

Smile, Red-Light Runners . . . You're on Automated Camera

Randy Jay Harrington

The Insurance Institute for Highway Safety estimates that more than 800 deaths occur annually as a result of red-light running (RLR).¹ Further, the Insurance Institute reports that the number of fatal crashes at intersections with traffic signals (signalized intersections) increased by 24 percent from 1992 to 1997. A 1990–91 study of urban police reports indicated that 22 percent of all urban crashes resulted from the drivers' running traffic controls. Of these, 24 percent involved their running red lights.²

With police resources declining in relation to the number of vehicles on the road, local officials around the country have begun exploring the use of cameras to detect traffic signal violators.³ In 1993, New York City became the first U.S. jurisdiction to place cameras at selected intersections in order to reduce RLR. Now, close to fifty cities in ten states operate 250 cameras in programs enforcing the requirement that drivers stop at red lights (red-light photo enforcement programs, for short). Camera suppliers predict that the number of operating cameras will double annually.⁴

Arizona and California are the only states that regard the camera-caught red-light violation as a criminal moving violation, subject to fines and license and insurance points. For points to be assessed, which could lead to revocation of a person's license and higher insurance rates, cities in Arizona and California must clearly identify the driver. Therefore they must produce a frontal photo of the driver and identify the license plate.

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At a SafeLight intersection in Charlotte, a camera mounted atop a 15-foot pole is activated when a vehicle runs a red light.



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Other states, including North Carolina, authorize municipalities to impose a civil penalty only, with no assessment of driver's license points. Therefore they require photographic verification of the license plate only, usually from the rear of the vehicle. In North Carolina a civil penalty citation is issued to the vehicle's registered owner. If it is not paid, the municipality issuing the citation may institute a civil action to collect the penalty.

This article summarizes the experience of Charlotte, North Carolina, in establishing and operating a red-light photo enforcement program, which it calls *SafeLight* Charlotte. The program appears to have reduced the number of RLR violations and associated crashes at *SafeLight* intersections.⁵ The city also has gained revenue from increased enforcement of red-light violations.

At each of Charlotte's intersections using red-light photo enforcement, called *SafeLight* intersections, there are at least two electric-wire loops per lane of travel buried in the pavement, a 35-millimeter camera atop a 15-foot pole, and a control box near the sidewalk that coordinates the traffic light with the loops and the camera. When the light turns red and after a .03-second grace period, the system becomes active. Once it does, a vehicle traveling more than 15 miles per hour triggers the loops (located directly in front of the painted, white stop bar).⁶ This causes the camera to take a rear photograph of the vehicle showing the light in its red phase and verifying that the light turned red before the vehicle entered the intersection. A second rear photograph then captures the vehicle in the intersection during the red phase.⁷

What led Charlotte to pursue red-light photo enforcement?

Charlotte's ranking among North Carolina urban jurisdictions for number of vehicle crashes rose from eighteenth in 1996 to first in 1998.⁸ In 1996, 34 percent of Charlotte's vehicle crashes were attributed to RLR.⁹ Further, 49 percent of the crashes at the 179 signalized intersections on Charlotte's 1998 list of high-accident locations (HAL)¹⁰ resulted from RLR.¹¹

Citizen concern matched crash statistics. Seventy-six percent of the city's residents believed RLR to be a major safety hazard,¹² and the media reported alarm-



The automated camera takes two photos of the vehicle and the light, one before the vehicle enters the intersection, and one after. Above, the second photo, with relevant data superimposed: "17 04" is the time of the violation; "28-08-98," the date it occurred; "0.67," the elapsed time between the two photos; "R 0 57," the total elapsed time of the red phase at the time of the second photo (here, 5.7 seconds); "014," the violation number on the camera film; and "V = 30," the vehicle speed.

ing incidences of RLR in the city.¹³ RLR even became a frequent topic on morning radio.

The statistics and the public concern drew the attention of Charlotte's city council, police department, and department of transportation. Led by the latter, these groups determined that photo enforcement offered the most effective and easiest method for reducing RLR and RLR-associated crashes.

How did Charlotte obtain authorization for its plan?

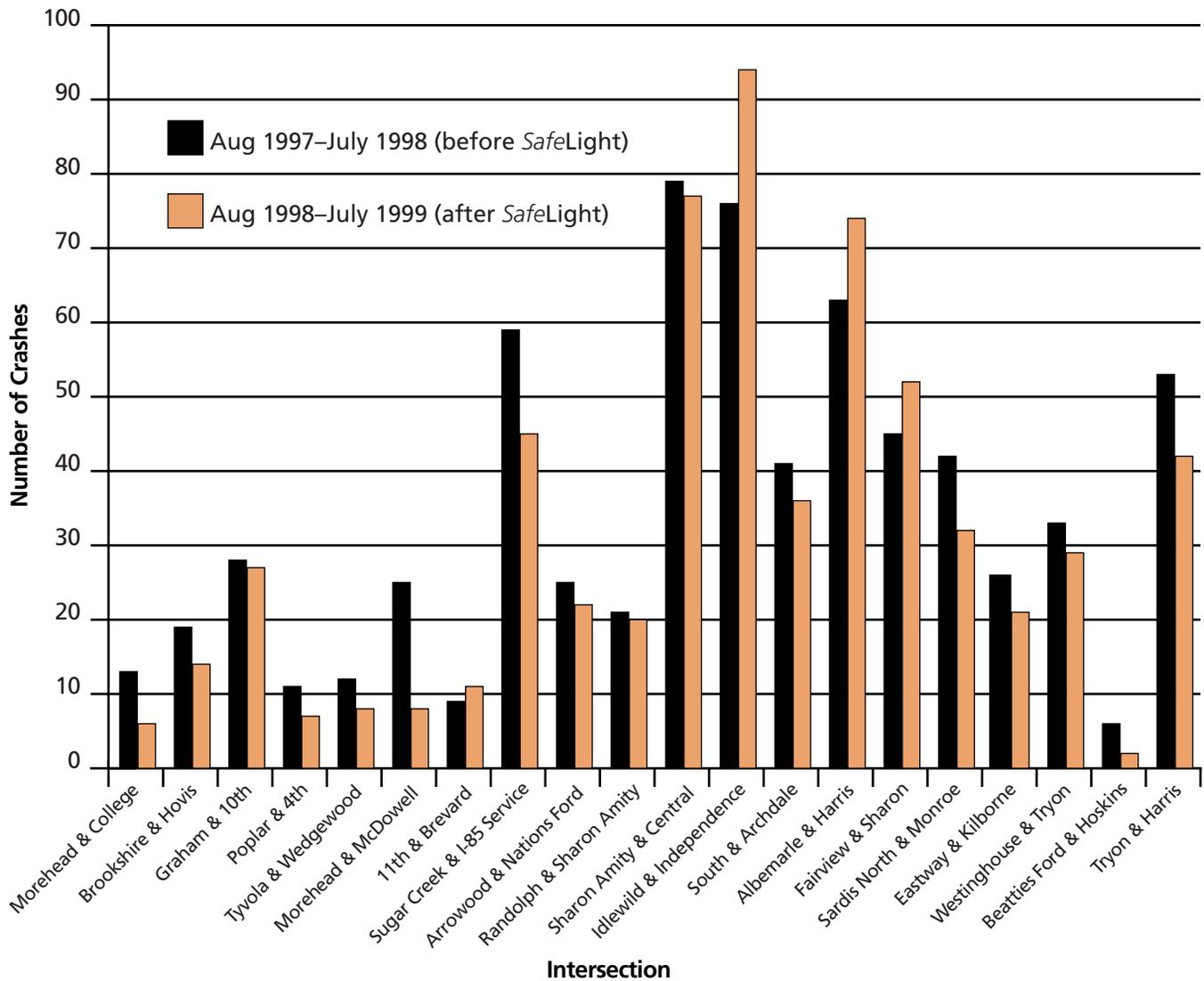
Before engaging in red-light photo enforcement, jurisdictions must obtain enabling legislation from both the General Assembly and their local governing bodies. In 1997 the General Assembly passed Section 160A-300.1 of the North Carolina General Statutes (hereinafter G.S.). The initial version of the statute applied to Charlotte only, authorizing the city to engage in this form of enforcement activity if the activity also was authorized by local ordinance and complied with the requirements set forth in the statute (described later). Since then, the statute has been amended to extend this authority to several more cities and towns, as well as to clarify the requirements for use of the technique.¹⁴

To obtain state and local authorization, Charlotte took seven steps. First, managers in the Charlotte Department of Transportation (CDOT) obtained the approval of their department head. Second, CDOT secured approval of the city manager. Third, CDOT presented the city council with statistics and information about the need for red-light photo enforcement. The council unanimously supported the idea and authorized CDOT to pursue state approval. Fourth, before approaching the legislature, CDOT worked with AAA Carolinas and local media to educate the public on the reasons for pursuing red-light photo enforcement (as opposed to increasing traditional enforcement). Fifth, CDOT took the proposal to Mecklenburg County's state legislative delegation. Sixth, the delegation presented the proposal to the General Assembly, which approved it through enactment of G.S. 160A-300.1. Finally, the city council enacted an ordinance establishing the *SafeLight* program. Two years elapsed from inception of the idea to operation of the first camera.

What concerns were expressed about red-light photo enforcement?

Several issues framed the debate about red-light photo enforcement. Most nota-

Figure 1. Crashes at SafeLight Intersections



Source: Data from CHARLOTTE DEP'T OF TRANSP., *SAFE*LIGHT PROGRAM, YEARLY ACCIDENT STATISTICS @ *SAFE*LIGHT INTERSECTIONS (AUG.–JUL.) 1 (Charlotte, N.C.: *SafeLight* Program, CDOT, Dec. 1999).

bly, critics argued that the cameras would invade people's privacy. Concerns about rising RLR violations overrode this argument,¹⁵ although the legislature included a requirement that signs be posted at all camera-equipped intersections notifying approaching motorists of the cameras.

Critics also argued that government should not penalize the vehicle's owner and assess insurance points against him or her without proof that the owner was driving the vehicle. In response, the legislature classified an RLR violation detected by photographic means as a civil nonmoving offense, punishable by a \$50 penalty only. In contrast, if RLR is detected by a law enforcement officer, it is a moving violation, carrying a \$25 fine,

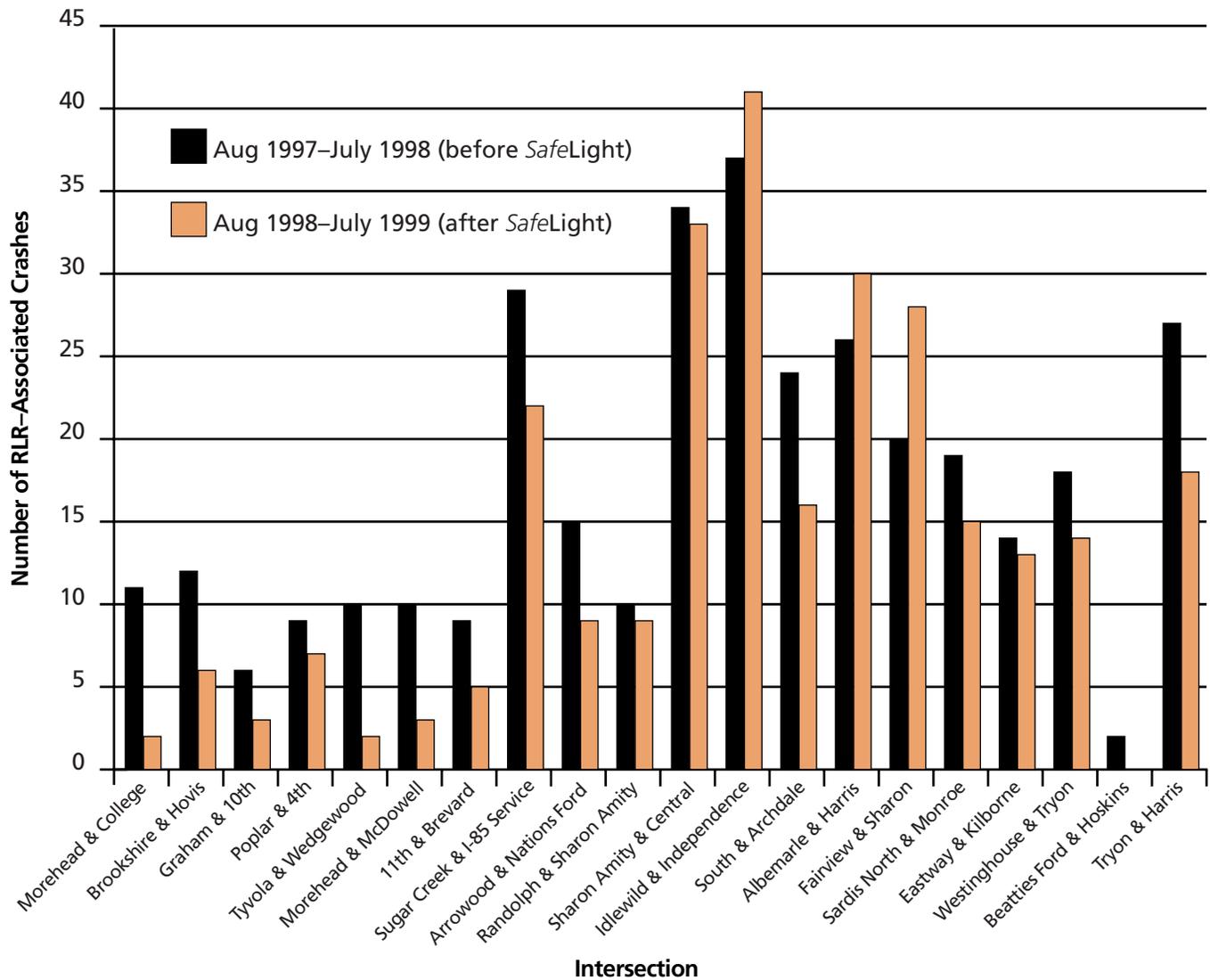
\$90 in court costs, and an assessment of points against the driver's license. A vehicle's owner may avoid liability for the civil nonmoving violation by signing an affidavit identifying the actual driver at the time of the violation.

In North Carolina, criminal motor vehicle fines go to the schools.¹⁶ However, because camera-caught RLR is characterized as a civil offense, the *SafeLight* program is able to retain all the resulting revenue.¹⁷ In response to the concerns of some citizens that the program was simply a government money-making scheme, Charlotte officials emphasized that the program's goal was to reduce the number of crashes and deaths at intersections, thus making Charlotte a safer community. The monetary penalties were to serve

as a mechanism for altering people's driving habits.¹⁸ Charlotte officials also emphasized that the police did not possess the resources to increase traditional enforcement at Charlotte intersections. Cameras, in contrast, could monitor intersections twenty-four hours a day, seven days a week.

Charlotte contracted out the daily operations and management of the *SafeLight* program, and some critics argued that the involvement of a private, for-profit company created a conflict of interest. Camera proponents countered that the public-private partnership had the benefit of imposing no new tax burden while producing additional local government revenue. Proponents also argued that any potential abuses would

Figure 2. RLR—Associated Crashes at SafeLight Intersections



Source: Data from CHARLOTTE DEP'T OF TRANSP., *SafeLight* PROGRAM, YEARLY ACCIDENT STATISTICS @ *SafeLight* INTERSECTIONS (AUG.–JUL.) 2 (Charlotte, N.C.: *SafeLight* Program, CDOT, Dec. 1999).

be held in check by a neutral, third-party appeal process.¹⁹

How has Charlotte implemented the *SafeLight* program?

Lockheed Martin IMS (IMS) operates the *SafeLight* program under a contractual arrangement. One city employee oversees the program and conducts its public relations. IMS employs nine people full-time and two people part-time to operate the project.²⁰ Technicians service the cameras daily and remove the used film. The film is then scanned into a computer and analyzed to verify picture integrity and license plate numbers. A verified license plate number is then checked against North Carolina Division of Motor Vehicle (DMV) records to identify the vehi-

cle's owner.²¹ After IMS obtains a positive DMV verification, it mails a citation to the owner. The citation includes an explanation of the violation, a description of the location of the intersection, a photo of the vehicle's license plate, and a photo of the vehicle in the intersection during the light's red phase.

The steps just described occur within forty-eight hours of the violation. If the violator fails to respond, IMS issues a Failure to Comply notice. If the violator still fails to respond, IMS turns the citation over to a collection agency, and an attorney sends a notice to the vehicle's owner.

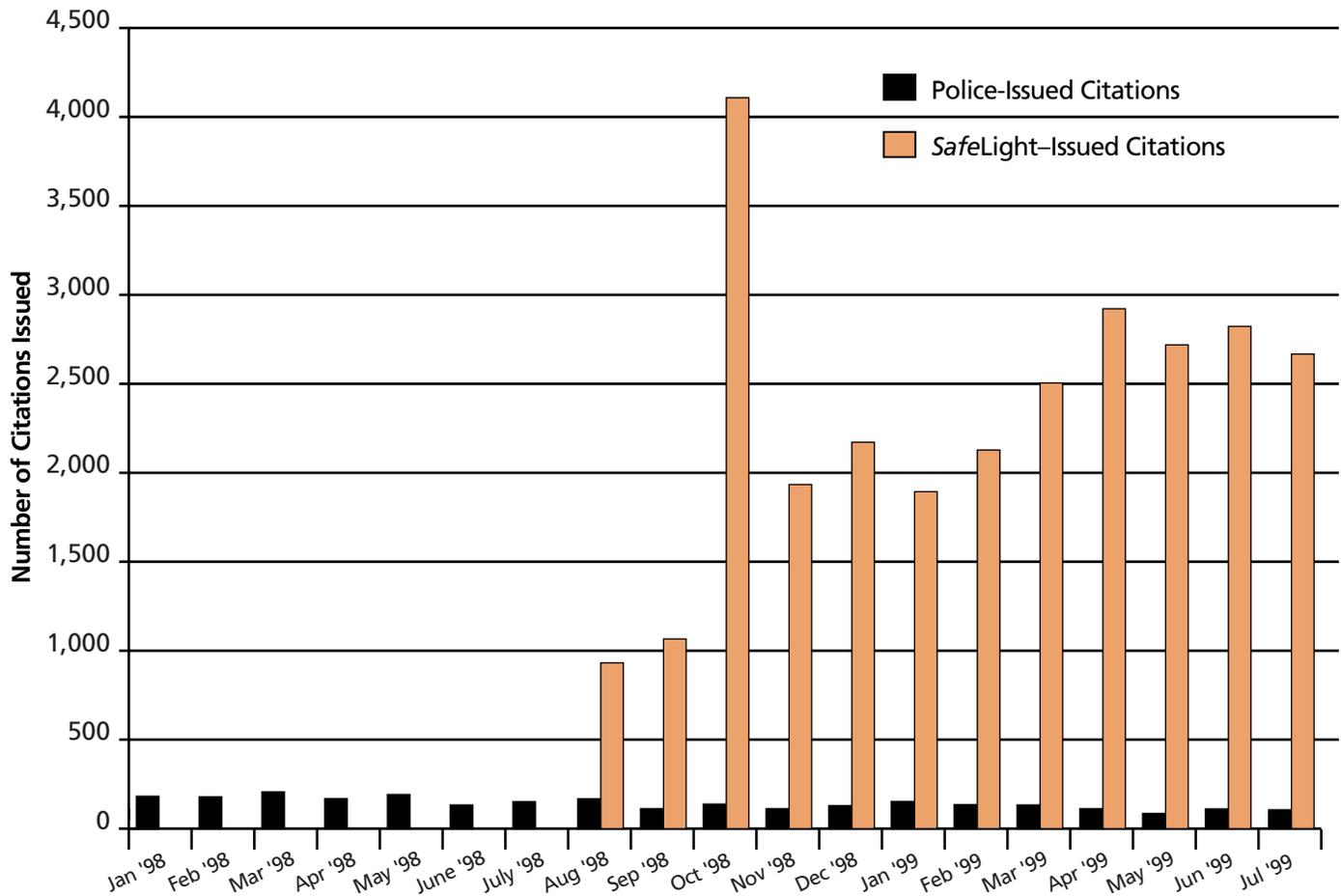
What have been the results?

SafeLight began issuing citations in August 1998. By October 1998 the number of

SafeLight intersections had grown from 2 to 22. By April 2000, 32—now 30 because of removal of two cameras during road construction—of Charlotte's 572 intersections were equipped to use cameras. Twenty intersections have permanent cameras, while two cameras rotate among the remaining 10 intersections. *SafeLight* reports the following results for August 1997 through July 1999 (except as noted):²²

- Citywide, the number of crashes increased 5.7 percent.
- *SafeLight* intersections experienced a 9.1 percent decrease in the number of crashes (see Figure 1).
- The number of crashes on approaches toward the camera decreased 27.1 percent.

Figure 3. RLR Citations Issued by Police vs. SafeLight Program



Source: Data for police-issued citations from Personal Interview with Capt. Larry Blydenburgh, Head of Highway Interdiction and Traffic Safety, Charlotte Police Dep't (Jan. 21, 2000); data for SafeLight-issued citations from CHARLOTTE DEP'T OF TRANSP., SAFELIGHT FIRST-YEAR REPORT 5 (Charlotte, N.C.: SafeLight Program, CDOT, Fall 1999).

- The number of RLR-associated crashes decreased 19.3 percent at SafeLight intersections (see Figure 2, page 43).
- Severity per crash decreased 27.1 percent at SafeLight intersections.²³
- At eight SafeLight intersections studied in August 1999, RLR decreased 93.0 percent.²⁴

Spillover effects on non-SafeLight intersections have not been determined. However, examination of statistics on a random sample of three SafeLight and three non-SafeLight intersections suggests that Charlotte has yet to experience a reduction in RLR-associated crashes at non-SafeLight intersections.

SafeLight has produced a far higher number of citations than has traditional enforcement. In 1999 the city processed 1,420 citations issued in the traditional manner. In SafeLight's first year of opera-

tion (August 1998–July 1999), it issued 27,870 citations (see Figure 3). The recipients of 369 of these citations filed for an administrative hearing, and 62 (17 percent) had their citations dismissed. In the second year of operation, 46,199 citations were issued. Four hundred thirty-four recipients filed for an administrative hearing, and of those, 68 (16 percent) had their citations dismissed.

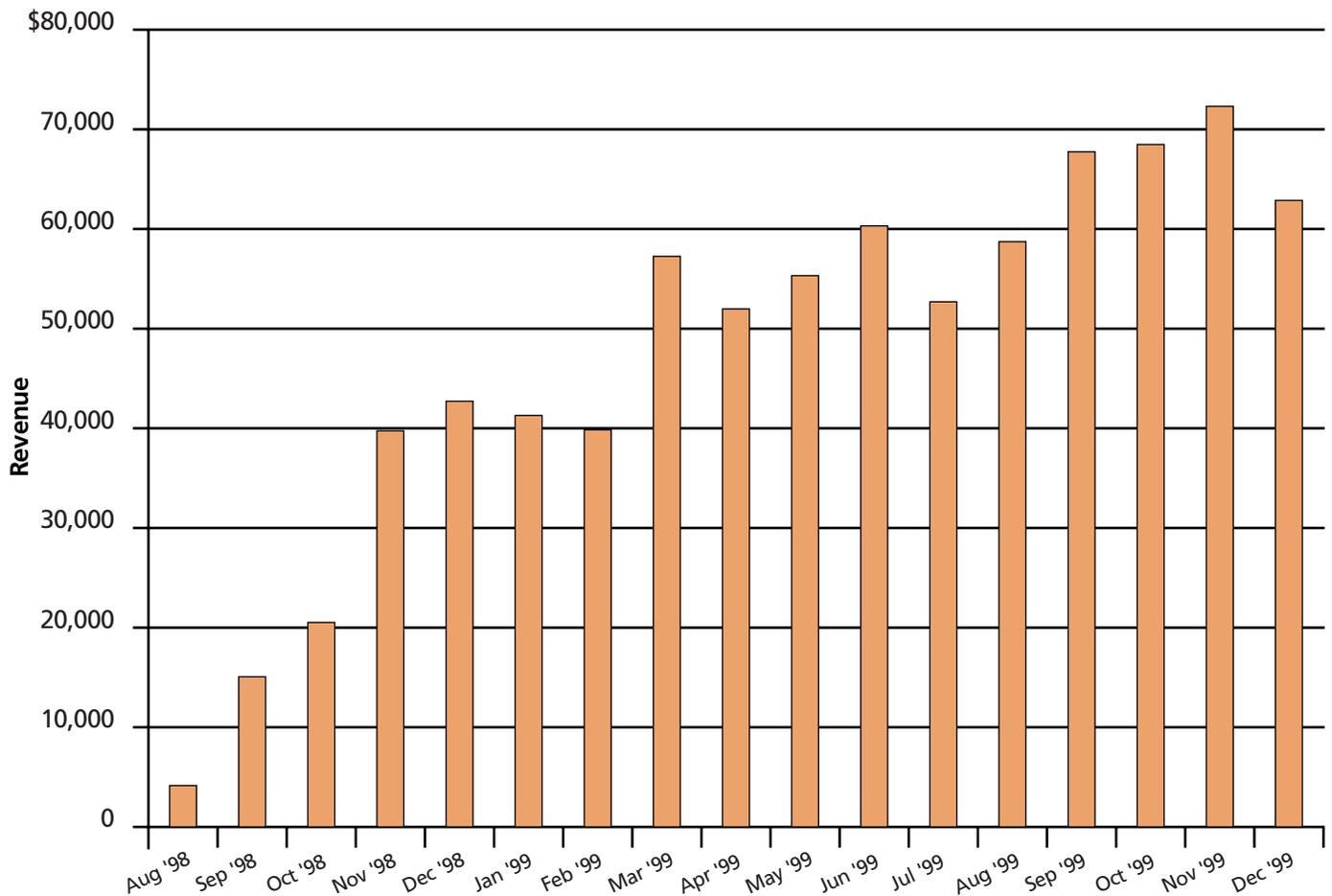
According to the Charlotte Police Department's traffic unit director, it takes an officer twelve to thirteen minutes to apprehend a red-light violator and issue an RLR citation.²⁵ At SafeLight intersections alone, the decrease in the number of crashes allowed the Charlotte police to save, or reallocate, approximately fifty-nine enforcement hours during the program's first year. A Charlotte police official predicts that, in the long run, fewer intersection crashes will reduce

workloads and allow officers to address other police needs.²⁶

The SafeLight program is financed entirely by citation revenue. Under the contractual arrangement, Charlotte receives \$22 (44 percent) of each \$50 RLR citation.²⁷ The rest goes to the contractor, IMS. During SafeLight's first year, penalties totaled \$1.39 million. IMS collected \$1.06 million of that. It received \$611,522, Charlotte \$447,835. SafeLight collected \$2.1 million in penalties during the 1999–2000 operating year.²⁸ Of this amount, \$889,108 went to Charlotte, \$1.2 million to IMS. After boosting the number of cameras from two to twenty-two in October 1998, Charlotte's first-year monthly revenue averaged \$52,787 (see Figure 4).

The capital costs to implement the SafeLight program are considerable but are borne by the contractor. (It would be

Figure 4. Monthly SafeLight Revenue Received by Charlotte (\$22 of Every \$50 Penalty)



Source: Charlotte Dep't of Transp., *SafeLight Program, SafeLight Monthly Deposit Tracking Sheet* (internal document, obtained from Brett Vines, *SafeLight Director*, Jan. 15, 2000).

incorrect, however, to say that there were no costs to Charlotte to implement the *SafeLight* program. Significant staff time was required from CDOT and the City Attorney's Office to get the program established and operating.) According to IMS, the equipment and installation costs per intersection in Charlotte average \$72,000, which includes a \$50,000 camera. IMS also spent approximately \$55,000 in *SafeLight's* first year to mail notices to violators. IMS's mailing costs rose to approximately \$86,000 in fiscal year 1999–2000 because of an increase in the volume of citations. Additionally, personnel, data center, and other administrative expenses exceed \$1 million annually.²⁹

According to IMS's project manager of municipal services in Charlotte, the company has yet to turn a profit. But considering that it received \$611,522 in

its first year of operation (1998–99) and \$1.2 million in its second year, and it estimates receipts of \$1.6 million in 2000–2001,³⁰ the project manager expects *SafeLight* to become profitable within the next couple of years.³¹

Other red-light photo enforcement programs in the United States have experienced similar reductions in RLR and associated crashes.³² The U.S. Federal Highway Administration predicts that RLR camera programs will result in a reduction in RLR violations of 20 to 60 percent.³³

However, caution is in order when interpreting violation and crash results. First, the number of violations may or may not be related to the number and the severity of collisions. Second, the results cited may or may not be the result of controlled, scientific studies.³⁴ Although initial results are promising, con-

crete findings require additional data and analysis over longer periods of time.

What recommendations do research and experience suggest for other local governments?

The literature on RLR and interviews with CDOT officials, IMS personnel, and the Mecklenburg County legislative delegation suggest that photo enforcement can reduce RLR violations and associated crashes. Following are eight recommendations for optimizing red-light photo enforcement programs:

1. *Impose a civil penalty only.* Imposing driver's license points on drivers who run red lights requires positive driver identification and thus the need for an additional, frontal camera. Sun visors and rear-view mirrors, sun glare, and the wearing of sunglasses and

In the first year of operation, Charlotte's SafeLight intersections experienced a 9.1 percent reduction in the number of crashes overall, a 19.3 percent reduction in the number of RLR-associated crashes, and a 27.1 percent reduction in the number of crashes on the camera approach.

hats hamper positive driver identification. Research indicates that RLR citation rates (the number of citations issued to violators in relation to the total number of recorded violations on film) vary from 13 to 30 percent in jurisdictions that classify RLR as a moving violation.³⁵ Such low rates reduce a program's ability to achieve its goals and support itself financially.³⁶ Therefore, North Carolina's enabling legislation, which authorizes local governments to impose only a civil penalty for RLR violations detected by camera, appears to be the most prudent course.

2. *Conduct a public information and education campaign.* An effective campaign is critical to obtaining support for a red-light photo enforcement program and for the program's continued success. In fact, the U.S. Federal Highway Administration identifies this as the most critical issue.³⁷ Citizen support can be garnered through early and frequent dissemination of information regarding the need for automated enforcement and the results of automated camera use. Media support also can be pursued as a means of gaining citizen support. As a program's first camera-equipped intersections begin operation, an element of the public information and education campaign might be a period of one or two months during which only warning tickets are issued.

3. *Consider contracting out program operation.* I was not able to determine as part of my study whether contracting



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out the *SafeLight* program has been wiser financially for Charlotte than operating it in-house. Clearly, though, the public-private partnership has produced revenue for Charlotte. Contractual arrangements have two major benefits. First, contractors specializing in this field enjoy technological advantages over most local government staffs. Second, contracting simplifies abandonment should the program fail to achieve expected results.³⁸

4. *Choose appropriate intersections.* Initially, Charlotte placed all its cameras at HAL (high-accident location) intersections. However, Charlotte learned that HAL intersections are not necessarily intersections that experience high numbers of red-light runners. In fact, research only tentatively supports using HAL intersections as camera locations; more definitive research is needed. Other factors to consider when choosing a red-light camera intersection include number of right-angle crashes, police reports, citizen complaints, number of RLR violations, and specific intersection studies. Also, planners should keep in mind that RLR problems may be the result of poorly designed intersections, poor sight lines to the traffic light, or poor timing of traffic-light phases. Interestingly, research warns against relying on traffic volume to determine camera locations. Instead, potential camera locations should be chosen on the basis of the estimated or actual number of RLR violations occurring at particular intersections.³⁹

Electric-wire loops embedded in the pavement, two per lane of travel, trigger camera operation when a vehicle passes over them at a speed greater than 15 miles per hour during the light's red phase.

5. *Use more than the legally required number of roadway signs to notify the public of red-light photo enforcement.* Although Charlotte's cameras monitor only one approach to an intersection, all four approaches at a *SafeLight* intersection display warning signs within 300 feet of the intersection. This is mandated by the statute authorizing red-light photo enforcement.⁴⁰ Additionally, Charlotte posts warning signs on major roadways at the city limits. Howard County, Maryland, posts warning signs on freeways and other major highways leading into the county but not at specific intersections. New York City posts no warning signs. Charlotte's and Howard County's approach of posting signs at the city and county limits would seem to increase the visibility of the program and to encourage safe driving habits at all intersections, rather than at the camera-equipped intersections alone. North Carolina cities and towns should post warning signs according to the requirements of G.S. 160A-300.1 and consider posting additional signs at major streets leading into the city or the town, to increase the program's visibility and its spin-off value in reducing RLR violations and associated crashes at noncamera intersections.

6. *Prepare for success.* Charlotte administrators recommend performing extra homework, including site visits to other operating programs, to learn about camera technology and its record of success and failure. Elected officials, citizens, and city supervisors are more apt to support a red-light photo enforcement program when time is taken to inform them of the requirements and the potential results of such a tool.⁴¹

7. *Budget time wisely.* There will be significant time requirements in three areas. First, some time will have to be spent at the state legislature: legislative approval is not pro forma. Second, marketing the idea to the media and the public should be a continuing effort. Third, sufficient time should be allowed for the process of requesting proposals from potential contractors. Charlotte's process took nine months and proved challenging. The process should allow extra time for planners to understand and evaluate the proposals and for prospective contractors to demonstrate their experience in operating a fully functioning system.

8. *Consider using digital cameras.* Digital cameras offer significant benefits over 35-millimeter cameras. They capture higher resolution photos and allow photos to be sent electronically from the intersection's camera directly to the program's main computers. This eliminates the need for film removal and developing, and that in turn reduces time and personnel needs.

Conclusion

Since the introduction of red-light photo enforcement in the United States in 1993, the technology has shown promising results in reducing the number of RLR violations and associated crashes. Additionally, jurisdictions have gained valuable experience operating successful programs. In the first year of operation, Charlotte's *SafeLight* intersections experienced a 9.1 percent reduction in the number of crashes overall, a 19.3 percent reduction in the number of RLR-associated crashes, and a 27.1 percent reduction in the number of crashes on the camera approach. A study of eight

SafeLight intersections revealed an RLR reduction of 93 percent. Without reliance on additional taxpayer support, Charlotte received \$447,835 in new revenue from penalties assessed during the program's first year. Initial results suggest that the *SafeLight* program is achieving its goal of creating a safer Charlotte by improving highway safety at signalized intersections.⁴²

Notes

1. Richard Retting, *Automated Enforcement of Traffic Laws*, TR [TRANSPORTATION RESEARCH] NEWS, Mar.–Apr. 1999, at 15, 29.

2. Insurance Inst. for Highway Safety, *Safety Facts* (last modified Dec. 16, 1999), available at http://www.highwaysafety.org/safety_facts/qanda/rlc.htm.

3. M. Freedman & N. Paek, *Enforcement Resources Relative to Need: Changes during 1978–89* (Arlington, Va.: Insurance Inst. for Highway Safety, 1992).

4. *Cameras Working against Light-Runners*, USA TODAY, Jan. 13, 2000, available at <http://www.usatoday.com/news/washdc/ncswed03.htm>.

5. CHARLOTTE DEP'T OF TRANSP., *SAFELIGHT PROGRAM, YEARLY ACCIDENT STATISTICS @ SAFELIGHT INTERSECTIONS* (AUG.–JUL.) (Charlotte, N.C.: *SafeLight* Program, CDOT, Dec. 1999) (hereinafter cited as *SAFELIGHT STATISTICS*).

6. The use of a minimum travel speed helps eliminate potential false-positive violations associated with left-turn-only lanes, right-turn-on-red maneuvers, and emergency vehicles. Some intersections in Charlotte require a higher threshold speed (16 or 18 miles per hour) to activate the cameras.

7. On the first photo, the computer prints the date, the time, the elapsed time since the beginning of the red phase of the light, the duration of the yellow phase, the violation number, the lane number, and the code for the intersection's location. On the second photo, the computer prints the date, the time, the elapsed time between photos, the total elapsed red-light time at the time of the second violation photo, the vehicle's speed, and the violation number.

8. NORTH CAROLINA DEP'T OF TRANSP., *TRAFFIC CRASH FACTS 1996*, at 106; *TRAFFIC CRASH FACTS 1997*, at 156; *TRAFFIC CRASH FACTS 1998*, at 156 (Raleigh, N.C.: NCDOT, 1997, 1998, 1999).

9. Personal Interview with Brett Vines, City of Charlotte Special Programs Manager/*SafeLight* Director (Dec. 16, 1999).

10. The HAL list, produced by the Charlotte Department of Transportation, ranks an intersection on the basis of its dangerousness compared with that of all other intersections in Charlotte. Three factors are

considered: (1) the number of crashes occurring in a three-year period at the particular intersection, (2) the total volume of traffic entering the particular intersection in a twenty-four-hour period, and (3) the severity of the injuries sustained for each crash occurring at the particular intersection. The three factors are used to calculate the Estimated Property Damage Only (EPDO) index. The resulting index determines the ranking of the HAL intersections. The HAL list includes the 221 most unsafe intersections.

11. City of Charlotte, N.C., *SafeLight Program* (last modified Dec. 31, 1999), available at <http://www.ci.charlotte.nc.us/citransportation/programs/ltfacts.htm>.

12. CHARLOTTE DEP'T OF TRANSP., *SAFELIGHT FIRST-YEAR REPORT 4* (Charlotte, N.C.: *SafeLight* Program, CDOT, Fall 1999). MarketWise, Inc., conducted a survey of Charlotte residents in fall 1997, before implementation. MarketWise also conducted a post-implementation survey of 404 Mecklenburg County residents in August 1999. This later study indicated that 78 percent supported the *SafeLight* program, while only 8 percent opposed it. Thirty-six percent expressed the opinion that the program had changed driving habits of people in general, at intersections.

13. Dianne Whitacre, *Drivers Flouting the Rules, City Tries to Stem Rise in Accidents* [press release], Charlotte, N.C.: *SafeLight* Program (last modified Nov. 29, 1997), available at <http://www.ci.charlotte.nc.us/citransportation/programs/press25.htm>.

14. The North Carolina General Assembly has approved camera use for the following cities and towns: Charlotte, Cornelius, Fayetteville, Greensboro, Greenville, High Point, Huntersville, Lumberton, Matthews, Pineville, Rocky Mount, and Wilmington. The General Assembly has denied camera approval to Chapel Hill and Raleigh. See S.L. 2000-37 (H 1553).

15. For example, North Carolina State Senator T. LaFontaine Odom, Sr. (D–Mecklenburg, Iredell, and Lincoln counties) noted that “it's the responsibility of city government to enforce [the] law[,] . . . and cameras seemed to work best.” Sen. T. LaFontaine Odom, Sr., Re: Charlotte's *SafeLight* Program, e-mail to the author (Jan. 13, 2000).

16. N.C. CONST. art. IX, § 7; *Cauble v. City of Asheville*, 314 N.C. 518, 336 S.E.2d 59 (1985).

17. The legality of cities retaining such revenue has yet to be challenged in court. Randy Jones, former manager of public service for CDOT, noted that cities probably could not afford the high costs of camera programs if they could not offset costs with penalty revenue. Personal Interview (Jan. 19, 2000).

18. Vicki Hyman, *Charlotte Program Credited with Reducing Crashes 27 Percent*, RALEIGH NEWS & OBSERVER, Oct. 24, 1999, at

26A. Brett Vines, *SafeLight* director, noted in Hyman's newspaper article that Charlotte spends its *SafeLight*-generated revenue on pedestrian safety, public safety campaigns, and sidewalk construction. According to the 1999-2000 *SafeLight Annual Report*, about \$400,000 of *SafeLight* revenue will fund major safety-improvement projects at local schools, including road widening and turn-lane construction. The report is available at <http://www.charmeck.nc.us/citransportation/programs/report2.htm#Revenue>.

19. The appeals process includes an administrative hearing before an independent hearing officer and an appeal through the Superior Court of Mecklenburg County.

20. Lockheed Martin IMS employs its own project manager to oversee its Charlotte operation and work closely with the city's *SafeLight* Director.

21. The system is able to obtain motor vehicle owner records from virtually all fifty states. For rental cars, IMS contacts the rental car company to obtain the renter's name and mailing address. If it cannot obtain the name, it sends the violation to the rental car company to forward to the driver. According to IMS, most rental car companies are cooperative, helpful, and supportive.

22. CHARLOTTE DEP'T OF TRANSP., *SAFE-LIGHT PROGRAM, SAFE-LIGHT STATISTICS*.

23. The EPDO index determines estimated crash severity. See note 10.

24. CITY OF CHARLOTTE, *SAFE-LIGHT FIRST-YEAR REPORT 10*. A test conducted by CDOT before installation of cameras examined eight intersections for one twelve-hour segment (7:00 A.M. to 7:00 P.M.). The pretest determined that motorists ran red lights 875 times. A test conducted after camera installation revealed that the number of violations at the same eight intersections decreased to 58 over a twenty-four-hour period.

25. Court appearance time and other forms of down time were excluded from the calculation. Traditional enforcement by a single officer also can be difficult and dangerous. The officer must be able to see the vehicle, the stop bar, and the traffic signal clearly at the same time. In apprehending a red-light violator, the officer may have to pursue the violator through the red phase, thus endangering himself or herself, other motorists, and pedestrians. Karl A. Passetti, *Use of Automated Enforcement for Red Light Violations*, in COMPENDIUM: GRADUATE STUDENT PAPERS ON ADVANCED SURFACE TRANSPORTATION SYSTEMS, at J-5 through J-6 (College Station: Texas Transp. Inst., Aug. 1997).

26. Captain Larry Blydenburgh, head of Highway Interdiction and Traffic Safety for the Charlotte Police Department, estimated that an officer spends one hour performing professional duties at a typical RLR crash scene and filing subsequent paperwork. Personal Interview with Capt. Larry Blyden-

burgh, Head of Highway Interdiction and Traffic Safety, Charlotte Police Dep't (Jan. 21, 2000). This article does not examine the monetary costs associated with traditional red-light enforcement in Charlotte. However, a 1997 report found that in Howard County, Maryland, traditional, team-oriented red-light enforcement cost \$25.40 per citation. Passetti, *Use of Automated Enforcement*, at J-30.

27. If it issues fewer than 35,000 citations per year, IMS receives \$28 of each \$50 citation. If it issues more than 35,000 but fewer than 60,000 citations per year, it receives an extra \$4 per citation (applicable only to the number between 35,000 and 60,000). If it issues more than 60,000 citations per year, it earns an extra \$1.50 per citation (applicable only to the number over 60,000). If the penalty is not paid or appealed within twenty-one days, a \$50 late penalty is charged. IMS collects \$23 of each \$50 late penalty, CDOT \$27. However, if a violator does not pay until a third notice is sent, IMS receives \$76 of the total \$100 charge, and CDOT \$24.

28. CHARLOTTE DEP'T OF TRANSP., *SAFE-LIGHT PROGRAM, CITY OF CHARLOTTE SAFE-LIGHT PROGRAM SUMMARY OF REVENUES AND EXPENDITURES* (Charlotte, N.C.: *SafeLight* Program, CDOT, Dec. 1999) (hereinafter cited as *REVENUES AND EXPENDITURES*).

29. Terence J. Lynam, Director, Customer and Constituent Relations, Lockheed Martin IMS, Re: Charlotte Red Light Program, e-mail to the author (Dec. 21, 1999).

30. CHARLOTTE DEP'T OF TRANSP., *SAFE-LIGHT PROGRAM, REVENUES AND EXPENDITURES*.

31. Personal Interview with Johnnie Fogg, Project Manager of Mun. Serv., Lockheed Martin IMS (Dec. 16, 1999). According to John Veneziano, Director of Public Works for Fairfax, Virginia, the city's three-camera Photo Red Light Program returned a profit after fifteen months. As of December 1999, Fairfax had paid \$831,380.00 in total contractual costs, and the city's net revenue totaled \$131,819.70. Fairfax contracts out the intersection installation, camera maintenance, and film developing. The police department reviews the photo violations, mails the citations, handles customer service, and supports the appeals process. Personal Interview with Veneziano (Jan. 24, 2000). I did not audit IMS's cost figures. However, the approximate \$50,000 purchase price for each of Charlotte's Gatsometer 35-millimeter cameras is consistent with prices charged for such high-speed/high-resolution cameras. Research by Hummer et al. found that in Howard County, Maryland, installation of the pavement loops and the poles for the camera cost between \$3,000 and \$7,000. Significant price differences can exist among types of cameras (35-millimeter and digital) and types of vehicle detectors (air tubes, inductive loops, earth magnetic loops, piezoelectric strips, video loops, and laser). JOSEPH E. HUMMER ET AL.,

TRAFFIC SIGNAL ENFORCEMENT INNOVATIONS FOR NORTH CAROLINA 24 (Report submitted to the North Carolina Governor's Highway Safety Program, Raleigh: North Carolina State Univ., Oct. 29, 1999).

32. Fairfax, Virginia's violation rate across camera and noncamera intersections had decreased by approximately 40 percent one year after photo enforcement began. Richard A. Retting et al., *Evaluation of Red Light Camera Enforcement in Fairfax, Va., USA*, ITE [INSTITUTE OF TRAFFIC ENGINEERS] JOURNAL, Aug. 1999, at 30. In Oxnard, California, the violation rate across camera and noncamera intersections decreased by approximately 42 percent. Richard A. Retting et al., *Evaluation of Red Light Camera Enforcement in Oxnard, California*, 31 ACCIDENT ANALYSIS AND PREVENTION 169 (1999). New York City experienced a 38 percent reduction in RLR violations. UNITED STATES DEP'T OF TRANSP., SYNTHESIS AND EVALUATION OF RED LIGHT RUNNING AUTOMATED ENFORCEMENT PROGRAMS IN THE UNITED STATES, FHWA-IF-00-004 at 17 (Washington, D.C.: Federal Highway Admin., Sept. 1999). San Francisco experienced a 42 percent reduction in violation rates during a six-month pilot program. Preliminary crash data suggested that the cameras in San Francisco reduced citywide crashes and injuries by red-light runners. HUMMER ET AL., TRAFFIC SIGNAL, at 24. Howard County, Maryland, experienced a 23 percent reduction in the number of RLR violations. Passetti, *Use of Automated Enforcement*, at J-30.

33. UNITED STATES DEP'T OF TRANSP., SYNTHESIS AND EVALUATION, at 27.

34. HUMMER ET AL., TRAFFIC SIGNAL, at 25.

35. HUMMER ET AL., TRAFFIC SIGNAL, at 23.

36. Brett Vines (current *SafeLight* director) and Randy Jones (former manager of public service for CDOT) both posit that categorizing an automated enforcement RLR violation as a civil nonmoving violation produces just as good results (in reductions in RLR violations and associated crashes), if not better, than making the offense a (more punishable) moving violation. Interviews with Vines, Jones.

37. UNITED STATES DEP'T OF TRANSP., SYNTHESIS AND EVALUATION, at 25.

38. Interviews with Jones, Vines.

39. HUMMER ET AL., TRAFFIC SIGNAL, at 61, 73.

40. G.S. 160A-300.1(b).

41. Interviews with Jones, Vines.

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