Texas Department of Transportation

UNIVERSITY of HOUSTON

PROJECT SUMMARY REPORT

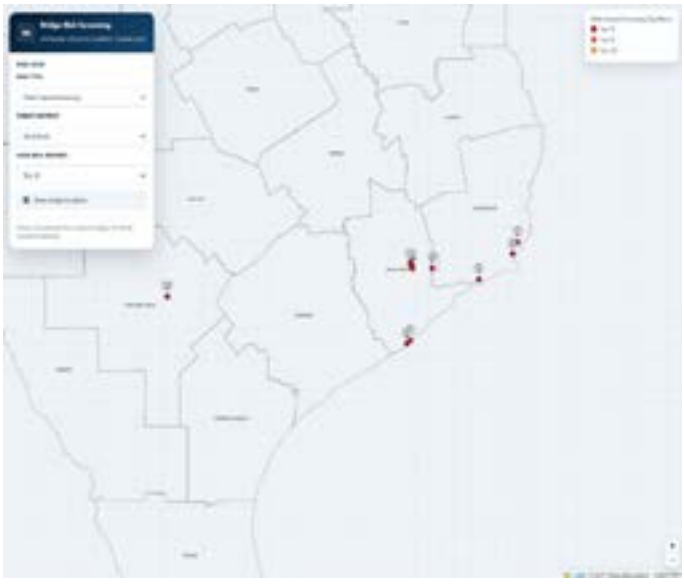
0-7239: Synthesis: Assess Hazard and Vulnerability Prioritization for Texas Bridges and Tunnels

Background

Recent incidents in Texas and across the United States have shown that natural and human-caused hazards can damage bridges and tunnels, threaten public safety, disrupt transportation, and require costly repairs. Project 0-7239 was initiated to develop a systematic approach for assessing and quantifying these hazards and vulnerabilities across Texas.

Building on this objective, the project developed statewide screening methods for fatigue, flood overtopping and scour, hurricane surge, heavy-vehicle pier collision, overload, overheight collision, tornado, vessel collision, and wildfire. The methods rank eligible bridge records within each risk category and identify bridges that recur near the top of multiple lists. The results are connected to bridge-level review, response selection, the GIS Tool, and proposed TxDOT manual language.

BRIDGE RISK SCREENING GIS TOOL



Bridge Risk Screening GIS Tool displaying the statewide Multi-Hazard Top 10 with TxDOT district boundaries, bridge ranks, filters, and legend.

What the Researchers Did

The research team reviewed research studies, federal and state guidance, state DOT practice, and bridge incidents. The team then assembled four data groups: bridge records for inventory, condition, load rating, and clearance; traffic and loading records for AADT, crashes, and weigh-in-motion; hazard records for flood, storm surge, tornado, and wildfire; and site evidence from vessel tracks, surface currents, and aerial imagery.

For each risk, the team defined the bridge population, assigned the applicable source information, calculated the risk-specific measure documented in the final report, and ranked the bridges at state and district scales.

The recurrence method groups the highest statewide ranks into bands and records when a bridge appears in more than one band. The contributing risk fields show which hazards produced each repeated appearance.

The GIS Tool allows a user to select a risk and TxDOT district, display a Top 10, Top 50, Top 100, or full ranked list, control supporting map layers, and open bridge-level values and imagery. Hazard-specific decision trees connect the confirmed ranking factor to inspection, analysis, traffic control, protection, strengthening, repair, rehabilitation, replacement, or project development.

What They Found

Fatigue. The Top 10 follow major freight, coastal, and high-demand corridors. Houston has three sites, Beaumont and Paris have two each, and Austin, Dallas, and Yoakum have one each.

Research Performed by:
University of Houston
Center for Transportation Research, UT Austin

Research Supervisor:
Dr. Lu Gao, UH

Researchers:
Yi-Lung Mo, UH
Zhe Han, CTR

Project Completed:
08-31-2026

Flood overtopping and scour. The Top 10 are concentrated in Central Texas, with five bridges in the San Antonio District, three in Austin, and two in Waco. This distribution follows Texas's Flash Flood Alley, which extends through San Antonio, Austin, and Waco. Eight of the ten carry FM or RM routes across creeks or rivers. In the southern part of this corridor, the steep terrain, shallow soils, and narrow channels of the Edwards Plateau generate rapid, high-velocity runoff that increases exposure to overtopping and scour.

Hurricane surge. All ten leading bridges are in Houston District, forming a coastal group around Galveston Bay and nearby connecting routes.

Heavy-vehicle pier collision. The leading sites are spread among Fort Worth, Houston, San Antonio, Dallas, and Pharr. Fort Worth, Houston, and San Antonio each contribute two sites.

Overload. Dallas contains four of the Top 10 and Austin contains three. Beaumont, Corpus Christi, and Houston each contribute one, producing a pattern centered on heavily used freight corridors.

Overheight collision. Houston contains four of the Top 10, while Atlanta, Bryan, Dallas, Fort Worth, Laredo, and Odessa each contain one. The locations are distributed across urban truck routes rather than one corridor.

Tornado. Houston and Dallas each contain three of the Top 10. Corpus Christi, Fort Worth, Pharr, and Waco each contain one, combining Gulf Coast and inland locations. Vessel collision. The Top 10 are concentrated on navigable coastal waterways: seven sites are in Houston, two are in Yoakum, and one is in Beaumont.

Wildfire. Amarillo contains four of the Top 10 and Houston contains two. Abilene, Austin, Bryan, and Wichita Falls each contain one, linking the Panhandle concentration with several localized central and coastal sites.

What This Means

TxDOT can move from statewide screening to bridge action through the same six-step process used in the final report:

1. Select candidate bridges. Choose a risk-specific list or the multi-hazard recurrence list and apply the state or district view needed for the review.
2. Check bridge identity and source information. Confirm the structure number, location, eligibility, source values, rank, and factors that produced the ranking.
3. Review current condition and identify the ranking factor. Examine inspection records, site conditions, completed work, and the technical records tied to the hazard. Determine whether the factor remains present.
4. Select the response. Follow the decision tree for the confirmed factor to choose inspection, analysis, traffic control, protection, strengthening, repair, rehabilitation, replacement, or project development.
5. Update relevant data and records. Record the review, corrections, completed work, and selected action in the bridge and program records used by the next assessment.
6. Rerun and review the statewide rankings. Recalculate the affected rankings after a scheduled update, material event, or source-data change and begin the next review cycle from the revised lists.

State program staff maintain the method and statewide data, whereas district staff confirm site conditions and carry out the bridge review. This division of work closes the loop because each completed review changes the information used in the next screening cycle.

For More Information

Project Manager:
Jade Adediwura, RTI Jade.Adediwura@txdot.gov

Research Supervisor:
Lu Gao, UH gaolu1504@gmail.com

Project Monitoring Committee Members:
Bernie Carrasco, Biniam Aregawi, Niyi Arowojolu, Frank Estrada III, Darshankumar Vadadoriya

Research and Technology Implementation Division
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
Keyword: Research

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