

# Hazard Elimination Program Manual



**Revised December 2005**

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# Manual Notice 2005-1

**To:** Holders of Subject Manual

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Traffic Operations Division

**Manual:** *Hazard Elimination Program Manual*

**Effective Date:** December 1, 2005

## Purpose

The purpose of this manual revision is to:

- ◆ change the title of the *Traffic Accident Information and Hazard Elimination Program Manual* to *Hazard Elimination Program Manual*.
- ◆ update information related to the Hazard Elimination Program (HES), including work codes and project service lives (Now both included in Appendix B)
- ◆ add an appendix for “Preventable Crashes Decoding”
- ◆ remove the obsolete chapter on Traffic Accident Information and traffic accident analysis.

## Contents and Instructions

Remove and recycle the entire contents of the previous edition of this manual (known as the *Traffic Accident Information and Hazard Elimination Program Manual*) and use the online version of the revised and renamed manual (*Hazard Elimination Program Manual*).

## Online Availability

This manual is available online through TxDOT’s wide-area network (Crossroads) at:

<http://txdot-manuals/dynaweb/coltraff/tfa>

and on the Internet at:

<http://manuals.dot.state.tx.us/dynaweb/coltraff/tfa>

## Contact

Address questions concerning information contained in this manual to Debra Vermillion of the Traffic Operations Division, 512-416-3137 or fax 512-416-3299.

## Archived Manual Notices

Past manual notices are available in a [pdf archive](#).

# Chapter 1

## Hazard Elimination Program

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## Section 1 Overview

### Introduction

The Hazard Elimination (HES) Program is part of the Highway Safety Improvement Program. The basic objective of the HES Program is to reduce the number and severity of crashes. The program objectives are accomplished through “highway safety projects” (see following subheading).

The HES Program is administered by the Traffic Operations Division (TRF). It is part of the TxDOT Unified Transportation Program (Category 8). TRF requests proposed highway safety projects from the districts through a statewide program call as funds are available. Questions regarding the HES Program should be addressed to TRF, Traffic Engineering (TE) Section.

### Nature of Highway Safety Projects

Highway safety projects may be for locations both on and off the state highway system (excluding interstate highways).

Highway safety projects may accomplish any of the following:

- ◆ correct or improve high-hazard locations
- ◆ eliminate roadside obstacles
- ◆ treat roadside obstacles
- ◆ improve highway signing and pavement marking
- ◆ install traffic control or warning devices at locations with a high number of crashes.

These projects may range from spot safety improvements and upgrading of existing conditions to new roadway construction (such as grade separations). Typically highway safety projects are small in scope, low in cost, and can be let to contract within 3 years.

### Program Funding

The HES Program is federally funded. HES program funds are eligible to cover 90 percent of project construction costs. The remaining 10 percent of project construction costs must be covered by state or local participation. Authorization to receive federal funds is found in Title 23, United States Code (23 U.S.C.), Section 148. The federal requirements outlining the HES Program structure are found in the Code of Federal Regulations, Title 23, Section 924.5.

### Confidentiality of Data

Federal statute 23 USC 409 makes data and reports confidential if they are compiled for the purpose of evaluating the safety of federal-aid highways. Data used in the Hazard Elimination Program should not be released. Any written request must be routed through the Office of General Counsel (OGC).

## Program Process Overview

The following table summarizes the process by which highway safety projects obtain HES Program funding.

**Hazard Elimination Program Funding Process**

Step	Responsible Party	Action
1.	TRF	Requests project proposals through a statewide program call.
2.	District	Identifies potential highway safety projects using historical crash data and other data.
3.	District	Determines the needed highway safety improvements and their costs. >> See Section 2 of this chapter, “Design Guidelines and Project Eligibility,” for details.
4.	District	Fills out a Safety Evaluation Report (SER) form for each proposed highway safety project and submits the forms to TRF along with the necessary backup data in response to the program call. >> See Section 3 of this chapter, “Project Submission,” for details.
5.	TRF	Analyzes the proposed highway safety projects for HES program eligibility, data accuracy, and conformance with design standards. >> See Section 2 of this chapter, “Design Guidelines and Project Eligibility,” for details.
6.	TRF	Subjects each eligible project to a benefit/cost analysis using the Safety Improvement Index (SII), then puts the projects into priority order based on the results. >> See Section 4 of this chapter, “Using the Safety Improvement Index,” for details.
7.	TRF	Places projects in the HES Program according to priority and appropriated federal funding; then sends listing of highway safety projects selected for funding in the HES Program to the districts.
8.	District	Sets projects up in DCIS in the assigned work program and may include qualifying projects in the Transportation Improvement Program (TIP) as appropriate.
9.	District	Notifies TRF of potential overrun of an HES project’s authorized funds prior to PS&E submittal.
10.	District	Submits PS&E for HES projects to the Design Division (DES) in accordance with standard PS&E submission schedule. >> See the <i>Plans, Specifications, and Estimate Preparation Manual</i> (Chapter 1, Section 3) for details on PS&E procedures.
11.	TRF	Handles overruns of project authorized funds at the divisional PS&E review stage in accordance with the current TxDOT policy. >> See Commission Minute Order 106788, March 28, 1996 or subsequent revisions.

## Time Limit for Letting

Each HES program has a specified funding lapse date. Programmed projects must be let to contract by this date. Each program lapse date will be included in the “All District Engineer” call for project proposals and notification of project selection memos. Due to the loss of Federal funds not obligated by the program lapse date, there will be no extensions of these dates. Projects should not be submitted that can not be let to contract by the specified lapse date.

## Section 2

### Design Guidelines and Project Eligibility

#### Introduction

The design guidelines presented in this section are intended to aid in planning Hazard Elimination (HES) projects. The design guidelines reference portions of the Roadway Design Manual and establish items of work not eligible for HES funding. These guidelines offer sufficient flexibility while retaining safety as the essential element of all HES projects.

#### Design Guidelines

***Freeway Project and Non-freeway “New Location or Reconstruction” Projects.*** All roadway elements affected by the scope of the approved HES safety improvement must comply with the “New Location and Reconstruction (4R) Design Criteria” found in the *Roadway Design Manual* (Chapter 3). Enhancements to features outside the scope of the HES project are at the district’s option and are to be funded using district funds under a separate CSJ.

***Non-freeway “Rehabilitation or Restoration” Projects.*** All roadway elements affected by the scope of the approved HES safety improvement must comply with the “Non-Freeway Rehabilitation (3R) Design Criteria” found in the *Roadway Design Manual* (Chapter 4). Enhancements to features outside the scope of the HES project are at the district’s option and are to be funded using district funds under a separate CSJ.

For all projects, existing roadway conditions (lane widths, shoulder widths, etc.) must be retained as a minimum.

#### Design Considerations

At the beginning of the HES project proposal process, highway designers should obtain crash data to identify the specific safety problems that might be corrected and follow the suggested design process in the *Roadway Design Manual* (Chapter 4, Section 3).

**Work Not Eligible for HES Funding**

The designer should bear in mind that some items of work are *not eligible* for the HES Program. *Some of the types* of work ineligible for HES funding are:

- ◆ all work on interstate highways (main lanes and frontage roads)
- ◆ bridge replacement
- ◆ general maintenance (maintenance of roadways, signs, signals, pavement markings, markers, etc.).

**Design Exceptions or Design Waivers**

When the HES design guidelines cannot be met, the current design exception or design waiver process established in the *Roadway Design Manual* (Chapter 1, Section 2) must be followed.

## Section 3

### Project Submission

#### HES Specific Rules

As a condition of obligating Federal Highway Safety Improvement funds, a state is required to submit an annual report to the secretary of transportation that describes the progress on safety improvement projects, their effectiveness, and their contribution to reducing roadway fatalities, injuries, and crashes. In order to comply with these requirements and to maintain the integrity of the program-selection process, the following HES specific rules must be adhered to and considered prior to project proposal submission:

***Each Submission a Project.*** Each Safety Evaluation Report (SER) submitted is a project. A project can have multiple control-sections (up to four), but these control-sections cannot be split up and let at different times if the project is programmed. If a portion or portions of your project will be affected by other on-going or planned improvements or construction, the affected portions should be submitted on a separate SER form.

***Leveraging of Project Estimate Not Allowed.*** The estimate included on the SER must be for the entire cost of the project. Districts cannot add district funds to the requested amount in order to “leverage” the cost of the project. All items must be included in the submitted estimate.

***Include all Proposed Corrective Actions.*** When completing the “Proposed Corrective Action” portion of the SER, give a detailed description of all corrective action to be performed. Work types are assigned based on the information contained in this portion of the SER. Only work types programmed will be considered “in scope,” and this is the only work that can be done as part of the safety project. Work considered incidental to the primary work type will not have a separate work code assigned, but the work will be allowed (for example, widening roadway to install a left-turn lane or extend drainage structures, re-striping an overlay project, etc.). If additional non-incidental work is required or desired, it will be considered “out of scope” and will be funded by the district under a separate CSJ.

***Projects Are Location Specific.*** Project selection is based on the crash history, traffic volumes, and roadway geometrics at the specified location. The project parameters need to be accurately identified in order for the project to be programmed correctly. When defining project parameters, consideration should be given to including distance for project approaches and tapers, as necessary. Once a project is programmed, the project location cannot be moved or altered.

(continued...)



**HES Specific Rules** *(continued)*

**No Changes after Programming.** The location, length, and scope of work cannot be changed on an HES project once it is programmed. For example, if the project was programmed for “Safety Treat Fixed Objects” from point “A” to point “B” for a length of 10 miles, the project length cannot be reduced to 5 miles or increased to 15 miles, changing the programmed beginning and ending points. Also, additional work outside the scope of the approved project cannot be added. In the same note, programmed work can not be eliminated from the project. Once programmed, each HES project is all or nothing.

**Deadline for Letting.** Due to the nature of HES projects (safety), the project must be let to contract prior to the program lapse date. Federal safety funds not obligated by the lapse date are forfeited by the state. Do not submit projects for consideration that cannot be let to contract by the published lapse date.

**No Local Let.** HES projects are not eligible for local letting. All HES projects must be let by TxDOT’s competitive bid process.

**No District Processing of PS&E.** HES projects PS&E are not eligible for district processing. All PS&E must be submitted through the Design Division (DES) for review.

**Field Evaluation**

Before the SER is completed for submission, a field evaluation should be done to determine the existing conditions at the proposed project site. This helps avoid the submittal of work that has already been constructed and provides the information necessary for a complete and accurate estimate. The district’s planning office should be involved in the review of all project proposals before submittal in order to determine if the improvement is already scheduled for construction under another program.

**Additional Off-System Project Information**

Off-system projects are eligible for funding under the federal HES program. When a project located off the state highway system is selected for funding, the local municipality is required to provide 10 percent of the project cost in matching funds.

The district should have a system in place to notify local municipalities within their district when a call for project proposals is issued. The district should evaluate and consider the eligibility and viability of safety projects suggested by the local municipality. If the project proposal meets the requirements of the HES program and is considered competitive by the district, it should be submitted to TRF for funding consideration.

The local municipality is required to provide all of the requested data (crash reports, traffic volumes, roadway geometrics, diagrams, etc.) to the district in order for the proposal to be properly evaluated and the SER form to be completed.

*(continued...)*

**Additional Off-System Project Information** *(continued)*

All off-system project proposals are to be handled through the responsible district office. Using the information provided by the local municipality, the district is required to complete the off-system SER and make the submission to TRF. All questions and comments concerning project submission will be directed to the district, not the local municipality.

Off-system project proposals are evaluated and ranked along with on-system proposals using the same rules, guidelines, and requirements.

Off-system projects are not eligible for local letting. All HES projects are required to be let by TxDOT's competitive bid process.

Improvements made with federal funds through the HES Program are required to be in place and maintained by the local municipality for a minimum of 10 years.

**Submission Form**

Districts should use the automated Safety Evaluation Report (SER) form to submit proposed HES projects to the Traffic Operations Division (TRF). The automated form is updated prior to any program call. All information requested on the SER is required.

The SER form is available in two versions — “on-system” and “off-system.”

The automated MS Word SER forms are available from TRF and through the on-line version of this manual. To open either form in MS Word, simply click the appropriate link here:

- ◆ On-System
- ◆ Off-System.

**Filling Out the SER**

Complete instructions for filling out the SER form are provided in Appendix A.

When filling out the SER form, districts should consider the following points for on- and off-system projects.

***On-System Projects:***

- ◆ The “Proposed Corrective Action” should be as detailed as necessary to provide a clear understanding of the work to be performed. An additional page may be attached if needed.
- ◆ TRF uses 3 years of crash history in determining the Safety Improvement Index (SII). The appropriate three-year period is stated in the program call and on the SER. (see Section 4 of this chapter for information on the SII).

*(continued...)*

**Filling Out the SER** (*continued*)

- ◆ Diagrams and typical sections of the existing conditions and proposed improvements *must* be submitted with the SER for all roadway work projects.
- ◆ Plan or roadway layouts showing the placement of all requested traffic control devices and luminaire poles *must* be submitted with the SER. The quantity of these devices should also be noted.
- ◆ For resurfacing projects, reasonably current skid data *must* be provided with the SER. Current skid numbers *must* be less than 40.
- ◆ For traffic signal installation projects, traffic signal warrant worksheets *must* be provided with the SER.
- ◆ The estimate *must* include all relevant cost, and *all* major work items *must* be shown on the SER. A detailed estimate should be attached to the SER if available. “Mobilization/Barricade” cost should be calculated at a minimum of 8 percent. A 10-percent inflation-factor cost is required to be added to all estimates.

**Off-System Projects.** For off-system projects, the same points listed for on-system projects apply, in addition to the following points:

- ◆ The off-system SER requires more roadway system information than the on-system SER.
- ◆ Hard copies of peace officer crash reports for each off-system project *must* be included with the SER. Automated data will not be accepted in lieu of the hard copies of peace officer reports. TRF can assist the district in obtaining these copies if needed.

## Section 4

### Using the Safety Improvement Index

#### Introduction

After verifying eligibility, the Traffic Operations Division (TRF) subjects each eligible proposed highway safety project to a benefit-cost analysis. The formula used for this purpose is the Safety Improvement Index (SII).

#### The SII Formula

In its most basic form, the SII is the ratio of the cost of crashes that have occurred at a location to the cost of constructing the proposed improvement. The SII incorporates adjustments to provide additional benefit for:

- ◆ locations experiencing increasing traffic over the project life
- ◆ improvements that will reduce maintenance costs
- ◆ projects expected to have long service lives over which construction costs can be amortized.

The SII formula is as follows:

$$S = \frac{R(C_f F + C_i I + C_p P)}{Y} - M$$

$$Q = \left( \frac{A_a - A_b}{A_b} \div L \right) S$$

$$B = \frac{S + \frac{1}{2}Q}{1.08} + \sum_{i=2}^L \left[ \frac{(S + \frac{1}{2}Q) + (i-1)Q}{(1.08)^i} \right]$$

$$SII = \frac{B}{C}$$

*(continued...)*

**The SII Formula** *(continued)*

where:

$S$  = annual savings in crash costs (equal to crash cost savings per year less annual maintenance costs)

$R$  = percentage reduction factor (see following subheading for explanation)

$F$  = number of fatal and incapacitating-injury crashes (see following subheading for explanation)

$C_f$  = cost of a fatal and incapacitating-injury crash (see following subheading for explanation)

$I$  = number of non-incapacitating and possible-injury crashes (see following subheading for explanation)

$C_i$  = cost of a non-incapacitating and possible-injury crash (see following subheading for explanation)

$P$  = number of property-damage-only (PDO) crashes (see following subheading for explanation)

$C_p$  = cost of a PDO crash (see following subheading for explanation)

$Y$  = number of years of crash data

$M$  = change in annual maintenance costs for the proposed project relative to the existing situation

$Q$  = annual change in crash cost savings

$A_a$  = projected average annual ADT at the end of the project service life

$A_b$  = average annual ADT during the year before the project is implemented

$L$  = project service life (see following subheading for explanation)

$B$  = present worth of project benefits over its service life

$C$  = initial cost of the project

**Obtaining SII Data**

Before calculating the SII, the “Proposed Corrective Action” described on the Safety Evaluation Report (SER) must be translated into “work codes.” Each SER may be defined by as many as three work codes. The HES Work Codes Table (contained in Appendix B of this manual) provides the work codes that correspond to various descriptions of work. The table also provides associated definitions, reduction factors, service lives, applicable maintenance cost, and preventable crash codes (see following explanation).

*(continued...)*

**Obtaining SII Data** (*continued*)

The data necessary to calculate each project's Safety Improvement Index (SII) can be obtained from the sources shown in the following table.

<b>Sources for SII Data</b>	
<b>Data Item</b>	<b>How It Is Obtained</b>
<p><math>R</math> — Percentage Reduction Factor</p> <p><i>Note:</i> The reduction factor represents the percentage reduction in crash costs or severity that can be expected as a result of the improvement.</p>	<p>From the HES Work Codes Table (contained in Appendix B of this manual).</p> <p><i>Note:</i> If the project is represented by more than one work code, TRF program administrators derive a composite reduction factor.</p>
<p><math>F</math> — Number of fatal and incapacitating-injury crashes</p> <p><math>I</math> — Number of non-incapacitating and possible injury crashes</p> <p><math>P</math> — Number of property-damage-only (PDO) crashes</p>	<p>The HES Work Codes Table (Appendix B of this manual) shows "Preventable Crash" codes. Preventable crashes are those with defined characteristics that may be affected by the proposed improvement as described by the work code. The codes correspond to numeric codes assigned by the Department of Public Safety (DPS) to the indicated variable. The DPS collects information from the peace officer's crash report and converts it into a coded format. The Preventable Crash Decoding Table (Appendix C of this manual) can be used to interpret the codes and determine the number of each type of crash. Three years of preventable crash data are used. The program call specifies the years used.</p>
<p><math>C_f</math> — Costs of fatal and incapacitating injury crashes</p> <p><math>C_i</math> — Costs of non-incapacitating and possible injury crashes</p> <p><math>C_p</math> — Costs of property-damage-only (PDO) crashes</p>	<p>The average cost of each type of crash is based on the comprehensive cost figures provided by the National Safety Council. The program call provides the cost figures used each year.</p>
<p><math>L</math> — Project service life</p>	<p>From the HES Work Codes Table contained in Appendix B of this manual.</p> <p><i>Note:</i> If the project is represented by more than one work code, TRF program administrators base the project service life on the primary work.</p>

**SII Results**

A project with an SII greater than or equal to 1.0 is considered cost effective. Projects with an SII of less than 1.0 will not be considered for funding.

*Note:* The SII does not establish the need or lack of a need for a project. The SII formula compares costs of crashes to costs of construction; it provides no evaluation of the appropriateness of the type of construction.

The SII was designed as a comparison device for project prioritization and should *not* be used as a measure for independent projects.

### **SII Calculator Available**

To open an Excel based program for calculating a project's SII, click on the following link:

[SII\\_calc.xls](#)

*Note:* All fields are protected except for the input fields.

*Note:* "Cost" amounts subject to change on an annual basis.

# Appendix A

## SER Form Instructions

### Introduction

This appendix provides detailed instructions for filling out the Safety Evaluation Report (SER) form. There are two versions of the form — one for on-system projects and one for off-system projects. Links to automated MS Word versions of both are provided here:

- ◆ [On-system](#)
- ◆ [Off-system](#)

See Chapter 1, Section 3, for [additional considerations](#) concerning the SER forms.

### On-system SER Form Instructions

The following instructions pertain to the fields found on the automated SER for on-system projects.

**Date** — Automatically filled in with the date you fill out the form.

**District** — From the pull-down list, select the correct TxDOT district.

**County Number** — Enter the appropriate county number from the TxDOT list of county numbers. For projects crossing county lines, indicate the county where the beginning point of the project is located.

**Location** — Enter a short description of the project location, including its distance from an identifiable landmark, such as an intersection, reference marker, or city limit. Include city name if the work is to be done inside a city or town.

**Highway System** — From the pull-down list, select the roadway type. *Note:* If the project is at an intersection, list the priority roadway first and the minor roadway beneath it.

**Route Number** — Enter the highway number(s).

**Control-Section** — Enter the control section corresponding to the roadway indicated. If the project extends through more than one control section, list each control section. If the project is at the intersection of two numbered highways, list the control-section for both highways.

**Beginning Milepoint** — Enter the beginning milepoint to the nearest 00.1 for each control section listed.

**Ending Milepoint** — Enter the ending milepoint to the nearest 00.1 for each control section listed.





**On-system SER Form Instructions** (*continued*)

**Length** — Enter total length of project rounded to the nearest 0.1 mile. Where the project extends through more than one control section, show the length included in each control section. *Note:* If the beginning and ending milepoints are equal, the length will be 00.1.

**Correctable Crash Data** — Three years of crash experience is requested, ending with the most recent full calendar year of data available. Show the respective numbers for the following types of crashes:

- ◆ Fatal and Incapacitating Injury
- ◆ Other Injury
- ◆ PDO (Property Damage Only).

**Period of Crash Data** — Pre-populated with 3 years of crash data being used for the current program call.

**Part of Roadway No. 1 Involved** — From the pull-down list, select the correct part of roadway for your priority highway.

**Estimated Letting Fiscal Year** — From the pull-down list, select the *fiscal year* in which this project will be let if it is programmed. List is limited to years prior to the program lapse date.

**Problem Statement** — Describe the conditions to be corrected by the proposed improvements. Include all possible contributing factors, any concerns from the public, and a narrative on the correlation between the correctable crashes to the total crashes. If the space provided is insufficient, attach an additional sheet.

**Proposed Corrective Action** — Describe in detail all of the measures being proposed to correct the problems addressed in the Problem Statement.

**Estimated Cost** — The estimated cost (in thousands) to the nearest \$100 for each of the following:

- ◆ **Main Component(s)** — the estimated cost for each major component of the project.
- ◆ **ROW** — the total estimated ROW cost.
- ◆ **Mobilization/Barricade, Traffic Control Signs, and Traffic Handling** — the total cost for all of these items (8 percent minimum).
- ◆ **Inflation Factor** – 10 percent automatically added to estimate cost.
- ◆ **TOTAL** — the total of all the above items.

**Prepared By** — Any questions concerning the proposed project will be directed to the person whose name appears on the form. Please include a phone number and e-mail address.

## Off-system SER Form Instructions

The following instructions pertain to the fields found on the automated SER for off-system projects.

**Date** — Automatically filled in with the date you fill out the form.

**District** — From the pull-down list, select the correct TxDOT district.

**County Number** — Enter the appropriate county number from the TxDOT list of county numbers. For projects crossing county lines, indicate the county where the beginning point of the project is located.

**Location** — Enter a short description of the project location, including its distance from an identifiable landmark, such as an intersection or city limit. Include city name if the work is to be done inside a city or town.

**City Name** — Enter the name of the city responsible for the roadway identified. If location is outside the city limits, leave blank.

**Length** — Enter total length of project rounded to the nearest 0.1 mile. Where the project extends through more than one control section, show the length included in each control section. *Note:* If the beginning and ending milepoints are equal, the length will be 00.1.

**Number of Lanes** — Enter the number of through traffic lanes.

**Estimated Letting Fiscal Year** — From the pull-down list, select the *fiscal year* in which this project will be let if it is programmed. List is limited to years prior to the program lapse date.

**Federal-aid System** — From the pull-down list, select the appropriate code for the federal-aid system.

**Highway Design** — From the pull-down list, select the appropriate code for highway design.

**Functional Classification** — From the pull-down list, select the appropriate code for functional classification.

**Part of Roadway No. 1 Involved** — From the pull-down list, select the correct part of roadway for your priority road.

**Correctable Crash Data** — Three years of crash experience is requested, ending with the most recent full calendar year of data available. Show the respective numbers for the following types of crashes:

- ◆ Fatal and Incapacitating Injury
- ◆ Other Injury
- ◆ PDO (Property Damage Only).

(continued...)

**Off-system SER Form Instructions** (*continued*)

**Period of Crash Data** — Pre-populated with 3 years of crash data being used for the current program call.

**Present ADT** — Enter the present average daily traffic count (ADT) in thousands.

**Future ADT** — Enter the estimated future ADT (in thousands) to the nearest 100 for the last year expected service life of the proposed project.

**Projected ADT** — Enter the projected ADT (in thousands) to the nearest 100 for 20 years from the program year.

**Problem Statement** — Describe the conditions to be corrected by the proposed improvements. Include all possible contributing factors, any concerns from the public, and a narrative on the correlation between the correctable crashes to the total crashes. If the space provided is insufficient, attach an additional sheet.

**Proposed Corrective Action** — Describe in detail all of the measures being proposed to correct the problems addressed in the Problem Statement.

**Estimated Cost** — The estimated cost (in thousands) to the nearest \$100 for each of the following:

- ◆ **Main Component(s)** — the estimated cost for each major component of the project.
- ◆ **ROW** — the total estimated ROW cost.
- ◆ **Mobilization/Barricade, Traffic Control Signs, and Traffic Handling** — the total cost for all of these items (8 percent minimum).
- ◆ **Inflation Factor** – 10 percent automatically added to estimate cost.
- ◆ **TOTAL** — the total of all the above items.

**Prepared By** — Any questions concerning the proposed project will be directed to the person whose name appears on the form. Please include a phone number and e-mail address.

# Appendix B

## Hazard Elimination Program (HES) Work Codes

### Introduction

This appendix lists and describes HES Work codes. The work codes are grouped into five categories, as shown in the following table.

Work Code Groups	
Code	Item
100	Signing and Signals
200	Roadside Obstacles and Barriers
300	Resurfacing and Roadway Lighting
400	Pavement Markings
500	Roadway Work

Work codes are listed by number within each group.

### Signing and Signals

#### 101 — Install Warning/Guide Signs

Definition: Provide advance signing for unusual or unexpected roadway features where no signing existed previously.

Reduction Factor (%): 20

Service Life (Years): 6

Maintenance Cost: N/A

Preventable Accident: (Vehicle Movements/Manner of Collision = 20–22 or 30) OR (Roadway Related = 2 or 3)

#### 102 — Install STOP Signs

Definition: Provide STOP signs where none existed previously.

Reduction Factor (%): 20

Service Life (Years): 6

Maintenance Cost: N/A

Preventable Accident: Intersection Related = 1 or 2

#### 104 — Improve Advance Warning Signals

Definition: Bring existing flasher units into conformance with current design standards. Refer to W.C. 106 for modernization of intersection flashing beacons.

Reduction Factor (%): To be defined.

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Will be determined from supplied diagram

(continued...) **Signing and Signals** (continued)

**105 — Install Intersection Flashing Beacon**

Definition: Provide an flashing beacon at an intersection where a beacon did not exist previously.

Reduction Factor (%): 25

Service Life (Years): 10

Maintenance Cost: \$2,100 (overhead)  
\$1,300 (roadside mounted)

Preventable Accident: Intersection Related = 1 or 2

**106 — Modernize Intersection Flashing Beacon**

Definition: Improve an existing overhead flashing beacon, located at an intersection, to current design standards. Refer to W.C. 104 for non-intersection flashing beacon.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Intersection Related = 1 or 2

**107 — Install Traffic Signal**

Definition: Provide a traffic signal where none existed previously.

Reduction Factor (%): 28

Service Life (Years): 10

Maintenance Cost: \$3,400 (Isolated)  
\$3,900 (Interconnected)  
\$5,400 (Diamond Interchange)

Preventable Accident: [(Intersection Related = 1 or 2) AND (Vehicle Movements/Manner of Collision = 10–39)] OR (First Harmful Event = 1 or 5)

**108 — Improve Traffic Signals**

Definition: Modernize existing intersection signals to current design standards. Refer to W.C. 106 for modernization of intersection flashing beacons.

Reduction Factor (%): 22

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: [(Intersection Related = 1 or 2) AND (Vehicle Movements/Manner of Collision = 10–39)] OR (First Harmful Event = 1 or 5)

**110 — Install Pedestrian Signal**

Definition: Provide a pedestrian signal at an existing signalized location where no pedestrian phase exists, but pedestrian crosswalks are existing. Refer to W.C. 403 for installation of pedestrian crosswalks.

Reduction Factor (%): 15

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: First Harmful Event = 1

(continued...)

**Signing and Signals** (continued)

**111 — Interconnect Signals**

Definition: Provide a communication link between two or more adjacent signals in a corridor. Specify all signalized intersections to be included in the interconnection.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: All

**112 — Overheight Warning System**

Definition: Install electronic devices to detect overheight loads.

Reduction Factor (%): 65

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Object Struck = 43

**113 — Install Delineators**

Definition: Install post mounted delineators to provide guidance.

Reduction Factor (%): 30

Service Life (Years): 2

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) AND (Light Condition = 3 or 4)

**114 — Install School Zones**

Definition: Place school zones to include flashers, signing and/or pavement markings where none existed previously. Refer to W.C. 403 for pedestrian crosswalk markings.

Reduction Factor (%): 20

Service Life (Years): 5

Maintenance Cost: N/A

Preventable Accident: All

**118 — Replace Flashing Beacon with a Traffic Signal**

Definition: Replace an existing flashing beacon at an intersection with a traffic signal.

Reduction Factor (%): 25

Service Life (Years): 10

Maintenance Cost: \$1,300

Preventable Accident: [(Intersection Related = 1 or 2) AND (Vehicle Movements/Manner of Collision = 10–39)] OR (First Harmful Event = 1 or 5)

**119 — Install Overhead Guide Signs**

Definition: Install overhead advance signing for unusual or unexpected roadway features where no signing existed previously.

Reduction Factor (%): 20

Service Life (Years): 6

Maintenance Cost: N/A

Preventable Accident: Vehicle Movement/Manner of Collision = 20–29

(continued...)

**Signing and Signals** (continued)

**121 — Convert 2-way STOP Signs to 4-way STOP Signs**

Definition: Provide 4-way STOP signs where 2-way STOP signs existed previously.  
Reduction Factor (%): 15  
Service Life (Years): 6  
Maintenance Cost: N/A  
Preventable Accident: Intersection/Intersection Related = 1 or 2

**122 — Install Advanced Warning Signals (Intersection — Existing Signal, Flashing Beacon or STOP Signs)**

Definition: Provide flasher units for in advance of an intersection where none previously existed.  
Reduction Factor (%): 10  
Service Life (Years): 10  
Maintenance Cost: \$1,300 per Approach  
Preventable Accident: Intersection Related = 1 or 2

**123 — Install Advanced Warning Signals (Curve)**

Definition: Provide flasher units in advance of a curve where none previously existed.  
Reduction Factor (%): 10  
Service Life (Years): 10  
Maintenance Cost: \$1,300 per Approach  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 20–24 or 30)

**124 — Install Advanced Warning Signals and Signs (Intersection — Existing Signal, Flashing Beacon or STOP Signs)**

Definition: Provide flasher units and signs in advance of an intersection where none previously existed.  
Reduction Factor (%): 15  
Service Life (Years): 10  
Maintenance Cost: \$1,300 per Approach  
Preventable Accident: Intersection Related = 1 or 2

**125 — Install Advanced Warning Signals and Signs (Curve)**

Definition: Provide flasher units and signs in advance of a curve where none previously existed.  
Reduction Factor (%): 15  
Service Life (Years): 10  
Maintenance Cost: \$1,300 per Approach  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 20–24 or 30)

(continued...)



**Signing and Signals** (continued)

**126 — Install Advanced Warning Signals and/or Signs (Intersection — Uncontrolled , No Existing Advance Warning)**

Definition: Provide flasher units and/or signs in advance of an uncontrolled intersection where none previously existed.

Reduction Factor (%): 20

Service Life (Years): 10

Maintenance Cost: \$1,300 per Approach

Preventable Accident: Intersection Related = 1 or 2

**127 — Install Advanced Warning Signals (Intersection — Existing Warning Signs)**

Definition: Provide flasher units in advance of an intersection where none previously existed. Advance warning signs already exist.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: \$1,300 per Approach

Preventable Accident: Intersection Related = 1 or 2

**128 — Install Advanced Warning Signs (Intersection — Existing Warning Signs)**

Definition: Provide signs in advance of an intersection where none previously existed. Advance warning signals already exist.

Reduction Factor (%): 5

Service Life (Years): 6

Maintenance Cost: N/A

Preventable Accident: Intersection Related = 1 or 2

**129 — Install Advanced Warning Signals (Curve — Existing Warning Signs)**

Definition: Provide flasher units in advance of a curve where none previously existed. Advance warning signs already exist.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: \$1,300 per Approach

Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 20–24 or 30)

**130 — Install Advanced Warning Signs (Curve — Existing Warning Signs)**

Definition: Provide signs in advance of a curve where none previously existed. Advance warning signals already exist.

Reduction Factor (%): 5

Service Life (Years): 6

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 20–24 or 30)

(continued...)

**Signing and Signals** (continued)

**131 — Improve Pedestrian Signals**

Definition: Bring existing pedestrian signal units into conformance with current standards.  
Reduction Factor (%): 10  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: First Harmful Event = 1

**132 — Install Advanced Warning Signals and Signs**

Definition: Provide flasher units and signs in advance of hazard where none previously existed.  
Reduction Factor (%): 10  
Service Life (Years): 10  
Maintenance Cost: \$1,300 per Approach  
Preventable Accident: To be determined

**133 — Improve School Zone**

Definition: Improve an existing school zone by upgrading signing, pavement markings or signals.  
Reduction Factor (%): 5  
Service Life (Years): 5  
Maintenance Cost: N/A  
Preventable Accident: All

**Roadside Obstacles and Barriers**

**201 — Install Median Barrier**

Definition: Construct a metal, concrete, or cable safety system median barrier where none existed previously.  
Reduction Factor (%): 65  
Service Life (Years): 15  
Maintenance Cost: N/A  
Preventable Accident: (Vehicle Movements/Manner of Collision = 30) OR [(Point of Impact = 04, 05 or 63) AND (Object Struck = 01, 03, 20–23, 29–30, 32–36, 39–40, 42, 56, 60, 62, or 63)]

**202 — Convert Median Barrier**

Definition: Remove an existing metal median barrier system and install a concrete or cable safety system median barrier.  
Reduction Factor (%): 40  
Service Life (Years): 15  
Maintenance Cost: N/A  
Preventable Accident: [(Point of Impact = 04, 05, 12, 16 or 63) AND (Object Struck = 23, 39, 56, 62, or 63)] OR (Vehicle Movements/Manner of Collision = 30)

(continued...)

**Roadside Obstacles and Barriers** (*continued*)

**203 — Install Raised Median**

Definition: Install a roadway divider using barrier curb.  
Reduction Factor (%): 25  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: (Part of Roadway No. 1 Involved = 1) AND (Vehicle Movements/Manner of Collision = 10, 14, 20–22, 24, 26, 28–30, 34 OR 38)

**204 — Flatten Side Slope**

Definition: Provide an embankment side slope of 6:1 or flatter.  
Reduction Factor (%): 46  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: Roadway Related = 3

**205 — Modernize Bridge Rail and Approach Guardrail**

Definition: Improve existing substandard bridge rail and approach guardrail to current design standards.  
Reduction Factor (%): 15  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Object Struck = 23, 39–41 or 56) OR (Bridge Detail = 2 or 3)

**206 — Improve Guardrail to Design Standards**

Definition: Bring existing substandard guardrail into conformance with current design standards.  
Reduction Factor (%): 7  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Object Struck = 20–26, 29–36, 40–42, 56–58, 60, 62, or 63)

**207 — Install Protection**

Definition: Install guardrail or concrete traffic barrier where none existed previously. Refer to W.C. 209 if using guardrail to safety treat a fixed object or drainage structures.  
Reduction Factor (%): 30  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Object Struck = 20–26, 29–36, 40–42, 56–58, 60, 62, or 63)

(*continued...*)

**Roadside Obstacles and Barriers** (*continued*)

**209 — Safety Treat Fixed Objects**

Definition: Remove, relocate or safety treat all fixed objects including the installation of guardrail for safety treatment of a fixed object or drainage structures within the project limits, to include both point and continuous objects.

Reduction Factor (%): 55

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (Object Struck = 20–26, 29–36, 40–42, 56–58, 60, 62, or 63)

**217 — Install Impact Attenuation System**

Definition: Provide any of a variety of impact attenuators where none existed previously.

Reduction Factor (%): 60

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: (Object Struck = 20, 30, 40 or 42)

**218 — Widen Bridge**

Definition: Provide additional width across an existing structure, either by rehabilitation or replacement. Specify existing bridge width, existing approach roadway width and roadway type (2 lane, 4 lane undivided, etc.)

Reduction Factor (%): 55

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: (Bridge Number is not blank) OR (Bridge Detail is not blank) OR (Vehicle Movements/Manner of Collision = 20, 21, or 30) OR (Roadway Related = 2 or 3)

**219 — Install Curb – Control of Access**

Definition: Installation of curb for an urban low speed design highway where no previous curb existed and the accident history indicates a control of access problem.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: [(Intersection Related = 3 or 4) AND (Vehicle Movements/Manner of Collision = 10–19, 20–29, 33–39, 40–44,)] OR (Roadway Related = 2 or 3) OR (Object Struck = 20, 22–23, 26, 29–36) OR (First Harmful Event = 1 or 4)

**220 — Relocate Luminaire Supports From Median**

Definition: Relocate luminaire supports from median (usually narrow) and place between outside curb and R.O.W.

Reduction Factor (%): To be defined.

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (Object Struck = 20–26, 29–36, 40–42, 56–58, 60, 62, or 63)

(*continued...*)

## Roadside Obstacles and Barriers (continued)

### 222 — Improve Impact Attenuation System

Definition:	Improve existing impact attenuators.
Reduction Factor (%):	10
Service Life (Years):	10
Maintenance Cost:	N/A
Preventable Accident:	(Object Struck = 20, 30, 40 or 42)

## Resurfacing and Roadway Lighting

### 303 — Resurfacing

Definition:	Provide a new roadway surface to increase pavement skid numbers on all the lanes (current skid numbers must be less than 40).
Reduction Factor (%):	42
Service Life (Years):	10
Maintenance Cost:	N/A
Preventable Accident:	Surface Condition = 2

### 304 — Safety Lighting

Definition:	Provide roadway lighting, either partial or continuous, where either none existed previously or major improvements are being made. Refer to W.C. 305 for intersection lighting.
Reduction Factor (%):	40
Service Life (Years):	15
Maintenance Cost:	\$100 per Luminaire
Preventable Accident:	Light Condition = 3 or 4

### 305 — Safety Lighting at Intersection

Definition:	Install lighting at an intersection where either none existed previously or major improvements are proposed. Refer to W.C. 304 for general lighting.
Reduction Factor (%):	75
Service Life (Years):	15
Maintenance Cost:	\$100 per Luminaire
Preventable Accident:	Light Condition = 3 or 4 AND Intersection Related = 1 or 2

## Pavement Markings

### 401 — Install Pavement Markings

Definition:	Place complete pavement markings, excluding crosswalks, in accordance with the TMUTCD where either no markings or nonstandard markings exist. Refer to W.C. 402 for edge marking, W.C. 403 for pedestrian crosswalks, W.C. 404 for centerline striping.
Reduction Factor (%):	20
Service Life (Years):	2
Maintenance Cost:	N/A
Preventable Accident:	(Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 21 or 30) OR (First Harmful Event = 3)

(continued...)

**Pavement Markings** (continued)

**402 — Install Edge Marking**

Definition: Place edge lines where none existed previously.  
Reduction Factor (%): 25  
Service Life (Years): 2  
Maintenance Cost: N/A  
Preventable Accident: Roadway Related = 2 or 3

**403 — Install Pedestrian Crosswalk**

Definition: Place pedestrian crosswalk markings where none existed previously. Refer to W.C. 114 for school zones, and W.C. 110 for pedestrian signal.  
Reduction Factor (%): 10  
Service Life (Years): 2  
Maintenance Cost: N/A  
Preventable Accident: First Harmful Event = 1

**404 — Install Centerline Striping**

Definition: Provide centerline striping where either no markings or nonstandard markings existed previously. Refer to W.C. 401 for complete pavement markings.  
Reduction Factor (%): 65  
Service Life (Years): 2  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movements/Manner of Collision = 30

**407 — Install Sidewalks**

Definition: Install sidewalks where none existed previously.  
Reduction Factor (%): 20  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: First Harmful Event = 1 or 5

**Roadway Work**

**501 — Modernize Facility to Design Standards**

Definition: Provide modernization to all features within the Right-of-Way to achieve current desirable standards. This includes work such as widening the travelway, widening the shoulders, constructing shoulders, flattening the side slopes, and treating roadside obstacles.  
Reduction Factor (%): 15  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: All

(continued...)

**Roadway Work** (*continued*)

**502 — Widen Lane(s)**

Definition: Provide additional width to the lane(s). Refer to W.C. 517 if adding a through lane.  
Reduction Factor (%): 30  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 13, 21, 23, 30 or 33)

**503 — Widen Paved Shoulder (to 5 ft. or less)**

Definition: Extend the existing paved shoulder to achieve desirable shoulder width. Refer to W.C. 504 or 537 for constructing a paved shoulder.  
Reduction Factor (%): 25  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (First Harmful Event = 4)

**504 — Construct Paved Shoulders (1 – 4 ft.)**

Definition: Provide paved shoulders of 1- to 4-foot width where no shoulders existed previously. Refer to W.C. 503 or 536 for widening paved shoulders.  
Reduction Factor (%): 25  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 20, 23–24 or 30) OR (First Harmful Event = 4)

**505 — Improve Vertical Alignment**

Definition: Reconstruct the roadway to improve sight distance.  
Reduction Factor (%): 50  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 20–24, 30, 32 or 34)

**506 — Improve Horizontal Alignment**

Definition: Flatten existing curves. Refer to W.C. 507 for providing superelevation, and W.C. 508 for intersection realignment.  
Reduction Factor (%): 50  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 20–24 or 30)

(*continued...*)

**Roadway Work** (continued)

**507 — Increase Superelevation**

Definition: Provide increased superelevation on an existing curve.  
Reduction Factor (%): 65  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related =2 or 3) OR (Vehicle Movements/Manner of Collision =30)

**508 — Realign Intersection**

Definition: Improve an existing intersection by partial or complete relocation of the roadway(s). Refer to W.C. 509 for channelization, and W.C. 506 for improving horizontal alignments.  
Reduction Factor (%): To be defined.  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Will be determined from supplied diagram

**509 — Channelization**

Definition: Install islands and/or pavement markings to control or prohibit vehicular movements. A sketch of the proposed channelization should be provided. Refer to W.C. 508 for intersection realignment.  
Reduction Factor (%): To be defined.  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Will be determined from supplied diagram

**510 — Construct Turn Arounds**

Definition: Provide turnarounds at an intersection where none existed previously.  
Reduction Factor (%): 40  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Intersection Related = 1 or 2) AND (Vehicle Movements/Manner of Collision = 12, 14, 18, 20, 22, 24, 26, 28, 29, or 34)

**514 — Grade Separation**

Definition: Construct vertical separation of intersecting roadways.  
Reduction Factor (%): 80  
Service Life (Years): 30  
Maintenance Cost: N/A  
Preventable Accident: Intersection Related = 1 or 2

**515 — Construct Interchange**

Definition: Construct vertical separation of intersecting roadways to include interconnecting ramps.  
Reduction Factor (%): 65  
Service Life (Years): 30  
Maintenance Cost: N/A  
Preventable Accident: Intersection Related = 1 or 2

(continued...)



**Roadway Work** (*continued*)

**516 — Close Crossover**

Definition: Permanently close an existing crossover.  
Reduction Factor (%): 95  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: (Part of Roadway Involved = 1) AND (Vehicle Movements/Manner of Collision = 10, 14, 20–22, 24, 26, 28–30, 34 or 38)

**517 — Add Through Lane**

Definition: Provide an additional travel lane.  
Reduction Factor (%): 28  
Service Life (Years): 20  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movements/Manner of Collision = 20–24, 26–27, 29–30

**518 — Install Continuous Turn Lane**

Definition: Provide a continuous two-way left turn lane where none existed previously.  
Reduction Factor (%): 45  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movements/Manner of Collision = 20–22, 24, 26, 28–30, 34 or 38

**519 — Add Left Turn Lane**

Definition: Provide an exclusive left turn lane where none existed previously. The affected intersection approaches must be specified.  
Reduction Factor (%): 25  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movements/Manner of Collision = 20–22, 24, 26, 28–30, 34 or 38 AND Intersection Related  $\neq$  4

**520 — Lengthen Left Turn Lane**

Definition: Provide additional length to an existing exclusive left turn lane. Affected intersection approaches must be specified.  
Reduction Factor (%): 40  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movements/Manner of Collision = 20–22 AND Intersection Related  $\neq$  4

(*continued...*)

**Roadway Work** (*continued*)

**521 — Add Right Turn Lane**

Definition: Provide an exclusive right turn lane where none existed previously .  
Affected intersection approaches must be specified.

Reduction Factor (%): 25

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Vehicle Movements/Manner of Collision = 20–23, 25–27, 33 or 36 AND  
Intersection Related  $\neq$  4

**522 — Lengthen Right Turn Lane**

Definition: Provide additional length to an existing exclusive right turn lane. Affected  
intersection approaches must be specified.

Reduction Factor (%): 40

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Vehicle Movements/Manner of Collision = 20–22 AND Intersection  
Related  $\neq$  4

**523 — Construct Pedestrian Over/Under Pass**

Definition: Construct a pedestrian crossover where none existed previously.

Reduction Factor (%): 95

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: First Harmful Event = 1

**524 — Increase Turning Radius**

Definition: Provide an increased turning radius at an existing intersection.

Reduction Factor (%): 10

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: [(Vehicle No. 1 Type = 2–3, 5–8) AND (First Harmful Event = 7)] OR  
[(Vehicle No. 2 Type = 2–3, 5–8) AND (First Harmful Event = 7)] OR  
(Vehicle Movements/Manner of Collision = 13, 20–21, 30 or 33)

**525 — Convert to One Way Frontage Roads**

Definition: Convert two-way frontage roads to one-way operation.

Reduction Factor (%): 25

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Part of Roadway Involved = 2

**526 — Increase Vertical Clearance (Lower Grade)**

Definition: Increase vertical clearance of a roadway underneath an overhead obstacle  
by lowering the roadway grade.

Reduction Factor (%): 50

Service Life (Years): 10

Maintenance Cost: N/A

Preventable Accident: Object Struck = 43

(*continued...*)

**Roadway Work** (*continued*)

**527 — Increase Vertical Clearance (Remove Structure)**

Definition: Remove an overhead structure in order to increase vertical clearance.  
Reduction Factor (%): 95  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Object Struck = 43

**528 — Construct Median Crossover**

Definition: Provide crossovers in the median where none previously existed.  
Reduction Factor (%): 20  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Part of Roadway Involved = 1) AND (Vehicle Movement/Manner of Collision = 10,14,20–22, 24, 26, 28, 29, 34 or 38)

**529 — Remove Raised Median/Concrete Island**

Definition: Permanently remove raised median/concrete island.  
Reduction Factor (%): 35  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Object Struck = 21 or 36

**532 — Texturize Shoulders (rolled in or milled in)**

Definition: Install milled-in or rolled-in rumble strips along the shoulder.  
Reduction Factor (%): 25  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 30)

**533 — Texturize Shoulders (Profile Pavement Markers)**

Definition: Install high-profile pavement markers along the shoulder.  
Reduction Factor (%): 15  
Service Life (Years): 5  
Maintenance Cost: N/A  
Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movement/Manner of Collision = 30) OR (Surface Condition = 2)

**535 — Widen Median Opening for Storage**

Definition: Widen an existing opening in the median to accommodate vehicles for storage.  
Reduction Factor (%): 20  
Service Life (Years): 10  
Maintenance Cost: N/A  
Preventable Accident: Vehicle Movement/Manner of Collision = 10, 14, 20 or 21

(*continued...*)

**Roadway Work** (*continued*)

**536 — Widen Paved Shoulders (to > 5 ft.)**

Definition: Extend the existing paved shoulder to greater than 5 ft. Refer to W.C. 504 or 537 for constructing a paved shoulder.

Reduction Factor (%): 40

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (First Harmful Event = 4)

**537 — Construct Paved Shoulders ( $\geq$  5 ft.)**

Definition: Provide paved shoulders 5 feet or greater where no shoulders existed previously. Refer to W.C. 503 or 536 for widening paved shoulders.

Reduction Factor (%): 40

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 20, 23–24 or 30) OR (First Harmful Event = 4)

**538 — Convert 2 Lane Facility to 4 Lane Divided**

Definition: Convert an existing 2 lane facility to a 4 lane divided facility.

Reduction Factor (%): 45

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: (Roadway Related = 2 or 3) OR (Vehicle Movements/Manner of Collision = 10, 13, 14, 20, 21, 22, 24 or 30)

**539 — Install Grass Median on Undivided Facility**

Definition: Install a grass median on an undivided facility.

Reduction Factor (%): 40

Service Life (Years): 20

Maintenance Cost: N/A

Preventable Accident: Vehicle Movements/Manner of Collision = 20 – 24 or 30

# Appendix C

## Preventable Crashes Decoding

### Part of Roadway No. 1 Involved

- |                   |                     |
|-------------------|---------------------|
| 1 — Main Lane     | 6 — Detour          |
| 2 — Frontage Road | 7 — Other           |
| 3 — Entrance Ramp | 8 — Transitway      |
| 4 — Exit Ramp     | 9 — Transitway Ramp |
| 5 — Connection    |                     |

### Roadway Related

- 1 — On roadway
- 2 — Off roadway on shoulder
- 3 — Off roadway beyond shoulder

### Intersection Related

- 1 — Intersection
- 2 — Intersection related
- 3 — Driveway access
- 4 — Non-intersection

### First Harmful Event

#### *Collision of a motor vehicle with:*

- |  |                  |
|--|------------------|
| 1 — Pedestrian                         | 5 — Pedalcyclist |
| 2 — Another motor vehicle in transport | 6 — Animal       |
| 3 — RR train                           | 7 — Fixed object |
| 4 — Parked car                         | 8 — Other object |

#### *Other than a collision:*

- 0 — Overtaken
- Other non-collision

#### Vehicle Movements & Manner of Collision*Two motor vehicles approaching at an angle:*

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 10 — Both going straight        | 15 — Both right turn             |
| 11 — #1 straight, #2 backing    | 16 — #1 right turn, #2 left turn |
| 12 — #1 straight, #2 stopped    | 17 — #1 right turn, #2 stopped   |
| 13 — #1 straight, #2 right turn | 18 — Both left turn              |
| 14 — #1 straight, #2 left turn  | 19 — #1 left turn, #2 stopped    |

***Two motor vehicles going same direction:***

- |                                      |                                  |
|--------------------------------------|----------------------------------|
| 20 — Both going straight – rear end  | 25 — Both right turn             |
| 21 — Both going straight – sideswipe | 26 — #1 right turn, #2 left turn |
| 22 — #1 straight, #2 stopped         | 27 — #1 right turn, #2 stopped   |
| 23 — #1 straight, #2 right turn      | 28 — Both left turn              |
| 24 — #1 straight, #2 left turn       | 29 — #1 left turn, #2 stopped    |

***Two motor vehicles going opposite directions:***

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 30 — Both going straight        | 35 — #1 backing, #2 stopped      |
| 31 — #1 straight, #2 backing    | 36 — #1 right turn, #2 left turn |
| 32 — #1 straight, #2 stopped    | 37 — #1 right turn, #2 stopped   |
| 33 — #1 straight, #2 right turn | 38 — Both left turn              |
| 34 — #1 straight, #2 left turn  | 39 — #1 left turn, #2 stopped    |

***Two motor vehicles — other:***

- 40 — #1 straight, #2 entering or leaving parking space
- 41 — #1 right turn, #2 entering or leaving parking space
- 42 — #1 left turn, #2 entering or leaving parking space
- 43 — #1 entering or leaving parking space, #2 stopped
- 44 — Both entering or leaving parking space
- 45 — Both vehicles backing
- 46 — All others

***Movement of vehicle in other than motor-with-motor crashes:***

- 01 — Vehicle going straight
- 02 — Vehicle turning right
- 03 — Vehicle turning left
- 04 — Vehicle backing
- 05 — Other

## Object Struck

- 00 — No code shown is applicable
- 01 — Vehicle overturned
- 02 — Vehicle hit hole in road
- 03 — Vehicle jackknifed
- 04 — Person fell or jumped from vehicle
- 09 — Vehicle hit train on tracks parallel to road – no crossing
- 10 — Vehicle hit train moving forward
- 11 — Vehicle hit train backing
- 12 — Vehicle hit train standing still
- 13 — Vehicle hit train – action unknown
- 20 — Vehicle hit highway sign
- 21 — Vehicle hit curb
- 22 — Vehicle hit culvert – headwall
- 23 — Vehicle hit guardrail
- 24 — Vehicle hit railroad signal pole or post
- 25 — Vehicle hit railroad crossing gates
- 26 — Vehicle hit traffic signal pole or post
- 27 — Vehicle hit overhead signal light, wires, sign, etc.
- 28 — Vehicle hit work zone barricade, cones, signs or material
- 29 — Vehicle hit luminaire pole
- 30 — Vehicle hit utility pole
- 31 — Vehicle hit mailbox
- 32 — Vehicle hit tree or shrub
- 33 — Vehicle hit fence
- 34 — Vehicle hit house, building or building fixture
- 35 — Vehicle hit commercial sign
- 36 — Vehicle hit other fixed object
- 38 — Vehicle hit work zone machinery or stockpiled materials
- 39 — Vehicle hit median barrier
- 40 — Vehicle hit end of bridge (abutment or rail end)
- 41 — Vehicle hit side of bridge (bridge rail)
- 42 — Vehicle hit pier or support at underpass, tunnel or overhead sign bridge
- 43 — Vehicle hit top of underpass or tunnel
- 44 — Vehicle hit bridge crossing gate
- 45 — Vehicle hit attenuation device
- 49 — Vehicle hit by falling/blowing rocks from a truck
- 50 — Vehicle hit fallen trees or debris on road
- 51 — Vehicle hit object from another vehicle in road
- 52 — Vehicle hit previously wrecked vehicle
- 54 — Vehicle hit other machinery
- 55 — Vehicle hit other object
- 56 — Vehicle hit concrete traffic barrier
- 57 — Vehicle hit delineator or marker post
- 58 — Vehicle hit retaining wall
- 59 — Vehicle hit HOV lane gate
- 60 — Vehicle hit guard post
- 61 — Fire hydrant
- 62 — Ditch (long narrow excavation dug in earth)
- 63 — Embankment (a raised strip of land or berm)

### **Bridge Detail**

- 0 — Structure not hit
- 1 — Vehicle retained on bridge or overpass
- 2 — Vehicle went through rail
- 3 — Vehicle went over rail
- 4 — Crash involved underpass
- 5 — Vehicle went between parallel structures
- + — Result unknown

### **Other Factor**

- 00 — No code shown is applicable
- 01 — Lost control or skidded (icy or slick road, etc.)
- 02 — Passenger interfered with driver
- 03 — Attention diverted from driving (delayed perception or lack of alertness)
- 04 — Open door or object projecting from vehicle
- 05 — Foot slipped off clutch or brake
- 06 — Gusty winds
- 10 — Vehicle passing or attempting to pass on left
- 11 — Vehicle passing or attempting to pass on right
- 12 — Vehicle changing lanes
- 13 — One car parked improper location
- 14 — One car forward from parking
- 15 — One car backward from parking
- 16 — One car entering driveway
- 17 — One car leaving driveway
- 18 — Road rage

### ***Vision obstructed by:***

- |                                 |                                 |
|---------------------------------|---------------------------------|
| 21 — Standing or parked vehicle | 26 — Headlight or sun glare     |
| 22 — Moving vehicle             | 27 — Hillcrest                  |
| 23 — Embankment or ledge        | 28 — Trees, shrubs, weeds, etc. |
| 24 — Commercial sign            | 29 — Other visual obstructions  |
| 25 — Highway sign               |                                 |

### ***Vehicle swerved or veered from intended course:***

- 30 — Reason not specified
- 31 — For surface or visibility
- 32 — For officer, watchman, flagman, or traffic control device (unable to stop, etc.)
- 33 — Avoiding pedestrian, pedalcyclist, etc. in road
- 34 — Avoiding animal in road
- 35 — Avoiding object in road
- 36 — Avoiding vehicle stopped or moving slowly in traffic lane
- 37 — Avoiding vehicle entering road
- 38 — Avoiding vehicle from opposite direction in wrong lane
- 39 — Avoiding previous crash
- 3 — Avoiding vehicle passing, changing lanes

(continued...)



**Other Factor** (*continued*)

***Vehicle slowing, stopping, or stopped on road:***

- 40 — Reason not specified
- 41 — Because of surface or visibility
- 42 — For officer, watchman, flagman, or traffic control device
- 43 — For pedestrian, pedalcyclist, etc. in road
- 44 — For animal in road
- 45 — For object in road
- 46 — Avoiding vehicle stopped or moving slowly in traffic lane
- 47 — To avoid vehicle entering road
- 48 — To avoid vehicle from opposite direction in wrong lane
- 49 — To avoid previous crash
- 50 — To make right turn
- 51 — To make left turn

***School bus related crash:***

- 60 — A school bus was involved in the crash, either as a participant or non-contact vehicle. Also included are crashes involving pedestrians struck exiting, boarding, or crossing the road to or from a school bus and crashes related to the presence of a school bus.

***Construction related:***

- 70 — Within posted road construction zone – not construction related
- 71 — Within posted road construction zone – construction related
- 72 — In other construction maintenance area – not construction related
- 73 — In other construction maintenance area – construction related

***Beach related:***

- 80 — Crash happened on a beach

**Light Condition**

- |                            |                        |
|----------------------------|------------------------|
| 1 — Daylight               | 4 — Darkness – lighted |
| 2 — Dawn                   | 5 — Dusk               |
| 3 — Darkness – not lighted |                        |

**Surface Condition**

- |         |                  |
|---------|------------------|
| 1 — Dry | 3 — Muddy        |
| 2 — Wet | 4 — Snowy or icy |

## Road Condition

- 0 — No defects
- 1 — Holes, ruts, etc., in surface
- 2 — Defective shoulders
- 3 — Foreign material on surface
- 4 — High water or flood debris
- 5 — Slick surface
- 6 — Obstruction in road not lighted (night)
- 7 — Obstruction in road not marked (day)
- 9 — Road under construction
- — Maintenance or repair activity affecting traffic

## Vehicle No. 1 Type

## Vehicle No. 2 Type

- 01 — Passenger car
- 02 — Passenger car & trailer
- 03 — Passenger car & house trailer
- 04 — Truce
- 05 — Truck & trailer
- 06 — Truck-tractor & semi-trailer (includes multiple trailers)
- 07 — Truck & house trailer
- 08 — Other truck combinations
- 09 — Farm tractor
- 10 — Road machinery
- 11 — Bus
- 12 — School bus
- 13 — Motorcycle
- 14 — Motor scooter or motorbike
- 15 — Other machinery
- 16 — Motor assisted bicycle (moped)
- 17 — Ambulance
- ++ — Vehicle type unknown