



# **Highway Safety Improvement Program (HSIP)**

**Fiscal Year 2010-11**

**Highway Safety Improvement Program (HSIP) – § 23 USC Section 148**

**Bicycle and Pedestrian Safety Program (BPSP)**

**Highway-Rail Grade Crossing Safety Program (H-RGCP) – § 23 USC Section 130**

**Traffic Engineering Division  
Virginia Department of Transportation  
Revised May 2009**

# Highway Safety Improvement Program

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# Chapter 1 Highway Safety Improvement Program (HSIP)

## 1.1 Program Overview

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorizes the Federal surface transportation programs for highways, highway safety, and transit from 2005-2009. SAFETEA-LU establishes a new core Highway Safety Improvement Program (HSIP) that is structured and funded to make significant progress in reducing highway fatalities and injuries. It also creates a positive agenda for increased safety on our highways. A considerable increase in funding is provided that is almost double the amount under TEA-21. States will be required to develop and implement an effective, integrated and coordinated Strategic Highway Safety Plan (SHSP) that involves a comprehensive, data driven approach to highway safety. Section 1401 of SAFETEA-LU includes the program and policy language for implementing the new HSIP which is coded in the new Section 148 of Title 23 of the United States Code (23USC148). The code continues Highway-Rail Grade Crossing Safety Program in Section 130, with dedicated set-aside funding, as part of the HSIP.

The Virginia Department of Transportation (VDOT) has developed a HSIP that involves the identification of problem safety areas, an analysis of problems and countermeasures, and the prioritization and scheduling of improvement projects. VDOT's HSIP program consists of the following programs: **Highway Safety Program (HSP)**, **High Risk Rural Roads Program (HRRRP)**, **Highway-Rail Grade Crossing Safety Program (H-RGCP)**, and **Bicycle and Pedestrian Safety Program (BPSP)**. The HRRRP is a set-aside of the HSIP funds for rural major collectors and below. Separate guidelines are provided in the web document at TED website. The BPSP was initiated in 2003 to dedicate resources to the most vulnerable highway users and will be funded out of Section 148 allocations (See Chapter 4).

**1.2 Program Administration** The VDOT Traffic Engineering Division (TED) serves as the focal point for administration of the Federal and State categorical safety programs (HSIP) within the Commonwealth of Virginia.

VDOT continues to implement an annual competitive application process for prioritizing and funding safety projects within the Commonwealth. Local governments, railroad companies, and VDOT Districts and Residencies submit applications for locations they recommend for improvement. The applications are evaluated on a statewide basis rather than on a local or district basis, to ensure that locations in need of improvement have a better opportunity to be selected and funded. The candidate projects compete against their respective counterparts for funding, based on a benefit/cost analysis for motorized highway improvements and on risk assessments for non-motorized and highway-rail grade crossing improvements.

VDOT's HSIP has set aside funds for lower cost improvements that can be implemented quickly. Treatments with minimal right of way and utility impacts that are typically traffic control device and roadway upgrades within the existing cross-section

may be proposed throughout the year. Such improvements have been labeled as Proactive Projects since they should follow a systematic approach to reduce crashes and risk. However, these systematic improvements must be implemented following a crash data driven approach as outlined in the web document Proactive HSIP Projects at TED website.

### **1.3 Program Funding**

The Highway Safety Improvement Program is now a core program with a specific set –aside for rail safety (23USC130). Nationally, SAFETEA-LU provides over \$5.06 billion for HSIP over four years – FY'06 through FY'09 and about \$220 million each year for H-RGCP. These are significant increases over TEA-21 funding that totaled \$3.97 billion over 6 years. New HSIP apportionment formula includes a factor on the ratio of the number of fatalities on each State's Federal-Aid System to total fatalities, the ratios of lane miles and vehicle miles traveled to national totals on each State's Federal-Aid Highways. For FY2010-11 Virginia is expecting to receive about \$33 million for HSIP and \$4.5 million for H-RGCP. A minimum of ten percent of the HSIP allocation will be set-aside funds for BPS program improvements. HRRR program receives about \$2.0 million each year.

Federal-aid projects are reimbursable for costs incurred. Requests for reimbursement must be submitted to VDOT for processing.

### **1.4 Program Contacts**

For additional information regarding the Highway Safety Improvement Program, please visit VDOT Traffic Engineering Division website (shown below) or contact:

Stephen Read, Highway Safety Improvement Programs Manager  
Traffic Engineering Division  
Virginia Department of Transportation  
1401 East Broad Street  
Richmond, VA 23219  
[HSIPProgram@VirginiaDOT.org](mailto:HSIPProgram@VirginiaDOT.org)  
Phone: (804) 786-9094  
Fax: 804-225-2448  
TTY711

*HSP and BPS Programs: Mr. Tracy Turpin, Phone (804) 786-6610*

*H-RGC Program: Mr. Michael Wray, Phone (804) 786-2822*

#### **VDOT Traffic Engineering Division website**

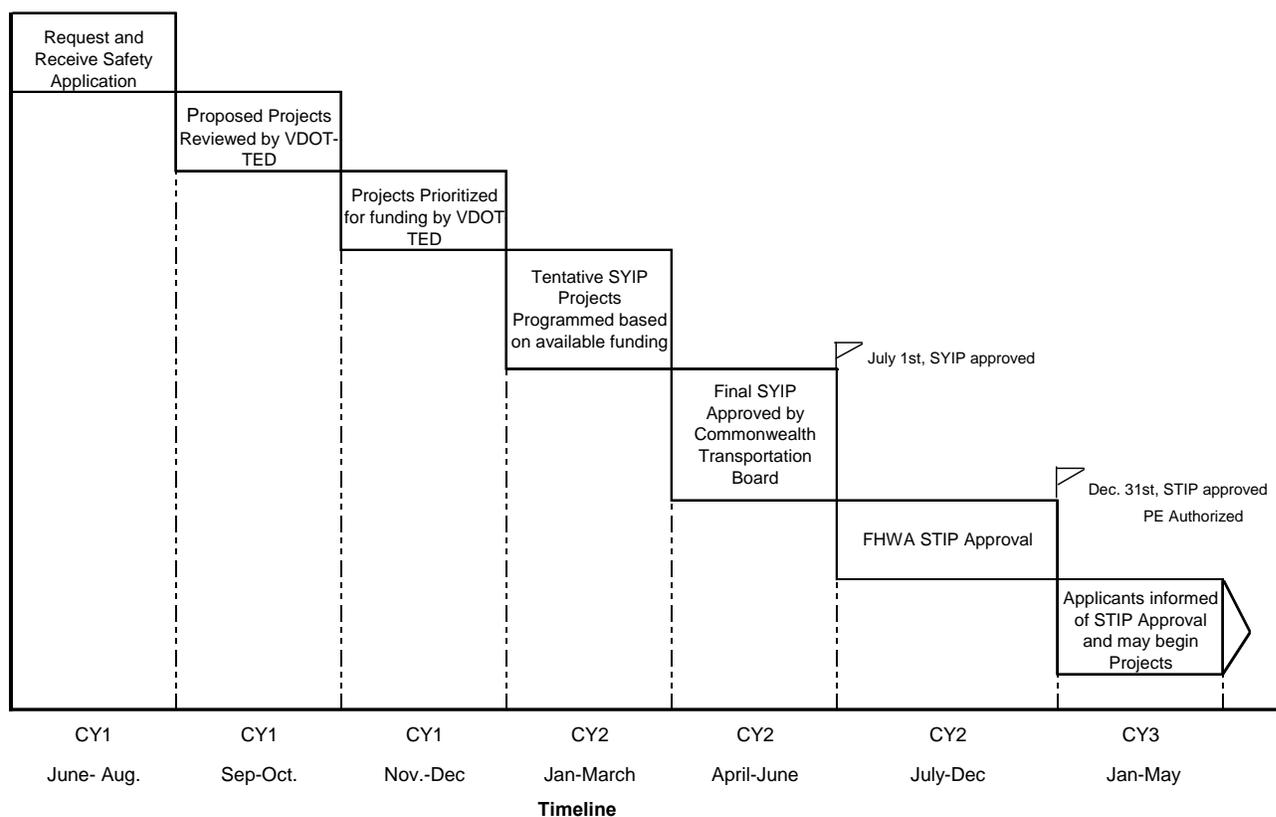
[www.virginiadot.org/business/trafficeng-default.asp](http://www.virginiadot.org/business/trafficeng-default.asp)

## Chapter 2 HSIP Project Life Cycle

### 2.1 Project Application

#### 2.1.1 Schedule

The HSIP annual application schedule follows both the federal and Virginia's fiscal years as shown in Figure 2-1. **Applications for FY 2009-10 HSIP projects will be accepted through September 1<sup>st</sup>, 2009.** Approximately 14-18 months are needed before safety projects can receive FHWA approval to begin the project. At the end of each Virginia fiscal year (FY), safety improvement applications are solicited for inclusion in the Six-Year Improvement Program (SYIP) of the following year. It is anticipated the incorporating the SYIP into the STIP for Federal Highway Administration (FHWA) approval will require an additional 6 months after Commonwealth Transportation Board approval of the SYIP (Virginia FY). After approval of the STIP, applicants are notified, funds must be authorized for preliminary engineering, and work on HSIP projects can begin. **Reimbursement cannot be requested for any work done prior to authorization by the Programming Division.**



Note: The FHWA STIP is approved for obligation and expenditures in the federal October to September fiscal year.

The Traffic Engineering Division (TED) will ensure, via the appropriate liaison and posting funded projects on the VDOT website, that each locality is notified whether or not a project has been selected for funding after the CTB approval.

- For urban areas - the Local Assistance Division will be the liaison between TED and the cities and towns.
- For secondary road projects - the TED will notify the resident engineers/administrators of approved projects.
- For all other projects - the TED will notify the applicant whether the projects have been approved or not approved for funding. Those projects not approved for funding may be resubmitted for consideration.

### **2.1.2 Eligibility and Requirements**

The eligibility criteria and procedures vary for the three safety programs. Generally speaking, the highway safety program requires a Benefit/Cost analysis at high crash locations while Railway and Bicycle & Pedestrian Safety Program requires a risk analysis. Please refer to the corresponding chapters for information on eligibility, funding limit, requirements and application procedures for each program.

**HSIP applicants are required to submit electronic version of some application documents in addition to a signed hardcopy.** Electronic application forms can be downloaded from VDOT traffic engineering website. ([www.virginiadot.org/business/trafficeng-default.asp](http://www.virginiadot.org/business/trafficeng-default.asp)). Please refer to the corresponding chapters for electronic submission requirements for each program under HSIP.

**HSIP applicants are required to rank multiple applications from a safety point of view for each safety program (HSP, BPSP and H-RGCP). The priority number will be reflected in the application form as well as the electronic documentation name.**

**Please refer to Appendix E for application checklist of each program.**

## **2.2 Project Development**

The implementation of projects involves phases of preliminary engineering, right-of-way acquisition, and construction. Throughout the project development process applicants must work with the project managers and/or coordinators to ensure that the scope and cost of the project do not increase beyond that which was identified on the application. If additional improvements are appropriate at the same location, the applicant should consider submitting another safety application or exploring other funding resources to cover the related project. The related project may be coordinated and/or advertised with the safety project.

Furthermore, project schedules must be minimized since a safety issue has been identified. The intent of the HSIP is to expend federal funds on safety improvements that can be designed and constructed within three years. **Projects should not require acquisition of significant rights of way, nor should they require extensive environmental review and mitigation.** Federal funds must be authorized within two months of the STIP approval. Applicants failing to get funds authorized within two

months must request a time extension from TED. Projects are subject to removal if the extension is not granted by TED.

## **2.3 Project Phases**

### ***2.3.1 Preliminary Engineering Phase***

Upon receipt of federal authorization for preliminary engineering, work can begin on the design of the HSIP project. The preliminary engineering phase includes project scoping and environmental documentation. Localities using a consultant for preliminary engineering must follow the required federal and state procedures for procuring professional services.

Within two months of authorizing preliminary engineering, an initial scoping meeting must be held to identify the project design elements, as well as to set project schedules. At that time the VDOT project manager or coordinator should determine if the target advertisement date and estimated costs are reasonable. If the target advertisement date or estimated costs are not reasonable and need to be changed, the TED Highway Safety Section must be notified.

Cities and Towns have the option of administering the design, advertisement and construction of their proposed safety project(s) or allowing VDOT to administer the project(s). If the City or Town elects to administer a project, then the locality must ensure that all VDOT and FHWA design, advertisement, contracting and construction requirements are satisfied. The City or Town must ensure that VDOT is kept apprised of the project's status, including updated estimates, planned advertisement dates, and other information. VDOT uses this information to coordinate funding and provide the required state and federal authorizations.

As with any federally funded project, HSIP projects are subject to required environmental analysis. Safety improvement projects typically involve very little environmental documentation since most projects qualify for "Programmatic Categorical Exclusion" or project specific "Categorical Exclusion". Projects with greater environmental impact, such as needed drainage improvements or projects in historic districts, require additional analysis and documentation.

### ***2.3.2 Right-of-Way Acquisition Phase***

**Projects should not require acquisition of significant rights of way, nor should they require extensive environmental review and mitigation.** Right-of-way acquisition may be authorized during the preliminary engineering phase. For no-plan and minimum plan projects, acquisition should adhere to VDOT R/W policy and procedures. Larger projects require approved right-of-way plans before right-of-way acquisition can begin.

### ***2.3.3 Construction Phase***

When preliminary engineering and right-of-way acquisition phases are completed on VDOT administered projects, the Scheduling and Contract Division prepares the

construction bid and contract documents. Programming Division secures authorization to advertise the project. The recommendation for the award of a project is made and is submitted to VDOT's commissioner for approval.

Federal regulations require all HSIP projects to be competitively bid. The only exception is when a "Cost Effectiveness Finding" is submitted to and approved by FHWA. The basis of this finding must be that VDOT state forces can construct the improvements at a considerably lower cost than advertising the project and receiving competitive bids. The finding must show both cost and time savings. Also, HSIP projects are not eligible for the Special Advertising and Award Process (SAAP).

Projects are also eligible for construction under an existing district-wide or locality-wide contract, provided the contract follows prescribed federal guidelines and have approval from the Commonwealth Transportation Board (CTB). Projects completed using regional contracts have generally included the installation of traffic control devices, such as pedestrian-activated signals.

## **2.4 Project Monitoring**

Once projects have been programmed and funds have been allocated, the VDOT-TED monitors the HSIP projects from inception to final voucher. The project monitoring process consists of tracking changes that occur to the following project functions: project advertisement dates, funding authorization dates, engineer's estimates and expenditures. TED will work with the applicant to recalculate the benefit to cost ratio (B/C) if project costs increase to determine if the project is eligible for additional HSIP funding. The B/C ratio used to qualify projects for federal funding based on which projects yield the greatest safety benefit per dollars spent. Attending field reviews, scoping meetings, reviewing and approving scoping reports may also be part of the monitoring process. The last phase of the project monitoring process is to evaluate and report the effectiveness to FHWA.

## **2.5 Program Evaluation**

VDOT is required to prepare an annual HSIP report for submittal to FHWA documenting the safety improvements programmed and completed with an assessment of the effectiveness of the program. To evaluate the effectiveness of each completed project, TED completes before-and-after crash studies. Crash statistics and traffic volume data (where available) are collected for three years before and after the construction period. **Applicants from towns and cities must agree to provide information necessary for a post-construction evaluation.** The data collected will also be used to assess and document crash reduction factors for selected HSIP improvements.

## **Chapter 3 Highway Safety Program (HSP)**

### **3.1 Program Overview**

The Highway Safety Improvement Safety Program's (HSIP) was formerly divided into the Hazard Elimination Safety (HES) and Bicycle and Pedestrian Safety Programs in Virginia. With SAFETEA-LU, the HES Hazard Elimination Safety Program in Virginia has been renamed the Highway Safety Program (HSP). The primary objective of the HSP is to identify and improve the safety of locations where there is a high incidence of vehicle crashes, particularly those resulting in injuries or fatalities.

To provide state-wide equity in identifying and funding safety improvements, VDOT annually solicits candidate projects from VDOT Districts and Residencies and from local agencies (**see Figure 2-1**). Each year TED produces District-wide listings of the high crash intersections and sections on VDOT maintained roadways and distributes them to VDOT Districts and Residencies. These listings compare the annual crash rate of locations to a "critical rate" that is statically above the District average rate for similar roadway types and configurations. These critical rate listings help Districts and Residencies identify high-crash locations that require further study and/or action to improve the measure of safety. Independent towns and cities must locate the high crash locations within their jurisdictions since VDOT does not "locate" their crashes on non-VDOT system roadways.

For intersections, the critical rate is slightly higher than the average crash rate and is expressed as the number of crashes within 0.03 miles (160 ft) radius of an intersection node per 1,000,000 entering vehicles (MEV) at the intersection. Average and critical rates are determined and summarized by district showing all counties within that particular district.

For highway sections, the critical rate is expressed as the number of crashes per 100,000,000 vehicle miles traveled (HMVMT) with average and critical rates calculated by district and by roadway system (interstate, primary, and secondary). Section rates are further summarized by characteristics of the route, number of lanes, divided/non-divided, control of access, urban/rural, and functional classification.

Further study is required for the most hazardous locations identified. Study of crashes for a three year period could reveal a crash type or severity pattern occurring at an intersection or highway section. If a crash pattern is determined, a countermeasure project may be identified to reduce or eliminate specific types of crashes. However, applications are not limited to the locations that are identified on the critical rate listing.

### **3.2 Project Eligibility**

Countermeasure projects must address specific highway safety problems on any public road, including interstates, or public surface transportation facility. For improvement projects to be eligible for HSP funding there must be a documented crash history.

Eligible safety improvements have been categorized by VDOT as follows:

- |                                |                            |
|--------------------------------|----------------------------|
| 1. Traffic Sign Improvement    | 6. Roadside Improvement    |
| 2. Traffic Signal Improvement  | 7. Realignment Improvement |
| 3. Channelization Improvements | 8. Illumination            |
| 4. Pavement Improvement        | 9. Regulation Improvement  |
| 5. Construction/Reconstruction | 10. Drainage               |

Some of the improvement categories are broadly defined. A detailed list of improvement types along with crash reduction factors and target crash type is provided in the "Improvement type" sheet in the B/C worksheet (See Appendix B). Consult with the TED HSIP staff for clarification or questions regarding project categories and/or eligibility.

Projects completed under regional contracts are eligible provided the contract contains the appropriate federal language. Railroads and private roads are not eligible for HSP funding. Special Advertised and Awarded Projects (SAAP) are not eligible as well.

### 3.3 Project Funding

Highway safety projects are federally financed at 90 percent with the state or locality providing 10 percent local match. All applicants are normally required to sponsor the project and to be responsible for the 10 percent match. Local matching funds can come from state highway construction funds (primary, secondary, urban) or local jurisdiction sources. Since FY2008-09 Six Year Plan, however, VDOT allocated state funds to provide the required local match so projects have been completely funded. **VDOT anticipates providing the 10 percent local match for the FY 2010-11 safety projects; however, the applicant should be willing and able to supply the local match should the state funding be unavailable.**

**Applications requesting more than \$1,000,000 of HSP funding will not be accepted.** The \$1,000,000 limit refers to the total amount of HSP funding required for project completion. Projects costing more than \$1,000,000 will be considered only if they are being jointly funded.

One of the major factors in the selection of projects is cost; therefore, any significant increase in project cost will also affect which projects are funded. The \$1,000,000 limit on HSIP funds also applies to cost increases once the project is added to the SYIP and STIP. **Any project exceeding the \$1,000,000 limit or its application estimate by more than 10% due to cost increases is subject to the removal of safety funds.** For cities and towns, any increase over the authorized project scope or the \$1,000,000 limit will be funded by the locality per the resolution agreement.

### 3.4 Project Requirements

Eligible project applications must encompass the following four factors:

- (1) Projects must be relevant to the program purpose of reducing crashes, particularly injury and fatal crashes, or risks motorists within the transportation network.
- (2) Proposed improvements must match hazardous situations.
- (3) Applicants must demonstrate that projects will meet all the necessary VDOT guidelines and standards for design and construction to ensure that approved projects will be completed in a reasonable time period. For example, an application for the installation of a traffic signal should provide a traffic signal warrant analysis<sup>1</sup>.
- (4) All projects must upgrade non-standard safety features to existing standards, when those features are within the scope and work area of the project. Requests for exceptions to this requirement will follow the appropriate procedures. Further, all projects must meet the requirements of the Americans with Disabilities Act (ADA).

### 3.5 Application Procedures

#### 3.5.1 Eligible Applicants

Statewide, local jurisdictions and VDOT offices are eligible for HSP funding. All applicants must be able to guarantee the required 10 percent match from the applicable highway system or local source.

#### 3.5.2 Application Requirements

For FY 2010-2011 proposed projects, all applications must be received in VDOT's Traffic Engineering office by **September 1<sup>st</sup>, 2009** to be considered for qualification of HSIP funds. **Applications received after September 1<sup>st</sup> will not be considered unless notification in writing is provided requesting an extension.**

**All projects submitted for the HSIP program must be on the latest version of the HSIP application.** The requested information must be provided for each location, as incomplete applications will not be processed. The following information is required for each application (**see Application form from TED website**):

- **Applicant Name and Mailing Address**

The name and mailing address of the governmental agency, municipality, organization, citizen's group or private individual who are proposing a safety improvement project.

- **Project Manager Name, Title and Phone Numbers**

The name, title, and daytime telephone and fax numbers of the individual who will be responsible for the management of the project.

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<sup>1</sup> Applicants submitting projects to install traffic signals at new locations **must** submit a copy of the warrant analysis showing that the signal meets the criteria outlined in the most recently adopted MUTCD.

- **Specific Location of Proposed Highway Improvement Project**

This section must define the location and limits of the proposed work. Preferably, this information should provide a route number or street name, a pair of termini and the county, city or town. The termini should be expressed as a distance and direction from nearby intersections (e.g., US-522 from 0.02 mi S. of Rte. 739 to 0.32 mi N. of Route 739 in Frederick County). Please also include an appropriately scaled map and/or sketch showing the location of the proposed improvement(s).

- **Fully Describe Project**

Describe the project in detail (e.g., *install left turn lane on US 522 southbound at Route 739* and not just *install turn lane*). The description must include a description of the present conditions, all the proposed countermeasure(s) (**see Appendix B for identifying countermeasures**), and the type and scope of all work to be done. You must also include any associated work that will be completed in conjunction with the proposed project (like storm water system adjustments, utility relocation -- these improvements may be completed with alternate funding sources). Short statements regarding any needed right of way acquisition, utility relocation and/or environmental assessment<sup>2</sup> should also be included. **A sketch plan of proposed improvement must now be included with the submitted application package.** The sketch plan might be based on VDOT GIS integrator, satellite map (map.google.com), or CAD files. **Additional photos and maps of the area are encouraged and recommended to help document existing conditions.**

If the project includes the installation of traffic signals at a new location a copy of the warrant analysis must be attached to the application.

The existing Average Daily Traffic (ADT) on all impacted segments (e.g. approaches to intersection) should be included in the description of the project. **Peak period vehicle turning movement counts are now required for proposed intersection improvements.** Additionally, the type of construction plans (complete, minimal or no plans) that will be required for the project must be indicated.

- **Proposed Project Construction / Implementation Schedule**

The application should include an estimated timetable for the design and construction of the proposed improvements. The approximate dates should be indicated in month/year format.

The Begin PE date has been set as January 2011 to allow for FHWA STIP approval and project authorization to begin. With this start, the advertisement date should not be any later than January 2013 for projects put in the FY 2010-2011 programs. The completion date of a project should not be any later than January 2014. **In other words, a project will be advertised in two years and completed in three years from STIP approval.** The applicant is responsible for coordinating the design of the project.

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<sup>2</sup> Most HSIP projects qualify for a "Programmatic Categorical Exclusion" simply because they are *safety* projects.

- **Estimated Project Costs**

The application must show the estimated project costs broken down by PE, R/W and Utilities, and Construction. All HSIP projects need at least \$5,000 in PE for VDOT Central Office processing and review. The estimates should be as detailed and accurate as possible, utilizing VDOT's Project Cost Estimation System (PCES) worksheets. Applicants who do not have access to the PCES worksheets shall submit detailed costs with a descriptive reason for not using PCES. VDOT will work with Cities and Towns to coordinate with the District Traffic Engineers and Urban Program Managers to ensure application cost estimates are consistent with PCES.

- **Signature**

Signature of a representative of the applicant with the authority to expend the required matching funds is required. Applications that are not signed will not be processed.

- **Electronic Submission**

**HSP applicants are required to submit an electronic version of the application form in addition to a signed hardcopy.** Electronic application forms may be downloaded from VDOT Traffic Engineering Division website. **Please do not email other documentation with the application form, rather send supplemental documents with the signed forms via regular mail to VDOT-TED.** The application form needs to be renamed as directed and e-mailed to HSIProgram@virginiadot.org. Multiple applications submitted by one applicant should be included in one email.

- HSP Application Form (spreadsheet) named in the format of **HSP.App\_2010\_ "Physical Jurisdiction" \_Project##.xls.**

Here "Physical Jurisdiction" refers to the jurisdiction of the proposed project location. "Project##" represents the priority ranking number of projects for each applicant. For example, VDOT Richmond District submits 4 candidate projects for HSP and the project which ranks second is located in Chesterfield County. The "physical jurisdiction" for this project is "Chesterfield County". The above two documents for this project should be named as:

- HSP.App\_2010\_Chesterfield County\_Project02.xls

**The subject of the email should follow the following format:**

**HSP\_2010\_ "Applicant" \_ Application**

For the second project of VDOT Richmond District, an email with the subject "HSP\_2007\_Richmond District Application" should be sent.

If a project is funded, applicants are required to submit a project status report to HSIProgram@virginiadot.org (forms can be downloaded from VDOT TED website) by December 31 of each year after authorization to proceed. Please refer to the "Project Status Report" section in this chapter for detailed requirements.

### **3.5.3 Benefit/Cost Analysis**

Proposed improvements are evaluated for eligibility based on the benefits from the expected crash reductions versus the cost of the improvement over a project life span. To determine the benefits, the latest three years of available crash reports related to the improvement are compiled by the severity of the crash. For projects on VDOT maintained roadways the crash data through the end of calendar year 2007 will be available for the FY2010-11 applications. Local cities and towns may have additional months of crashes to report. **Applicants are required to submit three years of Police crash reports (FR300's) within the project limits and to identify those crashes that are targeted for reduction, that is, crashes associated with the proposed improvement. A summary sheet to report the crash types and severity is provided in the HSP Application Spreadsheet.** The total and project related crash count history will be used in the evaluation of completed projects. Collision diagrams of the crashes within the project limits are highly recommended as they provide a helpful summaries of the crash types and severity.

For FY2010-11 Highway Safety Project (HSP), the application form and the B/C spreadsheet are combined into one spreadsheet to facilitate the electronic transmission of application data. The spreadsheet has the same form for intersection projects improvement projects and highway section improvement projects. A separate sheet is provided to document the identified problem and proposed improvements. For those proposed improvements without a known crash reduction factor, the applicant should document the expected risk reduction for those elements. Some examples of improvements that reduce risk are signing and marking for curves or pedestrians.

Please note that the B/C number in the application is only used to assess the eligibility of a proposed improvement for Highway Safety Improvement Program (HSP) funding. Improvements that provide expected crash reductions resulting in a benefit to cost ratio (B/C) greater than one (1.0) are eligible for HSIP funding. However, a high B/C ratio does not guarantee funding. Other factors such as the total targeted severe crashes, validity of improvement countermeasure; project cost and the time frame to complete the project are also considered to prioritize the eligible improvements. In general, quick improvement projects with no right-of-way acquisition that target high crash locations will receive more favorable consideration.

Instructions for the HSP Application worksheet are provided in the Appendix A of this document. Applicants should strictly follow the instructions to ensure accurate and consistent results. All calculations will be checked for accuracy by Traffic Engineering's HSIP staff.

### **3.6 Project Selection**

States are required to develop and maintain a method to determine the eligibility and prioritize safety improvements on a statewide competitive basis. VDOT has developed a benefit-to-cost (B/C) ratio analysis and ranking process to prioritize

improvement projects for Federal funding. To be eligible for HSIP funding, projects must have a B/C ratio greater than one.

Once all applications have been received, the TED will review and check all submittals to ensure the application follows VDOT and FHWA guidelines. FR300 crash reports will be reviewed to determine if the recorded crashes relate to the proposed type of improvement specified on the application. Field reviews may also be conducted to help define the problem and the reasonableness of the proposed improvement.

Project selection follows a two step process. The first step is to determine the eligibility of the projects for HSIP funding. All improvement projects having a B/C ratio (from the B/C worksheet) greater than one are eligible for funding. The second step is to prioritize eligible projects based on B/C ratio, project cost range, improvement types, engineering review and available HSIP funding. **Priority will be given to quick, low environmental impact solutions to high severe crash locations.**

After reviewing and ranking all of the applications on a statewide basis, TED will release approved lists of projects approximately around July of next year. The list will be posted on the TED website.

## **Chapter 4            Bicycle and Pedestrian Safety Program (BPS)**

### **4.1 Program Overview**

Bicycling and walking safety concerns often differ from motor vehicle-related concerns as non-motorized users are the most vulnerable to injury or death from a crash. Although bicycle and pedestrian involved crashes can cluster on a corridor or at a high risk intersection, they are more dispersed than vehicle crashes. Further, there is little information available on the potential crash reductions from engineering countermeasures. As such, safety benefit-to-cost (B/C) ratio analysis and ranking procedures used for highway safety improvements do not fully integrate factors addressing bicycle and pedestrian safety. Given the limitation of prioritizing non-motorized improvements, VDOT has developed the Bicycle and Pedestrian Safety (BPS) program to specifically address these safety issues.

The purpose of the BPS program is to implement safety projects addressing both bicycle and pedestrian crashes and the potential for crashes in Virginia. The safety projects target the reduction in the number and severity, or the risk of and exposure to crashes. The intent of the program is to promote improvement projects that address a known safety problem, are small in scale, and can be completed quickly. Hence, BPS projects should not involve the acquisition of significant right-of-way nor extensive environmental documentation and mitigation.

Furthermore, the program is intended to address bicycle and pedestrian safety concerns in locations with the potential for risk that typically do not have sufficient crash numbers needed to rank well for project selection under the traditional crash reduction methods. Proposed BPS projects are evaluated based on risk factors from documented purpose and need to compete against other like projects.

With the advent of the Safe Routes to School (SRTS) program from the SAFETEA-LU legislation, the BPS program will provide complimentary safety improvements. SRTS is intended to improve and encourage biking and walking within two miles of K-8<sup>th</sup> grade schools. Projects programmed under SRTS will be funded 100 percent by FHWA. As such, BPS projects should typically be outside of the range of the SRTS target area. For more information on the SRTS program is available at TED website. (<http://www.virginiadot.org/business/trafficeng-default.asp>)

### **4.2 Project Eligibility**

Eligible projects must address specific bicycle or pedestrian safety problems on any public road, public surface transportation facility, or publicly owned bicycle or pedestrian pathway or trail.

The eligible improvements for BPS program includes, but not limited to, on-street facilities; shared-use paths; treatments for intersections, mid-block crossings, crosswalks; signs and pavement markings; accessibility features; and traffic calming

measures. A list of crash types with recommended countermeasures, including cost estimates is provided in **Appendix C**. Projects that are not eligible for the program are bicycle parking, directional signing, landscaping, maintenance, traffic calming only for motor vehicles (i.e., no non-motorized traffic), and traffic management measures.

### **4.3 Project Funding**

The program will typically be funded using a 10 percent set-aside of the annual HSIP allocation from FHWA. For FY2009-10, the BPS apportionment is expected to be about \$3 million.

BPS program safety projects are federally financed at 90 percent with the state or locality providing 10 percent match. All applicants are required to sponsor the project and to be responsible for the 10 percent match. Local matching funds can come from state highway construction funds (primary, secondary, urban) or local jurisdiction sources. Since FY2008-09 Six Year Plan, however, VDOT allocated state funds to provide the required local match so projects have been completely funded. **VDOT anticipates providing the 10 percent local match for the FY 2010-2011 safety projects; however, the applicant should be willing and able to supply the local match should the state funding be unavailable.**

### **4.4 Project Requirements**

Eligible project applications must encompass the following five factors:

- (1) Projects need to be relevant to the program purpose of reducing crashes or risks for bicyclists and pedestrians within a transportation network.
- (2) Proposed improvements must match existing hazardous situations.
- (3) The proposed project cost must be less than \$500,000.
- (4) Applicants must demonstrate that projects will meet all the necessary guidelines and standards for design and construction to ensure that approved projects will be completed in a reasonable time period. For example, an application for the installation of a traffic signal should provide a traffic signal warrant analysis.
- (5) All projects must upgrade non-standard safety features to existing standards, when those features are within the scope and work area of the project. Requests for exceptions to this requirement will follow the appropriate procedures. Further, all projects must meet the requirements of the Americans with Disabilities Act (ADA).

### **4.5 Application Procedure**

#### **4.5.1 Eligible Applicants**

Both state and local agencies are eligible for Bicycle and Pedestrian Safety Program (BPS) funding. All applicants must sponsor the project and be able to guarantee identify funding for expenses above the application estimate from the applicable highway system or local source.

#### **4.5.2 Application Requirements**

The BPS application requests a description of the problem, a description of the solution proposed to address the problem, the proposed project schedule and cost, and a description of how the project will benefit the community and is supported by the applicant agency and community. Each application *must* also include the following information:

- Completed, and current BPS application
- Supporting safety analysis, such as crash data analysis and/or crash reports, if applicable
- Project drawing or sketch showing existing conditions and the proposed improvement (hand drawings are acceptable) and relevant photographs
- Cost estimates using VDOT's PCES or recent line item costs
- Supporting documents and engineering studies, if applicable

Please answer all of the information requested on the application form. Well-documented applications are more likely to receive higher scores and ranking for funding priorities. If extra space is needed to supply pertinent information, please use additional sheets or attach planning/engineering studies. A separate application form must be completed for each candidate location, and there is no limit to the number of applications that may be submitted.

Where applicable, project applications should be submitted through the same channels by which they were received. Applications are typically submitted to the district offices, which in turn submit the applications to the Highway Safety Improvement Program section of the Traffic Engineering Division.

#### **Electronic Submission**

**Applicants are required to submit electronic version of application documents in addition to a signed hardcopy.** Electronic application forms can be downloaded from VDOT Traffic Engineering Division website. Please do not email other documentation with the application form, rather send supplemental documents with signed forms via mail to VDOT-TED. The following documents need to be renamed as directed and e-mailed to [HSIPProgram@virginiadot.org](mailto:HSIPProgram@virginiadot.org) for each project. Multiple applications submitted by one applicant should be included in one email.

- BPS Application Form (word) named in the format of **BPSP.App\_2010\_”Physical Jurisdiction”\_Project##.doc.**

Here “Physical Jurisdiction” refers to the jurisdiction of the proposed project location. “Project###” represents the **priority ranking number** of projects for each applicant. For example, VDOT Richmond District submits 4 candidate projects for BPS and the project which ranks second is located in Chesterfield County. The “physical jurisdiction” for this project is “Chesterfield County”. The above document for this project should be named as:

- BPSP.App\_2010\_Chesterfield County\_Project02.doc

The subject of the email should follow the following format:  
**BPSP\_2010\_”Applicant”\_Application** For the second project of VDOT Richmond District, an email with the subject “**BPSP\_2010\_ Richmond District Application**” should be sent with the above documents attached.

If a project is funded, applicants are required to submit a project status report to [HSIProgram@viriniadot.org](mailto:HSIProgram@viriniadot.org) (forms can be downloaded from VDOT TED website) by December 31 of each year after authorization to proceed. Please refer to the “Project Status Report” section in this chapter for detailed requirements.

It is the responsibility of the applicant to ensure that the application is complete and accurate, and that it is delivered by the prescribed date. All applications for FY 2010-2011 must be received in the Traffic Engineering Division office no later than **September 1st, 2009**. All pertinent addresses are located on the bottom of the application form.

#### **4.6 Project Selection**

States are required to develop and maintain a method to prioritize safety improvements on a statewide competitive basis. VDOT has developed a risk based purpose and need scoring to review and prioritize proposed improvements submitted by applicants.

To effectively and equitably identify potential bicycle and/or pedestrian safety projects, a subjective 100 point-based scoring system is used to account for the following characteristics associated with these types of projects: minimal crash history that does not support a benefit/cost analysis; the potential for severe fatal and injury crashes; and well-documented safety hazards associated with each location.

The proposed project selection involves three phases: an initial review, a risk narrative review, and an engineering review.

The initial review addresses how the application meets the minimum eligible criteria, including:

- Project eligibility
- Project requirements
- Required authorization signature for the mandatory 10 percent match (refer to BPS program funding)

The risk narrative review phase scores the following four factors: (1) identification and demonstration of the problem, (2) relevance of the solution to the problem and its potential to correct or improve the problem (note sketch drawings and pictures of the location are needed for documentation), (3) potential for timely implementation based on cost and schedule and, (4) community support.

The engineering field review phase confirms that the existing problem matches the description of the proposed improvement on the application. This phase also looks for answers to questions raised regarding the proposed solution during the initial review phase, and finally, indicates how reasonable and feasible is the proposed solution.

Projects are funded based on the final ranked scores, until funds are exhausted. For inclusion in the Six Year Improvement Program, the final listing is submitted to VDOT Programming Division each year for the Commonwealth's Transportation Board approval before the July 1<sup>st</sup> beginning of the fiscal year. The final approved list will be posted on the TED website.

# Chapter 5 Highway-Rail Grade Crossing Safety Program (H-RGCP)

## 5.1 Program Overview

The purpose of the Highway-Rail Grade Crossing Safety Program (H-RGCP) is to reduce the risk and number of crashes between vehicles and trains. Section 130 of Title 23, US Code continues to provide funds to improve safety at any public highway-rail-grade crossing. A public road is defined as “any road under the jurisdiction of and maintained by a public roadway authority and open to public travel.” Private crossings are located “on a private roadway ... not maintained by a public roadway authority.” and are not eligible to be funded within this program.

Since inception of the Federal Highway Safety Act of 1973, approximately \$117 million has been spent on upgrading more than 1,278 rail grade crossing locations throughout the Commonwealth of Virginia. This program has continued with subsequent acts and has provided funds to enhance safety at grade crossing locations. Virginia’s grade crossing inventory presently consists of 1,981 public at-grade crossings.

## 5.2 Project Eligibility

Improvement projects are developed through applicant submitted proposals that are reviewed and ranked on a “Statewide Competitive Basis.”

The legislation requires at least fifty percent of appropriated funds to be available for installation of warning devices, which include the following:

- Standard signs and pavement markings
  - Active warning devices (flashing lights and/or gates)
  - Circuitry improvements (motion detectors and constant warning time predictors)
  - Traffic and railroad signal upgrades to provide interconnection
  - Crossing illumination
  - Surface improvements (upgrade to hi-type crossing surface consisting of rubber or concrete, etc.)
  - General site improvements (improve sight distance restrictions, alignment, grade, etc)
- Up to fifty percent is also available for elimination of hazards, including the following:

- Grade Separation
- Crossing closure
- Highway relocation
- Railroad relocation

Funding for the elimination of hazards shall not exceed two years of appropriated funds set aside for improvement types unless approved by the Traffic Engineering Division. These funds can also be used to cooperatively fund a project. However, HRGCP safety improvements are intended to be quickly completed to minimize the identified risks. As such, projects that require right-of-way and/or have utility impacts will be scrutinized whether completion will occur within 36 months of approval.

## 5.3 Project Funding

Highway-Rail safety projects are federally financed at 90 percent with the state or locality providing the 10 percent match. For FY2010-11 VDOT allocated state funds to

provide the required local match. **VDOT anticipates providing the 10 % match for FY2010-11. Please be sure to provide current estimates. If there is an increase in the estimate once PE has been completed, the applicant will be responsible for any additional funding over and above what was originally provided.** Federal part of the funding comes from Federal Safety funds (Section 130) for 90 percent of the project cost. It is worth noting that work performed prior to the Commonwealth Transportation Board (CTB) approval or Federal project authorization will not be eligible for Federal reimbursement from Section 130 funds. Selected projects must be included in the Metropolitan Planning Organization (MPO), Transportation Improvement Program (TIP) and the Statewide Transportation Improvement Program (STIP) and approved by the Federal Highway Administration (FHWA).

## 5.4 Project Requirements

States are required to develop and maintain a method to prioritize crossings for improvements on a statewide competitive basis. VDOT utilizes the Federal Railroad Administration's (FRA) "Accident Prediction Model" 1 as its methodology for establishing a statewide crossing improvement priority listing. The procedure is a mathematical formula, using a constant associated with the existing warning device status. The formula incorporates a factor for vehicle traffic, and number of trains that produce an "exposure index value." Additional factors utilized to compute the "accident prediction value" include:

- Through trains per day
- Maximum timetable speed
- Number of main tracks
- Highway surface
- Number of highway travel lanes
- Highway-Rail crashes

1 FRA uses the term accident rather than crash; references to the FRA methodology will use accident in Quotations.

These "accident prediction values" are used as a tool in developing a preliminary ranking of crossings in need of further review for safety improvements. Since exposure is the primary component of this procedure, the greater the "accident prediction value", the more likely it is to qualify funding.

## 5.5 Application Procedure

Each year, the Traffic Engineering Division will submit, by the end of May, highway-rail grade crossing inventory listings to the localities and Managers, Regional Traffic Engineers, and Resident Engineers for submittal of applications for safety improvements at grade crossing locations within their jurisdictions. The Local Assistance Division, Regional Traffic Engineers, and Resident Engineers are requested to work with, or forward these listings to, the appropriate persons in cities, towns and counties responsible for submitting location applications for candidate improvements. Utilizing the grade crossing list, the applicants are requested to conduct field reviews of the locations prior to submitting applications. Field reviews help identify and prioritize the safety needs of the candidate projects to be submitted. Applicants must provide all of the information requested on the application form (can be downloaded from TED website). A separate application form must be completed for each candidate location. **\*\* NOTE: If signal upgrades and surface improvements are needed at an individual location, a separate application must be submitted for each improvement type. In the past, combining these improvement types on one application has slowed the installation process due to scheduling conflicts between the railroad's surface replacement and**

**signal installation crews.** There is no restriction on the number of applications that can be submitted, however, signing the applications indicates agreement to participate with 10 percent matching funds. In addition, the application form should not be altered. The following information must be included in the application:

- Name of the locality, group, or agency requesting the grade crossing improvement.
- Name, title, and telephone of the contact person who is submitting and managing the proposed improvement.
- Location sketch or drawing of the proposed grade crossing improvement.
- Type of improvement.

With the exception of grade crossing improvements within railroad right of way, all improvements on VDOT or locality right of way shall include a cost estimate as detailed and accurate as possible using VDOT's Project Cost Estimating System (PCES). Applicants who do not have access to the PCES worksheets shall submit detailed costs with a descriptive reason for not using PCES. VDOT will work with Cities and Towns to coordinate with the District Traffic Engineers and Urban Program Managers to ensure application cost estimates are consistent. Please contact the HRGCP section for direction on submitting applications that include highway improvements outside of railroad right of way. Typical project costs for rail improvements are provided in **Appendix D**. Provide any additional or updated information not provided on the inventory sheet that could improve the ranking status when evaluated. For example: increased ADT counts, school bus traffic, hazardous material vehicle crossing, and land use development. Signature of the authorized person responsible for expending the additional funds is required to be considered for H-RGC funding.

### **Electronic Submission**

H-RGCP applicants are required to submit electronic version of application documents in addition to a signed hardcopy. Electronic application forms can be downloaded from VDOT Traffic Engineering Division website. Please do not email electronic documentation with the application form, rather send supplemental documents with the signed forms via mail to VDOT-TED. The following documents need to be renamed as directed and e-mailed to HSIProgram@viriniadot.org for each project. Multiple applications submitted by one applicant should be included in one email.

- H-RGCP Application Form (word) named in the format of **H-RGCP.App\_2010\_”Physical Jurisdiction”\_Project##.doc**. Here “Physical Jurisdiction” refers to the jurisdiction of the proposed project location. “Project##” represents the **priority ranking number** of projects for each applicant. For example, VDOT Richmond District submits 4 candidate projects for HRGCP and the project which ranks second is located in Chesterfield County. The “physical jurisdiction” for this project is “Chesterfield County”. The above three documents for this project should be named as: **H-RGCP.App\_2010\_Chesterfield County\_Project02.doc**

The subject of the email should follow the following format: **H-RGCP\_2010\_”Applicant” Application**. For the second project of VDOT Richmond District, an email with the subject **“H-RGCP\_2010\_Richmond District Application”** should be sent with the above documents attached. All applications for FY10-11 must be received in the Traffic Engineering Division office no later than **September 1, 2009**. Where applicable, project applications are to be submitted through the same channels by which they received the grade crossing inventory listings.

## 5.6 Project Selection

Applications received for grade crossing improvement projects will be evaluated on a statewide competitive basis. The grade crossing inventory listing is adjusted to incorporate additional data as identified on the applications, such as vehicle type, etc. Based on applications received, candidate locations are again ranked in a statewide order using the FRA “Accident Prediction” formula. Field review is conducted to evaluate the crossing to confirm or adjust the proposed improvement as needed. This review considers the following components:

- **Sight distance** – sufficient sight distance for approaching motorists to make a safe stop. Sight distance also applies to vehicles stopped at rail crossings.
- **Roadway geometry** – hazards and limitations to approaching motorists resulting from roadway geometry such as a steep grade, narrow pavement, horizontal curves, angle of crossing, adjacent roadway improvements.
- **Adjacent land use development** – adverse safety effects, caused by congestion, or other problems created by adjacent land use. A final priority ranking, referred to as a Priority Index value, is determined through an analysis of the previously collected data and field reviews. Once this Index is determined, candidate locations are ranked statewide in descending order for funding. Projects are funded utilizing the federal safety appropriations until funds are exhausted. As part of the Six Year Improvement Program the final listing is submitted to VDOT Programming Division each year for the Commonwealth’s Transportation Board approval before the July 1<sup>st</sup> beginning of the fiscal year. The final approved list will be posted on the TED website. In recent years approximately fifty to sixty crossing improvement projects were funded by the H-RGCP. There may be instances where crossing warning devices are scheduled as part of a roadway construction project and the proposed type of warning is an upgrade of the existing warning devices. When this occurs and diagnostic reviews determine a short term need for the installation of warning devices, the crossing improvement may be advanced in the implementation schedule.

## 5.7 Project Development

Projects are processed in accordance with project implementation procedures outlined hereinafter. Several VDOT sections are involved in the project development phase. The Rail Project Management Section (Hereinafter referred as RPMS) of Scheduling and Contract Development Division (SCD) typically authorizes the project with concurrence from H/RGCS Program Manager of Highway/Rail At-Grade Crossing Safety Section. VDOT’s Programming Division processes federal project authorization requests for funding obligation with the FHWA.

### 5.7.1 Design

Facilities that are the responsibility of the railroad for maintenance and operation shall conform to the standards established in the FHWA’s Manual on Uniform Traffic Control Devices (MUTCD). Restrictions apply when a highway/railroad grade crossing is located within the limits of a Federal-aid project for construction of a highway or improvement of an existing highway. For such a location, the crossing shall not be opened for unrestricted use by traffic, or the project accepted by VDOT until the

appropriate protective devices, advance warning signs, and pavement markings are installed and functioning properly. Recommended candidate grade crossing safety improvement types are subject to approval by the H/RGCS Section based on prioritization and field evaluations. Traffic control devices and pavement markings shall comply with the latest edition of the MUTCD supplement to the extent applicable to federal and state guidelines. Example: the MUTCD guidelines state advance warning signs (W10-1) SHALL BE installed for each public roadway approach at all public crossings.

### **5.7.2 Environmental Review**

VDOT's Environmental Division is also responsible for conducting and documenting the necessary environmental reviews to ascertain any adverse environmental impacts. Typically these types of projects are exempt from the State Environmental Review Process (SERP). However, the Environmental Division makes this determination on a project by project basis. Environmental documents are required for all actions before federal funds can be spent. Based on past experience, Grade Crossing Improvements Program projects, typically do not involve significant environmental impacts, and qualify as "Programmatic Exclusions (PCEs)" when such projects:

- Do not induce impacts to planned growth or land use for the area
- Do not require any relocation
- Do not require substantial land acquisition except when acquired for preservation purpose as permitted by categories in PCE Agreement
- Do not require a U.S. Coast Guard permit
- Do not require an individual U.S. Army Corps of Engineers Section 404 permit
- Do not have an adverse effect on historic properties
- Do not use land (i.e. convert it) protected by Section 4(f)
- Do not involve significant air, noise, or water quality impacts
- Do not have significant impacts on travel patterns
- Do not require any changes in Interstate access control
- Do not otherwise; either individually or cumulatively, have any significant environmental impacts

### **5.7.3 Agency and Railroad Agreements**

Where construction of a Federal-aid project requires the use of railroad properties or the adjustment to railroad facilities there shall be an agreement in writing. This agreement shall be compiled by VDOT's Rail Project Management Section and submitted to the appropriate railroad company for a detail engineering estimate, design and signature. The agreement is returned in a timely manner to VDOT for signature and processing with FHWA. Note: a third party agreement signature is required where VDOT does not maintain the roadway over the crossing such as incorporated cities. The written agreement shall include the following information where applicable:

- A detailed statement of the work to be performed by each party
- A method of payment
- The extent to which the railroad is obligated to move or adjust the facilities at its own expense
- The railroad's share of the cost
- An itemized cost estimate of the work to be performed by the railroad

- The method to be used for performing the work, either by railroad forces or by contract
- Identification of the party or parties responsible for maintenance
- The form, duration, and amounts of any needed insurance
- References to plans and specifications

The railroad company shall provide a plan sheet consisting of:

- Crossing Layout
- Existing warning system
- Width of pavement/proposed width
- Track layout
- Significant topography
- Limits of right of way
- A profile of highway approaches
- Other details sufficient to allow proper location of protective devices

## **5.8 Project Implementation**

Improvement projects will follow the following procedures in the project implementation phase.

1. Upon federal authorization the Rail Project Management Section shall notify the railroad company in writing to proceed with phase of work as described in the agreement.
2. The railroad company shall take the appropriate action to order equipment and begin work as scheduling permits and complete the project within a timely manner. Project implementation will take approximately twelve months.
3. The railroad performs the Force Account work, or, if non-railroad (highway) work is involved, the work is performed by VDOT forces or VDOT contract forces. VDOT audits all bills for compliance with applicable Federal regulations to determine the eligibility of the items.
4. When project is completed, the appropriate party will be responsible for installing and maintaining the warning signs and pavement markings outside of railroad right-of-way.
5. The railroad companies shall issue an "in-service" notice to the appropriate sections within VDOT when work is complete. VDOT Residencies where work is performed shall prepare a C-5 and copy the H/RGC Section after final inspection has been performed.
6. VDOT Rail Project Management Section shall process final bills with the Fiscal Division as received from the railroad companies.
7. VDOT performs a project audit, responds to any audit exceptions and prepares a Final Voucher for submittal to FHWA for approval.
8. The railroad, VDOT's H/RGCS Section and the Rail Project Management Section shall record and maintain project documentation upon completion and final audit.
9. Evaluation is conducted on a statewide basis.

## **5.9 Program Administration**

The Highway-Rail Grade Crossing Safety Program (H-RGCP) is administered by the Highway Safety Improvement Program section of the Traffic Engineering Division of VDOT. The objective of the program is to reduce the number of injuries and fatalities at grade crossings include the following:

1. Establish a multi-year program that is updated annually, on a schedule that meets the needs of the VDOT District Offices, Residencies and MPOs and other localities in building their Regional and Federal Statewide Transportation Improvement Programs.
2. Ensure that the most cost effective projects are being selected and that the objectives of the (H-RGCP), as defined in Federal law are being met.
3. Implement a structured process to approve or disapprove cost changes and changes in the scheduling of projects to encourage timely use of funds. These guidelines incorporate comments from the VDOT Traffic Engineering Division and of VDOT's Scheduling and Contract Development Division Rail Project Agreement Section.

## **Appendix A**

### HSP Application Form and Instructions

Applicant: Virginia Department of Transportation Northern Virginia District  
 Project Manager: Robert Jastrzebski  
 Title: Transportation Engineer  
 Email: jaro@slaw.jastrzebski@vdot.virginia.gov  
 Street Address: 14685 Avion Parkway  
 Tel: 703-383-24395 Fax: \_\_\_\_\_  
 MPO Area: \_\_\_\_\_  
 City, State, Zip: Chantilly, Virginia 20151  
 Priority #: 2 If submitting 2+ applications  
 Repeated Appl. from prev. yrs? NO

| Application Type      | VDOT District              | County  | Route (Include Name)       | System (1)         | Traffic Control             | From/Major Road           | To/Cross Road          | Study Period Begins | Study Period Ends |
|-----------------------|----------------------------|---------|----------------------------|--------------------|-----------------------------|---------------------------|------------------------|---------------------|-------------------|
| INTERSECTION          | Richmond                   | Fairfax | Route 1( Richmond Highway) | Urban (U)          | Segment spd>35              | Highland Lane (Route 624) | Frye Road (Route 3191) | 01/01/03            | 12/31/05          |
| Functional Class Code | E-Urban Principle Arterial |         |                            | Area Location Code | 2-Small Urban(5,000-49,999) |                           | Federal System Code    | 0-NON NHS           |                   |

**Briefly Describe Problem and Proposed Work**  
 There are several pedestrian fatalities along this stretch of Route 1 due to the absence of pedestrian facilities. We suggest installing a pedestrian crossing across Rte 1 with four flashing warning signs installed on mast arms (two at the cross walk and two 0.2 miles north and south of the cross walk to alert drivers of high pedestrian activities.

| Crash Data           | Crash Type |              | Rear End | Sideswipe Same Direction | Left Turn | Right angle | Run off Road | Head On/ Sideswipe - Opposite | Pedestrian | Other(1) | Other(2) | Total Related Crashes | Total Crashes at This Location |
|----------------------|------------|--------------|----------|--------------------------|-----------|-------------|--------------|-------------------------------|------------|----------|----------|-----------------------|--------------------------------|
|                      | Severity   | K=1 or 5     |          |                          |           |             |              |                               |            |          |          |                       |                                |
| Personal Injury (PI) | Fatal      | K=1 or 5     |          |                          |           |             |              |                               |            | 2        |          | 2                     | 2                              |
|                      | A=2        |              |          |                          |           |             |              |                               |            | 2        |          | 2                     | 13                             |
|                      | B=3        |              |          |                          |           |             |              |                               |            |          |          | 0                     | 6                              |
|                      | C=4        |              |          |                          |           |             |              |                               |            |          |          | 0                     | 35                             |
|                      | PDO        | PDO          |          |                          |           |             |              |                               |            |          |          | 0                     | 65                             |
|                      |            | <b>Total</b> |          |                          |           |             |              |                               |            | 4        |          | 4                     | 121                            |

**Notes** For traffic data, please fill corresponding section for intersection and section projects. Do not fill both traffic data sections.

| Traffic Data (Inter.)  | Period | Enter. ADT            | NB Ent. ADT | SB Ent. ADT | EB Ent. ADT | WB Ent. ADT | Other leg Ent. ADT | # of Approaches | Crash Rate (Intersection) | Critical Rate (Intersection) | For Intersection Project, Please fill the turning movement counts information in the "Intersection Sketch" Sheet | Traffic Annual Growth Rate |
|------------------------|--------|-----------------------|-------------|-------------|-------------|-------------|--------------------|-----------------|---------------------------|------------------------------|--|----------------------------|
|                        |        |                       |             |             |             |             |                    |                 |                           |                              |  |                            |
| Traffic Data (Section) | Period | Section Length (Mile) | Sec1        | Sec 2       | Sec 3       | Sec 4       | Sec 5              | Total/Average   | Speed Limit (Average)     | Crash Rate (Section)         | Yes  |                            |
|                        |        |                       |             |             |             |             |                    | 0.42            |                           | 0.80                         |  |                            |
|                        |        | Average AADT          |             |             |             |             |                    | 33,000          |                           |                              |  |                            |
|                        |        | Number of Lanes       |             |             |             |             |                    | 4               |                           |                              |  |                            |

| Improvement Action | Number of Improvements                         |                         | Discount Rate |      |      |                           | Project Cost           |             |              |                     |  |
|--------------------|--|-------------------------|---------------|------|------|---------------------------|------------------------|-------------|--------------|---------------------|--|
|                    | Number   | Improvement Description | Service Life  | PRF  | PRI  | PRPD                      | PE cost plus \$5000(2) | R/W&Utility | Construction | Annual Initial Cost |  |
| 1                  | Flashing light on sign (Flashing all the time) | 10                      | 0.10          | 0.10 | 0.10 | \$ 88,000                 |                        | \$ 316,971  | \$ 52,446    |                     |  |
| 2                  | Pedestrian Crosswalk                           | 7                       | 0.25          | 0.25 | 0.25 |                           |                        |             |              |                     |  |
| 3                  |  |                         |               |      |      |                           |                        |             |              |                     |  |
| 4                  |  |                         |               |      |      |                           |                        |             |              |                     |  |
|                    | <b>Total</b>                                   | 10                      | 0.33          | 0.33 | 0.33 | <b>Total Initial Cost</b> | \$ 404,971             |             | \$ 52,446    |                     |  |

NOTE: 1. A local resolution is required upon notification of program approval for secondary road and urban projects 2. VDOT District and Central Office personnel charge review and administration time to project managed by localities. Safety Projects not managed by VDOT shall include a minimum of \$5,000 for VDOT PE costs

| Project Administered by | Locality | Project Schedule (After STIP Approval) | Begin PE  | Target Advert. | Begin Construction | Estimated Complete Date | Type of Plan |
|-------------------------|----------|--|-----------|----------------|--------------------|-------------------------|--------------|
|                         |          |  | May, 2009 |                |                    |                         |              |

| B/C Calculation | Benefit                       |                               | Cost                 |               | Project Benefit |                  |                |                |  |
|-----------------|-------------------------------|-------------------------------|----------------------|---------------|-----------------|------------------|----------------|----------------|--|
|                 | Total Annualized Benefit      | Traffic Growth Factor (TGF)   | Total Annual Benefit | Type of Crash | Related Crash # | Annual Change in | Cost per Crash | Annual Benefit |  |
|                 | \$ 855,400                    | \$ 1.12                       | \$ 955,372           | K             | 2               | 0.22             | \$ 3,760,000   | \$ 814,667     |  |
|                 |                               |                               |                      | A             | 2               | 0.22             | \$ 188,000     | \$ 40,733      |  |
|                 | Total Annualized Initial Cost | Total Annual Maintenance Cost | Total Annual Cost    | B             | 0               | -                | \$ 48,200      | \$ -           |  |
|                 | \$ 52,446                     | \$ -                          | \$ 52,446            | C             | 0               | -                | \$ 22,900      | \$ -           |  |
|                 | <b>B/C=</b>                   |                               | <b>18.22</b>         | PDO           | 0               | -                | \$ 6,500       | \$ -           |  |
|                 |                               |                               |                      | <b>Total</b>  | 4               | 0.43             |                | \$ 855,400     |  |

Signature of Person with Authority to Expend 10% Matching Funds

Name (Print) \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

VDOT anticipates providing the 10 percent match for the FY2009-10; however, the applicant should be able to supply the local match if state funding becomes unavailable. Please submit an electronic copy of this spreadsheet to HSIProgram@virginiadot.org and mail a paper copy with signature to the address below.

**address:**  
 Attn: HSP Application  
 Mr. Ray Khoury, P.E.  
 State Traffic Engineer  
 Virginia Department of Transportation  
 1401 East Broad Street  
 Richmond, Virginia 23219

**Counties:**  
 Resident Engineers are requested to submit applications within their residency through the District Administrator and forward them to the State Traffic Engineer

(3) The yellow are required inputs and white areas are optional. The gray areas are automatically generated by embedded formulas.  
 (4) For all fields, please refer to "Instruction for FY2008-09 Highway Safety Project (HSP)" in the Appendix A of "HSIP Guideline"

## Instructions for FY2010-11 Highway Safety Project (HSP) Application

For FY2010-11 Highway Safety Program (HSP), the previous application form and the B/C spreadsheet were combined into one spreadsheet to facilitate the electronic transmission of application data.

Applicants are required to fill the yellow fields of the spreadsheet and submit an electronic version of the application to [HSIPProgram@virginiadot.org](mailto:HSIPProgram@virginiadot.org) and a paper copy with signature. The white areas are optional input area and the grey areas are automatically generated by embedded formulas. All areas other than input areas are protected to ensure the accuracy and consistency of the worksheet.

It is worth noting that the B/C number in the application is only used to assess the eligibility of a proposed improvement for Highway Safety Improvement Program (HSIP) funding. Improvements that provide expected crash reductions resulting in a benefit to cost ratio (B/C) greater than one (1.0) are eligible for HSIP funding. However, a high B/C ratio does not guarantee funding. Other factors such as the validity of improvement countermeasure, project cost and the time frame to complete the project are also considered to prioritize the eligible improvements. In general, low cost, quick improvement and project targeting high crash locations will receive more favorable consideration.

The following gives detailed explanation of each field in the application form.

### Applicant information

Fields in this section are self-explanatory.

### General Information Section

**Application Type:** Select the appropriate application type. “Regular” refers to regular annual application open during the period of June to September each year. “Proactive” refers to application using proactive funds allocated to each district.

**VDOT District:** Input the VDOT district that oversight the area

**County:** Input County/City name, such as Fairfax County, City of Richmond.

**Route:** Input route name of major direction, such as US1, SR6, Broad Street. If known, the 14 character VDOT name (Prefix, Route #, Suffix) should be provided.

**System:** If VDOT maintained road, select from “Interstate”, “Primary” and “Secondary” ; If local maintained, select “Urban”

**Traffic Control:** Select appropriate traffic control option. For section improvement project, select the one with the right speed limit.

**From/Major Road:** Input the start limit for section project and input the name of the major road for intersection project, include HTRIS node and offset where applicable

**To/Cross Road:** Input the end limit for section project and the name of the cross (minor) road for intersection project, include HTRIS node and offset where applicable

**Study Period Begins:** Input the begin date of **three** year traffic crash data collection period in the format of mm/dd/yy

**Study Period Ends:** Input the finish date of **three** year traffic crash data collection period in the format of mm/dd/yy.

**Functional Class Code:** Select the functional class of study area from drop-down list

**Area Location Code:** Select area location code from drop-down list

**Federal System Code:** Select federal system code from the drop-down list

**Briefly Describe Problem and Proposed work:** A brief explanation of why this location is chosen for safety improvement by identifying current or potential safety problems or concerns and proposed cost-effective safety countermeasures. The detailed description can be input on second page.

## Crash Data Section

Crash report information is needed to complete this section. **“Crash Summary” sheet must first be completed before filling this section.** “Crash Summary” Sheet can be found in the same excel file.

**Crash Severity:** The most severe vehicle occupant injury for each crash must be determined to categorize the crash using the KABCO scale. Since January 2004, the Virginia Police Crash Report (FR-300) indicates the severity of occupant injury in Field number 19; prior to 2004, Field # 15 of the FR-300 was used. The FR-300 Field 19 corresponding codes with the KABCO scale are as follows:

K= code of 1, dead before report (on scene), and code of 5, died later

A= code of 2, major visible injury

B= code of 3, minor visible injury

C= code of 4, complaint of but not visible injury

O= no codes, property damage only crash

**Each crash must be classified by the most severe outcome for all the occupants for each crash targeted for reduction (related crash) by the improvement.**

**Crash Type:** Several major types of crashes are listed; user can input additional collision types such as “Night”, “Wet Pavement” in “Others (1)” and “Others (2)”.

**Total Related Crashes:** Input the total target crashes related to the proposed countermeasures in this location. Please refer “improvement type” for target crash type for the countermeasure.

**Total Crashes:** Input the total crashes that occurred at this location, which should be more than or at least equal to Total Related Crashes. For example, include crashes on all approaches or other types not related to the improvement. This information will be used to evaluate the overall program effectiveness.

## Traffic Data Section

Note: For traffic data, please fill corresponding section for intersection and section projects. Do not fill both traffic data sections.

### *Traffic Data (Intersection Project)*

**Period:** Input the year of traffic data, such as 2003-05

**Enter. ADT:** Input Average Daily Traffic (ADT) entering the intersection on all approaches. That is, half of the total AADT on the approaching roadway links.

**Crash Rate:** Automatically calculated as 
$$\frac{\text{TotalCrashes} * 1,000,000}{\text{AADT} * 365 * 3}$$

**Critical Rate:** If known, input the critical rate for similar intersections in that VDOT District

**NB Ent. ADT:** Enter the North Bound Entering ADT  
**SB Ent. ADT:** Enter the South Bound Entering ADT  
**EB Ent. ADT:** Enter the East Bound Entering ADT  
**WB Ent. ADT:** Enter the West Bound Entering ADT  
**Other Leg En. ADT:** Enter the Ent. ADT from other legs if applicable  
The total number of the above entering ADT should equal to **Enter. ADT**  
# of Approaches:

**Traffic Data (Section Project)**

**Period:** Input the year of traffic data, such as 2003-05  
**Section Length:** Input the section length (mile)  
**Average ADT:** Input the Average Daily Traffic (ADT) information  
**Number of Lanes:** Input the number of through lanes in this section  
**Speed Limit:** Input the speed limit on this section.

**Crash Rate:** Automatically calculated as  $\frac{TotalCrashes * 100,000,000}{AADT * 365 * 3 * SectionLength}$

**Critical Rate:** If known, input the critical rate for a similar location in that VDOT District

**Top 5%?:** Input “Yes” or “No” depending on if it is one of the top 5 percent high crash locations identified each year

**Traffic Growth Rate:** Input the projected annual traffic growth rate for the area over the expected life of the improvement (normally based on last 10 to 20 years). This number will vary by jurisdictions and should be available from VDOT Transportation Planning offices.

**Improvement Action Section**

**Number of Improvements:** Enter total number of improvement actions (Contact HSIP staff if over 4 improvement actions are proposed)

**Discount Rate:** Equals to 5.0% (given by Central Office based on the latest Federal Reserve Fund rate as of 5/10/06.)

**Improvement Description:** Select improvement action from “Improvement Table”

**Service Life\*:** Input the corresponding service life from “Improvement Table”

**PRF:** Percentage Reduction of Fatal Crashes; Input the corresponding number from “Improvement Table”

**PRI:** Percentage Reduction of Injury Crashes; Input the corresponding number from “Improvement Table” Sheet.

**PRPD\*:** Percentage Reduction of Property Damage Only Crashes, Input from “Improvement Table” Sheet

**Total- Service life:** equals to maximum number of service life of all improvement actions.

**Total-PRF:** Equals  $1 - \prod_{k=1}^m (1 - PRF_k)$ , where m=number of improvement actions.

**Total-PRI:** Equals  $1 - \prod_{k=1}^m (1 - PRI_k)$ , where m=number of improvement actions.

**Total-PRPD:** Equals  $1 - \prod_{k=1}^m (1 - PRPD_k)$ , where m=number of improvement actions.

## ***Project Cost***

Costs are required to be generated by PCES or most recent line item costs used by locality.

**PE Cost:** Current value of Preliminary Engineering Cost for each improvement action

**R/W&Utility:** Current value of Right way and Utilities Cost for each improvement action

**Construction:** Current value of Construction Cost for each improvement action

**Annualized Initial Cost:** Annualized cost for each improve action over its service life

## **Project Schedule Section**

**Begin PE:** Enter the expected Preliminary Engineering date

**Target Advert.:** Enter the Target Advertisement date

**Begin Construction:** Enter the expected Begin Construction Date

**Estimated Completed Date:** Enter the estimated completed date of the project

**Type of Plan:** Select from “Complete”, “Minimal” and “No Plans”

**Project Administrated by:** Select from “VDOT” and “Locality”

## **B/C Calculation Section**

**Total Annualized Benefit:** Equals the sum of Annul Benefit from the reduction of each related injury type crash

**Traffic Growth Factor:** Equals  $(1 + g) * \frac{(1 + g)^n - 1}{g \times n}$ , where  $g$  =annual traffic growth rate  
and  $n$  =improvement action  
service life

**Total Benefit:** Equals Total Annualized Benefit \* Traffic Growth Factor

**Total Annualized Initial Cost:** Sum of the annualized initial cost for all improvement actions.

**Total Annual Maintenance Cost:** Sum of the annual maintenance cost for all improvement actions

**Total Cost:** equals to Total Annualized Initial Cost +Total Annual Maintenance Cost

**B/C:** equals to Total Benefit/Total Cost for the defined life of the improvement.

## ***Project Benefit***

**Related Crash #:** Number of related crashes by severity type in the study period (3 years)

**Annual Reduction:** Annual reduction number of related crashes by severity type

**Cost per Crash:**

Fatal: \$3,760,000<sup>1</sup>

Injury type A: \$188,000<sup>1</sup>

Injury type B: \$48,200<sup>1</sup>

Injury type C: \$22,900<sup>1</sup>

Property Damage Only: \$6,500<sup>2</sup>

**Source:**

1. National Safety Council (NSC), 2005 Injury Facts; Estimating the Costs of Unintentional Injuries, 2005
2. Hanley, Paul, The University of Iowa, Using Crash Costs in Safety Analysis, 2004

## Benefit/Cost Analysis Methodology for VDOT HSIP Program

### Assumption:

It is assumed that crash rate is linearly proportional to traffic exposure (using crash rate)

### Basic Formula:

$$\frac{B}{C} = \frac{\left[ (NF \times C_f \times PRF) + (NI_A \times C_{IA} + NI_B \times C_{IB} + NI_C \times C_{IC}) \times PRI + (NPD \times AAPD \times PRPD) \right] \times TGF}{\sum_i^m ((PECost_i + R/W \& UtilCost_i + ConstCost_i) \times K + AMC_i)}$$

Where:

$NF$  = Number of related fatal crashes per year,

$C_f$  = Cost of a fatal crash

$PRF$  = Percent Reduction in fatal crashes

$NI_A$  = Number of related injury A (incapacitating) crashes per year

$C_{IA}$  = Cost of an injury type A (incapacitating) crash

$NI_B$  = Number of related injury type B (Non-incapacitating) crashes per year

$C_{IB}$  = Cost of an injury type C (possible injury) crash

$NI_C$  = Number of injury type C crashes (possible injuries) per year

$PRI$  = Percent reduction in injury crashes

$NPD$  = Number of related property-damage-only crashes per year

$AAPD$  = Annual average cost of property-damage-only crashes,

$PRPD$  = Percent reduction in property-damage-only crashes

$TGF$  = Traffic growth factor =  $\frac{(1 + g) \times ((1 + g)^n - 1)}{g \times n}$ , where  $g$  = annual traffic growth rate

and  $n$  = improvement project service life

$PECost_i$  = Estimated preliminary engineering cost of improvement measure  $i$

$ConstCost_i$  = Estimated construction cost of improvement measure  $i$

$R/W \& UtilCost_i$  = Estimated right-of-way and utility costs of improvement measure  $i$ ,

$K$  = Capital recovery factor =  $\frac{i(1+i)^n}{(1+i)^n - 1}$  where  $i$  = interest rate and  $n$  = improvement project

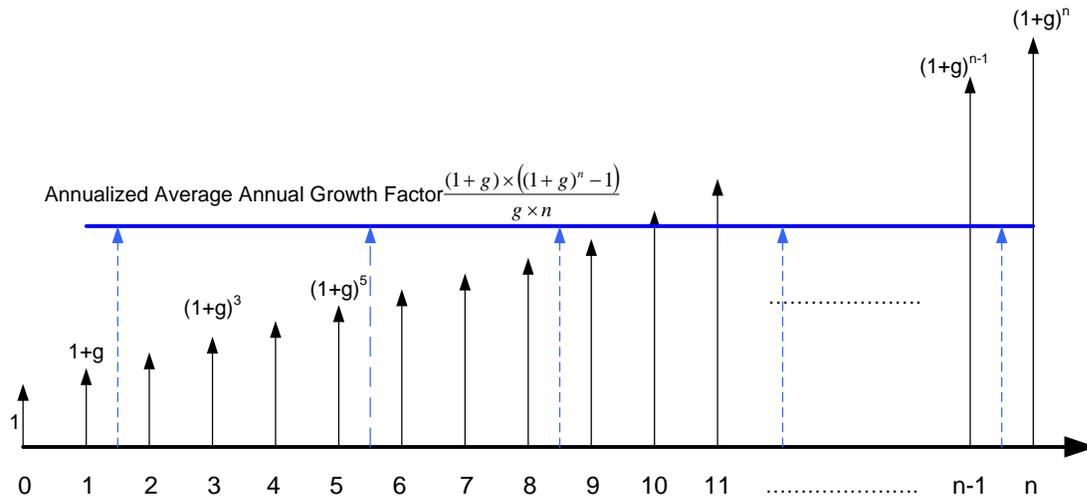
service life

$AMC$  = Annual maintenance cost for total improvement project

$m$  = Number of improvement types

Note: This B/C is only used to establish the eligibility of candidate safety projects for HSIP funding. Another B/C using Equivalent Property Damage Only (EPDO) is used in the prioritization process.

## Appendix: Derivation of Traffic Growth Factors



$$\begin{aligned}
 \text{Annualized Average Growth Factor} &= \frac{(1+g) + (1+g)^2 + (1+g)^3 + \dots + (1+g)^n}{n} \\
 &= \frac{(1+g) \times (1 + (1+g) + (1+g)^2 + \dots + (1+g)^{n-1})}{n} \\
 &= \frac{1+g}{n} \times \frac{(1 - (1+g)^n)}{(1 - (1+g))} \\
 &= \frac{1+g}{n} \times \frac{((1+g)^n - 1)}{((1+g) - 1)} \\
 &= \frac{(1+g) \times ((1+g)^n - 1)}{g \times n}
 \end{aligned}$$

Please email [ning.li@vdot.virginia.gov](mailto:ning.li@vdot.virginia.gov) for any questions or comments on the above method and permission for citation.

## **Appendix B**

HSP Improvement Type Table and Crash Reduction Factors

## Improvement Type Table for B/C Analysis

| IMPROVEMENT TYPE                                 | Service Life | CRF   |        |      | Target Crashes |         |          |             |            |           |            |              |     |              |          |              |       |  |
|--|--------------|-------|--------|------|----------------|---------|----------|-------------|------------|-----------|------------|--------------|-----|--------------|----------|--------------|-------|--|
|  |              | Fatal | Injury | PDO  | All            | Head On | Rear End | Right Angle | Side Swipe | Left Turn | Right Turn | Fixed Object | Ped | Run Off Road | Overturn | Wet Pavement | Night |  |
| <b>Traffic Sign Improvement</b>                  |              |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Warning Sign                                     |              |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| <i>Curve Warning</i>                             | 10           | 0.30  | 0.30   | 0.30 |                | X       |          |             |            |           |            |              |     | X            | X        |              | X     |  |
| <i>School zone</i>                               | 10           | 0.15  | 0.15   | 0.15 | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Regulatory Signs                                 | 10           |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| <i>Stop Sign (Two-way)</i>                       | 10           | 0.30  | 0.30   | 0.30 |                |         |          | X           |            | X         | X          |              | X   |              |          |              |       |  |
| <i>Yield</i>                                     | 10           | 0.25  | 0.25   | 0.25 |                |         |          | X           | X          |           |            |              |     |              |          |              |       |  |
| <i>All-way Stop</i>                              | 10           | 0.50  | 0.50   | 0.50 |                |         |          | X           |            | X         | X          |              | X   |              |          |              |       |  |
| Guide Sign                                       | 10           | 0.10  | 0.10   | 0.10 | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Variable Message Sign                            | 10           | 0.25  | 0.25   | 0.25 | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Upgrade signs(Increase size, conspicuity)        | 10           | 0.10  | 0.10   | 0.10 |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Flashing light on sign (Linked to signal)        | 10           | 0.25  | 0.25   | 0.25 |                |         | X        | X           |            |           |            |              |     | X            |          |              |       |  |
| Flashing light on sign(Flashing all time)        | 10           | 0.10  | 0.10   | 0.10 |                |         | X        | X           |            |           |            |              |     |              |          |              |       |  |
| Intersection Related Warning                     | 10           | 0.25  | 0.25   | 0.25 |                |         | X        | X           |            |           |            |              |     |              |          |              |       |  |
| Pavement Condition                               | 10           | 0.05  | 0.05   | 0.05 |                |         |          |             |            |           |            |              |     |              |          |              | X     |  |
| Eliminate Parking at intersection                | 10           | 0.35  | 0.35   | 0.35 |                |         |          | X           | X          |           |            | X            | X   |              |          |              |       |  |
| Prohit turns                                     | 10           |       |        |      |                |         |          |             |            | X         | X          |              | X   |              |          |              |       |  |
| <b>Traffic Signal Improvement</b>                |              |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Install a Traffic Signal                         | 20           |       |        |      |                |         |          |             | X          |           |            |              |     |              |          |              |       |  |
| 3 legs   |              | 0.34  | 0.34   | 0.34 |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| 4 legs   |              | 0.67  | 0.67   | 0.67 |                |         |          |             | X          |           |            |              |     |              |          |              |       |  |
| Remove Traffic Signal and install 4-way sto      | 20           | 0.24  | 0.24   | 0.24 | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Signal upgrading (Hardware)                      | 20           | 0.20  | 0.2    | 0.2  | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| Signal Phasing                                   |              |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |  |
| <i>Add All-Red Interval/Increase yellow time</i> | 50           | 0.3   | 0.3    | 0.3  |                |         |          | X           |            |           |            |              |     |              |          |              |       |  |
| <i>Interconnect and Optimize Signals</i>         | 5            | 0.25  | 0.25   | 0.25 | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| <i>Add pedestrian phase</i>                      | 20           | 0.50  | 0.5    | 0.5  |                |         |          |             |            |           |            |              | X   |              |          |              |       |  |
| <i>Optimize Signal Timing</i>                    | 5            | 0.10  | 0.1    | 0.1  | X              |         |          |             |            |           |            |              |     |              |          |              |       |  |
| <i>Add exclusive left-turn phase</i>             | 20           | 0.25  | 0.25   | 0.25 |                |         |          |             |            | X         |            |              |     |              |          |              |       |  |
| <i>Add protected/permissive left turn phase</i>  | 25           | 0.10  | 0.1    | 0.1  |                |         |          |             |            | X         |            |              |     |              |          |              |       |  |
| <i>Change from Pretimed to Actuated</i>          | 10           |       |        |      |                | X       | X        | X           | X          | X         |            |              |     |              |          |              |       |  |

| IMPROVEMENT TYPE                   | Service Life                                 | CRF   |        |      | Target Crashes |         |          |             |            |           |            |              |     |              |          |              |       |
|------------------------------------|--|-------|--------|------|----------------|---------|----------|-------------|------------|-----------|------------|--------------|-----|--------------|----------|--------------|-------|
|                                    |  | Fatal | Injury | PDO  | All            | Head On | Rear End | Right Angle | Side Swipe | Left Turn | Right Turn | Fixed Object | Ped | Run Off Road | Overturn | Wet Pavement | Night |
| <b>Channelization Improvements</b> |  |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | Add exclusive LT lane (with physical separa  | 8     | 0.48   | 0.48 | 0.48           |         |          | X           |            |           | X          |              |     |              |          |              |       |
|                                    | Increase turn lane length (with physical sep | 8     | 0.15   | 0.15 | 0.15           |         |          | X           |            |           |            |              |     |              |          |              |       |
|                                    | Add Two Way LT lane (with physical separa    | 8     | 0.25   | 0.25 | 0.25           |         |          | X           |            |           | X          |              | X   | X            |          |              |       |
|                                    | Add exclusive RT lane (Rural Unsignalized)   | 8     | 0.26   | 0.26 | 0.26           |         |          |             | X          | X         |            | X            |     |              |          |              |       |
|                                    | Add exclusive RT lane(Urban Signalized)      | 8     | 0.08   | 0.08 | 0.08           |         |          |             | X          | X         |            | X            |     |              |          |              |       |
|                                    | Install Roundabout                           | 20    | 0.72   | 0.72 | 0.72           | X       |          |             |            |           |            |              |     |              |          |              |       |
| <b>Pavement Improvement</b>        |  |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |
| <b>Marking</b>                     | Improving markings(conspicuity)              | 7     | 0.20   | 0.2  | 0.2            | X       |          |             |            |           |            |              |     |              |          | X            | X     |
|                                    | Two way Turn Ln(4 lane to 3 lane or 2 to 3)  | 7     | 0.25   | 0.25 | 0.25           |         |          |             |            | X         | X          | X            |     |              |          | X            | X     |
|                                    | Center Line Marking                          | 7     | 0.25   | 0.25 | 0.25           |         | X        |             |            | X(O)      |            |              |     |              |          | X            | X     |
|                                    | Left Turn Lane                               | 7     | 0.25   | 0.25 | 0.25           |         |          | X           |            |           | X          |              |     |              |          | X            | X     |
|                                    | Edgeline markings                            | 7     | 0.25   | 0.25 | 0.25           |         |          |             |            |           |            | X            |     | X            | X        |              |       |
|                                    | Raised Pavement Marking (RPM)                | 8     | 0.15   | 0.15 | 0.15           | X       |          |             |            |           |            |              |     |              |          |              |       |
|                                    | Add-No Passing Zone                          | 7     | 0.40   | 0.4  | 0.4            |         | X        |             |            | X         |            |              |     |              |          |              |       |
|                                    | <b>Install post-mounted Delineators</b>      | 10    | 0.30   | 0.3  | 0.3            |         |          |             |            |           |            |              |     |              |          |              | X     |
|                                    | Pedestrian Crosswalk                         | 7     | 0.25   | 0.25 | 0.25           |         |          |             |            |           |            | X            |     |              |          |              |       |
|                                    | Widen marking                                | 7     | 0.25   | 0.25 | 0.25           |         |          |             |            |           |            |              | X   |              |          |              |       |
| <b>Widening</b>                    | Widen the shoulder width (paved,ADT>2k)      | 12    |        |      |                |         | X        |             |            | X         |            | X            | X   | X            |          |              |       |
|                                    | From 0 ft to 2 ft                            |       | 0.13   | 0.13 | 0.13           |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 2 ft to 4 ft                            |       | 0.12   | 0.12 | 0.12           |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 4 ft to 6 ft                            |       | 0.13   | 0.13 | 0.13           |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 6 ft to 8 ft                            |       | 0.13   | 0.13 | 0.13           |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | Widen lane width                             | 20    |        |      |                | X       |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 9 ft to 10 ft                           |       | 0.13   | 0.13 | 0.13           |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 9 ft to 11 ft                           |       | 0.30   | 0.3  | 0.3            |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | From 9 ft to 12 ft                           |       | 0.33   | 0.33 | 0.33           |         |          |             |            |           |            |              |     |              |          |              |       |
| <b>Treatment</b>                   |  |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |
|                                    | Pavement skid resistance overlay             | 8     | 0.25   | 0.25 | 0.25           | X       |          |             |            |           |            |              |     |              |          |              |       |
|                                    | Superelevation                               | 8     | 0.25   | 0.25 | 0.25           |         |          |             |            |           |            | X            |     | X            | X        |              |       |
|                                    | Rumble Strip at stop controlled approach     | 8     | 0.25   | 0.25 | 0.25           |         |          | X           | X          |           |            |              |     |              |          |              |       |
|                                    | Shoulder Rumber Strip                        | 8     | 0.4    | 0.4  | 0.4            | X       |          |             |            |           |            |              |     |              |          |              |       |
|                                    | <b>Centerline Rumble Strip</b>               | 8     | 0.21   | 0.21 | 0.21           |         | X        |             |            | X(O)      |            |              |     |              |          |              |       |
| <b>Construction/Reconstruction</b> |  |       |        |      |                |         |          |             |            |           |            |              |     |              |          |              |       |

| IMPROVEMENT TYPE                                      | Service Life | CRF   |        |       | Target Crashes |         |          |             |            |           |            |              |     |              |          |              |
|---|--------------|-------|--------|-------|----------------|---------|----------|-------------|------------|-----------|------------|--------------|-----|--------------|----------|--------------|
|   |              | Fatal | Injury | PDO   | All            | Head On | Rear End | Right Angle | Side Swipe | Left Turn | Right Turn | Fixed Object | Ped | Run Off Road | Overturn | Wet Pavement |
| Add lanes (without physical separation)               |              |       |        |       |                | X       | X        | X           | X          | X         |            |              | X   | X            |          |              |
| <i>Lenghten Accelation/Deceleration Lane</i>          | 10           | 0.1   | 0.1    | 0.1   |                |         | X        |             |            |           |            |              |     |              |          |              |
| <i>Aux Left Turn lane</i>                             | 10           | 0.43  | 0.43   | 0.43  |                |         | X        |             |            | X         |            |              |     | X            |          |              |
| <i>Aux Right Turn Lane</i>                            | 10           | 0.21  | 0.21   | 0.21  |                |         | X        |             |            |           | X          |              |     |              |          |              |
| Install Pedestrian sidewalk                           | 20           | 0.5   | 0.5    | 0.5   |                |         |          |             |            |           |            | X            |     |              |          |              |
| Install the median barriers                           | 20           | 0.6   | 0.1    | -0.25 |                | X       |          |             | X(O)       |           | X          |              | X   | X            |          |              |
| <b>Roadside Improvement</b>                           |              |       |        |       |                |         |          |             |            |           |            |              |     |              |          |              |
| New / upgrade guardrail                               | 20           | 0.35  | 0.35   | 0.05  |                | X       |          |             |            |           | X          |              | X   | X            |          |              |
| Remove fixed object                                   | 10           | 0.3   | 0.3    | 0.3   |                |         |          | X           |            |           | X          |              | X   | X            |          |              |
| Relocate fixed object                                 | 10           | 0.3   | 0.3    | 0.3   |                |         |          |             |            |           | X          |              |     |              |          |              |
| Flatten side slope                                    | 20           | 0.1   | 0.1    | 0.1   |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Impact Attenuator                                     | 10           | 0.25  | 0.25   | 0.25  | X              |         |          |             |            |           |            |              |     |              |          |              |
| Install Animal fencing (only collisions with animals) |              | 0.85  | 0.85   | 0.85  |                |         |          |             |            |           |            |              |     |              |          |              |
| Increase roadside clear zone recovery dista           | 10           |       |        |       |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Add 5 ft  |              | 0.1   | 0.1    | 0.1   |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Add 8 ft  |              | 0.2   | 0.2    | 0.2   |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Add 10 ft   |              | 0.25  | 0.25   | 0.25  |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Add 15 ft   |              | 0.35  | 0.35   | 0.35  |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Add 20 ft   |              | 0.45  | 0.45   | 0.45  |                |         |          |             |            |           | X          |              | X   | X            |          |              |
| Install Breakable Sign support                        | 10           | 0.05  | 0.05   | 0.05  |                |         |          |             |            |           | X          |              |     |              |          |              |
| <b>Realignment Improvement</b>                        |              |       |        |       |                |         |          |             |            |           |            |              |     |              |          |              |
| Horizontal alignment changes (general)                | 25           | 0.25  | 0.25   | 0.25  | X              |         |          |             |            |           |            |              |     |              |          |              |
| Redesign Intersection                                 | 25           | 0.25  | 0.25   | 0.25  | X              |         |          |             |            |           |            |              |     |              |          |              |
| Vertical Alignment/Improve vertical curve             | 25           | 0.25  | 0.25   | 0.25  | X              |         |          |             |            |           |            |              |     |              |          |              |
| Improving the Sight Distance                          | 25           | 0.3   | 0.3    | 0.3   | X              |         |          |             |            |           |            |              |     |              |          |              |
| <b>Illumination</b>                                   |              |       |        |       |                |         |          |             |            |           |            |              |     |              |          |              |
| Install the street light/roadway segment              | 20           | 0.25  | 0.25   | 0.25  |                |         |          |             |            |           |            |              |     |              |          | X            |
| Lighting-Intersection and Interchange                 | 20           | 0.25  | 0.25   | 0.25  |                |         |          |             |            |           |            |              |     |              |          | X            |
| <b>Regulation Improvement</b>                         |              |       |        |       |                |         |          |             |            |           |            |              |     |              |          |              |
| Two-way to One-way operation                          | 20           | 0.5   | 0.5    | 0.5   | X              |         |          |             |            |           |            |              |     |              |          |              |
| Convert two-way stop to four way stop                 | 20           | 0.47  | 0.47   | 0.47  |                |         |          |             |            |           |            |              |     |              |          |              |
| Prohibit Right Turn on Red at sigalized inter         | 10           | 0.25  | 0.25   | 0.25  |                |         |          | X           |            | X         | X          | X            |     |              |          |              |

| IMPROVEMENT TYPE | Service Life              | CRF   |        |     | Target Crashes |         |          |             |            |           |            |              |     |              |          |              |       |  |   |  |
|------------------|---------------------------|-------|--------|-----|----------------|---------|----------|-------------|------------|-----------|------------|--------------|-----|--------------|----------|--------------|-------|--|---|--|
|                  |                           | Fatal | Injury | PDO | All            | Head On | Rear End | Right Angle | Side Swipe | Left Turn | Right Turn | Fixed Object | Ped | Run Off Road | Overturn | Wet Pavement | Night |  |   |  |
| <b>Drainage</b>  |                           |       |        |     |                |         |          |             |            |           |            |              |     |              |          |              |       |  |   |  |
|                  | Provide adequate drainage | 10    | 0.5    | 0.5 | 0.5            |         |          |             |            |           |            |              |     |              |          |              |       |  | X |  |

"O" under sideswipe crash type indicate opposite sideswipe crashes only.

Note: The above Crash Reduction Factors are based on literature review of the best available research and engineering judgement by the Traffic Engineering Division safety section of Virginia Department of Transportation. Variation from these Crash Reduction Factors may only be allowed under the approval of Central Office Traffic Enginee Division. Final countermeasure selection should be based on sound engineering judgement and should conform to applicable VDOT and FHWA policies and procedures.

## **Appendix C**

BPS Crash Groups with Recommended Countermeasures

The *Pedestrian Facilities Users Guide: Providing Safety and Mobility* (FHWA-RD-01-102, March 2002) identifies the following types of crash groups and recommended countermeasures.

| Types of Crashes                  | Countermeasures  | Estimated Costs  | Source       |
|-----------------------------------|--|--|--------------|
| <b>Midblock: Dart/Dash</b>        | Curb Extensions  | Curb extensions cost from \$2,000 to \$20,000 per corner, depending on design and site conditions  | FHWA website |
|                                   | Crossing Island  | Costs range from \$6,000 - \$9,000   | FHWA website |
|                                   | Raised pedestrian crossing (speed table)                 | Raised crosswalks are approximately \$5,000 - \$7,000, depending on drainage conditions and materials used.  | FHWA website |
|                                   | High-visibility crosswalk striping                       |  |              |
|                                   | Overhead illuminated crosswalks                          |  |              |
|                                   | Overhead Lighting  |  |              |
|                                   | In-pavement lighting                                     |  |              |
|                                   | Safety lighting  | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
|                                   | Street lighting  | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
|                                   | Median improvements (refuge areas)                       | \$10,000 to \$30,000 per 100 feet, depending on the design, site conditions, and whether the median can be added as part of a utility improvement or other street construction project.  | FHWA website |
|                                   | Midblock ped. traffic signals w/ tactile/audible feature |  |              |
|                                   | Roadway narrowing  | Adding striped shoulders or on-street bike lanes can cost as little as \$1000 per mile if the old paint does not need to be changed. The cost for restriping a mile of street to bike lanes or reducing the number of lanes to add on-street parking is \$5,000-\$10,000 depending on the number of old lane lines to be removed. Constructing a raised median or widening a sidewalk can cost \$100,000 or more per mile. | FHWA website |
| Paved shoulders (4' on each side) |  | \$87,000 per mile  | VDOT (2003)  |

| Types of Crashes           | Countermeasures  | Estimated Costs  | Source       |
|----------------------------|--|--|--------------|
| <b>Midblock: Dart/Dash</b> | Bike lanes (4' on each side w/ curb and gutter - CG-6) | \$320,000 per mile   | VDOT (2003)  |
|                            | Bike lanes (5' on each side w/ mountable curb- CG-3)   | \$340,000 per mile   | VDOT (2003)  |
|                            | Bike symbol on pavement                                | \$120.00 each  | VDOT (2003)  |
|                            | Bike Lane symbol                                       | \$120.00 each  | VDOT (2003)  |
|                            | Arrow symbol for bike lane                             | \$85.00 each   | VDOT (2003)  |
|                            | Marked crosswalks (pavement line 4")                   | \$1.00 L.F.  | VDOT (2003)  |
|                            | Pedestrian bridge (overpass and underpass)             | \$500,000-\$4 million depending on site characteristics  | FHWA website |
|                            | Pedestrian barriers (gate, fencing, etc.)              |  |              |
|                            | Raised Intersection                                    | The cost of a raised intersection is highly dependent on the size of the roads They can cost from \$25,000 to \$70,000   | FHWA website |
|                            | Pedestrian Crossing Signs                              |  |              |
|                            | Raised pedestrian crossing (speed table)               | Raised crosswalks are approximately \$5,000 - \$7,000, depending on drainage conditions and materials used.  | FHWA website |
|                            | Relocated bus stops (includes shelters)                | 1,000-\$10,000   | FHWA website |
| <b>Multiple Threat</b>     | Recessed Stop Lines                                    | Low. There is no extra cost when the recessed stop line is installed on new paving or as part of repaving projects. A "STOP HERE" sign can be used to supplement the recessed stop line. | FHWA website |
|                            | Traffic signals/pedestrian signals                     | \$30,000-\$140,000   | FHWA website |
|                            | Add Signs  | \$50-\$150 per sign  | FHWA website |
|                            | Raised Median  | \$15,000 to \$30,000 per 100 feet  | FHWA website |
|                            | Pedestrian Crossing Signs                              |  |              |
|                            | Pedestrian Signal Timing                               | Adjusting signal timing is very low cost, and requires a few hours of staff time to accomplish. New signal equipment is approximately \$20,000.  | FHWA website |
|                            | Pedestrian push button/pole in median                  |  |              |
| <b>Other Midblock</b>      | Relocated bus stops (includes shelters)                | 1,000-\$10,000   | FHWA website |
|                            | Remove Parking   | \$30-\$150 per sign  | FHWA website |

| Types of Crashes                                | Countermeasures                            | Estimated Costs  | Source       |
|---|--|--|--------------|
| <b>Failure to yield @ unsignalized location</b> | Roadway narrowing                          | Adding striped shoulders or on-street bike lanes can cost as little as \$1000 per mile if the old paint does not need to be changed. The cost for restriping a mile of street to bike lanes or reducing the number of lanes to add on-street parking is \$5,000–\$10,000 depending on the number of old lane lines to be removed. Constructing a raised median or widening a sidewalk can cost \$100,000 or more per mile. | FHWA website |
|   | Remove Parking                             | \$30–\$150 per sign  | FHWA website |
|   | Crossing Island                            | Costs range from \$6,000 - \$9,000   | FHWA website |
|   | Curb Extensions                            | Curb extensions cost from \$2,000 to \$20,000 per corner, depending on design and site conditions  | FHWA website |
|   | Raised pedestrian crossing (speed table)   | Raised crosswalks are approximately \$5,000 - \$7,000, depending on drainage conditions and materials used.  | FHWA website |
|   | Raised Intersection                        | The cost of a raised intersection is highly dependent on the size of the roads They can cost from \$25,000 to \$70,000   | FHWA website |
|   | Pedestrian Crossing Signs                  |  |              |
| <b>Bus-Related</b>                              | Relocated bus stops (includes shelters)    | 1,000–\$10,000   | FHWA website |
|   | Raised pedestrian crossing (speed table)   | Raised crosswalks are approximately \$5,000 - \$7,000, depending on drainage conditions and materials used.  | FHWA website |
|   | Raised Intersection                        | The cost of a raised intersection is highly dependent on the size of the roads They can cost from \$25,000 to \$70,000   | FHWA website |
|   | Pedestrian bridge (overpass and underpass) | \$500,000–\$4 million depending on site characteristics  | FHWA website |
|   | Pedestrian Crossing Signs                  |  |              |
|   | Curb Extensions                            | Curb extensions cost from \$2,000 to \$20,000 per corner, depending on design and site conditions  | FHWA website |
|   | Traffic signals/pedestrian signals         | \$30,000–\$140,000   | FHWA website |
|   | Pedestrian Signal Timing                   | Adjusting signal timing is very low cost, and requires a few hours of staff time to accomplish. New signal equipment is approximately \$20,000.  | FHWA website |
|   | Pedestrian push button/pole in median      |  |              |
| Overhead illuminated crosswalks                 |  |  |              |

| Types of Crashes             | Countermeasures                        | Estimated Costs  | Source   |              |
|------------------------------|--|--|--|--------------|
| <b>Bus-Related</b>           | Overhead Lighting                      |  |  |              |
|                              | In-pavement lighting                   |  |  |              |
|                              | <b>Turning Vehicles @ Intersection</b> | Safety lighting  | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
|                              |  | Street lighting  | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
|                              |  | Bike lanes (4' on each side w/ curb and gutter - CG-6) | \$320,000 per mile   | VDOT (2003)  |
|                              |  | Bike lanes (5' on each side w/ mountable curb- CG-3)   | \$340,000 per mile   | VDOT (2003)  |
|                              |  | Reduce curb radius                                     |  |              |
|                              |  | RTOR Restrictions                                      | \$30-\$150 per NO TURN ON RED sign. Electronic signs have higher costs.  | FHWA website |
|                              |  | Recessed Stop Lines                                    | Low. There is no extra cost when the recessed stop line is installed on new paving or as part of repaving projects. A "STOP HERE" sign can be used to supplement the recessed stop line. | FHWA website |
|                              |  | Prohibit Left Turns                                    |  |              |
|                              |  | ITS Technologies                                       |  |              |
|                              |  | Infrared detection technology                          |  |              |
|                              |  | Pedestrian Signal Timing                               | Adjusting signal timing is very low cost, and requires a few hours of staff time to accomplish. New signal equipment is approximately \$20,000.  | FHWA website |
|                              |  | Pedestrian push button/pole in median                  |  |              |
|                              |  | Loop Detectors for bicycles (6X15 quad)                | \$540.00 each  | VDOT (2003)  |
| Detector Amplifier           |  | \$200.00 each  | VDOT (2003)  |              |
| <b>Walking along roadway</b> | Clear Obstacles                        |  |  |              |
|                              | Audible signal                         |  |  |              |
|                              | Curb Ramps                             | \$800 to \$1,500 per curb ramp (new or retrofitted)    | FHWA website   |              |
|                              | Bike crossing (W11-1 30"X30")          | \$238.00 each  | VDOT (2003)  |              |
|                              | Bike lane ahead (R7-9 12"X18")         | \$110.00 each  | VDOT (2003)  |              |
|                              | Bikes prohibited (R5-6 24"X24")        | \$178.00 each  | VDOT (2003)  |              |
|                              | Bike route (D11-1 18"X24")             | \$151.00 each  | VDOT (2003)  |              |
|                              | Interstate bike route (D11-1 18"X24")  | \$151.00 each  | VDOT (2003)  |              |

| Types of Crashes               | Countermeasures                          | Estimated Costs  | Source       |
|--------------------------------|--|--|--------------|
| <b>Walking along roadway</b>   | Bike lane ahead R3-16 24"X30")           | \$205.00 each  | VDOT (2003)  |
|                                | Sidewalks (5' wide)                      | \$116,000 per mile   | VDOT (2003)  |
| <b>Working/Playing in Road</b> | Sidewalks (5' wide)                      | \$116,000 per mile   | VDOT (2003)  |
|                                | Curb Extensions                          | Curb extensions cost from \$2,000 to \$20,000 per corner, depending on design and site conditions                      | FHWA website |
|                                | Crossing Island                          | Costs range from \$6,000 - \$9,000   | FHWA website |
|                                | Raised pedestrian crossing (speed table) | Raised crosswalks are approximately \$5,000 - \$7,000, depending on drainage conditions and materials used.            | FHWA website |
|                                | Raised Intersection                      | The cost of a raised intersection is highly dependent on the size of the roads They can cost from \$25,000 to \$70,000 | FHWA website |
|                                | Overhead Lighting                        |  |              |
|                                | In-pavement lighting                     |  |              |
|                                | Safety lighting                          | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
|                                | Street lighting                          | Varies depending on fixture type and service agreement with local utility.   | FHWA website |
| <b>Crossing Expressway</b>     | Install/upgrade lighting                 |  |              |
|                                |  |  |              |

## **Appendix D**

Highway-Rail Grade Crossing Improvement Costs (FY 2010-2011)

## **Highway-Rail Grade Crossing Improvement Projects and Costs for FY 2010-2011**

### **Crossing Surface Improvement**

Hi-type Rubber Crossing Surface – Single track, two lane road - \$75,000

Hi-grade Rubber - Single track, two lane road – (\$260/ft) \$135,000

Lay-In Concrete Panels - Single track, two lane road – (\$180/ft) \$70,000

Platform Concrete Crossing Surface (Tub Type) - Single track, two lane road – (\$260/ft)  
\$110,000

### **Signal Improvements**

Upgrade to 12” Lens - \$50,000

Flashing Lights only - \$130,000

Flashing Lights and Gates - \$210,000

Cantilever Flashing Lights - \$275,000

\*Cantilever Flashing Lights and Gates - \$320,000

If sidewalk present at Highway/Rail Grade Crossing:

Pedestrian Gate – separate pedestal - \$55,000

Pedestrian Gate – add to gate - \$35,000

\*\*For NS – If a Unidirectional will be required, add \$90,000

Interconnection of Railroad Signals and Highway Traffic Signals –  
\$40,000-\$60,000

Source – VDOT’s Rail Project Agreement Section and the Norfolk Southern Railroad

\*Cantilever Flashing Lights and Gates are typically used where there are 2 or more travel lanes in one direction or sight distance is limited on either approach to a rail crossing

\*\* Unidirectional devices may be required when warning devices are installed at some crossing locations

**NOTE: The additional costs associated with traffic control, detours or lane closures, if needed, is not included in the installation estimates for rail upgrades/improvements**

## **Appendix E**

### HSIP Application Checklist

## Highway Safety Program (HSP) / High Risk Rural Road Program (HRRRP) Application Checklist

- HSP Application Form (with signature)
- Sketch map of the proposed improvement
- Crash Summary Sheet (from HSP Application Form)
- Turning Movement Counts if it is an intersection project
- Copy of FR300s on the Crash Summary Sheet
- A detailed breakdown of project cost by PE, R/W and Utilities, and Construction estimate from VDOT's Project Cost Estimation System (PCES) worksheets
- Additional photos and maps of the area are required

In addition to above hard copy documents, please provide:

- Electronic submission** to [HSIProgram@virginia DOT.org](mailto:HSIProgram@virginia DOT.org) with email subject: "HSP\_2010\_Applicant" Application

### Attachments:

- HSP.App\_2010\_Physical Jurisdiction\_Project##.xls

## Bike and Pedestrian Safety Program (BPSP) Application Checklist

- BPSP Application Form (with signature)
- Sketch map of the proposed improvement
- Crash Summary Sheet (from B/C worksheet), if applicable
- Copy of FR300s on the Crash Summary Sheet, if applicable
- A detailed breakdown cost by PE, R/W and Utilities, and Construction estimate from VDOT's Project Cost Estimation System (PCES) worksheets
- Additional photos and maps of the area are strongly encouraged

In addition to above hard copy documents, please provide:

- Electronic submission** to [HSIProgram@virginia DOT.org](mailto:HSIProgram@virginia DOT.org) with email subject: "BPSP\_2010\_Applicant" Application

### Attachments:

- BPSP.App\_2010\_Physical Jurisdiction\_Project##.doc.

## Highway-Rail Grade Crossing Safety Program (H-RGCP) Application Checklist

- H-RGCP Application Form (with signature)
- Sketch map showing the scope of work (footprint of the scope of work) as it relates to the actual improvement at the specified location
- Additional photos and maps of the area are strongly encouraged

In addition to above hard copy documents, please provide:

- Electronic submission** to [HSIProgram@VirginiaDOT.org](mailto:HSIProgram@VirginiaDOT.org) with email subject: "H-RGCP\_2010\_Applicant" Application

### Attachments:

- H-RGCP.App\_2010\_Physical Jurisdiction\_Project##.doc