Broadway Bridge Feasibility Study Traffic Analysis

PREPARED FOR:	City of West Sacramento, in cooperation with the City of Sacramento
PREPARED BY	Fehr & Peers

This memorandum presents key findings related to travel demand modeling and traffic operations analysis for the Broadway Bridge Feasibility Study. The study area includes the proposed bridge and approaches on the west side (West Sacramento) and east side (Sacramento) of the bridge.

Travel Demand Forecasting

Overview of Modeling Process

- All modeling conducted using a modified version of SACOG's SACMET travel demand model (TDM) that incorporates the MTP/SCS for the region.
- Same version of the model currently being used for the I Street Bridge Replacement Project, cumulative year (2040).
- Model enhanced within study are to include additional land use and roadway network detail.
- Network coding reviewed within the study area, and calibration of model improved using traffic counts conducted for previous studies.

Scenarios

Number of Lanes. **The following bridge lanes scenarios were analyzed:**

- Two-Lane Bridge
- Four-Lane Bridge

Bridge Connections. **The following bridge connection alternatives were analyzed:**

- West Side
  - Jefferson Boulevard Connection via 15th Street
    - Bridge ties into the 5th Street/15th Street intersection
    - Assumes Riverfront Street connection to 5th Street would be relocated to the north of the 5th Street/15th Street intersection
  - 5th Street Connection
    - Bridge ties into a T-intersection with 5th Street south of 15th Street
- East Side
  - X Street Connection
    - Bridge approach ties into the 3rd Street/X Street intersection and assumes closure of I-5 Southbound off-ramp to 3rd Street/X Street
    - Bridge connection to Broadway via one eastbound travel lane

- Broadway Connection
  - Bridge connects directly to Broadway using current alignment of Broadway
  - I-5 Southbound off-ramp to 3rd Street/X Street would remain open
- Broadway / X Street Realignment Connection
  - A hybrid scenario between the X Street and Broadway Connections described above.
  - Bridge approach along Broadway is realigned with the eastbound through movement tying directly onto X Street
  - I-5 Southbound off-ramp would remain open

For the purposes of the feasibility study, a revised alignment of Riverfront Street in the Jefferson Connection option on the west side enables an objective comparison of future trip distribution and/or potential changes in travel demand between the two bridge alignment options, and does not reflect actual location of the planned future local road network.

Bridge Travel Patterns

- West Side
  - Model is highly sensitive to the Jefferson Boulevard versus the 5th Street bridge connection options, showing substantial differences for travel patterns between the bridge and Southport.
  - Connection to Jefferson Boulevard provides two north-south options and divides trips to/from the bridge between Jefferson Boulevard and 5th Street.
  - Connection to 5th Street (without direct connection to Jefferson Boulevard) results in heavy reliance on 5th Street, and substantially fewer trips to/from the bridge using Jefferson Boulevard.

Figure 1 shows the bridge travel patterns on the west side for the Jefferson Boulevard connection and the 5th Street connection.

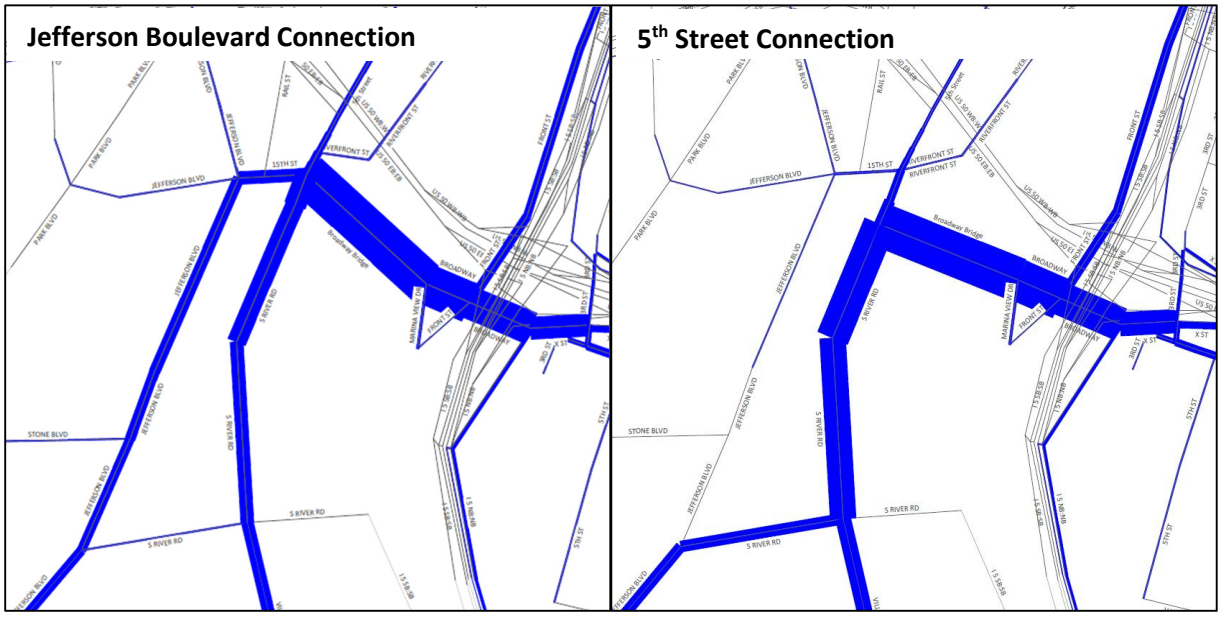


Figure 1. Bridge Travel Patterns on West Side of Bridge

- East Side
  - Bridge traffic mostly divided between three east-west streets: W Street, X Street, and Broadway; and one north-south street: Front Street.
  - Connection to X Street provides more evenly balances trips to/from the east between X Street and Broadway (compared to Broadway Connection).
  - From the three east-west streets, bridge traffic gradually disperses as it continues to the east, spreading out onto the gridded street system that provides multiple north-south options.
  - Figure 2 shows the bridge travel patterns on the east side for the X Street Connection and the Broadway Connection.

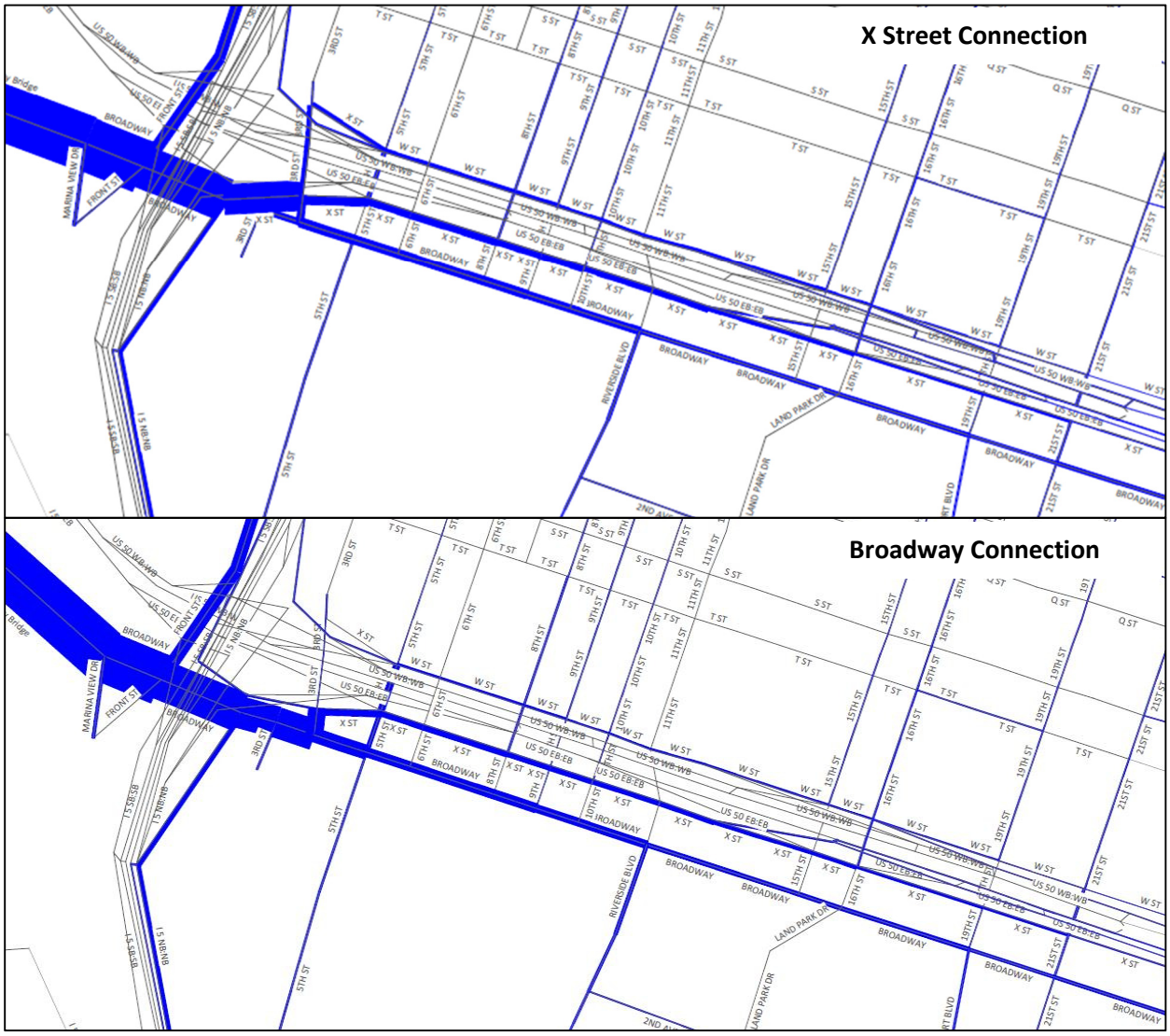


Figure 2. Bridge Travel Patterns on East Side of Bridge

Bridge Traffic Comparison

- Traffic volumes on the Broadway Bridge would not vary substantially due to the various bridge connection options on either side of the bridge, and are primarily dependent upon the number of lanes provided on the bridge.
- Year 2040 traffic volumes for a two-lane bridge would be approximately 32,000 trips per day.

- Year 2040 traffic volumes for a four-lane bridge would be approximately 49,300 trips per day (17,300 more daily trips than a two-lane bridge).
- Construction of a four-lane bridge would result in substantial increases in traffic volume on key roadways relative to a two-lane bridge.

Figure 3 shows the change in daily traffic volume between a two-lane bridge option and four-lane bridge option.

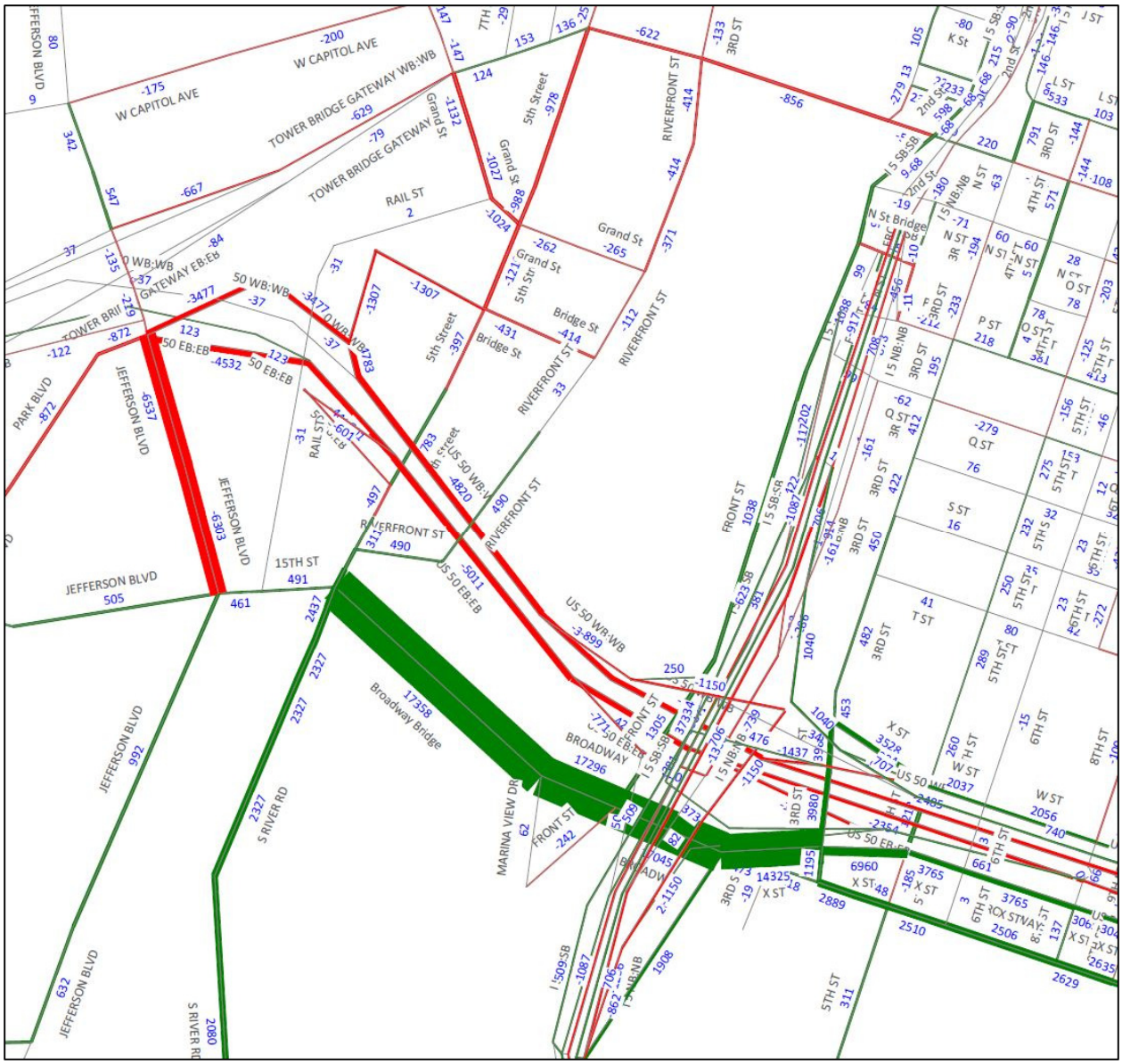
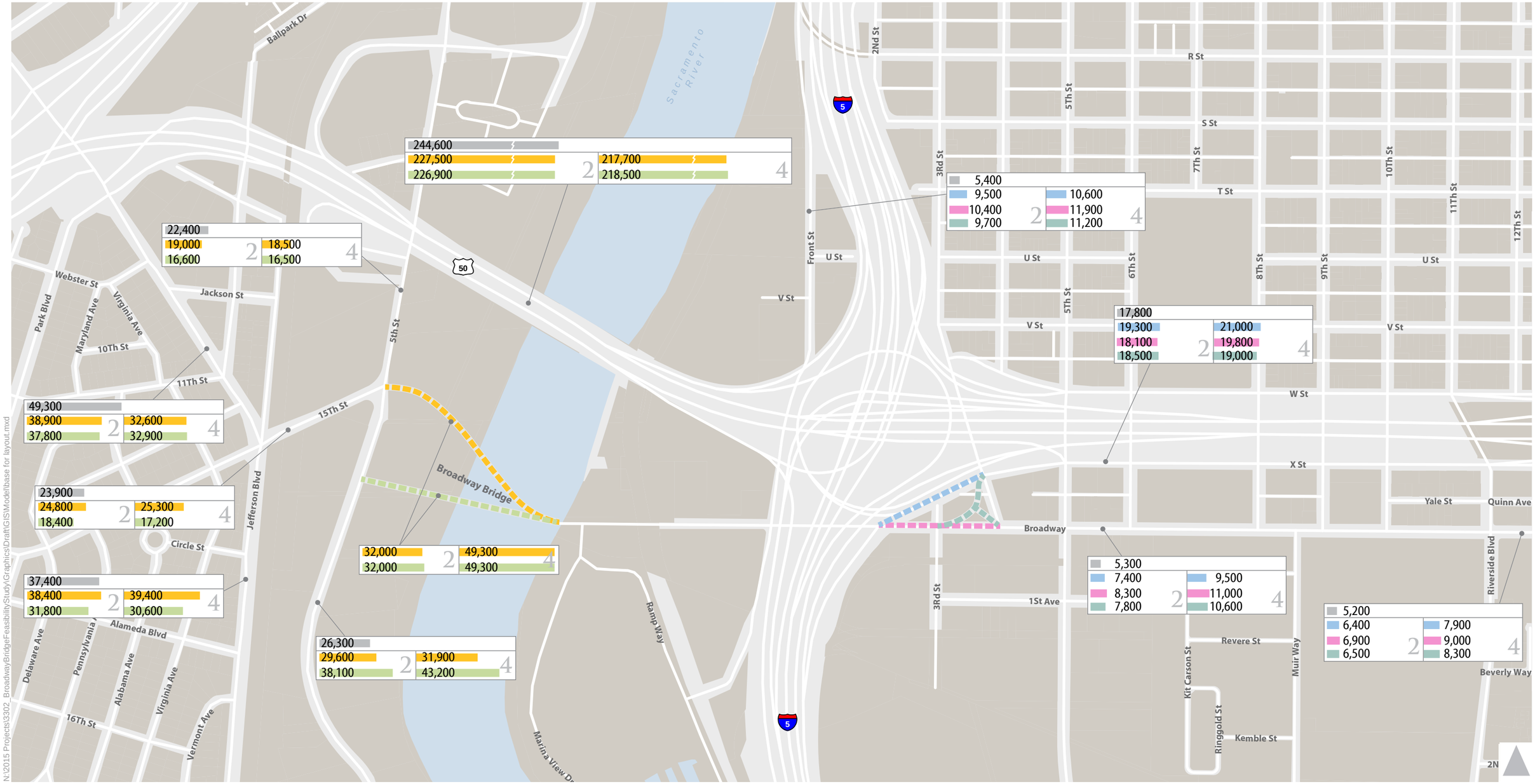


Figure 3. Change in Daily Traffic Volume between 2-Lane Bridge and 4-lane Bridge

Figure 4 summarizes the projected year 2040 daily traffic volumes on key roadways for both the two-lane and four-lane bridge option with the various bridge connection alternatives.



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West Side Alternatives

No Project		
With 2-Lane New Bridge	2	With 4-Lane New Bridge 4

- No Project
- Jefferson Blvd Connection
- 5th Street Connection

East Side Alternatives

No Project		
With 2-Lane New Bridge	2	With 4-Lane New Bridge 4

- No Project
- X St Connection, I-5 SB Off-ramp Closed
- Broadway Connection, I-5 SB Off-ramp Open
- Broadway/X Street Realignment Connection, I-5 SB Off-ramp Open

Figure 4

Broadway Bridge

Year 2040 Average Daily Traffic Volumes

Effects on State Highway System

- The Broadway Bridge would substantially reduce traffic on Jefferson Boulevard to/from US 50.
  - -10,700 daily trips with two-lane Broadway Bridge compared to No Project
  - -17,000 daily trips with four-lane Broadway Bridge compared to No Project

Figure 5 shows the change in daily traffic volume with the bridge compared to No Project under year 2040 conditions in the vicinity of Jefferson Boulevard and US 50.

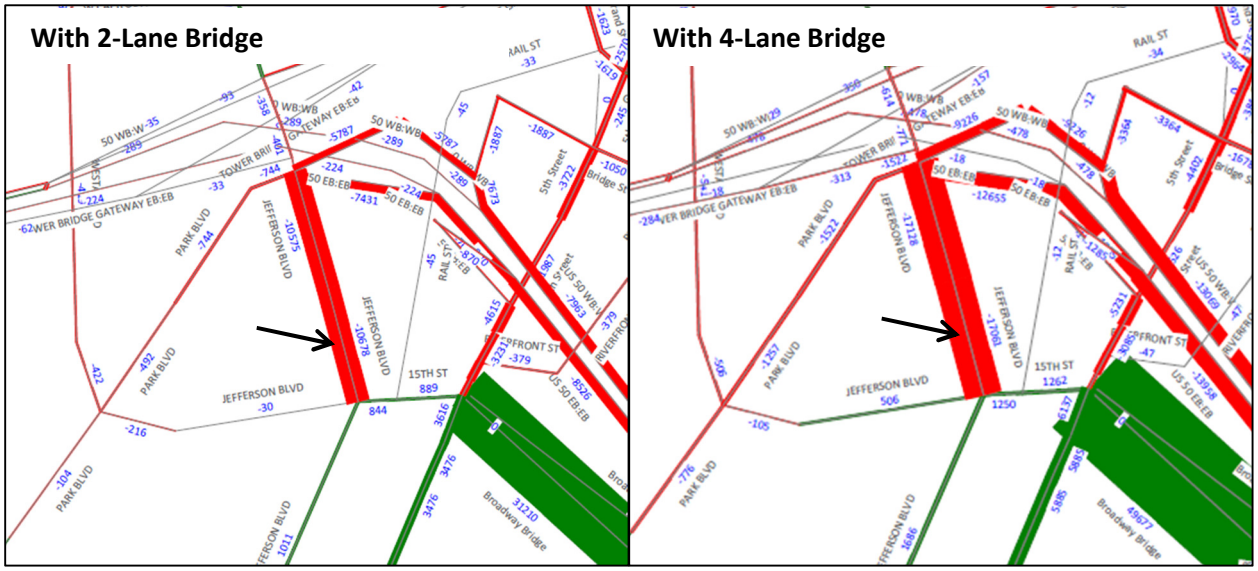


Figure 5. Change in Daily Traffic Volume from No Project – Jefferson Boulevard

- The bridge would increase traffic on the I-5 Northbound off-ramp to Broadway
  - 4,000 additional daily trips with two-lane Broadway Bridge compared to No Project
  - 5,700 additional daily trips with four-lane Broadway Bridge compared to No Project

Figure 6 shows the change in daily traffic volume with the bridge compared to No Project under year 2040 conditions, in the vicinity of the I-5 Northbound off-ramp at Broadway.

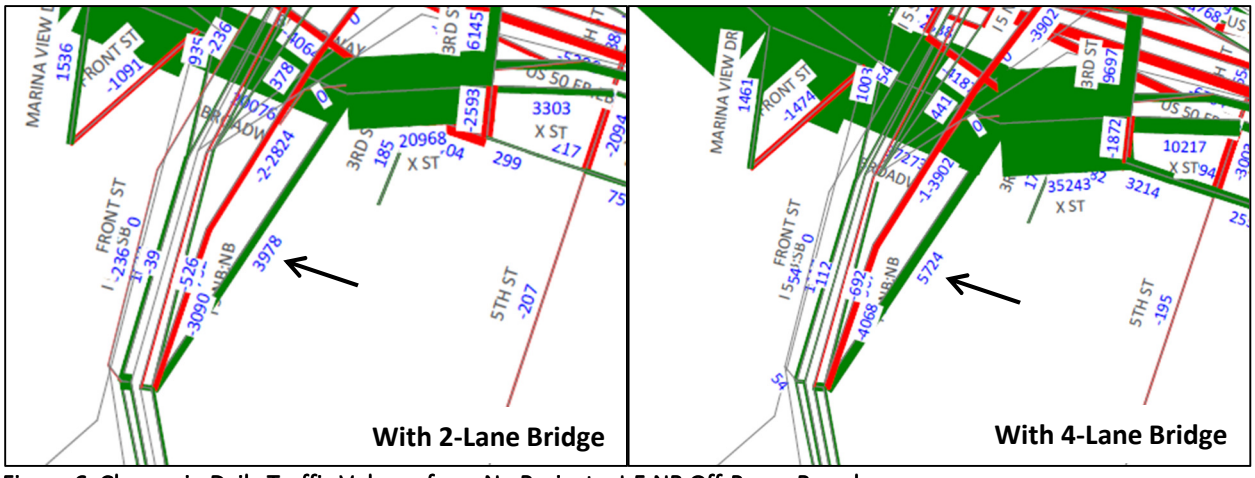


Figure 6. Change in Daily Traffic Volume from No Project – I-5 NB Off-Ramp Broadway

The Increase in traffic on I-5 Northbound off-ramp to Broadway is primarily due to a shift in trips to/from the south that currently use Pioneer Bridge. This result is not unexpected given the spacing of

existing crossings along Sacramento River (i.e., closest crossing approximately eight miles south of this location). Figure 7 shows the travel patterns for the I-5 Northbound Off-Ramp to Broadway.

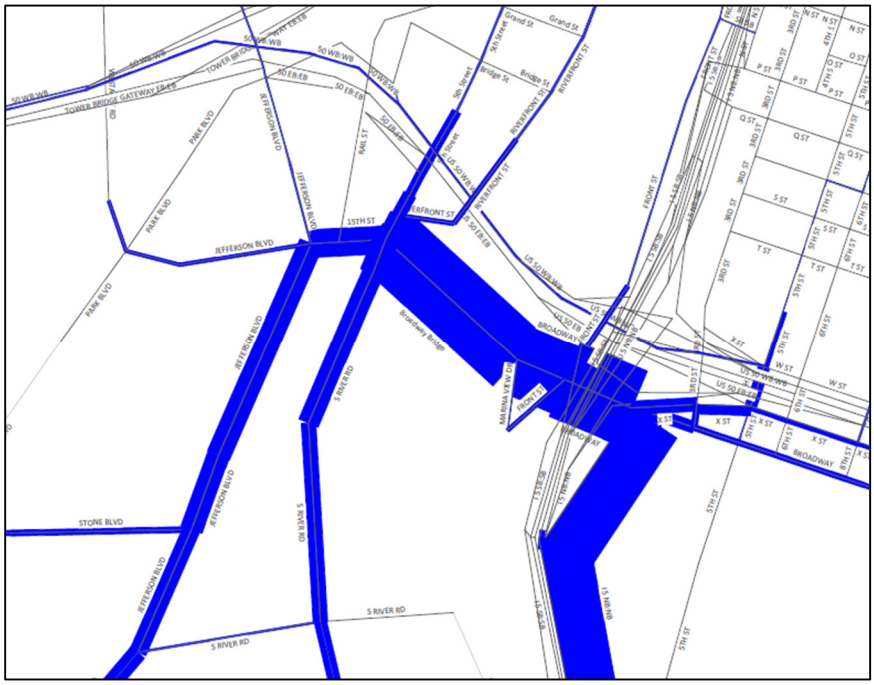


Figure 7. I-5 Northbound Off-Ramp Travel Patterns

- The bridge would decrease traffic on the Pioneer Bridge
  - -16,500 daily trips with two-lane Broadway Bridge compared to No Project
  - -27,000 daily trips with two-lane Broadway Bridge compared to No Project

Figure 8 shows the change in daily traffic volume with the bridge compared to No Project under year 2040 conditions in the vicinity of the Pioneer Bridge (US 50).

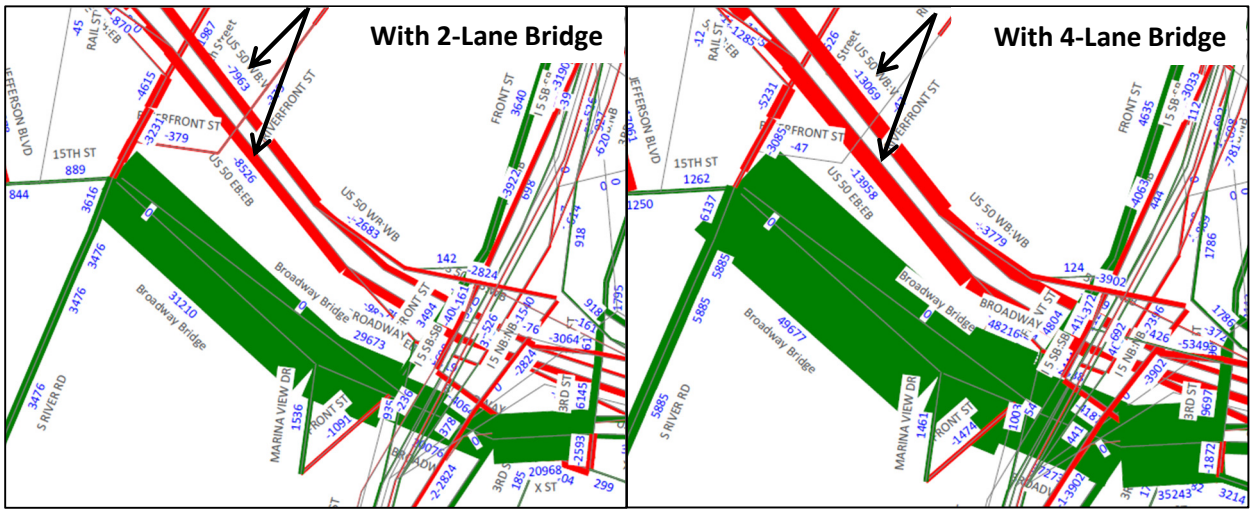


Figure 8. Change in Daily Traffic Volume from No Project – US 50 Pioneer Bridge

- Broadway Bridge would decrease traffic on Tower Bridge
  - -2,500 daily trips with two-lane Broadway Bridge compared to No Project
  - -3,400 daily trips with four-lane Broadway Bridge compared to No Project

Figure 9 shows the change in daily traffic volume with the bridge compared to No Project under year 2040 conditions in the vicinity of Tower Bridge.

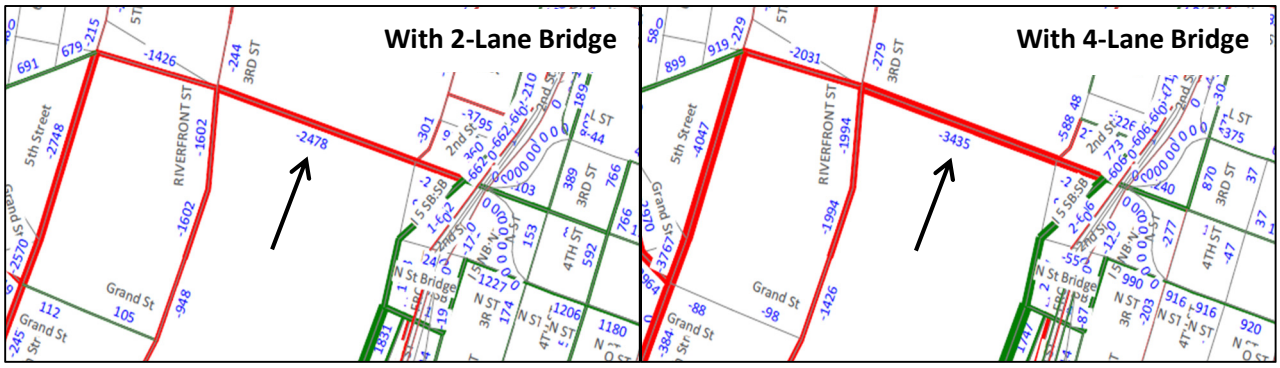


Figure 9. Change in Daily Traffic Volume from No Project – Tower Bridge

Effects on Broadway Corridor

Daily traffic volumes on the Broadway Bridge would not differ significantly between the X Street Connection and Broadway Connection scenarios (i.e., with the I-5 Southbound Broadway off-ramp open or closed).

By closing the off-ramp, right-of-way is provided to allow for a direct two-way connection between Broadway and X Street/3rd Street. By retaining the off-ramp, there would be:

- A less direct route from the Broadway Bridge onto X Street, resulting in additional volume on Broadway until it dissipates through the grid.
- A less direct route from 3rd Street onto the Broadway Bridge, resulting in additional volume on Front Street.
- Less traffic on US-50 between 3rd Street and 15th Street.

Figure 10 compares the difference in traffic volume between retaining the off-ramp (X Street Connection) versus closing the off-ramp (Broadway Connection).

Figure 11 displays a graph comparing traffic volumes along Broadway under the various bridge connection alternatives.

The two-lane bridge with Broadway Connection (off-ramp open) compared to the X Street Connection (off-ramp closed) would result in the following:

- 2,000 additional daily trips on Broadway directly east of 5th Street
- 1,500 additional daily trips on Broadway directly east of 9th Street
- 700 additional daily trips on Broadway directly east of Riverside Boulevard
- 800 additional daily trips on Broadway directly east of 16th Street

The four-lane bridge with Broadway Connection (off-ramp open) compared to the X Street Connection (off-ramp closed) would result in the following:

- 3,000 additional daily trips on Broadway directly east of 5th Street
- 3,000 additional daily trips on Broadway directly east of 9th Street
- 1,400 additional daily trips on Broadway directly east of Riverside Boulevard
- 700 additional daily trips on Broadway directly east of 16th Street

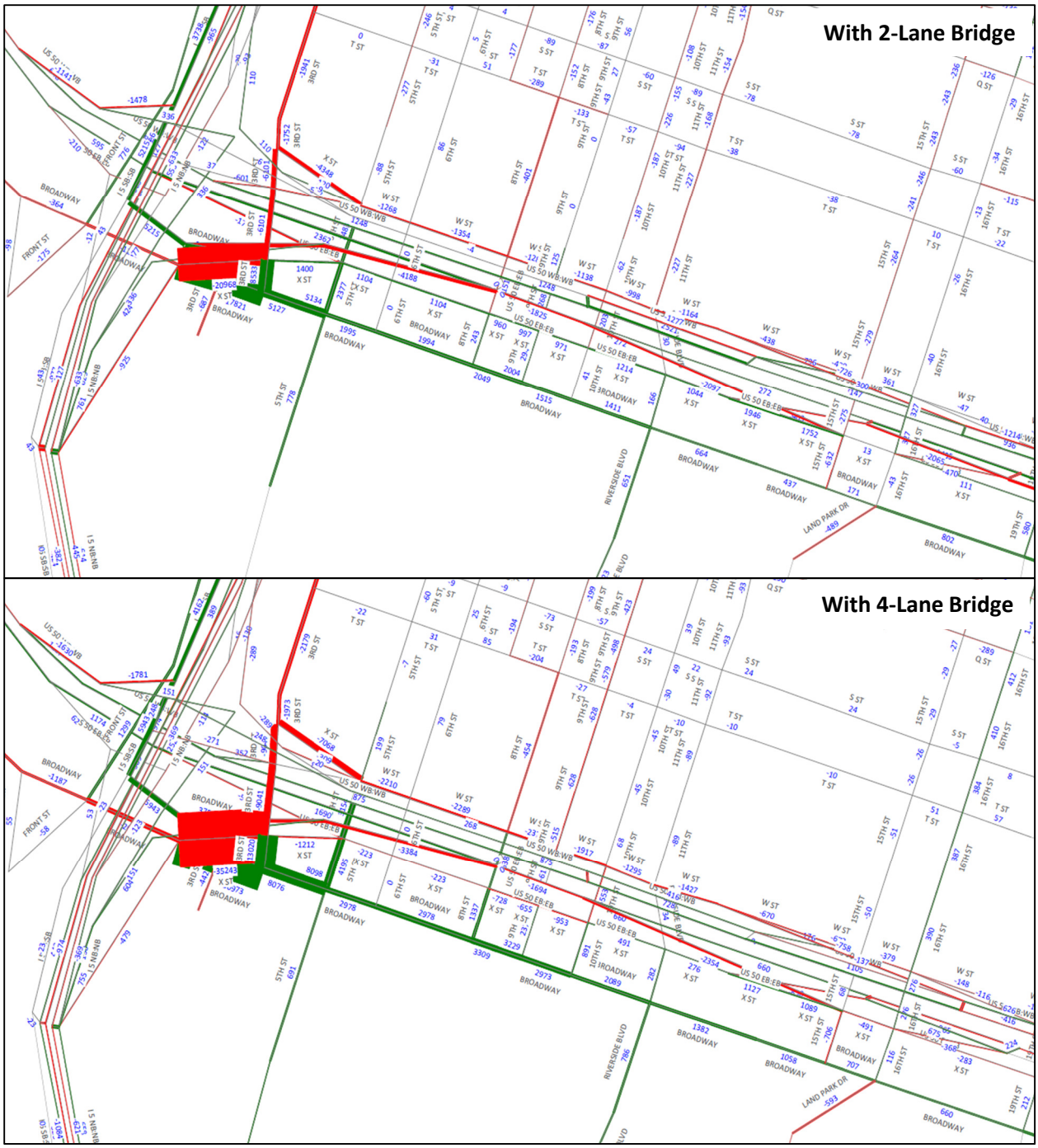


Figure 10. Difference in Daily Traffic Volume on Broadway with I-5 SB Off-Ramp Open vs. Closed

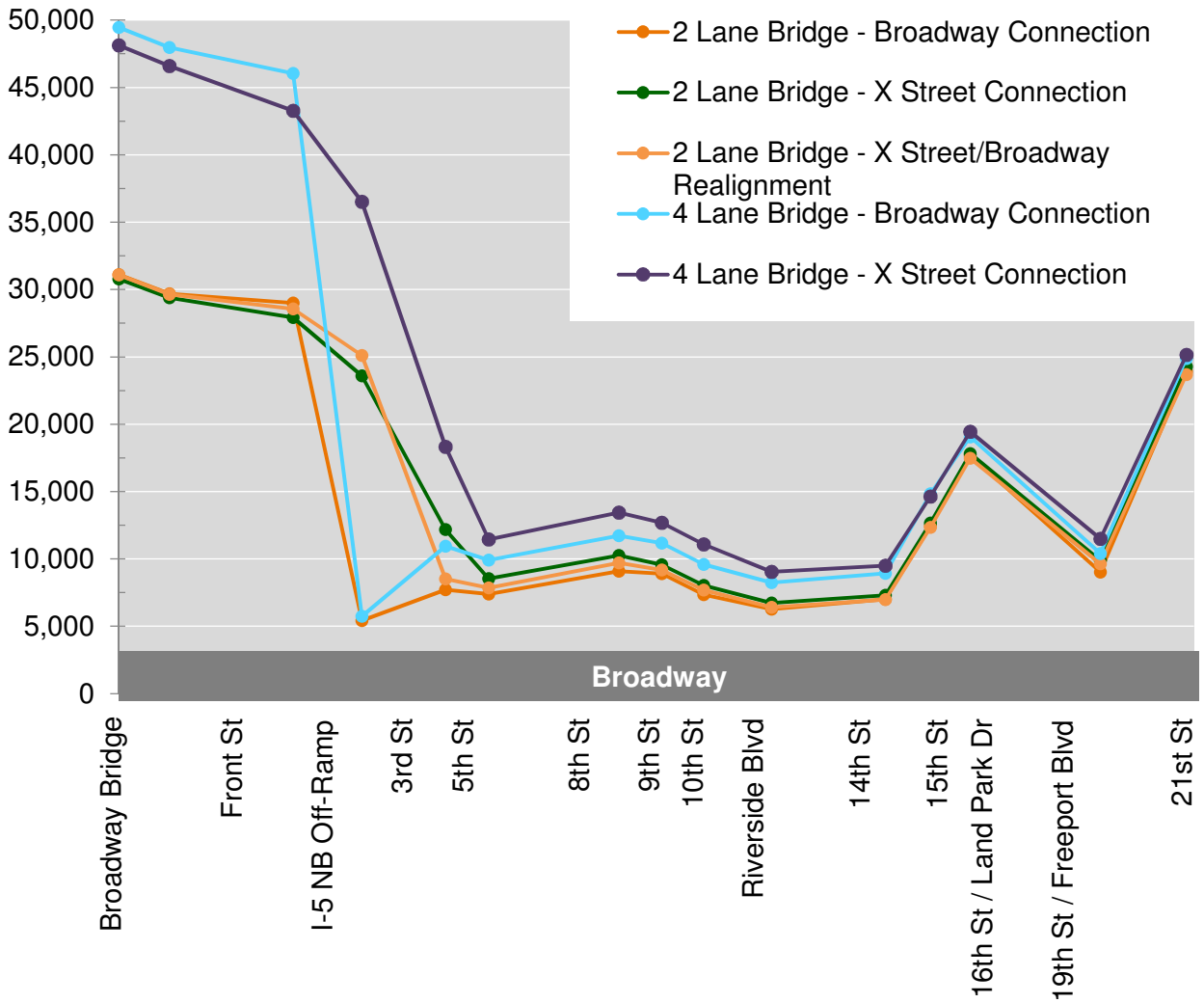


Figure 11. Daily Traffic Volume on Broadway

Effects on Local Neighborhood Streets

Construction of the Broadway Bridge would result in relatively minor changes in traffic on residential streets in the vicinity of the bridge as shown in Figure 12.

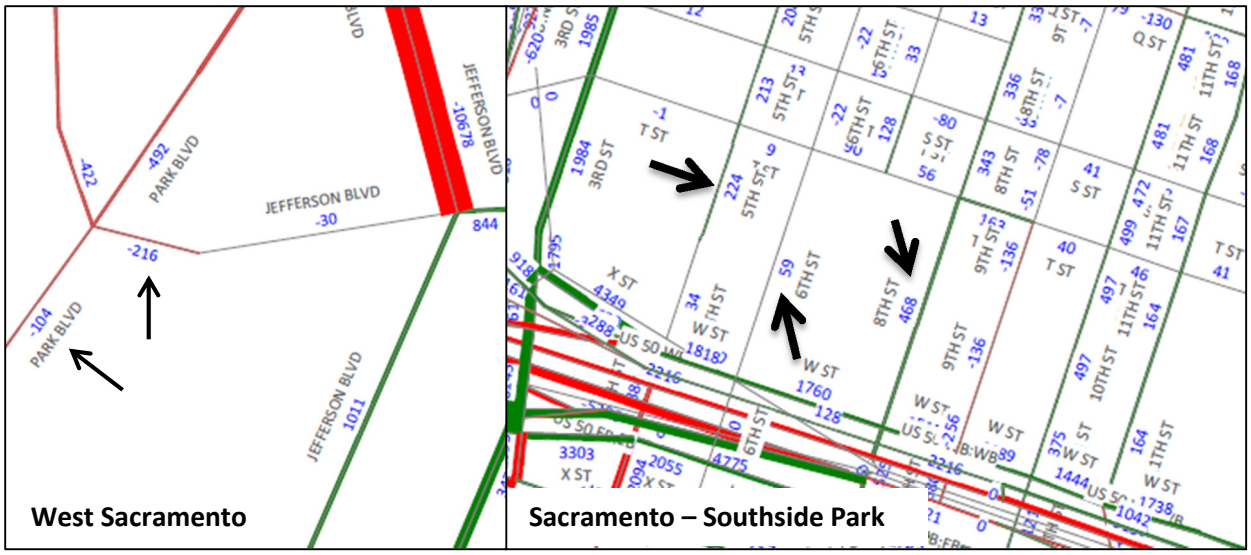


Figure 12. Change in Daily Traffic Volume from No Project to 4-Lane Bridge

The combined closure of the off-ramp and addition of the bridge in the X Street Connection scenario would result in relatively minor changes in total daily traffic volumes on key streets located south of Broadway (i.e., 5th Street and Riverside Boulevard). There would be slightly higher levels of traffic on these streets with the Broadway Connection, as shown in Figure 13.

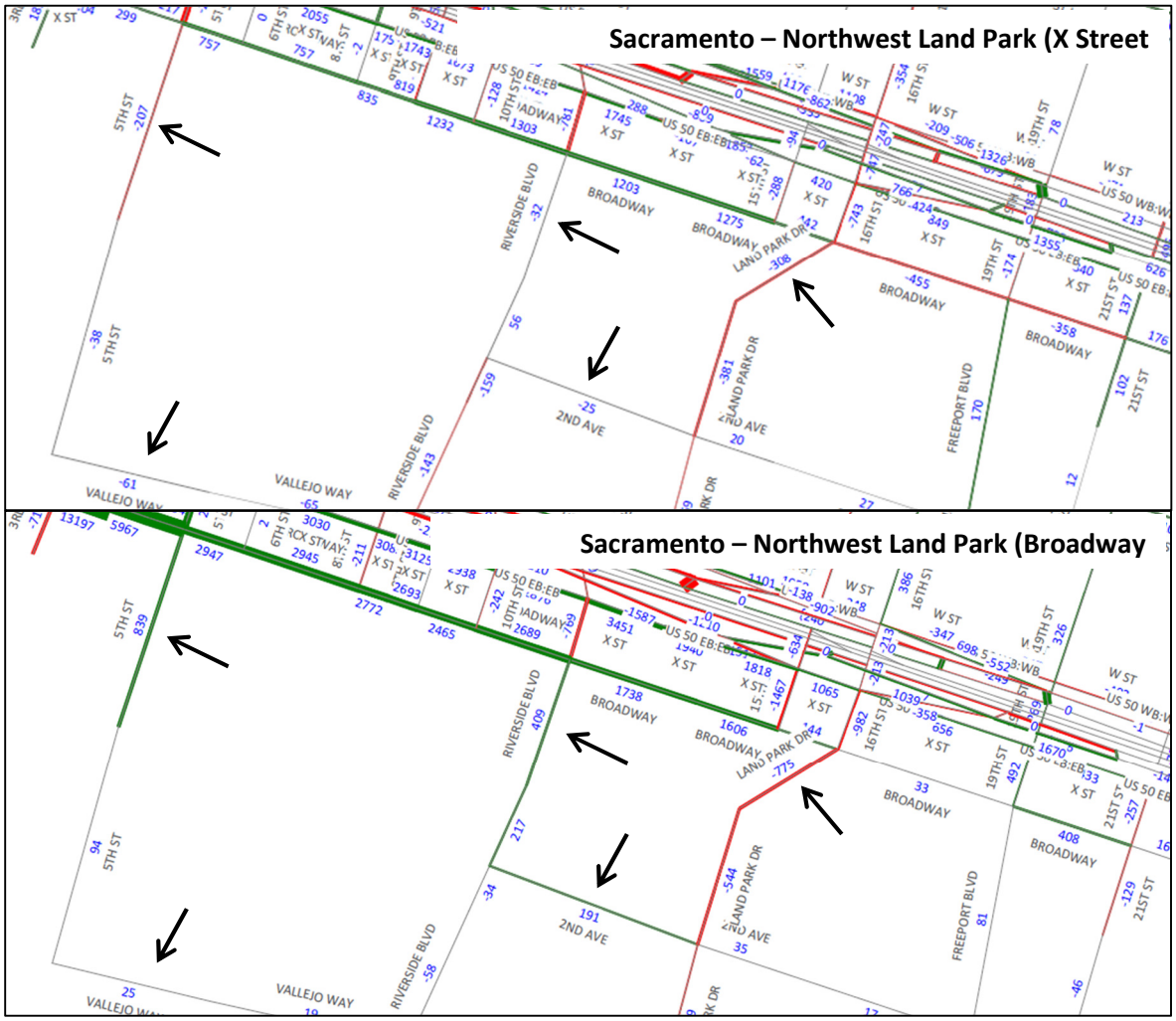


Figure 13. Change in Daily Traffic Volume from No Project to 4-Lane Bridge

Traffic Operations

Overview of Traffic Operations Process

- Traffic operations were evaluated at key intersections adjacent to the bridge for various bridge cross-sections and connection alternatives under year 2040 conditions.
- This planning-level analysis included assumptions for lane configurations and traffic controls based on the traffic forecast volumes and lane consistency between adjacent intersections and the bridge.
- Signal timings were optimized for all signalized intersections under each bridge scenario and approach alternative.
- Intersection level of service (LOS) was determined with HCM 2010 methodology using Synchro 8 software.

Scenarios

Bridge Number of Lanes. **The following bridge scenarios were analyzed:**

- Two-Lane Bridge
- Four-Lane Bridge

Bridge Connections. **The following bridge approach alternatives were analyzed:**

- West Side:
  - 5th Street Connection
- East Side:
  - X Street Connection
  - Broadway Connection

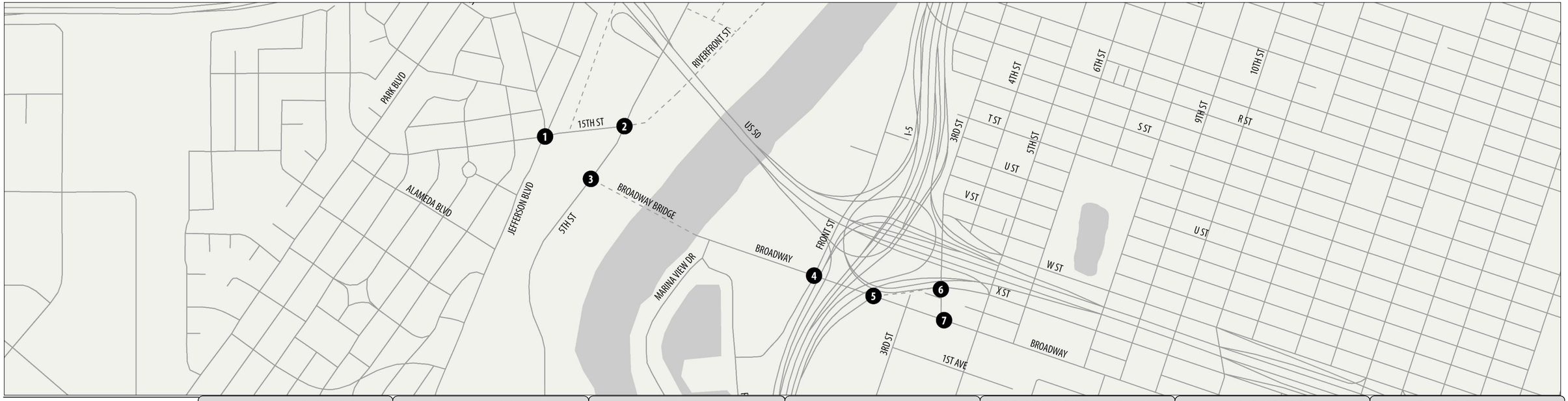
Study Intersections

The following intersections were analyzed:

- West Side:
  1. Jefferson Boulevard / 15th Street
  2. 5th Street / 15th Street
  3. 5th Street / Broadway Bridge
- East Side:
  4. Broadway / Front Street
  5. Broadway / I-5 NB Off-Ramp
  6. X Street / 3rd Street / I-5 SB Off-Ramp
  7. Broadway / 3rd Street

LOS Results

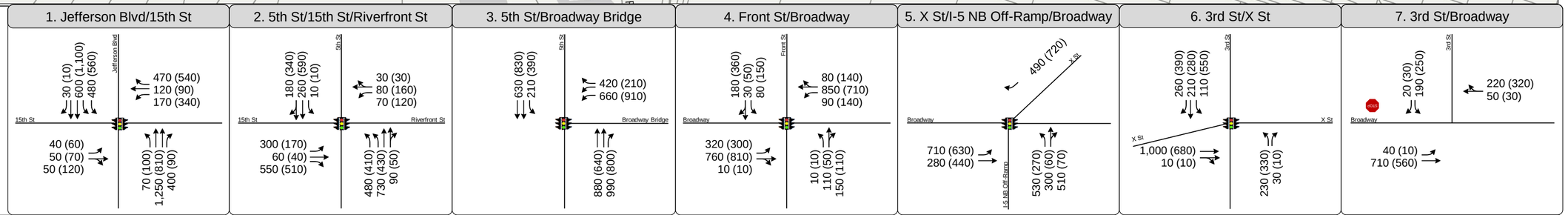
Two-Lane Bridge. The AM and PM peak hour traffic volumes and lane configurations for the study intersections under the two-lane bridge scenario are shown in Figure 14. The LOS results for this scenario are shown in Table 1. As shown in Table 1, all study intersections would operate at LOS D or better during both peak hours with a two-lane bridge in place.



2 Lane Bridge

West Connection – 5th St

East Connection – X St



2 Lane Bridge

West Connection – 5th St

East Connection – Broadway

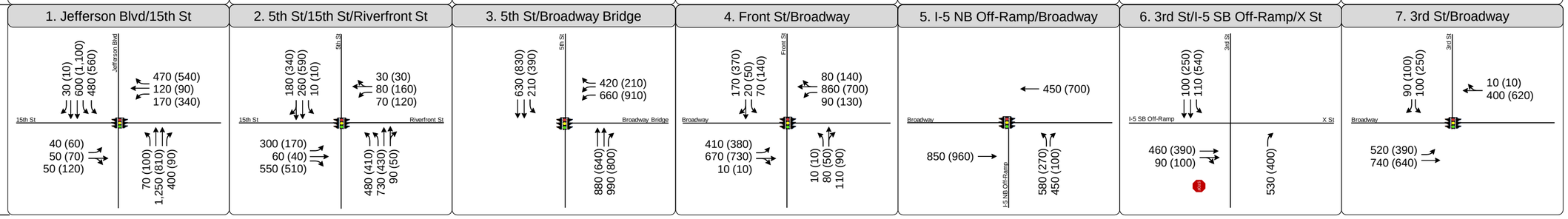


Figure 14

2 Lane Bridge Scenario
Peak Hour Traffic Volumes and Lane Configurations
Broadway Bridge Feasibility Study

Table 1. Two-Lane Bridge – Level of Service

	West Connection – 5th St East Connection – X Street			West Connection – 5th St East Connection – Broadway		
Intersection	Control Type	Delay / LOS AM	PM	Control Type	Delay / LOS AM	PM
1. Jefferson Blvd / 15th St	Signalized	31 / C	39 / D	Signalized	31 / C	39 / D
2. 5th St / 15th St	Signalized	24 / C	29 / C	Signalized	24 / C	29 / C
3. 5th St / Broadway Bridge	Signalized	17 / B	26 / C	Signalized	17 / B	26 / C
4. Broadway / Front St	Signalized	44 / D	32 / C	Signalized	47 / D	39 / D
5. Broadway / I-5 NB Off-Ramp	Signalized	26 / B	10 / A	Signalized	19 / B	9 / A
6. X St / 3rd St / I-5 SB Off-Ramp	Signalized	5 / A	6 / A	Side-Street Stop	10 / B	11 / B
7. Broadway / 3rd St	Side-Street Stop	26 / D	23 / C	Signalized	13 / B	18 / B

Notes:

For signalized intersections, delay is reported in seconds per vehicles for the overall intersection. For side-street stop controlled intersections, delay is report in seconds per vehicle for the worst movement.

Source: Fehr & Peers, 2015

For the two-lane bridge scenario, key assumptions related to intersection geometrics and traffic controls are noted below:

West Side:

- The lane configurations necessary to handle the traffic forecast volumes for the intersections of Jefferson Boulevard/15th Street and 5th Street/15th Street require the roadway segment of 15th Street between Jefferson Boulevard and 5th Street be widened to a four-lane section, with two lanes in each direction.
- 5th Street is assumed to be a four-lane roadway through the study intersections based on the assumed number of lanes in the MTP/SCS.
- The intersection of 5th Street/15th Street requires two northbound left-turn lanes to provide enough storage for queued vehicles. A single left-turn lane would not be sufficient due to the close proximity of the adjacent intersection of 5th Street/Broadway Bridge.
- The intersection of 5th Street/Broadway Bridge would require a northbound right-turn lane operating with an overlap phase with the westbound left-turn movement.

East Side:

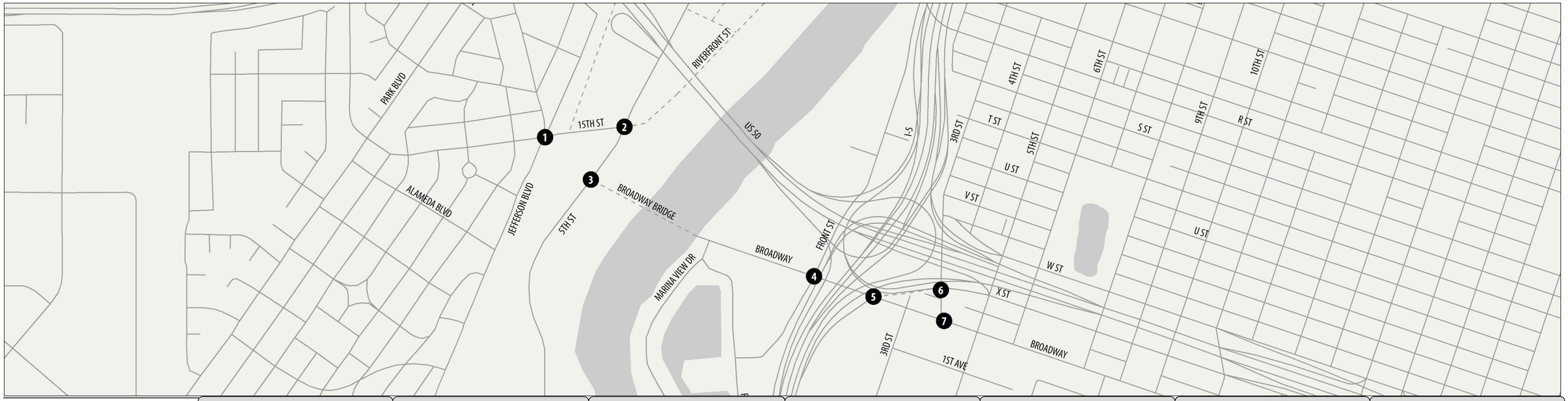
- The intersection of Broadway/Front Street would require left-turn pocket lanes for all approaches. The eastbound and westbound left-turn movements would require protected phasing.
- The intersection of Broadway/I-5 NB Off-Ramp would require signalization in both the X Street Connection and Broadway Connection alternatives. In the X Street Connection alternative, an eastbound left turn pocket from Broadway onto X Street would be necessary.
- The intersection of X Street/3rd Street in the X Street Connection alternative would need to be signalized.
- The intersection of Broadway/3rd Street in the Broadway connection alternative would need to be signalized.

Four-Lane Bridge. The AM and PM peak hour traffic volumes and lane configurations for the study intersections under the four-lane bridge scenario are shown in Figure 15. The LOS results for this scenario are shown in Table 2. As shown in Table 2, all study intersections would operate at LOS D or better during both peak hours, except for the Broadway/3rd Street intersection under the Broadway Connection alternative in the PM peak hour, which would operate at LOS F.

Table 2. Four-Lane Bridge – Level of Service

	West Connection – 5th St East Connection – X Street			West Connection – 5th St East Connection – Broadway		
	Control	Delay / LOS		Control	Delay / LOS	
Intersection	Type	AM	PM	Type	*AM*	*PM*
1. Jefferson Blvd / 15th St	Signalized	27 / C	40 / D	Signalized	27 / C	40 / D
2. 5th St / 15th St	Signalized	26 / C	28 / C	Signalized	26 / C	28 / C
3. 5th St / Broadway Bridge	Signalized	24 / C	39 / D	Signalized	24 / C	39 / D
4. Broadway / Front St	Signalized	38 / D	38 / D	Signalized	51 / D	55 / D
5. Broadway / I-5 NB Off-Ramp	Signalized	42 / D	20 / C	Signalized	18 / B	7 / A
6. X St / 3rd St / I-5 SB Off-Ramp	Signalized	6 / A	8 / A	Side-Street Stop	11 / B	13 / B
7. Broadway / 3rd St	Side-Street Stop	26 / D	24 / C	Signalized	45 / D	83 / F

Notes:
For signalized intersections, delay is reported in seconds per vehicles for the overall intersection.
For side-street stop controlled intersections, delay is report in seconds per vehicle for the worst movement.
Source: Fehr & Peers, 2015

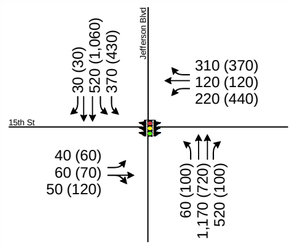


4 Lane Bridge

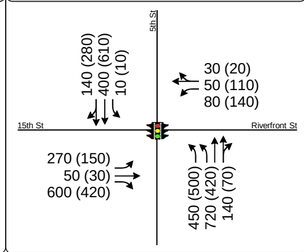
West Connection – 5th St

East Connection – X St

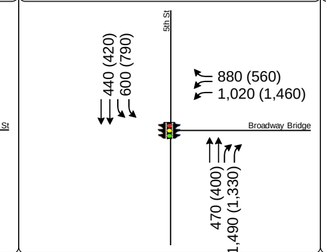
1. Jefferson Blvd/15th St



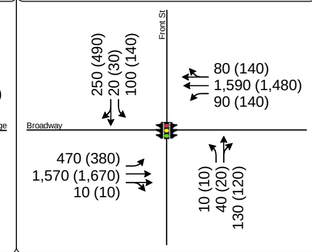
2. 5th St/15th St/Riverfront St



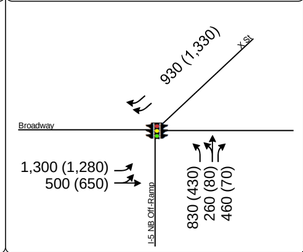
3. 5th St/Broadway Bridge



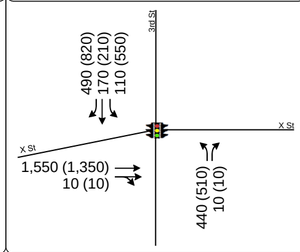
4. Front St/Broadway



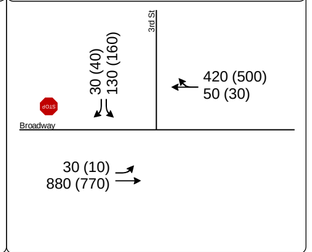
5. X St/I-5 NB Off-Ramp/Broadway



6. 3rd St/X St



7. 3rd St/Broadway

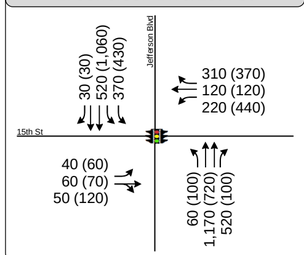


4 Lane Bridge

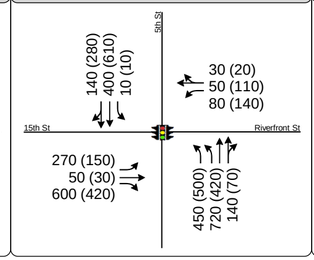
West Connection – 5th St

East Connection – Broadway

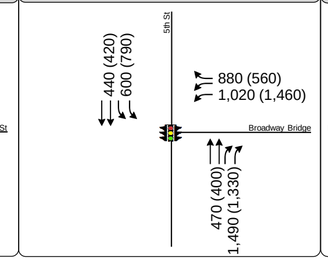
1. Jefferson Blvd/15th St



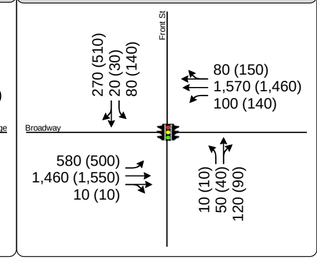
2. 5th St/15th St/Riverfront St



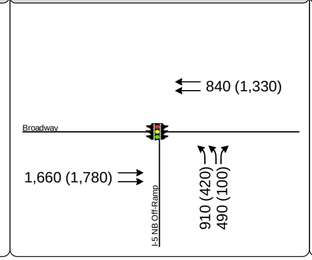
3. 5th St/Broadway Bridge



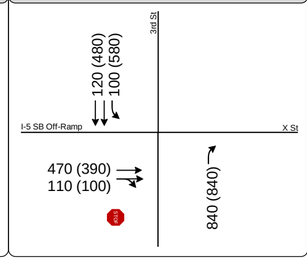
4. Front St/Broadway



5. I-5 NB Off-Ramp/Broadway



6. 3rd St/I-5 SB Off-Ramp/X St



7. 3rd St/Broadway

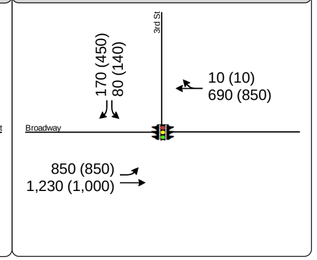


Figure 15

4 Lane Bridge Scenario
Peak Hour Traffic Volumes and Lane Configurations
Broadway Bridge Feasibility Study

For the four-lane bridge scenario, key assumptions related to intersection geometrics and traffic controls that differ from the two-lane scenario are noted below:

West Side:

- The intersection of 5th Street/Broadway Bridge would require two southbound-left turn lanes, two northbound right-turn lanes operating on an overlap phase with the westbound left-turn movement, and a single westbound right-turn lane operating on an overlap phase with the southbound left-turn movement.

East Side:

- The intersection of Broadway/Front Street would require left-turn pocket lanes for all approaches. The eastbound and westbound left-turn movements would require protected phasing. The westbound approach would require a five-lane section (one left turn lane, two through lanes, and two receiving lanes) in order for the intersection to operate at LOS E or better; however, this option may be constrained by the narrow right-of-way beneath the I-5 undercrossing.
- The intersection of Broadway/I-5 NB Off-Ramp would require an additional northbound approach lane, in both the X Street connection and Broadway connection alternatives.
- In the Broadway Connection alternative, the four-lane roadway cross section would need to extend from the Broadway Bridge to 3rd Street.

Additional right-of-way on Broadway and 3rd Street may be necessary for the intersections on the east side to operate at LOS E or better conditions.