

APPENDIX E

Countermeasure Effectiveness & Crash Reduction Factors

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Crash Reduction Factors for HSIP Program Projects

Intersection Locations

General

Improvement/Realignment/Reconstruction – CRF 30% for all crashes in rural areas and 50% for all crashes in urban areas. Intended for projects that modify the geometrics of the intersection.

Pavement

Widening and Resurfacing or Widening alone – Use 25% CRF for all crashes based on Kentucky study and review of other State practices.

Resurfacing alone – No Crash Reduction Factor identified. NCHRP Research Results Digest 255 shows a slight increase in total crashes with resurfacing in Illinois.

De-Slick (formerly known as skidproofing) – Techniques to improve surface friction require some showing that there is an existing surface friction deficiency. The preferred method is recent friction number testing by the Bureau of Materials and Physical Research. When improved friction qualities are required, one of several methods may be chosen, including improved friction surface mixture, surface grooving (longitudinal or transverse), or placement of a frictional surface treatment such as a seal coat. The designer must consider the acceptability of a given treatment in light of the class of highway, traffic levels, and expected life of the treatment. Use 45% CRF for reduction of wet pavement crashes.

Rumble Strips (Shoulder) – Shoulder rumble strips can adversely affect bicyclists use of the highway, and create noise that can be objectionable to adjacent property uses. The designer should weigh these concerns before proceeding with shoulder rumble strips. Use 30% CRF for fixed object, and run-off-the-road (including overturned off the road), crashes.

Rumble Strips (Centerline) – Centerline rumble strips pose similar concerns as shoulder rumble strips, and also may be objectionable where vehicles are allowed to cross the centerline for passing. Centerline rumble strips are considered experimental. Contact the Bureau of Safety Engineering.

Rumble Strips (Transverse) – CRF 25% for all crashes. Option to omit 2' strip in mid-lane for motorcyclists. (Low Cost Safety Improvements)

Channelization – CRF 50% for Rear End, Head On, Sideswipe Same Direction, Sideswipe Opposite Direction, Left Turn, and Run-off-the-Road crashes.

Raised Reflective Marker Median – CRF 50% for Head On, Sideswipe Opposite Direction, and Left Turn crashes.

Rumble Strip Median – CRF 50% for Head On, Sideswipe Opposite Direction, and Left Turn crashes.

Thermoplastic or Preformed Tape Median – CRF 50% for Rear End, Head On, Sideswipe Same Direction, Sideswipe Opposite Direction, Left Turn, and Right Turn crashes

Painted Median -- CRF 50% for Rear End, Head On, Sideswipe Same Direction, Sideswipe Opposite Direction, Left Turn, and Right Turn crashes

Lane Addition – CRF 50% for Rear End, Sideswipe Same Direction, Left Turn, and Right Turn crashes.

Left Turn Lane – CRF 25% for each leg with an added left turn lane for Rear End, Sideswipe Same Direction, Sideswipe Opposite Direction, and Left Turn crashes. Includes improvements with throat widening for the receiving leg. (LCSI)

Right Turn Lane – CRF 25% for each leg with an added right turn lane for Rear End, Sideswipe Same Direction, and Right Turn crashes. (LCSI)

Bidirectional Left Turn Lane – CRF 50% for Rear End, Head On, Sideswipe Same Direction, Sideswipe Opposite Direction, and Left Turn crashes.

Left Turn Acceleration Lane – CRF 50% for Rear End, Sideswipe Same Direction, Sideswipe Opposite Direction, Angle, and Left Turn Crashes.

Right Turn Acceleration Lane – CRF 50% for Rear End, Sideswipe Same Direction, and Right Turn crashes.

Deceleration Lane – CRF 50% for Rear End, Sideswipe Same Direction, and Right Turn crashes.

One-Way Couple – CRF 50% for all crashes.

Install Roundabout Conversion of stop control intersection (single lane approach) to roundabout ,CRF 60% for all crashes in rural areas and 70% for all crashes in urban areas.

Install passing lane – For passing lane in one direction of travel, CRF 25% for all crashes. For passing lanes in both directions of travel, CRF 35% for all crashes.

Increase width of paved shoulder –Increase paved shoulder width up to 8ft, CRF 10% for all crashes.

Increase lane width – Increase lane width from 9 ft. or 10 ft. to 12 ft., CRF 10% for all crashes. No CRF for widening from 11 ft. to 12 ft.

Signing

Modernization – CRF 25% to update an existing system to current MUTCD, for all crashes. (LCSI)

Installation – CRF 40% to install MUTCD compliant signage for all crashes.

Speed Signing – CRF 40% for all crashes for warranted adjustments of speed limits and signage locations.

Advance Warning Signs – CRF 25% for all crashes. (LCSI)

Four Way Stop – CRF 50% for all crashes. Conversion of 2-way to 4-way stop. (LCSI)

Minor Leg Stop – CRF 40% for Angle, Left Turn, and Right Turn crashes.

Yield Sign – Conversion of uncontrolled movement to yield control, CRF 40% for Angle, Left Turn, and Right Turn crashes.

Changeable Message Signs – CRF 10% for all crashes.

Delineators – CRF 40% for all crashes.

Overhead Sign Truss – CRF 40% for Rear End and Sideswipe Opposite Direction crashes.

Signalization

Modernization – CRF 25% for Pedestrian, Fixed Object, Rear End, Sideswipe, Angle, Left Turn and Right Turn crashes.

Install Traffic Signals – CRF 23% for total crashes. CRF 67% for Right Angle crashes. CRF Negative 38% for rear end crashes.

Relocation of Signal Supports – CRF 25% for Fixed Object crashes.

Advance Warning with Flasher – CRF 15% for Overturn, Fixed Object, Rear End, Sideswipe Same Direction, Sideswipe Opposite Direction, Angle, Left Turn, Right Turn, and Run-off-the-Road crashes.

Red/Yellow Flashing Beacon – Not recommended.

Red Flashing Beacon – CRF 45% for right angle crashes. (LCSI)

Add Left Turn Phase with Left Turn Lane – CRF 35% for all crashes. (LCSI)

Add Left Turn Phase without Left Turn Lane – CRF 25% for all crashes. (LCSI)

Phase Adjustment – CRF 25% for all crashes.

Increase to 12 Inch Lens – CRF 25% for all crashes.

Add Traffic Actuation – CRF 25% for Rear End, Angle, Left Turn and Right Turn crashes.

Time Lane Control – CRF 25% for Head On and Sideswipe Opposite Direction crashes.

Optical Programmed – CRF 25% for Rear End, Angle, Left Turn and Right Turn crashes.

Add Pedestrian Controls – CRF 25% for Pedestrian and Bicyclist crashes.

Add Mast Arms and Signal Head per Lane – CRF 25% for Rear End, Angle, Left Turn and Right Turn crashes.

Safety Lighting – CRF 25% for all crashes, or 50% for nighttime crashes. (LCSI).

Install automated enforcement of red light violations – CRF 25% for Angle crashes. CRF negative 15% for Rear-End crashes.

Non-Intersection (Segment) Locations

Pavement Treatments

Widening and Resurfacing or Widening alone – Use 25% CRF for all crashes based on Kentucky study and review of other State practices.

Resurfacing alone – No Crash Reduction Factor identified. NCHRP Research Results Digest 255 shows a slight increase in total crashes with resurfacing in Illinois.

De-Slick (formerly known as skidproofing) – Techniques to improve surface friction require some showing that there is an existing surface friction deficiency. The preferred method is recent friction number testing by the Bureau of Materials and Physical Research. When improved friction qualities are required, one of several methods may be chosen, including improved friction surface mixture, surface grooving (longitudinal or transverse), or placement of a frictional surface treatment such as a seal coat. The designer must consider the acceptability of a given treatment in light of the class of highway, traffic levels, and expected life of the treatment. Use 45% CRF for reduction of wet pavement crashes.

Rumble Strips (Shoulder) – Shoulder rumble strips can adversely affect bicyclists use of the highway, and create noise that can be objectionable to adjacent property uses. The designer should weigh these concerns before proceeding with shoulder rumble strips. Use 30% CRF for fixed object, and run-off-the-road (including overturned off the road), crashes.

Rumble Strips (Centerline) – Centerline rumble strips pose similar concerns as shoulder rumble strips, and also may be objectionable where vehicles are allowed to cross the centerline for passing. Centerline rumble strips are considered experimental. Contact the Bureau of Safety Engineering.

Pavement Marking

General Pavement Marking – For installation of MUTCD pavement markings on an existing road not having pavement markings, use a CRF of 30%. This also applies for adding elements of pavement marking not included on an existing road (for example, adding center, edge or no-passing markings.)

Raised Reflective Markers – On some curved roadways, RRPM's are not recommended as an HSIP safety countermeasure. See the following tables for recommended CRF's depending on type of road, ADT, and curvature. For tangent sections use a CRF of 30% for nighttime crashes. When applying RRPM's under this policy and they will be omitted through such curves, apply some other means of curve delineation such as chevrons or delineators.

AADT (veh/day)	CRF for Nighttime Crashes	
	When Degree of Curve < or = 3.5	When Degree of Curve Is > 3.5
0 to 5000	Negative 16% (crashes increase)	Negative 43% (crashes increase)
5001 to 15000	1%	Negative 26% (crashes increase)
15001 to 20000	24%	Negative 3% (crashes increase)

Crash Reduction Factors for RRPM's on Two-Lane Highways

AADT (veh/day)	CRF for Nighttime Crashes
20000 or less	Negative 13% (crashes increase)
20001 to 60000	6%
Over 60000	33%

Crash Reduction Factors for RRPM's on Four-Lane Freeways

Railroad Crossing

Modification – CRF 50% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Gates – CRF 60% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Crossbucks – CRF 60% for Train and Fixed Object crashes.

Flashing lights – CRF 60% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Flashing Beacons – CRF -- 60% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Warning Bells – CRF -- 50% for Train crashes.

Pavement Markings – CRF 30% for Train, Rear End, and Run-off-the-Road crashes.

Warning Signs – Standard CRF 40% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Warning Signs – Special CRF 40% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Delineators – CRF 40% for Train, Fixed Object, and Run-off-the-Road crashes.

Safety Lighting – CRF 50% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Resurfacing – CRF 25% for Train, Fixed Object, Rear End, and Run-off-the-Road crashes.

Grade Separation – CRF 100% for All crashes.

Removal – CRF 100% for All crashes.

Bridge

General Repair – CRF 15% for Parked Vehicle, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

Widen/Resurface – CRF 15% for Fixed Object, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

Widening – CRF 15% for Fixed Object, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

De-Slick – Formerly known as “Skidproofing”. CRF 45% for all wet pavement crashes.

Grooving – CRF 45% for all wet pavement crashes.

Frost/Ice Detectors - Sign – CRF 25% for CRF 15% for Fixed Object, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

Frost/Ice Detectors - Radio – CRF 25% for CRF 15% for Parked Vehicle, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

Guardrail – CRF 15% for fatality and injury crashes resulting from fixed objects, or run-off-the-road. Changed from crash reduction to crash severity reduction.

Separation between Pedestrians/Traffic – CRF 95% for pedestrian crashes.

Safety Lighting – CRF 50% for nighttime crashes.

Delineators – CRF 15% for fixed object and run-off-the-road crashes.

Impact Attenuators – CRF 70% for fatalities and injury crashes resulting from fixed object and run-off-the-road crashes. Changed from crash reduction to crash severity reduction.

Reconstruction – CRF 50% % for Fixed Object, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road crashes.

Curves

Realignment/Reconstruction – CRF 35% for Overturn, Fixed Object, Head On, Sideswipe Same Direction, Sideswipe Opposite Direction, and Run-off-the-Road crashes.

Superelevation – CRF's depend on the amount of superelevation deficiency (SD) corrected to bring the curve into compliance with geometric criteria. SD is the difference between the actual and optimal superelevation rate.

CRF = 0% for SD < 0.01 ft/ft.

CRF = 6(SD-0.01) X 100% for SD greater than 0.01 to 0.02 If SD = 0.0199, CRF = 6%

CRF = 6% + 3(SD-0.02) X 100% for SD over 0.02.

Daylighting – CRF 30% for Overturn, Fixed Object, Head On, Sideswipe Opposite Direction, Sideswipe Same Direction, and Run-off-the-Road. Daylighting is removing gutter on the inside edge of pavement and regrading shoulders to drain to the ditch.

Widening and Resurfacing or Widening alone – Use 25% CRF for all crashes based on Kentucky study and review of other State practices.

De-Slick (formerly known as skidproofing) – Techniques to improve surface friction require some showing that there is an existing surface friction deficiency. The preferred method is recent friction number testing by the Bureau of Materials and Physical Research. When improved friction qualities are required, one of several methods may be chosen, including improved friction surface mixture, surface grooving (longitudinal or transverse), or placement of a frictional surface treatment such as a seal coat. The designer must consider the acceptability of a given treatment in light of the class of highway, traffic levels, and expected life of the treatment. Use 45% CRF for reduction of wet pavement crashes.

Guardrail CRF 44% for fatal Run-off-the-road and fixed object crashes. CRF 47% for injury Run-off-the-road and fixed object crashes. Placing a guardrail affects values for fatal and injury crashes, but there might be an increment on PDO crashes. The overall CRF value for all crashes is 7%

Advance Warning Sign – CRF 20% for all crashes. This increment may be applied for each increment of improvement. For example, if the existing signage meets the requirements of MUTCD, then upgrading to double-up signing would provide a CRF of 20%. Further adding flashing amber beacons on the signs would provide a 20% CRF for the remaining crashes.

Chevrons or Delineators – CRF 40% for Overturn, Head-On, Sideswipe Opposite Direction, or Run-off-the-Road crashes.

Relocation – CRF 45% for all crashes. This is for relocation to another alignment designed to current criteria.

Roadside Safety

General/Fixed Obstacle Removal – CRF 50% for Fixed Object and Run-off-the-Road crashes for the removal of hazards within clear zone.

Curb Parking Removal – CRF 50% for Parked Vehicle, Rear End, and Run-off-the-Road crashes.

Guardrail – CRF 15% for fatality and injury crashes resulting from fixed objects, or run-off-the-road. Changed from crash reduction to crash severity reduction.

Utility Adjustment – CRF 32% for fatalities and 45% for injuries related to fixed object and run off the road crashes involving utility hazards (poles, etc.) for removal of these hazards from the clear zone.

Drainage Improvement – CRF 10% for all crashes. For drainage improvement to bring water encroachment into compliance with IDOT policies.

Shoulder Improvement – CRF 10% for Fixed Object and Run-off-the-Road crashes. Includes repair of paved shoulders, or restoring/placing aggregate shoulders to provide a cross slope meeting IDOT Standards and necessary slope matching.

Impact Attenuators – CRF 70% for fatalities and injuries crashes resulting from fixed object and run-off-the-road crashes. Changed from crash reduction to crash severity reduction.

Glare Shields – CRF 15% for Sideswipe Same Direction, Angle, and Run-off-the-Road crashes.

Fencing – CRF 15% for all crashes.

Other

Turnouts (Mailbox or other) – CRF 50% for crashes related to vehicles entering or exiting from the shoulder area, such as delivering mail.

Ramp Improvement – See curve countermeasures.