

PROVEN SAFETY COUNTERMEASURE:  
**Systemic Application of  
Multiple Low-Cost Countermeasures  
for Stop-Controlled Intersections**



FHWA Safety Program



U.S. Department of Transportation  
**Federal Highway Administration**



**Safe Roads for a Safer Future**  
*Investment in roadway safety saves lives*

<http://safety.fhwa.dot.gov>

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# Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections



## What is it?

*Systemic application of multiple low-cost countermeasures for stop-controlled intersections* involves systemically deploying a group of low-cost treatments at a large number of stop-controlled intersections throughout a jurisdiction.

The Federal Highway Administration (FHWA) promotes the systemic approach as a complementary technique to the traditional, site-based “hot spot” approach. Where the traditional approach is reactive and typically involves higher average cost per site, the systemic approach is more proactive and involves lower average cost per site. The premise behind the systemic approach is simple: it is not possible to predict exactly where crashes will occur, but it is possible to use the roadway characteristics associated with severe crash types to determine the locations that have a greater risk of experiencing a fatal or severe crash.

Overall, the systemic approach to safety has three components:

1. Analyze systemwide data to identify focus crash types
2. Look for similar risk factors present in severe crashes within the focus type
3. Deploy on a large scale those low-cost countermeasures that address the risk factors contributing to crashes

What are the low-cost treatments included in this proven safety countermeasure? They include:

- Pavement markings.
- Signing.
- Visibility and sight distance improvements.



Source: Missouri DOT



These low-cost strategies increase driver awareness and recognition of intersections and potential conflicts. Below are examples of the basic improvement package.

### Countermeasures for Through Approach(es)

- Doubled up (left and right), oversized advance intersection warning signs, with street name sign plaques.
- Retroreflective sheeting on sign posts.
- Enhanced pavement markings that delineate through lane edge lines.



Source: SCDOT

In addition to the basic treatments, South Carolina DOT (SCDOT) chose to also install flashing beacons and speed limit warning signs to create more awareness of the upcoming intersection.

### Countermeasures for Stop Approach(es)

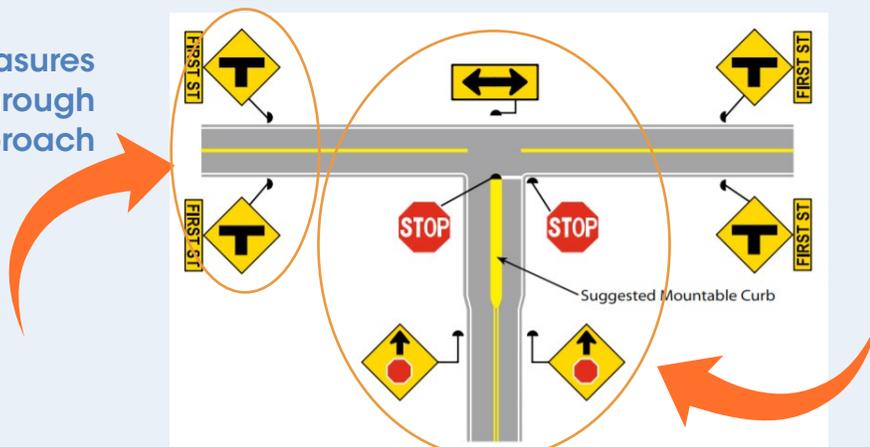
- Doubled up (left and right), oversized advance “Stop Ahead” intersection warning signs.
- Doubled up (left and right), oversized Stop signs.
- Retroreflective sheeting on sign posts.
- Stop bar placed at optimal location.
- Removal of any vegetation, parking, or physical obstruction that limits sight distance.
- Double arrow warning sign at stem of T-intersections.



Source: Pennsylvania DOT

Oversized advance “Stop Ahead” signs with reflective sheeting on the posts.

### Countermeasures for the Through Approach



### Countermeasures for the Stop Approach

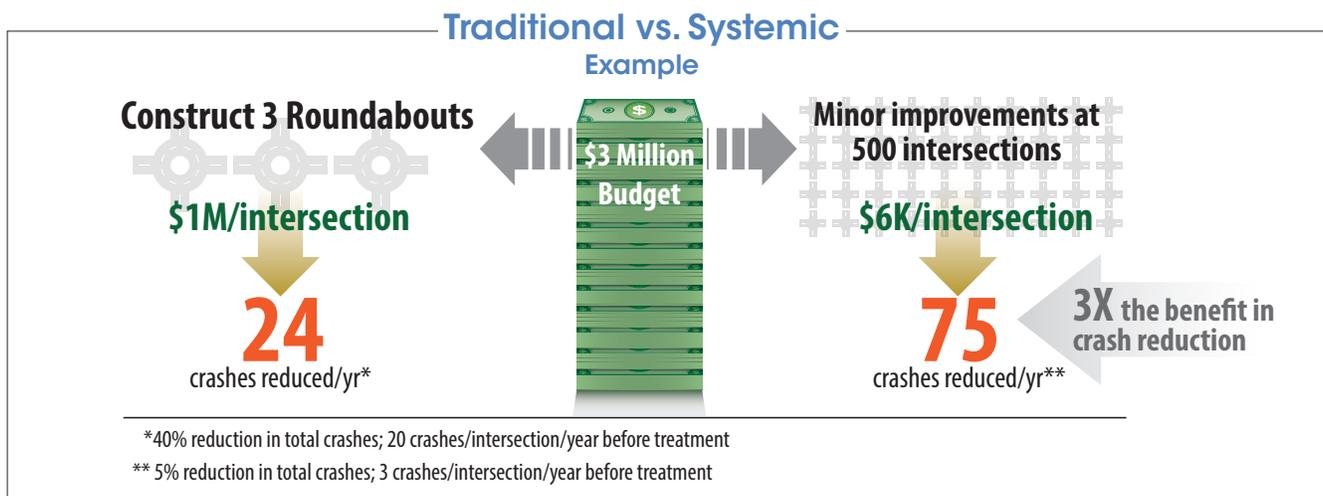
Basic plan that shows low-cost countermeasures at a stop-controlled T-intersection. (Source: FHWA)



## What are the Benefits?

Systemically applying multiple low-cost countermeasures at stop-controlled intersections offers valuable benefits to transportation agencies, enabling them to:

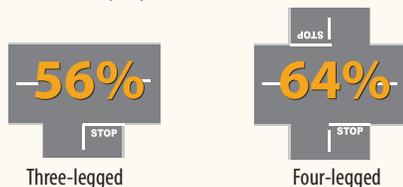
- Maximize resources due to the generally low cost of the treatments.
- Treat and improve a large number of intersections throughout their road network.
- Reduce injury and fatality crashes by 10 percent and nighttime crashes by 15 percent.<sup>1</sup>
- Advance safety cost-effectively by using a treatment package with an average benefit-cost ratio of 26:1—and perhaps as high as 36:1.<sup>2</sup>



### Louisiana sees impressive safety results

Louisiana Department of Transportation and Development (LaDOTD) installed low-cost safety treatments at 89 stop-controlled intersections. Researchers conducted a safety evaluation to assess the effectiveness of the treatments implemented at the rural stop-controlled intersections.

#### Fatal and Injury Crash Reductions at Intersections



Delta Region Transportation Development Program: Rural Safety Innovation Program Evaluation (FHWA-SA-14-029)

### South Carolina implements countermeasure for

**400+**  
INTERSECTIONS



**45**

FATAL AND INJURY CRASHES PREVENTED ANNUALLY

Safety Evaluation of Multiple Strategies at Stop-Controlled Intersections (FHWA-HRT-17-087)

<sup>1</sup> US DOT, FHWA, *Safety Evaluation of Multiple Strategies at Stop-Controlled Intersections*, FHWA-HRT-17-087 (Dec 2017). Available at: <https://www.fhwa.dot.gov/publications/research/safety/17087/17087.pdf>.

<sup>2</sup> Ibid. (Note: B/C ratios listed based on 7-year service life.)



## What Do I Need To Know To Apply this Countermeasure?

### The Systemic Approach and Intersection Safety Improvement Plans

The systemic approach is the basis of this proven safety countermeasure. FHWA offers a multitude of resources to assist transportation practitioners in applying this safety approach; for example, the [Systemic Safety Project Selection Tool](#) provides a step-by-step process for agencies to use in order to plan, implement, and evaluate systemic safety improvement projects.

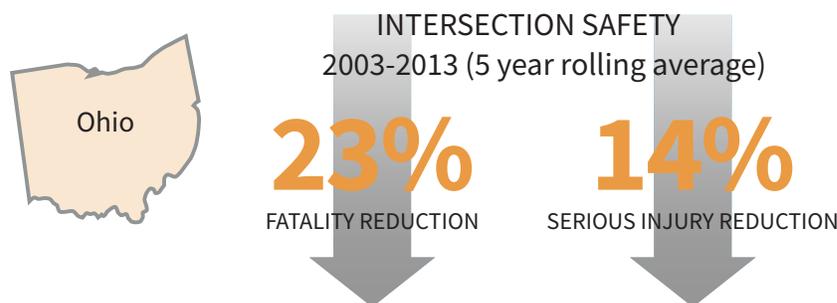
Between 2008-2013, FHWA collaborated with approximately 20 States to help them develop Intersection Safety Improvement Plans (ISIPs) that used the systemic approach. Many of these plans included recommendations for systemic application of multiple low-cost countermeasures at stop-controlled intersections for both State and local agency facilities. Each plan was customized to the specific State to be consistent with Highway Safety Improvement Program (HSIP) resources or other safety funding.

The most notable success story for this proven safety countermeasures comes from **South Carolina DOT (SCDOT)**. SCDOT identified more than 2,200 intersections for improvement in the South Carolina ISIP in 2008, resulting in the installation of systemic improvements—primarily signing and pavement marking enhancements—beginning in 2009. SCDOT’s experience is well documented on FHWA’s website, including the complete case study, process, lessons learned, and safety study results.

As a result of their ISIP implementation efforts, **Missouri DOT (MoDOT), Ohio DOT (ODOT), Pennsylvania DOT (PennDOT), and LaDOTD**, to name a few, have also successfully installed multiple low-cost sign and pavement marking improvements at stop-controlled intersections. Although Ohio DOT has not performed an analysis on the exact locations improved through their ISIP, it has found that the 5-year rolling averages from 2003 to 2013 have shown a 23 percent reduction in fatalities and a 14 percent reduction in serious injuries at all intersections.<sup>3</sup> In 2018-19, MoDOT has plans to complete a before and after assessment for stop-controlled intersections that received systemic improvements through the State’s ISIP.

*“A systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach helps agencies broaden their traffic safety efforts at little extra cost.”*

Learn more at: [FHWA Office of Safety’s Systemic Approach to Safety Website](#)

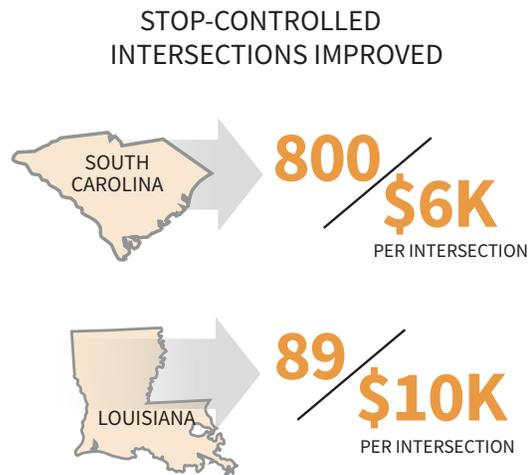


<sup>3</sup> US DOT, FHWA, *Improving Safety through Ohio’s Intersection Safety Implementation Plan*, FHWA-SA-16-081 (June 2016). Available at: [https://safety.fhwa.dot.gov/intersection/other\\_topics/isip/Improving\\_Safety\\_Ohio's\\_ISIP.pdf](https://safety.fhwa.dot.gov/intersection/other_topics/isip/Improving_Safety_Ohio's_ISIP.pdf).



## Funding

Many States cited above were able to accomplish such widespread success with these countermeasures by leveraging the connection between their Strategic Highway Safety Plans (SHSP), ISIPs, and HSIP. The consistency between a State's SHSP and ISIP, and the identification of the projects through a systematic, data-driven process, allows for projects on all public roads to be eligible for HSIP funds. FHWA's [Intersection Safety Implementation Plan Process Guide](#) notes available HSIP resources may not be sufficient to fund all of the improvements, but States can supplement funds with other Federal-aid, State, or local funds. Specially trained Local Technical Assistance Program (LTAP) safety engineers or consultants can also be engaged to provide support for these improvements.



Data Source: FHWA-SA-12-021 and FHWA-SA-14-029

## Implementation

Transportation agencies can take different approaches when installing countermeasures systemically. **SCDOT**, for example, used a single, statewide, low-bid contract for signing and pavement marking enhancements. The agency chose to issue a single contract instead of several smaller contracts to ensure administrative efficiencies, uniformity of implementation statewide, and lower pricing through economies of scale. More than 800 stop-controlled intersections were improved for approximately \$6,000 per intersection.<sup>4</sup>

Agencies can issue a Request for Qualifications or Request for Proposals to determine the technical qualifications of engineering services contractors before going through the low-bid process. Because of the complexity of the project and the design-build elements it entails, a hybrid approach that combines low-bid contracts awarded to pre-qualified contractors with pre-qualified engineering services subcontractors may be preferred, rather than strictly using a low-bid process.

**ODOT** used a different method, distributing HSIP funds to the districts to improve signing at stop-controlled intersections. The agency gave the districts a list of potential intersections, a standardized sign order form, and implementation guidance on rural intersection signing improvements. The ODOT sign shop produced the signs while district maintenance forces installed the devices.

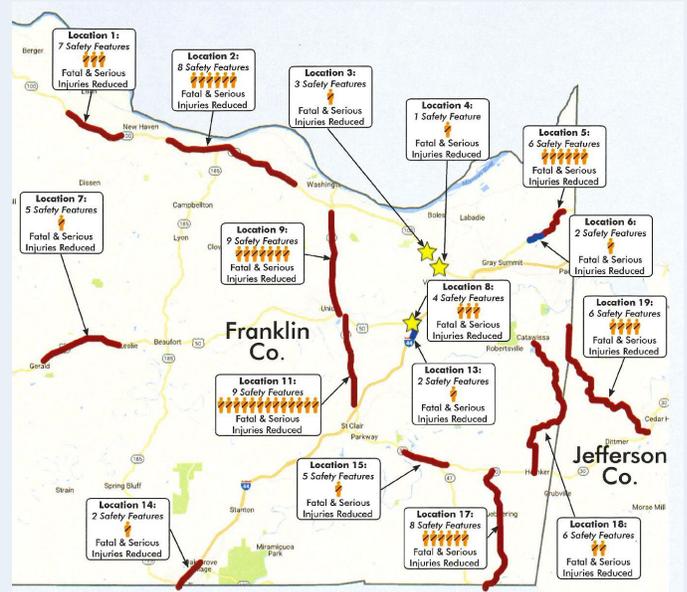
<sup>4</sup> US DOT, FHWA, *Safety Evaluation of Multiple Strategies at Stop-Controlled Intersections*, FHWA-HRT-17-087 (Dec 2017). Available at: <https://www.fhwa.dot.gov/publications/research/safety/17087/17087.pdf>.



Agencies can also incorporate this basic pavement marking and signing package into their policies or standards for all stop-controlled intersections. Then, as resurfacings and other projects occur, these low-cost improvements can be implemented seamlessly per policy.

### Innovative Approach

Using crash data, MoDOT’s St. Louis District identified locations throughout their jurisdiction, including intersections, with the highest safety concerns and chose teams comprising nationally known traffic and safety experts and contractors to deliver safety proposals. The teams competed in a unique design-build procurement that emphasized implementing the most cost-effective safety treatments based on an analysis using Highway Safety Manual methods. A fixed-price, variable-scope contract encouraged teams to provide the maximum safety benefit within the funding available.



Source: MoDOT

MoDOT won a [2017 National Roadway Safety Award](#) for this effort. For more information, visit the [project website](#).

### Outreach and Communication

Typically, projects involving the installation of this proven safety countermeasure require minimal public outreach efforts. These low-cost improvements only require a short-term work zone to implement, so traffic impacts are negligible. Residents in the area where these intersection improvements are taking place may comment on the additional brighter signing, or “sign clutter,” so transportation agencies should educate the community on the expected safety benefits of the projects. It may be necessary to conduct extra outreach in certain locations, such as historical neighborhoods, to address potential concerns.

If the systemic safety approach is a new concept to an agency, practitioners may need to educate internal management or decision makers on the benefits. In the past, the agency may have chosen projects purely using a traditional hot-spot approach, and it may be challenging to shift their mindset to the proactive, systemic method.

Due to the characteristics of implementing this type of large-scale project, with intersections spread around a State or jurisdiction, internal communication is vital. Regular meetings and site visits are recommended during implementation to ensure proper installation and determine if any alterations are necessary.



## What Else Can I Learn from Others?

### A Plan for Deployment

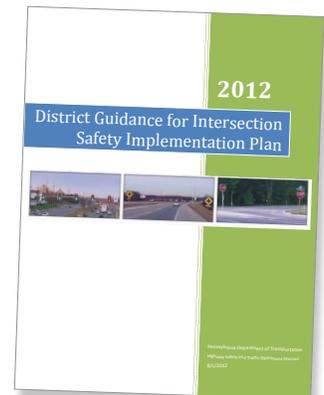
Virginia DOT (VDOT) deployed systemic safety countermeasures at signalized intersections across the State, and they plan to continue using the systemic approach for their stop-controlled intersections. In 2018, they completed a safety improvement plan for unsignalized intersections using systemic low-cost countermeasures. VDOT's study team analyzed the State's 80,000 unsignalized intersections by assessing crashes over a 5-year period to determine predominant crash trends and crash types. The team then assessed the risk factors that may affect the focus crash types and developed a tiered list of countermeasures. VDOT used their Virginia-specific safety performance functions and calculated the potential for safety improvement for the sites. These results were used to prioritize and narrow down the candidate sites to a manageable number. VDOT plans to have traffic engineering staff conduct studies at the recommended sites to finalize the safety improvement plan. The plan will be used as a guide for systemically deploying safety treatments at stop-controlled intersections within the State. For more information, see [Systemic Low-Cost Countermeasures for an Unsignalized Intersection Safety Improvement Plan for Virginia](#).

### Stop-Controlled Intersection Safety Review

In 2018, Alabama DOT (ALDOT) initiated a safety review of the State's 500+ stop-controlled intersections. The review consists of completing a crash data analysis, crash diagrams, desk and field reviews of the intersections, and a report that includes intersection location, existing safety features, map, crash summary, traffic data, and recommended short-, mid-, and long-term strategies. Although some of the intersections may need more complex improvements, the recommendations are primarily low-cost pavement marking and signing improvements, as well as ensuring sight distance is adequate. When complete, ALDOT plans to provide the intersection documents to the regions for programming and implementation.

### Noteworthy Practices from Pennsylvania DOT

PennDOT developed a brief guide to help its Districts successfully implement its ISIP.<sup>5</sup> The guide outlined each countermeasure category (which included signing and marking improvements at stop-controlled intersections) along with the basic implementation steps and responsible organization. In the guide, PennDOT also described their process for tracking the projects. Their Safety Management Division tracked the implementation of the countermeasures being deployed at the recommended locations. To facilitate the tracking, the agency developed a standard form for the Districts to record the pertinent information for each project, such as location details, project description, cost, and crash history. The information in the tracking forms serves as a valuable resource as PennDOT evaluates the effectiveness of the ISIP countermeasures.



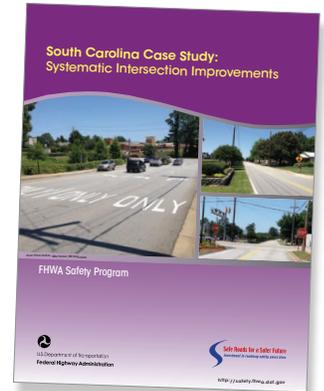
Source: PennDOT

<sup>5</sup> PennDOT Highway Safety and Traffic Operations Division, *2012 District Guidance for Intersection Safety Implementation Plan*. Available at: <https://www.penndot.gov/TravelInPA/Safety/Documents/District%20Intersection%20Safety%20Implementation%20Plan%20Guidance.pdf>.



## Lesson Learned on Developing Plans

When SCDOT first began its implementation, in-house designers provided site-specific drawings for each intersection, but then switched to four consulting firms because of the large level of effort. The plans provided enough detail to be considered a construction drawing, but revisions and adjustments were typically necessary once installation actually took place in the field. SCDOT indicated that it may be more efficient to have a single firm develop all the plans to avoid discrepancies and ensure better consistency. Read about South Carolina's experience and lessons learned in [\*FHWA's South Carolina Case Study: Systemic Intersection Improvements\*](#).



Source: FHWA

## Helping Local Agencies Implement this Low-Cost Systemic Strategy

Ohio DOT uses the Local Technical Assistance Program (LTAP) to promote this systemic proven safety countermeasure. Using Ohio's ISIP as a guide, ODOT has implemented low-cost systemic countermeasures at more than 1,000 intersections throughout the State. ODOT has not only focused on State-owned intersections, it has pushed the low-cost systemic approach down to the local agencies using LTAP. In 2013, the LTAP started a township signage program for its 1,100 townships in Ohio. Since its inception, 100 townships each year receive funds to install intersection signing. The process uses crash data to determine the prioritized list of townships, and then, the next 100 townships on the list are targeted the following year, and so on.

For more information, visit <https://safety.fhwa.dot.gov/intersection/>.



## For More Information:

<https://safety.fhwa.dot.gov/provencountermeasures/>

## FHWA Office of Safety



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