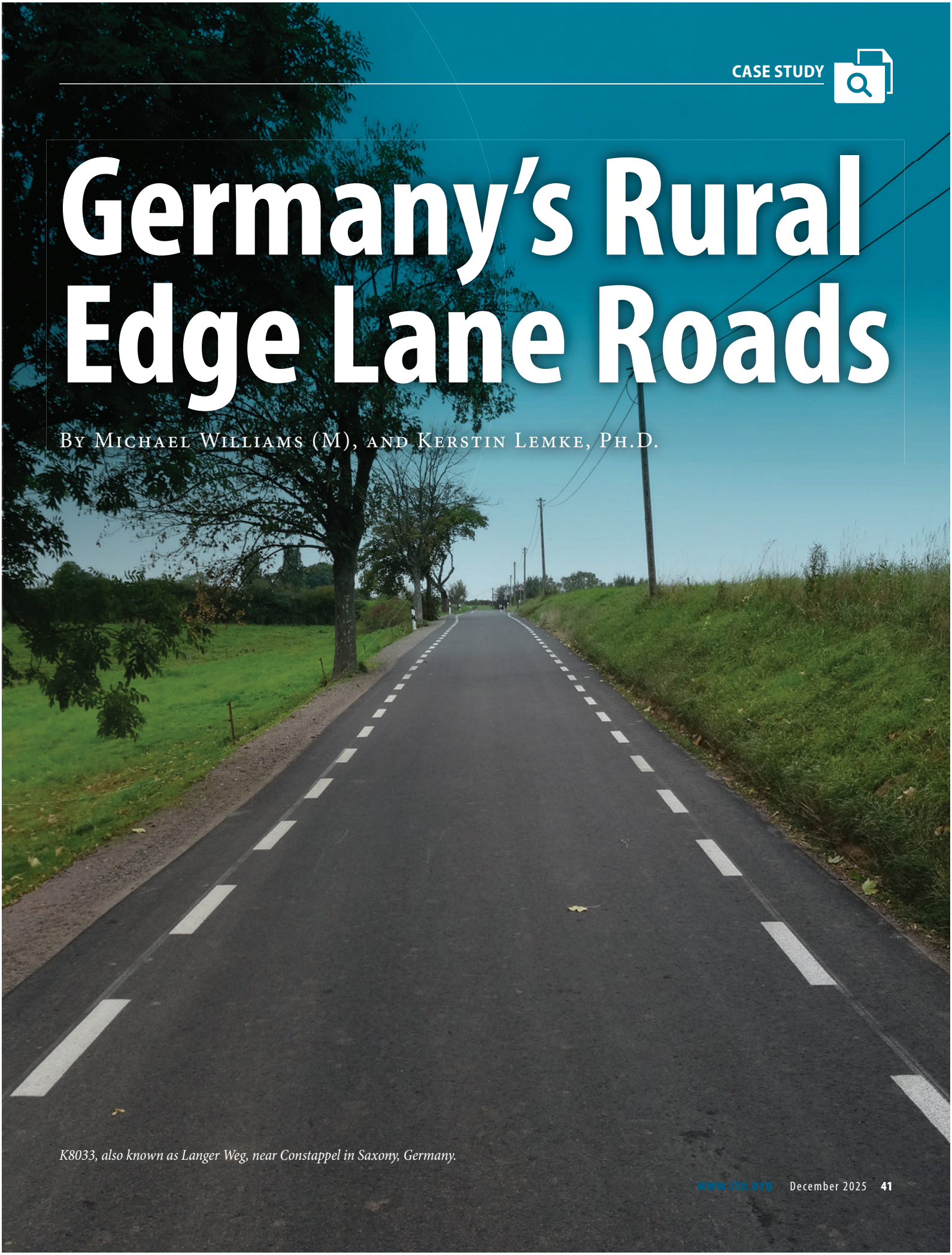
Germany's Rural Edge Lane Roads

By Michael Williams (M), and Kerstin Lemke, Ph.D.

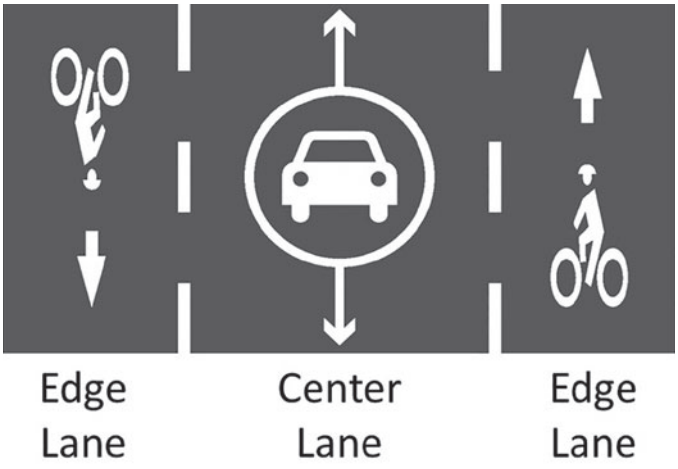


K8033, also known as Langer Weg, near Constappel in Saxony, Germany.

Many people familiar with the Edge Lane Road (ELR) treatment view it as a shared street treatment meant to provide vulnerable road user (VRU) facilities. Less well known is the treatment's ability to improve motorist safety on low-volume, rural roads. Two-lane rural roads often feature narrow travel lanes and minimal shoulders. These characteristics place drivers near the pavement edge and provide little safety margin in the face of challenges such as momentary inattention, low light levels, illness, etc. Per the NHTSA, 46 percent of motor vehicle (MV) traffic fatalities occurred on rural roads in 2017 and over half of those were classified as roadway departure crashes.[1] Additionally, the FHWA recommends a systemic approach to rural crashes since they tend to be randomly located.[2] The safety profile of Germany's rural roads is similar to the United States. Germany's decision to adopt an ELR-like standard for low-volume, rural roads to improve safety suggests safety improvements are possible for American rural roads as well.

ELRs are an alternative to the standard two-lane road treatment. An ELR is a roadway that supports two-way motor vehicle traffic in a single center lane and vulnerable road users in the edge lanes on either side. To bypass approaching motor vehicles drivers merge into the edge lanes, after yielding to any VRUs there, and return to the center after passing. ELRs do not use a centerline.

Germany uses ELRs in two ways. The first use is to create VRU facilities on urban roads, as many other countries do. For many years, ELRs were only allowed in urban areas by German standards. This article uses "ELR" when referring to this design. The first evaluation of this use was published in 1991.[3] A second use case was codified in the 2012 German rural road standards known as RAL (Richtlinien für die Anlage von Landstraßen).[4, 5] RAL established four recognizable design classes for rural roads. The intent was to create a tiered system of self-explanatory roads that elicit appropriate driving behavior. The standard design for roads below 3,000 ADT is known as EKL 4 and is an ELR-like design with narrow edge lanes not intended to support VRUs. "EKL 4" will be used when referring to this standard. This article presents information drawn from Germany's experience with both EKL 4 and rural ELRs.



Schematic of an Edge Lane Road.

The study of ELRs in other countries is complicated by translation issues and the different contexts in which they are used. Some notes on these challenges are:

- Collaboration between a U.S. author and native German author involved in this research helps mitigate these issues
- Other good German ELR research exists but was not cited due to its focus on urban use
- German ELRs primarily support bicyclists; other VRU types are not normally considered
- Motorists are expected not to drive in the edge lanes except when necessary
- Parking is not allowed in the edge lanes of the ELRs or EKL 4 treatments

German Progression to Standardized Local Rural Road Design

ELRs as cycling facilities were included in the 1995 edition of the ERA (Empfehlungen für Radverkehrsanlagen), a rough equivalent of the *AASHTO Bike Guide*.[6]

ELRs on urban streets were defined in the German Road Traffic Act (StVO) in 1997. They use a broken line marking similar to the United States. Maximum speed is limited to 50 kilometers per hour (km/h) (31 miles per hour [mph]). Motorists shall only use the edge lanes when necessary and must yield to VRUs. The StVO permitted use in urban areas only.

As part of an effort to restructure road guidance, a draft proposal was put forward by the German Road and Transportation Association (Forschungsgesellschaft für Straßen- und Verkehrswesen or FGSV) in 2008 to standardize on four designs for rural roads, EKL 1 through 4.[7] EKL 4 was the draft design for local rural roads. With no centerline and a broken line on each side, EKL 4 looked like a standard ELR but the 0.75 meter-wide (m) (2.5 feet [ft]) edge lanes are not intended to support VRUs. A planning speed of 70 km/h (43 mph) is the design basis. The proposed goals of EKL 4 were to:

- Slow MV speeds by using a broken line rather than a continuous line at the edges,
- Narrow the perceived roadway by moving the edge lines in from the pavement's edge,
- Promote increased attention and slower speeds when passing an approaching vehicle,
- Reduce roadway departure crash rates by moving drivers away from the road's edge, and
- Prolong pavement life by keeping vehicular loads away from the sensitive edge.

During this proposal's evaluation, the 2010 edition of ERA was issued.[8] Urban ELRs were included with recommended edge lanes of 1.50 m (4.9 ft) width and a minimum of 1.25 m (4.1 ft) (the draft of the next edition only mentions 1.50 m). The center must be wide enough to accommodate encounters of two cars. The ERA scales maximum allowed MV volumes with speed—up to 1,000 MV/hr at 50 km/h and up to 1800 MV/hr at 30 km/h (19 mph).

K314 near Neustadt am Rübenberge in Lower Saxony, Germany.

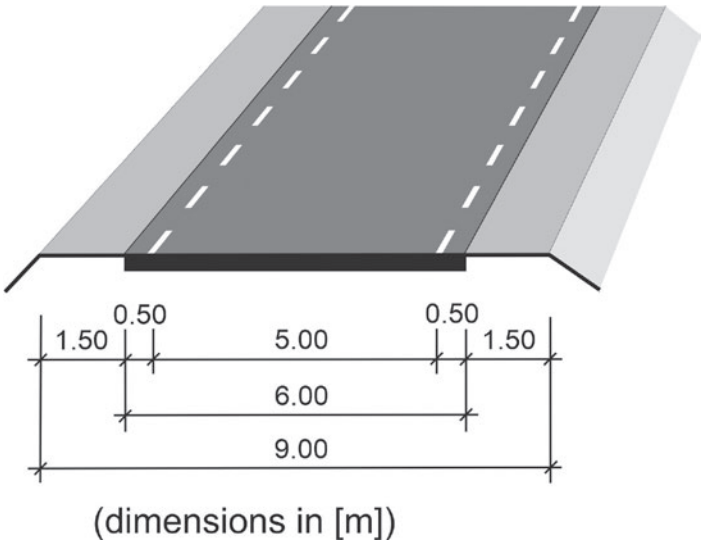


Figure 1. EKL 4 Dimensions from 2012 RAL.

Finally, RAL was published in 2012, with the following design parameters for EKL4 (Figure 1): [4]

- Volumes up to 3,000 ADT and heavy vehicles up to 150 vehicles/day,
- The broken line consists of a 1-m (3.3 ft) stroke with a 1-m gap,
- Edge lane width of 0.50 m,
- Planning speed of 70 km/h, and
- No specific sight distances recommended for this standard.

An amendment to the StVO incorporating the EKL 4 standard is awaiting the results of an ongoing study of EKL 4 on narrow, rural roads.[9] Its aim is to assess the upper ADT limits for EKL 4 and to explore if and at what point safety benefits decrease. To date, more than 80 routes have already been converted.

Similar to the grassroots adoption of ELRs in the U.S., the federal states Baden-Württemberg and North Rhine-Westfalia now allow ELRs on rural roads up to 4,000 to 5,000 ADT.[10,11]

German Research on EKL 4 and Rural ELRs

A 2010 study combined field observations on a new EKL 4 facility with driving simulator tests.[12, 13] The facility included 0.75m wide edge lanes, was 1.2 km (0.6 miles) long, and supported approximately 1,800 ADT with 90 heavy vehicles per day. Results showed a reduction in speed, a lack of unsafe vehicle encounters, and positive driver behavior during passing movements. Speed reductions lessened between the 3 month and 1-year post-conversion measurements but were below the pre-conversion measurements in both cases. Vehicle position moved to the center on straight segments and stayed to the right on curves where sight distance was limited.

A study of EKL 4 was conducted from 2008-2012 and was published in 2015. It included simulator testing (59 drivers), driver surveys, drivers unfamiliar with the new facilities driving in instrumented vehicles (20 drivers), and observations of drivers on five new EKL 4 roads (35 runs in each direction on each facility).[14] The new EKL 4 facilities ranged from 2.0 to 8.0 km (1.2 to 4.0 miles) in length, 1,358 to 3,146 ADT, and 5.0 to 6.0 m (16.4 to 19.7 ft) in pavement width. The simulator testing showed that drivers drove most slowly on narrow roads with wide edge lanes. Generally, drivers drove faster on roads with a centerline and with narrow edge lanes. Center lane widths of 4.5 m (14.8 ft) and greater tend to have a speed-increasing effect and narrower center lanes had a reducing effect. Reductions in speed were stronger with wide edge lanes. A significant increase in the distance to the pavement edge is seen compared to configurations with a centerline and greater distance to the pavement edge is seen with wide edge lanes versus narrow. Field testing showed little difference in 85th percentile and 50th percentile speeds with some test sections seeing a small increase in MV speeds after ELR conversion. Field encounters with cyclists mimicked the results seen in simulation—drivers slowed and passed with sufficient distance. Crash records for all five test sections from 3 years before and 3 years after EKL 4 conversion were analyzed but crash numbers were too small to draw any conclusions. The authors noted, "the majority of crashes were caused by animals or occurred at intersections." Despite the positive effects of wider edge lanes, authorities included the 0.50 m width in RAL to prevent confusion with VRU-supporting ELRs.

The largest study of rural ELRs was finished in 2017.[15] This work studied 18 pilot ELRs through 2013 and 2014 with wider edge lanes than EKL 4 to provide bicycle facilities. ELRs were restricted to a maximum of 4,000 ADT, and 150 heavy vehicles/day. Speed limits were reduced to 70 km/h or even 50 km/h. Measured volumes ranged from 480 to 4,080 ADT, facility lengths ranged from 800 to 7,700 m (2,624 to 25,262 ft), and pavement width ranged from 5.0 to 8.1 m (16.4 to 26 ft). Bicyclist symbols were used in the edge lanes. Two of the 18 sites used red-colored edge lanes. The study included videos of road users recorded from a fixed location (~24,000 road users over 187 hours), video of unsuspecting drivers recorded by a pursuit vehicle (680 drivers), road user surveys, crash data analysis, and speed surveys (1 pre- and 2 post-conversion studies for all routes). Public education efforts on the new treatments occurred in the early post-conversion period. Fifteen roads had a uniform 3 years of pre- and 2 years of post-conversion crash data available. The number of post-conversion crashes per year fell by about a third overall (lower speed limits contribute to this change also). Crashes involving personal injury fell more sharply than total crashes. Fatal crashes only occurred in the before period (two crashes). No head-on crashes with serious consequences occurred in the after period. Interestingly, the study states "There is no evidence of a reduction in crashes in which vehicles leave the road." Wider roads showed increased speeds but MV volumes >2,000 ADT led to speed reductions on those wide roads. The red edge lanes saw even greater speed reductions. 85th percentile truck speeds fell by 12 km/h (7.5 mph). A key finding of the study was that around 80 percent of the drivers drove in the edge lanes without an approaching MV present. This corresponds to the observations made with urban ELRs. Along with the small crash numbers this led to the conclusion to continue with the smaller edge lane width of 0.50 m in the EKL 4 standard and not to change legislation to allow for ELRs on rural roads to accommodate cyclists.

K24 near Schneverdingen in Lower Saxony, Germany.

Eastern Road, Scarborough, Maine, USA.

American Experience with Rural ELRs

Germany's success with their EKL 4 and ELR designs on rural roads mirrors the U.S. experience. NCHRP Report 362, FHWA-RD-87/008, NCHRP Report 633, and various crash modification factors, e.g., CMF 5404 all associate significant reductions in crash rate and reductions in roadway departure crashes with wider shoulders.[16–19] The Handbook of Road Safety Measures and FHWA/VCTIR 14-R3 show that the absence of centerlines on low-volume roads is safe.[20,21] The CMF Clearinghouse lists a crash modification factor value of .56 for the conversion to an edge lane road configuration, which approximates the crash reductions seen in the largest German study.[11, 15] Data

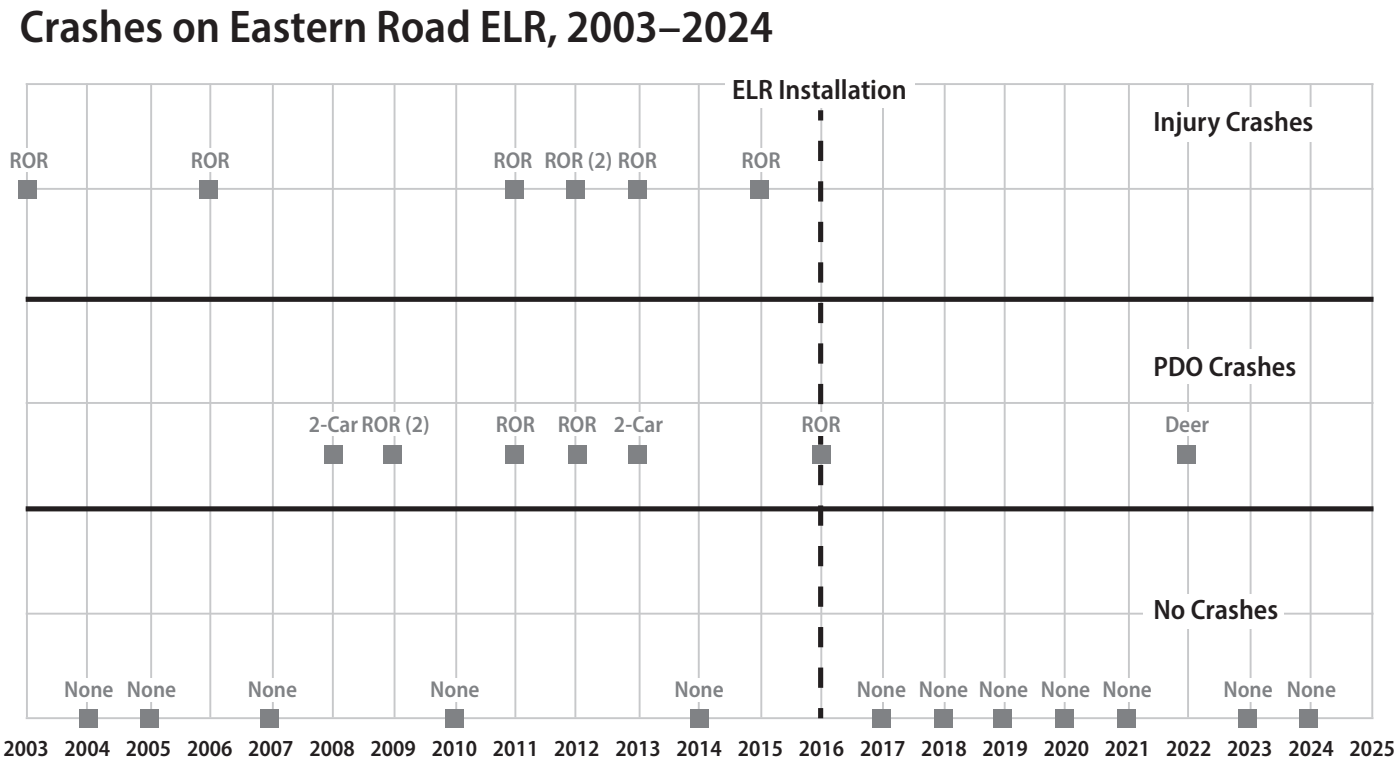


Figure 2. Eastern Road Crashes Before and After ELR Conversion – number in parenthesis indicate number of crashes.

from a recent, yet-to-be-published study that evaluated crash data on 16 ELRs in the United States over 8 years (5 years pre-conversion, 3 years post-conversion) found a crash rate reduction of 33 percent and no head-on crashes. This result aligns with both the CMF crash reduction rate and the findings from the large German study.

In a 2021 study of American ELRs, crash data for a rural ELR on Eastern Road in Scarborough, Maine showed a significant drop in roadway departure crashes following ELR conversion.[23] Figure 2, presenting that dataset, shows 11 roadway departure crashes (indicated as "ROR" for run-off-road) in the 13.5 years preceding ELR conversion and zero ROR crashes in the 8 years following ELR conversion.

Conclusion

By positioning drivers in the road's center, ELRs have effects that predict improved safety. Available sight distance is increased for intersections, driveways, and other roadside challenges. The multiple threat risk created as a driver travels next to parked vehicles is reduced. Greater distance to the pavement edge on narrow roads provides a greater safety margin. ELRs likely cause motorists to pay greater attention to the driving task. In some settings, ELRs reduce MV speeds. All these effects are independent of the treatment's benefits to VRUs. These effects result in the improved safety being seen in evaluations of crash data on American ELRs.

Germany has been using and evaluating various forms of the ELR treatment since at least 1991. Facing similar crash issues with low-volume, rural roads as the United States, Germany adopted a standardized ELR-like design for low-volume, rural roads called EKL 4. This design targets the safety profile on those roads but does not support VRUs. The EKL 4 standard was adopted in 2012 and research has shown the treatment to be safe and successful. These experiences highlight ELRs as a treatment that the United States and other countries should consider as a remedy for the stubborn fatal and serious injury crash rates on low-volume, rural roads. More information on this topic is available at https://www.edgelaneroads.com/rural-edge-lane-roads.html. **itej**

References

1. *2017 NHTSA Rural/Urban Comparison of Traffic Fatalities*. National Highway Traffic Safety Administration; 2019.
2. Local and Rural Road Safety Program | FHWA. Accessed April 30, 2025. https://highways.dot.gov/safety/local-rural (Accessed October 31, 2025).
3. Füsser K., Steinbrecher. *J.Friedrich-Ebert-Strasse, Krefeld - Wirkungsanalyse Einer Mehrzweckspur Als Vorher-Nachher- Untersuchung Aachen (Impact Analysis of a Multi-Purpose Track as a before-and-after Study on J. Friedrich-Ebert-Strasse in Krefeld, Germany).*; 1991.
4. FGSV. Richtlinien für die Anlage von Landstraßen (Guidelines for the Design of Rural Roads). Published online 2012. https://www.fgsv-verlag.de/ral-e

5. Thomas Richter. *Road Planning - Freeways and Country Roads*. 1st ed. Springer Wiesbaden; 2023. https://link.springer.com/book/10.1007/978-3-658-35189-2 (Accessed October 31, 2025).
6. FGSV. Empfehlungen für Radverkehrsanlagen - ERA, (Recommendations for Cycling Traffic Facilities). Published online 1995. https://www.fgsv-verlag.de/era
7. Richtlinien für die Anlage von Landstraßen (Guidelines for the Design of Rural Roads). RAL – The new road types for rural roads. 2008. https://www.bast.de/DE/Themen/Sicherheit/HF_2/Massnahmen/strassentypen.html
8. FGSV. Empfehlungen für Radverkehrsanlagen - ERA, (Recommendations for Cycling Traffic Facilities). Published online 2010. https://www.fgsv-verlag.de/era (Accessed October 31, 2025).
9. R. Koettnitz, P. Becher. Markierung schmaler Landstraßen (Marking of Narrow Rural Roads), Ongoing research FE 02.0412/2017/FGB.
10. Christian Eckert. Einrichtung von Schutzstreifen außerorts (Establishment of protective lanes outside of town). *nahmobil*. https://www.agfs-nrw.de/fachthemen/planung-und-nahmobilitaet/s-pedelecs-1-1. May 2024. (Accessed May 11, 2025).
11. State of Baden-Württemberg. Land ermöglicht Fahrradschutzstreifen außerorts (State allows cycle lanes outside of town). January 29, 2023. https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/land-ermoeglicht-fahrradschutzstreifen-ausserorts-1 (Accessed May 11, 2025).
12. Thomas Richter, Benedikt Zierke. Effect of a New Cross-Section Design on Low-Volume Roads. *TRR*. 2010;(No. 2195):14-19. doi:10.3141/2195-0
13. Thomas Richter, Benedikt Zierke. Safe design of rural roads by normalized road characteristics. In: *European Transport Conference, 2009 Proceedings.* Association for European Transport (AET); 2009. https://aetransport.org/past-etc-papers/conference-papers-pre-2009/conference-papers-2009 (Accessed October 31, 2025).
14. Bernard Schlag, Jana Voigt, Christian Lippold, Andreas Hegewald. *Auswirkungen von Querschnittsgestaltung und längsgerichteten Markierungen auf das Fahrverhalten auf Landstraßen (Effects of cross-sectional design and longitudinal markings on driving behavior on country roads)*. Federal Highway Research Institute (bast); 2015. https://bast.opus.hbz-nrw.de/files/1103/V249b_ELBA.pdf (Accessed October 31, 2025).
15. Bernd Sievers. *Schutzstreifen außerorts - Modellversuch zur Abmarkierung von Schutzstreifen außerorts und zur Untersuchung der Auswirkungen auf die Sicherheit und Attraktivität im Radverkehrsnetz (Protective stripes outside built-up areas - pilot project to mark protective stripes outside built-up areas and to investigate the effects on safety and attractiveness in the cycling network)*. Ministerium für Energie, Infrastruktur und Digitalisierung Mecklenburg-Vorpommern; 2017 https://www.dstgb.de/themen/mobilitaet/radverkehr/ergebnisse-des-modellprojekts-schutzstreifen-ausserorts/ (Accessed October 31, 2025).
16. Zegeer CV. *NCHRP Report 362 Roadway Widths for Low-Traffic-Volume Roads*.; 1994.
17. Zeeger, C.V., Hummer, J., Reinfurt, D., Herf, L., Hunter, W. *Safety Effects of Cross-Section Design for Two-Lane Roads, FHWA/RD-87/008*. Federal Highway Administration (FHWA); 1987.
18. Stamatiadis, N., Pigman, J., Sacksteder, J., Ruff, W., Lord, D. *Impact of Shoulder Width and Median Width on Safety*. Transportation Research Board; 2009.
19. Zeng, H., Schrock, S., Mulinazzi, T. *Evaluation of Safety Effectiveness of Composite Shoulders, Wide Unpaved Shoulders, and Wide Paved Shoulders in Kansas*. Kansas Department of Transportation; 2013.
20. Elvik, R., Vaa, T. *Handbook of Road Safety Measures*. First. Elsevier; 2004.
21. Lance Dougald, Benjamin Cottrell, Young-Jun Kweon, In-Kyu Lim. *Investigation of the Safety Effects of Edge and Centerline Markings on Narrow, Low-Volume Roads*.; 2013.
22. *Crash Modification Factor ID: 10976 Install Edge Lane Road (ELR)*. Federal Highway Administration (FHWA); 2021. https://cmfclearinghouse.fhwa.dot.gov/detail.php?facid=10976 (Accessed May 2, 2025).
23. Williams M, Lamera M, Bauranov A, Voulgaris C, Pande A. *Safety Considerations for All Road Users on Edge Lane Roads*. Mineta Transportation Institute; 2021. doi:10.31979/mti.2021.1925

Michael Williams (M), *is a transportation consultant specializing in active transportation, traffic calming, rural environments, small towns, and shared street treatments for more than 15 years. In addition to 15 years' experience as a licensed public works general contractor, he holds three engineering degrees and has been awarded more than 10 patents. Michael researches edge lane roads to increase awareness and adoption of this new roadway type. Michael's website, www.edgelaneroads.com, is the Internet's most complete source of information on the treatment.*

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Answer to "Where in the World?" on page 11: Waynesville, NC, USA. Photo submitted by Pete Yauch, P.E., PTOE, IMSA, RSP2I (H).