SAMPLE

Roadway Departure Safety Implementation Plan

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U.S. Department of Transportation
Federal Highway Administration

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Executive Summary

Note: The following document is an example Roadway Departure (RD) Safety Implementation Plan for a fictional State with fictional characteristics (e.g., number and types of RD crashes, implementation costs, and benefits). The purpose of this document is to give readers a general idea of the structure and content of the RD Safety Implementation Plans. It should not be used for State-specific data analysis, countermeasure selection or other decision-making safety management processes.

The State Strategic Highway Safety Plan (SHSP) has a safety goal of reducing the number of annual roadway fatalities within the State to no more than XXX by the end of XXXX.

Roadway departure fatalities account for approximately XX percent of all fatalities in STATE. A data analysis package along with a set of roadway departure countermeasures was merged to identify a set of cost effective countermeasures, deployment levels, and funds needed to achieve a XX percent roadway departure fatality reduction goal.

The data analysis indicates that the roadway departure goal can be achieved with the following enhancements to the safety program:

- The traditional approach of relying primarily on pursuing major improvements at high-crash roadway departure locations must be complemented with a) a systematic approach that involves deploying large numbers of relatively low-cost, cost-effective countermeasures at many targeted high-crash roadway departures and b) a comprehensive approach that coordinates an engineering, education, and enforcement (3E) initiative on corridors and in urban areas with large numbers of severe roadway departure crashes.
- The systematic improvement categories to be deployed include the following: sign and marking enhancements on curves with crash histories, centerline rumble strips on rural two-lane highways, edge line rumble stripes and shoulder rumble strips, installation of micro-texture or similar high skid surfaces, and selective rural tree removal program.
- The systematic and comprehensive approaches will generate a much larger number of roadway departure improvements statewide, and District personnel will have to be trained and take a more active role in identifying the appropriateness of systematic improvements within their Districts.
- The safety program needs to be expanded to incorporate low-cost, cost-effective countermeasures on other types of projects, such as resurfacing and surface transportation projects, when a crash history exists within the area of the work and the countermeasures can reduce future crash potential.
    - Use of the Safety Edge
- The safety program must encompass cost-effective treatments on local roads since a sizeable portion of the statewide roadway departure crash problem occurs on local roads.
- Additional countermeasures rarely or never used in this state need to be carefully and judiciously deployed on highway sections that have specific crash problems that these countermeasures can address. The countermeasure should be evaluated to determine if more widespread use is appropriate.

- To achieve the roadway departure safety goal, it will take an investment of approximately $XX million over the 5-year period or X million per year. In addition, X million annually will be needed for education and enforcement initiatives on corridors and cities.

This plan provides specific information on how these additions to the current safety program can be effectively implemented.

The bottom line for a successful plan implementation is that, once fully implemented over a 10-year period, approximately XX, XXX roadway departure crashes and almost XXXX disabling injury crashes will be prevented, and more than XXX lives will be saved.

Background

The STATE SHSP has an overall goal of reducing the number of roadway fatalities to more than XXX annually by the end of XXXX. One of the emphasis areas identified in the SHSP is to improve roadway departure safety. Roadway departure fatalities within the State account for approximately XX percent of all fatalities. The SHSP provides insight on broad initiatives in the roadway departure safety area to support achieving the overall goal, but it lacks detail regarding countermeasures, actions, deployment characteristics, costs, impacts, and key steps that have to be taken to improve roadway departure safety significantly. The roadway departure portion of the tentative SHSP goal is a XX percent reduction of roadway departure fatalities by XXXX. The purpose of this plan is to provide the specific details on countermeasures, actions, key steps, schedules, and investments needed to achieve that goal.

The Roadway Departure Safety Goal

Over the past several years, STATE has had continued reductions in roadway departure fatalities as indicated in Table 1.

Table 1: State Roadway Departure Fatalities

	2004	2005	2006	2007	2008	Total
Number of Roadway Departure Fatalities	547	596	538	496	469	2,646

The roadway departure goal is to reduce the XXX roadway departure fatalities that occurred in XXXX by XX percent by XXXX, or to prevent approximately XX additional roadway departure deaths from occurring annually.

The Approach

The HSIP program has been based upon a traditional approach directed towards improving roadway safety at specific high-crash locations by identifying and analyzing individual crashes at the locations, defining crash patterns, determining appropriate countermeasures to reduce future crash potential, and then implementing those countermeasures. While this is an important approach and needs to continue, it has limited impact in terms of reducing statewide numbers of roadway departure fatalities.

To help lower statewide roadway departure fatalities, two additional approaches are recommended to complement the traditional approach:

- Systematic application of large numbers of cost-effective, low-cost countermeasures at locations that have specific, moderate crash types above a specified crash frequency level.
- Comprehensive application of low-cost infrastructure improvements coupled with targeted education and enforcement initiatives on corridors and in municipalities that exhibit a very high severe roadway departure crash history.

In the systematic approach, the first step is to identify low-cost countermeasures. Then the crash data system is searched to identify highway sections that have targeted crashes at or above a crash threshold that would ensure cost-effective deployment of these countermeasures. Estimates of the impacts of the deployments can be made in terms of projected statewide roadway departure crashes prevented, annual lives saved, and overall deployment costs.

The comprehensive approach combines sets of cost-effective, low-cost infrastructure countermeasures with a coordinated set of education and highly visible enforcement initiatives targeted to reduce severe roadway departure crashes on corridors and within municipalities that have a severe roadway departure crash history.

Three other features need to be added to the plan to better improve the ability to achieve the safety improvement goal:

1. The safety program should be expanded to incorporate low-cost, cost-effective countermeasures on other types of projects such as resurfacing and surface transportation projects – especially if a crash history exists within the area of the work and the countermeasure can reduce future crash potential.

2. The safety program should include cost-effective treatments on local roads since a portion of the statewide roadway departure crash problem occurs on local roads.
3. Additional countermeasures rarely or never used in STATE need to be carefully and judiciously deployed on highway sections that have specific crash problems that these countermeasures can address. The countermeasure should be evaluated to determine if more widespread use is appropriate.

Distribution of the State Roadway Departure Fatality Problem

The roadway departure crash and fatality data for STATE was analyzed to gain insight on the distribution and characteristics of the roadway departure crash problem. Key information derived from the roadway departure data analysis is shown in Tables 2-5.

Table 2: Roadway Departure Crashes, and Fatalities by Locality – 2004-2008

Locality	Crashes		Fatalities	
	Total	Percentage	Total	Percentage
State	106,989	71.02%	2,244	84.81%
Rural	75,281	49.97%	1,886	71.28%
Urban	31,708	21.05%	358	13.53%
Local	43,661	28.98%	402	15.19%
Grand Total	150,650	100.00%	2,646	100.00%

Table 3: Summary of Roadway Departure Fatalities, Crashes, and Fatalities per 100 Crashes – 2004-2008

Locality	State Rural	State Urban	Local
All RD Crashes			
Fatalities	1,881	358	402
Crashes	75,281	31,708	43,661
Fat/100 Crashes	2.49	1.13	0.92
Interstate RD Crashes			
Fatalities	117	75	-
Crashes	6,296	8,973	-
Fat/100 Crashes	1.86	0.84	-
State Route Type RD Crashes			
Fatalities	1,318	168	-
Crashes	52,288	14,411	-
Fat/100 Crashes	2.52	1.12	-
US Route Type RD Crashes			
Fatalities	429	100	-
Crashes	14,350	7,372	-
Fat/100 Crashes	2.99	1.36	-
Other Route Type RD State Crashes			

Locality	State Rural	State Urban	Local
Fatalities	22	15	-
Crashes	2,347	952	-
Fat/100 Crashes	0.93	1.57	-

Table 4: Enforcement and Education-Related Roadway Departure Crashes by Human Factor and Locality – 2004-2008

Human Factor	Alcohol			Speeding or Unbelted				Speeding	Unbelted
Locality	State Rural	State Urban	Local	State Rural Interstate Only	State Urban Interstate Only	State Rural	State Urban	Local	Local
Enforcement and Education-related RD Crashes									
Fatalities	562	116	177	77	52	1,318	209	128	262
Incapacitating Injury Crashes	926	284	454	113	148	2,161	486	350	602
Total Crashes	7,733	3,245	5,828	1,547	2,224	18,558	5,550	6,192	6,178
Incapacitating Injury Crashes/ 100 Crashes	11.97	8.75	7.79	7.30	6.35	11.64	8.26	5.65	9.74
Fatalities/100 Crashes	7.27	3.57	3.04	4.98	2.34	7.10	3.77	2.07	4.24

Table 5: Roadway Departure Crashes by Crash Type, Number of Crashes, and Number of Fatalities--2004-2008

Crash Type	Number of Crashes	Number of Fatalities
Fixed Object	128,091	1,978
Head On	8,033	815
Overturn/Rollover	17,995	484
Ran Off Road - Left	10,391	158
Ran Off Road - Right	18,303	257
Ran Off Road - Straight	1,061	5
Sideswipe, Opposite Direction	12,115	136
Total	195,989	3,833

Summary of Roadway Departure Crash Concerns

- Crashes predominantly occur in rural areas; severity of crashes is greater in rural areas than urban areas.
- Approximately 25 percent of the fatalities involve head-on or opposing-flow sideswipe crashes.
- Driving violations (speeding, alcohol, and unbelted driving) are major factors in roadway departure crashes. Many of these crashes involve multiple driving violation factors.

Summary of Roadway Departure Countermeasure Deployments

A summary of the countermeasures, deployment levels, costs, and estimated lives saved provided in Table 6.

Table 6: Summary of Countermeasure Deployment Levels and Estimated Safety Impacts

Countermeasure	Approach	Number of Sections	Construction Cost ($ Million)	Enforcement, Education and EMS Costs (Annual $ Million)	Estimated Annual Crashes Reduced	Estimated Annual Incapacitating Injury Crashes Reduced	Estimated Annual Fatalities Reduced
Enhanced Signs and Markings for Curves – State Rural Roads	Systematic	976	4.87	-	198	13.34	5.13
Enhanced Signs and Markings for Curves Plus Flashing Beacons – State Rural Roads	Systematic	16	0.12	-	7	0.50	0.20
Enhanced Signs and Markings for Curves – State Urban Roads	Systematic	14	0.07	-	23	1.10	0.32
Enhanced Signs and Markings for Curves – Local Roads	Systematic	151	1.51	-	88	3.90	0.89
Centerline Rumble Stripes – ≥ 22 Feet Road Width – State Rural Roads	Systematic	254	3.49	-	99	9.40	10.87
Centerline Rumble Stripes – ≥ 20 and < 22 Feet Road Width – State Rural Roads	Systematic	368	4.02	-	158	12.30	7.64
Edge Line Rumble Stripes or Shoulder Rumble Strips – 2 & 4 Lane – State Rural Roads	Systematic	1,483	5.92	-	624	42.60	13.58
High Friction Surfaces – State Rural Roads – Micro Texture Surface	Systematic	159	6.81	-	200	8.30	2.18

Countermeasure	Approach	Number of Sections	Construction Cost ($ Million)	Enforcement, Education and EMS Costs (Annual $ Million)	Estimated Annual Crashes Reduced	Estimated Annual Incapacitating Injury Crashes Reduced	Estimated Annual Fatalities Reduced
Tree Removal/Safety Enhancements – State Rural Roads	Systematic	154	3.85	-	83	8.60	3.67
Tree Removal/Safety Enhancements – Local Roads	Systematic	16	0.40	-	16	1.60	0.70
Guard Rail Enhancements – State Rural	Systematic	115	2.30	-	-	1.31	0.56
Traffic Calming to Reduce Speeding-related Crashes (Pilot first)	Systematic	99	5.05	-	146	9.36	4.38
Enhanced Corridor Enforcement – Speeding-Related or Unbelted Driving – State Roads – Interstates	Education and Enforcement	20	-	0.6	19	1.30	0.60
Enhanced Corridor Enforcement – Speeding-Related or Unbelted Driving – State Roads – Not Interstates	Education and Enforcement	109	-	3.27	53	5.70	3.07
Enhanced Corridor Enforcement – Alcohol-Related – State Roads	Education and Enforcement	123	-	3.81	38	5.02	2.84
Corridor 3E Improvements – State Roads – Not Interstates	Comprehensive	3	1.50	0.30	68	3.00	1.50
Area-Wide 3E Improvements – Cities – State Roads	Comprehensive	2	2.00	0.20	300	16.00	4.40
Median Barrier – Raised Mountable, Flush, and Depressed Median Types – State Roads	Traditional	49	5.88	-	26	2.90	3.04
Total		4,111	47.85	8.18	2,146	146.23	65.57

Key First Steps

There are several key first steps that need to be taken before actual countermeasure implementation activities begin.

1. The draft implementation plan should be presented to the Districts and other affected Headquarters organizations to share, review, provide input, and understand the conceptual enhancements to the safety program.
2. Initial preparatory materials need to be developed, training provided, and processes established to begin implementation of the low-cost countermeasures being considered for systematic deployment. These countermeasures include sign and marking enhancements for curves, centerline rumble strips on rural non-freeway highways, edge line and shoulder rumble strips, and tree removal in rural areas.
3. Meetings need to be arranged with appropriate Maintenance, Design, and Planning personnel to further explore and define the processes and responsibilities that need to be developed to consider the incorporation of low-cost, cost-effective countermeasures into other program categories such as the resurfacing program and the surface transportation improvement program. The primary low-cost countermeasures to consider for inclusion in other project types at targeted high-crash sections are as follows: sign and marking enhancements for horizontal curves, centerline rumble strips in rural areas, edge line and shoulder rumble strips, expansion of the use of the pavement wedge from safety projects to all projects, tree removal in rural areas, and higher friction surfaces and/or surface drainage improvements.
4. Meetings need to be arranged with the Governor's Highway Safety Representative and appropriate police personnel to review the crash data that identifies highway sections with concentrations of speeding, unbelted, and alcohol-related crash histories. Targeted enforcement and education initiatives need to be developed and considered for implementation at many of these locations to reduce the potential for future similar crashes.
5. Data needs to be further analyzed and shared with regional and division personnel along with the Governor's Highway Safety Representative to identify candidate corridors and cities for the 3-E comprehensive initiatives.
6. The Roadway Departure Safety Committee created under the Strategic Highway Safety Plan should provide guidance and address issues and problems that arise during the implementation of the program. The committee should meet on a planned quarterly basis throughout the implementation phase.
7. The STATE DOT LEAD OFFICE should develop and deploy a tracking system to monitor the implementation of the various types of countermeasures being deployed. This system should include forms designed to secure "before" and "after" targeted crash histories, dates of implementation, linkages to other roadway departure improvements being implemented under other programs, and other information deemed pertinent.

Major Components of the Plan

The remaining sections of this plan provides a detailed description of key implementation steps for each of the major efforts needed to achieve a XX percent reduction in roadway departure fatalities. The efforts are categorized as follows:

- Systematic deployment of low-cost, cost-effective countermeasures.
- Incorporation of low-cost, cost-effective countermeasures into other programmed projects.
- Local road improvements
- Comprehensive 3-E improvements.
- Traditional improvements.
- Implementation of new countermeasures.

Systematic Deployment of Low-Cost Countermeasures

This initiative involves the installation of several sets of low-cost, cost-effective countermeasures at locations with high crash histories to decrease the potential of future crashes significantly. Four types of low-cost countermeasures have been identified for extensive systematic deployment as follows:

1. Enhanced sign and marking improvements for curves with crash histories.
2. Centerline rumble strips to reduce head-on and opposing-flow sideswipe crashes.
3. Edge line and shoulder rumble strips to reduce single vehicle roadway departure crashes.
4. Select tree removal or tree crash prevention countermeasures in rural areas to reduce future tree crash occurrences.

In addition to the above countermeasures, one other countermeasure may be deployed either systematically or as part of the traditional approach: surface friction enhancements to reduce the potential of future wet weather crashes.

The methodology to identify sections of a highway that have crashes at or above the threshold breaks down a roadway in uniform, discrete section lengths and identifies sections with a number of targeted crash types that equal or exceed the defined threshold. However, the output from this process needs refinement based upon field conditions or overall route characteristics. For more advanced analyses, additional methods and analysis tools are available in the Highway Safety Manual.

As an example, a single curve could have portions and crashes in two joining sections. Thus curve crashes on either side of a section identified as a high-crash curve section need to be reviewed to determine if there are any additional curve crashes that occurred on the same curve but in the adjoining section. As another example, a rural highway may be 10 miles in length and 75 percent of the sections on the route meet the crash threshold for edge line /shoulder rumble strips. For routes with numerous sections that meet the crash threshold, the application of edge line rumble strips on the entire route rather than just those sections that meet the threshold needs to be considered. This may be determined by field review or GIS mapping.

The Traffic Safety Unit has the list of sections of highway that equal or exceed the crash thresholds for each of these countermeasures.

Table 7: Summary of 5 Year Curve Crashes (2004-2008)

Locality	State Rural				State Urban				Local
ADT Interval	<1,000	1,001 - 3,000	3,001 - 5,000	>5,000	<1,000	1,001 - 3,000	3,001 - 5,000	>5,000	Total
Curve RD Crashes									
Fatalities	282	369	169	213	2	9	11	96	210
Incapacitating Injury Crashes	834	1,069	393	452	6	46	56	305	918
Total Crashes	11,475	16,072	6,165	7,006	129	977	969	6,729	20,710
Incapacitating Injury Crashes/100 Crashes	7.27	6.65	6.37	6.45	4.65	4.71	4.75	4.53	4.43
Fatalities/100 Crashes	2.54	2.30	2.74	3.04	1.55	0.92	1.14	1.43	1.01

Curves on rural State highways with the number of crashes at or above threshold levels and considered for sign and marking enhancements are summarized in Table 8.

Table 8: Enhanced Signs and Markings for Curves – Curve Roadway Departure Crashes – State Rural Roads (2004-2008)

AADT	Threshold Crash Level (5 Years)	Number of Curves	Number of Targeted 5 Year Crashes on Curves	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
<1,000	3	578	1,463	405	2.02	2.54	7.27	61	4.43	1.55
1,000-3,000	3	420	1521	294	1.47	2.30	6.65	64	4.24	1.47
3,001 - 5,000	3	222	937	155	0.77	2.74	6.37	39	2.48	1.07
>5000	4	175	817	122	0.61	3.04	6.45	34	2.19	1.03
Total				976	4.87	-	-		13.34	5.13

[1] Assumes 70% of curves can be improved.

[2] Assumes an average cost of $5,000 per curve.

[3] A CMF of 0.70 is used (oversized, left, and right fluorescent yellow, advance warning signs; chevrons; slow and XX mph pavement markings; center and edge lines).

Within the set of curves identified in Table 8, those curves with higher crash levels in which the addition of flashing beacons on the advanced curve warning signs can be considered are provided in Table 9.

Table 9: Enhanced Signs and Markings for Curves Plus Flashing Beacons – Curve Roadway Departure Crashes – State Rural Roads (2004-2008)

AADT (Between PC and PT)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
<1,000	10	-	-	-	-	2.54	7.27	-	-	-
1,000-3,000	10	5	63	4	0.03	2.30	6.65	-	-	-
3,001 - 5,000	10	5	70	4	0.03	2.74	6.37	-	-	-
>5000	12	12	110	8	0.06	3.04	6.45	-	-	-
Total	-	-	243	16	0.12	-	-	7	0.5	0.20

[1] Assumes 70% of curves can be improved.

[2] Assumes an average cost of $7,000 per curve for the flashing beacon.

[3] A reduction of 0.15 below the enhanced signs and markings for curves CMF (reducing the overall CMF from 0.70 to 0.55).

Curves on urban State highways that have crashes at or above crash thresholds in which sign and marking enhancements are to be considered are summarized in Table 10.

Table 10: Enhanced Signs and Markings for Curves – Curve Roadway Departure Crashes – State Urban Roads (2004-2008)

AADT (Between PC and PT)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
<1,000	10	-	-	-	-	1.55	4.65	-	-	-
1,000-3,000	10	3	56	-	-	0.92	4.71	-	-	-
3,001 - 5,000	10	2	25	-	-	1.14	4.75	-	-	-
>5000	12	16	432	-	-	1.43	4.53	-	-	-
Total	-	21	513	14	0.07	1.40	4.60	23	1.1	0.32

[1] Assumes 70% of curves can be improved.

[2] Assumes an average cost of $5,000 per curve.

[3] A CMF of 0.70 is used (oversized, left, and right fluorescent yellow, advance warning signs; chevrons; slow and XX mph pavement markings; center and edge lines).

The proposed signing and marking treatments for these curves is as follows:

- Oversize advanced fluorescent yellow curve warning signs, both left and right.
- Chevrons with spacing in accordance with the 2009 MUTCD.
- Advisory speed plates beneath the advanced warning sign using a standardized approach to determine the appropriate advisory speed.
- "SLOW" and curve symbol pavement markings in advance of the curve. Note that the curve pavement marking symbol layout must receive FHWA approval. In addition alternate methods to slow high end approach speeds such as the use of peripheral transverse pavement markings will also be considered.
- Elimination of any pavement edge drop offs two inches or greater in depth.

A summary of these enhancements including an estimated number of deployments, costs, and annual crashes, incapacitating injury crashes, and fatalities prevented is provided in Table 11.

Table 11: Basic Set of Sign and Marking Improvements – State Curve Roadway Departures (2004-2008)

Category	Approach	Number of Sections	Construction Cost ($ Million)	Enforcement, Education and EMS Costs (Annual $ Thousand)	Estimated Annual Crashes Reduced	Estimated Annual Disabling Injuries Reduced	Estimated Annual Fatalities Reduced
Enhanced Signs and Markings for Curves – State Rural Roads	Systematic	642	3.21	-	142	9.70	3.65
Enhanced Signs and Markings for Curves Plus Flashing Beacons – State Rural Roads	Systematic	16	0.12	-	7	0.50	0.20
Enhanced Signs and Markings for Curves – State Urban Roads	Systematic	14	0.07	-	23	1.10	0.32
Total	-	672	3.50	-	172	11.30	4.17

The basic steps and schedule to implement this initiative are as follows:

1. Gain management acceptance of the Roadway Departure Safety Implementation Plan.
2. Traffic Headquarters develops guidelines and a standard template treatment for curves that are at or above the threshold in the above tables. The guidelines will be issued to the District personnel for implementation. Note that the guidance will provide a process to consider treatment and funding alternatives for similar sharp curves on the same route.

   Schedule: *Guidelines issued* w*ithin 6 months of acceptance of the Plan*
3. District personnel will use guidelines and template(s) to field review each identified curve with crashes and determine appropriate sign and marking improvements. District personnel will assemble District wide or county wide contract plans to implement the improvements.

   Schedule: Curve sign and marking recommendations completed within 12 months of acceptance of the Plan
4. Contracts will be let and improvements will be implemented

   Schedule: Sign and marking enhancements for all curves completed within 24 months of acceptance of the Plan

Centerline Rumble Strips to Reduce Head-On and Opposing-Flow Sideswipe Crashes

Center line rumble strips will be implemented under two scenarios as follows

1. Systematic deployment of centerline rumble strips on two- and multi-lane undivided rural highways with a pavement width of at least 22 ft. and a crash threshold of at least X or more head-on and opposing-flow sideswipe crashes in a 15,000 ft. stretch of rural highway occurring in the past 5 years of crash data.
2. Pilot evaluation of deploying centerline rumble strips on the following highway types:
    a. Two lane undivided rural highways with a pavement width between 20 and 22 ft. and a crash threshold of at least X or more head-on and opposing-flow sideswipe crashes in a 15,000 ft. stretch of rural highway occurring in the past 5 years of crash data.
    b. Two- and multi-lane undivided urban highways with a pavement width of at least 22 ft. and a crash threshold of at least X or more head-on and opposing-flow sideswipe crashes in a 15,000 ft. stretch of urban highway occurring in the past 5 years of crash data.

The summary of high-crash, head-on, opposing flow sideswipe sections where centerline rumble strips are to be considered for installation on state rural highways at least 22 ft. in width are summarized in Table 12. The actual locations of these sections reside in the Office of Traffic Operations.

Table 12: Centerline Rumble Stripes – Head-On and Sideswipe, Opposite Direction Crashes – State Rural Roads ≥ 22 Feet Road Width (2004-2008)

Section Length	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes in the Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Disabling Injuries per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Disabling Injury Reduction	Annual Estimated Fatality Reduction
15,000 feet	3	363	1,397	290	4.35	12.24	17.67	46.93	8.29	5.74
Total	-	-	-	290	4.35	-	-	46.93	8.29	5.74

[1] Assumes 80% of locations can be improved.
[2] Assumes an average cost of $15,000 per section.
[3] A CMF of 0.79 is used.

Table 13: Centerline Rumble Stripes – Head-On and Sideswipe, Opposite Direction Crashes – ≥ 20 and < 22 Feet Road Width – State Rural Roads – Potential Full Impact if Pilot is Successful (2004-2008)

Section Length	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
15,000 feet	3	460	2,245	368	5.52	4.84	7.77	158	12.3	7.64

[1] Assumes 80% of locations can be improved.
[2] Assumes an average cost of $15,000 per section.
[3] A CMF of 0.56 is used.

Table 14: Centerline Rumble Strips – Head-On & Sideswipe, Opposite Direction Crashes – ≥ 22 Feet Road Width – State Urban Roads – Potential Full Impact if Pilot is Successful (2004-2008)

Section Length	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
15,000 feet	5	92	742	74	1.11	1.90	6.54	6	0.38	0.11

[1] Assumes 80% of locations can be improved.
[2] Assumes an average cost of $11,000 per section.
[3] A CMF of 0.95 is used.

The basic steps and schedule to implement this initiative are as follows:

Rural Highways 22 Ft. or Greater in Width Highway Sections with Head-on and Opposing Flow Crashes at or Above the Crash Threshold

1. Gain management acceptance of the Roadway Departure Safety Implementation Plan.
2. Traffic Headquarters will develop guidelines and a standard template treatment for centerline rumble strips that are at or above the threshold in the above tables. The guidelines will be issued to District personnel for implementation. Note that the guidance will provide a process to consider the treatment and funding alternatives for providing centerline rumble strips on the entire or major portion of the route. The guidelines will also address pavement condition: if the pavement is old and deteriorated (at least 5 years old) or showing signs of

visible distress, the application of centerline rumble strips may be deferred and incorporated into the next overlay of the section.

Schedule: Guidelines issued within 6 months of acceptance of the Plan.

3. District personnel will use the guidelines and template(s) to field review each identified highway section with crashes and determine the appropriateness of installing centerline rumble strips now or deferring until the next overlay. District personnel will assemble a District wide or county wide contract plans to implement the improvements.

   Schedule: Centerline rumble strip locations within the District on rural State highways 22 ft. or wider are finalized within 12 months of acceptance of the Plan.

4. Contracts will be let and improvements will be implemented.

   Schedule: Centerline rumble strips in place within 30 months of acceptance of the Plan.

Centerline Rumble Strips on Rural Highways between 20 and 22 Feet Wide

5. Gain management acceptance of the Roadway Departure Safety Implementation Plan.

6. The Safety Office, in conjunction with the Design Office, will develop guidelines and a standard template treatment for centerline rumble strips to be installed at locations meeting the threshold in the above table. The guidelines will be issued to region personnel for implementation. Note that the guidance will provide a process to consider the treatment and funding alternatives for providing centerline rumble strips on the entire route or a major portion of the route.

   a. The guidelines will also address pavement condition. If the pavement is old and deteriorated (e.g., approximately 5 years old or more) or showing signs of visible distress, the application of centerline rumble strips may be deferred and incorporated into the next overlay of the section.

   Schedule: Guidelines issued within 6 months of acceptance of the Plan.

7. Region personnel will use the guidelines and template(s) to field review each identified highway section with crashes to determine the appropriateness of installing centerline rumble strips now or deferring until the next overlay. Region personnel will assemble a region-wide or county-wide contract plans to implement the improvements.

   Schedule: Centerline rumble strip locations within the region on rural State highways are finalized within 12 months of acceptance of the Plan.

8. Contracts will be let and improvements will be implemented.

   Schedule: Centerline rumble strips in place within 30 months of acceptance of the Plan.

Edge Line Rumble Stripes and Shoulder Rumble Strips to Reduce Road Departure Crashes

Edge line and shoulder rumble strips will be implemented under two scenarios as follows:

1. Systematic deployment of edge line rumble stripes or shoulder strips will be considered on 55 MPH two- and multi-lane rural highways with a width of 22 ft. or wider and possessing a crash threshold of at least five or more single vehicle roadway departure crashes in a 3,000 ft. stretch of roadway in the past 5 years. If a paved shoulder is available, at least 4 ft. in width and in good structural condition, shoulder rumble strips should be considered; otherwise, edge line rumble stripes should be used.
2. Pilot evaluation of deploying edge line rumble stripes on 45-50 MPH two- and multi-lane rural highways with a width of 22 ft. or wider and possessing a crash threshold of at least five or more single vehicle roadway departure crashes in a 3,000 ft. stretch of roadway in the past 5 years.

The summary of high-crash, single vehicle sections where edge line and shoulder rumble strips are to be considered for installation are summarized in Table 15. The actual locations of these sections reside in the Office of Traffic Operations.

Table 15: Summary of Edge Line Rumble Stripe and Shoulder Rumble Strip Deployments (2004-2008)

Section Length (3,000 ft)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
2 lanes, < 4 foot paved shoulder (Edge Line Rumble Strips)	5	1,810	13,164	1,086	4.34	2.26	6.99	458	32.0	10.35
2 lanes, ≥ 4 foot paved shoulder (Shoulder Rumble Strips)	5	496	3,583	397	1.58	1.92	6.25	166	10.4	3.18
Total	-	2,306	16,747	1,483	5.92	4.18	13.24	624	42.4	13.53

[1] For edge line rumble stripes, assumes 60% of locations can be improved. For shoulder rumble strips, assumes 80% of locations can be improved.
[2] Assumes an average cost of $4,000 per section.
[3] A CMF of 0.71 is used.

The basic steps and schedule to implement this initiative are as follows:

1. Gain management acceptance of the Roadway Departure Safety Implementation Plan.
2. Traffic Headquarters will develop guidelines and a standard template treatment for edge line rumble stripes and shoulder rumble strips to apply on highway sections that are at or above the threshold in the above tables and issue the guidelines and template to District personnel for implementation. Note that the guidance will provide a process to consider the treatment and funding alternatives for considering the application of edge line rumble stripes and shoulder rumble strips on the entire route rather than on just those sections of the route that are at or above the crash threshold. The guidelines will also address pavement condition: if the pavement is old and deteriorated (at least 5 years old) or showing signs of visible distress, the application of rumble strips may be deferred and incorporated into the next overlay of the section. The guidelines will also consider applications in areas with concentrations of residences that are close to the highway where noise could become a significant concern. In addition, if the section is part of a designated bicycle route or has significant bicycle activity, edge line rumble stripes and shoulder rumble strips will be further evaluated to determine the appropriateness of applying rumble stripes or strips.

   Schedule: Guidelines issued within 6 months of acceptance of the Plan.
3. District personnel will use guidelines and template(s) to field review each identified highway section with crashes and determine appropriateness of installing edge line rumble stripes or shoulder rumble strips now or deferring until the next overlay. District personnel will assemble District wide or county wide contract plans to implement the improvements.

   Schedule: Sections and routes identified for edge line rumble stripes or shoulder installations identified within 12 months of acceptance of the Plan.
4. Contracts will be let and improvements will be implemented.

   Schedule: All identified edge line/shoulder rumble strip sections and routes implemented within 30 months of acceptance of the Plan.

Select Tree Removal in Rural Areas to Reduce Future Tree Crash Occurrences

The fixed object associated with the greatest number of roadway departure fatalities is trees. Most of these fatalities occur in rural areas. One of the challenges associated with this initiative is that tree removal alone may not be the sole low-cost countermeasure that needs to be implemented; removal or relocation of other vulnerable fixed objects also needs to be considered. In addition, many vulnerable trees may be located beyond the ditch line and on private property. Processes need to be developed to work with the property owner to allow for removal (or replace the tree at a less vulnerable location or with more crash-impact-friendly shrubbery). In addition, some sections with high numbers of tree crashes will not be suitable for tree removal, and alternate countermeasures such as edge line rumble strips or delineation may be considered to reduce the likelihood of tree collisions.

A hierarchy of questions that need asked in identifying the appropriate countermeasure to reduce future tree crashes is as follows:

- Should/can the tree be removed?
- If the answer is yes, are there other improvements needed to improve the safety of the section such as removing other vulnerable fixed objects and minor re-grading?

- Also, if the tree is off the right of way, can arrangements be made to accommodate the property owner to have the tree removed?
- If the tree can't be removed, would shielding result in a significant safety benefit? If shielding will not substantially improve safety, can other alternatives such as applying edge line rumble strips and wrapping delineation around the tree reduce the potential for future tree crashes?

The number of sections, crash threshold, costs, and safety impact of this initiative is provided in Table 16.

Table 16: Tree Removal/Safety Enhancements – Tree Crashes (Any Harmful Event) – State Rural Roads (2004-2008)

Section Length	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
3,000 feet	4	192	1,039	154	3.85	4.42	10.32	83	8.6	3.67

[1] Assumes 80% of locations can be improved by tree removal, other improvements to reduce roadway departure frequencies in the vicinity of the struck trees, or reduced speed to reduce severity. A field review will be needed to determine the appropriate countermeasure.

[2] Assumes an average cost of $25,000 per section.

[3] An average CMF of 0.50 is used as an overall average for all possible tree countermeasures.

The basic steps and schedule to implement this initiative are as follows:

1. Gain management acceptance to the Roadway Departure Safety Implementation Plan.
2. Traffic Headquarters will develop guidelines and a standard template treatment for tree removal/treatments and issue them to District personnel for implementation. Note that the guidance will provide a process to consider removal of trees both within and beyond right-of-way limits; property owner considerations; other complementary roadway departure countermeasures such as the removal of other fixed objects adjacent to the trees and minor re-grading to create a clear zone; identification and options for considering environmental and historical factors associated with the vulnerable trees; and a set of alternate countermeasures including edge line rumble strips and tree delineation to reduce the likelihood of tree crashes should the tree not be removed.

   Schedule: *Guidelines issued within 9 months of acceptance of the Plan.*

3. District personnel will use guidelines and template(s) to field review each identified tree section with crashes and determine appropriate tree removal or mitigation improvements. District personnel will assemble District wide or county wide contract plans to implement the improvements.

   Schedule: Improvement sets identified for all identified sections within 18 months of acceptance of the Plan

4. Contracts will be let and improvements will be implemented.

Schedule: All identified improvements implemented within 36 months of acceptance of the Plan.

Comprehensive Education, Enforcement, and Engineering (3-E) Improvements

This initiative involves a three pronged approach involving the actions summarized below.

A. Targeted Corridor Education and Enforcement (No or Very Minor Infrastructure Improvements)

This initiative combines education and enforcement actions on corridors stretching 5-miles in length that have high concentrations of roadway departure crashes involving speeding and unbelted drivers and roadway departure crashes involving alcohol.

The data was analyzed to identify 9,000-ft. sections of highway that have concentrations of speed or unbelted driver crashes both on and off the Interstate as well as concentrations of alcohol-related crashes. The speed and unbelted driver crashes were combined because the enforcement tactics to impact these types of violations are complementary. Alcohol-related crashes are concentrated in the late evening-early morning hours and the enforcement tactics emphasize sobriety checkpoints. Therefore, the alcohol enforcement sections were separated from the other enforcement sections. Summaries of the targeted sections for education and enforcement are provided in Tables 17 through 19.

Table 17: Enhanced Corridor Enforcement – Roadway Departure Crashes – Speed-Related or Unbelted Driver – State Roads – Interstates (2004-2008)

Section Length (9,000 ft)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
State Rural	15	13	241	10	0.3	4.98	7.30	6	.44	.30
State Urban	30	13	558	10	0.3	2.31	6.65	13	.86	.30
Total	-	-	-	20	0.6	-	-	19	1.30	0.60

[1] Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced enforcement (at least 10 hours per week of highly visible active enforcement per section).

[2] Assumes an average annual enforcement cost of $30,000 per section.

[3] A CMF of 0.85 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from speed and safety belt enforcement effectiveness information in NHTSA's *Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices* (http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf).

Table 18: Enhanced Corridor Enforcement – Roadway Departure Crashes – Speed-Related or Unbelted Driver – Not Interstates (2004-2008)

Section Length (9,000 ft)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
State Rural	10	115	1,608	92	2.76	7.10	11.64	38	4.4	2.70
State Urban	20	22	638	17	0.51	3.77	8.76	15	1.3	0.57
Local	20	-	-	-	-	2.07	5.65	-	-	-
Total	-	-	-	109	3.27	-	-	53	5.7	3.07

[1] Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced enforcement (at least 10 hours per week of highly visible active enforcement per section).

[2] Assumes an average annual enforcement cost of $30,000 per section.

[3] A CMF of 0.85 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from speed and safety belt enforcement effectiveness information in NHTSA's *Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices* (http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf).

Table 19: Enhanced Corridor Enforcement – Roadway Departure Crashes – Alcohol-Related – State Roads (2004-2008)

Section Length (9,000 ft)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
State Rural	7	119	1037	99	2.97	7.27	11.97	33	3.95	2.40
State Urban	10	27	368	20	0.6	3.57	8.75	12	1.05	0.43
Local	10	5	79	4	0.24	3.04	7.79	3	.02	.01
Total	-	-	-	123	3.81	-	-	38	5.02	2.84

[1] Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced alcohol enforcement (i.e., sobriety checkpoints).

[2] Assumes an average annual enforcement cost of $30,000 per section.

[3] A CMF of 0.80 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from sobriety checkpoint effectiveness information in NHTSA's *Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices* (http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf).

The crash data has identified XX Interstate and XXX non-Interstate sections of highway of 9,000 ft. in length that have high concentrations of speed-related or unbelted injury crashes. In addition, XXX sections with high concentrations of alcohol-related roadway departure crashes have been

identified. This effort involves inviting representative of the police personnel responsible for enforcement along these sections to initiate a coordinated education and enforcement approach by using a combination of targeted education and highly visible enforcement strategies. The objective of the effort is to reduce roadway departure fatalities on these sections by a minimum of XX percent. Some minor infrastructure improvements to provide roadside areas where enforcement personnel can safely pull cited drivers off the highway may also be needed. The effort begins with a preliminary meeting with the Governor's Highway Safety Representative to determine potential sources of revenue to finance the initiative. Following funding source analyses, meetings are arranged with appropriate police organizations responsible for enforcement along the identified sections of highway to determine interest in initiating a comprehensive education and enforcement initiative to reduce the number of future speed- and alcohol-related crashes and the number of drivers and occupants that have been severely injured or killed because they weren't buckled up.

Key Steps for Implementing Education and Enforcement Safety Corridors

Phase 1 – Preparatory

1. Perform an analysis of the crash data along the corridor to identify crash patterns that can be addressed by targeted education or enforcement actions.
2. Determine if there are safety grants that could be used to improve safety along the corridor and if adjustments to these grants should be considered to reduce the potential for future roadway departure crashes through an increase in targeted enforcement in the corridor.

Phase II – Meet with Appropriate Police Personnel

1. Arrange a meeting with police responsible for enforcement on the corridors.
2. Apprise the police of the concentration of targeted driver-related crashes on the candidate corridors.
3. Request a written commitment to enhance enforcement on the identified corridors. Indicate that the STATE DOT will consider placing special "targeted enforcement" signing on the corridor if a written commitment of at least 10 to 15 hours of visible and active enforcement directed at the driver violations cited in the targeted crashes is provided on the corridor.
4. Advise the meeting participants, if a written commitment for enforcement will be provided, that the data and the increased enforcement should be shared with the media in a joint press conference.
5. Collectively agree on an initial set of corridors on which to implement the enforcement measures, develop a coordinated strategy and schedule to announce the information to the media, and begin visible enforcement. Also, agree on an education component to apprise motorists of the increased targeted enforcement on the corridor, including the potential to install targeted enforcement signs. Agree to a 6 to 12 month follow-up meeting to evaluate the impact of the initiative and determine whether further actions are needed and if the initiative should be expanded to remaining corridors.

Phase III – Implementation

1. Meet with magistrates or District justices who have jurisdiction over the selected traffic corridor, explain the driver safety crash concerns on the corridor, and ask for their input and cooperation when visible enforcement begins.
2. Install the targeted enforcement corridor signs if appropriate.
3. Begin visible enforcement.
4. Hold a joint DOT/police press event for the corridor.
5. Periodically meet with police and magistrates to monitor enforcement levels and obtain any insight from police on observed changes in driving habits as a result of the added enforcement and signing. If anything newsworthy results, provide a press release.

Phase IV – Evaluation

1. After a full year of crash data becomes available, perform a "before and after" comparison of crashes on the corridor that may indicate a change in targeted crashes that the enforcement has reduced (e.g., alcohol, speeding, unbelted) in the "after" period to the crash statistics from the "before" period.[1] Continue monitoring until 3 years of "after" period data are available for analysis, and then complete a before/after study.
2. Potentially include a "before and after" comparison of speed distributions and a safety belt survey to determine if high-end speeding is being reduced and if more people are buckling up on the route.
3. Meet with the police, share the evaluation information, and make a determination as to whether the initiative should be expanded to the remaining corridors.
4. Methodology as outlined in Chapter 9 of the Highway Safety Manual (HSM) should be used for the assessment of safety changes related to the countermeasures applied. It can also help influence future decisions related to funding of these suggested countermeasures (see chapter 7 of HSM).

Table 20: Key Implementation Steps for Roadway Departure Education and Enforcement Strategies (2004-2008)

Step	Organization Responsible for Step	Schedule
1. Phase 1. Review the corridors, meet with the Governor's Safety Representative, identify potential grant opportunities for education and enforcement initiatives in the five areas.	Traffic Engineering Division, Governors Safety Representative	2 months
2. Determine the level of 402 funding that may be available to fund the initiative; also explore the use of other funding sources should a shortfall exist.	Traffic Engineering Division, Governors Safety Representative	4 months

[1] Note that a single year of crash data in the "after" period will not provide enough information for statistically significant analysis.

Step	Organization Responsible for Step	Schedule
3. Finalize funds available and select corridors to consider for heightened enforcement.	Traffic Engineering Division, Governors Safety Representative	6 months
2. Phase 2. Meet with State and Local Police in selected corridors, gain commitments, and finalize the initial set of corridors.	Traffic Engineering Division, Governors Safety Representative	6 months
3. Phase 3. Implement the education and enforcement initiative on designated corridors.	Traffic Engineering Division, Governors Safety Representative, State and local police	33 months
4. Phase 4. Evaluate the results, take any lessons learned, and make a decision to expand, expand with modifications, or terminate education and enforcement. Reference the Highway Safety Manual for valid designs and statistical techniques for conducting these evaluations.	Traffic Engineering Division, Governors Safety Representative, Highway Safety Executive Committee	36 months
5. If decision is to expand or expand with modifications, proceed with Phase 1 through 4 for additional corridors.	Traffic Engineering Division, Safety, Governors Representative	39 months

B. Targeted 3-E Engineering, Education, and Enforcement for Corridors

Table 21 identifies 5-mile long corridors with the highest concentrations of severe roadway departure crashes that are candidates for combined education, enforcement, and engineering initiatives.

Table 21: Candidate Corridors for 3-E (Engineering, Education, Enforcement) Initiatives (2004-2008)

County Name	Route Name	Number of Roadway Departure Fatalities	Number of RD Incapacitating Injury Crashes	Total Roadway Departure Crashes
Johnson	US 555	17	38	262
Emerson	ST 867	14	11	187
Jefferson	ST 5309	13	40	525
Hickory	US 16	9	19	162
Hammer	ST 5	9	6	158
Washington	CR 54	9	15	185
Cobain	ST 85	9	11	166
Hazard	US 14	9	9	173
Marshall	US 54	9	10	238
Mathers	ST 212	9	15	174

The crash data has identified XX State route corridors that have had X or more roadway departure fatalities over the past 5 years. The intent of this objective is to advance a set of 3-E initiatives on three of these corridors to reduce the potential for future severe roadway departure crashes. For

each of the corridors, this initiative will have as its objective a reduction in corridor roadway departure fatalities and severe injuries by a minimum of 25 percent using a combination of low-cost infrastructure improvements coupled with targeted education and enforcement initiatives. While the selection of the corridor has been based upon high frequencies of severe roadway departure crashes, the approach may be broader and encompass other corridor concerns such as intersections, mid-block pedestrian problems, and driver behavioral problems, including driving while intoxicated, lack of safety belts, and speeding.

The effort begins with a thorough analysis of the crash characteristics in the corridor to better understand the problems that need to be addressed and relate the patterns to potential countermeasures. A multi-disciplinary team is then formed to review the crash analysis, discuss the safety problems on the corridor, jointly field review the corridor to gain personal and group consensus of the major safety issues, and collectively develop an overall set of 3-E countermeasures to improve safety on the corridor. After the countermeasures have been identified and approved by the agencies involved, staged and coordinated implementation of the recommendations begins. The team performs oversight and monitors the implementation activities to insure that substantive safety progress along the corridor is being made.

A pilot effort of three corridors will be initiated first. The pilot will be evaluated by the Executive Committee for Highway Safety, and, if considered beneficial, will be expanded to the remaining corridors incorporating lessons learned from the pilot.

The goal of the corridor safety study is to reduce fatal and disabling injury crashes on designated high-volume arterials exhibiting high frequencies of severe crashes using low-cost, near-term solutions combined with highly visible enforcement, education, and emergency medical service initiatives.

Corridor safety studies are usually conducted using a team approach. The corridor team is normally comprised of at least the following representatives:

- District Traffic and Safety Engineer.
- District Press Officer.
- District Maintenance Manager or designee.
- Representative of State or local police responsible for enforcement on the corridor.
- Local government representative.

Additional team members may also include the Local Emergency Medical Services (EMS) coordinator, a Metropolitan Planning Organization (MPO) representative, and a highway design representative.

Once a corridor has been identified for a study, the District Traffic or Safety Engineer should perform an analysis of the crash data along the corridor to identify crash patterns that can be addressed by low-cost countermeasures and education/enforcement actions. All cluster lists need to be reviewed to identify specific locations within the corridor that appear on one or more of the cluster lists.

After the crash analysis is completed, the corridor safety team is convened to review and discuss the crash analysis, findings, and safety concerns along the corridor from each member's perspective. The team then conducts a field review of the corridor, usually in one or two vehicles, to assess areas of concern defined from the crash analysis and team discussions. The team then reconvenes and

reaches consensus on a set of countermeasures and initiatives that have strong potential to reduce future severe crashes.

The District Traffic and Safety Engineer and the District Press Officer take the results of the team field review meeting and prepare a cost estimate and an assessment of the probable safety impacts and cost effectiveness of implementing the recommended improvements. A brief report and tentative implementation schedule are prepared and used for programming cost-effective improvements.

Table 22: Key Implementation Steps for 3-E Corridor Enhancements

Step	Organization Responsible for Step	Schedule
1. Review 10 corridors and select three of the corridors to pilot and lead the implementation.	Traffic Engineering Division, Governors safety rep, District Traffic and Safety Engineers	3 months
2. Analyze data for the corridors selected, investigating all major crash patterns, and prepare a report of findings.	Traffic Engineering Division, Governors safety rep, Regional and District Traffic and Safety Engineers	6 months
3. Select a multidisciplinary team for each corridor to determine actions to reduce future crashes.	District Traffic and Safety Engineer	8 months
4. Hold meeting of multi-disciplinary teams, complete field reviews of corridors, identify set of comprehensive 3E improvements, and prepare brief corridor reports summarizing actions and improvements proposed to reduce future fatalities. As part of the report, estimated costs and schedules are also prepared.	Multi-disciplinary Team	12 months
5. Agencies approve the report, including approving their role as defined in the report.	Affected Organizations	14 months
6. Begin implementing report, including education and enforcement activities, and developing and letting contract to implement infrastructure improvements.	Affected Organizations	30 months
7. Evaluate corridor approach, take any lessons learned, and make a decision to expand, expand with modifications, or terminate corridor safety approach.	Highway Safety Executive Committee	42 months
8. If decision is to expand or expand with modifications, proceed with steps 2 through 7 for additional corridors.	Traffic Safety Unit, Governors safety rep, Regional and Division Safety Engineers	48 months

C. Targeted Engineering, Education, and Enforcement for Cities

Combined education, enforcement, and engineering initiatives in municipalities which have the highest frequencies of roadway departure crashes.

Table 23: Summary of Roadway Departure Crashes by Major City (2004-2008)

City Name	Number of Roadway Departure Fatalities	Number of Roadway Departure Incapacitating Injury Crashes	Total Roadway Departure Crashes
Youngstown	160	595	11,688
Bree	66	247	7,501
Old New York	58	176	2,385
New Amsterdam	55	114	3,307

The crash data has identified the four cities that have the largest number of roadway departure fatalities. Targeting 3-E for cities involves inviting one large and one mid-size to initiate an area-wide 3E approach. The objective of the effort is to reduce city roadway departure fatalities by a minimum of 10 percent using a combination of low-cost infrastructure improvements coupled with targeted education and enforcement strategies that extend beyond those that may be implemented in other systematic countermeasure deployments.

The effort begins with a preliminary meeting with city officials to determine interest in initiating a comprehensive roadway departure safety initiative. If interested, a thorough "clean up" of the crash data for roadway departure crashes on State and local roads within the urban area is completed such that clusters of crashes can be accurately combined. After the data is cleaned, a thorough analysis of the characteristics of crashes in the city is performed with the goal of understanding the problems that need to be addressed and relating the patterns to potential countermeasures. A city-wide, multi-disciplinary team is then formed to review the crash analysis, discuss the roadway departure safety problems in the city, jointly field review the selected problem areas to gain personal and group consensus of the major safety issues, and collectively develop an overall set of 3-E countermeasures to improve safety in the city. After the countermeasures have been identified and approved by the agencies involved, staged and coordinated implementation of the recommendations begins. The team performs oversight and monitors the implementation activities to insure that substantive safety progress is being made.

Table 24: Key Implementation Steps for Roadway Departure City-Wide 3E Improvements

Step	Organization Responsible for Step	Schedule
1. Review the cities and select candidates	Traffic Engineering Division, Governors Safety Representative	2 months
2. Contact selected cities and determine interest. If not interested, go to next candidate city. Finalize pilot cities.	Traffic Engineering Unit, Governors Safety Representative	6 months
3. Analyze crash data for pilot cities, investigating all major roadway departure crash patterns and prepare a brief report of findings.	Traffic Engineering Division, Governors Safety Representative	10 months

Step	Organization Responsible for Step	Schedule
4. Select a multi-disciplinary team in each selected city to determine actions to reduce future crashes.	Traffic Engineering Division, District Traffic Engineer, Governors Representative and city police, planning, and traffic engineering representatives	12 months
5. Hold a meeting of the multi-disciplinary team, complete field reviews of problem and typical roadway departure locations, identify set of comprehensive 3E improvements, prepare a city set of countermeasures and improvements proposed to reduce future roadway departure fatalities by at least 10 percent. As part of the set of countermeasures, estimated costs and schedules are also prepared.	Multi-disciplinary Team	18 months
6. Agencies approve the set of countermeasures, including approval of their role as defined in the plan.	Affected Organizations	21 months
7. Implementation of countermeasures begins, including education and enforcement activities and development and letting of contract to implement infrastructure improvements.	Affected Organizations	40 months
8. Evaluate city comprehensive approach, take any lessons learned, and make a decision to expand, expand with modifications, or terminate city comprehensive safety approach.	Traffic Engineering Unit, Governors Safety Representative	44 months
9. If decision is to expand or expand with modifications, proceed with steps 2 through 9 for additional cities.	Traffic Engineering Unit, Safety, Governors Representative	48 months

Deployment of Traditional Roadway Departure Countermeasures

Currently roadway departure improvements are generated within the HSIP program by identifying and studying crash locations that have high crash rankings. Two initiatives will be undertaken within the traditional roadway departure program as follows:

- In addition to candidate locations generated from the existing formulae, other potential roadway departure-specific improvement types under the traditional program are as follows:
    a. Median barriers or other improvements on full access control highways with remaining head-on and opposing-flow crashes (see Table 25).
    b. High friction surfaces on high-speed highways with wet pavement crashes or highway sections that require higher friction values.

A summary of the scope of these deployments and set of key steps needed to implement each of these initiatives effectively is included in Tables 26 through 28.

Table 25: Median Barrier – Head-On and Sideswipe, Opposite Direction Crashes – Raised Mountable, Flush, and Depressed Median Types – State Rural Roads (2004-2008)

Section Length (6,000 ft)	Threshold Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
State Rural Roads	2	61	161	49	5.88	11.68	11.11	26	2.9	3.04

[1] Assumes 80% of locations can be improved.

[2] Assumes an average cost of $120,000 per section.

[3] A CMF of 0.20 in terms of Incapacitating Injury Crashes and fatalities is used.

Table 26: Key Steps to Consider Median Enhancements to Reduce Head-On and Opposing Side-Swipe Crashes on Restricted Access High-Speed Highways

Step	Organization Responsible for Step	Schedule
1. Review each of the identified highway sections to determine the appropriateness of installing weak post-median barrier. If not appropriate (some flushed narrow paved medians may not be appropriate), consider edge line rumble strips on the median side to reduce frequency of crossovers.	District Traffic Engineer	6 months
2. Select improvements from field reviews and program.	District Traffic Engineer	9 months
3. Design and let contracts for construction.	District Office	18 months
4. Let projects are completed and opened to traffic.	District Office	36 months

Table 27: High Friction Surfaces – Roadway Departure Crashes – Wet – State Rural Roads (2004-2008)

Section Length	Threshold Crash Level (5 Years) [1]	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [2]	Construction Costs ($ Million) [3]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [4]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
3,000 feet	8	227	2,847	159	6.81	1.09	4.15	200	8.3	2.18

[1] Also need a wet to total crash ratio of at least 0.35 (average 0.22) and a skid number of 30 or less.

[2] Assumes 70% of locations will be tested below a skid number of 30 and can be improved.

[3] Assumes an average cost of $30,000 per section.

[4] A CMF of 0.50 is used.

Table 28: Key Steps to Consider Median Enhancements To Reduce Head-On and Opposing Side-Swipe Crashes on Restricted Access High-Speed Highways

Step	Organization Responsible for Step	Schedule
1. Develop guidelines for the use of micro-textures, epoxies, and other high-friction surfaces to be applied on sections of highway with high incidences of wet pavement crashes. Also establish guidelines for including cross section improvements if severe wheel rutting exists.	District Traffic Engineering, Maintenance, and Design Divisions	6 months
2. Arrange for skid tests to be conducted to determine if the skid number is below existing levels for adequate friction.	District Traffic Engineer	9 months
3. Field review each of the identified highway sections which have skid numbers below established levels to determine the appropriateness of installing a high friction courser and the limits of improvement. Identify the skid treatment type based upon the guidelines issued and estimate costs.	District Traffic Engineer	12-18 months
4. Compile District wide skid candidate improvement selection and program improvements	District Traffic Engineer	18 months
5. Once programmed, design and let District or area wide contracts for construction.	District Office	30 months
6. Let projects are completed and opened to traffic.	District Office	42 months

Roadway Departure Countermeasures on Local Roads

Only one roadway departure countermeasure will be pursued on local roads at this time: sign and marking enhancements on local road curves. Centerline and edge line rumble strips on local roads may be pursued at a later date depending on the success of the local curve signing program and the success of the centerline/edge line rumble strip program on State roads. Since local roads do not have a referencing system, candidate local roads for curve sign and marking enhancements was based upon the total number of curve crashes on each local road. Only those local roads that have three or more crashes per mile during the study period will be considered for further analysis.

The summary of local roads that meet these criteria is as follows:

Table 29: Enhanced Signs and Markings for Curves – Curve Roadway Departure Crashes – Local Roads (2004-2008)

Section Length (3,000 ft)	Threshold Curve Crash Level (5 Years)	Number of Local Roads	Number of Targeted 5 Year Crashes on Local Roads	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Incapacitating Injury Crashes per 100 Crashes	Fatalities per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
Curve Crashes	5	189	1,833	151	1.51	4.43	1.01	88	3.9	0.89

[1] Assumes 80% of curves can be improved.

[2] Assumes an average cost of $10,000 per local road (multiple curves on each local road to be improved)

[3] Assumes 80% of curve crashes occur on curves to be improved by sign and markings. A CMF of 0.70 is used (oversized, left, and right fluorescent yellow, advance warning signs; chevrons; slow and XX mph pavement markings; center and edge lines).

Thus there are XXX local road candidates for curve sign and marking enhancements. It is assumed that either the District Traffic Engineer or a trained LTAP safety engineer will perform the analysis on each of these roads. The analysis will first attempt to locate the curve crashes to specific curves on the local road. Only those curves which have X or X or more curve crashes in five years will be considered for improvements. The improvements will be equivalent to the same type of sign and marking improvement on state highways.

Key Implementation Steps

The key steps necessary to implement this initiative and realize the safety benefits of the improvements, organizations responsible for each key step, and the schedule to fully implement this activity are shown in Table 30.

Table 30: Key Implementation Steps for Basic Set of Sign and Marking Improvements – Local Curves

Step	Organization Responsible for Step	Schedule
1. Determine if Local Road Curve Assessment is to be conducted by District Traffic Engineer or LTAP coordinator	Traffic Division District Traffic Engineers	2 months
2. If decision is to use LTAP coordinator, adjust LTAP scope of work and contract to conduct necessary work. Train LTAP Safety Coordinator to analyze curves for improvement. Utilize same threshold levels and sign/pavement marking enhancements for state curves for local curves	Traffic Division, District Traffic Engineers	6 months
3. Determine if federal safety funds will be used to implement improvements. If so, update processes if needed for this type of work.	Traffic Division	8 months
4. Develop a template, guidelines and requirements for processes for use of Federal safety funds on local curves	Traffic Division	8 months

Step	Organization Responsible for Step	Schedule
5. Perform an assessment of each identified local road with five or more curves and identify sets of improvements.	District Traffic Engineer or LTAP Safety Engineer	14 months
6. Assemble curve improvements into a contract package. Execute necessary agreements with local governments. Let District-wide or county-wide local curve sign and marking contracts.	Districts	18 months
7. Complete curve sign and marking improvements	Districts	30 months
8. Assess success of local curve initiative and edge line / centerline rumble strip program on State highways. Based upon assessment, make a decision to expand edge, centerline rumble strips onto local roads.	Traffic Division	36 months

Incorporation of Low-Cost, Cost-Effective Countermeasures at Crash Locations within the Limits of Work for Programmed Projects

A considerable number of project types are implemented throughout the state. Within the contract limits of some these projects, high-crash sections exist where cost-effective, low-cost countermeasures may be considered for incorporation into the project to reduce the potential for future crashes. This initiative is to develop and implement a process to identify programmed projects that have crash histories within the geographic location of the project and determine if low-cost, cost-effective safety improvements should be incorporated into the project to reduce the potential of future crashes.

There are a number of issues that need to be addressed for this initiative to be successful, including:

1. **Type of project on which to consider incorporating the low-cost safety countermeasures** – Reconstruction projects will probably address most of the safety issues that low-cost countermeasures are designed to address. Specialty project types such as transportation enhancements may not be appropriate to consider for incorporating low-cost safety measures (except if the project has landscaping, tree, and shrubbery improvements). Bridge projects are usually limited to the bridge itself and may restrict the potential to incorporate these countermeasures into them. Resurfacing and 3-R projects offer the greatest opportunity for incorporation of low cost countermeasures since the primary improvement is normally limited to providing a smooth and structurally sound surface.
2. **Type of low-cost countermeasures to consider for incorporation into projects** – The predominant low-cost countermeasures that need to be considered for inclusion in programmed projects should meet the minimum crash thresholds defined for the systematic low-cost countermeasure initiative and include the following:
    a. Shoulder or edge line rumble strips in rural areas.
    b. Centerline rumble strips in rural areas.
    c. Tree removal in rural areas.

d. Use of the safety edge under the following conditions: at the edge of pavement if a non-paved shoulder is specified, at the outer edge of a paved shoulder, and during construction if a lift exceeding 2 inches will be open to traffic for a period of time.

e. Use of an micro-texture or similar high skid surface on sections which have X or more wet pavement crashes within a 3,000 foot section, a wet/total crash ratio above 22 percent, and a pavement cross section that is relatively flat, susceptible to accumulating water, and would not be corrected by the pavement overlay.

3. **Funding** – The method to finance safety improvements needs to be clarified within the state. The two basic options are to fund the safety as part of the existing project funding or fund the safety portion with HSIP funding.

4. **Process** – The process by which low-cost, cost-effective safety countermeasures are to be considered and included in other projects needs to be developed between the divisions involved. Some of the questions that need to be addressed include the following:

   a. When in the design development stage should the consideration be given?

   b. Who should identify projects that have crash histories above the threshold? Who will perform the analyses to determine the appropriate countermeasure?

   c. Who will make the decision to include or exclude?

   d. What can be done to easily and efficiently incorporate designated low cost improvements into the plan?

Key Implementation Steps

The key steps needed to effectively consider the initiative are shown in Table 31.

Table 31: Key Implementation Steps for Considering the Inclusion of Low-Cost, Cost-Effective Countermeasures in Other Programmed Projects

Step	Organization Responsible for Step	Completion Date (Months After Implementation Plan Acceptance)
1. Finalize a list of issues that need to be addressed to consider inclusion of low-cost, cost-effective countermeasures in other projects.	Traffic Division	4 months
2. Establish a meeting between the Design, Maintenance, and Traffic Engineering Divisions to further explore the inclusion of low-cost, cost-effective safety countermeasures into other projects, including discussing identified issues that need to be addressed.	Traffic Division	4 months
3. Hold a second meeting between the Divisions to reach consensus on a process to identify projects where low cost countermeasures should be considered for inclusion; mechanisms to fund justified safety elements to add to the project; and revisions to existing process to consider and incorporate safety elements efficiently into projects under design.	Traffic Division, Design, and Maintenance	6 months
4. Jointly develop an action plan to implement the results of the meeting.	Traffic Division, Design, and	8 months

Step	Organization Responsible for Step	Completion Date (Months After Implementation Plan Acceptance)
	Maintenance	
5. Adopt the action plan and begin implementation of the action plan.	Traffic Division, Design, and Maintenance	10 months
6. Evaluate effectiveness of Action Plan and modify as appropriate	Traffic Division, Design, and Maintenance	22 months

Deployment and Evaluation of New Roadway Departure Countermeasures

This initiative involves the limited and careful evaluation and potential deployment of new roadway departure countermeasures that offer the potential to reduce roadway departure crashes and fatalities beyond that which can be expected from existing countermeasures. One major roadway departure countermeasure has been identified that falls into this category: traffic calming to reduce high end speeds at selected rural sites.

THE STATE has minimal experience with the proposed new countermeasures. In addition, the actual effectiveness of rural traffic calming countermeasures has not been adequately validated. Nevertheless, rural traffic calming countermeasures fill gaps that the existing countermeasures cannot. STATE DOT will proceed cautiously with the deployment of these countermeasures to reduce risk of failure, concentrating initial deployment on those sections with high numbers of roadway departure crashes that the countermeasure is designated to impact. A brief evaluation/ implementation plan will be developed for the countermeasure that will include the limited deployment of an adequate number of improvements to identify implementation issues and any beneficial or adverse operational impacts. Any implementation issues or concerns identified from this initial deployment will be addressed and resolved before further implementation of the countermeasure is considered. Once all identified issues are resolved, sufficient additional improvements of the countermeasure will occur to improve the estimate of the effectiveness of the countermeasure in reducing targeted roadway departure crashes. When a better estimate of the effectiveness of the countermeasure is available, the countermeasure will be deployed cost effectively, depending upon the availability of funds and other priorities.

The extent to which traffic calming may be applied to the state's highways is provided in the following table, which identifies sections of roadway with high incidences of speed-related crashes.

Table 32: Infrastructure Traffic Calming Measures to Reduce Speeding-Related Crashes – State and Local Roads (2004-2008)

Locality and Section Length	Threshold Speeding Crash Level (5 Years)	Number of Sections	Number of Targeted 5 Year Crashes on Sections	Estimated Number of Improvements [1]	Construction Costs ($ Million) [2]	Fatalities per 100 Crashes	Incapacitating Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction [3]	Annual Estimated Incapacitating Injury Crash Reduction	Annual Estimated Fatality Reduction
Speeding Crashes (9000 ft) – State Rural Roads	15	68	1558	52	3.89	3.86	7.95	75	5.97	2.90
Speeding Crashes (9,000 ft) – State Urban Roads	15	53	1335	42	1.03	2.08	4.72	64	3.02	1.33
Speeding Crashes (9,000 ft) – Local Roads	15	6	142	5	013	2.07	5.65	7	0.39	0.15
Total	-	127	-	99	5.05	-	-	146	9.36	4.38

[1] Assumes 80% of locations can be improved by incorporating speed reduction traffic calming measures through pavement markings. No Interstate Highways included.

[2] Assumes an average cost of $25,000 per section.

[3] An average CMF of 0.70 is used as an overall average for all possible speed reduction measures.

Types of traffic calming may be found in FHWA Report HRT-08-067. In addition the use of peripheral transverse pavement markings on a continuous section rather than for a point specific location should be considered to reduce excessive speeds on throughout a section of roadway.

The key steps that need to be taken to consider these enhancements are as follows:

Table 33: Key Steps to Evaluate New Roadway Departure Countermeasures

Step	Organization Responsible for Step	Schedule
1. Review FHWA HRT-08-067 *Traffic Calming on Main Roads Through Rural Communities* and identify appropriate rural traffic calming measures to pilot.	Traffic Engineering Division,	9 months
2. Identify countermeasures, select sites for improvements, and prepare an evaluation plan for each of the selected new countermeasures.	Traffic Engineering Division, District Traffic	18 months
3. Install the countermeasures identified in the evaluation plans.	District Traffic Engineering	18-24 months
4. Evaluate the countermeasure and determine if use should be expanded, modified, or terminated.	Traffic Engineering Division, District Traffic Engineering, Highway Safety Executive Committee	24-42 months
5. If expanded, develop and provide guidance for further deployments.	Traffic Engineering Division	48 months

Performance Measures

Two types of performance measures are proposed:

1. Production performance measures that measure performance in implementing the products, processes, guidelines, and projects determined in the Plan that are needed to achieve the goal. These are described in Table 34.
2. Effectiveness performance measures the effectiveness of implemented countermeasures to reduce targeted crashes and compares actual to estimated effectiveness. These are show in Table 35, to be filled out by the State highway agency after implementation begins.

Production Performance Measures

Table 34: Production Performance Measures

Countermeasure or Action	Measure	Target Completion Date	Actual Completion
Systematic Improvements			
Curve sign enhancements – State, rural, and urban – systematic	980 curves	April 2012	Actual no. of curves
Curve sign and marking enhancements – State flashing beacons –systematic	14 curves	April 2012	Actual no. of curves
Centerline Rumble strips – systematic – 22 feet rural or greater	234 3-mile sections	October 2012	Actual centerline rumble strip miles
Centerline rumble strips – pilot – urban & 20-22 ft. rural roads	Pilot implemented	October 2012	Actual pilot completion date
Edge line / shoulder rumble strips (non-Interstate) – systematic – rural 55mph	1,200 0.6-mile sections	October 2012	Actual edge line / shoulder rumble strip miles
Edge rumble strips – pilot – 45-50mph rural highways	Pilot implemented	October 2012	Actual pilot completion date
Tree removal – systematic	164 0.6-mile sections	April 2013	Actual no. of tree crash sections treated
Incorporation of Low Cost, cost effective countermeasures at crash locations within the limits of work for programmed projects			
Action Plan to incorporate safety analysis results into other projects	Action Plan completed and implementation begins	October 2012	Actual Date
Implementation of Action Plan	% of other projects with crash histories incorporating safety treatments	At least 50% of resurfacing projects with crash histories incorporate low cost safety	Actual %
Comprehensive Education, Enforcement, and Engineering (3-E) Improvements			
3-E Targeted Engineering, Education, and Enforcement Corridors	3 Corridor Reports completed	October 2012	Actual Date

Countermeasure or Action	Measure	Target Completion Date	Actual Completion
3-E Targeted Engineering, Education, and Enforcement Corridors	3 Corridors Implemented and Evaluated	March 2013	Actual Date
3-E Targeted Engineering, Education, and Enforcement Cities	2 City Reports completed	March 2011	Actual Date
3-E Targeted Engineering, Education, and Enforcement Cities	2 Cities Implemented and Evaluated	October 2013	Actual Date
Traditional Roadway Departure Countermeasures			
Median Improvements to reduce cross median crashes – Traditional Program	32 miles of median sections with crashes protected from cross over crashes	January 2013	Actual Date
High friction surfaces for wet pavement crash sections – Traditional Improvements	100 low skid surfaces corrected	July 2013	Actual Date
New Roadway Departure Countermeasures			
Evaluation of rural traffic calming measures	Number of new (type) RD countermeasures being evaluated	Four new types under evaluation by March 2011	Actual number of different types under evaluation

Effectiveness Performance Measures– Program Effectiveness in Reducing Targeted Crashes

Table 35: Performance Measures

Countermeasure	Year Improvements Implemented	Year Evaluation Plan Developed	Year Evaluation Completed	Expected Crash Reduction	Actual Crash Reduction
Curve sign and marking enhancements – systematic					
Centerline Rumble strips – systematic					
Edge line / shoulder rumble strips (non-Interstate) – systematic					
Tree removal – systematic					
Resurfacing Projects with safety enhancements					
2-E Targeted Education and Enforcement Corridors					
3-E Targeted Engineering, Education, and Enforcement Corridors					
3-E Targeted Engineering, Education, and Enforcement Cities					
Median barrier					
High-friction surface					
New Traffic Calming Countermeasures					

This table is to be filled out by the State during implementation.

Summary

The number of roadway departure fatalities and incapacitating injuries within STATE can measurably decline over the next several years, but it will take a number of new and special actions, increased roadway departure safety emphasis, and additional funding to realize this benefit. The existing approach of emphasizing moderate- to high-cost improvements at high-crash roadway departure sections must be complemented with the deployment of a large number of low-cost, effective countermeasures and the use of a coordinated 3-E comprehensive approach on high-crash corridors and in municipalities that have a high number of roadway departure fatalities.

Recapping, the countermeasures, deployment levels, costs, and estimated lives saved needed to achieve the roadway departure safety goal are shown in Table 6. While the level and direction of effort is well beyond that currently being pursued for roadway departure safety, the expected outcome – preventing over XXXX crashes, nearly XXX incapacitating injury crashes, and more than XX fatalities annually on STATE'S highways – is worth the investment.