

City of Arts & Innovation

TO: HONORABLE MAYOR AND CITY COUNCIL DATE: DECEMBER 6, 2016

FROM: PUBLIC WORKS DEPARTMENT

WARDS: 1 & 3

SUBJECT: BROCKTON AVENUE RESTRIPING PROJECT UPDATE

ISSUE:

Review of post-construction traffic study data related to the Brockton Avenue Restriping Project.

RECOMMENDATION:

That the City Council receive and file the post-construction traffic study data.

COMMITTEE RECOMMENDATION:

On April 14, 2016, the Transportation Committee (Committee) reviewed this matter; Chair Davis and Vice-Chair Mac Arthur unanimously voted to receive and file the report, with Member Melendrez disqualified from voting. The Committee recommended that additional traffic studies, including residential and business surveys, be performed and that the item be directed to City Council for further discussion.

BACKGROUND:

On April 22, 2013 and October 2, 2013 the Utility Services/Land Use/Energy Development Committee reviewed the Brockton Avenue Restriping Project proposal and recommended approval to City Council. On October 22, 2013, the City Council approved the Brockton Avenue Restriping Project.

In order to improve safety and maintain similar roadway operations, Brockton Avenue was restriped between Mission Inn Avenue and Beatty Drive (Project). The Project reduced the number of thru lanes from four to two, installed bike lanes, and installed a two-way left-turn lane between Tequesquite Avenue and Beatty Drive to separate the left-turn motorists from thru traffic. Brockton Avenue retained the four-lane configuration between Fourteenth Street and Tequesquite Avenue to best serve Riverside Community Hospital's Phase II construction and future growth. Additionally, the project maintained on-street parking adjacent to the curb where lane widths permitted, converted traffic signals at selected intersections to protected/permissive, coordinated signals to optimize traffic, and rehabilitated the pavement. In conjunction with the improvements,

the Project also constructed new concrete sidewalk where it was missing, and reconstructed damaged concrete curb, gutter, sidewalk and driveways.

The Public Works Department completed the project in November 2014. Project benefits include:

- Enhancing safety for motorists by shifting left-turning vehicles from thru lanes onto a twoway left-turn lane, increasing sight distance for motorists entering Brockton Avenue from the side streets, and discouraging speeding;
- 2) Improved access and response times for emergency vehicles;
- 3) Increased pedestrian safety by reducing exposure across travel lanes;
- Encouraged increased use by cyclists and enhanced safety as the result of installation of the Class II bike lanes and bike buffers;
- 5) Increased on-street parking; and
- 6) Allowed Riverside Transit Agency (RTA) buses to pick up and drop off passengers without obstructing the travel lanes.

The combined benefits of these improvements was expected to reduce the accident rate while maintaining acceptable traffic operations.

DISCUSSION:

The Public Works Department conducted 6-month and 24-month post-construction traffic studies to assess accidents, traffic volumes, travel speeds, and bicycle and pedestrian activity along Brockton Avenue and nearby streets to determine if adjustments to traffic signal timing or striping were necessary to optimize operations. Table 1 reflects the Brockton Avenue 10-year pre-construction accident history and estimated reduction rates based on the Federal Highway Administration figures. Table 2 shows the 24-month period post-construction accident analysis. Although this is a relatively short after-study period, data shows a positive trend in reducing the accident rate.

Туре	Total	*Estimated Reduced By	*Estimated % Reduction
Rear End	87	58	67%
Sideswipe	45	31	69%
Broadside	142	17	12%
Head-On	31	1	3%
Pedestrian	13	13	100%
Bicyclist Involved	15	15	100%
Hit Object	22	0	0%
Overturned	2	0	0%
Other	5	1	20%
Not Stated	5	1	20%
Totals	367	137	37%

Table 1: Brockton 10-Year Accident History and Estimated Reduction (Before Project)

* Estimated accident reduction figures are based on Federal Highway Administration's road diet studies

Table 2 evaluates the reduction of accidents (November 2014 - October 2016) along Brockton Avenue following completion of the project. The post-project accident data reflects a 35%

reduction after project implementation indicating improved safety along the corridor. The 35% measured reduction is comparable to the anticipated 37% reduction.

Туре	24-Month Historical Average (Pre-Project)		% Increase / Reduction (Post- Project vs. 16 Month Historical Average)
Rear End	17.5	23	31%
Sideswipe	9	3	-67%
Broadside	28.4	14	-50%
Head-On	6.2	0	-100%
Pedestrian	2.6	3	15%
Bicyclist Involved	3	5	67%
Hit Object	4.4	0	-100%
Overturned	0.4	0	-100%
Other	1	0	-100%
Not Stated	1	0	-100%
Totals	73.5	48	35% Decrease

Although the number of through lanes was reduced, the capacity on Brockton Avenue was only slightly impacted. A 1999 study titled *Road Diets: Fixing the Big Roads* and a 2010 Federal Highway Administration's (FHWA's) study titled *Evaluation of Lane Reduction "Road Diet" Measures on Crashes* concluded there is a slight capacity reduction when a 4-lane roadway is reduced to 3-lanes. Both of these studies concluded that three-lane conversion projects have minimal effects on roadway capacity because the left-turning vehicles are accommodated in a common two-way left-turn lane and through traffic can travel unimpeded.

Table 3 illustrates the measured traffic levels along studied roadway segments before and after project implementation. The 2016 trend shows that traffic patterns and volumes are generally decreasing when compared to the initial after-counts performed in 2015 which can be attributed to the completion of large area projects including: State Route 91 HOV, Riverside Community Hospital Phase I, Riverside Grade Separation, Streeter Grade Separation, and the reconstruction of the Convention Center. Some of these projects implemented detours or caused traffic to divert which triggered fluctuating traffic patterns. Table 3 also illustrates that Brockton Avenue and adjacent streets have sufficient capacity to accommodate continued growth in the area.

Table 3: Adjacent Roadwa	y Volume and Capacity
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Location	Averaç Before (2014)	ge Daily (ADT) *After (2015)	Traffic **After (2016)	2015 % Increase	2015 vs 2016	2014 vs 2016	% Capacity
Merrill east of Brockton	1101	2230	1313	103%	-41%	19%	10.5%
Sunnyside east Brockton	342	360	388	5%	8%	13%	12.5%
Dewey west of Brockton	1134	2726	1745	140%	-36%	54%	14.0%
Twelfth west of Brockton	511	524	521	3%	0%	2%	16.8%
Garden Home west of Brockton	347	1101	179	217%	-84%	-48%	5.8%

Table 5. Aujacent Roadway	Table 3: Adjacent Roadway volume and Capacity						
Terracina east of Brockton	1000	2689	1992	169%	-26%	99%	64.3%
Sunnyside west of Brockton	489	604	392	24%	-35%	-20%	12.6%
Pine south of 13th	2542	3411	3223	34%	-6%	27%	25.8%
Redwood south of 13th	2198	3181	3434	45%	8%	56%	27.5%
Palm south of Tequesquite	6578	9335	9411	42%	1%	43%	52.3%
Palm north of Beachwood	6797	9335	9411	37%	1%	38%	52.3%
Palm north of Central	7226	9916	8626	37%	-13%	19%	47.8%
Palm north of Elmwood	7364	9537	9444	30%	-1%	28%	52.5%
Palm north of Gardena	7105	9835	8596	38%	-13%	21%	47.8%
Palm south of Beatty	8104	10993	8626	36%	-22%	6%	47.9%
Magnolia north of Ramona	21142	23296	22059	10%	-5%	4%	66.8%
Magnolia north of Oakwood	21037	25946	22345	23%	-14%	6%	67.8%
Magnolia south of Elizabeth	22954	30958	24600	35%	-21%	7%	74.5%
Magnolia south of Ramona	20673	24921	22318	21%	-10%	8%	67.6%
Brockton north of Dewey	9800	11572	11279	18%	-3%	15%	62.7%
Brockton north of Tenth	13967	14194	14380	2%	1%	3%	80.0%
Brockton south of Bandini	13341	11964	12720	-10%	6%	-5%	70.1%

Table 3: Adjacent Roadway Volume and Capacity

*Counts taken March 2015, **Counts taken March 2016

As part of the Project, Class II buffered bike lanes were installed to encourage increased bike use and provide wider and more accommodating bike lanes compared to Magnolia Avenue, the primary parallel arterial to Brockton Avenue. Table 4 shown below represents 3-days of data from pedestrian and bicycle counts taken on Brockton Avenue at Bandini Avenue and Brockton Avenue at Terracina Avenue. The counts were taken on a typical weekday (June 9, 2016) and on a typical weekend (June 11-12, 2016) and were selected due to their central position within the project limits. FHWA's *Road Diet Information Guide* shows that a striping configuration project which reduces travel lanes creates an improved pedestrian environment by making crossing the street easier, generating more predictable vehicular speeds, and providing a buffer between pedestrians and moving vehicles by including bike/parking lanes. Additionally, bicyclists benefit significantly from the addition of the Class II delineated bike lanes which provide a designated area for cyclists making them both more visible and easier to detect by motorists. The project also included 2-ft bike lane buffers which provide greater separation between moving vehicles and bicyclists, thereby enhancing safety and encouraging increased cycling.

1 abie 4. 2	Table 4. 24-Hour brockion Avenue broycle and redestrian counts					
Date	Day of the	@ Bandin	i Avenue	@ Terracir	na Drive	
	Week	# of Pedestrians	# of Bicyclists	# of Pedestrians	# of Bicyclists	
6/9/16	Thursday	112	81	57	37	
6/11/16	Saturday	163	82	24	40	
6/12/16	Sunday	113	112	42	22	

Table 4: 24-Hour Brockton Avenue Bicycle and Pedestrian Counts

The Project installed 11-ft buffered Class II bike lanes along many segments of Brockton Avenue which allowed for additional on-street parking opportunities including RTA loading/unloading

zones to service passengers without obstructing the travel lanes. Tables 5 and 6 demonstrate the fluctuating parking demand on Brockton Avenue during key periods, including:

- a. Regular weekday during normal RCC session (June 2, 2016)
- b. Regular weekday during RCC Final's Week (June 8, 2016)
- c. Regular weekday while RCC is on semester break (June 15, 2016)

Table 5: Northbound Brockton Ave On-Street Parking Counts	
Regular RCC Session / Finals Week / Semester Break	

Segment	7:30 am	10:00 am	1:00 pm	4:00 pm
Jurupa to Maplewood	0/0/0	0/0/0	0/0/0	0/0/0
Maplewood to Garden Home	0/0/0	0/0/0	0/1/0	0/0/0
Garden Home to Rosewood	1/1/0	2/1/0	0/0/0	0/0/0
Rosewood to Oakwood	3/2/0	0/2/0	1/0/0	1/0/1
Oakwood to Linwood	0/0/0	0/0/0	1/0/0	0/0/0
Linwood to Bandini	0/0/1	0/0/1	0/0/1	0/0/1
Bandini to Elmwood	0/0/1	0/0/0	0/0/0	0/0/0
Elmwood to Beechwood	1/2/1	1/2/1	0/2/1	0/2/1
Beechwood to Chapman	0/0/0	0/1/0	0/0/0	0/0/0
Chapman to Larchwood	0/1/0	3/0/0	2/2/0	3/3/0
Larchwood to Ramona	2/3/0	2/2/0	2/1/0	3/2/0
Ramona to Terracina	9/7/0	26 / 15 / 0	17 / 22 / 0	18 / 12 / 0
Terracina to Rice	0/2/0	5/2/0	2/3/0	2/2/0
Rice to Tequesquite	1/0/0	8/0/0	4/2/0	4/3/0
Tequesquite to 14 th	3/4/3	7 / 11 / 6	7 / 12 / 7	3/5/3
Total	20 / 22 / 6	54 / 36 / 8	36 / 45 / 9	34 / 29 / 6

Table 6: Southbound Brockton Ave On-Street Parking CountsRegular RCC Session / Finals Week / Semester Break

Segment	7:30 am	10:00 am	1:00 pm	4:00 pm
14 th to Tequesquite	0/0/0	0/0/0	0/0/0	0/0/0
Tequesquite to Alta Vista	3/2/1	8/3/5	6/4/4	5/6/4
Alta Vista to Homewood	0/0/0	0/0/0	0/0/0	0/0/0
Homewood to Ramona	1/1/0	10/1/0	8/0/0	5/1/0
Ramona to Larchwood	0/0/1	2/0/1	1/0/1	1/1/1
Larchwood to Highland	0/0/0	0/0/0	0/0/0	0/0/0
Highland to Beechwood	0/0/0	0/0/0	0/0/0	0/0/0
Beechwood to Elmwood	0/0/0	0/0/0	0/0/0	0/0/0
Elmwood to Bandini	0/0/0	0/0/0	0/0/0	0/0/0
Bandini to Linwood	1/1/1	2/0/2	1/0/1	0/0/1
Linwood to Oakwood	0/1/1	0/0/0	0/1/0	0/0/1
Oakwood to Rosewood	3/3/2	3/2/2	4/2/2	2/2/2
Rosewood to Edgewood	1/2/1	1/1/1	1/2/0	1/3/1
Edgewood to Maplewood	2/2/3	2/3/3	1/2/3	1/2/1
Maplewood to Rubidoux	0/0/0	0/0/0	0/0/0	0/0/0
Rubidoux to Jurupa	0/0/0	0/0/0	0/0/0	0/0/0
Total	11 / 12 / 10	28 / 10 / 14	22 / 11 / 11	15 / 15 / 12

During the four time periods, staff counted 220 parked vehicles along Brockton Avenue during a regular RCC day, 180 during a Final Exams day, and 76 when RCC was out of session. Based on a regular RCC school day, there were 40 (19%) fewer parked vehicles during a Final Exams day, and 144 (65%) fewer parked cars when RCC was out of session. In the northbound direction, the block between Ramona Drive and Terracina Drive, closest to RCC, had the biggest difference in parked vehicles. This block had 70 vehicles parked during a regular RCC day and zero when the college was out of session. In the southbound direction, the block between Homewood Court and Ramona Drive, closest to RCC, had the largest difference in parked vehicles. There were 24 vehicles parked during a regular RCC day and zero when the college was out of session. It is important to note that on-street parking existed along these two segments of Brockton Avenue before the project was implemented and based on the studies demand has not spread to new parking areas created by the project.

During the April 14, 2016 Transportation Committee meeting, residents voiced concern that traffic may have diverted from Brockton Avenue onto Redwood Drive, a one-way southbound street that is parallel to Brockton Avenue. Staff conducted travel time analysis and ordered an additional 24-hour count which was completed on September 14, 2016 on Redwood Drive, south of Thirteenth Street, to further assess impacts in the area. Based on the count data, traffic volumes on Redwood Drive initially increased after Project completion but have decreased by 15% in the past six months. Traffic fluctuations on Redwood Drive may also be attributed to the activities on Ryan Bonaminio and Mt Rubidoux Parks as Redwood Drive provides a direct connection to these popular recreational facilities.

Table 7: Redwood Drive 24-Hour Traffic Volume Counts

	Ave	rage Dail	y Traffic (ADT)	2014 vs	March	%
Location		*March 2015	*March 2016	* Sept. 2016	Sept. 2016	2016 vs Sept. 2016	Capacity
Redwood S 13th	2198	3181	3434	2915	+ 32%	- 15%	23.3%

*Counts taken After Project Completion

In addition, an Average Travel Speed Analysis was conducted on November 2-3, 2016 using GPS equipment to measure distance traveled, travel times, and average speed along Redwood Drive and Pine Street between University Avenue and Bandini Avenue. Average speed (including wait times at stop signs & signals) is an important factor because motorists will often look for shorter routes or routes on which they can maintain a higher average travel speed over the course of their trip. Figures 2 and 3 graphically illustrate the higher travel speeds on Brockton Avenue compared to Redwood Dr and the Project included traffic signal improvements to optimize traffic flow.

To minimize delay associated with the Project and discourage cut-through traffic onto parallel streets, the Project installed protected/permissive improvements at the following key signalized intersections:

- Brockton Avenue at University Avenue
- Brockton Avenue at Bandini Avenue
- Brockton Avenue at Thirteenth Street
- Brockton Avenue at Tequesquite Avenue

In addition to protected/permissive phasing, the Traffic Division implemented new traffic signal synchronization plans following construction – these signal timing plans allow for more efficient

movement of traffic along a synchronized corridor.

Figure 1 illustrates the routes driven along southbound Redwood Drive and Palm Avenue, northbound Palm Avenue and Pine Street, and the longer route along University Avenue, Brockton Avenue, and Bandini Avenue to travel between the end points of the two parallel measured segments.

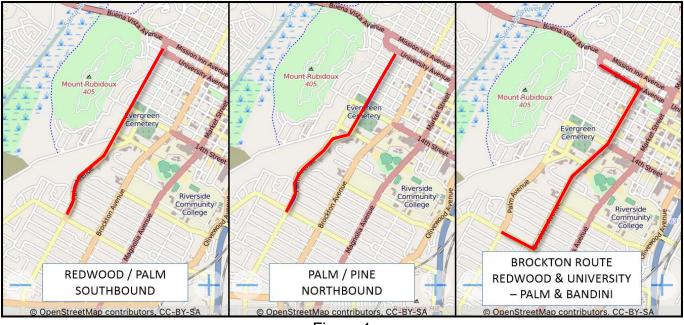
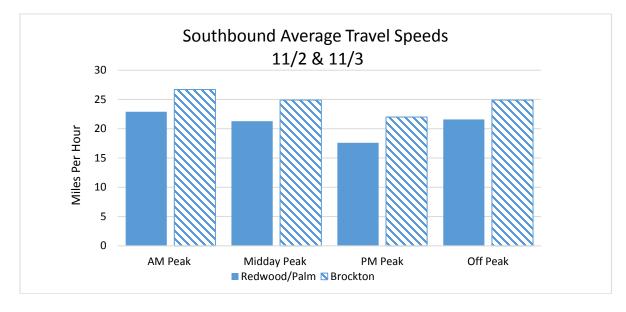


Figure 1

Synchronized traffic signals allow motorists to stop less frequently along Brockton Avenue than when traversing the stop signs on Redwood Drive or Pine Street. Protected/permissive signal phasing also improves operations as it allows motorists to turn left during the green left-turn arrow (protected phase) and during gaps in traffic during the green ball indication (permissive phase). Figures 2 and 3 reflect that neither Redwood Drive (southbound) nor Pine Street (northbound) provide higher travel speeds (including time spent stopped), so motorists are not being encouraged to divert from Brockton Avenue onto these roads.



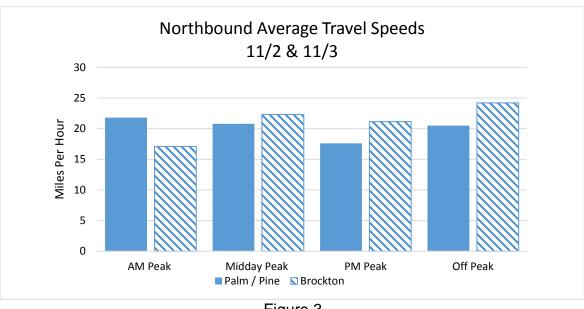


Figure 2



Per the above figures, the route along Brockton Avenue provides the highest average travel speed during all hours of the day in either direction of travel, with the exception of the northbound average travel speed during the AM peak period from 7 to 9 am. The lower average speed during the AM peak in the northbound direction along Brockton Avenue can be attributed to the high volume of motorists travelling towards the downtown and schools during this time. However, avoiding Redwood Drive / Pine Street and travelling further to use Brockton Avenue does provide a higher average travel speed for seven of the eight measured scenarios. The frequency of stop-controlled intersections along Redwood & Pine contributes to the lower average travel speeds.

Lower average travel speeds aren't always enough to deter or prevent cut-through traffic, so the Public Works Department conducted a Neighborhood Cut-Through Traffic Analysis on Redwood Drive on June 19, 2015 and concluded that 78% of all traffic that enters Redwood Drive is neighborhood traffic and is not using the street as an alternative to other routes. This is an indication that both the signal coordination along Brockton Avenue and traffic calming measures along Redwood Drive have been effective in encouraging motorists to make use of Brockton Avenue, an assertion that is supported when examining the roadway volumes shown previously in Table 3.

While the data indicates that the Brockton Avenue Striping Project provides several measurable benefits, residents' perception and experiences related to a project are also important when evaluating a project's benefit to the community. As such, the Public Works Department conducted and received in excess of 600 responses to a mailed and electronic survey that asked several questions related to safety, ease of use, and a desire to retain certain project features.

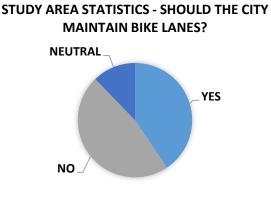
For the purposes of this report, the "survey area" is defined as results from residents responding from within the area generally bounded by Mission Inn Avenue to the north, Olivewood Avenue to the east, Jurupa Avenue to the south, and Mount Rubidoux to the west. City Staff also conducted in-person surveys of businesses along Brockton Avenue using a modified version of the residential/motorist survey.

When asked if the two-way-left-turn lanes provided improved access to driveways and side streets, approximately 49% of those surveyed responded that they did indeed notice an improvement – as shown below in Figure 4.





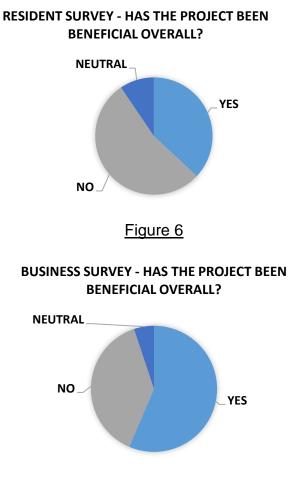
When asked if the City should maintain bicycle lanes along Brockton Avenue, approximately 47% of respondents responded 'No', with 41% wishing to maintain the lanes, and the remaining 12% remaining neutral (shown below in Figure 5).





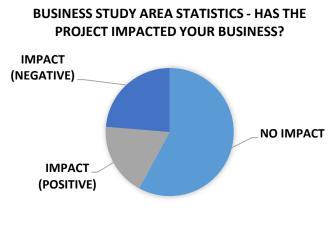
Survey respondents are generally in favor or neutral with respect to the two-way-left-turn lane, and generally against or neutral with respect to the bike lanes. However; the additional space for bicycle lanes is a direct result of reducing travel lanes to provide the two-way-left-turn lane. Removal of the bike lanes and maintenance of the two-way-left-turn lane would result in wider than recommended vehicle travel lanes, which would provide no additional benefit to motorists and in most cases raise speeding concerns. Neither the results in Figure 4 or Figure 5 show a clear majority in favor or against the project.

When asked if the project was beneficial overall the results were similarly mixed (shown below in Figure 6 and Figure 7). Approximately 53% of the residents responded that overall the project has not be beneficial. Although, when the same question was asked of businesses, 56% of businesses responded that "Yes", the project overall has been beneficial.





Many businesses also responded that the project has had no impact on their business, with smaller percentages mentioning that the restriping has had an impact (Figure 8). Some businesses had concerns regarding visibility and ease of access as a negative impact, while others cited increased parking availability and the attraction of additional customers as a positive impact.





As can be seen in the survey response figures, neither positive nor negative responses received more than a two-third majority for any one question. The close survey results mirror the previous

community engagement efforts prior to the project's implementation, and elevate the importance of measured safety benefits and findings associated with the restriping project- which are not readily apparent to motorists.

Preliminary findings indicate:

- The Brockton Avenue Restriping Project has reduced the number of accidents along Brockton Avenue by 35%. This preliminary result represents a significant collision reduction and is in line with FHWA figures.
- The survey results do not warrant change to the current striping configuration, less than 50% of respondents were against keeping the bike lanes.
- 24-Hour Bicycle Volumes show moderate use of the Class II bike lanes
- Over 50% of businesses found the project to be beneficial overall.
- Current traffic volumes show increased use of Brockton Avenue suggesting that motorists find the new configuration both comfortable and operationally acceptable, and that vehicles are not leaving Brockton to travel on other streets.
- The pre and post project 85th percentile speed (the speed that 85 percent of vehicles do not exceed) has remained relatively unchanged as it decreased by 3 mph, from 41 mph to 38 mph.
- Brockton continues to provide higher average travel speeds when compared to the adjacent routes of Redwood Avenue and Pine Street.

As part of the study process, Public Works has identified a need to further refine signal timing for the northbound direction of travel along Brockton Avenue during the AM peak hour of traffic. Public Works will continue to monitor traffic flow to assess whether potential signal timing changes and/or striping improvements are warranted to continue to ensure Brockton Avenue is performing optimally and efficiently serving all road users.

Surveys taken prior to the implementation of the Brockton Avenue restriping project found that the community saw benefits in the project. This continues to remain true for residents living within the project area as all road users including pedestrians and bicyclists can use these facilities. Public Works has studied the corridor and found that the project has had little impact on capacity, travel speeds, or parallel roadways. Reduction to a three lane configuration to include a two-way-left-turn lane is supported by the Federal Highway Administration as an effective safety countermeasure to reduce the number and severity of accidents. Based on the operations and safety enhancements, Public Works recommends that the improvements along Brockton Avenue remain in place.

FISCAL IMPACT:

There are no costs associated with receipt and review of the post-construction project traffic study data.

Prepared by:	Kris Martinez, Public Works Director
Certified as to	
availability of funds:	Scott G. Miller, PhD, Chief Financial Officer/City Treasurer
Approved by:	AI Zelinka, FAICP, Assistant City Manager
Approved as to form:	Gary G. Geuss, City Attorney

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Concurs with:

an sealer

Councilmember Paul Davis, Chair Transportation Committee

Attachments:

- 1. Project Location Map
- 2. Brockton Avenue 3-Lane Illustration
- 3. Brockton Ave Restriping Project Draft Report, dated April 24, 2015
- 4. Presentation