23 CFR Part 667 Report

November 2020

Introduction

23 CFR 667 requires that state transportation departments identify assets that have been repeatedly damaged by emergency events. Specifically, state transportation agencies "shall conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events."

The aim of this report is to outline the Texas Department of Transportation (TxDOT) method of compliance with Part 667, and to update the results in consideration of events and assets repaired through 2019. Rule §667.5 requires that the evaluation period carry through December 31 of the year preceding the year in which an evaluation is due. This analysis period includes repairs and improvements done in response to declared disasters in years 1997 through 2019.

TxDOT routinely considers the risk of weather events in the planning, development, and design phases of a project. Resiliency is built into bridges and pavements to maintain safe, navigable roadways at the lowest practicable cost over the life cycle of those assets. TxDOT's Maintenance Division leads the effort to identify assets addressed by Part 667. Other divisions and districts are contacted as needed to provide specific information on assets meeting the evaluation criteria.

The initial 2018 Part 667 report considered only assets that are part of the National Highway System (NHS). No qualifying recurrences were found in the initial NHS analysis. In compliance with Rule §667.7(b), this report, and all updates to follow, will additionally consider non-NHS roads and bridges.

As of this update, one bridge (SH 82 over Sabine Lake) and two sections of roadway (FM787 and SH316) have required emergency repairs on two or more occasions, and have met all the other requirements for consideration under Part 667. The bridge has since been replaced, and no repairs due to subsequent events have been needed. These cases are discussed with more detail in the results section of this report.

Qualifying Recurring Events

For proper recurrence analysis, it is imperative that the project data source be complete, reliable and current. TxDOT maintains well-categorized databases containing relevant details of construction, maintenance and repair records. The history of projects in these systems is sufficient to satisfy the scope of Part 667 requirements.

Several details factor into a determination of a true Part 667 recurrence. Many projects are categorized as Emergency Response (ER), which includes all projects resulting from declared disasters, and others. Projects are not categorized or organized by disaster

declaration from the Texas Governor or US President of the United States. However, a project's status of resulting from a declared disaster can be deduced by the recorded details. The time, location, funding source(s), ER category and summary description of a project all help to determine whether it qualifies for Part 667 consideration.

The criteria used to qualify events (and affected assets) are summarized below.

- The ER project is specifically to repair or increase resilience of an asset. Ancillary work such as debris cleanup and traffic control do not qualify.
- The asset is a road or bridge (or reasonably distinct section or component thereof).
- Damage to the asset resulted from an emergency event declared by the Governor or U.S. President.
- The same asset was damaged by two or more separate events.
- Repair work, or a combination of repair and enhancement was implemented respectively in response to the separate events.

Emergency Response to Events

TxDOT oversees many emergency response projects that are important to the transportation system, but are not considered road or bridge projects. A large portion of emergency work is performed on appurtenances such as signs, signals, electronics cabinets, lighting systems etc. Emergency projects are also executed for debris removal, traffic control, motorist assistance, counterflow operations and other support functions not necessarily related to the repair of a facility. These types of emergency projects are not included in this analysis. However, projects that involve guardrails or other accessories immediately adjacent to the roadway are considered if the project also addresses nearby erosion of the shoulders or edges of driving lanes. Protective features such as paved shoulders and riprap covering a bridge abutment are included as part of the asset.

Qualifying repairs can be easily identified for discrete assets such as culverts and short bridges. Long continuous assets such as causeways and roadways (where the length that constitutes a distinct asset has not been defined) are more difficult to delineate for consideration of recurrences. This problem was addressed by carefully locating the qualified ER projects and recording their coordinates. The project location is typically at an intersection, culvert, bridge abutment, or other distinct feature. If a project spanned a length of roadway, its midpoint was found.

With the projects well located, a GIS point distance tool was used to find all projects that were a tenth of a mile (geodesic ground distance) apart or less. Figure 1 shows several project locations and their tenth-mile buffers. Projects falling within another project's buffer zone were highlighted and examined in more detail.

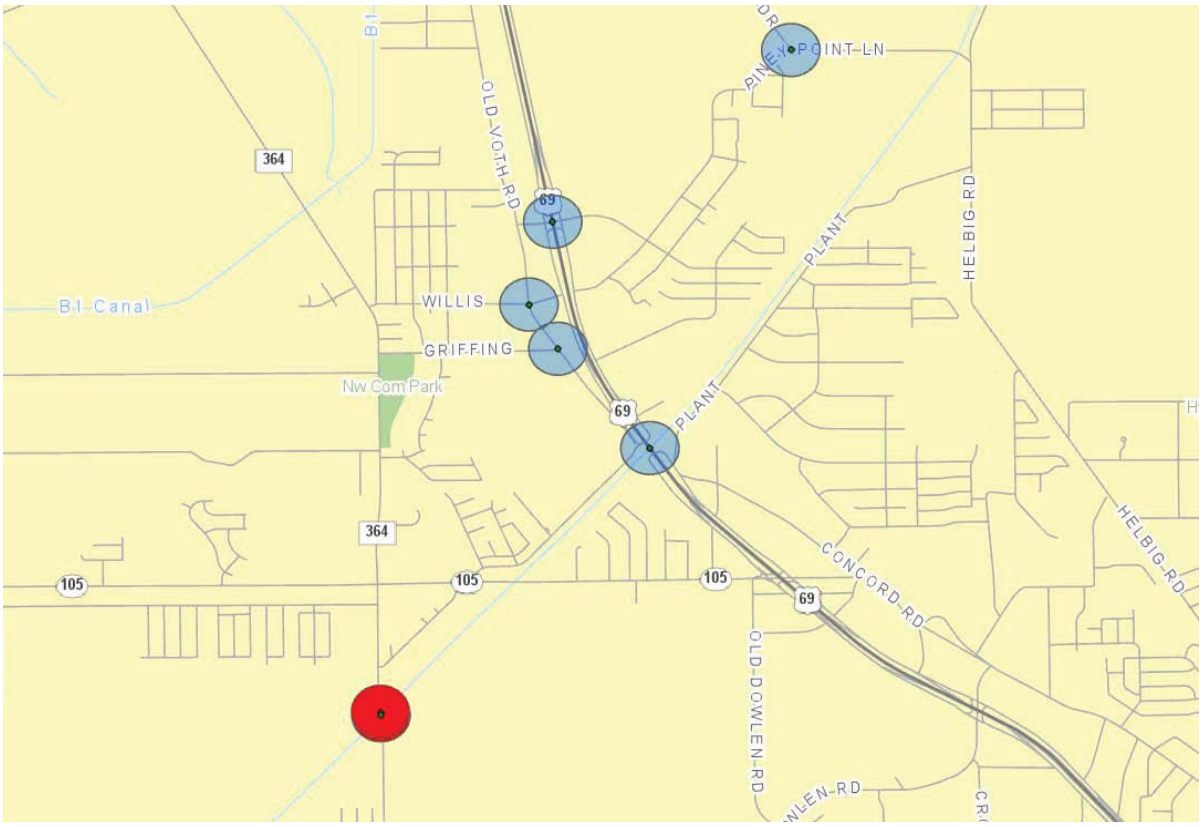

Fig. 1 – Project Locations and Tenth-mile Radii Containing One Point (Blue) or More (Red)

The spatial analysis reduced the list to a reasonable number of projects that could be manually reviewed. These closely neighbouring projects were examined in detail to determine their timing and purpose.

The timing of the projects was also important to consider, because many projects coincided spatially, but were found to be in response to the same event. Small groups of neighbouring projects that were executed at close to the same time were consolidated as one event/response. Occasionally there were follow-up repairs or resilience measures applied several months after the initial repair. These too were consolidated as a response to the initial event.

If two repairs were performed at the same location, on separate occasions, but were performed to repair significantly different features of the asset, they are not considered recurrences. For example, the Southern embankment under a large bridge was damaged by flood-induced scour and repaired (with resilience enhancements), then the Northern embankment was later damaged by flood-induced scour. This pair of events was not considered a true recurrence. Both embankments are now sufficiently reinforced and have withstood flooding with no further problems.

Alternative Analysis Methods

TxDOT organizes roadways by control sections, which are sections of pavement typically 4-15 miles long. Ideally, they would remain uniform in structure throughout their length, and could be considered distinct assets. Each project, emergency or otherwise, is assigned a number that nominally includes a control section. Unfortunately, repairs and upgrades are not always kept to within control section boundaries, nor are they uniformly applied throughout the control section length. Over time this (as well as patchwork) has resulted in varying pavement structures within a given control section. Because of their non-uniformity of structure and varied lengths, control sections are not deemed a satisfactory way of delineating pavement assets.

An analysis by control sections was nonetheless performed. It resulted in a great number of recurrences, partly due to their length being generally longer than the 0.1-mile radius chosen for the GIS analysis. Also, when many small repairs are done on several roadways, that work may be assigned a county-wide control section. Once the list of recurrences was generated and manually examined, most recurrences were dismissed for reasons outlined earlier in this report, and the remaining projects were the same as those found by the GIS analysis.

In the GIS analysis, several radii ranging from 50 feet to half a mile were tried. It was found that radii of 50, 100 and 200 feet all generated the same number of recurrences, because the projects occurred at the same location. At longer radii such as 0.25 - 0.5 miles, far more recurrences were found, but then dismissed for the same reasons as they were dismissed in the control section analysis. The tenth-mile radius provides a reasonable balance between generated results and manual review.

Improvements in Response to Events

Alternative strategies are easier to plan when repeated failures are of a similar nature, such as repeated instances of erosion/scour. Failures are considered in this analysis even if a facility was damaged by more than one type of emergency event (fire, flood, sinkhole, etc.). TxDOT takes both the cause and type of damage incurred into account when making repairs and improvements to guard against further damage. All recurrences found thus far have been weather-related and similar in nature.

A facility may have had more than one qualified repair, separated in time from an initial repair by several months. Following an emergency event, TxDOT engineers make an assessment as to the likelihood of similar damage occurring again. Where the likelihood and severity of the risk warrants a preventive or resilience improvement measure, the improvement is implemented. An immediate functional fix is done, but subsequent projects

are often enhancements to the facility that were not critical to its function. These improvements are not considered recurrences if done in response to a single event.

A bridge that has been subjected to severe channel erosion and damage to its concrete riprap will often be repaired using stone riprap, gabion baskets, sheet piling, or other channel stabilization features that add resiliency to the structure. Other projects, such as minor repairs to concrete riprap that address localized damage, are executed to simply restore the asset back to its original condition.

Following the collision and damage to the Queen Isabella Causeway in 2001, primary bridge elements were replaced immediately. In 2003, a collision prevention system was installed. Though these projects involve the same asset at different times, the second is considered a protective improvement.

Part 667 Analysis for the Initial TAMP

TxDOT's Maintenance Division submits damage reports and reimbursement requests for projects and other expenses to FHWA following a declared disaster. FHWA determines reimbursement eligibility and a project's disposition. For the initial analysis, a table of emergency repair projects spanning from 1997 to mid-2017 was utilized to determine if these projects met the criteria discussed.

These projects were narrowed to instances where work was performed on a NHS asset, and additional steps were taken to determine whether each asset had been included in prior emergency repair projects. Further filtering of projects was performed to determine if projects addressing an asset were in response to separate events. An asset exhibiting failure more than once would be a candidate for reporting in accordance with Part 667. Fortunately, no such recurrences were found in that (NHS-only) analysis.

Results of 2020 Analysis

The most common mode of failure found in this analysis is erosion. One bridge (SH82) and two sections of pavement (FM787 and SH316) were found to have suffered damage and required repairs more than one time in the timeframe of 1997 through 2019.

State Highway 82
The SH82 bridge (over Sabine Lake, near the Louisiana border) was damaged by Hurricane Rita in 2005, requiring repairs to its fender system and other components. The same bridge suffered damages caused by Hurricane Ike in 2008. A more resilient bridge was built in 2010. The new bridge has not been damaged by subsequent storms including Hurricane Harvey. This recurrence is considered to have been adequately addressed by the new bridge.

Fig. 2 - Sabine Lake Bridge Built in 2010 and Nearby Intracoastal Canal

The nearby Intracoastal Canal bank has also faced problems. Several pavement failures have occurred on SH82 along the bank. Though this has not occurred more than once at the same location, it is noteworthy due to the similar mode of failure and likely solution. Erosion of the East bank is a continual issue due to ocean liner wake and the deepening of the canal through dredging. The bank is further eroded by tropical storms. Hurricane Harvey caused enough immediate erosion for the pavement edge to fail, as shown in Figure 3.

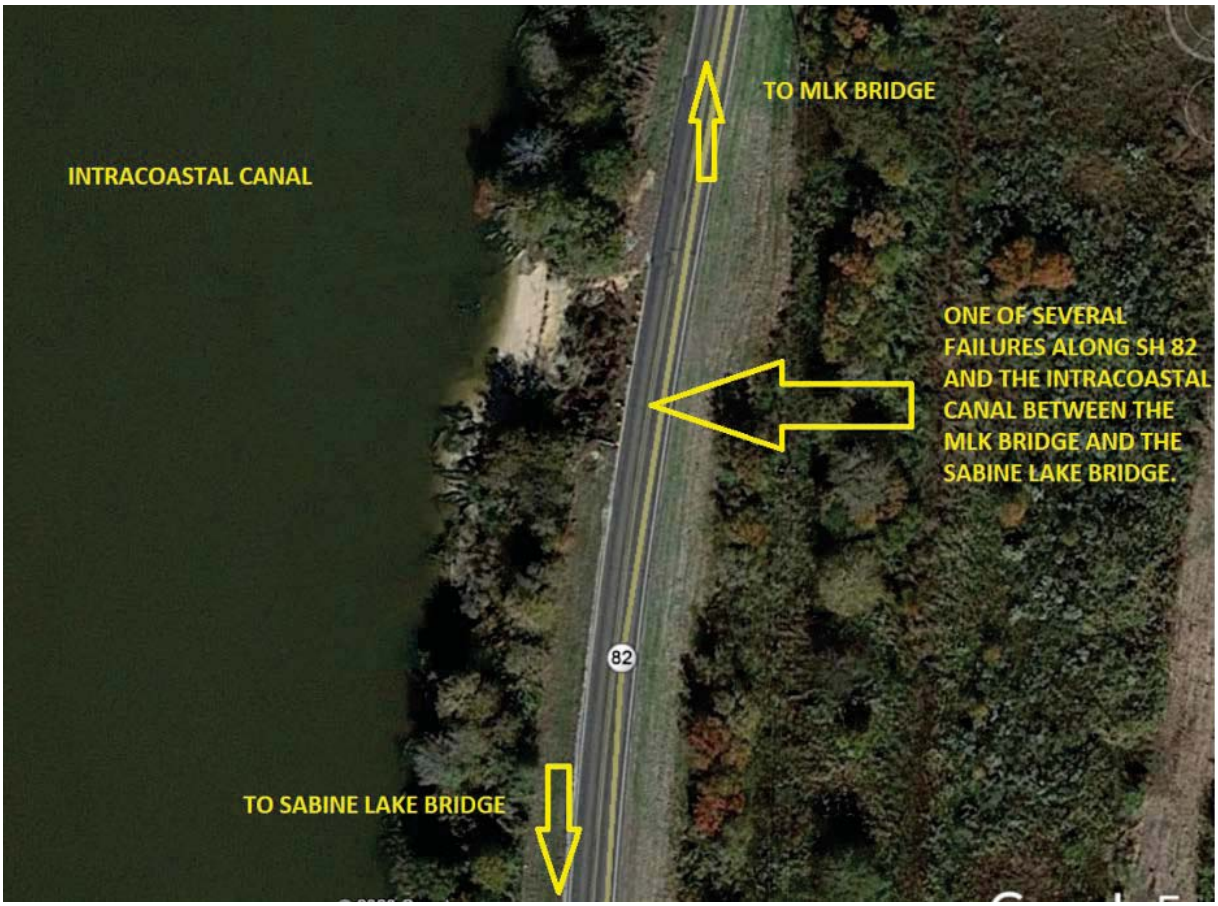

Fig. 3 – Pavement Failure due to Hurricane Harvey

The Port Arthur Maintenance Office of TxDOT's Beaumont District quickly repaired the bank and pavement to quickly reopen all lanes of SH82.

Fig. 4 - State Highway 82 Repairs

Beaumont District personnel wish to improve the SH82 Intracoastal Canal bank by applying a captured-riprap system similar to the one successfully utilized on State Highway 87. SH87 follows the opposite canal bank, parallel to SH82.

Fig. – State Highway 87 Successful Canal Bank Stabilization

Farm-to-Market Road 787

FM787 near the Trinity River required repairs to the bridge and adjacent pavement in 2001 after Tropical Storm Allison. In 2002, the bridge was extended such that its northeast abutment is now roughly 150 feet further inland from the embankment. While the bridge has been sufficiently resilient to withstand storms (including Hurricane Harvey), the nearby section of pavement has required ongoing repairs.

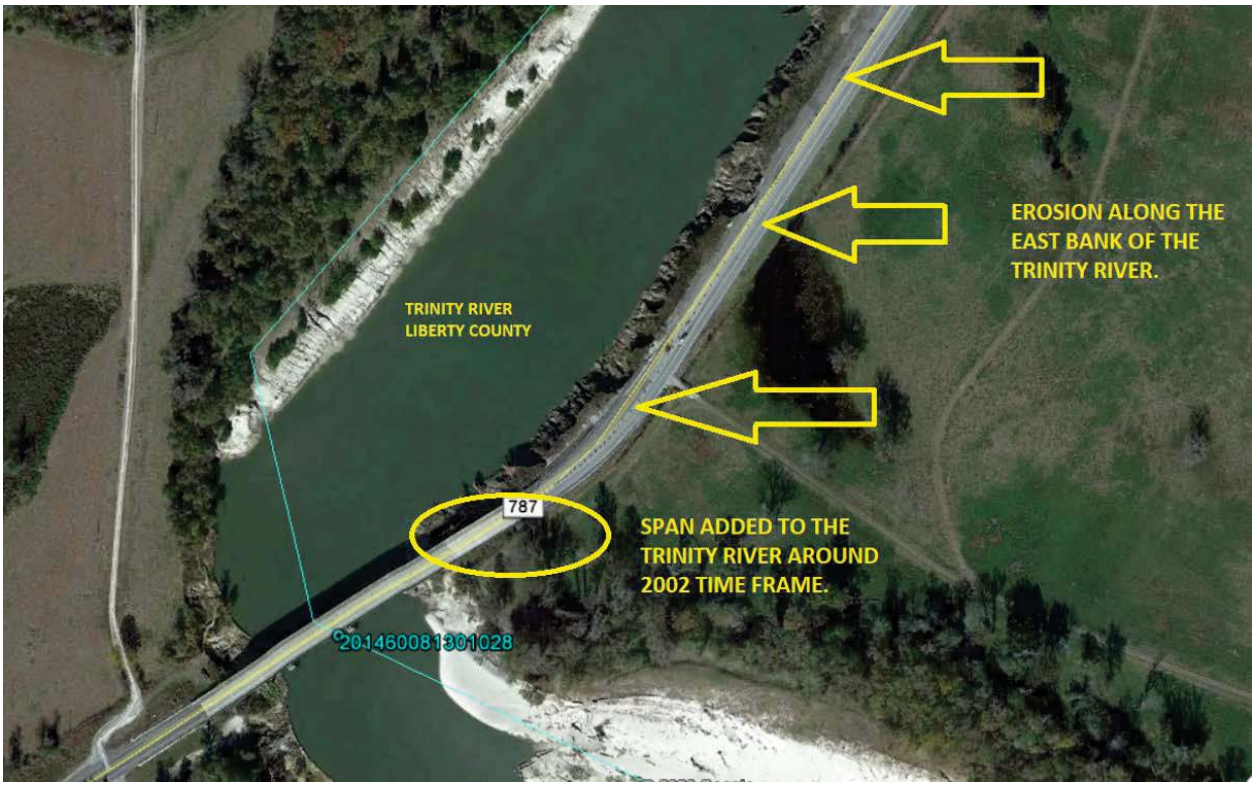

Fig. 2 – Farm-to-Market Road 787 at the Trinity River

While the roadway remains functional with one lane open, a $15.55M project has been initiated for the stabilization of the East bank of the Trinity River through extensive application of sheet piling and riprap. With the foundation stabilized, the pavement will be reconstructed and the facility will be reopened in its original two-lane configuration.

A river migration study has been completed. TxDOT's Beaumont District plans to relocate the bridge and roadway as funds become available. This will address the periodic flooding and gradual encroachment of the river.

State Highway 316

SH316 turns at Matagorda Bay to become a beachfront road. This section is vulnerable and faces recurring damage. The problem is compounded by the gradually receding coastline. TxDOT's Yoakum District keeps the edge repaired and has placed riprap for now. The District is also coordinating with local authorities for a more permanent mitigation project.

Fig. 3 – State Highway 316 Storm Damage

Fig. 4 – State Highway 316 Riprap Placement

Continued Monitoring

Maintenance Division staff will continue to review emergency repair projects as soon as data are available after the occurrence of a qualifying event. As this report is updated with new data, it will be distributed to the appropriate personnel responsible for the design, maintenance and repair of the affected assets. Appropriate project level design criteria and resiliency actions will be considered in future projects, reducing the probability of future damage. Once the root cause of the damage has been addressed and implemented, the road or bridge will be removed from the evaluation, though not exempted from scrutiny should there be another recurrence.