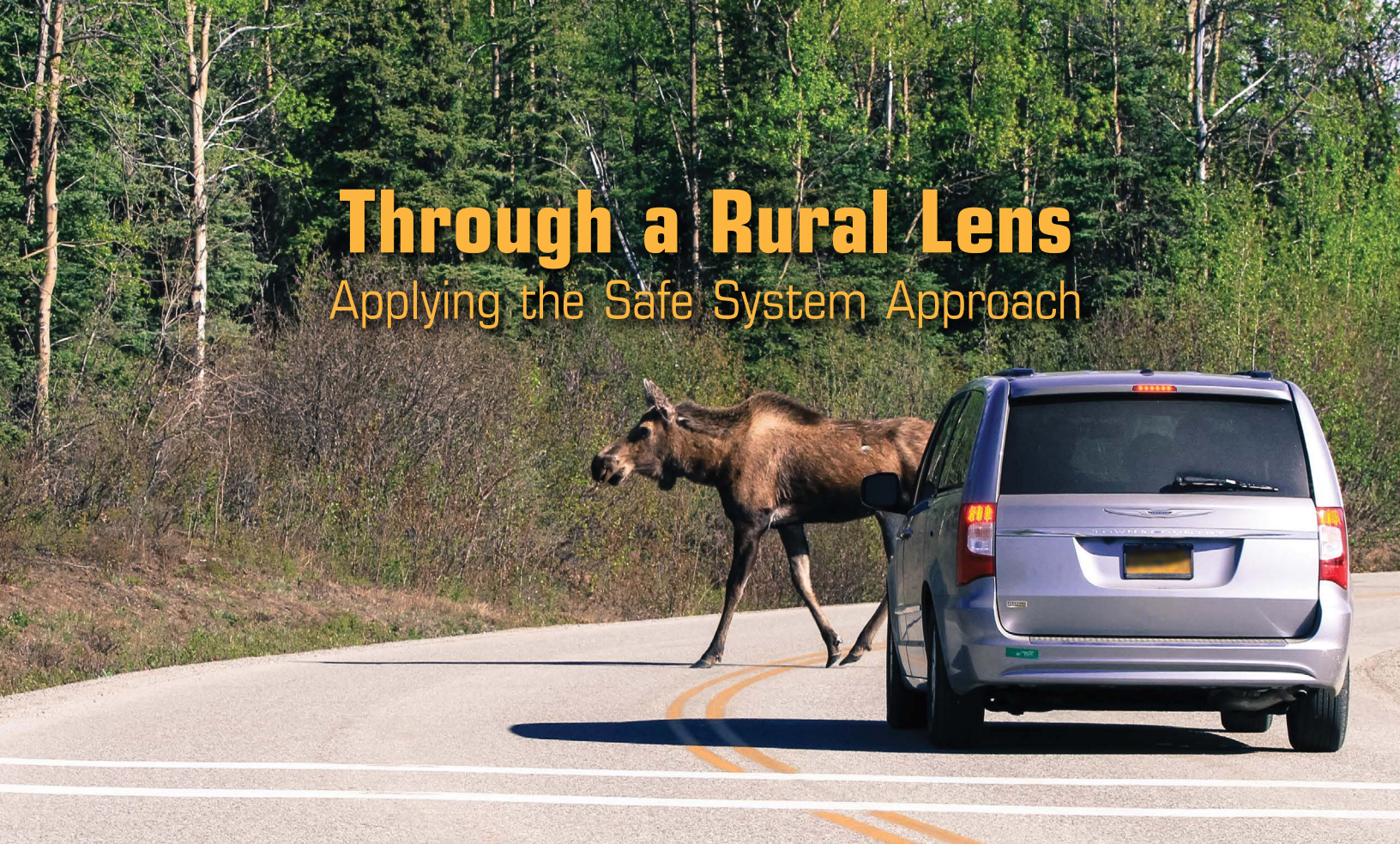


Through a Rural Lens

Applying the Safe System Approach



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The statistics are distressing. From 2017 to 2021, the number of people who died on rural roadways came to 83,206.¹ That is 43 percent of all roadway deaths when only 19 percent of the U.S. population lived in rural areas and only 31 percent of the total vehicle miles traveled were in rural areas (1, 2).

¹ The authors compiled statistics based on data from the NHTSA Fatality and Injury Reporting System Tool, 2017–2021. <https://cdan.dot.gov/query>.

A Safety Reboot

To counter spiraling fatalities, the U.S. Department of Transportation (U.S. DOT) and FHWA recently adopted the Safe System Approach as referenced in the *National Roadway Safety Strategy* (3). It is a guiding paradigm to address roadway safety. Used internationally for three decades in places like Sweden, where the number of road fatalities per 100,000 inhabitants decreased from 6.7 in 2000 to 1.8 in 2020 (an astonishing 73 percent reduction), the Safe System Approach is well respected (4). As shown in Figure 1, the Safe System Approach puts aside business

Drivers on rural roads must keep an extra sharp eye out for crash hazards, such as a moose sauntering across a road in Alaska. Wildlife and slow-moving farm equipment, as well as the many miles of empty road far from emergency responders, are part of the safety equation for travelers along rural roads.

Traditional

Prevent crashes

Improve human behavior

Control speeding

Individuals are responsible

React based on crash history

Safe System

Prevent deaths and serious injuries

Design for human mistakes/limitations

Reduce system kinetic energy

Share responsibility

Proactively identify and address risks

FIGURE 1 Comparison of traditional and Safe System Approach (5).

as usual, requires a new mindset, and encourages culture change.

By building and reinforcing multiple layers of protection, the Safe System Approach works to prevent crashes and minimize the severity of crashes that do occur. This shift from a conventional safety approach focuses on human mistakes, as well as human vulnerability, and provides an effective way to address and mitigate the risks inherent in the U.S. transportation system. The Safe System's many redundancies work together to strengthen all parts of the transportation system "so that if one part fails, the other parts still protect people" (5).

The Principles

Transportation professionals can incorporate the following six principles of the Safe System Approach (Figure 2, outer ring) to create a positive traffic safety culture, which is "integral to helping our nation move toward a vision of a highway system with no fatalities" (6). For progress on safety improvements to be made, there must be a shift away from how safety has been approached in the past. Reframing safety culture can be accomplished by applying the six principles, listed in the remainder of this section with specific examples for rural roads.

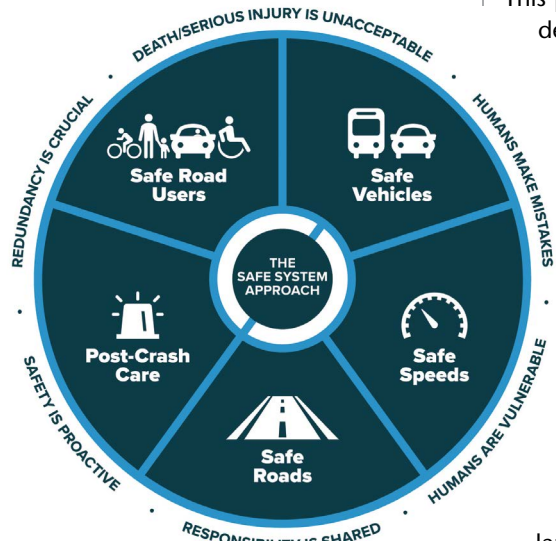


FIGURE 2 Safe System Approach (5).



FHWA, Central Federal Lands Highway Division

Cut through evergreens and outlined with snow, the circular construction of a roundabout near unincorporated Tahoe City, California, promotes lower speeds and results in fewer fatal crashes in rural areas.

DEATH AND SERIOUS INJURY ARE UNACCEPTABLE

According to NHTSA, there were a staggering 15,322 fatal traffic crashes and 17,103 fatalities in rural areas in 2021.¹ To reduce or eliminate these deaths requires assessing the safety culture. For many rural agencies and their employees, this is personal. The job is to help their neighbors get to work and return home safely. This perspective is critical for making decisions when it comes to investing in roadway safety.

HUMANS MAKE MISTAKES

Roadway departures—crashes occurring after a vehicle crosses an edge line or center line, or otherwise leaves the traveled way—are a prime factor in rural roadway deaths. In fact, 10,988 people died in 2020 in roadway departure crashes on rural roads (2).

Three ways to counter roadway departure crashes are to keep vehicles on the roadway and in the lane, provide for a safe recovery, and reduce crash severity if the vehicle does leave the roadway.

HUMANS ARE VULNERABLE

The Safe System Approach focuses not just on managing speed but on managing the transfer of kinetic energy. The sum of kinetic energy is important in determining injury severity. The kinetic energy released in a crash is equal to one half of the vehicle mass multiplied by the square of the vehicle's velocity.

The roundabout, for example, is one intersection configuration that reduces the kinetic energy of crashes. Roundabouts reduce fatal and severe crashes by 88 percent in rural environments (7). Well-designed roundabouts significantly reduce human vulnerability through

- Forcing slow speeds—15 to 25 miles per hour—for all users,
- Reducing conflict points from 32 in a traditional four-way intersection to eight in a roundabout, and
- Creating a smaller angle of conflict between two vehicles that result in sideswipe crashes that are common in roundabouts rather than more serious T-bone crashes.

RESPONSIBILITY IS SHARED

Compared with urban transportation agencies, the resources available to rural agencies are extremely limited. Those who own and maintain rural roadways often have multiple job duties. Jurisdictions are large. Coordination and collaboration are essential between law enforcement, emergency services, and road supervisors. And everyone has a part to play in saving lives.

Development of a local road safety plan or safety action plan can help rural roadway owners prioritize safety and focus on the goal of zero fatalities and serious injuries. Plan development can be championed by a multidisciplinary team and include stakeholders and collaboration of those who use a data-driven approach to identify risk factors and prioritize solutions and safety projects based on the Safe System Approach. On its web page, which is devoted to local road safety plans (LRSPs), FHWA provides a do-it-yourself template, training, resources, and examples of LRSPs. This website's comprehensive explanations of how and where to start a plan are particularly useful for those in the early stage of plan development, but the LSRP do-it-yourself web page also can be used to modify, refine, or update an existing plan.

SAFETY IS PROACTIVE

Crash locations in rural areas tend to be random rather than clustered in hot spots. However, rural fatal crash types are predictable—they often occur on curves and at intersections. Therefore, rather than using a traditional site-specific approach to implement safety improvements, rural areas may find more success if applying a proactive approach called systemic safety. The Systemic Safety Approach is based on risk factors of roadway features or characteristics correlated to specific severe crash types. For instance, deploying low-cost curve and chevron signs on curves with radii between 500 and 1,000 feet across the network may prevent the next death or severe injury crash.

REDUNDANCY IS CRUCIAL

Reducing risk requires that all parts of the roadway system be strengthened so that

if one part fails, people are still protected. Examples of redundancy on a rural divided highway would be a median, an inside shoulder, and the use of cable median barrier to prevent crossover head-on crashes. The median itself provides separation, the shoulder provides a recovery area, and the barrier adds redundancy against a severe head-on crash.

Elements That Make Roads Safe

In addition to the six Safe System Approach principles that can guide safety culture change, there are five elements—the inner circle in Figure 2—that provide layers of protection and shared responsibility to promote a holistic approach to safety across the entire transportation system.

SAFE ROAD USERS

Roadway owners must consider the safety of all road users—who vary in age, experience, physical abilities, and so on—and all roadway modes (i.e., freight, transit, motorcycle, pedestrian, bicycle, and more). For instance, 63 percent of occupants killed in rural pickup truck crashes in 2020 were unrestrained—the highest percentage of any passenger vehicle occupants killed in rural and urban areas (2). Furthermore, in 2021, NHTSA reported the following breakdown of rural roadway deaths:¹

- Large trucks: 3,228,
- Motorcycles: 1,956,
- Pedestrians: 1,170, and
- Pedalcyclists: 142.²

Education and designing for human mistakes and limitations must go hand in hand for change to occur. For this reason, the National Center for Rural Road Safety created Rural Road Safety Awareness Week, an annual social media campaign to help rural practitioners increase awareness of the need to reduce fatalities and serious injuries.

² According to NHTSA, pedalcyclists are bicyclists and other cyclists, including riders of two-wheel, nonmotorized vehicles, tricycles, and unicycles.

High-visibility enforcement is a technique that not only reinforces safety policies and road user choices, but also educates the public on why they should choose positive behavior. An example is Iowa's High Five Rural Traffic Safety Project, which is focused on seatbelt use on rural roads.

Another resource for rural agencies is NHTSA's *Countermeasures That Work*, a guide that provides proven educational and enforcement countermeasures that can be used by transportation, public health, and law enforcement agencies (8).

SAFE VEHICLES

FHWA defines safe vehicles as those “designed and regulated to minimize the occurrence and severity of collisions using safety measures that incorporate the latest technology” (5). The advancement of safe vehicles over the past few decades includes seat belts, antilock brakes, and airbags. Newer vehicle models include back-up cameras, lane assist technology, and semiautonomous features.

However, rural areas tend to have more unpaved roads, fewer pavement markings, and less communication infrastructure, all of which affect the usefulness of some vehicles' safety features.

Good quality tires can have significant effects on friction. Vehicles have different friction demands, depending on the characteristics of the roadway. For example, a vehicle traversing a horizontal curve requires a greater level of friction than a vehicle on a straight section. Common locations that require higher friction values are horizontal curves, steep grades, or intersection approaches. Pavement friction is critical for changing vehicle direction and ensuring the vehicle remains in its lane.

Vehicle-to-vehicle infrastructure examples in rural areas include Wyoming's connected vehicle pilot to provide freight fleets with important weather information and Missouri's addition of a real-time digital warning system on their motorist-assist vehicles that communicates with popular navigation applications (e.g., Waze) and alerts the public of vehicles on the shoulder (9).

SAFE SPEEDS

Speed plays a part in crash risk—smaller field of vision and increased time for stopping and braking—and crash severity. Figure 3 shows the relationship between impact speed for various types of crashes and the fatality risk to those users. In 2020's rural fatal crashes, 71 percent of drivers were on roadways where the posted speed limit was 55 miles per hour or higher (2). In 2021, crashes involving speeding on rural roadways claimed the lives of 4,833 people.¹ The grim statistics in rural areas, where high speeds are already expected, make the challenges even greater. Some strategies include addressing high-speed roadways that quickly become rural town centers' main streets. Within a short distance, the road changes quickly and necessitates that drivers slow from highway speeds to safely navigate a road with pedestrians, bicyclists, and traffic going to or from local businesses. This situation requires posted and operating speeds to be reduced to ensure safety. Washington State Department of Transportation (DOT) uses a target speed approach for determining design speed. This approach's objective is to establish the design speed at the desired operating speed.

Similarly, many agencies use speed feedback signs to educate the public about traveling speeds and encourage drivers to slow down. Wyoming DOT uses variable speed limit signs to reduce the regulatory speeds in inclement

weather. This strategy can prevent crashes and reduce roadway closures.

SAFE ROADS

Roads in rural areas have unique features such as narrow lanes, minimal shoulders, sharp curves, lack of cell service, high speeds, lack of pedestrian and bicycle facilities, and uncontrolled intersections. These can all become risk factors. Several ways to improve rural road safety include the implementation of proven safety countermeasures. These data-driven solutions are known to reduce fatal and injury crashes. In rural areas, where funding is limited, low-cost countermeasures are a way to improve safety within an existing budget. For example, Montana DOT includes the systemic installation of centerline rumble strips. Other low-cost countermeasures—such as clearing vegetation at intersections, installing delineators on curves, testing and replacing signs and pavement markings for retroreflectivity on a regular basis, and using maintenance logs to prioritize damaged guardrails or missing signs—can all have significant safety impacts.

Additionally, a road with wide shoulders can be reconfigured to have narrower lanes and a bicycle lane or a shared-use lane for the safety of all road users. A rural example of a road diet—a transportation planning technique where the number of travel lanes or the effective width of the road is reduced to achieve systemic improvements—is found in Battle Lake, Minnesota.

Engineering solutions were identified to reduce the frequency of fatal and serious injury crashes occurring on the roadways in South Carolina through the use of the state DOT's Rural Roads Safety Program.

Separating vulnerable road users in time and space includes providing time via a signal or beacon, or space such as sidewalks, bicycle lanes, separated paths, or wide shoulders that keep vulnerable road users away from vehicles. In Washington State, the Lummi Nation Haxton Way pedestrian path and lighting project improved safety on Haxton Way, a rural two-lane road where there were numerous deaths of tribal members (10). The completed two-mile, multipurpose trail system consists of a paved trail, porous pavement, elevated boardwalks, new pedestrian bridges over Red River and the Lummi Slough, intersection improvements, and solar LED trail lighting.

POST-CRASH CARE

In 2020, 66 percent of drivers killed in rural areas died at the scene of the crash. Of all drivers who were transported to hospitals and died en route, 57 percent were in rural areas and 42 percent were in urban areas (2). Emergency responders and access to trauma centers are essential to survival in rural crashes. In rural areas, emergency response personnel are more likely to be volunteers than paid emergency response personnel centrally located at a medical facility or fire station. The time it takes for volunteers to reach the scene can increase response times. Limitations in cellular service also can make notifying first responders difficult.

As part of its new rural road safety program, the Washington Traffic Safety Commission is working with the Washington Chapter of the American College of Surgeons Committee on Trauma to implement rural trauma team development courses that emphasize a team approach to initial assessment, stabilization, and transfer of injured people from a crash scene. This type of course can improve coordination of care, result in increased competence with advanced trauma life support principles, and decrease patient transport times.

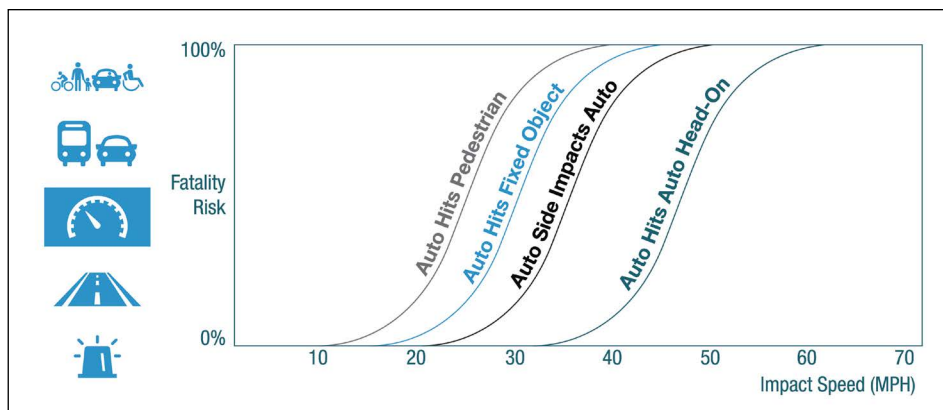


FIGURE 3 Crash types, speeds, and fatality risks. (Source: FHWA as adapted from Australian Roads and Traffic Authority of New South Wales.)

Traffic incident management training specific to rural areas is important to ensure that rural responders are equipped to deal with incidents that include crashes involving horse-drawn vehicles or live-stock. FHWA is in the process of finalizing a rural lesson addendum to their national traffic incident management training.

A discussion of post-crash care is not complete without mentioning communications. To assist with broadband network expansion and improve communications, Colorado has created public-private partnerships to leverage transportation rights-of-way in expanding access (see Page 30).

Summary

As U.S. agencies work to integrate and institutionalize the Safe System Approach, the unique challenges faced by rural agencies and communities can be met with customized solutions. Some agencies own and operate rural, as well as urban roadways; some agencies are 100 percent rural. Their approaches may be different and tailored to their own communities, but the hope is that their goals and intentions are the same: zero roadway deaths via a safe system. This can be achieved using the many resources available and lessons learned from agencies eager to share their experiences.

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Cab02 at the English-language Wikipedia, CC BY-SA 3.0

An Amish driver guides a horse-drawn carriage to town—a common sight along Route 340 in rural Pennsylvania. In states with sizable Amish or Mennonite communities, such as Pennsylvania, Ohio, Indiana, Wisconsin, and New York, emergency responders must be ready to handle crashes where human and equine injuries may need to be addressed.

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