



## **Safety Improvement Projects**

### **I. Introduction**

#### **A. Purpose**

The purpose of this *Design Manual Supplement* is to revise the design policy related to safety projects on state transportation facilities. This supplement:

- Applies to projects programmed for the 09-11 Biennium or after.
- Revises the Design Matrices for Intersection and Corridor safety improvements.
- Provides for the greatest safety benefit with limited funding.

#### **B. References**

None.

#### **C. Background**

Design Matrices 3, 4, and 5 in Chapter 325 of the *Design Manual* include rows for crash reduction projects that are identified based on historical crash occurrences. There are rows for Non-Interstate Freeways (3-11, 4-10, and 5-13), Intersections (3-12, 4-11, and 5-14), and Corridors (3-13, 4-12, and 5-15).

The intent of these projects has been to address all of the design elements identified on the matrix rows. There are no similar rows for the Interstate facilities.

#### **D. Discussion**

In an effort to provide the greatest safety benefit with limited funding, this supplement revises WSDOT policy to focus highway safety project modifications on improvements that have the greatest potential to reduce severe or fatal injuries.

The intent of this policy change is to:

- Address the elements that are associated with severe injury crashes.

- Consider a range of solutions that include minor operational modifications, lower-cost improvements such as channelization, and higher-cost improvements such as signalization and widening.
- Recognize the substantial tradeoffs that must be made with the numerous competing needs and costs a highway designer faces in project development.

Because projects programmed for the 09-11 Biennium will be developed on a “need” basis, a matrix approach might not be the most efficient method of scoping these projects. It is proposed that the elements be determined and documented in a Project Analysis. This Project Analysis will:

- Include an analysis of the crash history.
- Identify operational, low-cost, and high-cost solutions.<sup>1</sup>
- Propose the appropriate solution based on a benefit/cost analysis as part of the Project Analysis.

Sites With Potential for Improvement (SWPI) are developed for the purpose of identifying potential project locations. These sites have been identified through a system-wide analysis. Only the sites with correctible contributing factors, traffic movements, or locations will be addressed. The SWPIs that may benefit from a safety-focused highway modification include the following:

- Collision Prevention
- Collision Reduction (including Collision Analysis Locations [CAL])
- System Improvements (such as safety initiatives)

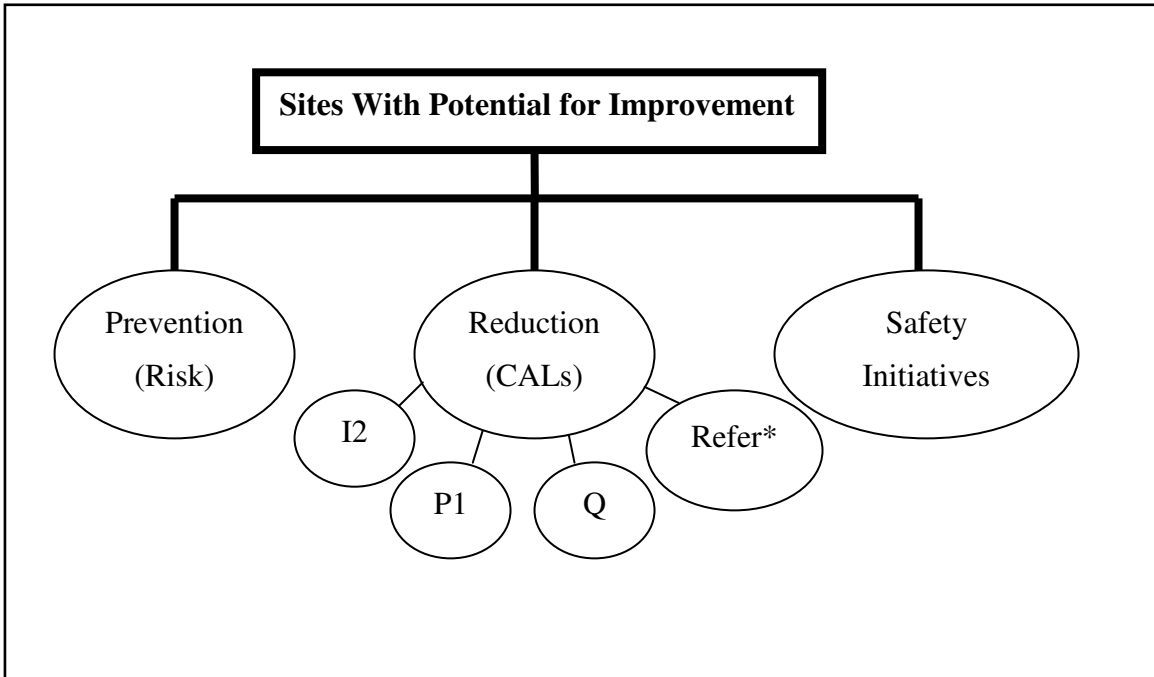
All SWPIs are analyzed incorporating additional collision and risk data to determine contributing factors. Proposed countermeasures are developed to specifically address those contributing factors and locations.

Analyze the SWPIs and proposed countermeasures using the Project Analysis early in the scoping process; ensure there is enough detail for a reasonable cost estimate; and have scoping reviewed by the responsible design or traffic operations approval authority. Those projects identified through the process above will fall under several categories, as shown in the diagram below.

- For I2-funded projects, see the Design Matrices (Design manual Supplement May 2008).
- For spot improvements in P1, see Chapter 410.
- For Q projects, see Chapter 340.

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<sup>1</sup> Guidance on developing and using Project Analysis documents is forthcoming.



### E. Implementation

This change is effective for SWPI projects programmed for the 09-11 Biennium.

## II. Instructions

### A. Insert this entire Supplement behind the existing matrices in Chapter 325.

The Contents and Index sections remain unchanged for this supplement. They will be updated with the next regularly scheduled *Design Manual* revision.

\* Some locations without a highway improvement solution will be referred to Enforcement and Education agencies for consideration.



↕ Project Type																Bridges			Barriers			
	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width [13]	On/Off Conn.	Median Width	Cross Slope Lane	Cross Slope Shldr	Fill/Ditch Slopes	Clear Zone	Sign. [10]	Delini. [9]	Illumin.	Vert. Clear. [11]	Bike & Ped.	Lane Width	Shldr Width	Structural Capacity	Term. & Trans. Section [12]	Std Run	Bridge Rail [14][19]	
<b>(1-1) Preventive Maintenance</b>																						
<b>Pavement Restoration</b>																						
(1-2) Diamond Grinding										EU	EU	F		DE					F	EU	F	
(1-3) Milling with HMA Inlays									EU	F	EU	F		DE					F	EU	F	
(1-4) Nonstructural Overlay				DE				EU	EU	EU	F	EU	F	F					F	F	F	
<b>Pavement Rehab./Resurf.</b>																						
(1-5) HMA Structural Overlays	EU	DE	F	F	F[17]	DE	F	EU	F	F	EU	F	F	F		F	DE		F	F	F	
(1-6) PCCP Overlays	EU	DE	F	F	F[17]	DE	F	EU	F	F	EU	F	F	F		F	DE		F	F	F	
(1-7) Dowel Bar Retrofit	EU	DE	F	F	F[17]	DE	DE		F	F	EU	F	F	DE			DE		F	F	F	
<b>Bridge Rehabilitation</b>																						
(1-8) Bridge Deck Rehabilitation																		(11)	F[6]	F[22]	F	
<b>Safety</b>																						
(1-9) Median Barrier				DE															F[20]	F[20]		
(1-10) Guardrail Upgrades				DE						F									F	F[23]		
(1-11) Bridge Rail Upgrades																			F	F[22]	F	
(1-12) Collision Analysis Locations*	Design Elements determined based on a Project Analysis (See Note 27)																					
<b>Reconstruction (16)</b>																						
(1-13) New/Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	

- Not Applicable
- F** Full design level (see Chapter 440).
- DE** Design Exception to full design level.
- EU** Evaluate Upgrade to full design level.

- (6) Applies only to bridge end terminals and transition sections.
  - (9) Continuous shoulder rumble strips required in rural areas (see Chapter 700).
  - (10) See Chapter 820.
  - (11) See Chapter 1120.
  - (12) Impact attenuators are considered as terminals.
  - (13) See Chapters 440 and 640.
  - (14) Includes crossroad bridge rail (see Chapter 710).
  - (16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).
  - (17) DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant accidents (see Chapter 940).
  - (19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
  - (20) Applies to median elements only.
  - (22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
  - (23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.
  - (27) A Project Analysis is used to document the needs at a location and determine the appropriate design elements to address these needs
- \* Collision Analysis Locations are those sites identified through a system-wide analysis that have a high severity collision history. These sites are created with the intent to modify, where appropriate, specific highway elements that have a high potential to reduce the identified high severity collisions.

## Design Matrix 1

### Interstate Routes (Main Line)

(Supplement to be used on projects programmed for '09-'11 biennium)



↓ Project Type																Bridges (11)				Intersections			Barriers			
	Design Elements ⇨															Lane Width	Shldr Width	Vertical Clearance	Structural Capacity	Turn Radii	Angle	I/S Sight Dist.	Term. & Trans. Section (12)	Std Run	Bridge Rail (14)(19)	
Preservation																										
Roadway																										
(3-1) Non-Interstate Freeway	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F		B	B		DE/F	DE/F	F			F	B	F		
(3-2) HMA/PCCP/BST Overlays	DE/M	DE/M	DE/M	DE/M	DE/F	DE/F	DE/M	DE/M	DE/M	DE/M				B	B	M	DE/M	DE/M	F			B	F	B	F	
(3-3) Replace HMA w/ PCCP at I/S	DE/M	DE/M	EU/M	EU/M	DE/F		DE/M	EU/M	DE/M	DE/M				B	B	M	DE/M	DE/M	F			B	F	B	F	
Structures																										
(3-4) Bridge Replacement	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)			F	F		F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	
(3-5) Bridge Deck Rehab.														B	B	M			F			F(6)	F(22)	F	F	
Improvements (16)																										
Mobility																										
(3-6) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	
(3-7) Urban	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F			F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	
(3-8) Rural	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F			F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	
(3-9) HOV	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F			F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	
(3-10) Bike/Ped. Connectivity	(5)	(5)	(5)	(5)	(5)					(5)	(5)	(5)	(5)			F	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	
Safety																										
(3-11) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	
(3-12) Intersection (1)			F(2)	F(2)	F						F(2)	F	F	F	M						F	F	F	F	F	
(3-13) Corridor (1)(24)	M(4)	M(4)	M(4)	M(4)	F	F(17)	M(4)	M(4)	M(4)	M(4)	F	F	F			F	M(4)	M(4)	F		M(4)	M(4)	F	F	F	
(3-14) Median Barrier				DE/F																			F(20)	F(20)		
(3-15) Guardrail Upgrades				DE/F																			F	F(23)		
(3-16) Bridge Rail Upgrades																							F	F(22)	F	
(3-17) Risk: Roadside											F	EU/F	F	F									F	F	F	
(3-18) Risk: Sight Distance	F/M(21)	F/M(21)	F/M(21)	F/M(21)							F/M(21)	F(21)	F(21)	F			F	F(21)	F(21)	F(21)		F/M(21)	F/M(21)	F(21)	F	F
(3-19) Risk: Roadway Width			F/M(21)	F/M(21)	F(21)	F(21)	F/M(21)	F/M(21)	F/M(21)	F/M(21)	F	F	F			F	F(21)	F(21)	F(21)		F/M(21)	F/M(21)	F(21)	F	F	
(3-20) Risk: Realignment	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F			F	F(2)	F(2)	F		F/M(21)	F(2)	F(2)	F	F	
(3-26) Collision Analysis Locations*	Design Elements determined based on a Project Analysis (See Note 1)																									
Economic Development																										
(3-21) Freight & Goods (Frost Free)(8)	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	EU/F	F	B			EU/F(26)	DE/F	DE/F	F	F	EU/F	EU/F	EU/F	F	F	
(3-22) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F	F			F	F	F	F	F	F	F	F	F	F	
(3-23) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F	F			F	F	F	F	F	F	F	F	F	F	
(3-24) Bridge Restrictions	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)			F	F		EU/F(26)	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	
(3-25) Bike Routes (Shldrs)			EU/M	(7)	EU/F						EU/M	EU/M				F	EU/M	EU/M	F				B	F	EU/F	

- Not Applicable
  - F** Full design level (see Chapter 440).
  - M** Modified design level. See Chapter 430.
  - B** Basic design level. See Chapter 410.
  - F/M** Full for freeways/Modified for non-freeway
  - DE** Design Exception to full design level.
  - EU** Evaluate Upgrade to full design level.
- (1) Collision Analysis Locations (CALs) require a Project Analysis to document the needs at a location and determine the appropriate design elements to address these needs.
  - (2) Modified design level may apply based on a corridor or project analysis (see 325.03(5)).
  - (3) If designated as LJA acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies (see 325.03(5)).

- (4) Full design level may apply based on a corridor or project analysis (see 25.03(5)).
- (5) For bike/pedestrian design see Chapters 1020 and 1025.
- (6) Applies only to bridge end terminals and transition sections.
- (7) 4 ft minimum shoulders.
- (8) If all weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.
- (11) See Chapter 1120.
- (12) Impact attenuators are considered as terminals.
- (14) Includes crossroad bridge rail (see Chapter 710).
- (16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).
- (17) DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant accidents (see Chapter 940).

- (18) On managed access highways within the limits of incorporated cities and towns, City and County Design Standards apply to areas outside the curb or outside the paved shoulder where no curb exists.
  - (19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
  - (20) Applies to median elements only.
  - (21) Analyses required. See 325.03(5) for details.
  - (22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
  - (23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.
  - (24) Apply Full design level to projects that realign or reconstruct significant portions of the alignment.
  - (26) Sidewalk ramps must be addressed for ADA compliance (see Chapter 1025).
- \* Collision Analysis Locations are those sites identified through a system-wide analysis that have a high severity collision history. These sites are created with the intent to modify, where appropriate, specific highway elements that have a high potential to reduce the identified high severity collisions.

### Design Matrix 3 Main Line NHS Routes (Except Interstate)

(Supplement to be used on projects programmed for '09-'11 biennium)





↕ Project Type																Bridges (11)				Intersections			Barriers				
	Design Elements ⇨															Lane Width	Shldr Width	Vertical Clear.	Structural Capacity	Turn Radii	Angle	I/S Sight Dist.	Term. & Trans. Section (12)	Std Run	Bridge Rail (19)		
Horiz. Align.	Vert. Align.	Lane Width	Shldr Width	Lane Transition	Median Width	Cross Slope Lane	Cross Slope Shldr	Fill/ Ditch Slopes	Access (3)	Clear Zone (18)	Sign, Del., Illumin.	Basic Safety	Bike & Ped.														
<b>Preservation</b>																											
<b>Roadway</b>																											
(5-1) HMA/PCCP																											
(5-2) BST																											
(5-3) BST Routes/Basic Safety																											
(5-4) Replace HMA with PCCP at I/S																											
<b>Structures</b>																											
(5-5) Bridge Replacement	M	F	M	M	F																						
(5-6) Bridge Repl. (Multilane)	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)		F	F		F	F(2)	F(2)	F	F	M	M	F	F	F	F	F	F	F
(5-7) Bridge Deck Rehab																											
<b>Improvements (16)</b>																											
<b>Mobility</b>																											
(5-8) Urban (Multilane)	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	EU/F	EU/F	F	F	F	F	F	F	F
(5-9) Urban	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F	F	F	F
(5-10) Rural	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F	F	F	F
(5-11) HOV	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F	F	F	F
(5-12) Bike/Ped. Connectivity	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)		F	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
<b>Safety</b>																											
(5-13) Non-Interstate Freeway	F(2)	F(2)	F(2)	F(2)	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F		F(2)	F(2)	F	F	F	F	F	F	F
(5-14) Intersection (1)																											
(5-15) Corridor (1)	M(4)	M(4)	M(4)	M(4)	F	M(4)	M(4)	M(4)	M(4)	F	F	F		M	M(4)	M(4)	F		M(4)	M(4)	F	F	F	F	F	F	F
(5-16) Median Barrier																											
(5-17) Guardrail Upgrades																											
(5-18) Bridge Rail Upgrades																											
(5-19) Risk: Roadside																											
(5-20) Risk: Sight Distance	F/M(21)	F/M(21)	F/M(21)	F/M(21)																							
(5-21) Risk: Roadway Width																											
(5-22) Risk: Realignment	F/M	F/M	F/M	F/M	F	F/M	F(2)	F(2)	F/M	F	F	F		F	F(21)	F(21)	F(21)		F/M(21)	F/M(21)	F(21)	F	F	F	F	F	
(5-27) Collision Analysis Locations*	Design Elements determined based on a Project Analysis (See Note 1)																										
<b>Economic Development</b>																											
(5-23) Freight & Goods (Frost Free) (8)	EU/M	EU/M	EU/M	EU/M	EU/F	EU/M	M	M	EU/M		F	B	B	EU/F(26)	DE/M	DE/M	F		EU/M	EU/M	EU/F	F	B	F	F	F	F
(5-24) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F			F	F	F	F	F	F	F	F	F
(5-25) Bridge Restrictions	M	F	M	M	F	M	M	M	M		F	F		EU/F(26)	M	M	F	F	M	M	F	F	F	F	F	F	F
(5-26) Bike Routes (Shldrs)																											

- Not Applicable
  - F** Full design level (see Chapter 440).
  - M** Modified design level. See Chapter 430.
  - F/M** Full for freeways/Modified for non-freeway
  - B** Basic design level. See Chapter 410.
  - DE** Design Exception to full design level.
  - EU** Evaluate Upgrade to full design level.
- (1) Collision Analysis Locations (CALs) require a Project Analysis to document the needs at a location and determine the appropriate design elements to address these needs.
  - (2) Modified design level may apply based on a corridor or project analysis (see 325.03(5)).

- (3) If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies (see 325.03(5)).
- (4) Full design level may apply based on a corridor or project analysis (see 325.03(5)).
- (5) For bike/pedestrian design see Chapters 1020 and 1025.
- (6) Applies only to bridge end terminals and transition sections.
- (7) 4 ft minimum shoulders.
- (8) If all weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.
- (11) See Chapter 1120.
- (12) Impact attenuators are considered as terminals.

- (16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).
  - (18) On managed access highways within the limits of incorporated cities and towns, City and County Design Standards apply to areas outside the curb or outside the paved shoulder where no curb exists.
  - (19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
  - (20) Applies to median elements only.
  - (21) Analyses required. See 325.03(5) for details.
  - (22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
  - (23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.
  - (26) Sidewalk ramps must be addressed for ADA compliance (see Chapter 1025).
- \* Collision Analysis Locations are those sites identified through a system-wide analysis that have a high severity collision history. These sites are created with the intent to modify, where appropriate, specific highway elements that have a high potential to reduce the identified high severity collisions.

## Design Matrix 5

### Main Line Non-NHS Routes

(Supplement to be used on projects programmed for '09-'11 biennium)