SR-60 – 7th Avenue Intersection Control Evaluation (ICE)

I-605 Corridor Improvement Project (CIP)

I-605/SR-60

EA# 3101U0

October 9, 2017

Metro

Caltrans

Contents

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1 Purpose of ICE Memo

In accordance with Caltrans' Interchange Design Procedure (Topic 503 of the Highway Design Manual), interchanges are to be reviewed by the Design Coordinator and/or the Design Reviewer, Headquarters Traffic Liaison, and the Federal Highway Administration Transportation Engineer. In accordance with Caltrans' Traffic Operations Policy Directive 13-02, the District ICE Coordinator shall review intersection control strategies considered during the interchange review. This memorandum documents the interchange configurations considered, along with associated intersection control strategies, the recommended configuration to feature in the I-605 Corridor Project alternatives, and the rationale supporting the recommendation.

Caltrans has provided further guidance through its "ICE Process Informational Guide." This memorandum documents the interchange configurations considered, along with associated intersection control strategies, the recommended configuration to feature in the I-605 Corridor Improvement Project alternatives, and the rationale supporting the recommendation.

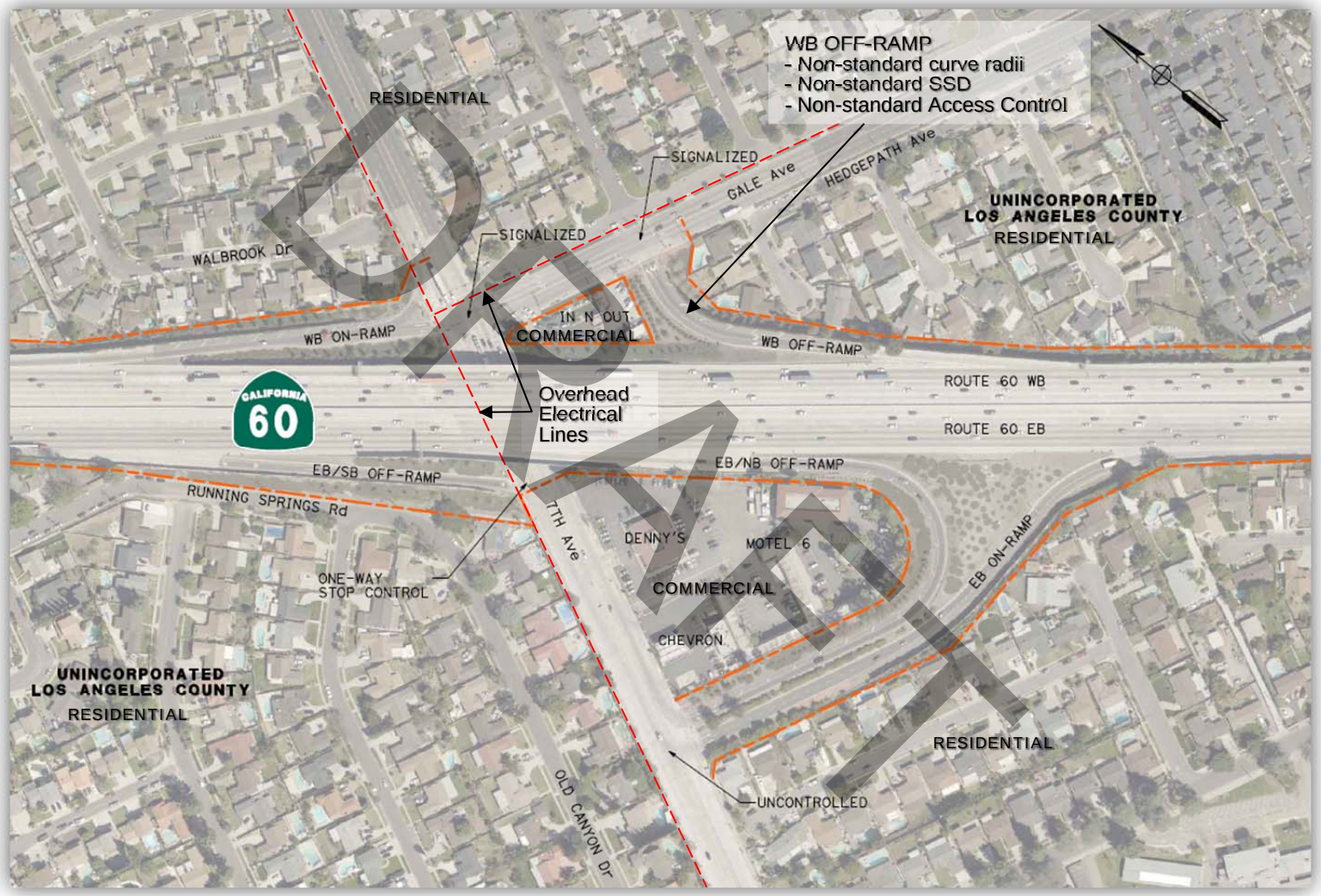
2 Background

The SR-60 / 7th Avenue Interchange is located in a highly urbanized area within Hacienda Heights in Unincorporated Los Angeles County. The project is providing improvements to the westbound on-ramp from 7th Avenue, the westbound (WB) off-ramp to 7th Avenue and the eastbound (EB) off-ramp to southbound 7th Avenue. These improvements are being made in order to accommodate SR 60 mainline widening required to improve the I-605 / SR-60 Interchange.

3 Existing Interchange Deficiencies

The existing interchange is configured as shown in Figure 3-1 below:

Figure 3-1 – SR 60 at 7th Avenue Existing Interchange Configuration and Geometric Deficiencies



As shown, the existing interchange doesn't follow a typical configuration. In the northeast quadrant there exists a single "hook" off-ramp similar to a Type L-6 configuration. In the northwest and southwest quadrants, compact diamond configurations (Type L-1) exist.

Geometric deficiencies include:

- Westbound off-ramp to 7th Avenue:
  - The existing "hook" ramp radius is a non-standard 200' providing a design speed of 30 mph
  - There is non-standard, horizontal stopping sight distance of 181' providing a design speed of 28 mph
  - There is an existing commercial driveway (In-N-Out), located 42' west of the terminus. This is less than the 50' required for standard access control.
- Eastbound off-ramps to 7th Avenue:
  - The existing EB off-ramp to SB 7th Avenue has non-standard vertical stopping sight distance, a non-standard intersection angle, and non-standard corner sight distance.
  - The existing EB off-ramp to NB 7th Avenue has a non-standard curve radius of 163' providing a design speed of 22 mph and non-standard lane widening required for trucks on curved ramps.
  - The existing EB on-ramp has a non-standard curve radius of 400' providing a design speed of 34 mph

Accidents at this interchange are noted in Figure 3-2. Accident data was received from Caltrans for each of the interchange ramps for the most recent three year period available.

Locations that are above the State average rates for similar facilities include:

- EB to SB 7th Avenue off-ramp where the accident rate is 155% higher than the state average. Of the nine total accidents more than half (5) were rear ends.
- EB to NB 7th Avenue off-ramp where the accident rate is 31% higher than the state average. Of the 11 total accidents four were hit objects, three were rear ends, two were sideswipes and one was a broadside/overturn accident.
- EB 7th Avenue on-ramp where the accident rate is 30% higher than the state average. Of the five total accidents three were broadsides and two were sideswipes.
- WB 7th Avenue off-ramp at Gale Avenue where the accident rate is 129% higher than the state average. Of the ten total accidents three were rear ends, three were broadsides, two were sideswipes and two were hit objects.

Figure 3-2 – SR-60 at 7th Avenue Interchange Accident Locations

4 Context Sensitive Elements

This interchange is located in a highly urbanized area which creates several physical constraints as shown in Figure 3-1 including:

- Commercial development in the northeast quadrant of the interchange (In-N-Out Burger)
- Commercial development in the southeast quadrant of the interchange (Chevron, Denny's, Motel 6)
- Residential properties adjacent to right of way in each quadrant
- Overhead distribution electrical lines adjacent to the roadway and crossing mainline freeway.

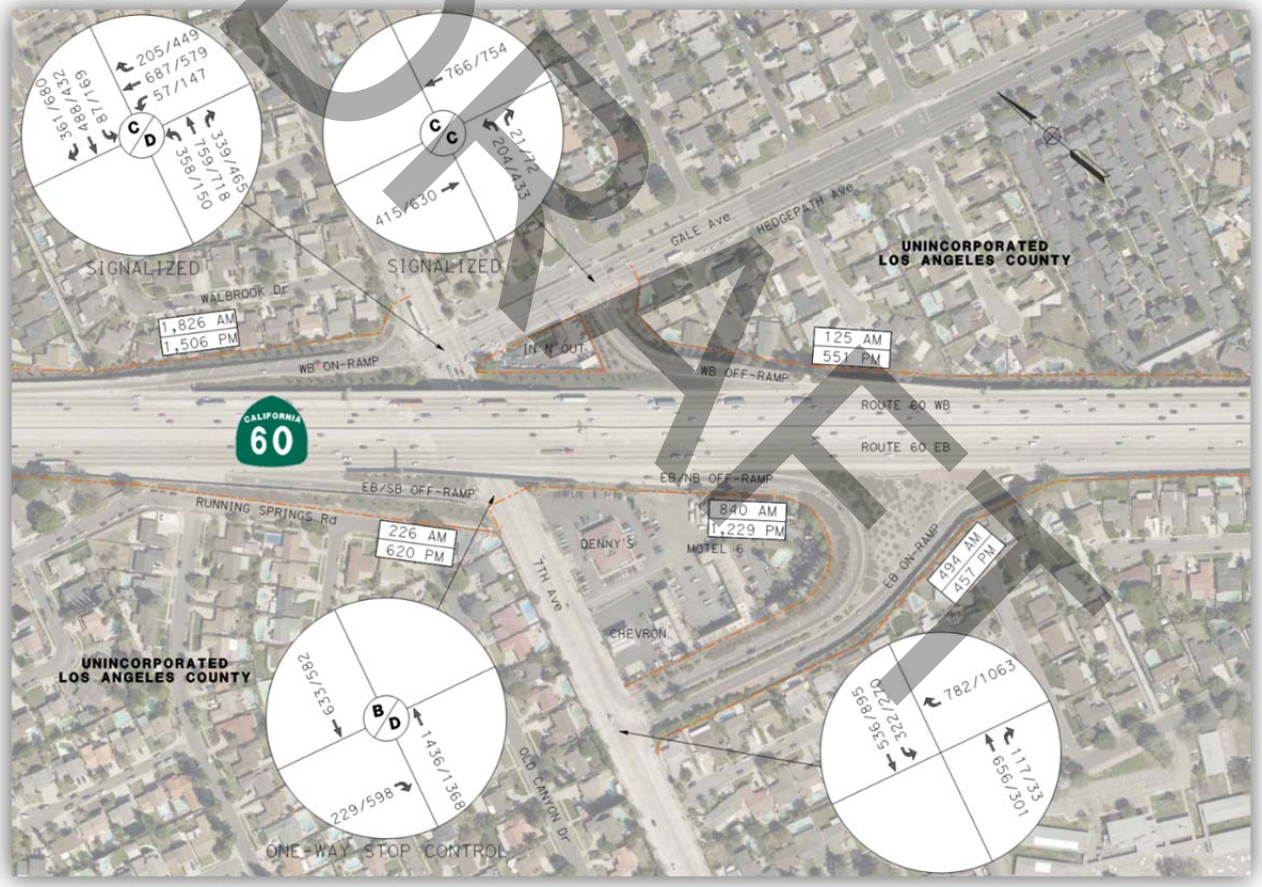
There are no bike path facilities located at this interchange and there are none planned.

Foothill Transit operates the bus system within this interchange area. Routes 281 and 282 operate on 7th Avenue north of Gale Avenue and along Gale Avenue.

5 Traffic Volumes

Existing Traffic Volumes for the intersections (2016) and projected traffic volumes for the ramps (2051) are provided in Figure 5-1 below:

Figure 5-1 – Traffic Volumes at SR-60/7th Avenue Interchange



Notable features include:

- Existing traffic volumes are an acceptable LOS of D and better.
- WB on-ramp from 7th Avenue, the NB left-turn lane does not have adequate storage length in the AM peak period and the SB left-turn lane does not have adequate storage length in the PM peak period
- EB off-ramp to SB 7th Avenue volume is relatively low.
- WB off-ramp to 7th Avenue volume is relatively low; however, there is a high percentage of trucks that utilize this ramp (approximately 7%.) Most of these trucks are turning left towards the industrial tracts located to the north in the City of Industry.
- The highest volume ramp is the WB on-ramp from SB 7th Ave.

6 Step 1 - Screening

6.1 Interchange Options

Various interchange configurations were considered and are summarized in Table 6-1. This interchange is located within a highly urbanized area that has been fully developed. Due to the context sensitive elements any major reconfiguration of the interchange would cause significant impacts beyond what would be gained by a modified interchange. As a result, it was determined that any major modification to the interchange configuration would not be viable or practical; however, improvements to individual ramps could be considered and are presented in the next section. Figure 6-1 provides a design option for this interchange in which the EB and WB on- and off-ramps are signalized or stop controlled.

6.1.1 Removal of EB off-ramp to SB 7th Avenue

Removal of the EB off-ramp to SB 7th Avenue has been considered because of the higher than average level of accidents experienced at this ramp. If this ramp were removed vehicles would be routed to the existing EB to NB loop off-ramp. An additional ramp lane would be required at the exit as well as at the intersection to accommodate both NB and SB movements, The existing stop-controlled intersection would require signalization and a free-right turn would be evaluated considering the high volume of traffic heading north on 7th Avenue. This option is shown in Figure 6-2.

Figure 6-1 – 7th Avenue Interchange Design Configuration

Design Option (Existing Configuration Improved)

- WB Alternatives 02/2A: WB direct on-ramp (signalized) & hook off-ramp (signalized)
- EB Alternatives 02/2A: EB direct off-ramp (stop-controlled)

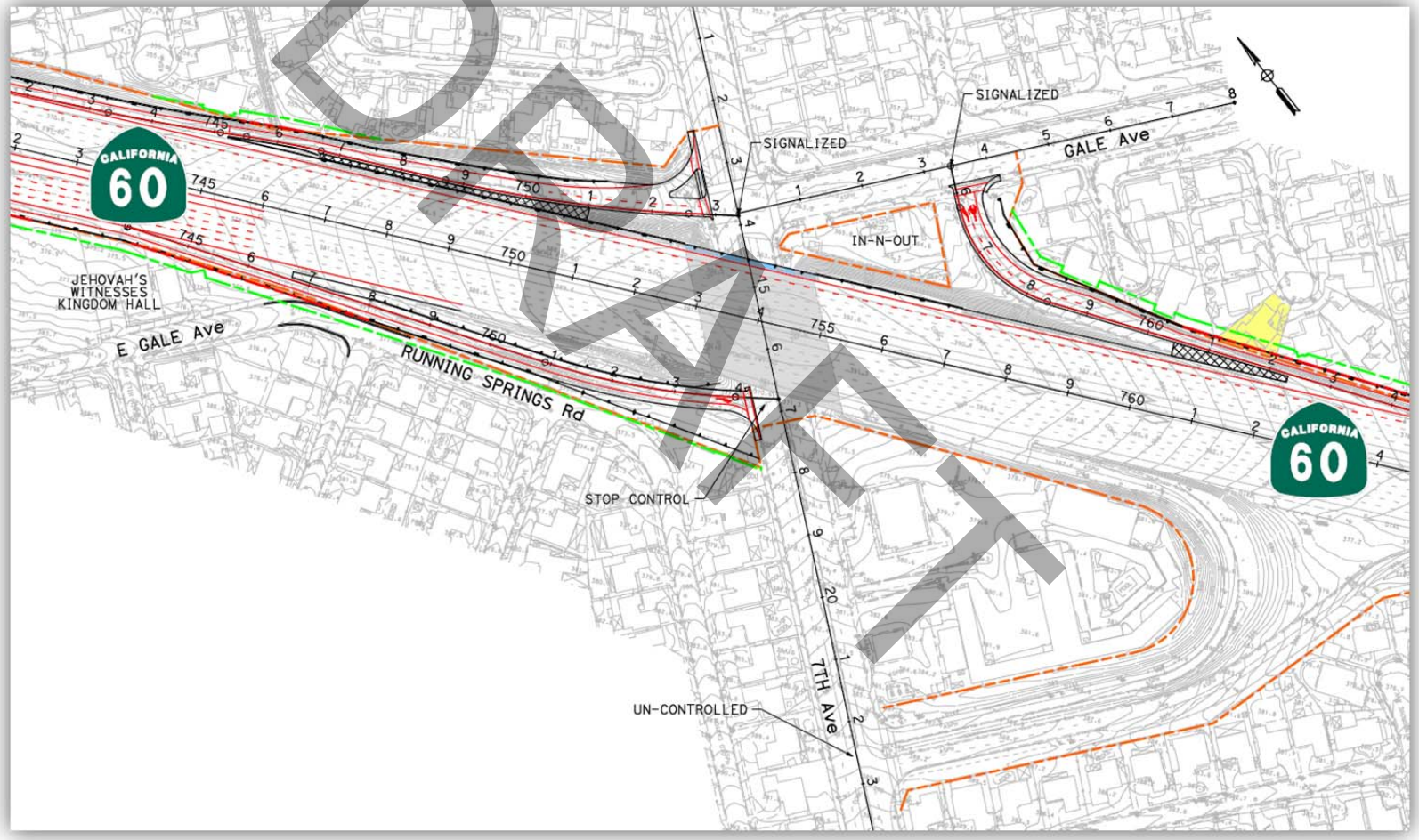


Figure 6-2 – EB to SB 7th Avenue Off-Ramp Removed Configuration

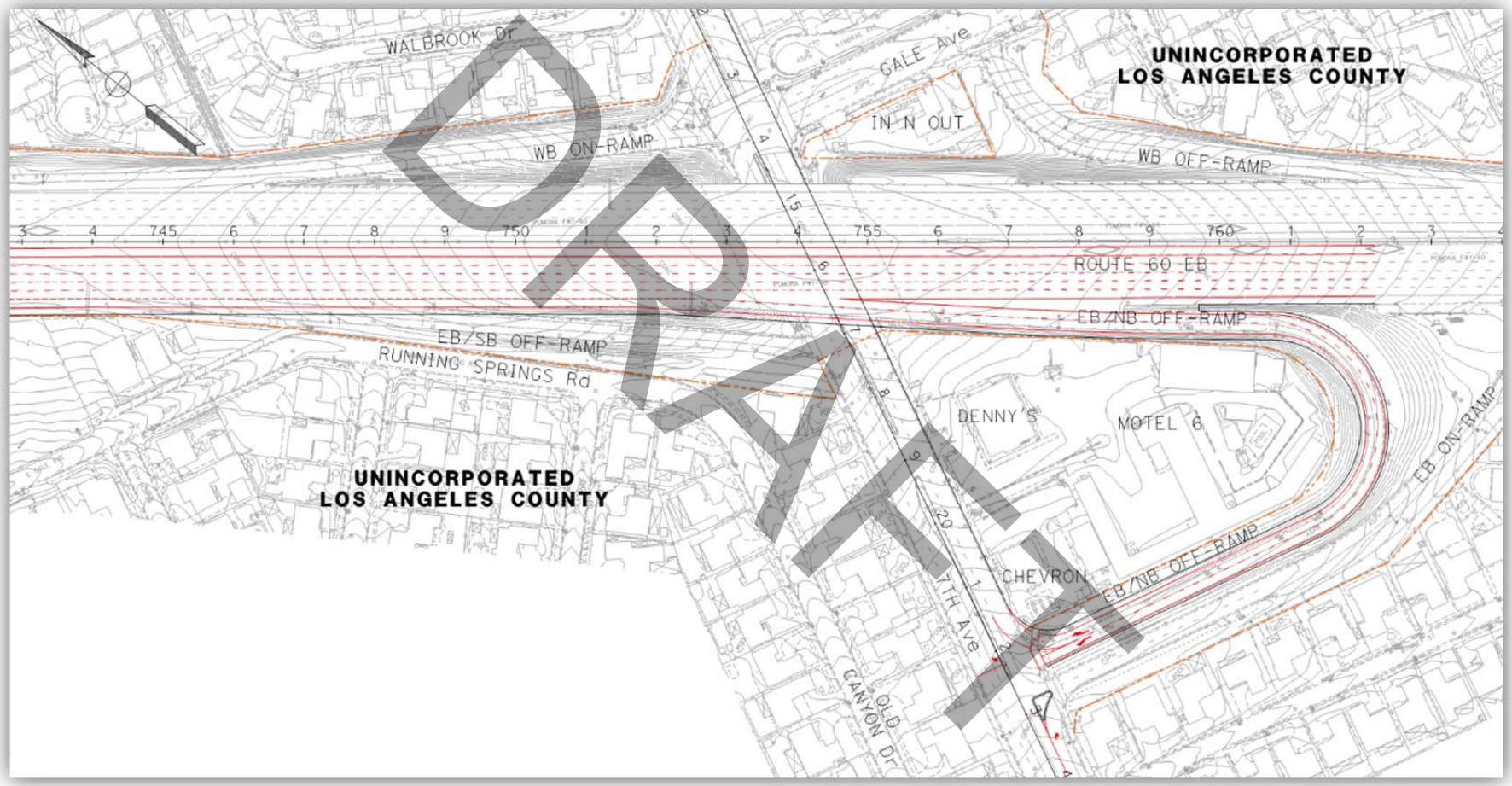


Table 6-1 - Interchange Configuration Options Screening

Interchange Type	Existing Interchange Configuration	Existing Interchange Configuration with EB to SB ramp removed	Configurations from Chapter 500 – Figure 502.2 of HDM (Types L-1 to L-12)	Double Roundabout (Teardrop or Raindrop)	Divergent Diamond Interchange (DDI)	Single Point Urban Interchange (SPUI) (Type L-13)
Right of Way Impacts	Minor	Minor	Major	Major	Major	Major
Construction Cost	Moderate	Moderate	Very High	High	Very High	Very High
Ease of Construction	Moderate	Moderate	Complex	Complex	Complex	Complex
Traffic impact during construction	Moderate	Moderate	Major	Major	Major	Major
Expected Driver Acceptance	Good	Good	Good	Moderate	Moderate	Moderate
Recommended for further study?	**Yes**	**Yes**	No	No	No	No
Notes	The existing interchange option meets purpose and need for the project.	EB to SB ramp removal considered due to higher accident rates.	Any major modification to the existing configurations as outlined in Chapter 500 would cause significant impacts with little gained benefits.	This configuration is not applicable as ramp intersections are offset from each other**.**	A DDI is not applicable as intersections are offset from each other. It would be a major modification that would cause significant impact with little gained benefits.	Not applicable as ramp intersections are offset from each other**.**

6.2 Intersection Options

Other viable options are considered for the signalized at-grade intersections with the local roads. Improvements are considered for the EB on- and off-ramp intersection and WB on- and off-ramp intersection.

6.2.1 EB and WB On- and Off-Ramp Intersection Roundabouts

A roundabout configuration was considered for both intersections at the WB on-ramp and 7th Avenue/Gale Ave and the WB off-ramp to 7th Avenue. Figure 6-3 below is a conceptual design that features a two-lane roundabout, three-lane SB approach, and three-lane WB approach which includes one by-pass lane. As designed, this roundabout would achieve the acceptable levels of service; however, properties along Kinbrae Avenue and Doverfield Avenue would be significantly impacted. Consideration was given to reducing the property impacts of this design by reducing the geometric footprint; however, by reducing the footprint the LOS would be worsened. For example, if a short by-pass lane is removed at the 7th Avenue SB approach, the SB approach would have a LOS E. If there is no short by-pass at the 7th Avenue WB approach, the WB leg would have a LOS F and the queue would spill back to the upstream intersection at Gale Avenue and WB SR-60 off ramp.

Figure 6-3 – Conceptual Roundabout Design at WB Ramps

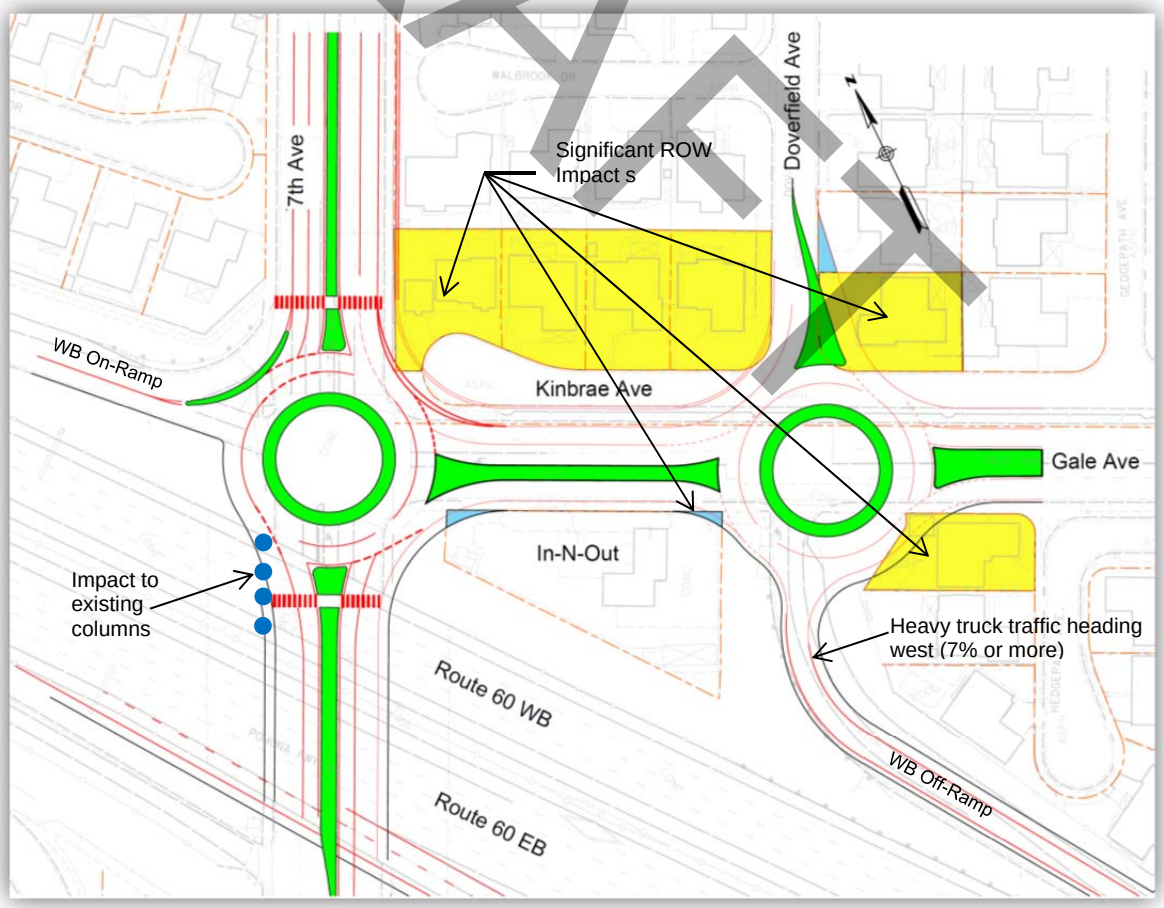
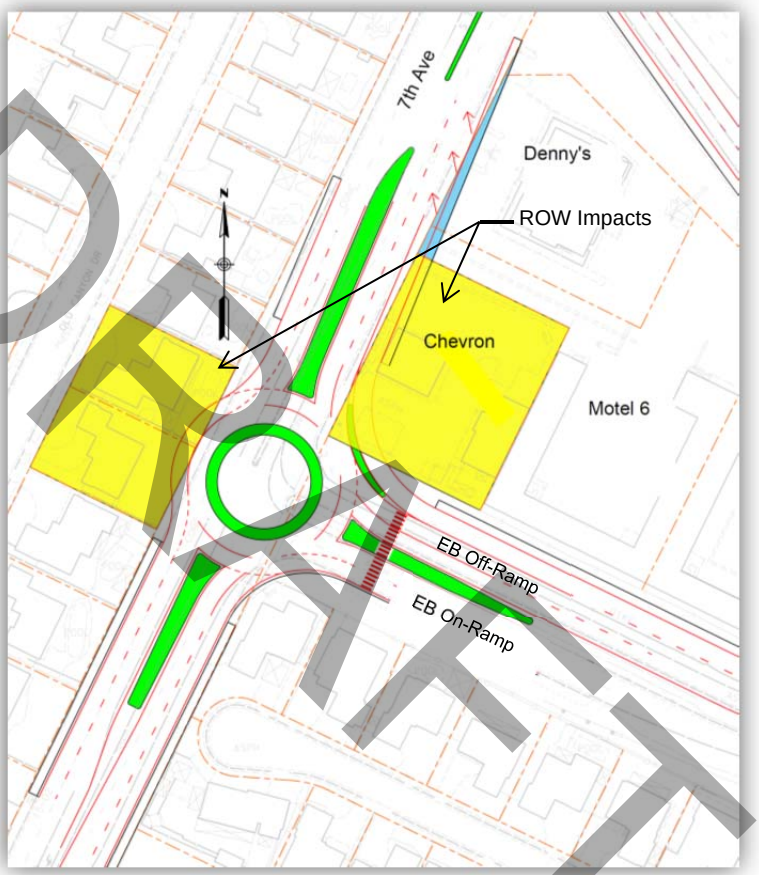


Figure 6-4 is a conceptual design for a roundabout at the EB on- and off-ramp intersection. This design assumes that the existing EB to SB off-ramp would be eliminated. This design option would operate at an acceptable LOS; however, as shown, residential and commercial right of way impacts would be incurred.

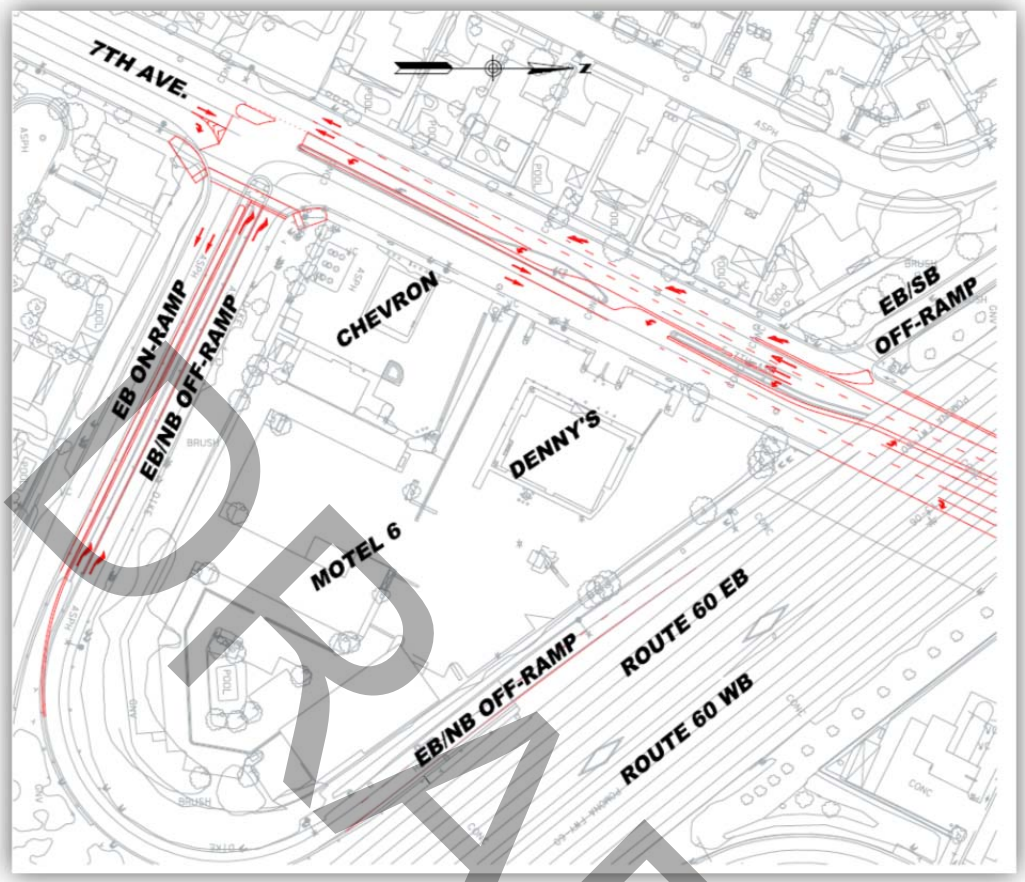
Figure 6-4 – Conceptual Roundabout Design at EB Ramps



6.2.2 Other Intersection Designs

Another intersection option was considered. Figure 6-5 provides a design for 7th Avenue south of SR-60. The design below takes advantage of the Continuous Green T-intersection design in which the through movement for SB 7th Avenue has a continuous green light. This design assumes the existing EB off-ramp to SB 7th Avenue would remain. Two right turns would be required for the EB off-ramp to NB 7th Avenue. In addition, preliminary analysis shows that the intersection of the EB ramps and 7th Avenue will require signalization. Optimization of this signal will be analyzed as this concept moves to Step 2.

Figure 6-5 – Continuous Green T- Intersection Design at EB Ramps



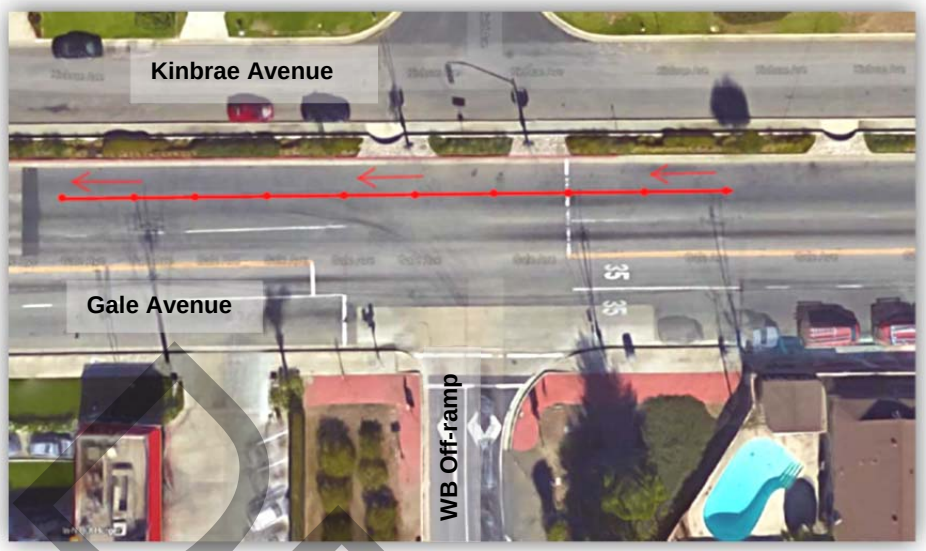
6.2.3 Other Intersection Options Screened

As part of the evaluation several other at-grade configurations were considered as shown in Table 6-2 below. Closer consideration was given to the Continuous Green Tee intersection and to the Quadrant Roadway in the WB direction and is discussed below.

WB off ramp Continuous Green Tee Intersection

A Continuous Green Tee Intersection could be considered at the westbound off-ramp to Gale Avenue (Figure 6-6). This modification would allow vehicles heading west to continue at the top of the T-intersection. The benefit of this design is that through vehicles would not need to stop thus reducing a conflict point; however, because of the closely spaced intersections (350') and high truck volumes this option would cause undesirable weaving transitions. As a result this option is screened from further analysis.

Figure 6-6 – Conceptual WB off ramp Green Tee Intersection Design



Quadrant Roadway

The quadrant roadway as shown in Figure 6-7 was evaluated. The impacts to the context sensitive elements of these options would be significant in that the quadrant roadway configuration would result in undesirable levels of traffic encroaching into the existing residential neighborhoods. As a result this option is screened from further analysis.

Figure 6-7 – Quadrant Roadway Design

Table 6-2. At-grade Intersection Configurations

At-grade configuration	Reason for not considering
Displaced Left Turn	A displaced left turn requires that the left turn be several hundred feet prior to intersection. This can not be accomplished without major impacts to adjacent land uses at any of the intersections
Continuous Green Tee	For the WB ramp intersection this configuration is impractical as weaving needed weaving distances between interchanges would not be desirable; however, a configuration similar to the concept is being considered for the EB ramp intersections.
Offset Tee Pair	An offset tee pair intersection requires minor street offsets. This configuration is not applicable to ramp intersections.
Jughandle	The jughandle requires displacement of left and right turn movements. Improvements to this configuration would cause substantial impacts to the neighborhood.
Quadrant Roadway	The quadrant roadway requires a bypass side street. This option was reviewed and it was determined that the disruption to the existing neighborhood would be too great of an impact.
Bowtie	The bowtie configuration requires upstream and downstream improvements and would not fit into the existing configuration
Split	Split phase signalization is not applicable to these intersections.
Paired	Would not fit into existing configuration

6.3 Recommended Options for Further Analysis

6.3.1 Interchange Options

The two interchange options as shown in Figures 6-1 and 6-2 are recommended for further analysis. The interchange shown in Figure 6-1 takes advantage of the existing configuration, is adapted for the proposed widening of the mainline and improves on existing operational and geometric deficiencies. Figure 6-2 proposes to remove the existing EB to SB 7th Avenue off-ramp and improve on the existing EB to NB 7th Avenue off-ramp to accommodate both NB and SB traffic movements.

6.3.2 Intersection Options

For the WB ramp intersections, it is expected that the roundabout option would have negligible operational benefits when compared to the existing signalized intersection. The capital costs and the right of way requirements of the roundabout option are considerably higher. As a result it is recommended that the roundabout option for the WB ramp intersections be screened from further consideration. Also, for the WB ramp intersections, the option of a Continuous Green Tee intersection and the Quadrant Roadway should be screened from further consideration.

For the EB ramp intersection further analysis is recommended. Two options to be considered and refined are as shown in Figures 6-4 and 6-5. The roundabout in Figure 6-4 should be further analyzed to determine if its footprint can be reduced to avoid right of way encroachments. The design would be compared to the costs and benefits of the conventional intersection conceptual design presented in Figure 6-5. The analysis of these intersections will be completed in Step 2.

7 Step 2 – Design and Traffic Analysis

Step 2 is to be completed when the recommended options for further analysis are concurred with.

7.1 Interchange Options

As part of the Step 1 screening process it was determined that the existing configuration would be compared to the proposal of removing the EB to SB 7th Avenue off-ramp. The analysis for this determination is summarized in Table 6-1. To reach a determination of the preferred option consideration will be given to the costs and benefits of each option.

7.2 Intersection Options

As part of the screening process it has been recommended that the EB ramps intersections be further analysed. The analysis would take into consideration context sensitive elements, traffic operations, safety performance, right of way impacts, environmental constraints, construction costs and impacts and life cycle costs as summarized on Table 7-1.

Table 7-1 – Intersection Control Evaluation- EB-ramp Intersections

No.	Feature	Roundabout	Continuous Green T - Intersection	Conventional Signal	Notes
1	2051 No Build Traffic Operations AM/PM Level of Service (LOS)	A/B	TBD	C/C	
2	2051 Build Traffic Operations AM/PM Level of Service (LOS)	TBD	TBD	TBD	
3	Right of Way Acquisition Area (ft2)	TBD	None	None	

Table 7-1 – Intersection Control Evaluation- EB-ramp Intersections

No.	Feature	Roundabout	Continuous Green T - Intersection	Conventional Signal	Notes
4	Right of Way Impacts (No Potential Impact = 0) (Potential Adverse Impact = 5)	4	0	0	Note type of acquisition: -Residential -Commercial -Industrial -Parks/Recreation
5	Environmental Constraints (No Potential Impact = 0) (Potential Adverse Impact = 5)	TBD	TBD	TBD	Note type of constraint: - Noise - Air Quality - Safety - Historic/Archeological - Natural Resources - Hazardous Waste - Adjacent Access
6	Construction Traffic Control Constraints (All lanes remain open = 0) (Full closure = 5)	3	1	1	
7	Total Cost (High, Moderate, Low)	Moderate	Moderate	Moderate	
8	Life Cycle Cost (High, Moderate, Low)	Low	Moderate	Moderate	
9	Safety Performance B/C Ratio	TBD	TBD	TBD	

7.3 Recommendations

Recommendations for the interchange and intersections control systems will be provided at the conclusion of Step 2 – Design and Traffic Analysis.