Chapter 321  Sustainable Safety

321.01  General

WSDOT has a transportation safety goal titled Target Zero as part of the Washington State Strategic Highway Safety Plan. In pursuit of that goal, WSDOT recognizes that risk exists in all modes of transportation. The universal objective is to reduce the number and severity of crashes within the limits of available resources, science, technology, and legislatively mandated priorities.

The Secretary’s Executive Order 1085, Sustainable Highway Safety Program, sets the overarching policy for the Washington State Department of Transportation (WSDOT) to embark on a more targeted and scientifically-based approach for identifying and addressing collision risks. This policy relies on quantification of safety modifications using various tools and assessment techniques to determine appropriate safety countermeasures.

The policy directs engineers to base project-level decisions on the safety analysis of specific locations and corridors. Proven low-cost countermeasures should be considered. Focusing on proven lower-cost targeted countermeasures at specific locations optimizes the return on investment of safety dollars. These lower-cost investments allow for additional identified locations to be addressed.

Implementing Sustainable Safety improves WSDOT’s effectiveness in reducing the risk of fatal and serious injury collisions statewide. It focuses on site-specific crash contributing factors and types of collisions through the use of state-of-the-art principles and analytical methods to diagnose, quantify, and predict potential collision risks. The Sustainable Safety approach relies on peer review of projects presented to region and Headquarters (HQ) experts to critically review and offer potential options to project scope and approaches.

The Sustainable Highway Safety Policy directs WSDOT to use the most effective and efficient resources to achieve the goals of the Washington State Strategic Highway Safety Plan: Target Zero. This approach:

1. Maximizes the reduction in the risk of fatal and serious injury collisions on Washington’s highways.
2. Provides the most accurate assessment of collision risk.
3. Identifies the most critical risk locations.
4. Provides the most accurate assessment of potential collision reduction benefits.
5. Identifies and deploys solutions with the greatest benefit/cost.
6. Reduces waste by removing design elements that provide marginal or no reduction in collision risk.
7. Addresses the greatest number of crucial risk locations for a given investment level.
8. Provides a more accurate assessment of project and program performance.
9. Provides scientific and engineering tools to continually improve and refine safety analyses.

Practical Design is an approach to making project decisions that focus on the need and purpose for the project using the most cost-effective solutions. Practical Design that integrates Sustainable Safety supports Washington in reaching its Target Zero goal. Sustainable Safety is an essential part of successful Practical Design implementation. It provides the process and methods to incorporate safety performance assessment and peer review into Performance-Based Practical Design. Sustainable Safety allows the planner, engineer, and decision maker, to identify and quantify the safety performance of design alternatives. Sustainable Safety is a critical and complementary element of Practical Design.

321.02 Sustainable Safety for I-2 Projects

The Highway Safety Executive Committee (HSEC) formally adopted the Highway Safety Manual (HSM) for statewide implementation in 2011. The HSM introduced a science-based technical approach to identifying sites with the most potential for reducing crash severity or frequency, and potential countermeasures for addressing factors contributing to those crashes. For a brief introduction of the Highway Safety Manual, see: www.highwaysafetymanual.org/about.aspx

As part of the endorsement of HSM, WSDOT implemented SafetyAnalyst as the new tool for screening and initial ranking of sites within the state system. SafetyAnalyst is used to analyze the entire roadway network and identify sites with potential for safety improvements. These sites are identified as collision analysis segments and the statewide locations with the highest potential for reducing the number and/or severity of fatal and serious injury collisions. The formal process for evaluating and scoping safety projects is illustrated in the Safety Scoping Process flowchart. The safety scoping process identifies a Safety Review Panel where the regions present their proposed projects for approval.

321.02(1) Safety Management Process

The safety management process is a methodology used to reduce crashes on existing roadway networks statewide. These steps are a set of tools available for use in conjunction with sound engineering judgment. The typically responsible groups are mentioned below; however, depending on how a region is organized, the responsible groups may vary. The seven steps are:

1. **Network Screening is initiated** by HQ Capital Program Development & Management (CPDM), approved by HSEC, then refined by the region Planning, Traffic, or Programming Office. In this step, the whole or a subset of the transportation network is screened to identify and rank sites from most likely to least likely to realize reductions in collision frequency and/or severity by implementing countermeasures.

2. **Diagnosis** is usually done through preparation of the Collision Data Analysis Report by the region Program Management or Traffic Office. This step provides an understanding of safety performance using observed collision history and physical characteristics to determine the contributing factors and potential sites with higher-than-normal safety opportunities for that type of site using HSM methodologies.
3. **Selecting Countermeasures** is usually done by the region Program Management or Traffic Office with region Design Office input. In this step, the higher-than-normal collision sites are further evaluated to identify factors that may be contributing to observed collisions. Countermeasures are then selected to address the factors contributing to the number and/or severity of collisions.

4. **Economic Appraisals** is usually done by the region Program Management Office in coordination with the region Traffic Office. In this step, economic appraisals are performed to compare the benefits of potential collision countermeasures (calculated using crash modification factors) versus countermeasure costs and their effects on overall project costs.

5. **Prioritize Projects** is usually done in coordination with the region Program Management office, region Traffic Office and CPDM. In this step, potential safety projects are reviewed and prioritized based on their benefits and costs.

6. **Design decision documentation** is performed by the Region Office preparing the design using safety analyses for design decisions and documentation of those decisions. Specific uses include:
   - Design of I-2 Safety Projects
   - Safety analysis of alternatives
   - Safety analysis for design deviations/project analyses/corridor analyses (see Chapter 300)
   - Work zone design

7. **Safety Effectiveness Evaluation** is a post-project step, usually performed by HQ CPDM, HQ Design Office, or the region or HQ Traffic Office, that analyzes the effectiveness of countermeasures used in past projects. Countermeasures are evaluated for their effectiveness in reducing the number and/or severity of collisions in order to determine if predicted collision reductions were realized. Safety effectiveness evaluations play an important role in assessing how well funds have been invested in safety improvements. Each of these aspects of safety effectiveness evaluation may influence future decision-making activities related to allocation of funds and revisions to highway agency policies. CPDM and HQ Design evaluate the overall effectiveness of the I-2 safety program.

### 321.03 Sustainable Safety for Other Projects

The **Highway Safety Manual** and its safety analysis tools have been developed to aid design decision making and documentation. It does so by helping to quantify the safety performance implications of design decisions and by providing a basis for predicting and documenting the future safety performance of those decisions. Safety analysis tools may be appropriate for the following activities:

- **Design Decisions:**
  - To analyze and document the safety performance of any alternatives and design decisions.

- **Design Deviations/Corridor Analyses/Project Analyses** (see Chapter 300):
  - To predict the safety performance of each design alternative, and to help weigh the safety risk of each alternative as part of the information needed to apply engineering judgment.
Most of the alternatives discussed in deviations have safety aspects that should be analyzed to compare them to the other alternatives. If a deviation has no safety aspects, a safety analysis would not provide benefit.

- Interchange Justification Reports (IJRs) Collision Analysis. (See Chapter 550 about collision analysis in IJRs.)
  - Identify and document the existing safety performance of the freeway section and the adjacent affected local surface system.
  - Predict the safety performance from traffic flow and geometric conditions imposed by the access point revision alternatives.
  - The scope of a collision analysis in an IJR is the decision of the IJR support team and the approving authority(ies), the Assistant State Design Engineer for your region, and the Federal Highway Administration (FHWA) Safety/Design Engineer.

Whether or not a deviation needs a safety analysis of its alternatives is ultimately the decision of the approving authority (see Exhibit 300-2).

321.04 Safety Analysis Process & Tools

Perform a safety analysis to: identify sites with the most potential for crash frequency or severity reduction; identify factors contributing to crashes and the associated potential countermeasures to address these issues; conduct economic appraisals of improvements and prioritize projects; evaluate the crash reduction benefits of implemented treatments; and calculate the effect of various design alternatives on crash frequency and severity. Calculate these effects for planning, design, operations, and policy decisions.

The safety analysis process is intended to be scalable. In every safety analysis, determine the correct level needed. The approving authority for the design or planning document in question is always the final authority on whether a safety analysis is needed and how extensive it is. (See Exhibits 300-2 and 300-3 for a list of approving authorities.)

321.04(1) Collision Data Analysis Report

The primary tool used to document the results of a safety analysis is the Collision Data Analysis Report. A report template with instructions is available here:

http://www1.wsdot.wa.gov/riskmanagement/shs/safetytools.htm

Conduct a collision data analysis to determine the contributing factors associated with the collisions. Once the contributing factors are known, identify countermeasures that range from low cost to high cost. Complete a benefit/cost analysis to determine what countermeasure to select. Based on the selected countermeasure, determine and document those design elements and levels to be included in the project (see the Safety Scoping Process flowchart). Complete the following documentation:

- Include an analysis of the collision history to identify contributing factors.
- Identify which of the 4 E’s (Engineering, Enforcement, Education, and Emergency Services) best address the contributing factors. If you select engineering solutions, then consider countermeasures that include operational, low-cost, and high-cost solutions.
• Select the recommended countermeasure based on a benefit/cost analysis. Tools available for use in selecting recommended countermeasures include HSM, SafetyAnalyst, Road Safety Assessments (RSAs), Interactive Highway Safety Design Model (IHSDM), and the Crash Modification Clearinghouse. New and other tools will be assessed for use as they become available. WSDOT's “Short List” of approved countermeasures can be found here:

http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetycountermeasures.htm

321.04(2) Safety Analysis Resources and Tools

Various tools are available to support a safety analysis. All of the safety performance tools mentioned below can be found through the Sustainable Highway Safety website:

http://wwwi.wsdot.wa.gov/riskmanagement/shs/

• SafetyAnalyst: This application is used by and CPDM for network screening. It is also used during scoping and design for gathering collision data for analysis. SafetyAnalyst has collision data broken down into highway segments and intersections that can be displayed in tables, graphs, and charts. The collision data in SafetyAnalyst is updated once every year when the last year’s data has been input in the Collision Data Mart.

• The Collision Data Mart: This database application is another way to obtain collision data. Access to this application is granted by your supervisor and the Transportation Data Office. The data is updated as it comes in.

• Collision Analysis Data Report: This template is the basis for all collision analyses for all types of design documentation that need collision analyses (see 321.04(1)).

• Interchange Safety Analysis Tool enhanced (ISATe): This tool analyzes the safety performance of freeway segments, speed change lanes, interchange ramps, ramp terminal intersections, and collector-distributer (CD) lanes.

• Highway Safety Manual Spreadsheets: There are different spreadsheet options for Highway Safety Manual safety performance predictions. Each of these spreadsheet tools can predict the safety performance of highway segments and intersections for three types of highways: Rural Two-lane Two-way, Rural Multilane, and Urban-Suburban Arterial.

Following are the spreadsheet options, with their benefits and limitations:

1. AASHTO Highway Spreadsheets: These spreadsheets are the simplest of the three, but they can only handle a maximum of two segments and two intersections of the same type of highway at a time.

2. Extended Highway Spreadsheets: These spreadsheets are a little more complicated, but they can handle an unlimited number of highway segments and intersections of the same highway type. In other words, you can analyze an unlimited number of highway segments and intersections as long as you don’t change highway types.
3. **Collision Analysis Tool (CAT):** This is an application with an accessible spreadsheet behind it. It can handle an unlimited number of segments and intersections for any of the highway types. In other words, you can analyze an unlimited number of highway segments and intersections and can mix and match highway types. This tool also calculates Benefit Cost ratio of alternatives.

4. **WSDOT Crash Modification Factor (CMF) Short List:** This is a spreadsheet displaying the latest pre-approved CMFs that can be readily used if the context of the listed CMF matches the context of the alternative being analyzed. To back up the CMFs on this spreadsheet, there are detailed investigation reports for each CMF type.
   - Crash Modification Factor Clearinghouse: For needed CMFs not yet on the short list, this online AASHTO database holds all of the advertised CMFs. Consult this database when no suitable CMF can be found on the short list: [http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetycountermeasures.htm](http://wwwi.wsdot.wa.gov/riskmanagement/shs/safetycountermeasures.htm)

### 321.05 References

#### 321.05(1) Federal/State Directives, Laws, and Codes

- 23 United States Code (USC) 148 – Federal requirements for the Highway Safety Improvement Program (HSIP)
- Revised Code of Washington (RCW) 47.05.010 – The statement of purpose for priority programming of transportation projects
- Secretary’s Executive Order 1085 – Sustainable Highway Safety Program

#### 321.05(2) Design Guidance

- *Highway Safety Manual* (HSM), AASHTO, 2010

#### 321.05(3) Supporting Information

- Sustainable Highway Safety Internal Web Page – Contains all of the procedures and tools to implement highway safety: [http://wwwi.wsdot.wa.gov/riskmanagement/shs/](http://wwwi.wsdot.wa.gov/riskmanagement/shs/)

### 321.06 Documentation

Refer to Chapter 300 for documentation requirements.