Engineering Countermeasures to Reduce Red-Light Running

Red-Light Running Defined

There is no simple or single reason to explain why drivers run red lights, but beginning with a definition will provide a framework for discussion. The simplest definition of red-light running (RLR) is the act of entering, and proceeding through, a signalized intersection after the traffic signal has turned red. According to the Uniform Vehicle Code (UVC)[1], a motorist "...facing a steady circular red signal shall stop at a clearly marked stop line, but if none, before entering the crosswalk on the near side of the intersection, or if none, then before entering the intersection and shall remain standing until an indication to proceed is shown..." (§11-202). An intersection is defined in the UVC as "... the area embraced within the prolongation or connection of the lateral curb lines, or if none, then the lateral boundary lines of the roadways of two highways which join one another at, or approximately at right angles, or the area within which vehicles traveling upon different highways joining at any other angle may come in conflict" (§1-132). See Figure 1.

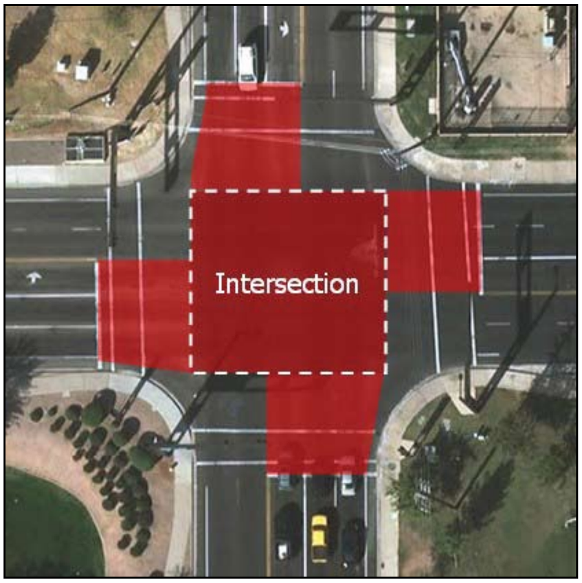

Figure 1: Diagram of UVC definition of an intersection

Red-Light Running Fatalities

FHWA identified the following four elements from the Fatality Analysis Reporting System that provide a consistent definition of red-light running fatalities.

- The crash occurred at an intersection or was intersection-related;
- The intersection was controlled by an active traffic signal;
- A driver was charged with either failing to stop for a red signal or failing to obey a traffic control device; and
- A driver was going straight at the time of collision.

On average, during the 2000 to 2007 period, 916 annual RLR fatalities have resulted. In 2007, 883 RLR fatalities have occurred. This represents a reduction of 33 RLR fatalities or approximately 3.5 percent as compared to the most recent five-year average. A chart illustrating the RLR fatalities between 2000 and 2007 is shown in Figure 2.

1. National Committee on Uniform Traffic Laws and Ordinances (NCUTLO). *Uniform Vehicle Code*. 2000.

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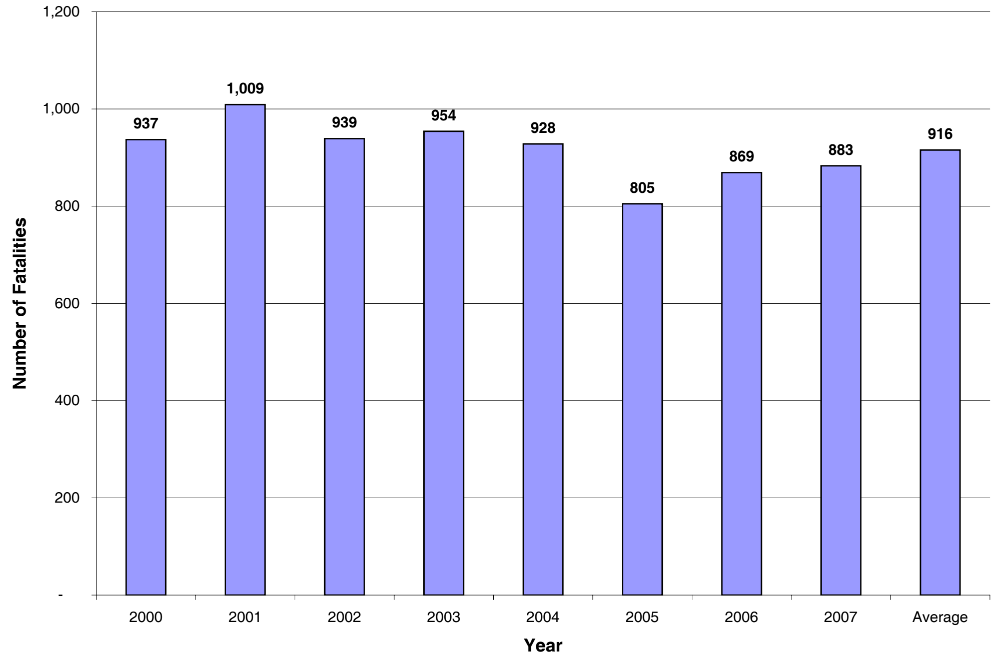

Figure 2: Red Light Running Fatalities Year 2000 to 2007

Factors Affecting Red-Light Running

Overview

A number of intersection and human factors influence RLR. How these factors interact to increase or decrease the risk of RLR will assist in identifying the varied reasons behind RLR. Red-light runners can be categorized into intentional and unintentional violators. In general, engineering countermeasures should help address the unintentional violations, and enforcement countermeasures should help address the intentional violations.

An example of an intentional reason would be, "I was in a hurry and I thought I could beat the yellow light." Examples of an unintentional reason for running a red light would be, "I could not see the signal, the sun was in my eyes or I tried to slow down but I was caught in the dilemma zone when the light turned red." Research has found that more than 50% of red-light violations happen within the first 0.5-seconds of the red signal indication and 94.2% of red-light violations occur within the 2.0-seconds of the red-light onset.[2] Engineers must look at each of these reasons, conduct field surveys of the intersections and subsequently recommend targeted engineering, enforcement, and education countermeasure programs to reduce the RLR problem. Prior to the discussion of engineering causes and countermeasures, this brief will describe several of the legal, demographic, human behavioral factors, vehicular, and intersection characteristics related to RLR.

Meaning of Yellow Indication

The meaning of the yellow indication is different in legal codes of the states. The law as stated in the UVC and the Manual on Uniform Traffic Control Devices (MUTCD) is considered a permissive yellow law, meaning that the driver can enter the intersection during the entire yellow interval and be in the intersection during the red indication as long as he/she entered the intersection during the yellow interval. As of 2009, permissive yellow rules were followed by at least half of the states.[3] However, in other states there are two types of restrictive yellow laws that apply, namely:

- Vehicles can neither enter the intersection nor be in the intersection on red; or
- Vehicles must stop upon receiving the yellow indication, unless it is not possible to do so safely.

This will need to be considered in combination with the definition of an intersection when developing a plan to address red-light running. Any public information and education campaign would need to incorporate a learning objective regarding the meaning of the yellow indication.

Demographic Characteristics

The demographics category includes the age, gender and vehicle occupancy characteristics of the red-light runner. It also includes whether or not the red-light runner was wearing a seat belt and looks at his/her driving record.

Age. Younger drivers between the

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2. RITA, John A. Volpe National Transportation Systems Center, *Analysis of Red Light Violation Data Collected from Intersections Equipped with Red Light Photo Enforcement Cameras*, DOT-VNTSC-NHTSA-05-01. Washington, DC, 2006.

3. Interim Report: NCHRP Project 03-95 Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersection. Prepared by Vanasse Hangen Brustlin for the Transportation Research Board, September 2009.

ages of 18 to 25 years old are more likely to run red lights compared to other age groups.[4]

Gender. Red-light runners are more likely than non-runners to be male.[5]

Occupancy. Drivers have a higher probability of running red lights when driving alone compared to when passengers are in their vehicles.[6]

Seat Belts. Red-light runners are less likely to wear safety belts.[7]

Driving Record. Drivers with poor driving records and driving smaller and older cars have a higher tendency to run red lights.[8] Red-light runners are more likely than non-runners to be driving with suspended or revoked driver's licenses.

Human Behavioral Factors

Driver Inattention. Many common distractions that cause drivers to reduce their focus on the task of driving include:

- Drowsiness;
- Conversing with passengers;
- Manipulating radio and/or GPS devices;
- Eating; and
- The use of a cellular phone or other electronic devices.

4. Porter, B.E. and Berry, T.D. A Nationwide Survey of Self-Reported Red Light Running: Measuring Prevalence, Predictors, and Perceived Consequences. *Accident Analysis and Prevention*, 33, 735-741. 2001.
5. Retting, R.A. et al. Evaluation of Red Light Camera Enforcement in Oxnard, California. *Accident Analysis and Prevention*, 31, 169-174. 1999.
6. Porter, B.E. and Berry, T.D. 2001.
7. Retting, R. A. and Williams A.F. Characteristics of Red Light Violators: Results of a Field Investigation. *Journal of Safety Research*, 27(1), 9-15. 1996.
8. Ibid.

Speeding. Motorists may:

- Accelerate when anticipating a change in signal indication, in order to make it through the intersection on the yellow. If a motorist misjudges the time of the signal change, he or she will enter the intersection against the red signal indication; and/or
- Drive above the posted speed limit or drive too fast for conditions, increasing the distance available to react to a change in the traffic signal indication.[9]

Aggressive Driving Headway. Drivers that follow closely (headway of less than two seconds) are more likely to run a red light.[10]

Vehicular Chacteristics

Larger-sized vehicles. There is a significant statistical difference between the rates of RLR for following a passenger car and for following a larger-size vehicle with higher rates of RLR for driving behind a larger-size vehicle due to vertical visibility blockage of the traffic signal pole.[11]

Intersection Characteristics

Traffic Volumes. The RLR frequency increases as the approach traffic volume at intersections increases.[12]

Time-of-Day Characteristics. The average red-light violations are higher during AM and PM peak hours compared to other times of the day.[13,14]

Approach Grade. Drivers on downgrades are less likely to stop than drivers on level or upgrade approaches.

Frequency of Signal Cycles. Many researchers recognize a correlation between the frequency of signal changes and red light running.[15,16,17] If the cycle length increases, the hourly frequency of signal changes decreases, which should reduce the exposure of drivers to potential red-light running situations.[18]

Type of Signal Control. The type of signal control plays a role in the exposure of drivers to red-light running situations. Highway corridors with vehicle-actuated traffic control tend to produce more compact vehicle platoon configurations than pretimed

9. Retting, R.A. et al., 1999.
10. Bonneson, et. al. *Engineering Countermeasures to Reduce Red-Light-Running*. Report No. FHWA/TX-03/4027-2. Texas Department of Transportation, Austin, TX. 2002.
11. Radwan, E. et al. "Red-Light Running and Limited Visibility Due to LTVs Using the UCF Driving Simulator." Orlando, FL: Center for Advanced Transportation Systems Simulation, University of Central Florida, Florida Department of Transportation. 2005.
12. Brewer et al. Engineering Countermeasures to Red-Light-Running. *Proceeding of the ITE 2002 Spring Conference and Exhibit* (CD-ROM). Washington, DC: Institute of Transportation Engineers. 2002.
13. Retting et al. Red-Light Running and Sensible Countermeasures: Summary of Research Findings. Transportation Research Record 1640, 23-26. Transportation Research Board, Washington, DC. 1998.
14. Lum, K.M. and Wong, Y.D. Impacts of Red Light Camera on Violation Characteristics. *Journal of Transportation Engineering*, November/December, 648-656. 2003.
15. Porter, B.E. and England, K.J. Predicting Red-Light Running Behavior: A Traffic Study in Three Urban Settings. *Journal of Safety Research*, 31(1),1-8. 2000.
16. Baguley, C. Running the Red at Signals on High-Speed Roads. *Traffic Engineering & Control*, 29, 7-8. 1988.
17. Van der Horst, R. and Wilmick A. Drivers' Decision-Making at Signalized Intersections: An Optimization of the Yellow Timing. *Traffic Engineering & Control*, December, 615-622. 1986.
18. Cesar Quiroga, Edgar Kraus, Ida van Schalkwyk, and James Bonneson, CTS-02/150206-1: Red Light Running, A Policy Review, Texas Transportation Institute, Center for Transportation Safety, March, 2003, Page 4.

Table 1: Summary of Engineering Countermeasures to Reduce Red-Light Running

Improve Signal Visibility/ Conspicuity	Increase the Likelihood for Stopping	Remove Reasons for Intentional Violations	Eliminate the Need to Stop
Signal for Each Approach Through Lane	Install Signal Ahead Signs	Adjust Yellow Change Interval	Coordinate Signal Operation
Install Backplates	Install Transverse Rumble Strips	Provide or Adjust All-Red Clearance Interval	Remove Unwarranted Signals
Modify Placement of Signal Heads	Install Activated Advance Warning Flashers	Adjust Signal Cycle Length	Construct a Roundabout
Increase Size of Signal Displays	Improve Pavement Surface Condition	Provide Dilemma Zone Protection	
Install Programmable Signal/ Visors or Louvers			
Install LED Signal Lenses			

traffic control.[19] The result is an increase in the number of drivers who may be exposed to the yellow and/or red indications during "max out" phase terminations in the operation of the system and a reduction in the probability of stopping before the stop line after the light changes to yellow as long the approach is occupied. If the approach is unoccupied for a period of time, the green may reach its maximum limit and "gap out" forcing the green phase to end regardless of whether the approach is occupied. There is a greater potential for RLR as the frequency of max out increases.

Yellow interval duration. Both long yellow intervals which can violate driver expectancy and short yellow intervals (intervals shorter than the Institute of Transportation Engineers (ITE)-suggested values[20]) have resulted in a high number of RLR violations.

Engineering Countermeasures To Reduce Red Light Running

Overview

ITE and the Federal Highway Administration (FHWA) developed a publication titled *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running: An Informational Report.*[21]

Similar work has been completed by Bonneson, Brewer, and Zimmerman. The principal objectives of these publications are to identify engineering design and operational features of an intersection that could be upgraded to reduce RLR. The engineering countermeasures can be grouped into four distinct areas:

- Improving signal visibility/ conspicuity;
- Increasing the likelihood of stopping;
- Removing the reasons for intentional violations; and
- Eliminating the need to stop.

Table 1 summarizes the countermeasures that can be considered under each of the countermeasure groupings identified above. These engineering countermeasures are based on a driver characteristic called the "unintentional violator." This type of driver may be incapable of stopping or may be inattentive while approaching the intersection due to poor judgment by the driver or in the design or operation of the intersection. A second type of driver characteristic is the "intentional violator" who, based on his/her judgment, knows they may violate the signal yet proceeds through the intersection anyway. This type of driver is most affected by enforcement countermeasures, while unintentional red-light runners are most affected by engineering countermeasures.

Increase Signal Visibility/ Conspicuity

Signal for Each Approach Through Lane. Section 4D.15 of the MUTCD only requires that "a minimum of two signal faces shall be provided for the major movement on the approach..." Under this standard, it would be acceptable to have only two signals on an approach with three or more through lanes. When a signal is positioned such that it is over the middle of the lane, it is in the center of the motorist's cone of vision, thereby increasing its visibility. The additional signal head further increases the likelihood that a motorist will see the signal display for the approach. Placement of a primary signal head over each through lane has been demonstrated to have the lowest incidence of crashes.

Install Backplates. Backplates are used to improve the signal visibility by providing a background around the signals, thereby enhancing the contrast. They are particularly useful in complex visual environments, in east-west directions, and against bright sky backgrounds, but many agencies use backplates on all signals because of the conspicuity they provide. A retroreflective yellow border strip around the

19. Van der Horst, R. Driver Decision Making at Traffic Signals. *Transportation Research Record* 1172, 93-97. 1998.
20. *Traffic Engineering Handbook*, Washington, DC. ITE. 1999.
21. *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running*: An Informational Report, ITE. 2003 http://safety.fhwa.dot.gov/intersection/redlight/rlr_report/)/.

Figure 3: Example of backplates on a multilane arterial intersection

outside perimeter of signal backplates has also been found to significantly reduce nighttime crashes at signals and also helps drivers identify an intersection as signalized during a power failure.

Modify Placement of Signal Heads. Overhead-signal displays help to overcome the three most significant obstacles posed by locations that have only pole-mounted signal heads, which are: (1) they generally do not provide good conspicuity, (2) mounting locations may not provide a display with clear meaning and (3) motorists' line-of-sight blockage to the signal head due to other vehicles, particularly trucks, in the traffic stream. Studies have shown significant reduction in crashes attributed to the replacement of pole-mounted signal heads with overhead-signal heads. However, even with overhead signals, pole-mounted supplemental signal faces should be considered to further enhance signal visibility and conspicuity.

Increase Size of Signal Displays. 12-inch signal lenses should be considered for all signals, and especially those displaying red indications, to increase signal visibility. The MUTCD requires 12-inch-diameter signal lenses for approaches where speeds are greater than 40 mph and for some other circumstances. Yet many road authorities have made it their policy to use 12-inch-diameter lenses universally for new installations, regardless of the approach speed. Studies in Michigan, North Carolina, and elsewhere have shown the safety benefits of using 12-inch lenses, even in low-speed situations.

Install Programmable Lens Signals/ Visors or Louvers. Optically programmed or visibility-limited signals limit the field of view of a signal. They allow greater definition and accuracy of the field of view. The MUTCD speaks of visibility-limited signals mostly with regard to left-turning traffic at an intersection. The MUTCD permits the use of visibility limited signal faces in situations where the road user could be misdirected, particularly at skewed or closely-spaced intersections when the road user sees the signal indications intended for other approaches before seeing the signal indications for their own approach. Because the field of view is restricted and requires specific alignment, the signals require rigid mounting instead of suspension on overhead wires. There is some concern associated with glare and the limitations of seeing the signal. Signal visibility alignment requires attention both in design and in field maintenance.

Install LED Signal Lenses. LED units are used for three main reasons: they are very energy efficient, are brighter than incandescent bulbs, and have a longer life increasing the replacement interval. LED signals may be noticeably brighter and more conspicuous than an adjacent signal with the incandescent bulb. LED traffic signal modules have a service life of 6 to 10 years compared to incandescent bulbs that have a life expectancy of only 12 to 15 months. There is a belief that LEDs are brighter and last longer and therefore would provide safety benefits but this has not been quantified. Some studies have found that LED units tend to lose brightness over time instead of exhibiting an immediate failure.

Increase the Likelihood for Stopping

Install Signal Ahead Signs. The MUTCD (Section 2C.29) requires an advance traffic control warning sign when "the primary traffic-control device is not visible from a sufficient distance to permit the road user to respond to the device." In addition to the normal symbolic SIGNAL AHEAD warning sign, a sign with the legend BE PREPARED TO STOP (W3-4) can be used.

Install Transverse Rumble Strips. Rumble strips are a series of intermittent, narrow, transverse areas of rough-textured, slightly raised or depressed road surface. The rumble strips provide an audible and a vibrotactile warning to the driver. When coupled with the SIGNAL AHEAD warning sign and also the pavement marking word message— SIGNAL AHEAD—the rumble strips can be effective in alerting drivers of a signal with limited sight distance. There are no known studies reporting on how this treatment can reduce red-light violations or the resulting crashes; hence their use should be restricted to special situations. If used, they should be limited to lower-speed facilities (less than 40 mph) and be reserved for locations where other treatments have not been effective. Rumble strips should not be installed if there will be excessive noise for adjacent residential areas or there are numerous bicyclists using the facility.

Install Activated Advance Warning Flashers. The purpose of an activated advance-warning flasher (AAWF) is to forewarn the driver when a traffic signal on his/her approach is about to change to the yellow and then the red phase. This type of treatment provides a specific warning of an impending traffic signal change ahead. AAWFs inform drivers of the status of a downstream signal. Yellow flashing beacons with the sign are activated or an otherwise blank changeable message such as "Red Signal Ahead" is illuminated for several seconds. The sign and the flashers are placed a certain distance from the stop line as determined by the speed limit on the approach.

Improve Pavement Surface Condition. As a vehicle approaches a signalized intersection and slows to stop for a red light, it may be unable to stop due to poor pavement friction and as a result, proceed into the intersection. Countermeasures to improve skid resistance include asphalt mixture (type and gradation of aggregate as well as asphalt content), pavement overlays, and pavement grooving. Additionally, countermeasures can be considered such as the use of a SLIPPERY WHEN WET sign with a supplemental Advisory Speed Plate for a lower advisory speed.

Remove Reasons for Intentional Violations

Adjust Yellow Change Interval. MUTCD (Section 4D.10) provides guidance regarding the duration of yellow change interval. It indicates that the duration of the yellow change interval should be approximately 3 to 6 seconds, with longer intervals reserved for high-speed approaches. The MUTCD does not provide guidance regarding the calculation of clearance interval durations other than to provide ranges of acceptable values. ITE prepared a formula to calculate the yellow change interval that uses a number of operational parameters including perception-reaction time, deceleration rate, approach speed and grade.[22]

There is a correlation between the duration of the yellow interval and red light running events. Van der Horst observed a substantial reduction in the number of red-light running events after increasing the duration of the yellow interval from 3 to 4 seconds (in urban areas) and from 4 to 5 seconds (in rural areas).[23] A small adjustment was observed in the drivers' stopping behavior, which was attributed to the relatively low increase in the duration of the yellow interval.[24]

ITE suggests that a long change interval may encourage drivers to use it as part of the green interval and therefore maximum care should be used when exceeding five seconds. If the calculated or selected yellow change interval length exceeds 5 seconds, it may be the choice of the local jurisdiction to handle the additional time with a red clearance interval. Furthermore, using a yellow change interval length less than 3 seconds may violate driver expectancy and result in frequent entry on red indications. If the interval is too short, rear-end crashes may result.

ITE is in the process of preparing *Guidelines for Determining Traffic Signal Change Intervals: a Recommended Practice* (RP). In 1985 ITE published a Proposed Recommended Practice titled *Determining Vehicle Change Intervals* that was not ratified to become an recommended practice. Later, in 2001, ITE published the informational report *A History of the Yellow and All-Red Intervals for Traffic Signals*.

ITE plans to prepare the RP to reflect the current state-of-the-practice and to provide the user with a broader overview of key considerations to determine yellow change and red clearance intervals for traffic signals and their application. A separate effort is underway by the National Cooperative Highway Research Program (NCHRP Project 03-95) to prepare a document titled *Guidelines for Timing Yellow and All-Red Intervals at Traffic Signals.* This project will have a longer time horizon because it will incorporate new primary data into the research.

Provide or Adjust All-Red Clearance Interval. An all-red clearance interval is an optional portion of a traffic signal cycle that can follow a yellow change interval and precede the next conflicting green interval. The purpose of the all-red interval is to allow time for vehicles that entered the intersection during the yellow-change interval to clear the intersection before the traffic-signal display for the conflicting approaches turns to green. Engineering formulas should be used to calculate whether this extra clearance interval is needed and what its duration should be based on the speeds, intersection widths and other factors. The all-red clearance interval may also be useful in mitigating the "go" decision by a motorist in the amber dilemma zone when there is not enough time to clear the intersection, particularly at high speed locations. Generally, the duration of the all-red clearance interval is from 0.5 to 3.0 seconds. The MUTCD provides guidance that the all-red clearance interval should not exceed 6 seconds (Section 4D.10).

Adjust Signal Cycle Length. Proper timing of signal-cycle lengths can reduce driver frustration that might result from unjustified short or long cycle lengths. Longer cycle lengths mean fewer cycles per hour and therefore fewer yellow-change intervals per hour and thus can reduce the number of opportunities for traffic-signal violations. On the other hand, signal cycles that are excessively long can encourage RLR because drivers do not want to have to wait several minutes for the next green interval.

Provide Dilemma Zone Protection. The "dilemma zone" has been defined recently to be the area in which it may be difficult for a driver to decide whether to stop or proceed through an intersection at the onset of the yellow-signal indication. It is also referred to as the "option zone" or the "zone of

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22. *Determining Vehicle Signal Change and Clearance Intervals*, Washington, DC: ITE, 1994.

23. Van der Horst, R. 1998.
24. Cesar Quiroga, Edgar Kraus, Ida van Schalkwyk, and James Bonneson, CTS-02/150206-1: Red Light Running, A Policy Review, Texas Transportation Institute, Center for Transportation Safety, March, 2003, Page 5.

indecision." One potential countermeasure to reduce red-light running is to reduce the likelihood that a vehicle will be in the dilemma zone at the onset of the yellow interval. This can be accomplished by placing vehicle detectors at the dilemma zone. They detect if a car is at the dilemma zone immediately before the onset of the yellow interval. If a vehicle is there, the green interval can be extended so that the vehicle can travel through the dilemma zone and prevent the onset of the yellow while in the dilemma zone.

Eliminate the Need to Stop

Coordinate Signal Operation. Interconnected signal systems provide coordination between adjacent signals and are proven to reduce stops, reduce delays, decrease accidents, increase average travel speeds, and decrease emissions. An efficient signal system is also one of the most cost-effective methods for increasing the capacity of a road. With reduced stops, the opportunity to run red lights is also reduced. In addition, if drivers are given the best signal coordination practical, they may not be as compelled to beat or run a red signal.

Remove Unwarranted Signals. If there is a high incidence of RLR violations, this may be because the traffic signal is perceived as being not necessary and does not command the respect of the motoring public. Sometimes signals are installed for reasons that dissipate over time. For instance, traffic volume may decrease due to changing land-use patterns or the creation of alternative routes. The removal of a traffic signal should be based on an engineering study. Factors to be considered are included in ITE's *Traffic Control Devices Handbook.* If a signal is eliminated, the traffic engineer must continue to monitor the intersection for any potential increase in crashes.

Construct a Roundabout. When a roundabout replaces a signalized intersection, the RLR problem is obviously eliminated. Single-lane roundabouts and other roundabouts have been shown to have significantly less crashes (and less severe crashes) than signalized intersections. Readers should consult *NCHRP 572: Roundabouts in the United States*[25] and FHWA's *Roundabouts: An Informational Guide*.[26]

Figure 4: Example of entry to multi-lane roundabout

Intersection Field Assessment Form

The following intersection field inspection form sheet is provided and can be downloaded online at http://safety.fhwa.dot.gov/intersection/redlight/redl_reports/fieldinspfrm.cfm.

The field inspection form should be used to identify the extent to which an intersection approach may exhibit traffic operational or engineering design issues that could have an effect on red-light running. A separate field assessment sheet should be completed for each intersection approach. The form shows the types of information that an engineer or an engineering technician should evaluate to determine if a red-light running problem exists at a specific location. Based on the data, the transportation engineering professional can identify if the RLR problems are due to intentional or unintentional (traffic operational or engineering and design) reasons and can suggest engineering countermeasures as a first step prior to consideration of the placement of automated red light cameras at an intersection.

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25. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_572.pdf.
26. Robinson, B. W., L. Rodegerdts, W. Scarbrough, W. Kittelson, R. Troutbeck, W. Brilon, L. Bondzio, K. Courage, M. Kyte, J. Mason, A. Flannery, E. Myers, J. Bunker, and G. Jacquemart. *Roundabouts: An Informational Guide*. Report FHWA-RD-00-067. FHWA, U.S. Department of Transportation, June 2000. (This document is being updated, with publication likely in 2010.)

INTERSECTION FIELD INSPECTION FORM

LOCATION INFORMATION

Intersection Identification:____________________ with ____________________

Approach Name:____________________ Direction Heading:__________

PART 1. CHECK SIGNAL VISIBILITY

Type of Signal Mounting: **Span Wire** **Mast Arm** **Pole** **Structure** Sight Distance to the Signal: _______*feet*

Requires Advance Warning Sign? **Y** **N** Advance Signal Warning Sign Present: **Y** **N**

Is anything blocking the view of the signals? **Y** **N** If yes, describe____________________

Can signal faces on other approaches be seen? **Y** **N** If yes, do these signals have visors, shields, or programmable lenses? **Y** **N**

PART 2. CHECK SIGNAL CONSPICUITY

Could visual clutter detract from the signal? **Y** **N**

Are the signal indications confusing? **Y** **N**

If yes, explain:____________________

____

Are backplates present? **Y** **N**

Are backplates necessary? **Y** **N**

Are other glare-reducing steps needed? **Y** **N**

Signal lens type: **Incandescent** **LEDs**

Signal Lens Size Adequate?:

- Red signal lens size: 8 inch 12 inch
- Distance from stop line to signal: _______*feet*
- Near side signal? **Y** **N**
- Is existing size adequate? **Y** **N**

Number of Signal Heads Adequate?

- Total number of signal heads for major movement: ______
- Total number of lanes for major movement: ______
- Is existing number adequate? **Y** **N**

Signal Heads Placement Adequate? **Y** **N**

PART 3. CHECK SIGNAL CONTROL PARAMETERS

Grade (as decimal) g =___________(uphill is positive)

Approach speed V =___________*mph*

Cross street width W =___________*feet*

Calculate the needed change period *(CP)* for this approach using agency practice or the following equation:

$$CP = 1.0 + \overbrace{\frac{1.47 * V}{(20 + 64.4g)}}^{\text{Yellow}} + \overbrace{\frac{W + 20}{1.47 * V}}^{\text{All-red}}$$

	Actual Value	Calculated Value	Is Existing Adequate?
Yellow Interval	________	________	**Y** **N**
All Red Interval	________	________	**Y** **N**

PART 4. CHECK OTHER FACTORS

Is horizontal location adequate? **Y** **N** Pavement condition on approach: **Adequate** **Polished** **Severely Rutted**

Should signal warranting study be conducted? **Y** **N** Other concerns:____________________

PART 5. IDENTIFY PROMISING COUNTERMEASURES

Visibility Deficiency

____ Install additional signals on near side
____ Change signal mounting
____ Install SIGNAL AHEAD sign
____ Install Advance Warning Flashers
____ Remove/relocate sight obstruction
____ Install programmable lenses
____ Install shields and visors
Other____________________

Conspicuity Deficiency

____ Add signals to achieve one per lane
____ Replace with LED lens type
____ Replace with 12" signal head
____ Install double red signal
____ Install/enhance backplates
____ Install rumble strips on approach
____ Install near side signal

Signal Timing Operation Deficiency

____ Change yellow interval
____ Add/change all-red interval

Other Measures

____ Determine if signal is warranted
____ Consider roundabout or innovative design
____ Improve pavement condition

Inspection By: ____________________ Date:__________

Figure 5: FHWA Intersection Field Inspection Form

Resources

FHWA. *Field Guide for Inspecting Signalized Intersections to Reduce Red Light Running*. FHWA-SA-05-008. Washington, DC. 2005.

http://safety.fhwa.dot.gov/intersection/redlight/redl_reports/fguide_isirlr/
(HTML)

http://safety.fhwa.dot.gov/intersection/redlight/redl_reports/fieldinspfrm.cfm.
(Field Inspection Form plus downloadable .pdf form)

Federal Highway Administration, National Highway Traffic Safety Administration, *Red Light Camera Systems Operational Guidelines*, Washington, DC. January 2005.

Red Light Camera Systems Operational Guidelines, January 2005 (HTML)

http://safety.fhwa.dot.gov/intersection/redlight/fhwasa05002/fhwasa05002.pdf.

FHWA, Research, Development, and Technology, Turner-Fairbank Highway Research Center, *Association of Selected Intersection Factors with Red-Light Running Crashes*, FHWA-RD-00-112. Washington, DC. 2000.

http://www.hsisinfo.org/pdf/00-112.pdf

Institute of Transportation of Engineers. *A History of the Yellow and All-Red Intervals for Traffic Signals*. Washington, DC: ITE. 2001.

Institute of Transportation Engineers, *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running*. An Informational Report. Washington, DC. 2003.

http://safety.fhwa.dot.gov/intersection/redlight/rlr_report/rlrbook.pdf

Texas Transportation Institute. *Engineering Countermeasures to Reduce Red-Light Running*. Report 4027-2, College Station, TX. August 2002.

http://tcd.tamu.edu/Documents/4027-2.pdf

Texas Transportation Institute. *Evaluation of Enforcement Issues and Safety Statistics Related to Red Light Running*. Research Report 4196-1. College Station, TX. September 2003.

http://tcd.tamu.edu/Documents/4196-1.pdf

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Safe Roads for a Safer Future
Investment in roadway safety saves lives

ENGINEERING COUNTERMEASURES TO REDUCE RED-LIGHT RUNNING

November 2009

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