U.S. Department of Transportation
Federal Highway Administration

A Systemic Approach to Reducing Roadway Departures

New Jersey
March 30, 2021

Federal Highway Administration | RESOURCE CENTER | 20 YEARS OF SERVICE

Safe Roads for a Safer Future
Investment in roadway safety saves lives
http://safety.fhwa.dot.gov

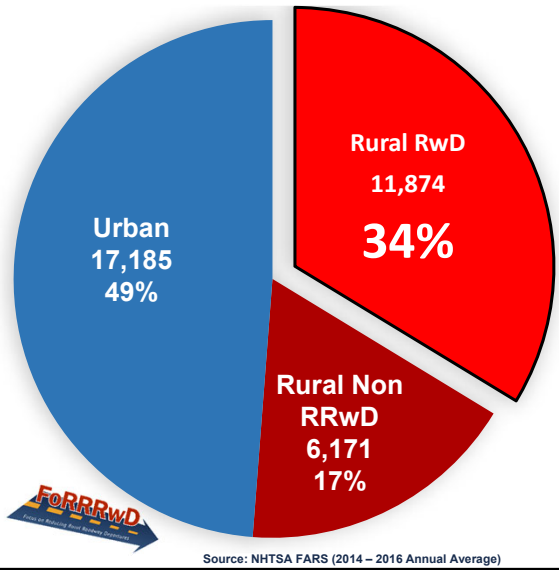
EDC

FoRRRwD
Focus on Reducing Rural Roadway Departures

Course Objectives

- Understand why the systemic approach is critical to reduce roadway departures.
- Describe the 4-steps in the systemic safety planning process.
- Identify risk factors that are commonly used in the Systemic Approach to reduce rural roadway departures.

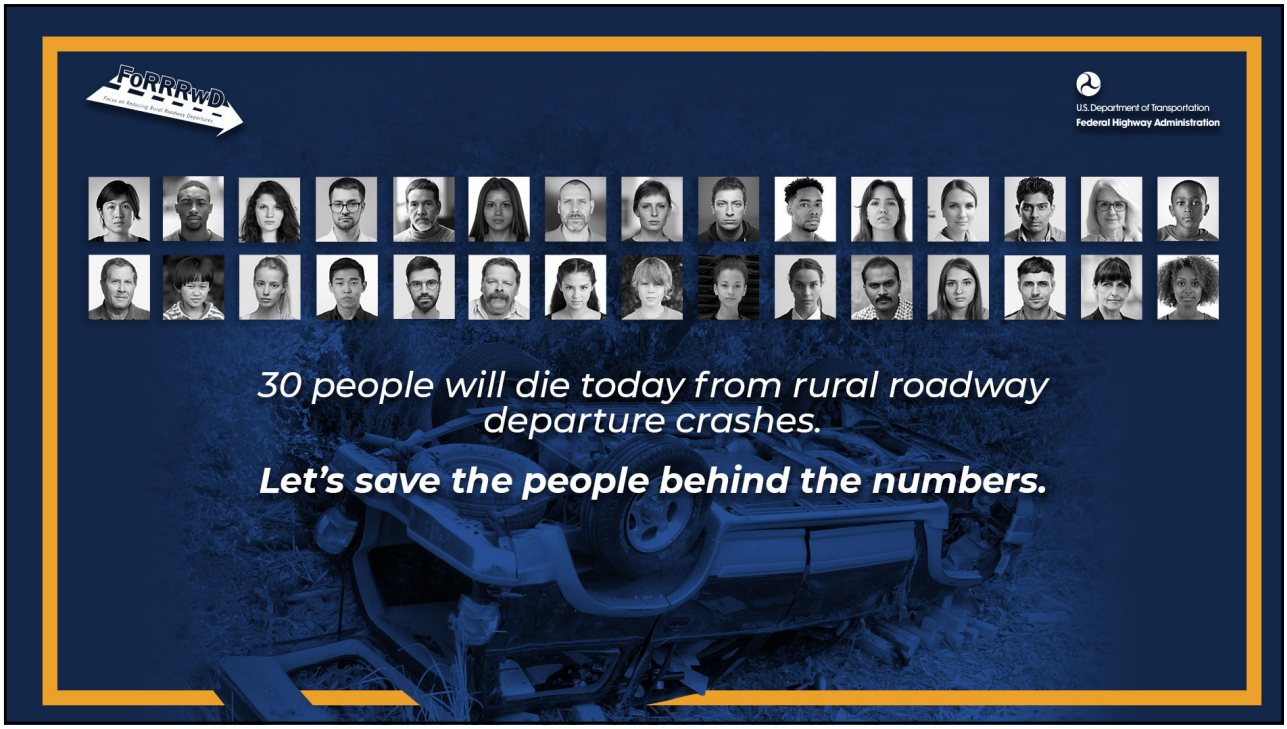
The Rural RwD Component of Fatalities



Source: NHTSA FARS (2014 – 2016 Annual Average)

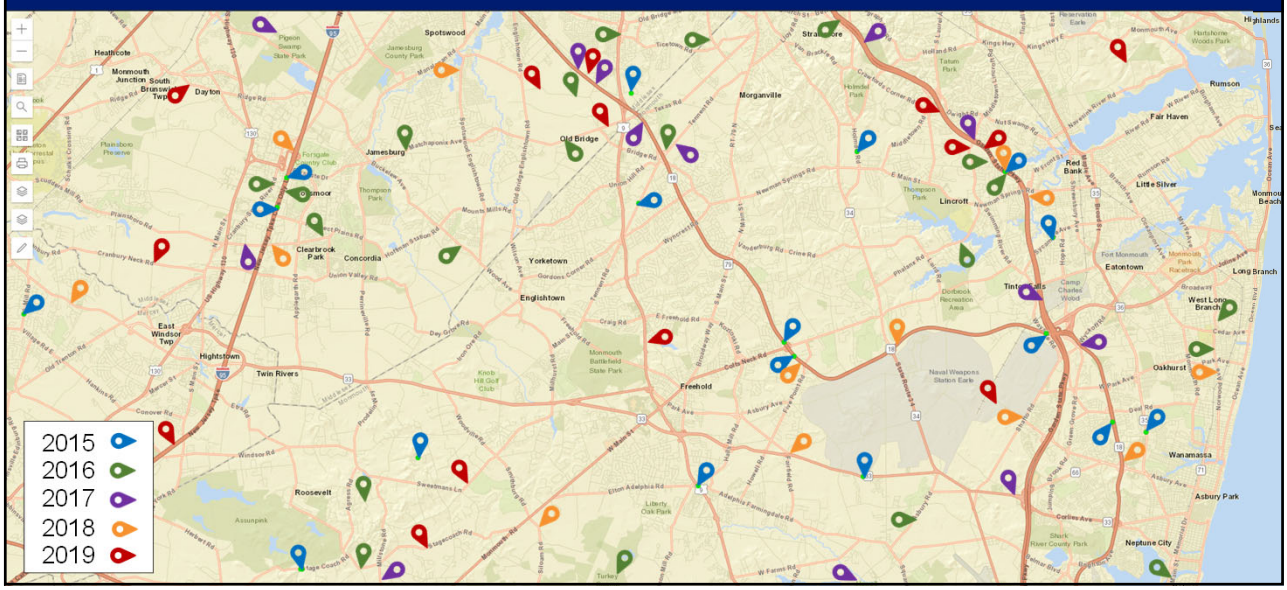
FHWA Roadway Departure (RwD) Definition:
A crash in which a vehicle crosses an edge line, a center line, or otherwise leaves the traveled way.

Source: Oregon State Police



Where would you invest in safety improvements?

Source: NHTSA FARS



Roadway Departure Crash Types in New Jersey

Most Harmful Event	Year				
	2015	2016	2017	2018	2019
Head-ons	64	66	62	50	58
Tree	56	66	74	48	48
Rollover/Overturn	35	39	29	30	16
Poles/supports	36	35	22	21	20
Barriers	7	14	21	15	23
Bike/Pedestrian	10	16	16	12	13
Other vehicle	19	6	18	8	6
Other Fixed Objects	3	15	9	7	9
Fire/Explosion	10	5	7	8	7
Other	1	3	2	2	1
Bridge Pier or Support	2	1	0	1	0
Other Object (Not Fixed)	0	0	1	1	1
Embankment	0	0	1	1	0

Source: NHTSA FARS


Fatal crash locations
are
random
Source: Pexels


Fatal crash types are
predictable
Source: Pixabay

Minnesota Example

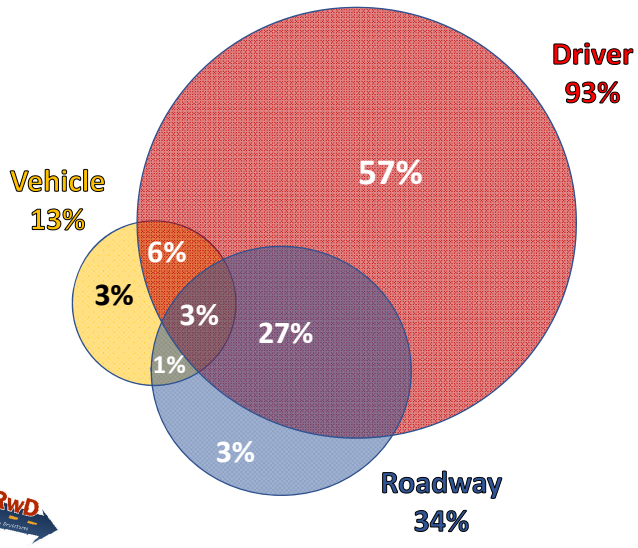
Minnesota

- Rural paved secondary
  - 22,000 miles
  - 13,000 intersections
  - 19,000 curves
  - **0 locations > 1.0 severe crash/year**

Note: 60% of Minnesota's severe crashes (fatal + serious injury) occurred on local system (with half on county owned roads)

Cleveland, Minnesota
https://commons.wikimedia.org/wiki/File:2009-0805-MN-DoddRoad.jpg

Contributing Causes of Crashes



The Driver is weakest link in this system, so we must design around human needs.

FROM: Lum & Reagan, Public Roads Magazine, Winter 1995, "Interactive Highway Safety Design Module"

Focusing on Reducing Rural Roadway Departures (FoRRRwD)

- **Mission** - Reduce the potential for serious injury and fatal roadway departure crashes on **all public rural roads** by increasing the systemic deployment of proven countermeasures.

Systemic Safety: Definition

The term "systemic safety improvement" means an improvement that is **widely implemented** based on **high-risk roadway features** that are correlated with **particular crash types, rather than crash frequency.**

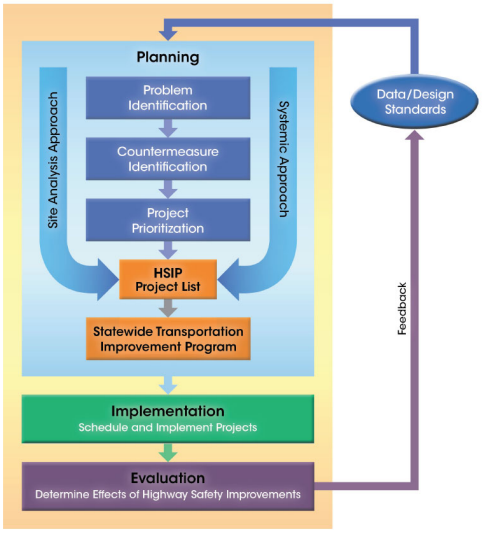
-- 23 USC 148 (a)(12) Systemic safety improvement

https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/ddsa_resources/ddsa_systemic_analysis.pdf

Systemic Approach

- Complementary approach to site-specific
  - Proactively identify safety improvements
  - Does not replace reactionary approach
- Primary approach for rural and local roads

You don't have to wait until a crash occurs to make improvements!



https://safety.fhwa.dot.gov/systemic/fhwasa13019/sspst.pdf

Definitions

- Systemic – Deploying countermeasures at locations with the ***greatest potential*** for safety improvement
- Systematic – Deploying countermeasures at ***ALL*** locations

Systemic Example:
Provide enhanced delineation on curves with radii between 500-700 feet which were over-represented in severe crashes

Benefits of Systemic Safety Planning

Benefits of the Systemic Approach to Safety

Prevents crashes before they occur.
Rather than waiting for crashes to occur, the systemic approach uses roadway factors to treat potential future crash locations now.

Leverages in-house resources.
Since systemic improvements are low cost, agencies may already have needed materials in their inventories and can install them using maintenance staff.

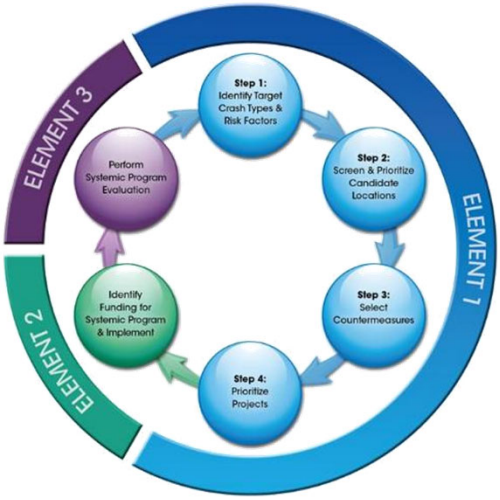
Optimizes safety benefit.
Low-cost systemic improvements can be deployed widely across the system, yielding a greater overall safety benefit.

Improves future planning.
A better understanding of roadway factors that contribute to crashes will improve future design, operations, and maintenance practices.

https://safety.fhwa.dot.gov/systemic/fhwasa17010/fhwasa17010.pdf

Systemic Safety Project Selection

1. **Systemic Process**
2. Balance Funds
3. Evaluate Effectiveness



FHWA's Systemic Safety Tool

https://safety.fhwa.dot.gov/systemic/fhwasa13019/sspst.pdf

Element 1 - Systemic Safety Planning Process

Step 1 **Identify Focus Crash Types & Risk Factors**

Step 2 **Screen & Prioritize Candidate Locations**

Step 3 **Select Countermeasures**

Step 4 **Prioritize Projects**

Step 1: Identify Focus Crash Types & Risk Factors

Gather crash and other data, then analyze the data through the following tasks:

- Task 1: Select Focus Crash Types
- Task 2: Select Focus Facilities
- Task 3: Identify and Evaluate Risk Factors

STEP 1 | STEP 2 | STEP 3 | STEP 4

Gather Data

Typical data to Identify Focus Crash/Facility Types and Risk Factors can include:

- Crash type
- Crash severity
- Crash location
- Crashes by system
  - State
  - Local
- Crashes by facility type
  - Rural, 2-lane roads (all, segments, curves)
  - Urban, 2-way stop-controlled intersection

"Do what you can, with what you have, where you are."

– Theodore Roosevelt

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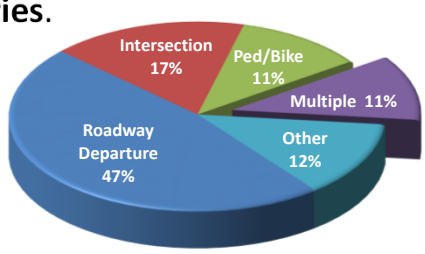
Task 1 – Select Focus Crash Types

What does "focus crash type" mean?

The crash type that represents the **greatest number of severe crashes** across the roadway system being analyzed and provides the **greatest potential to reduce fatalities and severe injuries**.

- Roadway Departure
- Intersection
- Pedestrian
- Speeding



US Fatalities by FHWA Focus Area
(FARS 2014-2016)

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 1 – Select Focus Crash Types

Select Focus Crash Types

- Systemwide analysis
- Strategic Safety Plans
  - Strategic Highway Safety Plans
    - Emphasis areas
  - Safety Implementation Plans
    - Examples: IL, KY, LA, MN, MO, NE, OH, NY, Thurston County, WA.
- Regional and jurisdictional analyses
  - May differ from statewide needs

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 1 - Select Focus Crash Types

Fatal and Severe Injury Crashes (2007-2011) Percent by Jurisdiction								
Emphasis Area	Statewide 114,592 mi		State 15,486 mi		County 19,938 mi		City, Town, Village 76,735 mi	
Total Fatal/Serious Injury	100%	63,443	31%	19,819	10%	6,572	45%	28,597
Pedestrian	19%	11,786	9%	1,860	6%	421	28%	8,122
Bicycle	5%	3,390	3%	518	3%	187	8%	2,414
Heavy Vehicle	5%	3,123	6%	1,266	4%	234	4%	1,051
Run-Off-Road	26%	16,668	30%	5,985	44%	2,892	18%	5,128
Intersection	41%	25,791	25%	5,033	30%	1,957	64%	18,270
Head-on	5%	3,071	7%	1,439	7%	490	3%	887

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Task 2 - Select Focus Facilities

What does “focus facility” mean?

The facility type on which the **focus crash type most frequently occurs**.

- Rural, Two-Lane Highways
- Urban, Signalized Intersections
- Horizontal Curves
- Rural, Thru-STOP Intersections

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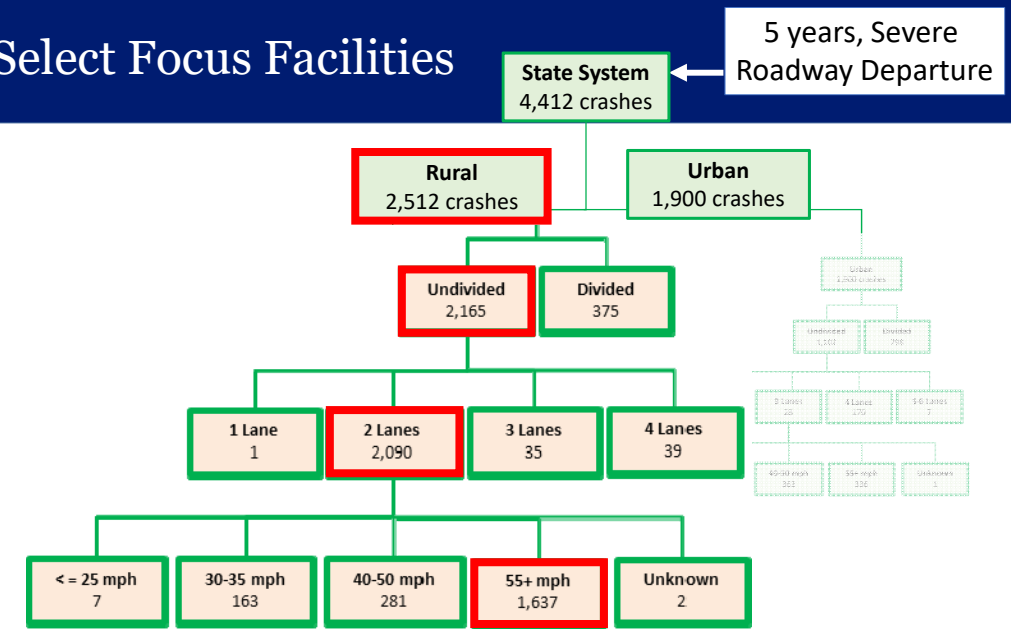
Task 2 - Select Focus Facilities



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Crash Tree Combinations

Primary
- State / Local
- Rural / Urban
- Segment / Intersection
- Segment Type
  - Freeway, multilane, two-lane, one-way
- Intersection Control
  - Signalized
  - Unsignalized
  - Uncontrolled

Secondary
- Tangent / Curve
- High-speed / Low-speed
- Street Lighting
- District or Regions
- Traffic Volume
- Lane Width
- Shoulder Type/Width
- Alignment
- Land Use

STEP 1 | STEP 2 | STEP 3 | STEP 4

Helpful Hints for Selecting Focus Facilities

- Crash trees can include all severe crashes or just severe crashes for one focus crash type
  - Narrow crash types to target countermeasures
  - Narrow facility types to identify candidate sites
- Examine total and severe crash categories
  - May reveal different patterns
- Experience suggests 100+ crashes for identifying patterns
  - Increase sample size by:
    - Increasing number of years
    - Increasing geographic area (region instead of county)
    - Include minor injuries
  - Note: For smaller or rural jurisdictions, less crash data can be utilized for analysis.

Task 3- Identify and Evaluate Risk Factors

- Identify potential risk factors
  - Roadway and intersection features
  - Traffic volume
  - Transit stops, land use, etc.
- Evaluate risk factors
- Select final risk factors

http://www.creative-commons-images.com/highway-signs/r/risk.html

Task 3- Identify and Evaluate Risk Factors

What does "risk factor" mean?

A representation of risk in terms of the observed **characteristics associated with** the locations where the **targeted crash types** occurred.

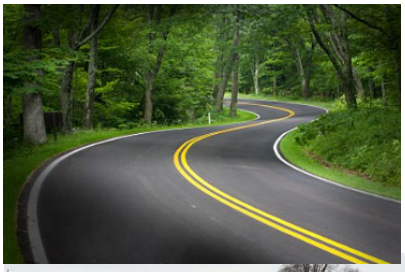
Potential Risk Factors might include:

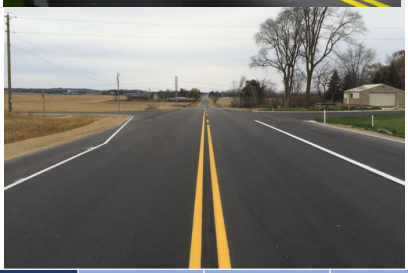
- Number of lanes
- Traffic Volume
- Speed Limit
- Lane & Shoulder width
- Median width / type
- Horizontal curvature
  - Superelevation
  - Delineation
  - Advance warning
  - Speed differential
  - Visual trap
- Pavement condition / friction
- Roadside features
  - Sideslope design
  - Clear zone
- Driveway density
- Other features
  - Rumble strips
  - Lighting

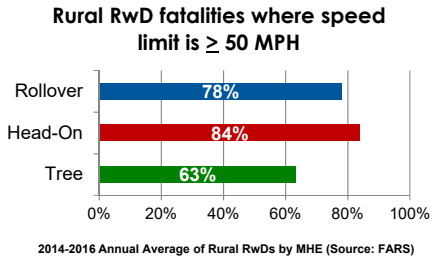
STEP 1 | STEP 2 | STEP 3 | STEP 4

Data to Identify Risk Factors

- AADT
- Corridor Geometrics
- Visual Trap
- Crash Types
- Speed







2014-2016 Annual Average of Rural RwDs by MHE (Source: FARS)

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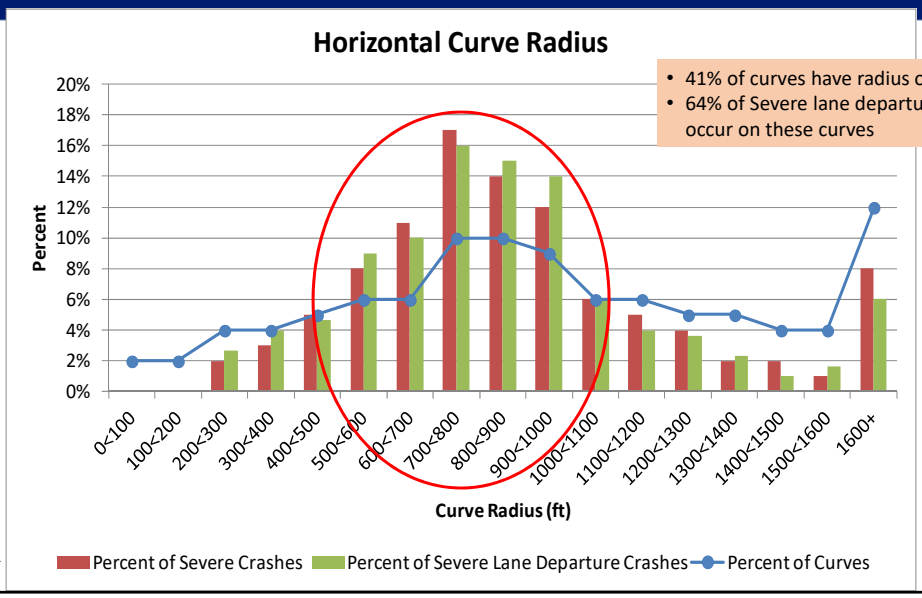
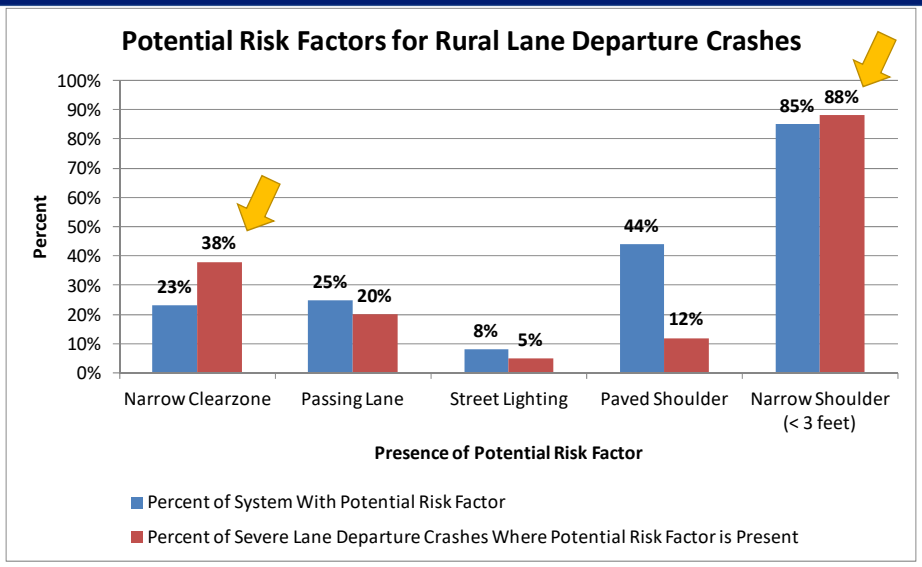
Evaluate Risk Factors: Example 1

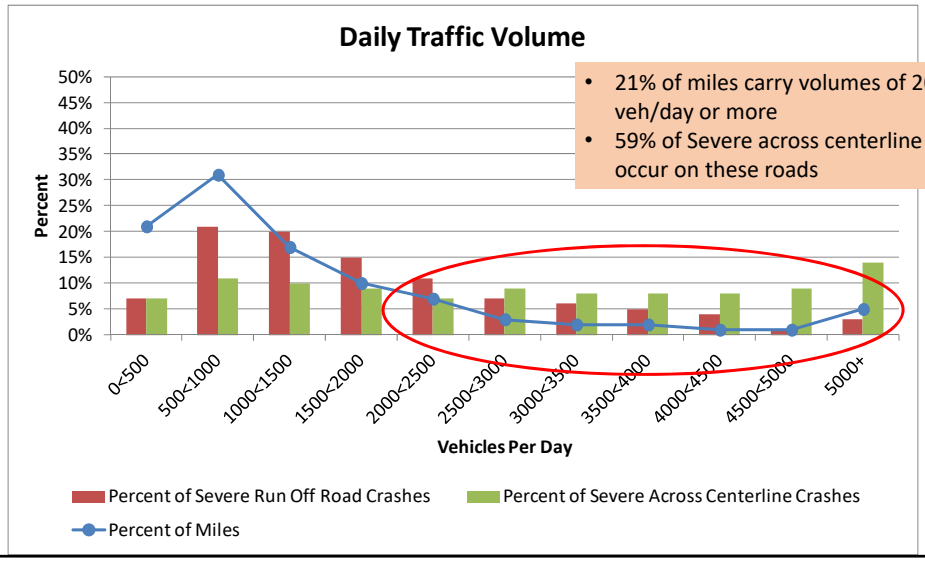


- 41% of curves have radius of 500' to 1000'
- 64% of Severe lane departure crashes occur on these curves

Evaluate Risk Factors: Example 2

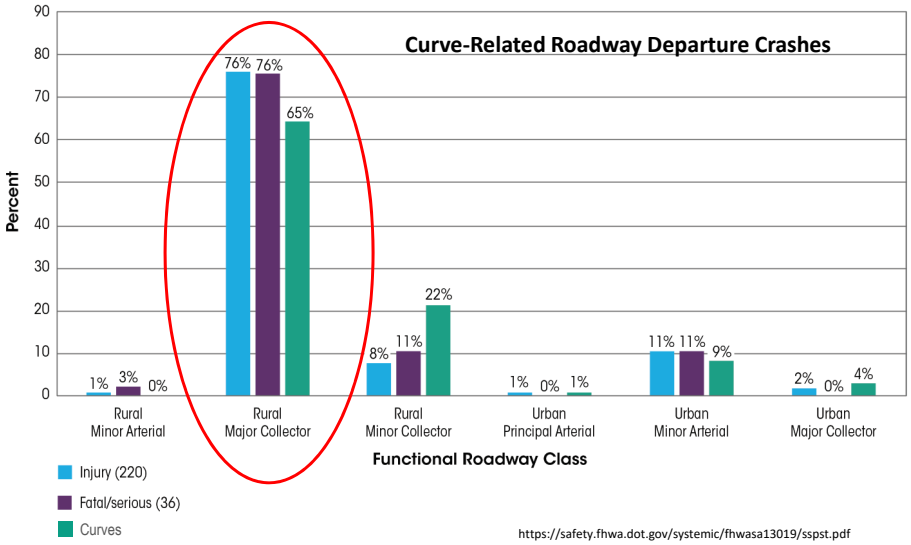


Evaluate Risk Factors: Example 3



- 21% of miles carry volumes of 2000 veh/day or more
- 59% of Severe across centerline crashes occur on these roads

Evaluate Risk Factors: Example 4



https://safety.fhwa.dot.gov/systemic/fhwasa13019/sspst.pdf

Data Driven: Quantitative vs. Qualitative

Use qualitative ratings when needed:

Good, Fair, Not-So-Good (curve radius, roadside, etc.)

High, Medium, Low (traffic volumes, crash frequency, etc.)

It is important to include the risk factors that are key to your roadway network

Helpful Hints on Identifying Risk Factors

- Minimum of 2 to 3 risk factors is suggested to differentiate between sites
- Many counties use more
  - For example, some counties in Washington State used on average 6-7 risk factors
- Combining risk factors may be appropriate
  - Can indicate if a particular crash type is overrepresented
  - Look to literature

Step 2 - Screen and Prioritize Candidate Locations

Now that you have the data and identified focus crash types & risk factors, lets screen that information to develop a prioritized list by stepping through the following tasks:

- Task 1: Identify Network Elements to Analyze
- Task 2: Conduct Risk Assessment
- Task 3: Prioritize Focus Facility Elements

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 1: Identify Network Elements

- Spot-based (curves for example)
- Segments
- Verify selected risk factors

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Example: Identify Network Element

Corridor	Route Type	Route Number	Start	End	Length (miles)	Average Daily Traffic
144.01	CNTY	89	CSAH-30	CSAH-30	1.4	480
40.04	CSAH	40	New London Corp Limit	CSAH-2	5.9	450
131.01	CNTY	89	CSAH-30	MNTH-23	0.7	145
9.02	CSAH	9	CR-90, Willmar Corp Limit	CSAH-10	5.6	940
5.06	CSAH	5	150th Ave NW, CSAH-29	CSAH-1	10.1	628
31.02	CSAH	31	New London Corp Limit	MNTH-23	1.6	920
8.01	CSAH	8	Renville County Line	Lake Lillian Corp Limit	3.6	750
4.01	CSAH	4	CSAH-8	CSAH-20	6.7	320
2.05	CSAH	2	CSAH-10	MNTH-23	9.8	385
4.04	CSAH	4	CR-98	CSAH-40	2.4	290
38.01	CSAH	38	CSAH-40	CSAH-48	2.1	130
132.01	CNTY	89	CSAH-8	CSAH-8	2.2	190
42.01	CSAH	42	CSAH-7	County Line	0.5	120
9.03	CSAH	9	CSAH-10	CSAH-40, Redwood Street	4.9	1,800
25.01	CSAH	25	CSAH-5	USTH-71	3.2	1,315

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Task 2: Conduct Risk Assessment

- Document crash history and patterns
- Document physical and traffic characteristics
- Conduct evaluation of network elements

Rank	Corridor	ADT Range	Road Departure Density	Access Density	Curve Critical Radius Density	Edge Risk	Totals
1	144.01	★	★	★	★	★	★★★★★
2	40.04	★	★	★	★	★	★★★★★
3	131.01		★	★	★	★	★★★★
4	9.02	★	★	★	★		★★★★
5	5.06	★	★	★	★		★★★★
6	31.02	★	★	★	★		★★★★
7	8.01	★	★			★	★★★
8	4.01		★	★		★	★★★
9	2.05			★	★	★	★★★

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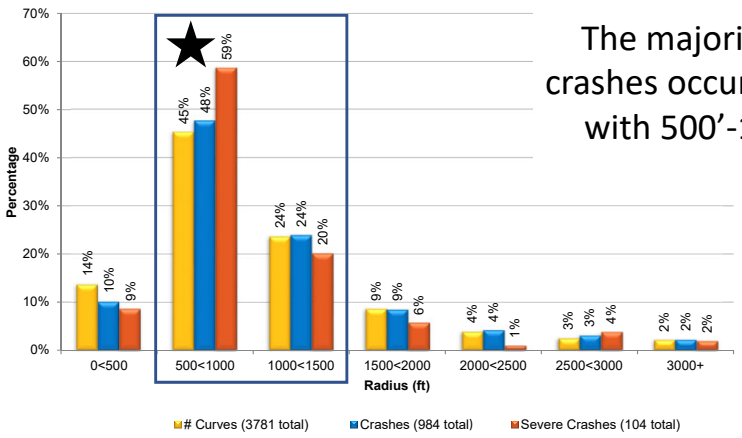
Quantitative Crash Analysis Method: Minnesota Example



The majority of severe crashes occurred on curves with 500'-1,500' radii.

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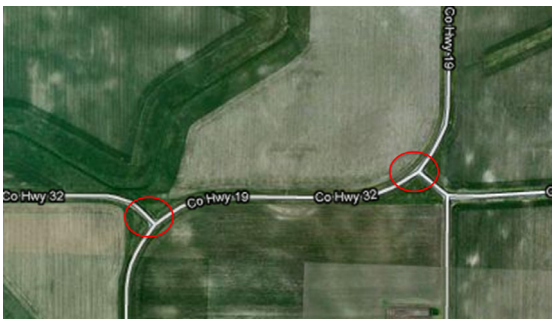
Presence of a Visual Trap

Intersection in a Curve



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Prioritization – Minnesota Example

Complete census of 504 curves

Curve Count	ID	Corridor	Segment	Crashes Total	Severe	K	A	B	C	PDO	Severe RoR K	A	Radius (ft)	Length Curve (ft)	ADT	Intersection on Curve	Chevrons	Visual Trap	Rank	Proximity	Chevron Candidate
1	001A	1.01	CSAH 1	1	-	-	-	-	-	1	-	-	92	125	50	-	-	-			
2	001B	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	557	422	50	-	-	-	★		
3	001C	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	823	493	50	-	-	-	★		
4	001D	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	379	359	50	-	-	-			
5	001E	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	669	456	50	-	-	-	★		
6	001F	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	270	431	50	-	-	-			
7	001G	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	314	324	50	-	-	-			
8	001H	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	545	239	50	-	-	-	★		
9	001I	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	459	225	50	-	-	-			
10	001J	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	368	274	50	-	-	-			
11	001K	1.01	CSAH 1	1	-	-	-	-	-	1	-	-	318	390	50	-	-	-			
12	001L	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	267	399	50	-	Yes	-			Installed
13	001M	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	1,475	345	50	-	-	-	★		
14	001N	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	763	578	130	Yes	-	-	★★		
15	001O	1.01	CSAH 1	-	-	-	-	-	-	-	-	-	859	353	210	Yes	-	-	★★		
16	002A	2.02	CSAH 2	1	-	-	-	1	-	-	-	-	583	752	930	-	-	-	★★	Yes	Yes
17	002B	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	584	635	930	Yes	-	-	★★★	-	Yes
18	002C	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	799	665	930	Yes	-	-	★★★	-	Yes
19	002D	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	963	626	930	-	-	-	★★	Yes	Yes
20	002E	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	1,234	584	930	-	-	-	★★	Yes	Yes
21	002F	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	1,188	719	930	-	-	-	★★	Yes	Yes
22	002G	2.02	CSAH 2	1	1	-	1	-	-	-	-	1	938	556	930	-	-	-	★★★	-	Yes
23	002H	2.02	CSAH 2	-	-	-	-	-	-	-	-	-	1,199	402	930	-	-	-	★★	Yes	Yes
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502	249ZH	249.01	CR 249	-	-	-	-	-	-	-	-	-	432	301	275	Yes	-	-		Yes	Yes
503	249ZI	249.01	CR 249	-	-	-	-	-	-	-	-	-	814	344	275	-	-	-		Yes	Yes
504	249ZJ	249.01	CR 249	-	-	-	-	-	-	-	-	-	800	685	275	-	-	-	★	Yes	Yes

Stars	#	%	Chevrons in Place #	Chevrons in Place %
★★★★★	0	0%	0	0%
★★★★	7	1%	2	0%
★★★	25	5%	4	1%
★★	108	21%	1	0%
★	250	50%	2	0%
-	114	23%	5	1%
	504	100%	14	3%

32 High Priority Curves (6%)

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 3: Prioritize Focus Facility Elements

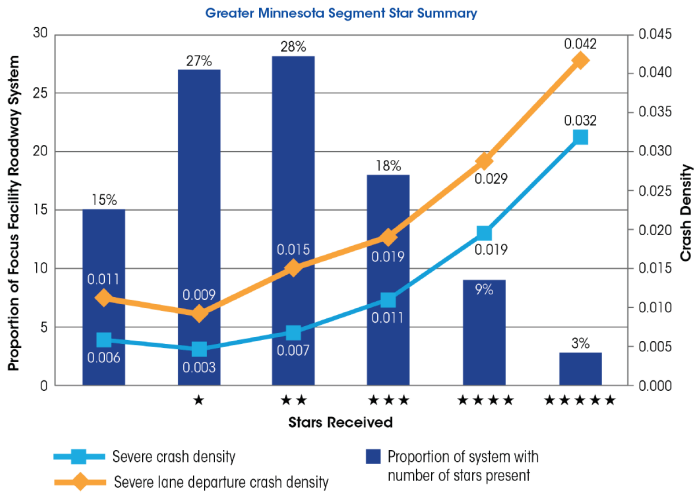
- Total the number of risk factors present
  - Assign equal or relative weights
  - Set threshold for high-priority candidates

Example Criteria for Relative Weight of Risk Factors*

Category	Higher Confidence	Lower Confidence
Factor overrepresented by **X** percentage points	> 10%	≤ 10%
Factor present in **X%** of severe crashes	≥ 30%	< 30%
Weight	1 point	½ point
* *Served as a guide, not a standard*		

STEP 1 | STEP 2 | STEP 3 | STEP 4

Use of Risk Assessment Results to Set Thresholds for Candidate Selection



30% of the system had 3 or more risk factors

STEP 1 | STEP 2 | STEP 3 | STEP 4

Helpful Hints

- Assess risk factors
  - Do selected characteristics represent increased risk?
  - Data-driven (descriptive statistics and CMFs)
- Prioritize locations for further consideration
  - What level of risk deserves treatment?
- Collect additional data as needed
  - Is there sufficient data to conduct risk assessment?
  - Document characteristics of crash locations

CRASH MODIFICATION FACTORS CLEARINGHOUSE
http://www.cmfclearinghouse.org/

STEP 1 | STEP 2 | STEP 3 | STEP 4

Step 3 – Select Countermeasures

After screening and prioritizing locations, now it's time to select countermeasures by going through the following tasks:

- Task 1: Assemble Comprehensive List of Countermeasures
- Task 2: Evaluate/Screen Countermeasures
- Task 3: Select Countermeasures for Deployment

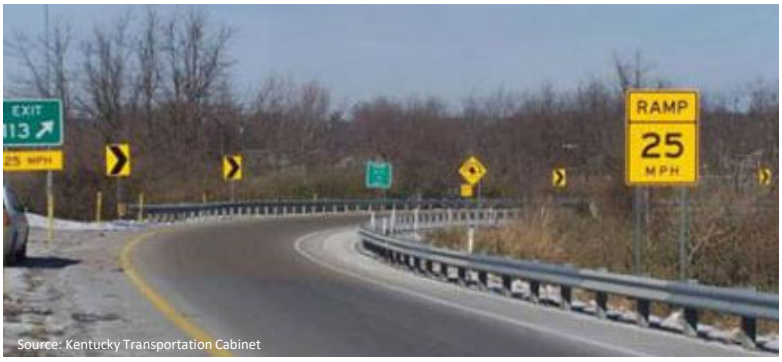
STEP 1 | STEP 2 | STEP 3 | STEP 4

Roadway Departure Countermeasures

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 2: Evaluate and Screen Countermeasures

- Documented **effectiveness**
- Implementation and maintenance **costs**
- Consistency with agency polices, practices, and experiences



Source: Kentucky Transportation Cabinet

STEP 1 | STEP 2 | **STEP 3** | STEP 4

Task 3: Select Countermeasures

- Represent highest priorities
  - Most **cost-effective** countermeasures addressing **targeted** crash types
- Provide a range of options for **flexibility**
- Consistent with agency practices and policies


Source: FHWA

STEP 1 | STEP 2 | **STEP 3** | STEP 4

Helpful Hints on Countermeasure Selection

- Seek input from stakeholders during screening process
- Remove initial countermeasures that are not feasible
- There is no optimum number of countermeasures
  - Provide at least one alternative
- Determine appropriate number of locations for initial list
  - Goals and funding amounts
  - Identify locations for on-the-shelf projects
  - Implement with typical construction and maintenance projects
- Consider bundling low cost improvements.

Step 4 – Prioritize Projects

Finally, you develop a list of high priority safety improvement projects for implementation by going through the following tasks:

- Task 1: Create Decision Process for Countermeasure Selection
- Task 2: Develop Safety Projects
- Task 3: Prioritize Safety Project Implementation

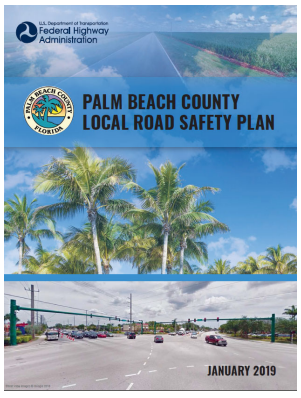
Task 1: Create Decision Process

- **Decision Process:** set of criteria to identify appropriate countermeasure.
  - Provides consistency in project development
  - Considers multiple locations for which countermeasures are appropriate and affordable
  - Considers issues such as traffic volume, environment, adjacent land use, or cross-section

https://commons.wikimedia.org/wiki/File:Centerline_Rumble_Strip.jpg

STEP 1 | STEP 2 | STEP 3 | STEP 4

Example Decision Process



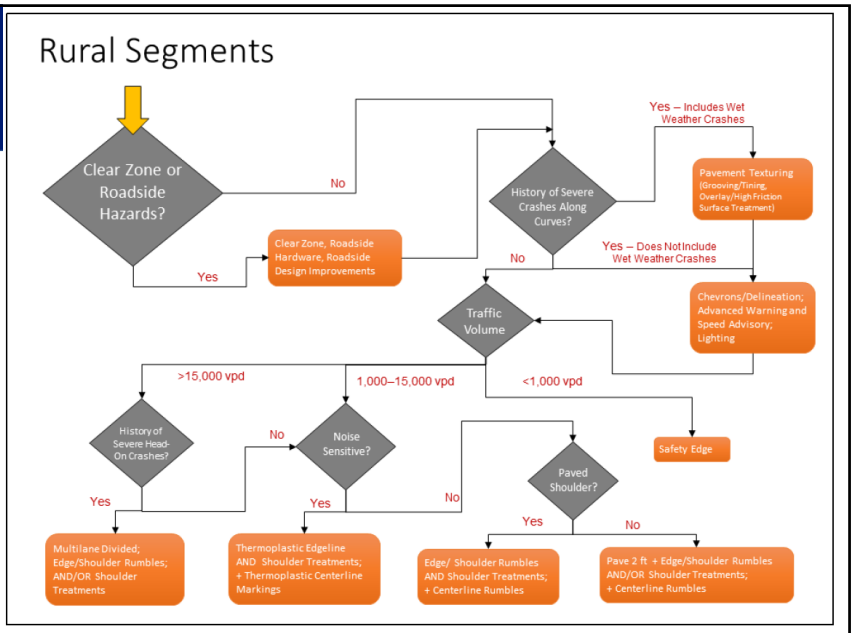


Figure 6-4. Rural Segments Project Development Decision Tree

STEP 1 | STEP 2 | STEP 3 | STEP 4

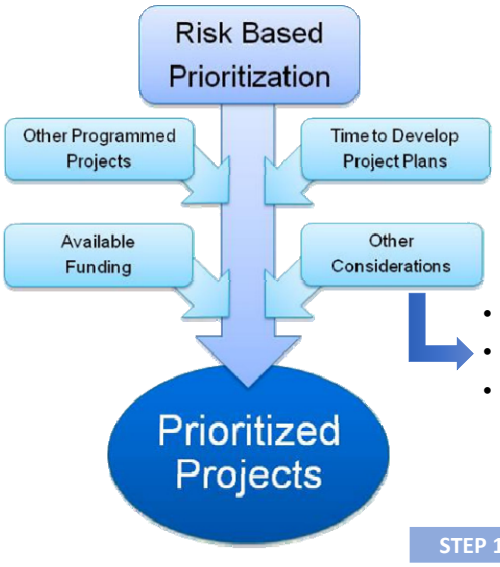
Task 2: Develop Safety Projects

- Apply decision process
- Identify specific countermeasures for each candidate site
- Document decision process and results

https://safety.fhwa.dot.gov/provencountermeasur es/uslimits2/

STEP 1 | STEP 2 | STEP 3 | STEP 4

Task 3: Prioritize Safety Projects



- Education
- Enforcement
- Maintenance

STEP 1 | STEP 2 | STEP 3 | STEP 4

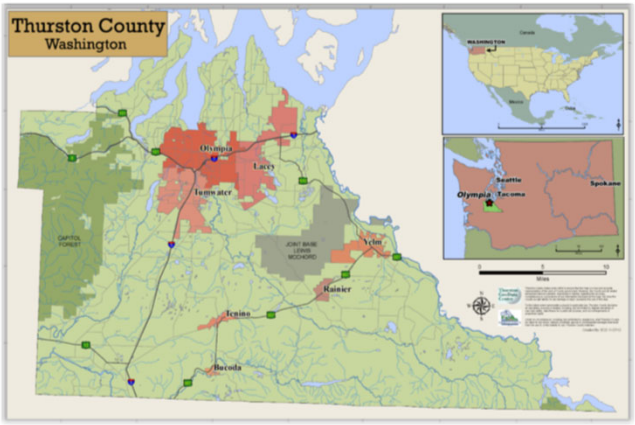
Benefit-Cost Example - Maine

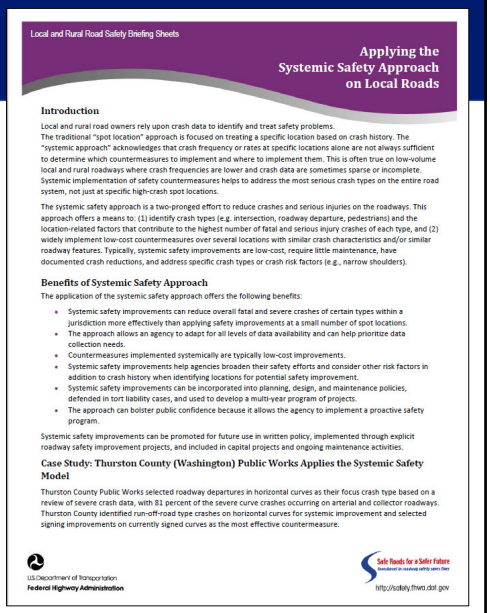
- Curve with 2000 AADT
- Annual severe crash cost of $10,000
- Cost for installation of outside edge line rumble strip
  - $2,000 (on new paving project)
- Crash modification factor of 0.86
- Annual benefit: $1,400
- Benefit/Cost ratio (10 yrs @ 6%): 5.2
- Conclusion: outside edge line is cost effective

https://safety.fhwa.dot.gov/rsdp/downloads/fhwasa16041.pdf

STEP 1 | STEP 2 | STEP 3 | STEP 4

Thurston County, Washington





Local and Rural Road Safety Briefing Sheets

Applying the Systemic Safety Approach on Local Roads

Introduction

Local and rural road owners rely upon crash data to identify and treat safety problems.
The traditional "spot location" approach is focused on treating a specific location based on crash history. The "systemic approach" acknowledges that crash frequency or rates at specific locations alone are not always sufficient to determine which countermeasures to implement and where to implement them. This is often true on low-volume local and rural roadways where crash frequencies are lower and crash data are sometimes sparse or incomplete. Systemic implementation of safety countermeasures helps to address the most serious crash types on the entire road system, not just at specific high-crash spot locations.

The systemic safety approach is a two-pronged effort to reduce crashes and serious injuries on the roadways. This approach offers a means to: (1) identify crash types (e.g. intersection, roadway departure, pedestrians) and the location-related factors that contribute to the highest number of fatal and serious injury crashes of each type, and (2) widely implement low-cost countermeasures over several locations with similar crash characteristics and/or similar roadway features. Typically, systemic safety improvements are low-cost, require little maintenance, have documented crash reductions, and address specific crash types or crash risk factors (e.g., narrow shoulders).

Benefits of Systemic Safety Approach

The application of the systemic safety approach offers the following benefits:

- Systemic safety improvements can reduce overall fatal and severe crashes of certain types within a jurisdiction more effectively than applying safety improvements at a small number of spot locations.
- The approach allows an agency to adapt for all levels of data availability and can help prioritize data collection needs.
- Countermeasures implemented systemically are typically low-cost improvements.
- Systemic safety improvements help agencies broaden their safety efforts and consider other risk factors in addition to crash history when identifying locations for potential safety improvement.
- Systemic safety improvements can be incorporated into planning, design, and maintenance policies, defended in tort liability cases, and used to develop a multi-year program of projects.
- The approach can bolster public confidence because it allows the agency to implement a proactive safety program.

Systemic safety improvements can be promoted for future use in written policy, implemented through explicit roadway safety improvement projects, and included in capital projects and ongoing maintenance activities.

Case Study: Thurston County (Washington) Public Works Applies the Systemic Safety Model

Thurston County Public Works selected roadway departures in horizontal curves as their focus crash type based on a review of severe crash data, with 81 percent of the severe curve crashes occurring on arterial and collector roadways. Thurston County identified run-off-road type crashes on horizontal curves for systemic improvement and selected signing improvements on currently signed curves as the most effective countermeasure.

U.S. Department of Transportation
Federal Highway Administration

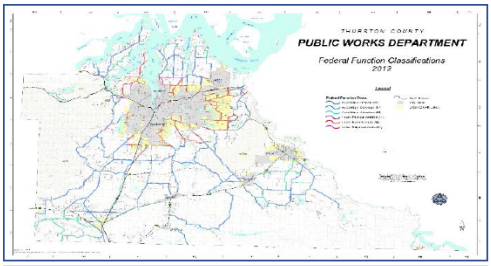
Safe Roads for a Safer Future
http://safety.fhwa.dot.gov

https://safety.fhwa.dot.gov/local_rural/training/fhwasa14081/systemic_app.pdf

Thurston County, Washington

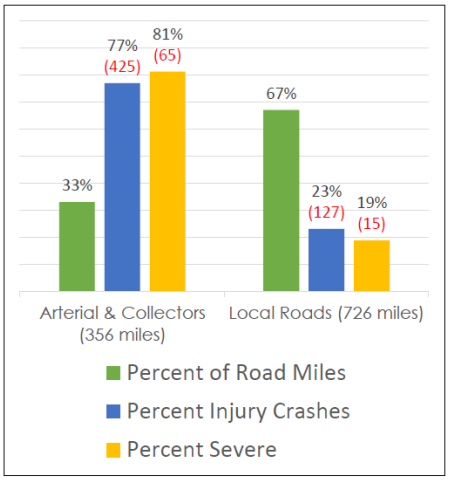
2006-2010 Collision Data	Fatal/Serious Injury Crashes Only		
	All Roads	All Counties	Thurston County
Angle (left-Turn)	16% (2175)	13% (468)	9% (16)
Intersection-Related	33% (4557)	22% (812)	19% (34)
Horizontal Curve	26% (3674)	39% (1419)	45% (80)

Thurston County, Washington



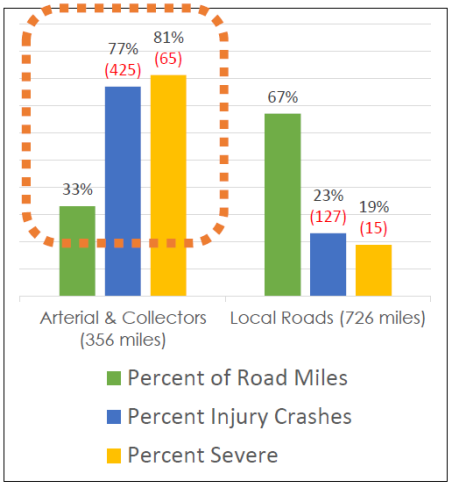
Next we were left with:

- Over 1000 centerline miles
- Over 1500 crashes



Thurston County, Washington

Focus area reduced to about 350 centerline miles

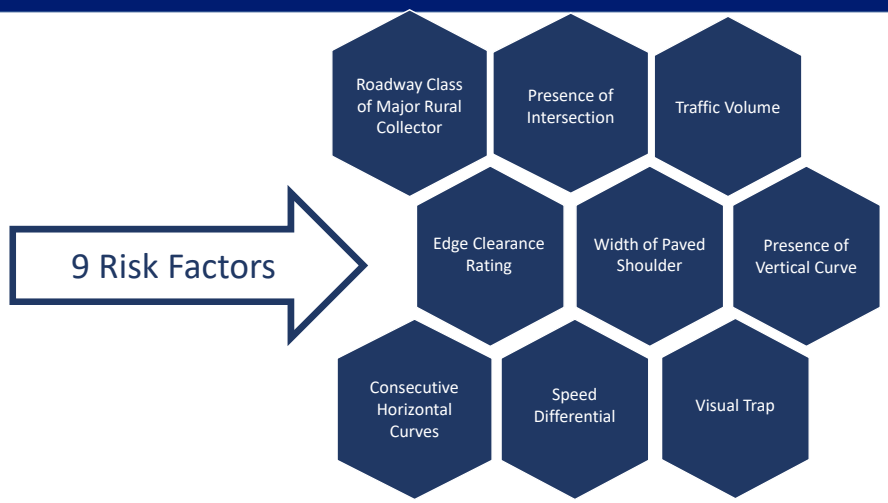


Thurston County, Washington

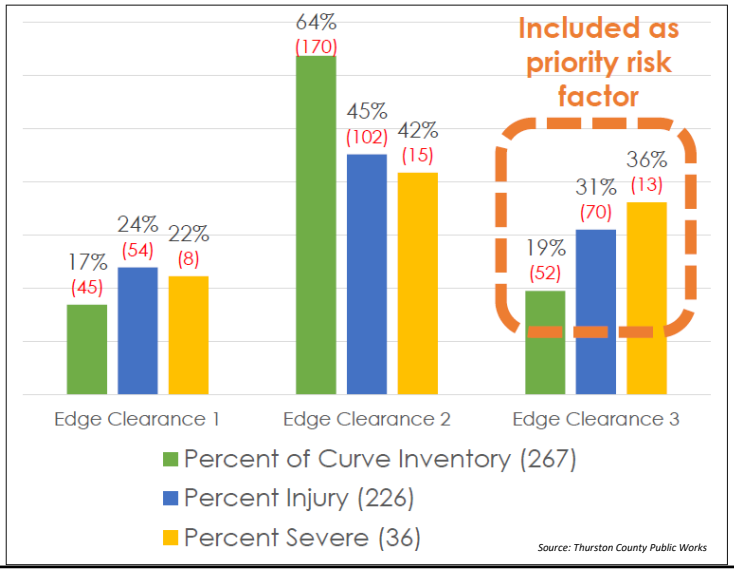
Focus Crash Type → **Roadway Departures in Horizontal Curves**

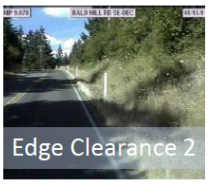
Focus Facility Type → **Arterial and Collector Roadways**

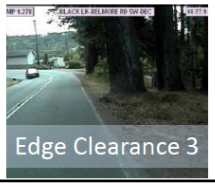
Thurston County, Washington



Thurston County, Washington

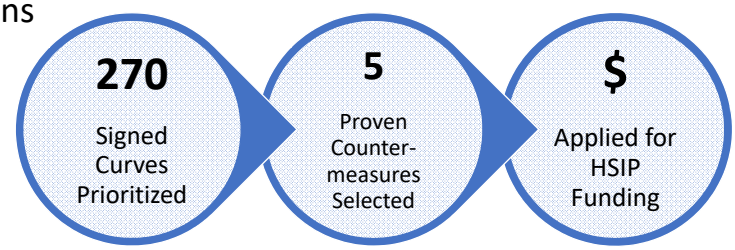






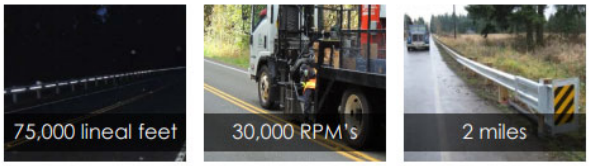
Thurston County, Washington

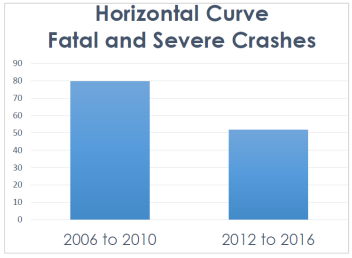
- Chevron and large arrow signs
- Larger signs
- Rumble strips
- Barrier delineation
- Extension lines



Note: In addition to the 5 proven countermeasures provided, Thurston County used other low-cost and corridor consistency countermeasures.

Thurston County, Washington





35% Reduction in Target Crashes

Source: http://www.countyengineers.org/assets/docs/LRSP%20Pilot_Webinar%203.pdf

Systemic Safety Resources

- State
  - Strategic Highway Safety Plans
  - Safety Implementation Plans
- FHWA
  - Systemic Safety Project Selection Tool
  - Crash Tree Maker and User Guide
  - CMF Clearinghouse
  - Reliability of Safety Management Series
  - Highway Safety Benefit-Cost Analysis Guide and Tool
- AASHTO
  - Highway Safety Manual (HSM)
  - NCHRP Report 500 Series
  - AASHTOWare Safety Analyst
- Roadway Safety Foundation
  - US Road Assessment Program (usRAP)

Roadway Safety Data Program (RSDP) Toolbox

https://safety.fhwa.dot.gov/rsdp/

Source: https://safety.fhwa.dot.gov/systemic/

Course Objectives Review

Understand why the systemic approach is critical to reduce roadway departures.

- Which of these are true regarding the Systemic Approach?

a. A lot of detailed data is required
b. You only address locations where there has been at least 1 serious crash
c. It involves identifying risk factors for different crash types
d. Countermeasures selected should be installed on all road sections
e. Agencies can determine how to prioritize sections based on the number of risk factors present.

Course Objectives

Describe the 4-steps in the systemic safety planning process.

- Which of these are steps in the systemic safety planning process?

a. Identify Focus Crash Types and Risk Factors
b. Screen & Prioritize Candidate Locations
c. Select Countermeasures
d. Prioritize Projects
e. All of the above

Course Objectives

Identify risk factors that are commonly used in the Systemic Approach to reduce rural roadway departures.

- What Risk Factors might be used for rural RwD's?