



M E T R O P O L I T A N T R A N S P O R T A T I O N C O M M I S S I O N

Program for Arterial System Synchronization (PASS)

F Y 1 5 / 1 6 C y c l e - F a c t S h e e t s

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CITY OF FREMONT

CITY OF HAYWARD

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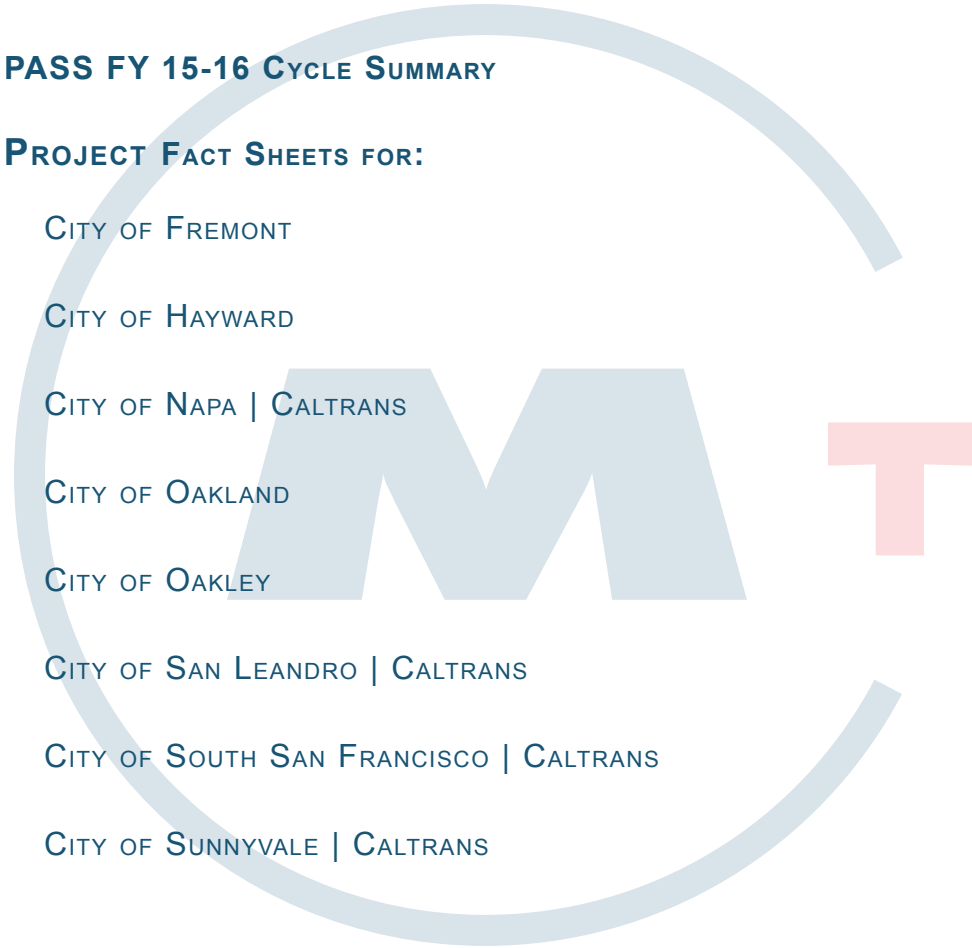
CITY OF OAKLAND

CITY OF OAKLEY

CITY OF SAN LEANDRO | CALTRANS

CITY OF SOUTH SAN FRANCISCO | CALTRANS

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PASS FY 15/16 CYCLE

The purpose of the Program for Arterial System Synchronization (PASS) is to provide technical and financial assistance to Bay Area agencies to help improve the safe and efficient operation of certain traffic signal systems and corridors. The PASS provides traffic engineering assistance to local jurisdictions to retime their traffic signals.

Eight projects from the PASS 15/16 cycle are listed in the table below, consisting of 153 traffic signals from five counties in the Bay Area. MTC, in partnership with Caltrans and the local agencies, has successfully completed these projects. In this cycle, five Caltrans signals were coordinated with local agency signals along major arterials in the Bay Area.

As a part of each project, new traffic counts were collected in the field to understand the traffic patterns and volumes along the corridors. The 7-day 24-hour volume counts (Average Daily Traffic, ADT), peak periods turning movement counts, including vehicular, pedestrian, bicycle counts, and historical collision data were analyzed in developing and implementing new coordination plans. Field implementation and fine-tuning are the last, but the most important, tasks to successfully achieve traffic progression. To provide a common time-source for some traffic signals, GPS clocks were installed for six projects.

BENEFIT-COST SUMMARY

The PASS project benefits are assumed to be 100 percent on the first day after implementation of the new timing plans, declining steadily to zero by the end of the fourth year. The results from the eight projects are summarized below:

- Total Auto Travel Time Savings: 25% or over 1.7 million hours
- Average Auto Speed Increase: 47%
- Total Auto Fuel Consumption Savings: 19% or over 5.9 million gallons
- Total Auto Emissions Reduction: 214.4 tons (ROG: 19.2 tons; NOx: 14.1 tons; PM2.5: 0.7 tons; CO: 180.4 tons)

Total Project Costs: \$914,500

Total Lifetime Benefits: \$55,201,000

Overall Benefit-Cost Ratio: 60:1

OTHER BENEFITS

The optimized signal timing plans were developed and implemented based on the 2014 California MUTCD guidelines. The Walk time and Flashing Don't Walk clearance timing parameters were updated to provide adequate crossing time for children and seniors to safely cross the study intersections. The minimum green times were reviewed and increased at many intersections to enhance safety for bicyclists crossing the intersections. The yellow time and all-red timing parameters were reviewed and updated to provide additional clearance time for vehicles to clear or stop safely at the intersections. Timing plans were optimized to reduce unnecessary delays along the side streets and achieve progression along the corridors.

#	County	Project Sponsors	# of Signals	Timing Plans/Services	Consultant
1	Alameda	City of Fremont	24	Weekday Peaks; School PM Peak; Weekend Peaks	Iteris
2	Alameda	City of Hayward	13	Weekday Peaks	Iteris
3	Napa	City of Napa, Caltrans	14	Weekday Peaks; Weekend Peaks	TJKM
4	Alameda	City of Oakland	43	Weekday Peaks; Weekend Peak/Off-Peak	Kimley-Horn
5	Contra Costa	City of Oakley	5	Weekday Peaks; School PM Peak	TJKM
6	Alameda	City of San Leandro, Caltrans	7	Weekday Peaks; Weekend Peaks	Iteris
7	San Mateo	City of South San Francisco, Caltrans	10	Weekday Peaks; School PM Peak; Weekend Peaks	TJKM
8	Santa Clara	City of Sunnyvale, Caltrans	37	Weekday Peaks; Weekend Peaks	DKS
Total Signals			153		

Mowry Ave, Stevenson Blvd, Fremont Blvd - Signal Timing Project

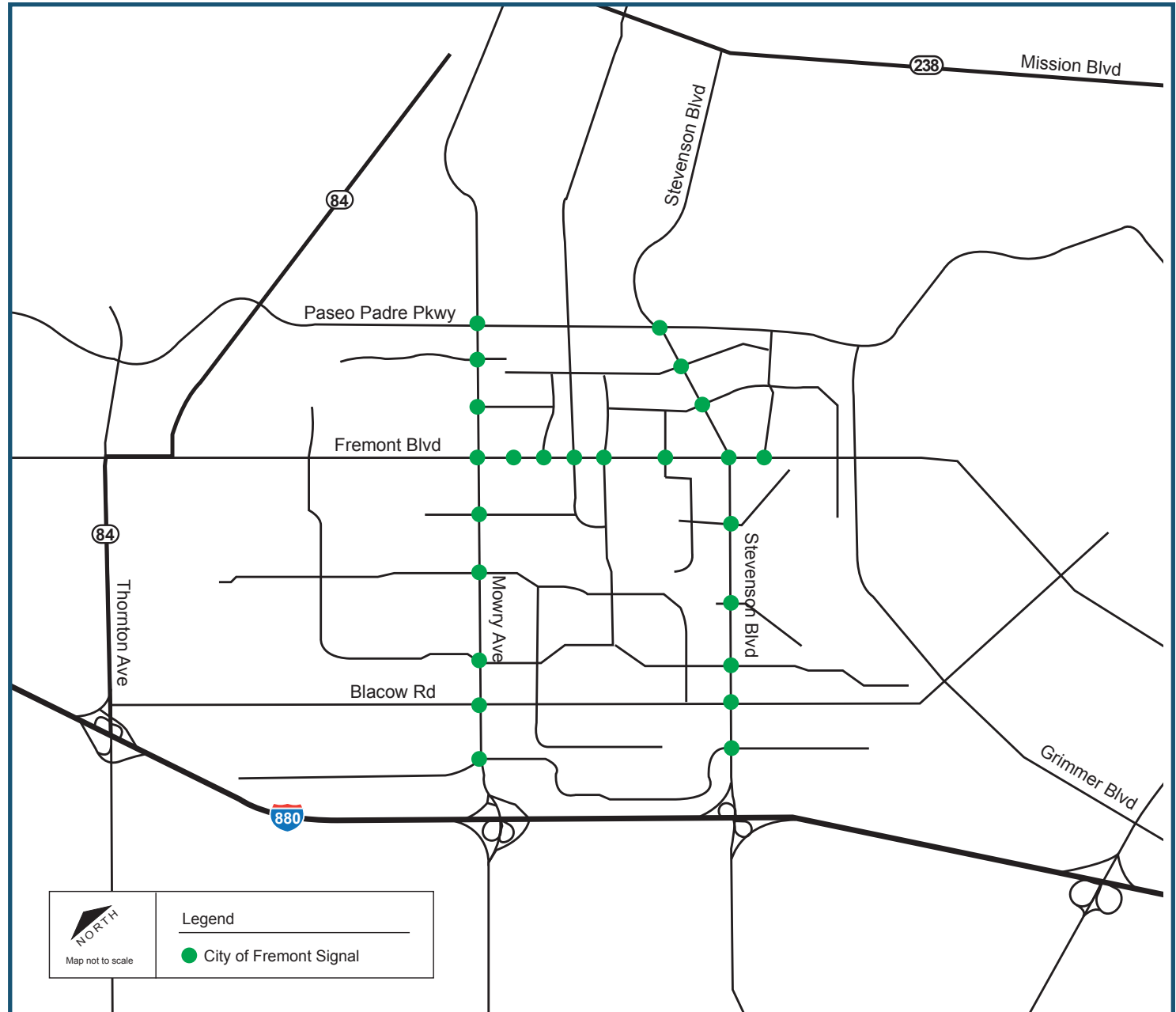
City of Fremont | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Fremont received a Program for Arterial System Synchronization (PASS) grant from the Metropolitan Transportation Commission to conduct a signal timing study for 24 traffic signals on Mowry Avenue, Stevenson Boulevard, and Fremont Boulevard. All signals are owned, maintained, and operated by the City of Fremont

The goal of the project was to conduct timing analysis and develop and implement signal coordination plans during the weekday AM, midday, afternoon school, and PM peak periods, and also weekend peak periods for the 24 project signals.

The PASS project involved the completion of the following major tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct travel time surveys; review collision history; develop coordination plans for the analysis periods; implement and fine-tune the recommended timings; and conduct “before” and “after” travel time surveys to assess the performance of the new plans. The field fine-tuning was conducted during typical weekday peak periods and minor adjustments were made to the offsets and splits based on observed traffic conditions.



BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: The minimum green time intervals were reviewed and updated for bicyclists. Changes to minimum green intervals were made at 14 project intersections.



BENEFITS TO PEDESTRIANS: The pedestrian timings were reviewed based on the latest 2014 California MUTCD to enhance safety. The pedestrian clearance intervals (Walk and Flashing Don't Walk times) were increased on all project intersections, ensuring adequate time for pedestrians to cross.

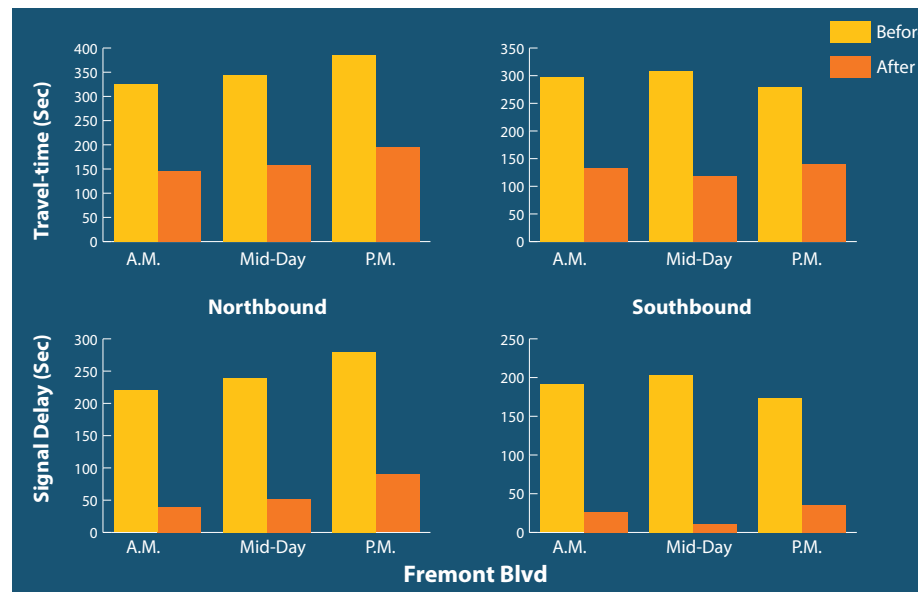


BENEFITS TO TRAFFIC SAFETY: A review of intersection-level collisions along the corridors was conducted to identify any collision patterns that may be corrected through signal timing adjustments. In addition, the yellow intervals were updated based on the latest 2014 California MUTCD standards using the 85th Percentile vehicular speeds along project corridors.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$117,600
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$0
Agency Staff Costs (Estimate)	\$29,400
Total Costs	\$147,000

Project Benefits				
Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	272,469 hrs.	\$5,648,704	730,915 hrs.	\$15,152,967
Fuel Consumption Savings	971,299 gal.	\$2,987,553	2.61M gal.	\$8,014,281
ROG Emissions Reduction	2.98 tons	\$3,898	7.98 tons	\$10,458
NOx Emissions Reduction	2.29 tons	\$42,803	6.13 tons	\$114,821
PM2.5 Emissions Reduction	0.11 tons	\$36,849	0.30 tons	\$98,850
CO Emissions Reduction	30.71 tons	\$2,493	82.37 tons	\$6,687
Total Lifetime Benefits	\$23,398,064			

Overall Project Benefits	Auto
Average Decrease in Travel Time	32%
Average Speed Increase	56%
Average Fuel Savings	25%
Average Reduction in Signal Delay	56%
Average Reduction in Number of Stops	47%
Overall Benefit-Cost Ratio	159:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 56%

Average Reduction in Number of Stops: 47%

Auto Fuel Consumption Savings: 25% or 2,605,564 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 96.78 tons

Auto Travel Time Savings: 32% or 730,915 hours



Overall Project Benefit-cost Ratio = 159:1



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Project Consultant:

Iteris, Inc.



Tennyson Road - Signal Timing Project

City of Hayward | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Hayward received a grant from the Metropolitan Transportation Commission's Program for Arterial System Synchronization (PASS) to conduct a signal timing study for 13 traffic signals along Tennyson Road. All of the project intersections are owned, operated, and maintained by the City of Hayward.

The goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans during weekdays for the 13 project signals. Timing plans developed and implemented consisted of typical weekday AM, midday, and PM periods.

The PASS project involved the completion of the following tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct field review of the project area; conduct "before" and "after" travel time surveys; review actuated settings; review collision history; develop the existing conditions model; develop coordination plans for the typical weekday AM, midday, and PM peak periods; implement and fine-tune the recommended timings; and document the analyses/findings for the project. The field fine-tuning was conducted during typical weekday peak periods and minor adjustments were made to the offsets and splits based on observed traffic conditions.



GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, four GPS clocks were installed as a part of the project. These GPS clocks enable the signal controllers, that are not interconnected, to regularly synchronize their clocks, ensuring more effective traffic signal coordination.

BENEFITS TO VARIOUS MODES



BENEFITS TO PEDESTRIANS:

The Walk time and Flashing Don't Walk timing parameters were updated at six intersections to provide

adequate time for children and seniors to safely cross the study intersections within close proximity of schools.



BENEFITS TO TRAFFIC SAFETY:

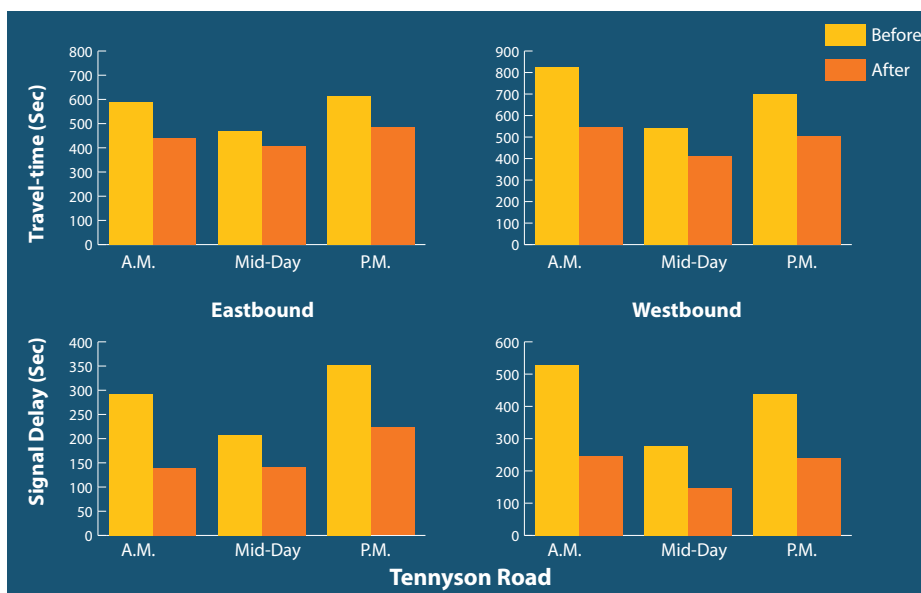
To enhance traffic safety, the yellow clearance timing parameters were updated based on the latest 2014

California MUTCD standards using 85th Percentile vehicular speed along Tennyson Road. An additional intersection analysis was done at one intersection, providing recommendations to improve safety and to promote efficient signal operations.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$34,600
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$2,000
Agency Staff Costs (Estimate)	\$8,650
Total Costs	\$45,250

Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	71,044 hrs.	\$1,472,860	190,581 hrs.	\$3,951,029
Fuel Consumption Savings	238,364 gal.	\$733,169	639,426 gal.	\$1,966,768
ROG Emissions Reduction	0.74 tons	\$965	1.98 tons	\$2,588
NOx Emissions Reduction	0.58 tons	\$10,772	1.54 tons	\$28,897
PM2.5 Emissions Reduction	0.03 tons	\$8,203	0.7 tons	\$22,005
CO Emissions Reduction	7.07 tons	\$574	18.96 tons	\$1,539
Total Lifetime Benefits	\$5,972,826			

Overall Project Benefits	Auto
Average Decrease in Travel Time	26%
Average Speed Increase	32%
Average Fuel Savings	19%
Average Reduction in Signal Delay	56%
Average Reduction in Number of Stops	47%
Overall Benefit-Cost Ratio	132:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 56%

Average Reduction in Number of Stops: 47%

Auto Fuel Consumption Savings: 19% or 639,426 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 23.18 tons

Auto Travel Time Savings: 26% or 190,581 hours



Overall Project Benefit-cost Ratio = 132:1



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Project Consultant:

Iteris, Inc.



CITY OF HAYWARD
HEART OF THE BAY

Redwood Rd/Trancas St, Soscol Ave - Signal Timing Project

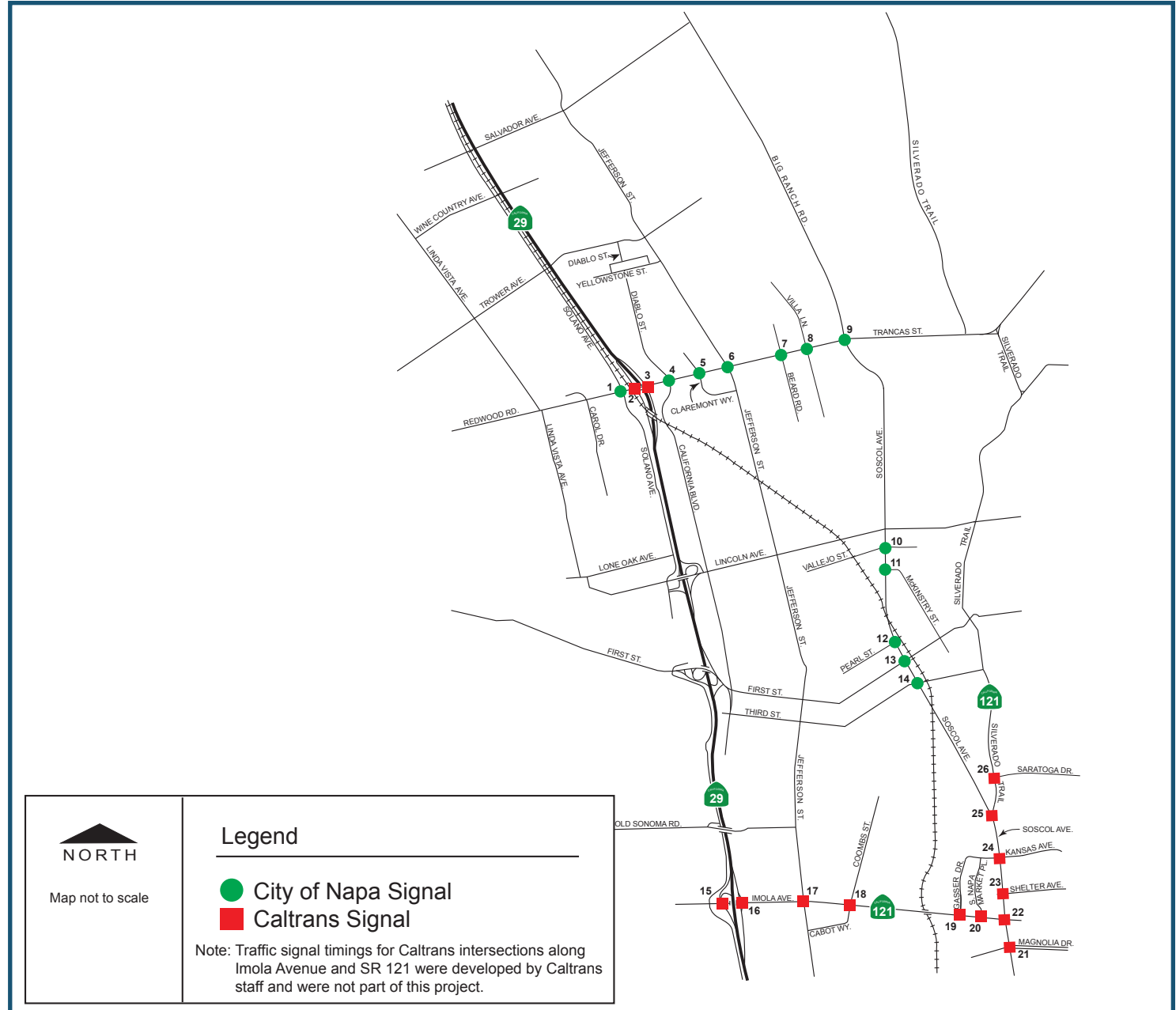
City of Napa | Caltrans | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Napa, in conjunction with Caltrans, received a grant from the Metropolitan Transportation Commission's Program for Arterial System Synchronization (PASS) to conduct a signal timing study for 14 traffic signals along corridors on Redwood Road/Trancas Street, and Soscol Avenue. Project intersections are owned, operated, and maintained by either the City of Napa or Caltrans.

The goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans during weekday AM, midday, and PM and weekend peak periods.

The PASS project involved the completion of the following tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct field review of the project area; conduct "before" and "after" travel time surveys; review actuated settings; review collision history; develop the existing conditions model; develop coordination plans for the typical weekday AM, midday, PM, and weekend peak periods; implement and fine-tune the recommended timings; and document the analyses/findings for the project. The field fine-tuning was conducted during typical weekday and weekend peak periods and minor adjustments were made to the offsets and splits based on observed traffic conditions.



GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, five GPS clocks were installed as a part of the project. These GPS clocks enable the signal controllers to regularly synchronize their clocks, efficiently deploy the timing plans at the same time, and thus help maintain the efficiency of signal coordination.

BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: The minimum green time intervals were reviewed and updated for bicyclists. Changes to minimum green intervals were made at 14 project intersections.



BENEFITS TO PEDESTRIANS: The Walk timing and Flash Don't Walk clearance-timing parameters were reviewed and updated where required

at the 14 intersections to provide adequate time for children and seniors to safely cross the study intersections to accommodate the new walking speed of 3.5 feet/second, as specified in the 2014 California MUTCD standards.



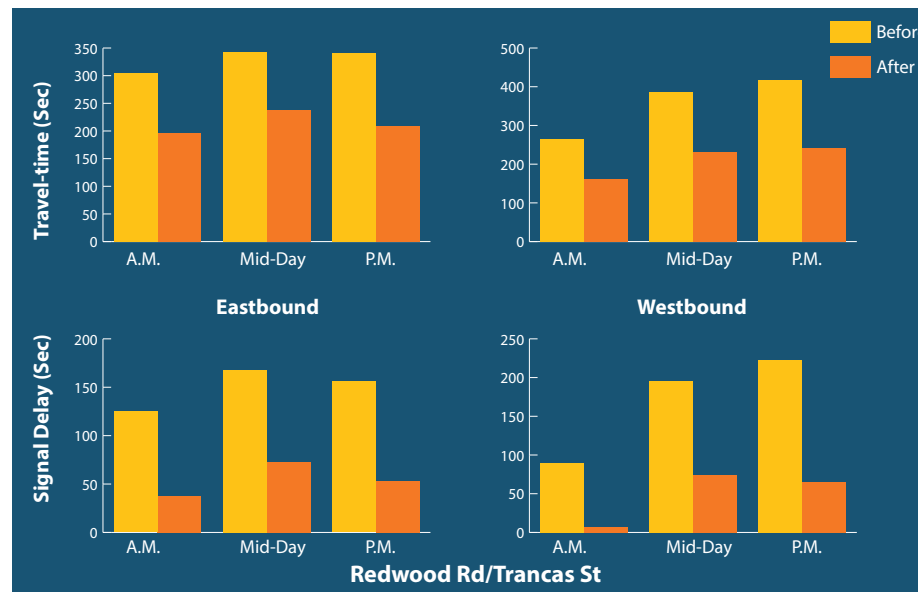
BENEFITS TO TRAFFIC SAFETY: The yellow clearance timing parameters were reviewed and updated where required based on posted speed limits and 85th Percentile speeds

where available along the study corridors at 14 project intersections and no changes were made to all red clearance-timing parameters.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$70,600
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$2,500
Agency Staff Costs (Estimate)	\$17,650
Total Costs	\$90,750

Project Benefits				
Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	93,517 hrs.	\$1,938,747	250,864 hrs.	\$5,200,799
Fuel Consumption Savings	362,143 gal.	\$1,113,890	971,468 gal.	\$2,988,073
ROG Emissions Reduction	1.26 tons	\$1,6552	3.39 tons	\$4,441
NOx Emissions Reduction	0.86 tons	\$16,190	2.32 tons	\$43,431
PM2.5 Emissions Reduction	0.05 tons	\$14,859	0.12 tons	\$39,859
CO Emissions Reduction	10.54 tons	\$8565	28.28 tons	\$2,296
Total Lifetime Benefits				\$8,278,900

Overall Project Benefits	Auto
Average Decrease in Travel Time	42%
Average Speed Increase	87%
Average Fuel Savings	33%
Average Reduction in Signal Delay	75%
Average Reduction in Number of Stops	67%
Overall Benefit-Cost Ratio	91:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 75%

Average Reduction in Number of Stops: 67%

Auto Fuel Consumption Savings: 33% or 971,468 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 34.11 tons

Auto Travel Time Savings: 42% or 250,864 hours



Overall Project Benefit-cost Ratio = 91:1



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Project Consultant:

TJKM Transportation Consultants



40th St, Harrison St, Jackson St, Macarthur Blvd - Signal Timing Project

City of Oakland | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Oakland received a Program for Arterial System Synchronization (PASS) grant from the Metropolitan Transportation Commission to conduct a signal timing study for 43 traffic signals along corridors on 40th Street, Harrison Street, Jackson Street, and Macarthur Boulevard. Project intersections are owned, operated, and maintained by the City of Oakland.

The goal of the project was to conduct timing analysis, develop, and implement signal coordination plans during the weekday AM, midday, and PM peak periods, and also one off-peak period. Additionally, weekend plans were developed for two peak periods.

The PASS project involved the completion of the following major tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct travel time surveys; review collision history; develop coordination plans for the analysis periods; implement and fine-tune the recommended timings; and conduct “before” and “after” travel time surveys to assess the performance of the new plans.



GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, 40 GPS clocks were installed as a part of the project. These GPS clocks enable the signal controllers to regularly synchronize their clocks, efficiently deploy the timing plans at the same time, and thus help maintain the efficiency of signal coordination.

BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: The minimum green intervals were reviewed for bicyclists on the corridors. Changes to the minimum green intervals were made at one intersection.



BENEFITS TO PEDESTRIANS: The pedestrian timings were reviewed based on the 2014 California MUTCD to enhance safety and changes were recommended at five project intersections.

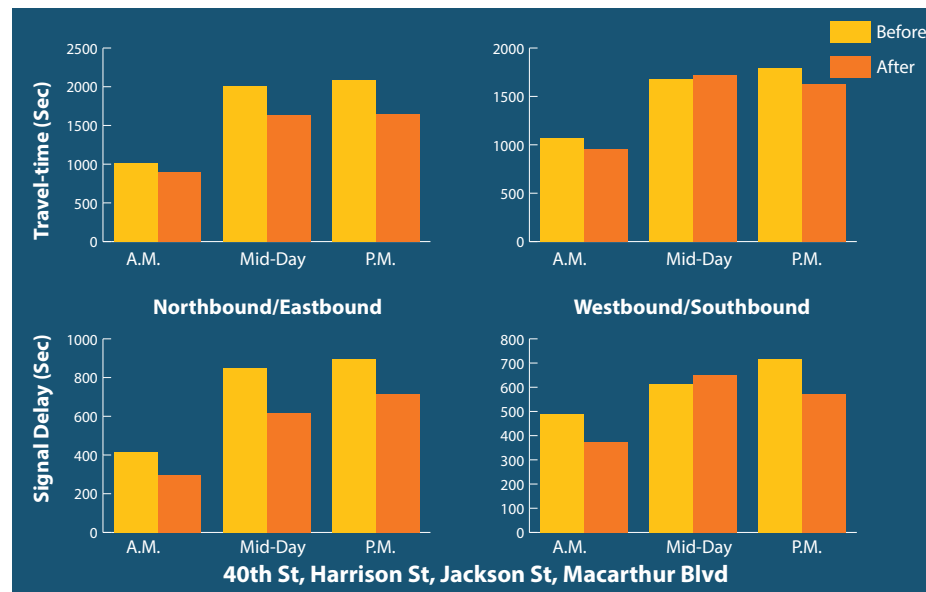


BENEFITS TO TRAFFIC SAFETY: A review of intersection-level collisions along the corridors was conducted to identify any collision patterns that may be corrected through signal timing adjustments. No specific timing changes were recommended as a result of the collision review. The yellow clearance timing parameters were updated at three project intersections to meet the 2014 California MUTCD standards.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$222,600
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$5,390
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$20,000
Agency Staff Costs (Estimate)	\$55,650
Total Costs	\$303,640

Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	33,329 hrs.	\$690,969	89,408 hrs.	\$1,853,564
Fuel Consumption Savings	95,929 gal.	\$295,060	257,334 gal.	\$791,515
ROG Emissions Reduction	0.37 tons	\$481	0.99 tons	\$1,291
NOx Emissions Reduction	0.22 tons	\$4,053	0.58 tons	\$10,873
PM2.5 Emissions Reduction	0.01 tons	\$3,851	0.03 tons	\$10,331
CO Emissions Reduction	2.61 tons	\$212	7.01 tons	\$569
Total Lifetime Benefits				\$2,668,144

Overall Project Benefits	Auto
Average Decrease in Travel Time	14%
Average Speed Increase	15%
Average Fuel Savings	9%
Average Reduction in Signal Delay	26%
Average Reduction in Number of Stops	37%
Overall Benefit-Cost Ratio	9:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 26%

Average Reduction in Number of Stops: 37%

Auto Fuel Consumption Savings: 9% or 257,334 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 8.61 tons

Auto Travel Time Savings: 14% or 89,408 hours



Overall Project Benefit-cost Ratio = 9:1



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Empire Avenue and Main Street - Signal Timing Project

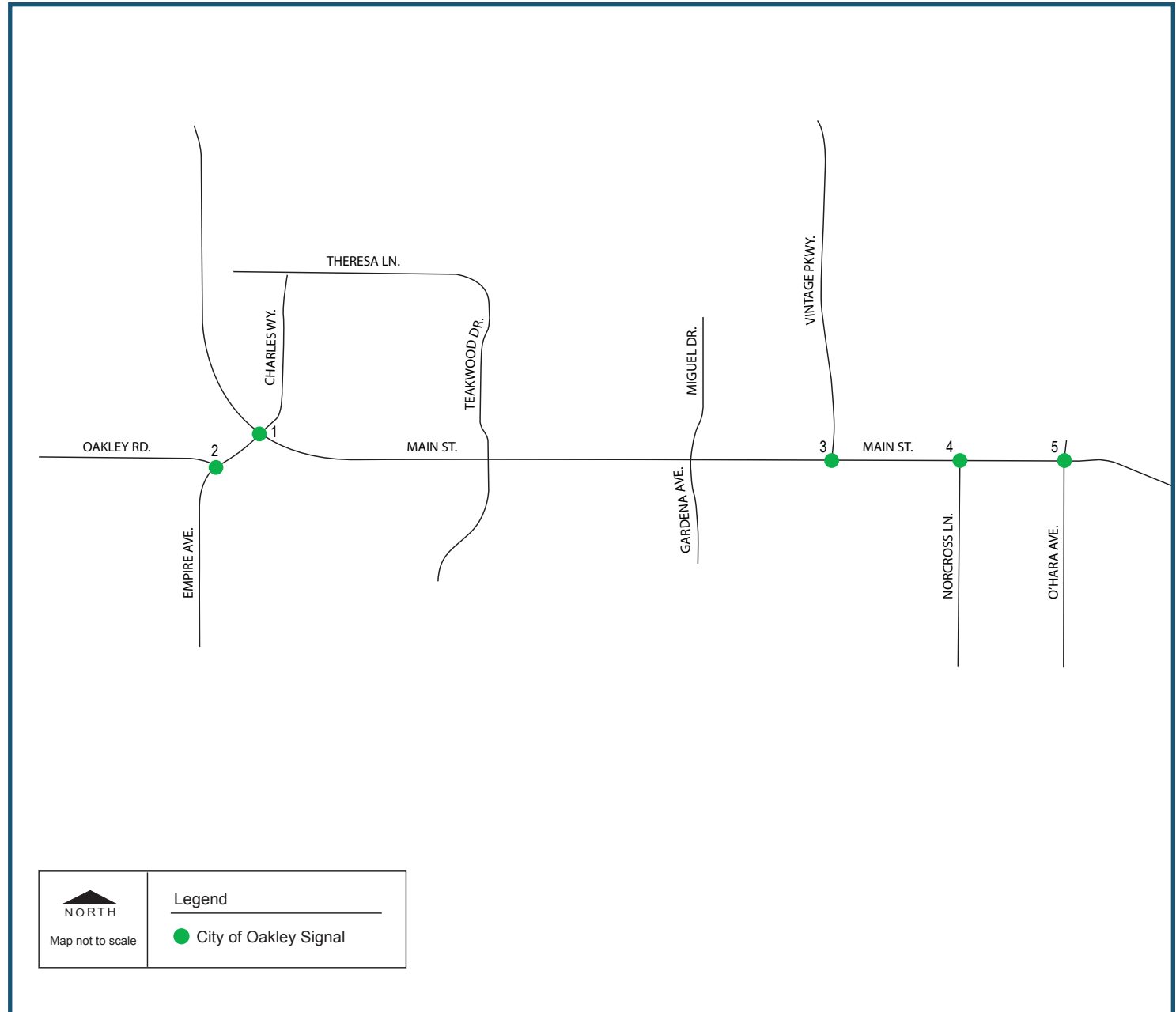
City of Oakley | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Oakley received a grant from the Metropolitan Transportation Commission's Program for Arterial System Synchronization (PASS) to conduct a signal timing study for five traffic signals along Empire Avenue and Main Street. Project intersections are owned, operated, and maintained by the City of Oakley.

The goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans during weekday AM, midday, school PM, and PM peak periods.

The PASS project involved the completion of the following tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct field review of the project area; conduct travel time surveys; review actuated settings; review collision history; develop the existing conditions model; develop coordination plans for the typical weekday AM, midday, school PM and PM peaks; implement and fine-tune the recommended timings; conduct the "before" and "after" travel time surveys; and document the analyses/findings for the project.



GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, five GPS clocks were installed as a part of the project. These GPS clocks enable the signal controllers to regularly synchronize their clocks, efficiently deploy the timing plans at the same time, and thus help maintain the efficiency of signal coordination.

BENEFITS TO VARIOUS MODES



BENEFITS TO PEDESTRIANS:

The Walk timing and Flash Don't Walk clearance-timing parameters were reviewed and updated where required

at the five intersections to provide adequate time for children and seniors to safely cross the study intersections to accommodate the new walking speed of 3.5 feet/second, as specified in the 2014 California MUTCD standards.



BENEFITS TO TRAFFIC SAFETY:

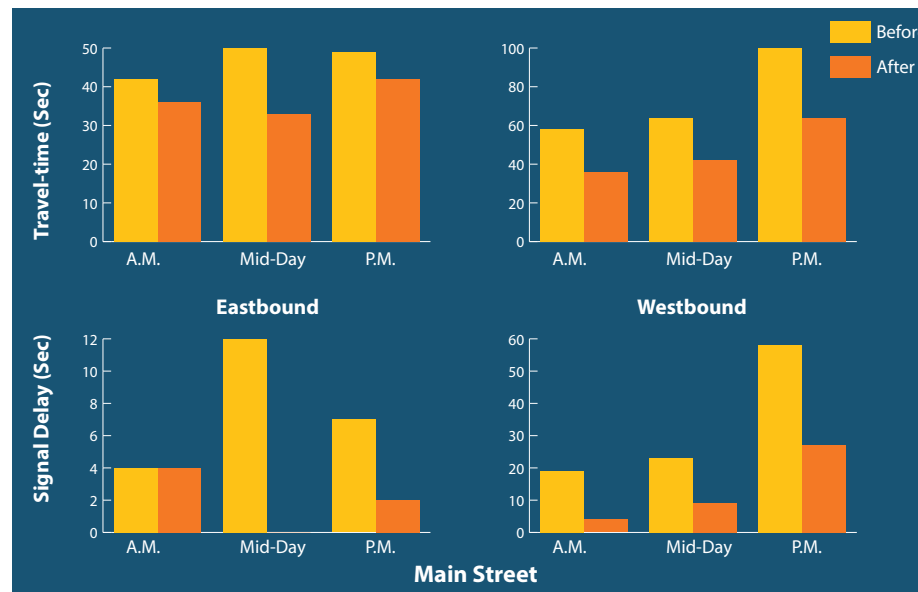
The yellow clearance timing parameters were reviewed and updated where required based on posted speed limits

along the study corridors at the five project intersections and no changes were made to all red clearance-timing parameters.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$26,500
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$2,500
Agency Staff Costs (Estimate)	\$6,625
Total Costs	\$35,625

Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	9,965 hrs.	\$200,985	26,006 hrs.	\$539,154
Fuel Consumption Savings	13,594 gal.	\$41,814	36,468 gal.	\$112,168
ROG Emissions Reduction	0.05 tons	\$62	0.13 tons	\$165
NOx Emissions Reduction	0.03 tons	\$601	0.09 tons	\$1,612
PM2.5 Emissions Reduction	0.00 tons	\$582	0.00 tons	\$1,561
CO Emissions Reduction	0.39 tons	\$32	1.05 tons	\$85
Total Lifetime Benefits				\$654,746

Overall Project Benefits	Auto
Average Decrease in Travel Time	34%
Average Speed Increase	89%
Average Fuel Savings	27%
Average Reduction in Signal Delay	67%
Average Reduction in Number of Stops	50%
Overall Benefit-Cost Ratio	18:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 67%

Average Reduction in Number of Stops: 50%

Auto Fuel Consumption Savings: 27% or 36,468 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 1.27 tons

Auto Travel Time Savings: 34% or 26,006 hours



Overall Project Benefit-cost Ratio = 18:1



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Project Consultant:

TJKM Transportation Consultants



San Leandro Boulevard - Signal Timing Project

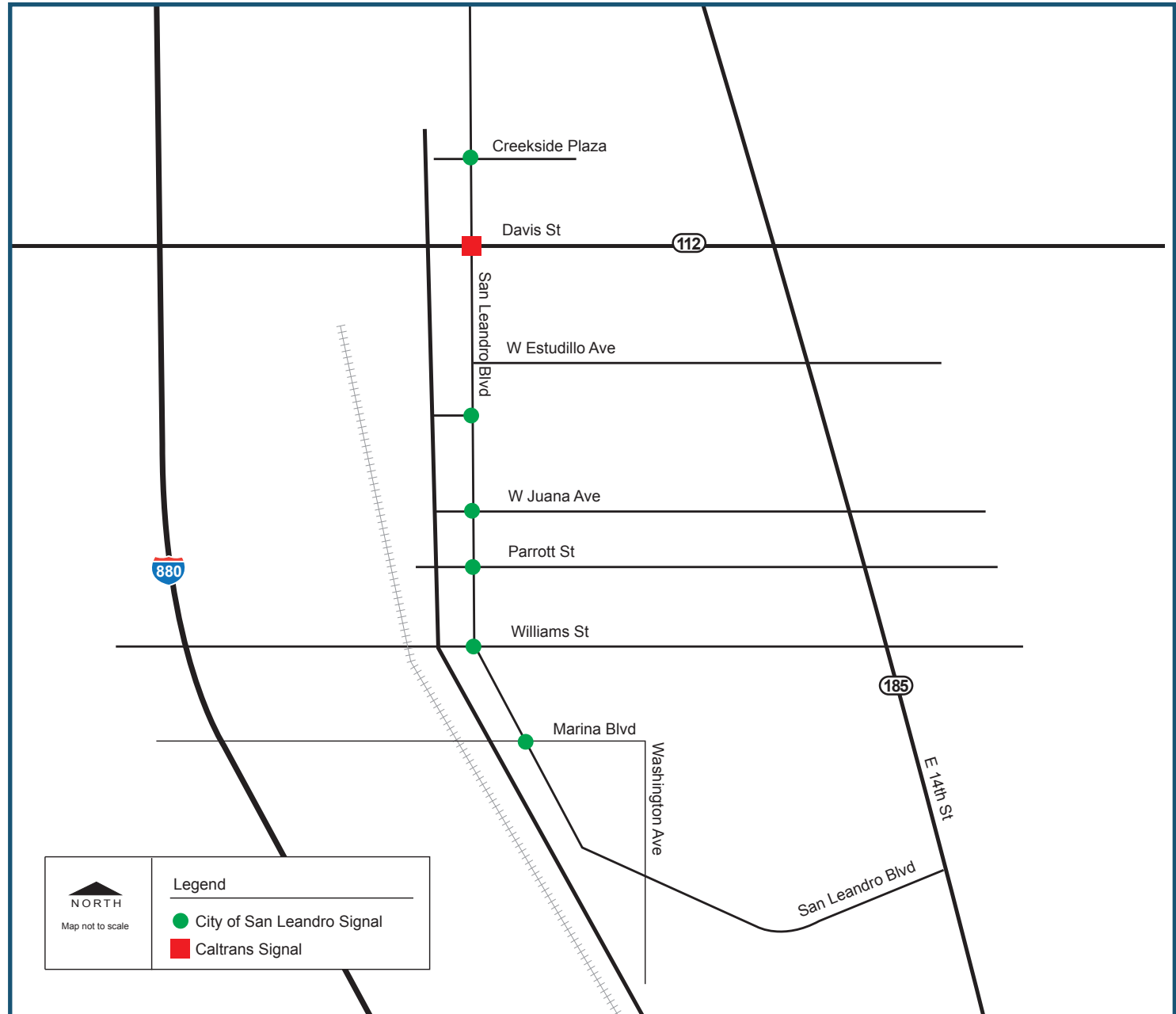
City of San Leandro | Caltrans | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of San Leandro, in conjunction with Caltrans, received a Program for Arterial System Synchronization (PASS) grant from the Metropolitan Transportation Commission to conduct a signal timing study for seven traffic signals along the San Leandro Boulevard corridor. With the exception of one traffic signal, all signals are owned, operated, and maintained by the City of San Leandro.

The overall goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans during the weekday AM, midday, and PM peak periods, along with three weekend peak periods.

The PASS project involved the completion of the following major tasks: collect traffic volumes and turning movement counts at all project intersections; analyze traffic data to develop optimized timing plans, implement and fine-tune the recommended timing plans in the field; conduct travel time surveys to analyze the performance measures of the new timing plans; and document the analyses/findings for the project.



GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, one GPS clock was installed as a part of the project. The GPS clock enables the signal controller to regularly synchronize its clock with the rest of the project intersections.

BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: The minimum green time was reviewed for all project intersections to enhance safety for bicyclists along San Leandro Boulevard. The minimum green time was increased for the through movements at four study intersections.



BENEFITS TO PEDESTRIANS: The Walk time and Flashing Don't Walk clearance timing parameters were reviewed at all project intersections and updated at three intersections to provide adequate time to safely cross the study intersections, with additional focus for the area within the nearby BART station.

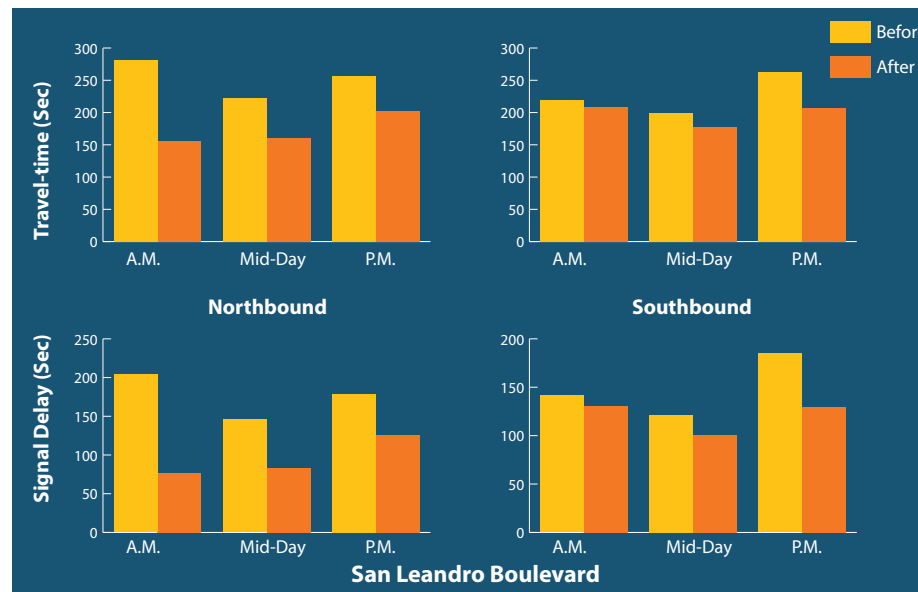


BENEFITS TO TRAFFIC SAFETY: To enhance traffic safety, the yellow clearance timing parameters were updated based on the latest 2014 California MUTCD standards using the 85th Percentile vehicular speeds along San Leandro Boulevard. Furthermore, an additional intersection analysis was done at one intersection to enhance vehicular and pedestrian safety and to provide a more efficient traffic signal operations.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$36,400
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$500
Agency Staff Costs (Estimate)	\$9,100
Total Costs	\$46,000

Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	24,812 hrs.	\$514,393	66,560 hrs.	\$1,379,887
Fuel Consumption Savings	63,260 gal.	\$194,576	169,698 gal.	\$521,962
ROG Emissions Reduction	0.23 tons	\$303	0.62 tons	\$813
NOx Emissions Reduction	0.15 tons	\$2,823	0.40 tons	\$7,572
PM2.5 Emissions Reduction	0.01 tons	\$2,630	0.02 tons	\$7,055
CO Emissions Reduction	1.75 tons	\$142	4.71 tons	\$382
Total Lifetime Benefits	\$1,917,672			

Overall Project Benefits	Auto
Average Decrease in Travel Time	23%
Average Speed Increase	29%
Average Fuel Savings	15%
Average Reduction in Signal Delay	56%
Average Reduction in Number of Stops	47%
Overall Benefit-Cost Ratio	42:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 56%

Average Reduction in Number of Stops: 47%

Auto Fuel Consumption Savings: 15% or 169,698 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 5.75 tons

Auto Travel Time Savings: 23% or 66,560 hours



Overall Project Benefit-cost Ratio = 42:1



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Iteris, Inc.



Gateway Blvd and Hickey Blvd - Signal Timing Project

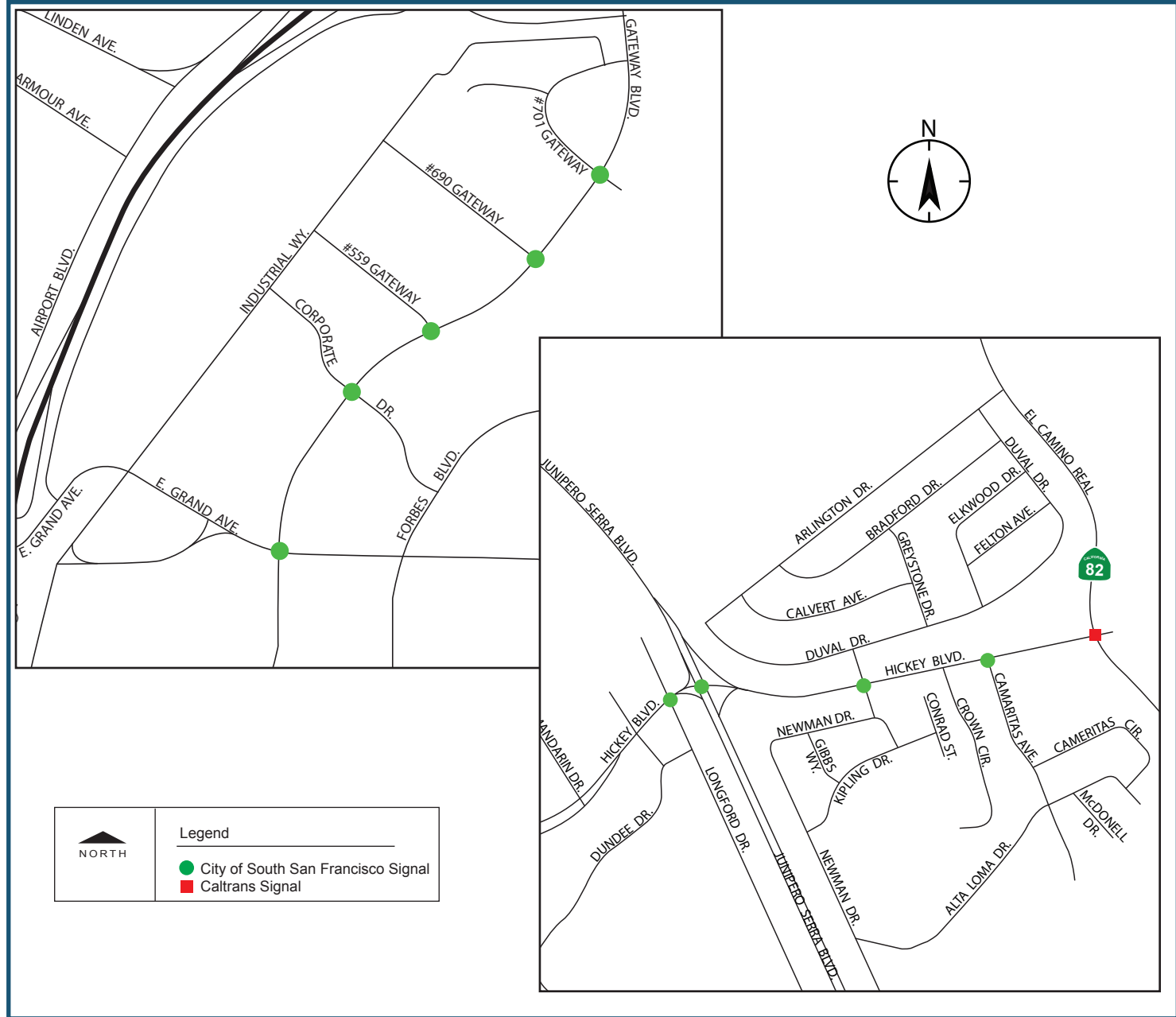
City of South San Francisco | Caltrans | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of South San Francisco (SSF) received a grant from the Metropolitan Transportation Commission's Program for Arterial System Synchronization (PASS) to conduct a signal timing study for 10 traffic signals along Gateway Boulevard and Hickey Boulevard. Project intersections are owned, operated, and maintained by either SSF or Caltrans.

The goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans. Timing plans were developed for a typical weekday AM, midday, school PM, PM and weekend peak periods along Hickey Boulevard and weekday AM, midday, PM and weekend peak periods along Gateway Boulevard.

The PASS project involved the following tasks: collect turning movement counts, including vehicles, pedestrians, and bicycles; conduct "before" and "after" travel time surveys; develop coordination plans for all scenarios; implement and fine-tune the recommended timings; and document the analyses/findings for the project. The field fine-tuning was conducted during typical weekday and weekend peak periods and minor adjustments were made to the offsets and splits based on observed traffic conditions.



PROJECT OVERVIEW (CONTINUED)

GPS SIGNAL COMMUNICATIONS

To provide a common time-source and enable communication between the signals, eight GPS clocks were installed as a part of the project. These GPS clocks enable the signal controllers to regularly synchronize their clocks, efficiently deploy the timing plans at the same time, and thus help maintain the efficiency of signal coordination.

BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: For improved safety, the minimum green intervals were reviewed for bicyclists on the corridor. Changes to minimum green intervals were made where required at the five study intersections along Gateway Boulevard.



BENEFITS TO PEDESTRIANS: The Walk timing and Flash Don't Walk clearance-timing parameters were reviewed and updated where required at the 10 intersections to provide adequate time for children and seniors to safely cross the study intersections to accommodate the new walking speed of 3.5 feet/second, as specified in 2014 California MUTCD standards.

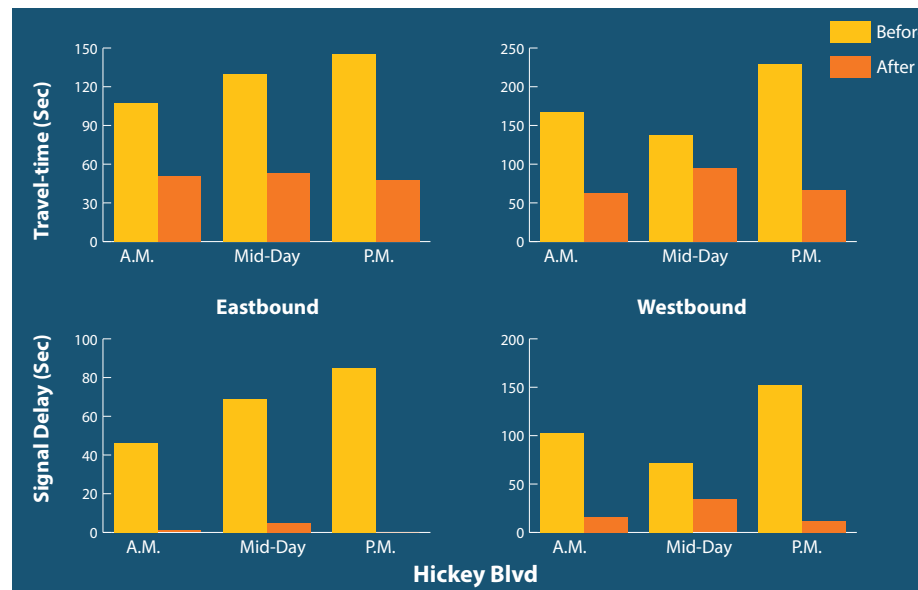


BENEFITS TO TRAFFIC SAFETY: The yellow clearance timing parameters were reviewed and updated where required based on posted speed limits along the study corridors at the 10 project intersections and no changes were made to all red clearance-timing parameters.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$62,000
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$4,000
Agency Staff Costs (Estimate)	\$15,500
Total Costs	\$81,500

Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	61,617 hrs.	\$1,277,405	165,290 hrs.	\$3,426,711
Fuel Consumption Savings	111,635 gal.	\$343,369	299,466 gal.	\$921,107
ROG Emissions Reduction	0.39 tons	\$517	1.06 tons	\$1,387
NOx Emissions Reduction	0.26 tons	\$4,921	0.70 tons	\$13,200
PM2.5 Emissions Reduction	0.01 tons	\$4,797	0.04 tons	\$12,868
CO Emissions Reduction	3.26 tons	\$265	8.74 tons	\$710
Total Lifetime Benefits				\$4,375,983

Overall Project Benefits	Auto
Average Decrease in Travel Time	56%
Average Speed Increase	118%
Average Fuel Savings	43%
Average Reduction in Signal Delay	84%
Average Reduction in Number of Stops	60%
Overall Benefit-Cost Ratio	54:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 84%

Average Reduction in Number of Stops: 60%

Auto Fuel Consumption Savings: 43% or 299,466 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 10.54 tons

Auto Travel Time Savings: 56% or 165,290 hours



Overall Project Benefit-cost Ratio = 54:1



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City of Sunnyvale Signal Timing Project

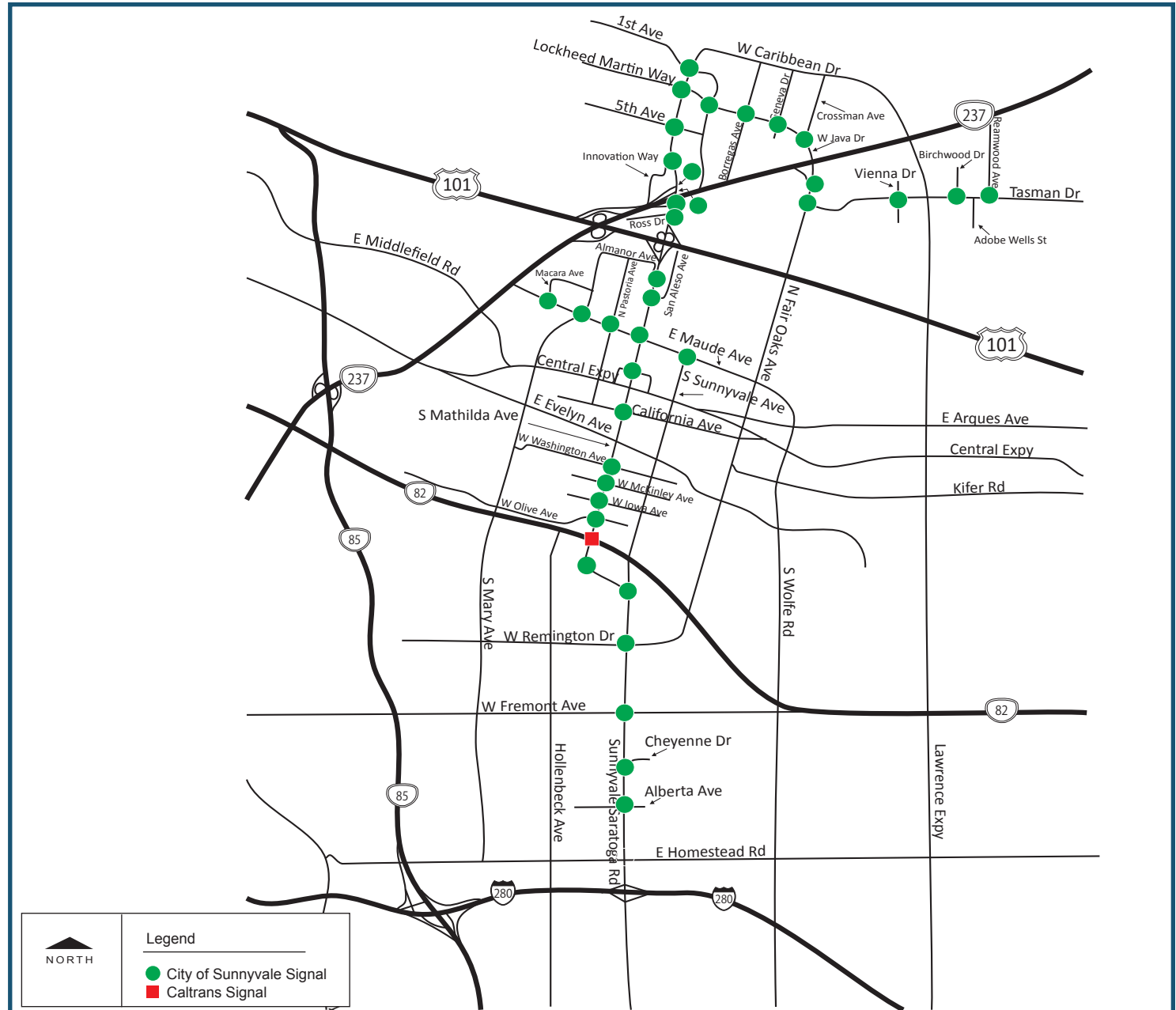
City of Sunnyvale | Caltrans | Metropolitan Transportation Commission

PROJECT OVERVIEW

The City of Sunnyvale received a grant from the Metropolitan Transportation Commission's Program for Arterial System Synchronization (PASS) to conduct a signal timing study for a total of 37 traffic signals along Mathilda Avenue/Sunnyvale-Saratoga Road, Tasman and Java Drives, and Maude Avenue. Two of the project intersections are owned by Caltrans, but all intersections are operated and maintained by the City of Sunnyvale.

The goal of the project was to conduct a timing analysis, develop, and implement signal coordination plans for typical weekday a.m., midday, and p.m. peak periods along Mathilda Avenue/Sunnyvale-Saratoga Road and weekday a.m., midday, p.m. and weekend peak periods along all other corridors.

The PASS project involved the completion of the following tasks: collect turning movement counts, including vehicular, pedestrian, and bicycle counts; conduct field review of the project area; conduct "before" and "after" travel time surveys; review actuated settings; review collision history; develop the existing conditions model; develop coordination plans for typical weekday and weekend peak periods; implement and fine-tune recommended timings; conduct the "before" and "after" travel time surveys; and document



PROJECT OVERVIEW (CONTINUED)

the analyses/findings for the project. The field fine-tuning was conducted during typical weekday and weekend peak periods and minor adjustments were made to the offsets and splits based on observed traffic conditions.

BENEFITS TO VARIOUS MODES



BENEFITS TO BICYCLISTS: For improved safety, the minimum green intervals were reviewed for bicyclist safety. Changes to minimum green intervals were made where required at study intersections along all project corridors.



BENEFITS TO PEDESTRIANS: The Walk timing and Flash Don't Walk clearance-timing parameters were reviewed and updated at all 37 study intersections to provide adequate time for children and seniors to safely cross the study intersections to accommodate the new walking speed of 3.5 feet/second, as specified in 2014 California MUTCD standards.



BENEFITS TO TRAFFIC SAFETY: The yellow clearance timing parameters were revised for 32 intersections. The revisions were based on posted speed limits in accordance with the California MUTCD 2014. The all red time parameters were revised for all 37 study intersections based on the Institute of Transportation Engineers (ITE) recommendations.

Project Costs	
Consultant Costs (Basic Services/Plans)	\$136,100
Consultant Costs (Additional Plans, TSP, IM Flush Plans, etc.)	\$0
Other Project Costs (GPS Clocks, Communications equipment, etc.)	\$0
Agency Staff Costs (Estimate)	\$34,025
Total Costs	\$170,125

Project Benefits				
Measures	First Year		Lifetime (5 Years)	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings	89,225 hrs.	\$1,849,760	239,350 hrs.	\$4,962,086
Fuel Consumption Savings	349,522 gal.	\$1,075,072	937,613 gal.	\$2,883,942
ROG Emissions Reduction	1.15 tons	\$1,509	3.09 tons	\$4,048
NOx Emissions Reduction	0.88 tons	\$16,554	2.37 tons	\$44,408
PM2.5 Emissions Reduction	0.04 tons	\$14,151	0.12 tons	\$37,960
CO Emissions Reduction	10.92 tons	\$886	29.28 tons	\$2,377
	Total Lifetime Benefits			\$7,934,821

Overall Project Benefits	Auto
Average Decrease in Travel Time	11%
Average Speed Increase	16%
Average Fuel Savings	9%
Average Reduction in Signal Delay	31%
Average Reduction in Number of Stops	18%
Overall Benefit-Cost Ratio	47:1



PROJECT BENEFITS SUMMARY



Average Reduction in Auto Signal Delay: 31%

Average Reduction in Number of Stops: 18%

Auto Fuel Consumption Savings: 9% or 937,613 gallons



Total Emissions Reduced (ROG, NOx, PM2.5, CO): 34.86 tons

Auto Travel Time Savings: 11% or 239,350 hours



Overall Project Benefit-cost Ratio = 47:1



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DKS Associates



Project Sponsors:

CALTRANS

CITY OF FREMONT

CITY OF HAYWARD

CITY OF NAPA

CITY OF OAKLAND

CITY OF OAKLEY

CITY OF SAN LEANDRO

CITY OF SOUTH SAN FRANCISCO

CITY OF SUNNYVALE

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