

## Roadway and Lane Departures Emphasis Area Strategies, Countermeasures and Action Plans

Strategy Number	Description
1	Analyze run-off-the-road and head-on crashes and roadway characteristics using the new safety methodologies (e.g., <i>Highway Safety Manual</i> and systemic approaches).
2	Keep vehicles from encroaching on the roadside or opposite lane.
3	Minimize the consequences of vehicles leaving the road.
4	Minimize the likelihood of crashing in adverse conditions.
5	Identify and address behavioral characteristics associated with roadway departure.
6	Improve emergency response time in rural areas.

## STRATEGY 1

Analyze run-off-the-road and head-on crashes and roadway characteristics using the new safety methodologies (e.g., *Highway Safety Manual* and systemic approaches).

### Countermeasure

Focus	Number	Description	Action Plan
<b>Improved data systems</b>	1A	Improve data systems for targeting locations with a high probability of roadway departure crashes by road type, geometric characteristics, vehicle type, and area type.	✓

## Improved Data Systems Countermeasure (1A) Action Plan

**Improve data systems for targeting locations with a high probability of roadway departure crashes by road type, geometric characteristics, vehicle type, and area type.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Identify critical information such as position prior to crash and position of point of impact to accurately identify roadway departure crashes and the actions that contributed to these crash types. (Participating organizations: Texas A&amp;M Transportation Institute [TTI], Texas Department of Transportation [TxDOT], Department of Public Safety [DPS], and law enforcement agencies)</li> <li>2. Enhance the standard crash report form (CR-3) reporting process by including the identified critical information. (Participating organizations: TxDOT and DPS)</li> <li>3. Provide training to peace officers about the additional information in the CR-3. (Participating organizations: TTI, TxDOT, DPS, and law enforcement agencies) Identify a list of roadway elements by road type and area type needed in order to use the methodologies documented in the standard manuals such as the <i>Texas Roadway Safety Design Handbook</i>, <i>Highway Safety Manual</i>, the Federal Highway Administration's (FHWA's) <i>Systemic Safety Project Selection Tool</i>, and <i>Roadside Design Guide</i>. (Participating organizations: TTI and TxDOT)</li> <li>4. Prepare a guidebook and provide training on how to collect additional roadway characteristics that are not in the existing databases but are needed for using the methodologies presented in the standard manuals. (Participating organizations: TTI, TxDOT, and city and county agencies)</li> <li>5. Prioritize the cities and counties and roadway types for identifying problematic areas (consider a pilot project). (Participating organizations: TTI and TxDOT)</li> <li>6. Collect roadway characteristics needed for using the methodologies. (Participating organizations: TxDOT and city and county agencies)</li> <li>7. Analyze data by using the advanced methods to identify priority locations by vehicle type. (Participating organizations: TTI and TxDOT)</li> <li>8. Disseminate data analysis results. (Participating organizations: TTI and TxDOT)</li> </ol>
Participating Organizations	See above for each step.
<b>Effectiveness</b>	***
<b>Cost to Implement</b>	\$\$\$
<b>Time to Implement</b>	Long (5+ years)
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Resistance to change the CR-3 reporting process.</li> <li>• Personnel needed to collect required roadway characteristics data.</li> <li>• Inconsistent results among various methodologies for prioritizing locations.</li> <li>• Funds to collect additional variables.</li> </ul>

## STRATEGY 2

Keep vehicles from encroaching on the roadside or opposite lane.

### Countermeasures

Focus	Number	Description	Action Plan
<b>Roadway configuration</b>	2A	Revise roadway configuration to provide additional paved recovery area (e.g., convert four-lane roadways to three-lane roadways with design features compatible with surrounding land use context).	
<b>Positive guidance</b>	2B	Provide additional positive guidance (i.e., rumble strips, stripe lines, raised pavement markings, chevrons including light-emitting diode [LED] chevrons, curve delineators, speed feedback signs, edge lines and centerlines, and wider edge lines), and conduct public information campaigns to explain the purpose and how to navigate the roadway safely.	✓
<b>Target speeds</b>	2C	Establish target speeds and use engineering techniques to manage speeds in areas experiencing or susceptible to roadway and lane departures.	
<b>Driver education</b>	2D	Educate drivers about driving around trucks (e.g., avoiding trucks).	

## Positive Guidance Countermeasure (2B) Action Plan

**Provide additional positive guidance (i.e., rumble strips, stripe lines, raised pavement markings, chevrons including LED chevrons, curve delineators, speed feedback signs, edge lines and centerlines, and wider edge lines), and conduct public information campaigns to explain the purpose and how to navigate the roadway safely.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Use safety screening methods to identify, prioritize, and select roadway segments where positive guidance devices may be effective in reducing roadway and lane departures. (Participating organizations: TxDOT and city and county agencies)</li> <li>2. Select countermeasures based on cost, time to implement, and barriers for selected roadway segments and public input. (Note: A comprehensive listing of potential countermeasures grouped by cost and time to implement with effectiveness measures is posted at <a href="http://www.texasshsp.com">www.texasshsp.com</a>.) Consider the needs of all users, including bicyclists and adjacent residents. (Participating organizations: transportation and law enforcement agencies, and public information officers)</li> <li>3. Program funds for implementing countermeasures or incorporating them into existing projects. (Participating organizations: TxDOT, city and county agencies, and metropolitan planning organizations [MPOs])</li> <li>4. Implement countermeasures in new and existing projects. (Participating organizations: transportation agencies at state, city, and county levels)</li> <li>5. Publicize countermeasures to build additional support for projects. (Participating organizations: media outlets, and principal investigators and staff at state, city, and county transportation agencies)</li> <li>6. Evaluate effectiveness. (Participating organizations: TxDOT and city and county agencies)</li> </ol> <p>Note: See page 10 for a resource listing.</p>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	Various, ranging from * to ***
<b>Cost to Implement</b>	Various, ranging from \$ to \$\$\$
<b>Time to Implement</b>	Various, ranging from short to long
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Adequate knowledge of screening methods.</li> <li>• Changing engineering practices about incorporating safety into projects and screening for existing issues.</li> <li>• Implementing countermeasures proactively before there is a problem.</li> <li>• Funding sources.</li> <li>• Providing for continuing maintenance.</li> </ul>

## DEFINITIONS FOR POSITIVE GUIDANCE COUNTERMEASURE (2B)

- **Reflective pavement marker:** The crash modification factor (CMF) ranges from a 33% reduction to a 43% increase in nighttime crashes—item 672 6006 is \$2.50 each, and item 672 6010 is \$3.00 each.
- **Edge lines:** Highway Safety Improvement Program (HSIP) Work Code (WC) 402 0.25, 2 years, CMF 8 reduction in all crash types with 11% to 13% reduction in run-off-the-road crashes—\$0.43 per linear foot.
- **Wide edge lines:** 6-inch CMF 12% to 37% reduction in all crash types—\$0.60 per linear foot.
- **Centerlines:** HSIP WC 404 0.65, 2 years, CMF crash reduction minimal but where placed in conjunction with edge lines, an approximately 24% reduction in all crash types—\$0.40 per linear foot.
- **Milled edge line rumble strips:** HSIP WC 532 0.5, 10 years—CMF 16% to 17% reduction for all crash types—item 533 6003 is \$0.15, and item 533 6005 is \$0.59.
- **Profile edge line markings:** HSIP WC 533 0.6, 5 years—item 666 6283 is \$0.38 per linear foot (4 inches) or \$0.62 per linear foot (6 inches).
- **Raised edge line rumble strips:** HSIP WC 534 0.6, 2 years—item 6056 6001 is \$2.75 per linear foot.
- **Milled centerline rumble strips:** HSIP WC 542 0.35, 10 years CMF 14% to 15% reduction for all crash types—item 533 6004 is \$0.11.
- **Profile centerline markings:** HSIP WC 543 0.35, 5 years—item 666 6287 is \$0.40 per linear foot (4 inches) or \$0.64 per linear foot (6 inches).
- **Raised centerline rumble strips:** HSIP WC 544 0.35, 2 years—item 6056 6002 is \$2.75 per linear foot.
- **Transverse rumble strips:** HSIP WC 545 0.15, 5 years, CMF at approach to intersection 33% reduction to 33% increase for all crash types—item 6056 6001 is \$2.75 per linear foot.
- **Delineators:** HSIP WC 113 0.3, 2 years, CMF installed in combination with edge line and centerline marking results in 45% reduction in all crash types—item 658 2292 is \$45 each.
- **Chevrons:** HSIP WC 137 0.25, 10 years, CMF installed with curve warning signs results in 31% to 44% reduction in all crash types—item 644 6007 is \$650 each.
- **LED flashing chevrons:** HSIP WC 136 0.35, 10 years—item 6068 6001/6002 is \$4,500 each.
- **Advance warning signals:** replace signs with signals HSIP WC 123 0.1, 10 years—item 685 6004 is \$5,250 each.
- **Install advance warning signals and signs:** HSIP WC 125 0.15, 10 years, CMF 26% to 30% reduction in all crash types—item 685 6004 is \$5,250 each.
- **Install advance warning signs:** HSIP WC 130 0.05, 6 years—item 644 6004 is \$575 each.
- **Driver feedback signs.**
- **Install median barriers:** HSIP WC 201 0.55, 20, CMF any type of median barrier can result in up to a 24% increase in total crashes, but will reduce fatal crashes by up to 43% and injury crashes by up to 30%—varies depending on concrete, cable, etc.
- **Install raised medians:** HSIP WC 203 0.25, 20, CMF urban areas: 14% to 71% reduction in all crash types—varies depending on work.
- **Flatten side slopes:** HSIP WC 204 0.46, 20, CMF for cross-median, fixed-object, run-off-the-road, or other crash types in rural areas: 9% reduction up to a 9% increase in all levels of severity—varies depending on how much the slope is flattened.

- **Modernize bridge rails and approach guardrails:** HSIP WC 205 0.15, 10.
- **Improve guardrails to design standards:** HSIP WC 206 0.35, 10—estimated \$110 per linear foot.
- **Safety-treat fixed objects:** HSIP WC 209 0.5, 20, CMF removed or relocated fixed object associated with a 38% reduction in all crash types—varies depending on work items.
- **High-friction surface treatment (curve):** HSIP WC 306 0.45, 3014 6001 \$28 per square yard.
- **Widen lanes:** HSIP WC 502 0.3, 10, CMF widening rural lane widths from 11 feet to 12 feet results in a 5% reduction in all crash types—depends on how much and type of work.
- **Widen paved shoulders (to 5 feet or less):** HSIP WC 503 0.25, 20, CMF effectiveness varies by width but generally expected to reduce all rural crash types by 18% to 38%—depends on how much and type of work.
- **Construct paved shoulders (1–4 feet):** HSIP WC 504 0.25, 20, CMF results in approximately a 19% reduction in all crash and injury types—depends on how much and type of work.
- **Widen paved shoulders (to >5 feet):** HSIP WC 536 0.4, 20, CMF from 3 feet to 6 feet: 7% to 18% reduction in all crash types and severity types; widening greater than 6 feet results in increased reductions up to 8 feet—depends on how much and type of work.
- **Construct paved shoulders (≥5 feet):** HSIP WC 0.4, 20—depends on how much and type of work.
- **Road diet:** Revise roadway configuration to provide additional paved recovery area (e.g., convert four-lane roadways to three-lane roadways with design features compatible with surrounding land use context). CMF 19% to 25% reduction in urban crashes; approximate 47% reduction in suburban crashes.

## STRATEGY 3

**Minimize the consequences of vehicles leaving the road.**

### Countermeasure

Focus	Number	Description	Action Plan
<b>Forgiving roadside features</b>	3A	Implement barriers, median treatments, and forgiving roadside objects (e.g., use median barriers, safety-treat fixed objects, establish safe-clear policies, and improve slopes) with consideration given to land use context.	✓

## Forgiving Roadside Features Countermeasure (3A) Action Plan

**Implement barriers, median treatments, and forgiving roadside objects (e.g., use median barriers, safety-treat fixed objects, establish safe-clear policies, and improve slopes) with consideration given to land use context.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Use safety screening methods to identify, prioritize, and select roadway segments where forgiving roadside features may be effective in reducing the consequences of roadway and lane departures. Include locations where improvements are already planned. (Participating organizations: TxDOT and city and county agencies)</li> <li>2. Select countermeasures based on cost, time to implement, and barriers for selected roadway segments and public input. (Participating organizations: transportation and law enforcement agencies, and public information officers)</li> <li>3. Program funds for implementing countermeasures or incorporating them into existing projects. (Participating organizations: TxDOT, city and county agencies, and MPOs)</li> <li>4. Implement countermeasures in new and existing projects. (Participating organizations: transportation agencies at state, city, and county levels)</li> <li>5. Publicize countermeasures to build additional support for projects. (Participating organizations: media outlets, and principal investigators and staff at state, city, and county transportation agencies)</li> <li>6. Evaluate effectiveness. (Participating organizations: TxDOT and city and county agencies)</li> </ol>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	Various, ranging from * to ***
<b>Cost to Implement</b>	Various, ranging from \$ to \$\$\$
<b>Time to Implement</b>	Various, ranging from short to long
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Adequate knowledge of screening methods.</li> <li>• Changing engineering practices about incorporating safety into projects and screening for existing issues.</li> <li>• Implementing countermeasures proactively before there is a problem.</li> <li>• Funding sources.</li> <li>• Providing for continuing maintenance.</li> </ul>

## STRATEGY 4

**Minimize the likelihood of crashing in adverse conditions.**

### Countermeasures

Focus	Number	Description	Action Plan
<b>Nighttime locations</b>	4A	Identify locations subject to nighttime crashes. Examples are developing and using screening and systemic crash analysis tools to identify locations, providing additional roadway delineation, and providing roadway lighting.	✓
<b>Wet-weather locations</b>	4B	Identify and address locations subject to wet-weather run-off-the-road crashes.	✓

## Nighttime Locations Countermeasure (4A) Action Plan

**Identify locations subject to nighttime crashes. Examples are developing and using screening and systemic crash analysis tools to identify locations, providing additional roadway delineation, and providing roadway lighting.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Develop a program analogous to the TxDOT Wet Surface Condition Reduction Program (formerly the Wet Weather Accident Reduction Program) specific to nighttime crashes.</li> <li>2. Encourage the use of network screening techniques, such as those outlined in the <i>Highway Safety Manual</i> (HSM), to identify locations with high rates of nighttime crashes. This includes two components: <ul style="list-style-type: none"> <li>• Identify and publicize existing training materials regarding HSM usage.</li> <li>• Develop new training materials as needed to specifically address nighttime crashes.</li> </ul> </li> <li>3. Automate the network screening process via a Microsoft Excel macro or other software tool.</li> <li>4. Apply a systemic process to diminish relying on the public to identify traffic safety issues.</li> </ol>
<b>Participating Organizations</b>	TxDOT; research agency or university, and city or county project managers; advisors; and safety contractors
<b>Effectiveness</b>	*** (automation will allow TxDOT employees to function more efficiently)
<b>Cost to Implement</b>	\$\$ (working within a Microsoft Excel framework may be cost effective; an external software tool may be most costly)
<b>Time to Implement</b>	Medium (need to tailor existing software to do what is needed)
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Dedicated champions.</li> <li>• Buy-in from participating agencies.</li> <li>• Developing a simple yet reliable automated system.</li> <li>• Obtaining sufficient funding for development.</li> <li>• Obtaining sufficient funding for countermeasure implementation.</li> </ul>

## Wet-Weather Locations Countermeasure (4B) Action Plan

**Identify and address locations subject to wet-weather run-off-the-road crashes.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Identify advanced safety screening methods, such as those outlined in the HSM, to prioritize locations with high risk for wet-weather crashes. (Participating organizations: TxDOT and research agencies)</li> <li>2. Combine the methods identified in step 1 with the TxDOT Wet Surface Condition Reduction Program to select top locations for treatment. (Participating organizations: TxDOT and research agencies)</li> <li>3. Assess the road friction level at the time of the crash, and select countermeasures based on the contributing factor. For example, if the crash is due to lack of pavement friction, then a suitable high-friction treatment is needed. If it is due to oil spills, then a treatment that deals with the removal of oil spills is required. (Participating organizations: law enforcement agencies and research agencies)</li> <li>4. Automate the network screening process and countermeasure selection via a Microsoft Excel macro or other software tool.</li> <li>5. Program funds for implementing countermeasures or incorporating them into existing projects. (Participating organizations: TxDOT, city and county agencies, and MPOs)</li> <li>6. Implement countermeasures in new and existing projects. (Participating organizations: transportation agencies at state, city, and county levels)</li> </ol>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	Various, ranging from * to ***
<b>Cost to Implement</b>	Various, ranging from \$ to \$\$\$
<b>Time to Implement</b>	Various, ranging from short to long
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Adequate knowledge of screening methods.</li> <li>• Dedicated champions.</li> <li>• Developing a simple yet reliable automated system.</li> <li>• Funding sources.</li> </ul>

## STRATEGY 5

Identify and address behavioral characteristics associated with roadway departure.

### Countermeasures

Focus	Number	Description	Action Plan
Curves	5A	Provide consistent curve treatments and advisory speeds for similar conditions.	✓
Automated speed enforcement	5B	Encourage adoption of laws that allow automated speed enforcement.	✓
Truck driver medical requirements	5C	Encourage adoption of laws that change medical card requirements for truck drivers.	
Driving hours for truck drivers	5D	Encourage adoption of laws that require automated recording systems for trucks to monitor driving hours.	
Truck driver health and restrictions	5E	Encourage adoption of truck driver health checkups and driving restrictions.	

Note: renumbered from the original listing.

## Curves Countermeasure (5A) Action Plan

**Provide consistent curve treatments and advisory speeds for similar conditions.**

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Analyze vehicle speed data on horizontal curves. (Participating organizations: TxDOT and TTI)</li> <li>2. Update the GPS Method for determining the advisory speed and margin of safety. (Participating organizations: TxDOT and TTI)</li> <li>3. Develop a curve handbook and implementation tools (e.g., Atlanta District; refer to FHWA proven countermeasures). (Participating organizations: TxDOT and TTI)</li> <li>4. Present findings to TxDOT districts, cities, and counties. (Participating organizations: TxDOT and TTI)</li> <li>5. Conduct curve studies and apply consistent treatments. (Participating organizations: TxDOT and city and county agencies)</li> <li>6. Evaluate treatments. (Participating organizations: TxDOT and TTI)</li> </ol>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	***
<b>Cost to Implement</b>	\$\$
<b>Time to Implement</b>	Medium to long
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Equipment required for curve studies.</li> <li>• Personnel needed to conduct curve studies.</li> <li>• Funds to construct curve treatments.</li> </ul>

## Automated Speed Enforcement Countermeasure (5B) Action Plan

### Encourage adoption of laws that allow automated speed enforcement.

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Gather data from other states that use automated speed enforcement including public opinion/acceptance, safety effectiveness, and Texas state law. Use a National Transportation Safety Board report as a reference: <i>Reducing Speeding-Related Crashes Involving Passenger Vehicles</i>, 2017, <a href="https://www.nts.gov/safety/safety-studies/Documents/SS1701.pdf">https://www.nts.gov/safety/safety-studies/Documents/SS1701.pdf</a>. (Participating organizations: TxDOT and TTI)</li> <li>2. Conduct a public opinion poll about automated speed enforcement. (Participating organizations: TxDOT and TTI)</li> <li>3. Develop an informational packet on the benefits of automated speed enforcement. (Participating organizations: TxDOT and TTI)</li> <li>4. Present findings to key stakeholders including the Legislative Affairs Office at TxDOT, city government affairs departments, the Texas Municipal League, safety advocates, legislative committees, and legislators. (Participating organizations: TxDOT, TTI, city agencies, law enforcement agencies, and safety advocates)</li> <li>5. Adopt statewide legislation (possibly as a pilot). (Participating organization: Texas Legislature)</li> <li>6. Evaluate short- and/or long-term impacts. (Participating organizations: TxDOT and TTI)</li> </ol>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	***
<b>Cost to Implement</b>	\$\$
<b>Time to Implement</b>	Medium
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Legislative issues.</li> <li>• Privacy issues.</li> <li>• The “need for speed” mentality among drivers.</li> </ul>

## STRATEGY 6

**Improve emergency response time in rural areas.**

### Countermeasures

Focus	Number	Description	Action Plan
<b>Emergency air flight time</b>	6A	Provide resources to decrease emergency air flight response time.	
<b>Advanced life support</b>	6B	Provide resources to increase the availability and use of advanced life support equipment to first responders.	
<b>Expedition of crash notification</b>	6C	Implement measures to provide faster crash notification for emergency medical services.	✓

## Expedition of Crash Notification Countermeasure (6C) Action Plan

### Implement measures to provide faster crash notification for emergency medical services.

Element	Description
<b>Steps for Implementation</b>	<ol style="list-style-type: none"> <li>1. Develop a coalition by region between TxDOT, DPS, local law enforcement, emergency medical services (EMS), the 911 System, cities, counties, and the Texas Department of State Health Services (DSHS) to create lines of communication between entities. (Participating organizations: DSHS and EMS agencies)</li> <li>2. Develop a system to be used by all departments involved for reporting areas of safety concerns. (Participating organizations: DSHS and EMS agencies)</li> <li>3. Analyze locations reported and implement safety measures as warranted. (Participating organizations: TxDOT and city and county agencies)</li> <li>4. Streamline current 911 dispatch protocols to include notification of other agencies and stakeholders. (Participating organization: 911 System)</li> <li>5. Increase law enforcement presence on targeted rural roads. (Participating organizations: DPS and local law enforcement)</li> <li>6. Research new technologies, such as Onstar, and/or apps, such as Waze, to notify EMS of potential crashes. (Participating organizations: EMS agencies)</li> <li>7. Research grant funding opportunities to improve EMS response services. (Participating organizations: EMS agencies)</li> </ol>
<b>Participating Organizations</b>	See above for each step.
<b>Effectiveness</b>	***
<b>Cost to Implement</b>	\$\$\$
<b>Time to Implement</b>	Medium
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Lack of funding for equipment and personnel; the need to apply for grants.</li> <li>• Volunteer training; the need to find hospitals and other EMS agencies that will provide free training to EMS offices located in rural areas.</li> <li>• Volunteer availability; the need for funding to have staff available 24 hours a day, seven days a week.</li> </ul>