	150	**490**	**590**	**520**	**600**
	WB Right-turn	250	**790**	**1,080**	70	**410**
4. Prairie Ave / Florence Ave	EB Through	940	80	540	130	660
	EB Right-turn	175	50	**530**	100	**660**

Note:
*SB Centinela queue storage capacity is shorter than that of the NB direction due to the placement of the SB approach stop bar (north of La Colina). In addition, SB Centinela queue storage capacity in this scenario is shorter than existing and grade-separated conditions for the same reason. Bold font: projected queue length exceeds the storage capacity.



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Centinela Grade Separation
Traffic Analysis

Figure 6
Intersection Lane Configurations with At-Grade Crossing

6.0 OPENING YEAR 2019 ANALYSIS

This section presents the analysis results for opening year 2019. Opening year 2019 represents the opening year for the Crenshaw/LAX Line. Opening year traffic volumes at the study intersections are based on growth rate factors from the City of Inglewood (historical volume trend of 1.34% annual growth rate), and applied to the 2017 traffic counts for each time period. It is not anticipated that the future NFL stadium (or retail, office, or residential) at the Hollywood Park Commercial and Entertainment Complex will be complete by 2019. Thus, opening year volumes at the study intersections do not include traffic generated by that future development. **Figure 7** shows the opening year 2019 weekday peak hour intersection volumes.

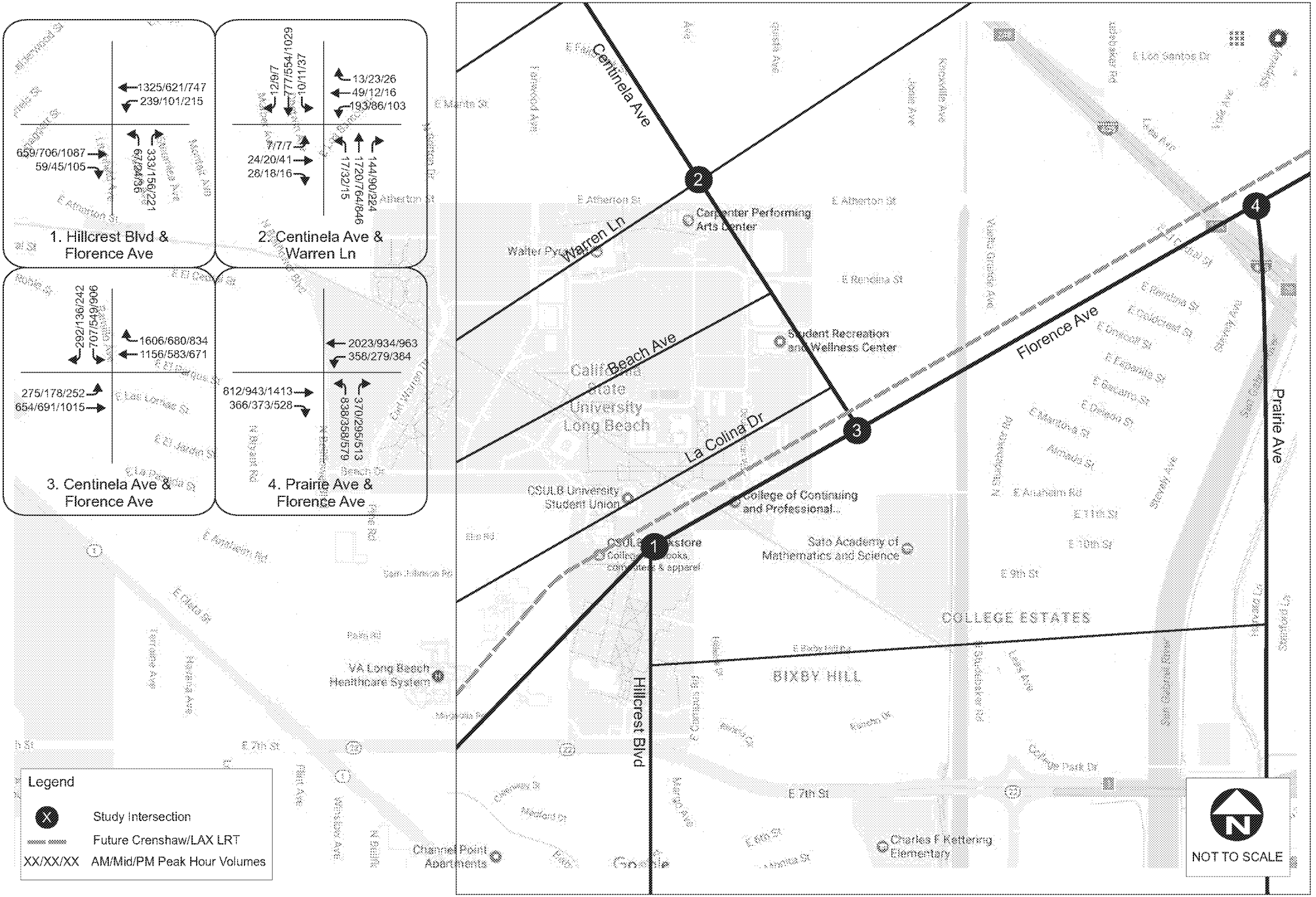
6.1 Opening Year 2019 Traffic Operations with At-Grade Crossing

An LOS and queue analysis was conducted to evaluate opening year 2019 intersection operations with the at-grade crossing using the 2019 traffic volumes. The assumptions from Metro for the opening year operation of the Crenshaw/LAX Line in this scenario are as follows:

- 5-minute headways per direction during peak hours;
- 2-car trains;
- Trains speeds of 35 – 45 mph in the westbound direction and 40 – 50 mph in eastbound direction.

Table 6 summarizes the opening year 2019 with at-grade crossing LOS at the study intersections for the weekday peak hours. Detailed LOS output data is provided in **Appendix C**. **Table 7** summarizes the opening year 2019 with at-grade crossing average and maximum queues at the critical intersection movements. As shown in **Table 6**, in the near-term, with 5-minute headways, 2-car trains, and slightly higher background traffic conditions, this intersection LOS would change from existing LOS C or better to LOS F conditions in both the a.m. and p.m. peak hours. The vehicle queues at Centinela/Florence may accumulate and begin to spill back from the LRT tracks to the three adjacent intersections periodically (Warren to the north, Prairie to the east, and Hillcrest to the west).

As shown in **Table 7**, the distance from the Centinela Avenue/Warren Lane intersection back to the future at-grade crossing (influence zone area) is approximately 560 feet. The influence zone queues, resulting from vehicle back-up at the northbound approach of the Centinela Avenue/Warren Lane intersection, are forecast to be under 100 feet on average. Thus, no salient safety issue was identified for this at-grade crossing because the influence zone queue from the adjacent intersections is projected to be within the storage capacity on Florence and on Centinela.



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Centinela Grade Separation Traffic Analysis

Figure 7
Opening Year 2019 Weekday Peak Hour Intersection Volumes

Table 6: Opening Year 2019 with At-Grade Crossing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave Vehicle Delay (seconds) - LOS	PM Peak Hour Ave Vehicle Delay (seconds) - LOS
1. Hillcrest Blvd / Florence Ave	76.5 – E	91.5 – F
2. Centinela Ave / Warren Ln	19.9 – B	28.6 – C
3. Centinela Ave / Florence Ave	**103.7** – F	**98.1** – F
4. Prairie Ave / Florence Ave	**83.6** – F	28.7 – C

Table 7: Opening Year 2019 with At-Grade Crossing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave. Queue (ft)	Max. Queue (ft)	Ave. Queue (ft)	Max. Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	50	230	80	**400**
	WB Through	475	40	**490**	30	420
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	560*	30	450	30	370
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	520*	260	**> 520**	300	**> 520**
	SB Right-turn (Gate Spillback)	230	**280**	**> 520**	**310**	**> 520**
	EB Left-turn	150	**500**	**590**	**530**	**600**
	WB Right-turn	250	**780**	**1,060**	90	**510**
4. Prairie Ave / Florence Ave	EB Through	940	700	480	140	650
	EB Right-turn	175	60	**470**	100	**660**

Note:
*SB Centinela queue storage capacity is shorter than that of the NB direction due to the placement of the SB approach stop bar (north of La Colina). In addition, SB Centinela queue storage capacity in this scenario is shorter than existing and grade-separated conditions for the same reason.
Bold font: projected queue length exceeds the storage capacity.

6.2 Opening Year 2019 Traffic Operations with Grade-Separated Crossing

This section presents an analysis of the effect that a grade separation would have on traffic operations in the study area. Utilizing the same traffic volumes as the 2019 at-grade crossing analysis, the network was analyzed assuming no signal phasing or timing would be dedicated to a crossing train (i.e., no pre-emption or gate down time). Also, the dedicated pedestrian-only phase across Florence Avenue was removed. Thus, the signal timing and phasing would resemble existing conditions. The lane configurations were assumed to be the same as the 2019 at-grade condition. **Table 8** summarizes the opening year 2019 with grade-separated LOS results at the study intersections for the weekday peak hours. Detailed LOS output data is provided in **Appendix C**.

Table 8: Opening Year 2019 with Grade-Separated Crossing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds)- LOS
1. Hillcrest Blvd / Florence Ave	14.0 – B	12.4 – B
2. Centinela Ave / Warren Ln	11.2 – B	9.4 – A
3. Centinela Ave / Florence Ave	20.1 – C	15.3 – B
4. Prairie Ave / Florence Ave	24.7 – C	30.6 – C

With the potential grade-separated crossing in opening year 2019, the Centinela Avenue/Florence Avenue intersection is forecast to operate at comparable LOS as the existing conditions (LOS C in the a.m. and LOS B in the p.m). The remaining three study intersections are expected to operate at LOS C or better.

Table 9 summarizes the opening year 2019 with grade-separated crossing average and maximum queues at the critical intersection movements. Under this year 2019 scenario with grade-separate crossing, the projected vehicle queue length at Centinela/Florence is slightly longer than the queue length under 2017 baseline (no LRT) conditions.

Table 9: Opening Year 2019 with Grade-Separated Crossing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave. Queue (ft)	Max. Queue (ft)	Ave. Queue (ft)	Max. Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	60	**350**	50	**230**
	WB Through	475	20	460	10	100
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	600	40	390	20	230
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	600	40	200	50	230
	SB Right-turn (Gate Spillback)	230	60	**340**	20	180
	EB Left-turn	150	50	**200**	40	140
	WB Right-turn	250	30	230	10	140
4. Prairie Ave / Florence Ave	EB Through	940	90	420	270	850
	EB Right-turn	175	30	**260**	100	**760**

Bold font: projected queue length exceeds the storage capacity.

7.0 FUTURE YEAR 2040 ANALYSIS

This section presents the methodology for developing future traffic volumes for the study area, as well as the analysis results for future year 2040.

7.1 Traffic Forecasting Methodology

In coordination with the City of Inglewood, the 2016 SCAG RTP/SCS travel demand model was used as a basis for developing long-range traffic forecasts for the study area intersections. The socio-economic data in the forecast year was refined and adjusted to reflect several future developments. These include:

- Hollywood Park Project which includes an 80,000-seat sport stadium, 6,000-seat performance venue, 2,500 residential dwelling units, 890,000 square feet of retail; 780,000 square feet of office; 120,000 square foot casino, and a 300-room hotel
- The TOD plans around the future Crenshaw/LAX Line stations (Downtown Inglewood, Fairview Heights, Westchester/Veterans) on either side of the project area
- The TOD plan around the Metro Green Line station at Imperial/Crenshaw
- Murphy Bowl Project (Clippers Arena) at Yukon Avenue/Century Boulevard

A full list of future development projects included in the future year forecasting is provided in **Appendix D**. Two model runs were completed, using TransCAD software, for this analysis:

- Existing Year (2016); and
- Forecast Year (2040).

The completion of the Crenshaw/LAX Line was included as a baseline assumption in the forecast year model run. While the SCAG model includes the Crenshaw/LAX Line as a baseline assumption for travel mode share, the delay along at the Centinela Avenue/Florence Avenue intersection related to the at-grade crossing is not accounted for in the model's trip route determination. Thus intersection-level delays that may be caused by the at-grade crossing do not influence trip diversion to other routes in the SCAG model. No manual adjustments were made to account for trip diversion.

An NCHRP-255 delta process was used for post-processing raw link volumes to produce the refined and adjusted turning movements used in the VISSIM analysis. The delta process took existing count information as a baseline, and calculated link volume growth between the existing year travel model (2016) and the future year model scenario (2040). The model growth was then applied to the existing intersection turning movement count data. Average annual growth in traffic was calculated to be approximately 0.8%.

7.2 Initial Grade Crossing Policy Analysis – Future Year 2040 Conditions

Figure 8 shows the future year 2040 weekday peak hour intersection volumes, and **Table 10** shows the highest bi-directional cross street traffic volume per lane for the a.m. peak hour and p.m. peak hour. Using 2040 volumes, the Initial Screening assessment was re-visited. In **Figure 9**, these values are plotted on the same nomograph as previously shown in Section 4.1.

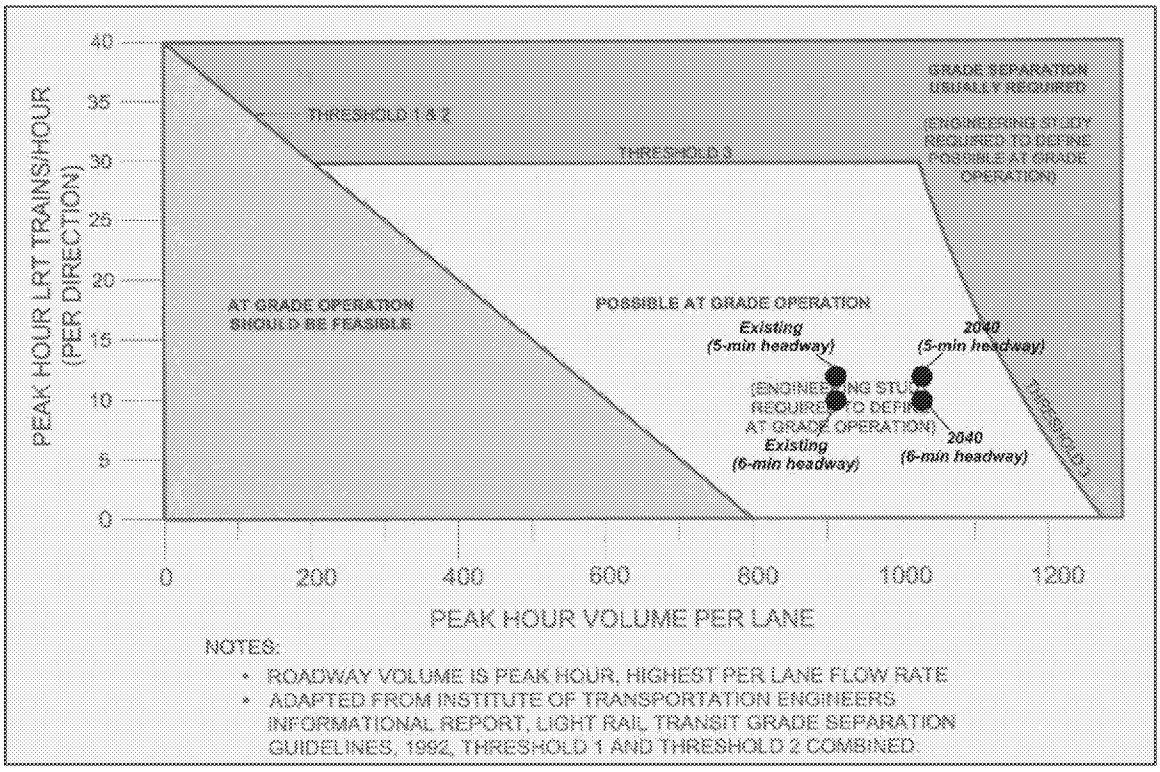
Table 10: Future Year 2040 Cross-Street Traffic Volume per Lane – AM and PM Peak Hour

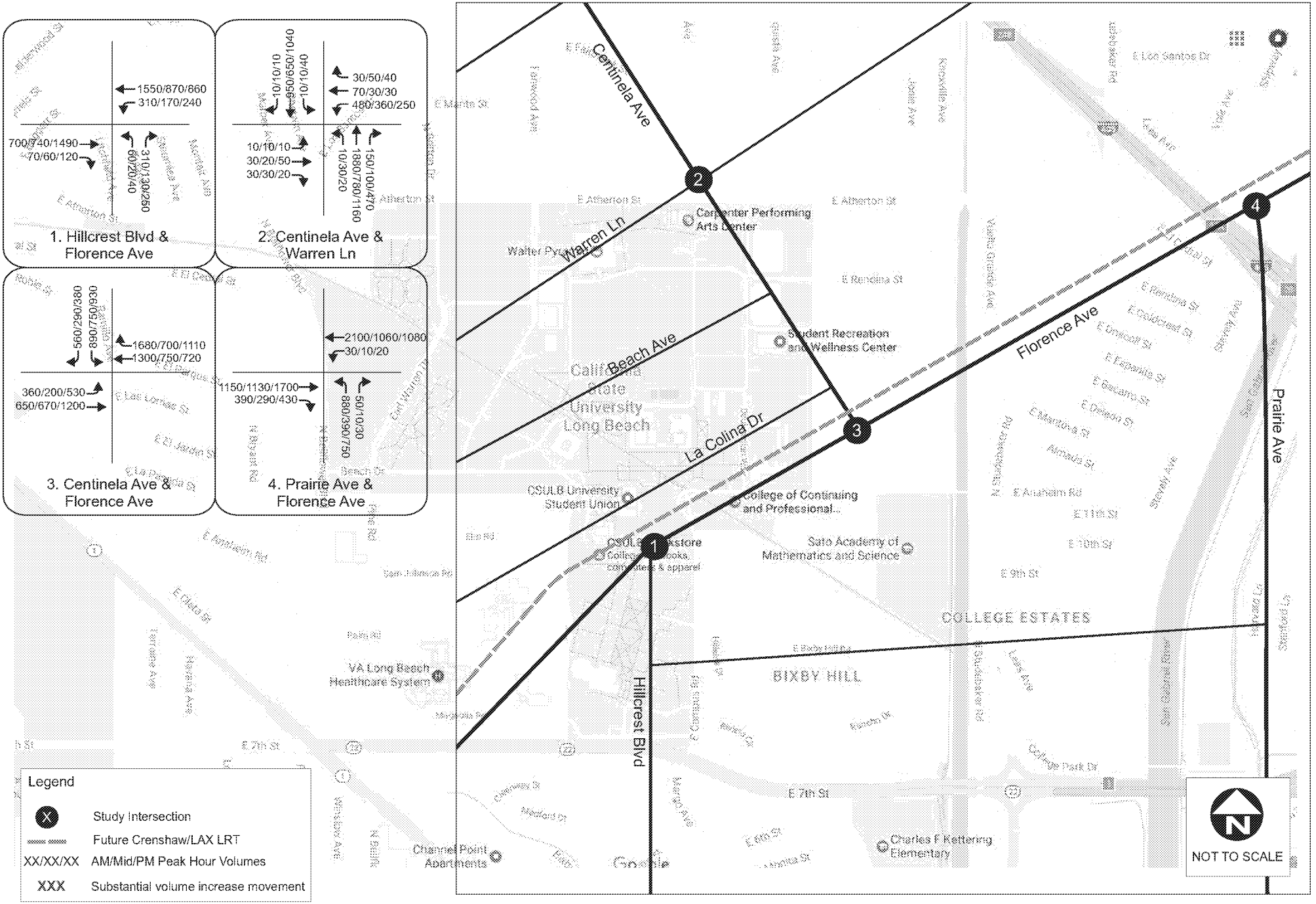
At-Grade Crossing	Cross-Street # of Lanes		Highest Cross-Street Volume/Lane
	NB	SB	Future Year 2040
Centinela Ave (north of Florence Ave)	2	4*	1,020 vehicles/lane (a.m.) 820 vehicles/lane (p.m.)

* Proposed configuration with at-grade crossing

Peak hour headways of five (5) minutes per direction are anticipated for the Metro Crenshaw Line/LAX Line. This frequency equates to 12 trains per hour for the peak hour. For comparison purposes, in each analysis year, both the 5-minute (12 trains per hour) and 6-minute (10 trains per hour) headway conditions are plotted.

Figure 9 – Nomograph for Initial Screening – Future Year 2040 AM Peak Hour





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Centinela Grade Separation Traffic Analysis

Figure 8
Future Year 2040 Weekday Peak Hour Intersection Volumes

As shown in **Figure 9**, the Centinela Avenue crossing continues to be categorized as a "possible at-grade operation", but further engineering study is required to define the operation. Further engineering analysis is described below.

7.3 Future Year 2040 Traffic Operations with At-Grade Crossing

An LOS and queue analysis was conducted to evaluate future year 2040 intersection operations using the 2040 traffic volumes. The following assumptions for the operation of the Crenshaw/LAX Line in this scenario are as follows:

- 5-minute headways per direction during peak hours;
- 3-car trains;
- Trains speeds of 35 – 45 mph in the westbound direction and 40 – 50 mph in eastbound direction.

Table 11 summarizes the future year 2040 LOS at the study intersections for the weekday peak hours. Detailed LOS output data is provided in **Appendix C**. **Table 12** summarizes the future year 2040 with at-grade crossing average and maximum queues at the critical intersection movements.

Table 11: Future Year 2040 with At-Grade Crossing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds)- LOS
1. Hillcrest Blvd / Florence Ave	**99.3** – F	**77.2** – F
2. Centinela Ave / Warren Ln	**82.3** – F	**87.9** – F
3. Centinela Ave / Florence Ave	**117.9** –F	**108.5** – F
4. Prairie Ave / Florence Ave	**85.3** – F	70.7 – E

Table 12: Future Year 2040 with At-Grade Crossing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave. Queue (ft)	Max. Queue (ft)	Ave. Queue (ft)	Max. Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	50	**390**	70	**460**
	WB Through	475	50	**580**	20	380
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	560*	40	380	60	470
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	520*	470	**> 520**	470	**> 520**
	SB Right-turn (Gate Spillback)	230	**490**	**> 520**	**410**	**> 520**
	EB Left-turn	150	**530**	**590**	**520**	**600**
	WB Right-turn	250	**750**	**1,060**	**700**	**1,060**
4. Prairie Ave / Florence Ave	EB Through	940	50	450	150	670
	EB Right-turn	175	20	**460**	60	**620**

Note:
*SB Centinela queue storage capacity is shorter than that of the NB direction due to the placement of the SB approach stop bar (north of La Colina). In addition, SB Centinela queue storage capacity in this scenario is shorter than existing and grade-separated conditions for the same reason.
Bold font: projected queue length exceeds the storage capacity.

As shown in **Table 11**, due to the cumulative traffic growth and more frequent 5-minute headway and 3-car train services, this intersection LOS would deteriorate from existing LOS C or better to over-saturated LOS F in both the a.m. and p.m. peak hours.

Traffic movements approaching the at-grade crossings (southbound, eastbound left turn and westbound right-turn) may experience extensive delays and queue lengths and motorists may have to wait for more than one signal cycle before they can safely cross the LRT tracks. These traffic movements could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest) frequently.

As shown in **Table 12**, the influence zone queues, resulting from vehicle back-up at the northbound approach of the Centinela Avenue/Warren Lane intersection, during the a.m. and p.m. peak hours, are forecast to be under 100 feet on average. The distance from the Centinela Avenue/Warren Lane intersection back to the future at-grade crossing (influence zone area) is approximately 560 feet. Thus, no salient safety issue is anticipated with the influence zone queue.

The delay and LOS results shown in **Table 11** represent the average delay and LOS across all movements of an intersection. Some movements are forecast to operate better or worse than others. The following is a summary of the most critical movements at the Centinela Avenue/Florence Avenue intersection:

- AM Peak Hour
  - The eastbound left-turn movement is forecast to experience the highest average delay at the intersection, approximately 420 seconds per vehicle. This means that the eastbound left turn movement would be over-saturated under 2040 with LRT conditions. Motorists may experience significant wait time in a long queue for several signal cycles before they can exit the intersection. Due to the frequent LRT operations (every five minutes in each direction), this movement would not receive a sufficient amount of green time to serve the projected left-turn vehicle demand due to other competing movements (such as the westbound right-turn movement and the southbound movement) that also require green time to cross the LRT tracks .
  - The southbound right-turn movement is forecast to experience a delay of approximately 161 seconds. The analysis assumes one right-turn lane with three left-turn lanes. This right-turn movement delay could potentially be improved by modifying the approach to include one right-turn lane, one shared left-turn/right-turn lane, and two left-turn lanes. However, the southbound left-turn movement would then experience additional delay.
- PM Peak Hour
  - Similar to the AM peak hour conditions, with the frequent LRT operations, the eastbound left-turn movement would also experience over-saturated conditions during the PM peak hour, at approximately 250 seconds per vehicle.
  - The southbound right-turn movement is forecast to experience the next highest average delay at the intersection, approximately 169 seconds. This right-turn lane delay could potentially be improved by modifying the approach to include one right-turn lane, one shared left-turn/right-turn lane, and two left-turn lanes. However, the southbound left-turn movement may be affected.
- During both a.m. and p.m. peak hours, the eastbound Florence Avenue through movement and westbound Florence Avenue right-turn movement are forecast to generally have the lowest average delays. These lower delays are due to the number of lanes provided at each approach as well as the amount of green time allocated during the course of a peak hour. The westbound right-turn movement, in particular, would experience lower delays, mostly due to the overlap with the southbound movement.

7.4 Future Year 2040 Traffic Operations with Grade-Separated Crossing

This section presents an analysis of the effect that a grade separation would have on traffic operations in the study area. Utilizing the same traffic volumes as the 2040 at-grade crossing analysis, the network was analyzed assuming no signal phasing or timing would be dedicated to a crossing train (i.e., no pre-emption or gate down time). Also, the dedicated pedestrian-only phase was removed. Thus, the signal timing and phasing would resemble existing conditions. The lane configurations were assumed to be the same as the 2040 at-grade condition. **Table 13** summarizes the future year 2040 with grade-separated crossing LOS at

the study intersections for the weekday peak hours. Detailed LOS output data is provided in **Appendix C**.

Table 13: Future Year 2040 with Grade-Separated Crossing Intersection Peak Hour LOS

Intersection	AM Peak Hour Ave. Vehicle Delay (seconds) - LOS	PM Peak Hour Ave. Vehicle Delay (seconds) - LOS
1. Hillcrest Blvd / Florence Ave	13.6 – B	32.8 – C
2. Centinela Ave / Warren Ln	34.9 – C	42.7 – D
3. Centinela Ave / Florence Ave	31.7 – C	**55.3 – E**
4. Prairie Ave / Florence Ave	25.4 – C	43.2 – D

As shown in **Table 13**, with the potential grade-separated crossing, due to the cumulative traffic growth, the Centinela Avenue/Florence Avenue intersection is forecast to operate at LOS C in the a.m. peak hour and LOS E in the p.m. peak hour. The remaining three study intersections are expected to operate at LOS D or better.

Table 14 summarizes the future year 2040 with grade-separated crossing average and maximum queues at the most critical intersection movements.

The average traffic queue for the southbound left turn and right turn queue may be extensive and begin to spill back to Warren to the north. The average eastbound and westbound movement queues can be generally accommodated within one block of the at-grade crossing, but the maximum queue may begin to spill back to Prairie and to Hillcrest periodically.

Table 14: Future Year 2040 with Grade-Separated Crossing Intersection Peak Hour Queues

Intersection - Movement		Storage Capacity (ft)	AM Peak Hour		PM Peak Hour	
			Ave. Queue (ft)	Max. Queue (ft)	Ave. Queue (ft)	Max. Queue (ft)
1. Hillcrest Blvd / Florence Ave	WB Left-turn	230	70	**270**	50	**240**
	WB Through	475	20	**480**	10	130
2. Centinela Ave / Warren Ln	NB Through (Influence Zone)	600	60	450	60	410
3. Centinela Ave / Florence Ave	SB Left-turn (Gate Spillback)	600	130	530	370	**> 600**
	SB Right-turn (Gate Spillback)	230	**460**	**> 600**	160	**> 600**
	EB Left-turn	150	60	**240**	**280**	**590**
	WB Right-turn	250	30	**270**	20	180
4. Prairie Ave / Florence Ave	EB Through	940	120	620	840	**1,120**
	EB Right-turn	175	30	**250**	**250**	**840**

Bold font: projected queue length exceeds the storage capacity.

8.0 SAFETY EVALUATION

A safety review was performed as described in the Metro Grade Crossing Safety Policy to help determine whether adverse safety conditions would suggest and support a grade-separated solution. While several factors may be used as part of a preliminary safety review, the main intent of this traffic analysis is to reevaluate the need for a grade separation at the Centinela Avenue crossing due to increased development in the City of Inglewood. Therefore, the safety evaluation conducted in this report will only focus on the one element that is relevant to this changed condition: safety issues related to traffic queuing. **Figures 10** and **11** show a comparison of existing average queue lengths and 2040 with at-grade crossing average queue lengths at the intersection approaches, during the a.m. and p.m. peak hours respectively.

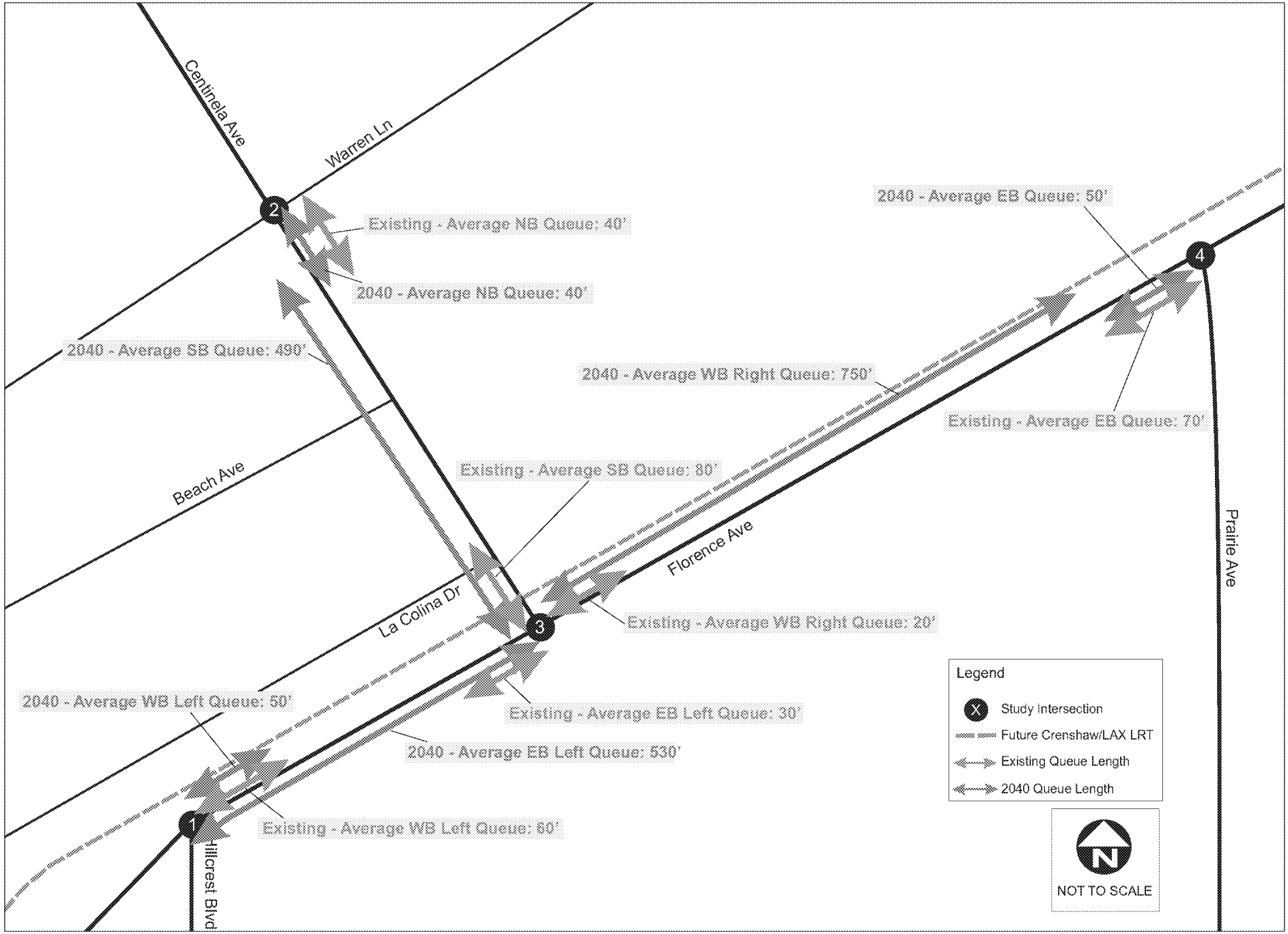

Figure 10
Existing and 2040 At-Grade Average AM Queue Lengths at Centinela/Florence Intersection

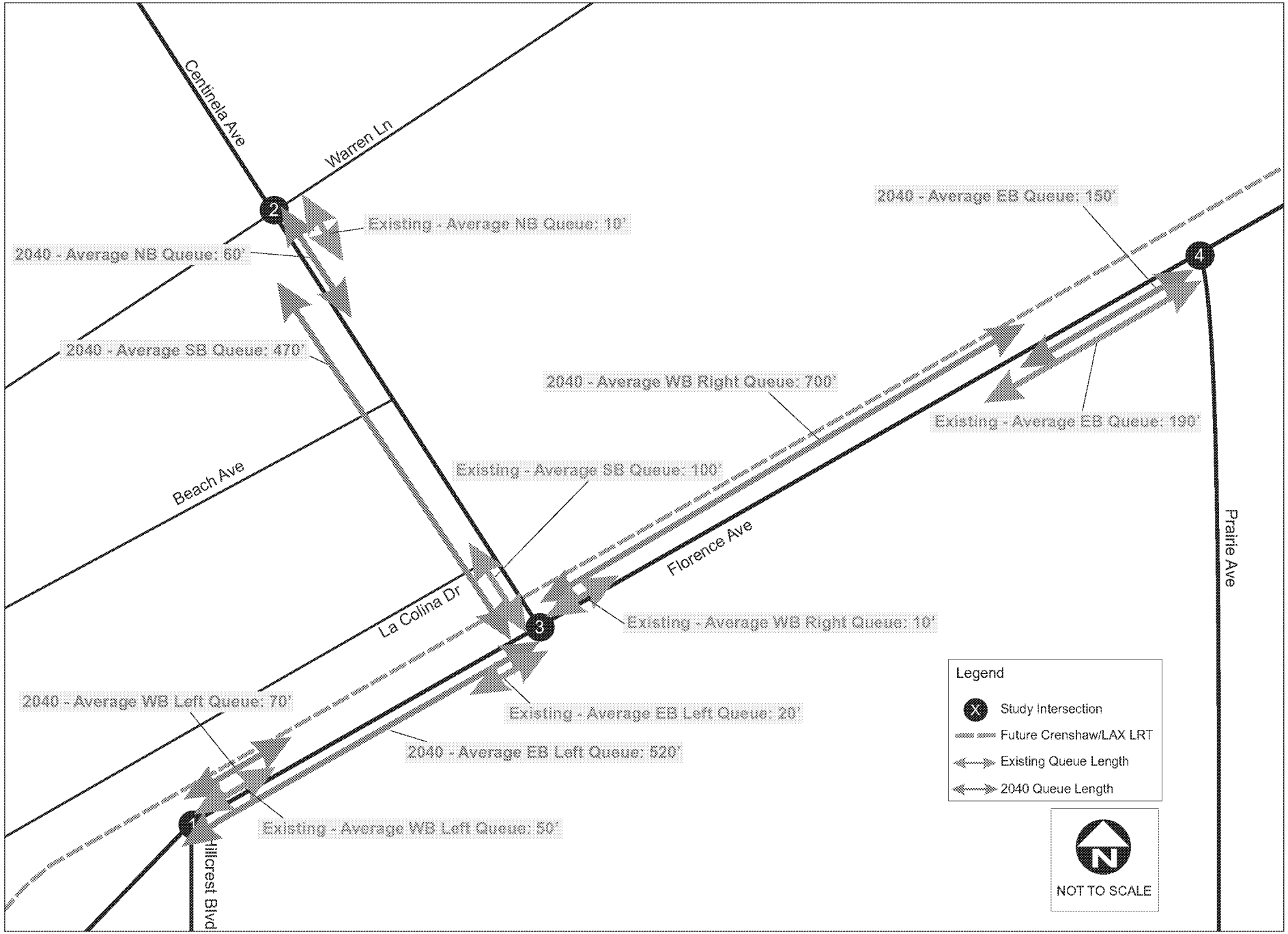

Figure 11
Existing and 2040 At-Grade Average PM Queue Lengths at Centinela/Florence Intersection

As discussed above, the queues resulting from vehicle back-up at the northbound approach of the Centinela Avenue/Warren Lane intersection (i.e., influence zone queue), is forecast to be under 100 feet on average during the two peak time periods. The distance from the Centinela Avenue/Warren Lane intersection back to the future at-grade crossing is approximately 560 feet. Thus, it is concluded that no salient safety issue associated with the influence zone queue conditions is identified for this location with northbound vehicles potentially blocking the LRT tracks.

Similarly, westbound vehicles at the Hillcrest Boulevard/Florence Avenue intersection and eastbound vehicles at the Prairie Avenue/Florence Avenue intersection are not forecast to experience average queues that back up to the Centinela Avenue/Florence Avenue intersection. Thus, the average queues from these two adjacent intersections are not forecast to result in blocking of the LRT tracks.

In addition, based on the VISSIM analysis, adequate track clearance times are provided for the southbound Centinela Avenue approach volumes, as well as volumes that turn onto Centinela Avenue from La Colina Drive in all at-grade scenarios.

9.0 CONCLUSIONS

This study analyzed traffic operations in the vicinity of the Centinela Avenue grade crossing of the Crenshaw/LAX Line in the City of Inglewood. The Centinela Avenue crossing is currently under construction as an at-grade crossing between the Fairview Heights and Downtown Inglewood stations.

Existing, Opening Year 2019, and Future Year 2040 conditions were evaluated at the study intersections, describing the intersection LOS and queue values at critical movements. Opening year 2019 traffic volumes were developed based on available 2017 traffic count with a growth rate, while future year 2040 volumes were based on SCAG regional model forecasts incorporating land use assumptions from future development projects in the area.

At Centinela/Florence intersection, the influence zone and gate spillback queues were estimated for all study scenarios (existing, 2019 opening year, and 2040). The key findings from the queueing analysis are:

- **Existing conditions**: The intersection is operating at LOS C or better in the peak hours and no significant traffic queuing conditions was identified based on field observations.

- **Existing Plus At-Grade Crossing scenario**: If the LRT tracks were in operations with 5-minute headways and 3-car trains with the current background traffic, this intersection LOS would change from LOS C or better to LOS F in both peak hours. Traffic movements in the southbound queue (left turn and right-turn), eastbound left turn queue and westbound right turn queue could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest). Yet, the influence zone queue length is not anticipated to extend from the adjacent

intersections to cross the LRT tracks (i.e., no salient safety issue was identified).

- **Opening year 2019 with at-grade crossing scenario**: In the near-term, with 5-minute headways, 2-car trains, and slightly higher background traffic conditions, this intersection LOS would change from existing LOS C or better to LOS F conditions in both the a.m. and p.m. peak hours. The vehicle queues at Centinela/Florence may accumulate and begin to spill back from the LRT tracks to the three adjacent intersections periodically (Warren to the north, Prairie to the east, and Hillcrest to the west). However, no salient safety issue was identified for this at-grade crossing because the influence zone queue from the adjacent intersections is projected to be within the storage capacity on Florence and on Centinela.

- **Opening year 2019 with grade-separated crossing scenario**: The intersection is anticipated to operate at comparable LOS and queuing conditions to the existing conditions.

- **Future Year 2040 with At-Grade Crossing**: Due to the cumulative traffic growth and more frequent 5-minute headway and 3-car train services, this intersection LOS would deteriorate from existing LOS C or better to LOS F in both the a.m. and p.m. peak hours. Traffic movements approaching the at-grade crossings (southbound, eastbound left turn and westbound right-turn) may experience extensive delays and queue lengths and motorists may have to wait for more than one signal cycle before they can safely cross the LRT tracks. These traffic movements could potentially spill back from the LRT tracks to the adjacent intersections (Warren, Prairie, and Hillcrest) frequently. However, no salient safety issue was identified for this at-grade crossing because the influence zone queue from the adjacent intersections is projected to be within the storage capacity on Florence and on Centinela.

- **Future Year 2040 with Grade-Separated Crossing**: Due to the cumulative traffic growth, this intersection is projected to operate at LOS C in the a.m. peak hour and at the border line LOS E in the p.m. peak hour. The average traffic queue for the southbound left turn and right turn queue may be extensive and begin to spill back to Warren to the north. The average eastbound and westbound movement queues can be generally accommodated within one block of the at-grade crossing, but the maximum queue may begin to spill back to Prairie and to Hillcrest periodically.