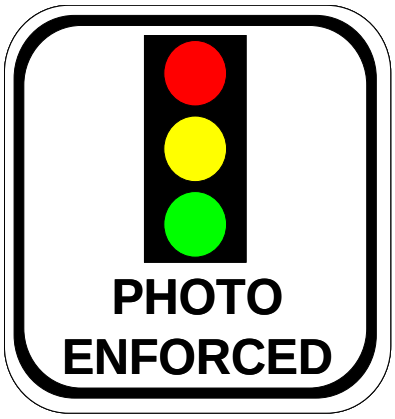
# Red Light Running Camera
# (Photo Enforcement)
# Engineering Safety Analysis Guidelines

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## INTRODUCTION

The 2007 Virginia General Assembly enacted legislation (Chapter 903 of the 2007 Virginia Acts of Assembly in Appendix A) allowing the use of cameras in Virginia counties, cities, and towns to enforce compliance with traffic signals. The legislation allows localities by ordinance to install and operate red light running camera systems at no more than one intersection for every 10,000 residents within the locality. In Planning District 8, localities may install and operate red light running cameras at no more than 10 intersections or one intersection for every 10,000 residents within the locality, whichever is greater. Planning District 8 is the geographic area served by the Northern Virginia Regional Commission consisting of 14 member localities including: the counties of Arlington, Fairfax, Loudon and Prince William; the cities of Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park; the towns of Dumfries, Herndon, Leesburg, Purcellville and Vienna. Based on the legislation provisions, Appendix B provides a tabulation of the maximum number of intersections at which photo enforcement at any one time could be operated for each locality, based on 2005 population data.

The legislation requires VDOT approval of intersections to have traffic signal photo enforcement. It also contains requirements for analysis, approval, and annual monitoring. This document provides guidance to Virginia localities on what must be submitted to VDOT for each proposed photo enforced intersection. The Institute of Transportation Engineers and Federal Highway Administration have also published guidance documents regarding red light running countermeasures and photo enforcement, *Making Intersections Safer: A Toolbox of Engineering Countermeasures to reduce Red-Light Running* published in 2003 and *Red Light Camera System Operational Guidelines* published in 2005. References and links to these documents and other related literature and research can be found in Appendix C.

## LEGISLATIVE REQUIREMENTS

Intersection Selection Factors and Implementation Criteria

When selecting potential intersections for installation of red light running cameras, the legislation states localities shall consider the following factors:

i. The accident rate for the intersection,
ii. The rate of red light violations occurring at the intersection,
iii. The difficulty experienced by law-enforcement officers to apprehend violators,
iv. The ability of law-enforcement officers to apprehend violators safely within a reasonable distance from the violation.

Localities must submit their list of potential photo enforcement intersections along with an engineering safety analysis to the Virginia Department of Transportation for final approval.

The legislation also requires a minimum 0.5 second grace period between the time the signal turns red and the time the first violation is recorded by the camera.

Public Awareness Program

Prior to implementation of red light running cameras or expansion of the monitoring system, a locality shall conduct a public awareness program advising the public that a photo enforcement system is being implemented. Further guidance on public awareness campaigns can be found in national publications such as *Red Light Camera Systems: Operational Guidelines*, published by the Federal Highway Administration and the National Highway Traffic Safety Administration in January 2005. In addition, localities must place conspicuous signs within 500 feet of the intersection approach at which a red light running camera is installed informing motorists of the enforcement effort. A standard warning sign for use across the Commonwealth will be the MUTCD's standard sign.

Evaluation and Certification Efforts

Localities are required to evaluate the photo enforcement system on a monthly basis to ensure all cameras and traffic signals are operating properly. The results of the evaluation are to be made available to the public. Localities shall annually certify compliance with the legislation and make all records available for inspection and audit by the Commonwealth Transportation Commissioner or the Commissioner of the Department of Motor Vehicles.

Engineering Study Guidelines

Before red light running camera(s) can be installed at an intersection, the locality is required to complete an engineering safety analysis for the specific intersection. The engineering study should document the current clearance intervals (yellow and all-red), whether the signal is coordinated with other signals along the corridor, and the current condition of other safety features (i.e., lane markings, median control, speed limits, signing, etc.).

## ENGINEERING STUDY GUIDELINES

When considering the use of a red light camera system it is important to perform an engineering study to identify potential issues with the intersection configuration that may be contributing to red light violations or potential improvements/countermeasures that may need to be implemented instead of a photo enforcement system. Virginia legislation requires that localities submit a list of intersections for photo enforcement to VDOT for final approval. VDOT has established engineering study guidelines to assist localities in preparing photo enforcement request submittals. The engineering safety analysis should include a statement explaining why photo enforcement is proposed for a specific intersection. **VDOT requires the engineering safety analysis to be stamped and signed by a licensed professional engineer.** An engineering analysis template is provided in Appendix D and includes sections for: Intersection and Signal Data, Signal Timings and Traffic Data, and Crash and Enforcement Data.

Intersection and Signal Data

*Signal Visibility*

As motorists approach an intersection their line of sight to the intersection and the traffic signal should be unobstructed. The engineering analysis of the intersection should address intersection and traffic signal visibility.

Engineering counter measures such as 'signal ahead' signs (with or without flashers) may be installed to warn drivers approaching a signalized intersection and to prepare them to stop if necessary for proposed intersections.

Adding additional signal heads so that there is one signal head over each lane may be an appropriate countermeasure for intersections with high percentages of heavy vehicles. LED lighting, 12 inch signal lamps and backplates shall be considered to make traffic signals more visible to drivers, especially under adverse weather and lighting conditions and to combat sun glare issues.

*Pavement Markings, Conditions and Treatments*
Information requested in the study report includes: a diagram of the intersection, sight distance on the approach, grade of the approach, data on signal heads, pavement markings, and warning signs.

The engineering analysis of the intersection should document pavement and marking conditions in the vicinity of the intersection.

Signal Timings and Traffic Data

*Clearance Intervals*
The Manual on Uniform Traffic Control Devices (MUTCD) and the Institute of Transportation Engineers (ITE) provide guidance on calculating clearance intervals – yellow and all red intervals. VDOT guidance on applying these guidelines is documented in Traffic Engineering Division Memo Number 306 contained in Appendix E.

The yellow interval is designed to warn motorists of the change in assignment of right-of-way. Yellow intervals should provide motorists with adequate time to make the appropriate decision and either proceed through the intersection before the signal turns red or make a comfortable deceleration and stop before entering the intersection. The likelihood of a motorist entering an intersection on red increase as the amount of yellow time is decreased. Increasing the perception reaction time used in calculating the yellow clearance interval from 1.0 to 1.5 seconds has been shown to reduce the number of red light violations.

*Signal Timing and Phasing*
The engineering analysis of the intersection should include an evaluation of the intersection timings, phasing, and coordination with other intersections. The amount of traffic entering the intersection, the time of day, the number of turns, and sequence of the signals are all important factors and vary from intersection to intersection. Traffic engineering judgment and local knowledge of the intersection in conjunction with signal optimization and simulation should result in the most efficient traffic signal timing at the intersection.

*Vehicle Detection Data*
The engineering analysis of the intersection should include an evaluation of loop detector locations and the existence of a dilemma zone. Location of loop detectors at relatively higher speed intersections (speeds greater than 30 mph) is an important factor in signalized intersection design. At a certain distance from the intersection, depending on speed, drivers seeing the onset of the yellow phase may be indecisive about stopping or proceeding through the intersection. This zone of driver indecision is often referred to as a "dilemma zone".

One measure to reduce the likelihood of vehicles being in the "dilemma zone" is to install a vehicle detector in the zone that will extend green time if a vehicle is present and not allow the yellow interval to begin while a vehicle is present in the zone. Dilemma zone detection is not generally used with coordinated signal systems.

*Traffic Volume Data*

The engineering analysis should include an intersection volume count containing both the number of passenger cars and heavy vehicles. At a minimum, volume counts should include a 48-hour automatic traffic recorder directional and classification count from which to calculate an ADT, and turn movement counts concurrent with the same time period as the red-light violation counts. Utilizing a decreased deceleration rate of 8 or 9 ft/sec^2, as allowed in TE Memo 306, resulting in a longer yellow interval should be considered where there are significant volumes of trucks, which generally have slower deceleration rates, particularly on downhill grades.

Crash and Enforcement Data

*Three-year Crash Analysis*

The engineering analysis of the intersection should include a crash analysis that focuses on identifying crashes related to red light running violations. The crash analysis should include at least 3-years of historical crash data. Indicators of red light running related crashes can be found in crash reports in sections such as contributing cause, collision type, traffic control, offense charged, and the narrative and/or diagram. This data should be evaluated in detail to determine if a red light running problem is resulting in crashes at an intersection. Crash rates should be reported in crashes per million entering vehicles and by types of crashes, specifically for angle and rear end crash types. The most prominent crash types of red light running violators are angle and turning crashes. Crashes involving single vehicles or pedestrians and bicyclists can also occur as a result of red light running when violators or other drivers take evasive action to avoid crashes or when coming in conflict with pedestrians and bicyclists legally in the intersection.

*Violation Rates*

The engineering analysis should document the frequency or violation rate of red light running at an intersection. This documentation will help to determine if a problem exists and will also provide a measure for comparison once photo enforcement is implemented.

Counts of red light violations at an intersection should be done either manually through field observations or by video camera. This data may also provide important information on driver behavior and operational conditions at an intersection. The legislation states that violation rates be expressed as number of violations per 1,000 vehicles.

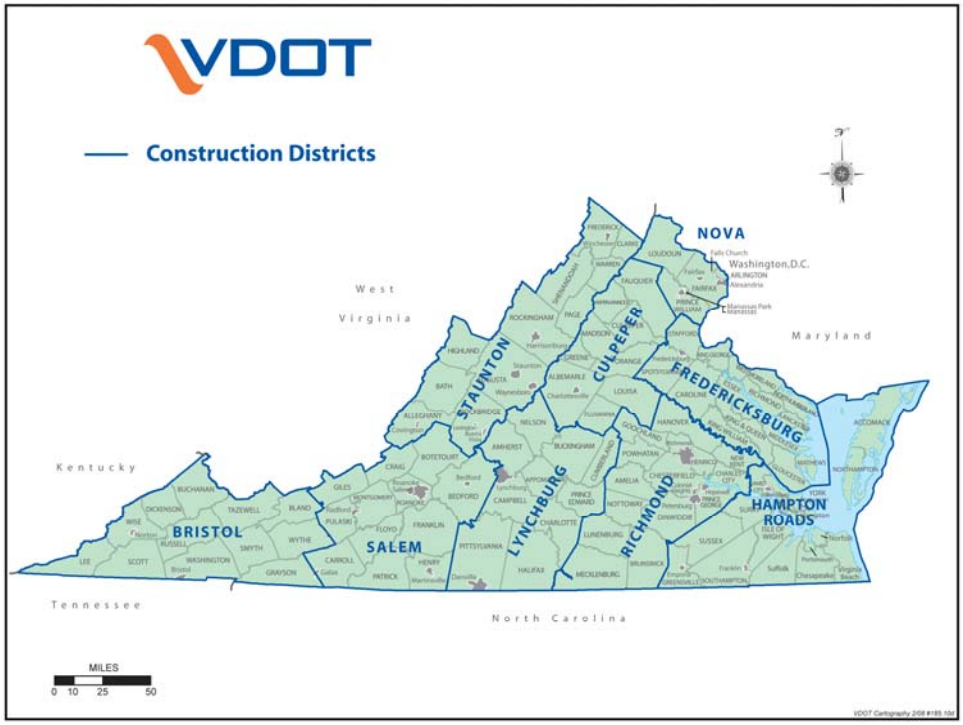
*Enforcement Endorsement*

The engineering analysis should document law enforcement opinions regarding red light running violations at specific intersections. In addition, as part of the engineering analysis, there should be documentation of law enforcement difficulties and safety issues related to apprehending red light violators by conventional means other than photo enforcement.

## APPROVAL PROCESS

The VDOT District Administrator, or his designee is the approving authority. Localities are responsible for completing and submitting the Engineering Safety Analysis to VDOT's District Administrators. VDOT's district or regional operations staff will review the engineering analysis and consult with localities' staff regarding recommendations and comments. Appeals or Exceptions will be to the Commissioner or his designee.

The contact information for the District Administrators and a map of VDOT's districts is provided below and is also provided at the end of Appendix B.




<u>Bristol District</u>
Ken Brittle
Acting District Administrator
870 Bonham Road
Bristol, VA 24201

<u>Culpeper District</u>
James S. Utterback
District Administrator
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Culpeper, VA 22701

<u>Fredericksburg District</u>
Quintin D. Elliott
District Administrator
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Fredericksburg, VA 22405

<u>Hampton Roads District</u>
Dennis W. Heuer, P.E.
District Administrator
1700 North Main Street
Suffolk, VA 23434

<u>Lynchburg District</u>
Rob Cary, P.E.
District Administrator
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<u>Northern Virginia District (NOVA)</u>
Morteza Salehi
District Administrator
14685 Avion Parkway
Chantilly, Virginia 20151-1104

<u>Richmond District</u>
Thomas A. Hawthorne, P.E.
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<u>Salem District</u>
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<u>Staunton District</u>
Garrett W. Moore, P.E.
District Administrator
P.O. Box 2249
811 Commerce Road
Staunton, VA 24401

## INTERFACING WITH VDOT SIGNAL EQUIPMENT

Safe and efficient signalized intersections are a high priority for the Department. Considerable technical equipment is located throughout a modern signalized intersection. Highly trained technicians maintain and operate these systems. Allowing improperly trained personnel to work on this equipment could jeopardize the safety of the traveling public as well as expose the Department and/or the locality to liability.

VDOT will not allow access to, or any work around, any Department maintained traffic signal component unless a VDOT traffic signal technician is present. VDOT will require a detailed plan as to what work is scheduled and how it is proposed to be accomplished. Forty-eight (48) hours of notice must be given to schedule a VDOT signal technician. Qualifications of those performing work for a locality must be submitted and approved by VDOT. An insurance certificate may be required.

February 19, 2008
*Revised August 26, 2009*

# APPENDIX A

# LEGISLATION

# VIRGINIA ACTS OF ASSEMBLY -- 2007 RECONVENED SESSION

## CHAPTER 903

*An Act to amend the Code of Virginia by adding a section numbered 15.2-968.1, relating to local ordinances establishing certain traffic signal enforcement programs; penalties.*

[S 829]

Approved April 4, 2007

**Be it enacted by the General Assembly of Virginia:**

**1. That the Code of Virginia is amended by adding a section numbered 15.2-968.1 as follows:**

*§ 15.2-968.1. Use of photo-monitoring systems to enforce traffic light signals.*

*A. The governing body of any county, city, or town may provide by ordinance for the establishment of a traffic signal enforcement program imposing monetary liability on the operator of a motor vehicle for failure to comply with traffic light signals in such locality in accordance with the provisions of this section. Each such locality may install and operate traffic light signal photo-monitoring systems at no more than one intersection for every 10,000 residents within each county, city, or town at any one time, provided, however, that within planning District 8, each study locality may install and operate traffic light signal photo-monitoring systems at no more than 10 intersections, or at no more than one intersection for every 10,000 residents within each county, city, or town, whichever is greater, at any one time.*

*B. The operator of a vehicle shall be liable for a monetary penalty imposed pursuant to this section if such vehicle is found, as evidenced by information obtained from a traffic light signal violation monitoring system, to have failed to comply with a traffic light signal within such locality.*

*C. Proof of a violation of this section shall be evidenced by information obtained from a traffic light signal violation monitoring system authorized pursuant to this section. A certificate, sworn to or affirmed by a law-enforcement officer employed by a locality authorized to impose penalties pursuant to this section, or a facsimile thereof, based upon inspection of photographs, microphotographs, videotape, or other recorded images produced by a traffic light signal violation monitoring system, shall be prima facie evidence of the facts contained therein. Any photographs, microphotographs, videotape, or other recorded images evidencing such a violation shall be available for inspection in any proceeding to adjudicate the liability for such violation pursuant to an ordinance adopted pursuant to this section.*

*D. In the prosecution for a violation of any local ordinance adopted as provided in this section, prima facie evidence that the vehicle described in the summons issued pursuant to this section was operated in violation of such ordinance, together with proof that the defendant was at the time of such violation the owner, lessee, or renter of the vehicle, shall constitute in evidence a rebuttable presumption that such owner, lessee, or renter of the vehicle was the person who committed the violation. Such presumption shall be rebutted if the owner, lessee, or renter of the vehicle (i) files an affidavit by regular mail with the clerk of the general district court that he was not the operator of the vehicle at the time of the alleged violation or (ii) testifies in open court under oath that he was not the operator of the vehicle at the time of the alleged violation. Such presumption shall also be rebutted if a certified copy of a police report, showing that the vehicle had been reported to the police as stolen prior to the time of the alleged violation of this section, is presented, prior to the return date established on the summons issued pursuant to this section, to the court adjudicating the alleged violation.*

*E. For purposes of this section, "owner" means the registered owner of such vehicle on record with the Department of Motor Vehicles. For purposes of this section, "traffic light signal violation monitoring system" means a vehicle sensor installed to work in conjunction with a traffic light that automatically produces two or more photographs, two or more microphotographs, video, or other recorded images of each vehicle at the time it is used or operated in violation of § 46.2-833, 46.2-835, or 46.2-836. For each such vehicle, at least one recorded image shall be of the vehicle before it has illegally entered the intersection, and at least one recorded image shall be of the same vehicle after it has illegally entered that intersection.*

*F. Imposition of a penalty pursuant to this section shall not be deemed a conviction as an operator and shall not be made part of the operating record of the person upon whom such liability is imposed, nor shall it be used for insurance purposes in the provision of motor vehicle insurance coverage. No monetary penalty imposed under this section shall exceed $50, nor shall it include court costs.*

*G. A summons for a violation of this section may be executed pursuant to § 19.2-76.2. Notwithstanding the provisions of § 19.2-76, a summons for a violation of this section may be executed by mailing by first class mail a copy thereof to the owner, lessee, or renter of the vehicle. In the case of a vehicle owner, the copy shall be mailed to the address contained in the records of the Department of Motor Vehicles; in the case of a vehicle lessee or rentor,*

*the copy shall be mailed to the address contained in the records of the lessor or rentor. Every such mailing shall include, in addition to the summons, a notice of (i) the summoned person's ability to rebut the presumption that he was the operator of the vehicle at the time of the alleged violation through the filing of an affidavit as provided in subsection D and (ii) instructions for filing such affidavit, including the address to which the affidavit is to be sent. If the summoned person fails to appear on the date of return set out in the summons mailed pursuant to this section, the summons shall be executed in the manner set out in § 19.2-76.3. No proceedings for contempt or arrest of a person summoned by mailing shall be instituted for failure to appear on the return date of the summons. Any summons executed for a violation of this section shall provide to the person summoned at least 60 business days from the mailing of the summons to inspect information collected by a traffic light signal violation monitoring system in connection with the violation.*

*H. Information collected by a traffic light signal violation monitoring system installed and operated pursuant to subsection A shall be limited exclusively to that information that is necessary for the enforcement of traffic light violations. On behalf of a locality, a private entity may not obtain records regarding the registered owners of vehicles that fail to comply with traffic light signals. Notwithstanding any other provision of law, all photographs, microphotographs, electronic images, or other personal information collected by a traffic light signal violation monitoring system shall be used exclusively for enforcing traffic light violations and shall not (i) be open to the public; (ii) be sold or used for sales, solicitation, or marketing purposes; (iii) be disclosed to any other entity except as may be necessary for the enforcement of a traffic light violation or to a vehicle owner or operator as part of a challenge to the violation; or (iv) be used in a court in a pending action or proceeding unless the action or proceeding relates to a violation of § 46.2-833, 46.2-835, or 46.2-836 or requested upon order from a court of competent jurisdiction. Information collected under this section pertaining to a specific violation shall be purged and not retained later than 60 days after the collection of any civil penalties. If a locality does not execute a summons for a violation of this section within 10 business days, all information collected pertaining to that suspected violation shall be purged within two business days. Any locality operating a traffic light signal violation monitoring system shall annually certify compliance with this section and make all records pertaining to such system available for inspection and audit by the Commonwealth Transportation Commissioner or the Commissioner of the Department of Motor Vehicles or his designee. Any person who discloses personal information in violation of the provisions of this subsection shall be subject to a civil penalty of $1,000.*

*I. A private entity may enter into an agreement with a locality to be compensated for providing the traffic light signal violation monitoring system or equipment, and all related support services, to include consulting, operations and administration. However, only a law-enforcement officer employed by a locality may swear to or affirm the certificate required by subsection C. No locality shall enter into an agreement for compensation based on the number of violations or monetary penalties imposed.*

*J. When selecting potential intersections for a traffic light signal violation monitoring system, a locality shall consider factors such as (i) the accident rate for the intersection, (ii) the rate of red light violations occurring at the intersection (number of violations per number of vehicles), (iii) the difficulty experienced by law-enforcement officers in patrol cars or on foot in apprehending violators, and (iv) the ability of law-enforcement officers to apprehend violators safely within a reasonable distance from the violation. Localities may consider the risk to pedestrians as a factor, if applicable. A locality shall submit a list of intersections to the Virginia Department of Transportation for final approval.*

*K. Before the implementation of a traffic light signal violation monitoring system at an intersection, the locality shall complete an engineering safety analysis that addresses signal timing and other location-specific safety features. The length of the yellow phase shall be established based on the recommended methodology of the Institute of Transportation Engineers. All traffic light signal violation monitoring systems shall provide a minimum 0.5-second grace period between the time the signal turns red and the time the first violation is recorded. If recommended by the engineering safety analysis, the locality shall make reasonable location-specific safety improvements, including signs and pavement markings.*

*L. Any locality that uses a traffic light signal violation monitoring system shall evaluate the system on a monthly basis to ensure all cameras and traffic signals are functioning properly. Evaluation results shall be made available to the public.*

*M. Any locality that uses a traffic light signal violation monitoring system to enforce traffic light signals shall place conspicuous signs within 500 feet of the intersection approach at which a traffic light signal violation monitoring system is used. There shall be a rebuttable presumption that such signs were in place at the time of the commission of the traffic light signal violation.*

*N. Prior to or coincident with the implementation or expansion of a traffic light signal violation monitoring system, a locality shall conduct a public awareness program, advising the public that the locality is implementing or expanding a traffic light signal violation monitoring system.*

February 19, 2008
*Revised August 26, 2009*

# APPENDIX B

## NUMBER OF ALLOWABLE PHOTO ENFORCED INTERSECTIONS PER LOCALITY

# Number of Allowable Photo Enforced Intersections (by County)

| Jurisdiction | 2005 Population | Potential Number of Intersections | VDOT Operations Region | VDOT Construction District |
|---|---|---|---|---|
| Accomack | 39,100 | 3 | Eastern | Hampton Roads |
| Albemarle | 90,400 | 9 | Northwestern | Culpeper |
| Alleghany | 17,200 | 1 | Northwestern | Staunton |
| Amelia | 9,875 | 0 | Central | Richmond |
| Amherst | 32,201 | 3 | Southwestern | Lynchburg |
| Appomattox | 12,640 | 1 | Southwestern | Lynchburg |
| Arlington | 195,600 | 19 | Northern | Nova |
| Augusta | 69,916 | 6 | Northwestern | Staunton |
| Bath | 4,900 | 0 | Northwestern | Staunton |
| Bedford | 63,600 | 6 | Southwestern | Salem |
| Bland | 7,100 | 0 | Southwestern | Bristol |
| Botetourt | 31,800 | 3 | Southwestern | Salem |
| Brunswick | 18,400 | 1 | Central | Richmond |
| Buchanan | 25,300 | 2 | Southwestern | Bristol |
| Buckingham | 16,200 | 1 | Central | Lynchburg |
| Campbell | 51,300 | 5 | Southwestern | Lynchburg |
| Caroline | 24,300 | 2 | Central | Fredericksburg |
| Carroll | 29,700 | 2 | Southwestern | Salem |
| Charles City | 6,800 | 0 | Central | Richmond |
| Charlotte | 12,700 | 1 | Central | Lynchburg |
| Chesterfield | 286,500 | 28 | Central | Richmond |
| Clarke | 13,900 | 1 | Northwestern | Staunton |
| Craig | 5,100 | 0 | Southwestern | Salem |
| Culpeper | 29,153 | 2 | Northern | Culpeper |
| Cumberland | 9,500 | 0 | Central | Lynchburg |
| Dickenson | 16,500 | 1 | Southwestern | Bristol |
| Dinwiddie | 25,800 | 2 | Central | Richmond |
| Essex | 10,300 | 1 | Central | Fredericksburg |
| Fairfax | 985,087 | 98 | Northern | Nova |
| Fauquier | 62,900 | 6 | Northern | Culpeper |
| Floyd | 14,800 | 1 | Southwestern | Salem |
| Fluvanna | 24,900 | 2 | Northwestern | Culpeper |
| Franklin | 50,100 | 5 | Southwestern | Salem |
| Frederick | 67,600 | 6 | Northwestern | Staunton |
| Giles | 16,500 | 1 | Southwestern | Salem |
| Gloucester | 35,700 | 3 | Eastern | Fredericksburg |
| Goochland | 19,300 | 1 | Central | Richmond |
| Grayson | 16,600 | 1 | Southwestern | Bristol |
| Greene | 16,900 | 1 | Northwestern | Culpeper |
| Greensville | 12,300 | 1 | Eastern | Hampton Roads |
| Halifax | 36,700 | 3 | Central | Lynchburg |
| Hanover | 95,100 | 9 | Central | Richmond |
| Henrico | 283,300 | 28 | Central | Richmond |
| Henry | 55,100 | 5 | Southwestern | Salem |

**Number of Allowable Photo Enforced Intersections (by County) - continued –**

| Jurisdiction | 2005 Population | Potential Number of Intersections | VDOT Operations Region | VDOT Construction District |
|---|---|---|---|---|
| Highland | 2,400 | 0 | Northwestern | Staunton |
| Isle of Wight | 32,200 | 3 | Eastern | Hampton Roads |
| James City | 56,600 | 5 | Eastern | Hampton Roads |
| King and Queen | 6,900 | 0 | Central | Fredericksburg |
| King George | 20,000 | 2 | Northern | Fredericksburg |
| King William | 14,400 | 1 | Central | Fredericksburg |
| Lancaster | 11,500 | 0 | Central | Fredericksburg |
| Lee | 25,300 | 2 | Southwestern | Bristol |
| Loudoun | 207,829 | 20 | Northern | Nova |
| Louisa | 28,700 | 2 | Northwestern | Culpeper |
| Lunenburg | 13,100 | 1 | Central | Richmond |
| Madison | 13,500 | 1 | Northern | Culpeper |
| Mathews | 9,400 | 0 | Eastern | Fredericksburg |
| Mecklenburg | 32,600 | 3 | Central | Richmond |
| Middlesex | 10,200 | 1 | Eastern | Fredericksburg |
| Montgomery | 30,844 | 3 | Southwestern | Salem |
| Nelson | 15,000 | 1 | Southwestern | Lynchburg |
| New Kent | 15,700 | 1 | Central | Richmond |
| Northampton | 13,200 | 1 | Eastern | Hampton Roads |
| Northumberland | 12,900 | 1 | Central | Fredericksburg |
| Nottoway | 15,800 | 1 | Central | Richmond |
| Orange | 29,300 | 2 | Northern | Culpeper |
| Page | 24,000 | 2 | Northwestern | Staunton |
| Patrick | 19,400 | 1 | Southwestern | Salem |
| Pittsylvania | 61,800 | 6 | Southwestern | Lynchburg |
| Powhatan | 25,800 | 2 | Central | Richmond |
| Prince Edward | 20,400 | 2 | Central | Lynchburg |
| Prince George | 36,900 | 3 | Central | Richmond |
| Prince William | 348,022 | 34 | Northern | Nova |
| Pulaski | 34,400 | 3 | Southwestern | Salem |
| Rappahannock | 7,000 | 0 | Northern | Culpeper |
| Richmond | 9,500 | 0 | Central | Fredericksburg |
| Roanoke | 90,000 | 9 | Southwestern | Salem |
| Rockbridge | 21,500 | 2 | Northwestern | Staunton |
| Rockingham | 73,768 | 7 | Northwestern | Staunton |
| Russell | 29,100 | 2 | Southwestern | Bristol |
| Scott | 23,600 | 2 | Southwestern | Bristol |
| Shenandoah | 38,900 | 3 | Northwestern | Staunton |
| Smyth | 32,300 | 3 | Southwestern | Bristol |
| Southampton | 17,900 | 1 | Eastern | Hampton Roads |
| Spotsylvania | 114,000 | 11 | Northern | Fredericksburg |
| Stafford | 117,300 | 11 | Northern | Fredericksburg |
| Surry | 6,900 | 0 | Eastern | Hampton Roads |
| Sussex | 12,000 | 1 | Eastern | Hampton Roads |

**Number of Allowable Photo Enforced Intersections (by County) - continued –**

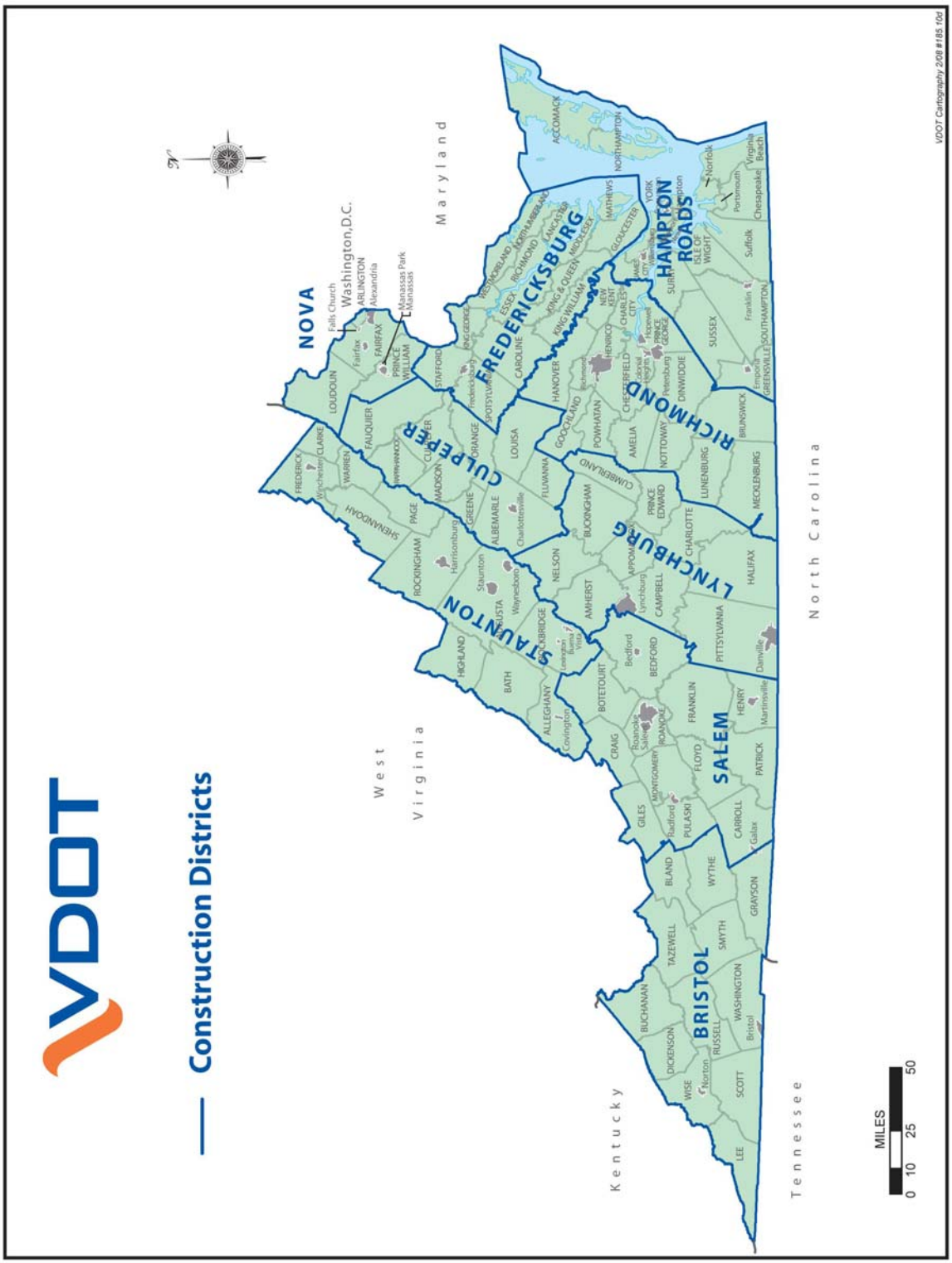
| Jurisdiction | 2005 Population | Potential Number of Intersections | VDOT Operations Region | VDOT Construction District |
|---|---|---|---|---|
| Tazewell | 44,100 | 4 | Southwestern | Bristol |
| Warren | 19,801 | 1 | Northwestern | Staunton |
| Washington | 52,100 | 5 | Southwestern | Bristol |
| Westmoreland | 16,700 | 1 | Central | Fredericksburg |
| Wise | 41,700 | 4 | Southwestern | Bristol |
| Wythe | 27,700 | 2 | Southwestern | Bristol |
| York | 62,100 | 6 | Eastern | Hampton Roads |
| **TOTAL** | | **451** | | |

# Number of Allowable Photo Enforced Intersections (by City)

| Jurisdiction | 2005 Population | Potential Number of Intersections | VDOT Operations Region | VDOT Construction District |
|---|---|---|---|---|
| Alexandria | 135,200 | 13 | Northern | Nova |
| Bedford | 6,200 | 0 | Southwestern | Salem |
| Bristol | 17,400 | 1 | Southwestern | Bristol |
| Buena Vista | 6,500 | 0 | Northwestern | Staunton |
| Charlottesville | 39,900 | 3 | Northwestern | Culpeper |
| Chesapeake | 213,400 | 21 | Eastern | Hampton Roads |
| Colonial Heights | 17,300 | 1 | Central | Richmond |
| Covington | 5,800 | 0 | Northwestern | Staunton |
| Danville | 46,400 | 4 | Southwestern | Lynchburg |
| Emporia | 5,500 | 0 | Eastern | Hampton Roads |
| Fairfax | 22,700 | 10 | Northern | Nova |
| Falls Church | 10,800 | 10 | Northern | Nova |
| Franklin | 8,400 | 0 | Eastern | Hampton Roads |
| Fredericksburg | 21,200 | 2 | Northern | Fredericksburg |
| Galax | 6,900 | 0 | Southwestern | Salem |
| Hampton | 145,500 | 14 | Eastern | Hampton Roads |
| Harrisonburg | 43,500 | 4 | Northwestern | Staunton |
| Hopewell | 22,500 | 2 | Central | Richmond |
| Lexington | 7,000 | 0 | Northwestern | Staunton |
| Lynchburg | 68,000 | 6 | Southwestern | Lynchburg |
| Manassas | 36,700 | 10 | Northern | Nova |
| Manassas Park | 13,100 | 10 | Northern | Nova |
| Martinsville | 14,700 | 1 | Southwestern | Salem |
| Newport News | 182,200 | 18 | Eastern | Hampton Roads |
| Norfolk | 235,500 | 23 | Eastern | Hampton Roads |
| Norton | 3,900 | 0 | Southwestern | Bristol |
| Petersburg | 31,300 | 3 | Central | Richmond |
| Poquoson | 11,900 | 1 | Eastern | Hampton Roads |
| Portsmouth | 98,800 | 9 | Eastern | Hampton Roads |
| Radford | 15,500 | 1 | Southwestern | Salem |
| Richmond | 193,300 | 19 | Central | Richmond |
| Roanoke | 93,600 | 9 | Southwestern | Salem |
| Salem | 25,100 | 2 | Southwestern | Salem |
| Staunton | 23,100 | 2 | Northwestern | Staunton |
| Suffolk | 77,100 | 7 | Eastern | Hampton Roads |
| Virginia Beach | 435,600 | 43 | Eastern | Hampton Roads |
| Waynesboro | 20,000 | 2 | Northwestern | Staunton |
| Williamsburg | 13,400 | 1 | Eastern | Hampton Roads |
| Winchester | 25,700 | 2 | Northwestern | Staunton |
| **TOTAL** | | **254** | | |

# Number of Allowable Photo Enforced Intersections (by Town)

| Jurisdiction | 2005 Population | Potential Number of Intersections | VDOT Operations Region | VDOT Construction District |
|---|---|---|---|---|
| Blacksburg | 39,130 | 3 | Southwestern | Salem |
| Christiansburg | 17,926 | 1 | Southwestern | Salem |
| Clifton | 206 | 10 | Northern | Nova |
| Hamilton | 718 | 10 | Northern | Nova |
| Haymarket | 1,083 | 10 | Northern | Nova |
| Hillsboro | 125 | 10 | Northern | Nova |
| Leesburg | 36,269 | 10 | Northern | Nova |
| Lovettsville | 1,160 | 10 | Northern | Nova |
| Middleburg | 880 | 10 | Northern | Nova |
| Occoquan | 757 | 10 | Northern | Nova |
| Quantico | 622 | 10 | Northern | Nova |
| Round Hill | 639 | 10 | Northern | Nova |
| Culpeper | 12,047 | 1 | Northern | Culpeper |
| Dumfries | 4,816 | 10 | Northern | Nova |
| Front Royal | 14,499 | 1 | Northwestern | Staunton |
| Herndon | 21,965 | 10 | Northern | Nova |
| Purcellville | 4,680 | 10 | Northern | Nova |
| Vienna | 14,842 | 10 | Northern | Nova |
| **TOTAL** | | **146** | | |


VDOT
Construction Districts
NOVA
FREDERICKSBURG
HAMPTON ROADS
CULPEPER
RICHMOND
STAUNTON
LYNCHBURG
SALEM
BRISTOL
Maryland
West Virginia
Kentucky
Tennessee
North Carolina
MILES
0 10 25 50
VDOT Cartography 2/08 #185 10d

**Submit Engineering Safety Analyses to the following District Administrators (DAs):**

Bristol District
Ken Brittle
Acting District Administrator
870 Bonham Road
Bristol, VA 24201

Culpeper District
James S. Utterback
District Administrator
1601 Orange Road
Culpeper, VA 22701

Fredericksburg District
Quintin D. Elliott
District Administrator
87 Deacon Road
Fredericksburg, VA 22405

Hampton Roads District
Dennis W. Heuer, P.E.
District Administrator
1700 North Main Street
Suffolk, VA 23434

Lynchburg District
Rob Cary, P.E.
District Administrator
4219 Campbell Avenue
Lynchburg, VA 24501

Northern Virginia District (NOVA)
Morteza Salehi
District Administrator
14685 Avion Parkway
Chantilly, Virginia 20151-1104

Richmond District
Thomas A. Hawthorne, P.E.
District Administrator
2430 Pine Forest Drive
Colonial Heights, VA 23834

Salem District
Richard L. Caywood, P.E.
District Administrator
731 Harrison Avenue
Salem, VA 24153

Staunton District
Garrett W. Moore, P.E.
District Administrator
P.O. Box 2249
811 Commerce Road
Staunton, VA 24401

February 19, 2008
*Revised August 26, 2009*

# APPENDIX C

# REFERENCE DOCUMENTS

# REFERENCES

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

*Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running*, Federal Highway Administration and Institute of Transportation Engineers, Washington, DC, 2003.

*Field Guide for Inspecting Signalized Intersection to Reduce Red-Light Running*, Federal Highway Administration and Institute of Transportation Engineers, Washington, DC, 2003.

*Intersection Safety Briefs*, Federal Highway Administration and Institute of Transportation Engineers, Washington, DC, 2004.
http://www.ite.org/library/IntersectionSafety/BriefingSheets.pdf

*Determining Vehicle Signal Change and Clearance Intervals*, An Informational Report of the Institute of Transportation Engineers, Prepared by ITE Technical Council Task Force 4TF-1ITE, Washington, DC, August 1994.

*Manual on Uniform Traffic Control Devices for Streets and Highways*, 2003 Edition, Federal Highway Administration, Washington, DC, 2003.

*A Policy on Geometric Design of Highways and Streets*, American Association of State Highway Transportation Officials, Washington, DC, 2001.

Garber, N.J., et. al., *An Evaluation of Red Light Camera (Photo-Red) Enforcement Programs in Virginia: A Report in Response to a Request By Virginia's Secretary of Transportation*, Virginia Transportation Research Council, Charlottesville, VA, January 2005.

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Retting, R.A., A.F. Williams, C.M. Farmer, and A.F. Feldman, "Evaluation of Red Light Camera Enforcement in Fairfax, Virginia," ITE Journal, October 1998, pp. 30-34

A. Kamyab et. al., *Red Light Running in Iowa: The Scope Impact and Possible Implications*, Final Report, Center for Transportation Research and Education, Ames, Iowa, 2000.

J.S. Milazzo, J.E. Hummer and L.M. Prothe, *A Recommended Policy of Automated Electronic Traffic Enforcement of Red-Light Running Violations in North Carolina*, North Carolina Governor's Highway Safety Program, North Carolina State University, 2001.

Lockwood, M., and Kastenhofer, I., *Evaluation of Traffic Engineering Aspects of Photo Monitoring Programs in Virginia*, Virginia Department of Transportation, Richmond, VA, May 2002

Council, F.M., B. Persaud, K. Eccles, C. Lyon, and M.S. Griffith. *Safety Evaluation of Red-Light Cameras*. Washington, DC: Federal Highway Administration, Report No. FHWA-HRT-05-048, April 2005.

February 19, 2008
*Revised August 26, 2009*

# APPENDIX D

# ENGINEERING SAFETY ANALYSIS TEMPLATE

February 19, 2008
*Revised August 26, 2009*

# VDOT
# Traffic Signal Photo Enforcement
# Engineering Analysis Template

Local Jurisdiction: _____ VDOT District:_____
(County/City/Town)

Intersection: _____
Street Name (Route #) at Street Name (Route #)

This Study performed under the direction of _____
(licensed professional engineer)

## A. INTERSECTION & SIGNAL DATA

1. Signal Visibility

a. Minimum Sight Distance to Signal

| Approach | Grade | Speed Limit (mph) | Measure (ft) | Required (ft)* |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

*See attached table of minimum sight distance requirements from the MUTCD.

b. Are "SIGNAL AHEAD" signs present? ☐ Yes ☐ No
Are "SIGNAL AHEAD" signs needed? ☐ Yes ☐ No
Are other warning signs present in the vicinity of the intersection? ☐ Yes ☐ No
Explain: _____
_____

c. Information on Signal Heads

| Approach | Lens Size | Lens Type (LED or Bulb) | Back Plates (Yes or No) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

2. Pavement and Markings Data

a. Stop bars in "good" condition? ☐ Yes ☐ No
Explain: _____
_____

b. Lane lines "clearly" visible? ☐ Yes ☐ No
Explain: _____
_____

c. Crosswalks "clearly" marked? ☐ Yes ☐ No
Explain: _____
_____

d. Pavement conditions (ruts, potholes, cracking, etc.)?

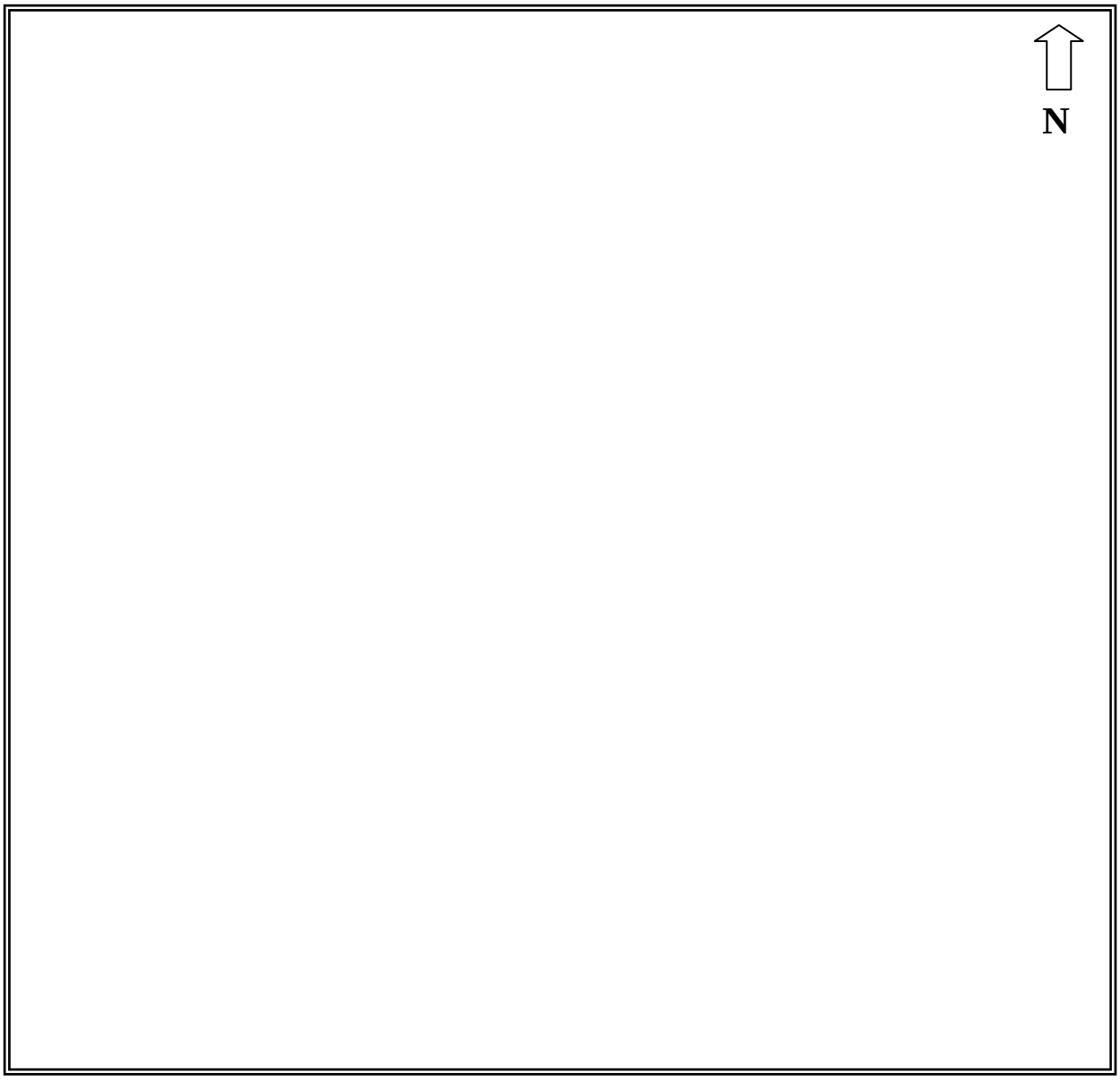
☐ Good Explain: _____
☐ Fair Explain: _____
☐ Poor Explain: _____

e. Pavement surface treatments exist? (rumble strips, texturing, pavers, etc.)

☐ Yes Explain: _____
_____

☐ No

3. Provide diagram of intersection including: pavement markings, width of lanes and medians, location of signal heads and signs, locations of loops/detectors, and grades.



## B. SIGNAL TIMING & TRAFFIC DATA

1. Clearance Intervals

| Approach | Posted Speed Limit | Grade | Width of Intersection | Yellow Interval | | All Red Interval | |
|---|---|---|---|---|---|---|---|
| | | | | Existing | Calculated* | Existing | Calculated* |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

*Reference TE Memo 306 provided in Appendix E for calculation of Clearance Intervals

2. Include existing controller settings for each phase and each time-of-day. Information should include applicable settings such as minimum green, max 1 & 2, passage, minimum gap/ext, protected-permissive, lead-lag, yellow and all red, walk and ped clearance time, recall settings, offsets, cycle length, etc. Include analysis of peak hour conditions and a determination of whether signal timings are contributing to red-light running problem.

a. Does signal timing or phasing factor in as a possible contributor to RLR at this intersection?

☐ Yes Explain: _____

_____

☐ No

b. List comments or recommendations on potential signal timing or phasing changes:

_____

_____

_____

3. Vehicle Detection Data

| Approach | Detection Type (loop, video, etc.) | Detector Location (measured from stop bar) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

4. Traffic Volume Data

| Approach | Daily Volumes | | Peak Hour Volumes | |
|---|---|---|---|---|
| | Total | Heavy Vehicles | Total | Heavy Vehicles |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## C. CRASH & ENFORCEMENT DATA

1. Three-Year Crash Data

| Collision Type | 3-year Total | Number of Injury Crashes | Number of Fatal Crashes | Crashes Associated With Red-Light-Running |
|---|---|---|---|---|
| Angle | | | | |
| Rear End | | | | |
| Head On | | | | |
| Sidewsipe | | | | |
| Pedestrian | | | | |
| Bicyclist | | | | |
| **TOTAL** | | | | |

2. Crash Rate
   a. Number of crashes per million entering vehicles: _____
   b. Locality rate for comparison (if available): _____

3. Violation Rate
   a. Number of red light running citations per year issued by law enforcement at the evaluated intersection, if available.
   Number: _____ Year: _____

   b. Observed Violations
   Date: _____
   Time Period: _____

| Approach | Traffic Volume | Number of Violations |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

4. Enforcement and Operational Issues
   a. Describe the difficulty experienced by law enforcement officers in patrol cars or on foot in apprehending violators.
   _____
   _____

   b. Describe the ability of law enforcement officers to apprehend violators safely within a reasonable distance from the violation.
   _____
   _____

   c. Are pedestrians at risk due to violations? ☐ Yes ☐ No
   Explain: _____
   _____

   Number of pedestrians per hour? _____
   Pedestrian crosswalk provided? ☐ Yes ☐ No

   d. Have there been any changes to the operations of the intersection (signal timing, restriping, or increased enforcement) within the past three years? ☐ Yes ☐ No
   Explain: _____
   _____

**Minimum Sight Distance**

| **85th Percentile Speed (mph)** | **Minimum Sight Distance (ft)** |
|---|---|
| 20 | 175 |
| 25 | 215 |
| 30 | 270 |
| 35 | 325 |
| 40 | 390 |
| 45 | 460 |
| 50 | 540 |
| 55 | 625 |
| 60 | 715 |

Table 4D-1 *Manual on Uniform Traffic Control Devices,* (Revision 1, Nov 2004) Transportation Research Board (TRB), Washington, DC, 2003

February 19, 2008
*Revised August 26, 2009*

# APPENDIX E

# CLEARANCE INTERVAL CALCULATIONS (TE MEMO 306)

February 19, 2008
*Revised August 26, 2009*

**VIRGINIA DEPARTMENT OF TRANSPORTATION**

# *TRAFFIC ENGINEERING DIVISION*

## MEMORANDUM

| | |
|---|---|
| **GENERAL SUBJECT:** Traffic Signals | **NUMBER:** 306 |
| | **DATE:** August 16, 2001 |
| **SPECIFIC SUBJECT:** Calculation of Clearance Intervals | **SUPERSEDES:** |
| **DIRECTED TO:** District Administrators | **SIGNATURE:** Ilona O. Kastenhofer |

In an effort to establish consistency throughout the Commonwealth, this memorandum will govern the method in which the timing of the yellow change intervals and all red intervals is established.

The formula recommended by the Institute of Transportation Engineers will be employed in the following manner:

$$\textbf{yellow change interval} = t + V/(2a \pm 64.4g)$$

where:

- **yellow change interval** = the length of the yellow phase and is expressed in seconds.
- **t** = the perception reaction time expressed in seconds. This is 1 second unless the engineer responsible determines that the situation warrants increasing it to 1.5 seconds.
- **V** = the posted speed expressed in feet/second.
- **a** = the deceleration rate expressed in feet/second$^2$. This should be 10 ft/sec$^2$ under typical conditions. Engineers may decrease this to 8 or 9 feet/second$^2$ if conditions warrant such as heavy truck traffic or increase to 11 or 12 feet/second$^2$ if warranted.
- **g=** the grade of approach (percent/100); use + for a positive grade and – for a negative grade
- minimum yellow time should be 3 seconds and the maximum should be 6 seconds.

## all red interval = (w+l)/V

where:

- **all red interval** = the length of the all red phase expressed in seconds, and follows the yellow change interval.
- **w** = width of intersection, curb to curb expressed in feet.
- **l** = vehicle length, taken as 20 feet.
- **V** = posted speed in feet/second.
- minimum all red interval should be 1 second and the maximum should be 3 seconds. Longer all reds can be used at the engineer's discretion where extreme conditions warrant.

## General

- all timings will be calculated to the nearest tenth of a second
- if rounding to the nearest half second is desired, it should be done in the following manner:

.0 to .1 – rounded down to whole number
.2, .3, .4 – rounded up to next half second
.6 – rounded down to half second
.7, .8, .9 rounded up to next whole number

**In all cases of developing signal timings, engineering judgment governs final decisions.**

cc: Mr. Charles D. Nottingham
Mr. A. V. Bailey, II
Mr. T. F. Boyd
Mr. Claude D. Garver, Jr.
Ms. C. S. Sorrell
Mr. J. C. Southard
Mr. C. F. Gee
Mr. Roberto Fonseca
Division Administrators
Resident Engineers
District Traffic Engineers
Ms. Kathe Jefferson
Mr. Dan Dennis