



Guideline for Enhancing Delineation at TxDOT Low Water Crossings

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Cooperative Research Program

TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS

in cooperation with the
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tti.tamu.edu/documents/0-6992b-P2.pdf](https://tti.tamu.edu/documents/0-6992b-P2.pdf)

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TxDOT Research Project 0-6992: *Traffic Safety Improvement at Low Water Crossings*. The laboratory and controlled field study testing results allowed the researchers to recommend marking or marker treatments that will provide long-range warning of a flooded roadway condition at night while delivering adequate short-range visibility to help motorists traverse flooded areas during daylight and nighttime conditions. The following provides guidance that TxDOT could apply to improve conspicuity and visibility at low water crossings.

The Problem

The most critical situation is the flooded roadway condition at night. Drivers may not be able to see the water across the roadway in time to stop safely due to the lack of ambient lighting, lack of warning systems, and/or familiarity with roadway conditions. Tests conducted by the Texas A&M Transportation Institute indicated that both the markings and Retroreflective Raised Pavement Markers (RRPMs) evaluated lose visibility when covered with water. This loss of visibility can be used to provide additional positive guidance that the road is covered with water. The visibility of pavement markings is generally limited to within 500 ft under low beam illumination. RRPMs can be used to provide much longer detection distances.

Guidelines

For long-range warning of the flooded roadway condition at night, the researchers recommend

- Apply RRPMs to the center line and lane lines through the areas where flooding conditions may occur. RRPM should be carried a minimum of 500 ft outside of the potential flooded area. The roadway configuration should govern the type of RRPM used as follows:
 - For two-lane two-way roads, yellow RRPMs should be used along the center line area (See Figure 1).
 - For multilane undivided highways, yellow center line and white lane line RRPMs should be implemented (See Figure 2).
 - For divided highways, white lane line RRPMs should be implemented (See Figure 3).
- Using the minimum allowable spacing on the RRPMs for the roadway type and marking configuration.
- At problematic locations, RRPMs could be used along the edge line markings to provide additional warning and guidance.

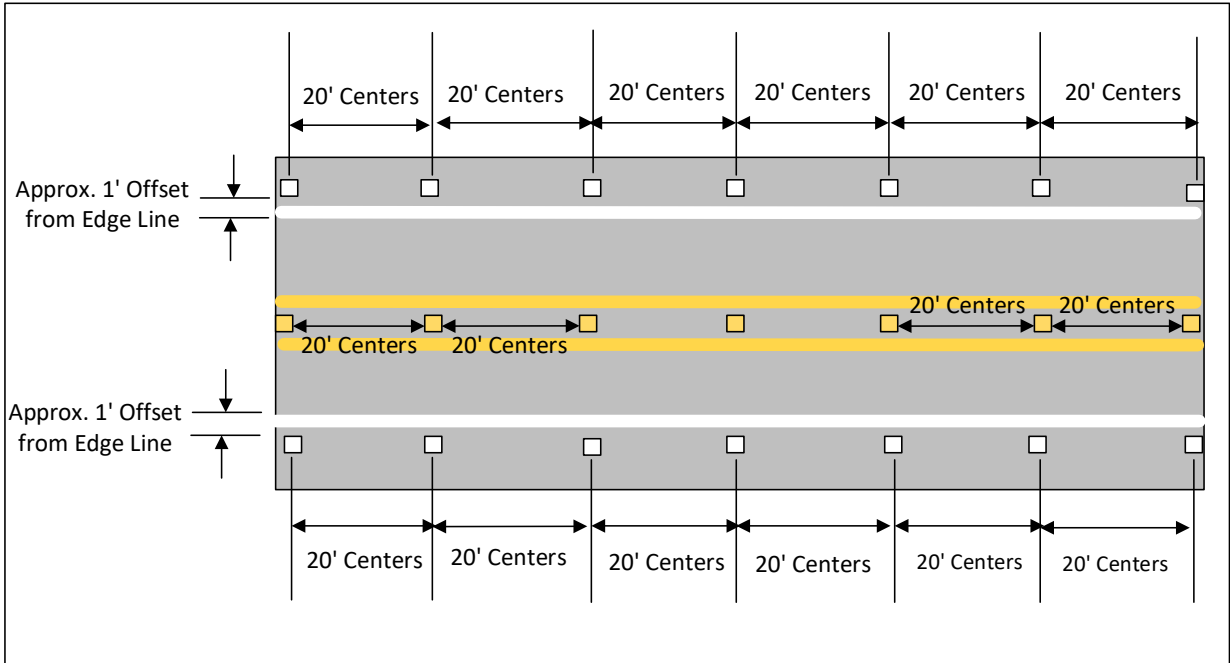


Figure 1. Recommended RRPM Spacing and Placement for Low Water Crossing and Flood-Prone Areas on Two-Lane Highways.

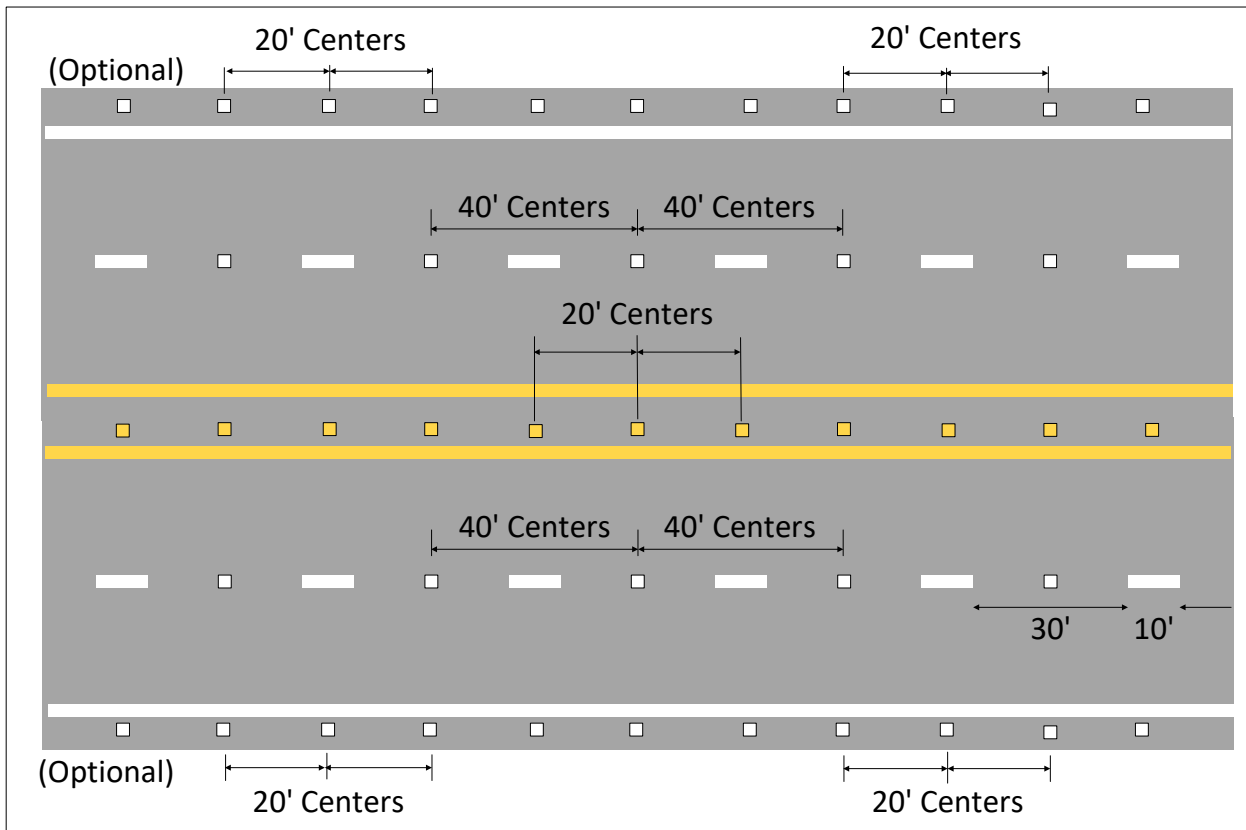


Figure 2. Recommended RRPM Spacing and Placement for Low Water Crossing and Flood-Prone Areas on Undivided Multi-lane Highways.

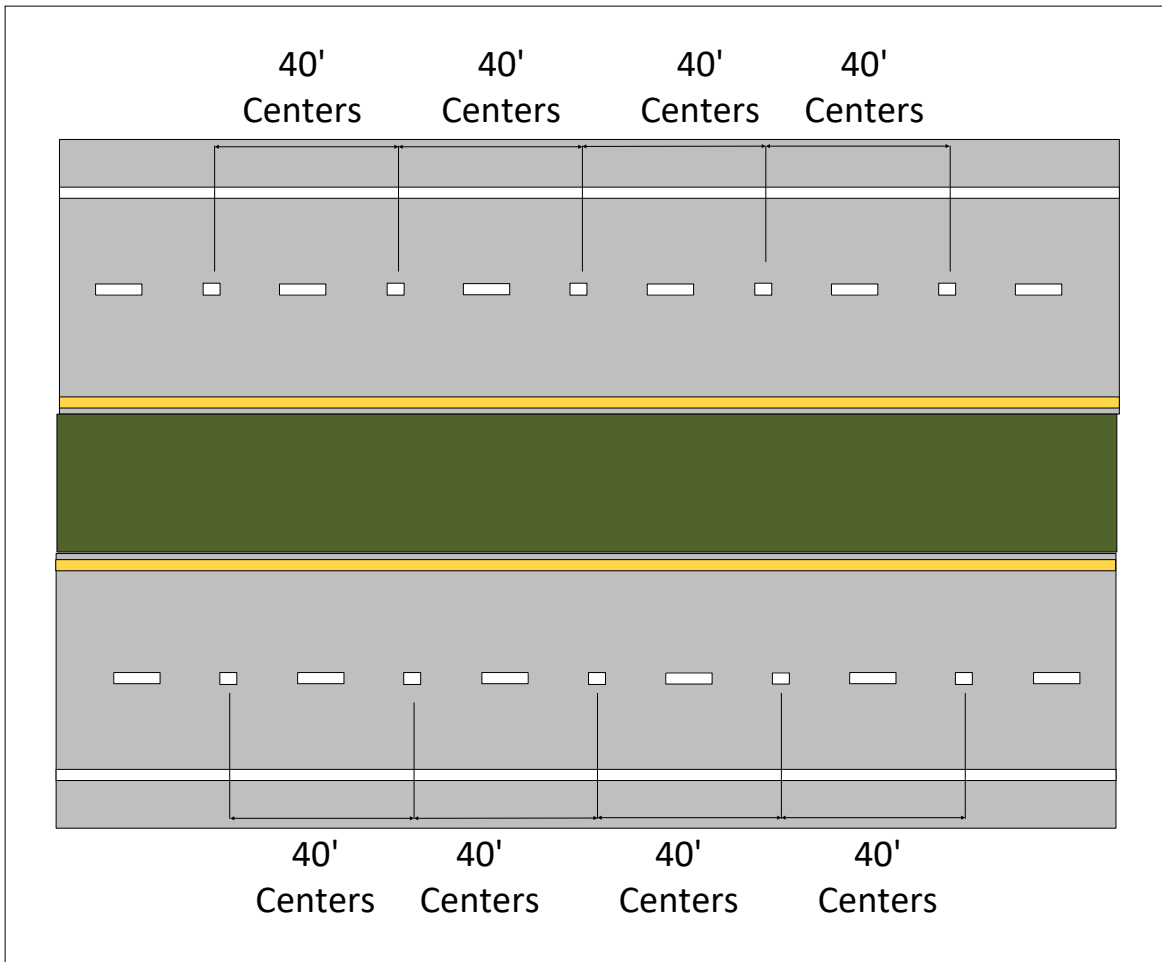


Figure 3. Recommended RRPM Spacing and Placement for Low Water Crossing and Flood-Prone Areas on Divided Multi-lane Highways.

Other suggested improvements include the following:

- Use both white and yellow standard pavement markings throughout the same areas the RRPMs would be implemented. These markings will help guide motorists through the LWC area when the water is shallow. At night and in deeper water situations during the day, these markings will be less visible or not visible at all and thus may serve as a deterrent to enter the water because of the lack of visibility.
- Use traditional pavement marking materials. The researchers did not find any benefit in flooded conditions of utilizing more expensive preformed tape or wet-weather pavement marking systems over traditional paint markings.
- Consider using Internally Illuminated Raised Pavement Markers (IIRPMs) at problematic locations where drivers regularly drive through high water conditions and drive off the roadway. Yellow IIRPMs could be implemented to improve delineation of the center line of the roadway. In conjunction with an active warning system for flooded conditions, red IIRPMs and signing could be used to indicate a stop and turn around condition due to flooding. The red IIRPMs could be placed across the lane and activated automatically when

flooded conditions limit the safe passage of the roadway. This type of setup should be limited to problematic areas due to the added costs compared to the low costs of standard markings and RRPMS. Using the red IIRPM in the manner suggested requires a request for experimentation from the FHWA.