

Automated Red Light Enforcement (ARLE)
At
East 14th Street-Davis Street
&
East 14th Street-Fairmont Avenue

FINAL REPORT

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APPENDIX A – Signal Timing Sheets

**AUTOMATED RED LIGHT ENFORCEMENT
AT
EAST 14TH ST-DAVIS ST and EAST 14TH ST-FAIRMONT AVE
CITY OF SAN LEANDRO**

I. Introduction

The City of San Leandro has maintained an Automated Red Light Enforcement (ARLE) System at four intersections since 2005. Based on a relative new policy (starting in 2015), the City has had to file an annual encroachment permit application to Caltrans to allow the City to continue to maintain and operate the ARLE System at two Caltrans controlled intersections on East 14th Street (State Route-185).

Willdan Engineering has evaluated the ARLE system at two Caltrans intersections (East 14th St / Davis Street-Callan Avenue and East 14th Street / Fairmont Avenue). This report provides a summary of the evaluation, which was done in accordance to Caltrans Traffic Operations Policy Directive 14-01 Revision 1 dated 8/5/15 and titled "Installation of Automated Red Light Enforcement Systems by Local Government Agencies on the State Highway System". The Directive outlines the following tasks (to be completed by 8/1/16):

1. Check Original Signal Warrant
2. Check Signal Timing in General
3. Determination of Yellow Change Interval
4. Analysis of Collision Data to Identify Expected Reduction of Collisions
5. Comparison of Collision Data from Similar Intersections (with and without ARLE)
6. Contact Parties Familiar with the Intersections
7. Field Review both Intersections to Observe Site Conditions and Observe Drivers to Determine their Behavior Patterns
8. Evaluation of Previous Countermeasures
9. Identification and Evaluation of Possible Countermeasures
10. Evaluation of Citations being Issued at the Intersections
11. Document Safety Performance based upon a Systematic Comparison

II. Original Signal Warrant

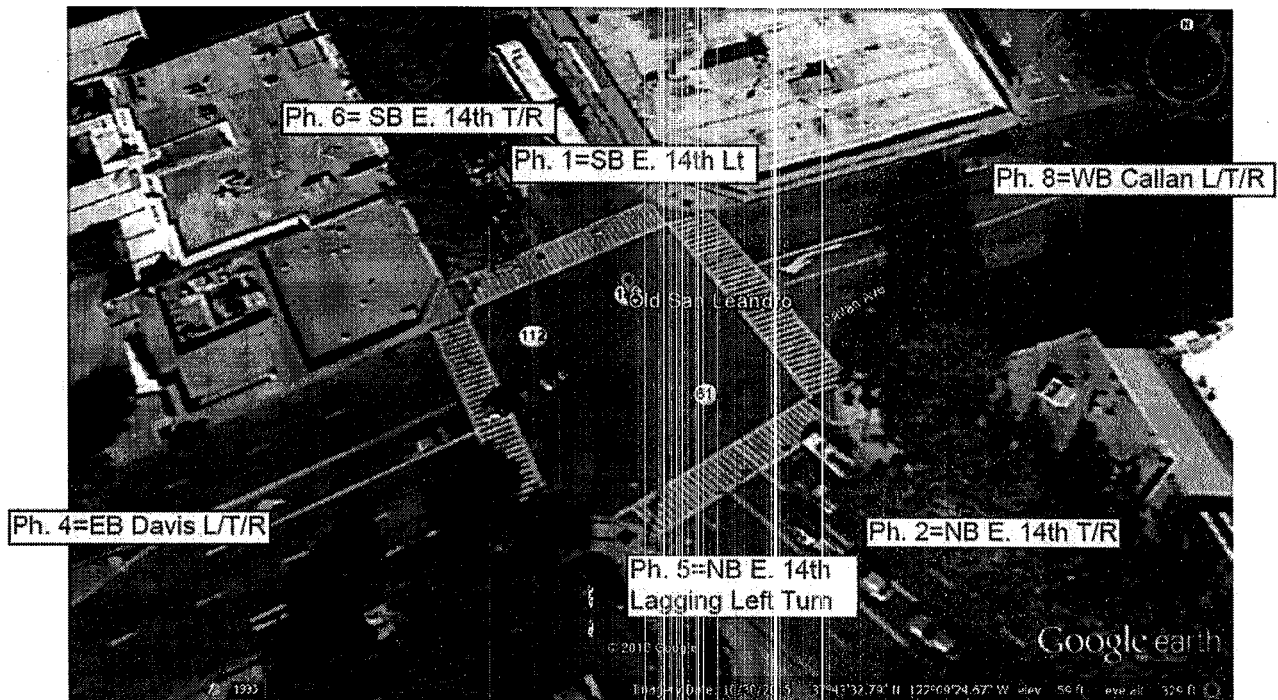
As of 7/25/16, Caltrans has not provided the original signal warrants for either intersection.

III. General Signal Timing

In an email dated 5/20/16, Caltrans provided the current timing sheets for the two intersections (see Appendix A). The following is a brief summary of the general signal timing information.

East 14th Street and Davis Street/Callan Avenue

This fully actuated intersection has five signal phases as shown below.



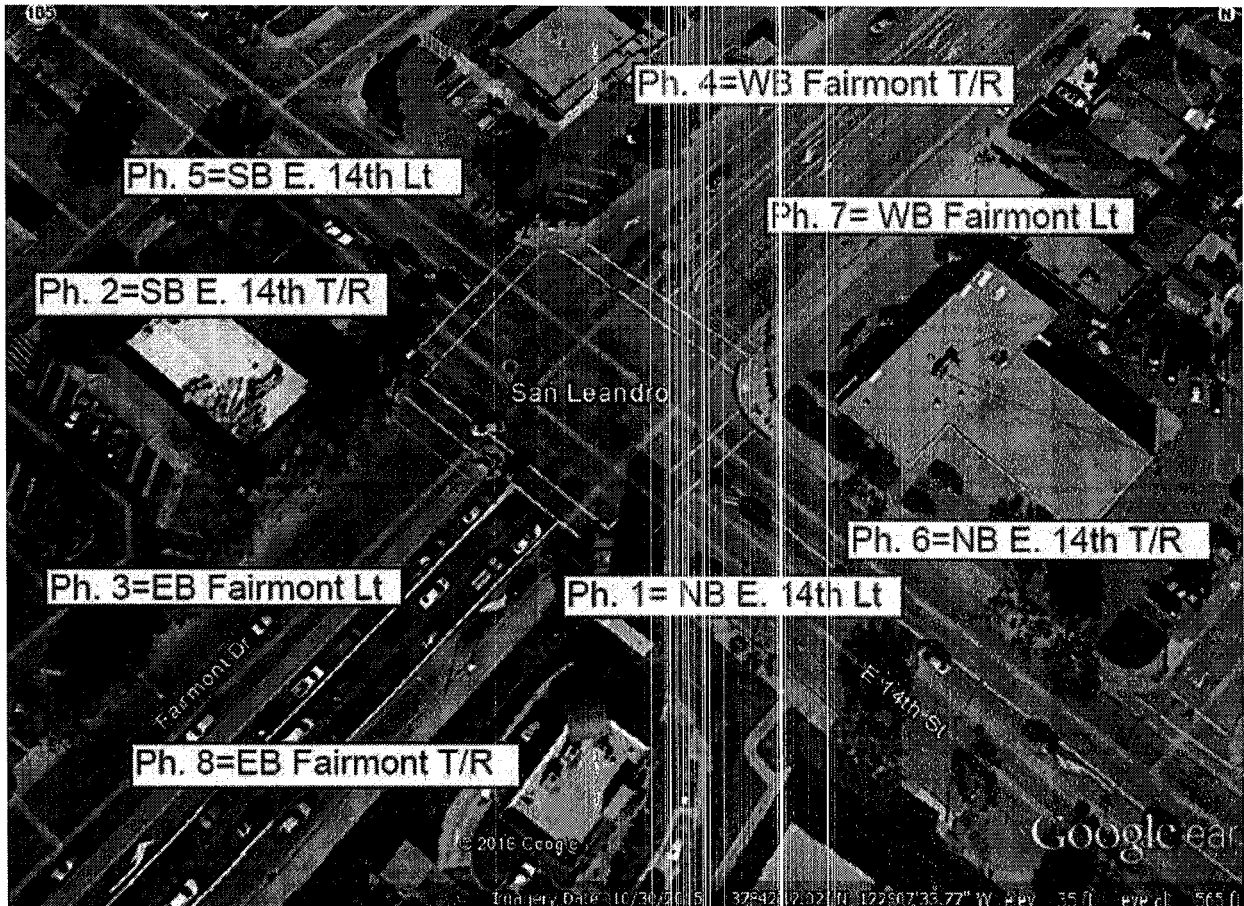
The master controller for this intersection is located at East 14th Street and 136th Avenue. On weekdays, the cycle length is as follows:

- 90 seconds from 7:00 a.m. to 11:00 a.m.
- 85 seconds from 11:00 a.m. to 6:30 p.m.

The "Walk" time at each corner is 7 seconds. The last timing change was on 5/14/15, when "Updated Yellow Time Compliance" was performed

East 14th Street and Fairmont Avenue

This fully actuated intersection has eight signal phases as shown below.



The master and slave controllers for this intersection are in the same cabinet that is located on the northeast corner. The cycle length is as follows:

- 85 seconds from 6:30 a.m. to 9:00 a.m. on weekdays
- 95 seconds from 9:00 a.m. to 7 p.m. on weekdays and weekends.

The “Walk” time at each corner is 5 seconds long. The last timing change was on 8/19/15, when “Updated Yellow Time Compliance” was performed.

IV. Yellow Change Interval

The following table summarizes the yellow time for each of the phases.

Intersection	Yellow Time in Seconds for Each Signal Phase							
	Ph. 1	Ph. 2	Ph. 3	Ph. 4	Ph. 5	Ph. 6	Ph. 7	Ph. 8
East 14 th -Davis	3.7	4.1	--	3.7	3.7	4.1	--	3.7
East 14 th -Fairmont	3.7	4.1	3.7	4.1	3.7	4.1	3.7	4.1

Each of the protected left turn movements (i.e., Phases 1, 3, 5 and 7) and the EB Davis (Phase 4)-WB Callan (Phase 8) through movements have a yellow change interval of 3.7 seconds. The 2014 Manual on Uniform Traffic Control Devices (MUTCD) on page 932 states that the minimum yellow interval should be 3.7 seconds for a "Posted Speed or Unposted Prima Facie Speed" of 30 mph. This 3.7 seconds of yellow is appropriate for the through movements as there is a 30 mph speed limit sign posted on eastbound Davis Street east of Clarke Street and on westbound Davis Street west of East 14th Street.

The following movements have a yellow time of 4.1 seconds:

- Northbound East 14th Through at Davis-Callan (Phase 2)
- Southbound East 14th Through at Davis-Callan (Phase 6)
- Southbound East 14th Through at Fairmont (Phase 2)
- Westbound Fairmont Through at East 14th (Phase 4)
- Northbound East 14th Through at Fairmont (Phase 6)
- Eastbound Fairmont Through at East 14th (Phase 8).

The MUTCD states that 4.1-second yellow is the minimum time for a posted speed limit of 35 mph. This 4.1 seconds of yellow is appropriate since there is a 30 mph speed limit sign posted on northbound East 14th north of Chumalia Street, as well as a 35 mph sign posted on northbound East 14th (north of Hesperian Boulevard-Bancroft Avenue) and on eastbound Fairmont (just east of East 14th).

V. Expected Reduction in Collisions

The ARLE cameras (installed 5/11/06 at East 14th and Davis-Callan) are positioned to catch violators who enter the intersection during the red light for the northbound East 14th through movement at Davis-Callan (see Photo 1).

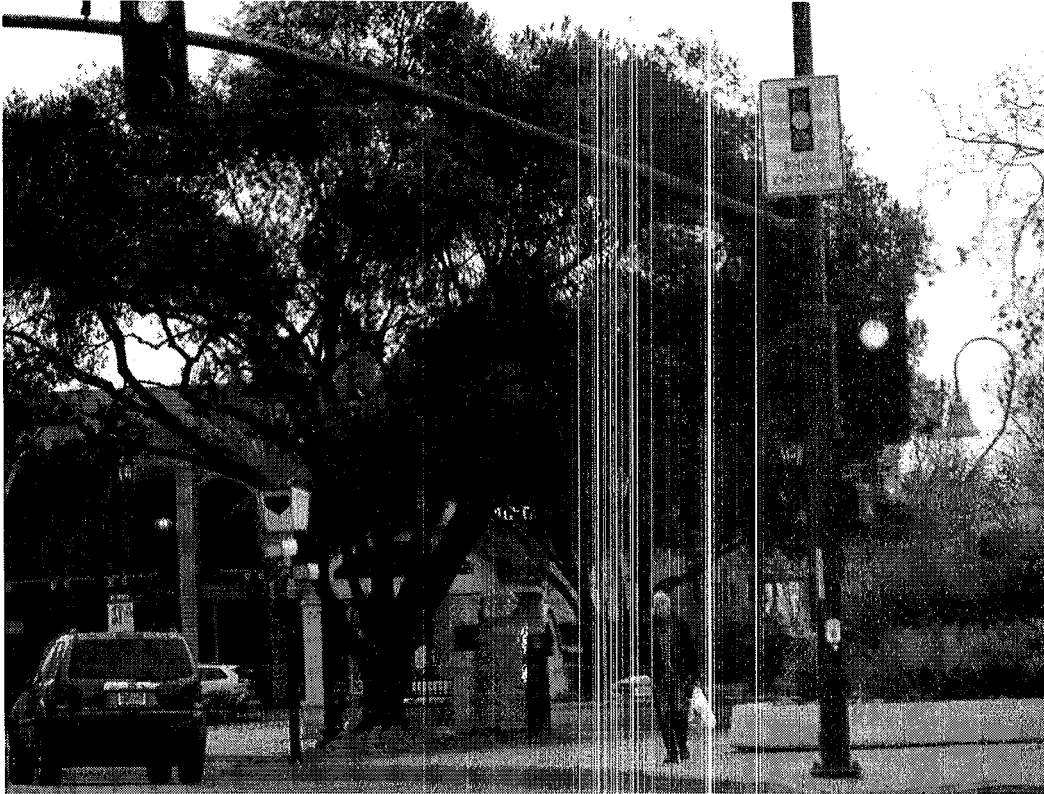


Photo 1: Camera on East 14th south of Davis pointed at the back of NB vehicles.

Collision diagrams for a nine-year period (1/1/96-12/31/04) before the ARLE was installed and for a 9.5 year period (5/11/06-12/31/15) were reviewed. Since the Police Department quit documenting Property Damage Only (PDO) collisions starting roughly in 2006, the multi-page City of San Leandro Traffic Collision reports were requested for only injury collisions (involving northbound vehicles). More specifically, the collision that occurred on the following dates were evaluated:

- 7/25/00
- 4/14/02
- 8/19/03
- 5/31/09.

After a close review of these reports, it appears that the ARLE would not have prevented the first three collisions (that occurred prior to 2004). As for the 5/31/09 collision, the northbound left turning motorcyclist who hit the pedestrian entered the intersection during the green arrow.

The ARLE at East 14th and Fairmont was installed on 5/11/06 with the intent of catching violators on the eastbound Fairmont approach (see Photo 2).



Photo 2: Cameras on the south side of Fairmont at East 14th.

Using the same process described above resulted in the evaluation of injury collisions involving eastbound Fairmont vehicles that occurred on the following dates:

- 4/12/02
- 5/30/02
- 7/14/02
- 1/30/04
- 7/15/06
- 12/20/06
- 3/30/12
- 12/22/13.

The evaluation reveals that an ARLE would not have prevented any of the four collisions that occurred prior to 2005. Although the ARLE was in place by 2006, it had no bearing on the most recent four collisions. After reviewing over 13 years of collision data for the two intersections, our findings are inconclusive with regards to an ARLE reducing collisions.

VI. Comparison with Similar Intersections

ARLE Intersections

The injury plus fatality collision rate at four ARLE intersections were calculated for a nine year period (1/1/96-12/31/04) pre-ARLE and for a nine year period (1/1/07-12/31/15) post-ARLE. The results summarized in the below table indicate that on average that the collision rate was reduced by 47 percent ($=0.08/0.17$) after the installation of the ARLE.

Collision Diagram Orientation		Volume (ADT)	Pre ARLE Injury+Fatal Rate	After ARLE Injury+Fatal Rate	After - Pre Injury+Fatal Rate
Horizontal	Vertical				
Davis	East 14th	26,100	0.22	0.10	-0.12
Fairmont	East 14th	40,527	0.15	0.05	-0.10
Floresta/Halcyon	Washington	32,970	0.18	0.14	-0.04
Marina	Teagarden	29,700	0.16	0.06	-0.10
Totals for 4 ARLE Intersections		129,297	0.17	0.09	-0.08

Non-ARLE Intersections

The injury plus fatality collision rate at six signalized intersections without ARLE were calculated for the same nine year periods (1/1/96-12/31/04 and 1/1/07-12/31/15). The results summarized in the below table indicate that on average that the collision rate was reduced by 68 percent ($=0.21/0.31$) during the most recent nine year period.

Collision Diagram Orientation		Volume (ADT)	Pre 2005 Injury+Fatal Rate	Post 2006 Injury+Fatal Rate	Post 06-Pre '05 Injury+Fatal Rate
Horizontal	Vertical				
Estudillo	Bancroft	23,440	0.22	0.08	-0.14
Davis	Doolittle	40,741	0.07	0.09	0.02
Davis	San Leandro	45,200	0.12	0.11	-0.01
Halcyon-Fairmont	Hesperian	35,840	0.14	0.08	-0.06
Marina	Alvarado	25,990	0.08	0.08	0.00
Marina	Merced	39,110	0.16	0.16	0.00
San Leandro	Washington	24,250	0.24	0.10	-0.14
Fargo	Washington	30,560	0.19	0.10	-0.09
Totals for 8 Intersections w/o ARLE		265,131	0.31	0.10	-0.21

VII. Stakeholders Meetings

On May 25, 2016, the Consultant met with the San Leandro Police Officer in charge of issuing the citations generated by ARLE. Soon after the meeting, the Officer provided the citation data used for the analysis provided below in Section X.

The Consultant, San Leandro Traffic Engineering staff, and Caltrans Signal Engineering and Maintenance staff met at Caltrans District 4 on Monday, June 6, 2016. The Meeting Agenda and simplified responses and/or findings from Caltrans staff were as follows:

1. Self-Introductions
2. Purpose of the Meeting
3. Questions for Caltrans Staff:
 - a. Has Caltrans had any maintenance or operational issues with the ARLE system at the two intersections? (Response: No)
 - b. Has Caltrans ever had to deal directly with Redflex regarding the two intersections? (Response: No)
 - c. Has the ARLE system been installed elsewhere within District 4? (Response: No)
 - d. What improvements would Caltrans like regarding the ARLE system? (Response: None)
 - e. Would Caltrans like ARLE to be installed elsewhere in San Leandro? (Response: Neutral)
 - f. What has Caltrans implemented in District 4 to reduce red light violations? (Response: Proper yellow times)
 - g. Is there anything else you would like us to know regarding the two intersections or ARLE in general? (Response: No)
4. Close the Meeting

VIII. Field Review

Half an hour of field observations were conducted at each of the two intersections during the p.m. peak period on Tuesday, May 3, 2016. Special attention was given to the two approaches (i.e., NB East 14th at Davis and EB Fairmont at East 14th) with ARLE to determine if the following signal timing parameters were set properly:

- Green interval (e.g., was there any cycle failure)
- Yellow interval (e.g., is it long enough)
- Pedestrian timing (i.e., activation and duration of Walk & Flashing Don't Walk)
- Volume density timing (e.g., were the phases gapping out appropriately)
- Cycle length (e.g., was it consistent to allow for coordination)
- Activation of ARLE (none was observed).

In general, both intersections appeared to be timed properly and no unusual driving behavior was observed. However, on two separate occasions, a driver attempting a left turn from northbound East 14th at Davis-Callan was observed entering the intersection during the red. Increasing the green time for this movement may help the situation.

IIX. Previous Countermeasures

As of 7/25/16, Caltrans has not provided information regarding previous countermeasures.

IX. Possible Countermeasures

After completing the above tasks, a countermeasure has not been identified that would substantially reduce collisions involving red light violators.

X. Evaluation of Citations

Over roughly a 10 year period (i.e., May 2006-April 2016), a total of 4,190 ARLE citations were issued with the following breakdown:

- NB East 14th approach at Davis-Callan had 882 citations (an average of 7/month)
- EB Fairmont approach at East 14th had 3,308 citations (an average of 28/month).

So four times as many ARLE citations are being issued at East 14th-Fairmont as at East 14th-Davis.

At each intersection, the ARLE captured violators in three approach lanes. The following table summarizes the distribution of citations by approach lane:

Movement and Lane	Percent (Number) of Citations
NB East 14th Left at Davis-Callan	15% (628)
NB East 14th Through at Davis-Callan	4% (158)
NB East 14th Thru or Rt. at Davis (curb lane)	2% (96)
EB Fairmont (#1) Through Lane at East 14th	4% (184)
EB Fairmont (#2) Through at East 14th	7% (302)
EB Fairmont Right at East 14th	67% (2,822)

The eastbound Fairmont right-turn movement (in a dedicated right turn only lane) accounted for approximately two-thirds of all the ARLE citations issued for the two intersections. In general, drivers often feel safe completing a right turn without coming to a complete stop because right turns are usually permitted on red.

XI. Safety Comparison

The best way to compare the traffic safety of similar intersections is to calculate the respective collision rate. Since the San Leandro Police quit documenting PDO collisions, the collision rates calculation was based on Injury + Fatality collisions.

For whatever reason, it appears that the injury plus fatality collision rate at signalized intersections (with or without ARLE) has decreased dramatically over the most recent nine year period (when compared to the previous nine year period). ARLE cannot take credit for this reduction, because the collision rate decreased more at signalized intersections without ARLE.

XII. Conclusions

Eighteen years of collision data and a decade worth of citations were reviewed for this Study. The findings include the following:

- Collision rate at the four ARLE intersections and the eight non-ARLE intersections are decreasing.
- Two-thirds of the ARLE citations being issued at the two intersections is for the eastbound Fairmont right turn movement at East 14th.
- 62 percent (=782/1,272) of the ARLE citations for the left-turn or through movement at the two intersections were issued for NB East 14th at Davis-Callan.
- ARLE citations are being issued at a rate of roughly 32 per month.

After completing the aforementioned evaluation, it is concluded that the presence of the ARLE cameras (working or not) may be a deterrent to drivers who would spontaneously enter the intersection on red. If the City add one more intersection to continue operation of the ARLE (from a cost-effectiveness point of view), that choice should be East 14th-Fairmont (because it would generate four times as many citations as East 14th-Davis).

Appendix A
Signal Timing Sheets