The following case studies are excerpts from *Emerging Safety Countermeasures for Wrong-way Driving*—a report developed by the Department of Civil Engineering of Auburn University (AU) under contract with the American Traffic Safety Services Association (ATSSA). The Illinois Department of Transportation, United States Department of Transportation, and Federal Highway Administration provided additional support and contributions. If you would like to obtain a full copy of the report, please email info@zumar.com.

**Case 3: Red retroreflective strips and red retroreflective raised pavement markers, various locations in Texas**

Two low-cost countermeasures, red retroreflective strips on sign supports and red retroreflective raised pavement markers (RRPMs), are often used by transportation agencies to increase the nighttime conspicuity of DO NOT ENTER and WRONG WAY signs and associated pavement markings, respectively.

The MUTCD states that a strip of retroreflective material attached to a sign support shall be at least two inches in width and shall be placed for the full length of the support from the sign to within two feet above the edge of the roadway. Its color shall match the background color of the sign except for the YIELD and DO NOT ENTER signs, which shall have red-colored strips. For enhancing pavement markings targeted at preventing wrong-way maneuvers, the MUTCD provides options that allow the use of red RRPMs to supplement wrong-way arrows placed on the roadway (FHWA 2009). Figure 10 shows a nighttime view of DO NOT ENTER and WRONG WAY signs with red retroreflective strips.

![Figure 10. Red retroreflective strips on sign posts to enhance nighttime visibility. (Image: Huaguo Zhou)](image)

The North Texas Tollway Authority (NTTA), which are actively addressing wrong-way driving on their system, established the Wrong-Way Driving Task Force in 2009 to investigate a sudden increase of wrong-way related crashes on one NTTA facility during the first half of the year. The NTTA staff conducted a thorough analysis of all wrong-way crashes within their jurisdiction, followed by researching possible countermeasures, and documented their findings and recommendations in a special report (NTTA 2009). The task force recommended a comprehensive “3E” approach, which combines and focuses Engineering countermeasures, law Enforcement, and public Educational efforts on a specific problem in an effort to reduce future incidents. Accordingly, the NTTA immediately implemented several low-cost engineering enhancements across their system, including the combination of red retroreflective strips on all DO NOT ENTER and WRONG WAY sign supports and red RRPM-supplemented wrong-way arrows at every exit ramp. Figure 11 and 12 depict a treated NTTA location in daytime and nighttime conditions, respectively.

![Figure 11. NTTA exit ramp with red retroreflective strips on sign supports and red RRPM-supplemented wrong-way arrow pavement markings (daytime). (Image: Yang Ouyang)](image)

Moreover, the NTTA updated its signing and marking standards to require the use of red RRPM-supplemented wrong-way arrow pavement markings at all exit ramps in the future. Combined, these low-cost enhancements to signing and markings at NTTA exit ramps are expected to help make these locations less susceptible to wrong-way driving incidents by increasing visibility and conspicuity, especially during nighttime conditions.

**AGENCY CONTACT:** Yang Ouyang, PE, PTOE
Traffic Operations Engineer, North Texas Tollway Authority
214-224-2256 | youyang@ntta.org
Case 8: Enhanced DO NOT ENTER and WRONG WAY signs, various locations in Illinois and Texas

Several studies concluded that impaired drivers, older drivers, and fatigued drivers were overrepresented in wrong-way driving crashes (Copelan 1989; Moler 2002; NTTA 2009; Zhou et al. 2012; Zhou et al. 2014). Other studies (FHWA 2001; Potts et al. 2004) suggest that signs that are larger than the minimum required dimensions can increase their visibility, especially for older drivers at night.

The MUTCD requires a minimum of one DO NOT ENTER sign where traffic is prohibited from entering a restricted roadway, as well as one WRONG WAY sign placed along the right side of the exit ramp or one-way roadway, some further distance beyond the crossroad (FHWA 2009). The MUTCD also prescribes the nominal (minimum) dimensions of the signs based on the type of roadway and number of lanes (i.e. single or multiple lanes, expressway or freeway, etc.). However, the MUTCD allows as an option the use of larger-than-minimum-dimension signs, stating that there may be situations for “special applications where speed, volume, or other factors result in conditions where increased emphasis, improved recognition, or increased legibility is needed, as determined by engineering judgment or study.”

In response to an increase in wrong-way driving crashes in the Chicago area, the Illinois Department of Transportation (IDOT) replaced nominal sized DO NOT ENTER signs with larger ones, going from 30” × 30” to 36” × 36” to increase the visibility of these signs at a number of exit ramps. Figure 22 depicts a comparison between the conditions before and after at IL 394 northbound to US 30 westbound Will County.

Another example of oversizing signs to address wrong-way driving comes from the NTTA in the Dallas area. This location is at the southern terminus of the Dallas North Tollway (DNT) where it joins side-by-side with a one-way local street and becomes part of the local street network. The NTTA observed a high frequency of wrong-way incidents originating from this area due to the adjacent developments and the unique roadway configuration. Similar to the wrong-way driving countermeasures that the NTTA deployed at other locations on their system, this site was treated with multiple oversized signs, flashing LED border signs, red retroreflective strips on sign posts, low-mounted DO NOT ENTER and WRONG WAY signs, and red RRPM-enhanced wrong-way arrows all at the same location. Since the implementation of these treatments, the number of wrong-way driving incidents has decreased. While it is not possible to explicitly associate the wrong-way driving reduction to one specific countermeasure, the larger signs contribute to the overall enhanced visibility and conspicuity of the locations, and proved a degree of valuable redundancy to further ensure that wrong-way driving is less likely. Figure 23 depicts the first set of enhanced WRONG WAY signs used by the NTTA at this location.

AGENCY CONTACT: Regina Cooper
Traffic Operations Engineer, IDOT District 1
847-705-4153 | regina.cooper2@illinois.gov

Yang Ouyang, PE, PTOE
Traffic Operations Engineer, North Texas Tollway Authority
214-224-2256 | youyang@ntta.org

American Traffic Safety Services Association
15 Riverside Parkway, Suite 100 | Fredericksburg, VA 22406-1022
540-368-1701 | www.atssa.com