Texas Department of Transportation

Interstate 37 in Texas Interstate Access Justification

SAFETY DATA CASE STUDY

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16. Abstract This case study presents a safety analysis performed by the Texas Department of Transportation (TxDOT) for an Interstate Access Justification Report. The Interstate 37 (I-37) corridor is an important freight route, critical hurricane evacuation linkage, and the only crossing of the Nueces River within 25 miles. This corridor is part of the National Primary Highway Freight System. US 77, which connects to I-37 at the end of the project area, is a part of the Texas Highway Freight Network. Several planning studies, including the I-37 Corridor Study Report, I-69 to I-410, identified the need for mainline widening and the replacement of the Nueces River Bridge. As a result, TxDOT planned a widening project along this stretch of interstate to accommodate greater traffic demand, necessitating additional travel lanes and several key design changes, including environmentally sensitive alterations to the Nueces River Bridge. TxDOT reviewed the study area's historic crash frequency and rates to make targeted improvements to the project design. After this review, the TxDOT project team used the Highway Safety Software to predict crashes along I-37 for both a No Build scenario with no changes to the corridor and a Build scenario with proposed capacity, mobility, and safety alternatives. The results indicated that predicted crashes are expected to decrease with implementation of the proposed improvements compared to the existing conditions for both the base (2020) and design (2040) years. Total crashes are expected to decrease by 7.53 crashes (12.8 percent) per year for the base year and by 13.44 crashes (14.3 percent) per year for the design year.		
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Acronyms

Acronym	Description
AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
CMF	crash modification factor
CRIS	Crash Records Information System
FHWA	Federal Highway Administration
HCS	Highway Capacity Software
HSM	Highway Safety Manual
HSS	Highway Safety Software
IAJR	Interstate Access Justification Report
SPF	safety performance function
STARS	Statewide Traffic Analysis and Report System
TX	Texas
TxDOT	Texas Department of Transportation

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Executive Summary

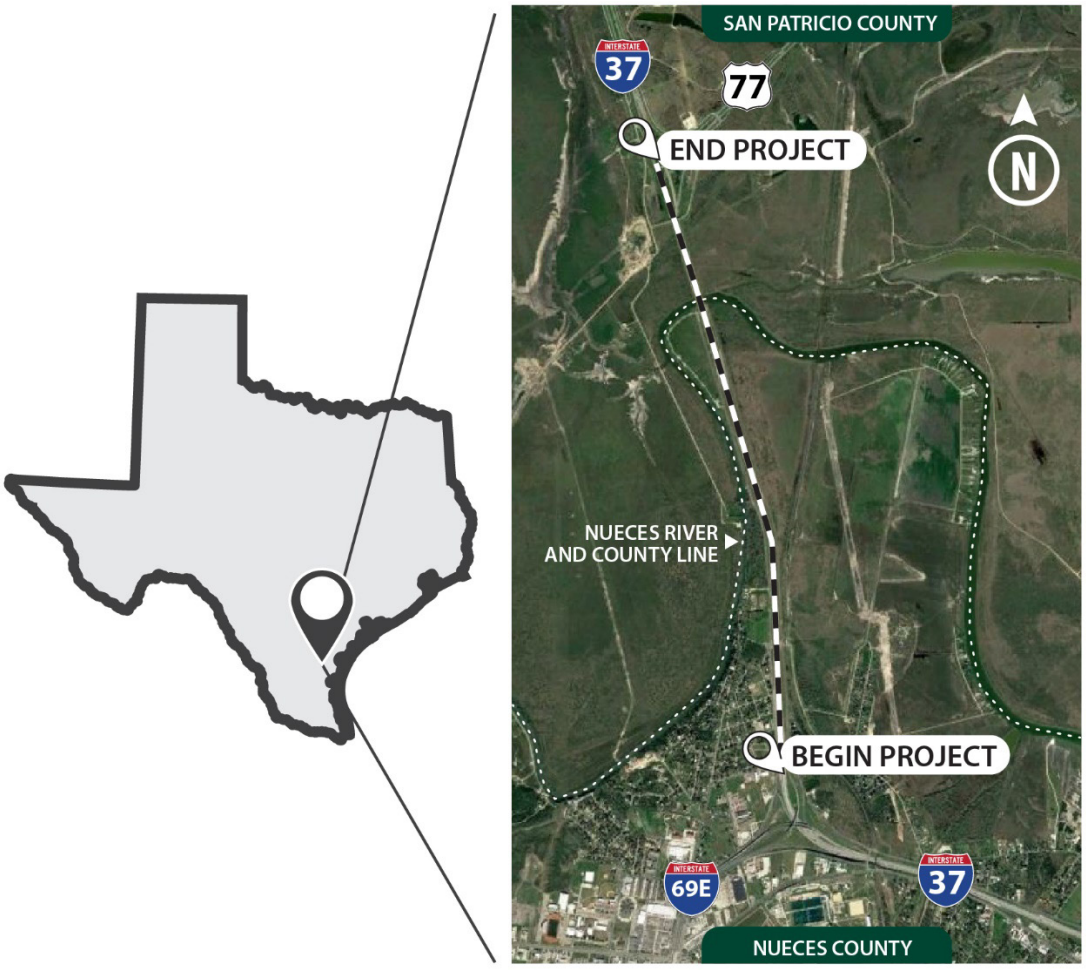
This case study presents a safety analysis performed by the Texas Department of Transportation (TxDOT) for an Interstate Access Justification Report. The Interstate 37 (I-37) corridor is an important freight route, critical hurricane evacuation linkage, and the only crossing of the Nueces River within 25 miles. This corridor is part of the National Primary Highway Freight System. US 77, which connects to I-37 at the end of the project area, is a part of the Texas Highway Freight Network. Several planning studies, including the *I-37 Corridor Study Report, I-69 to I-410*, identified the need for mainline widening and the replacement of the Nueces River Bridge. As a result, TxDOT planned a widening project along this stretch of interstate to accommodate greater traffic demand, necessitating additional travel lanes and several key design changes, including environmentally sensitive alterations to the Nueces River Bridge. TxDOT reviewed the study area's historic crash frequency and rates to make targeted improvements to the project design. After this review, the TxDOT project team used the Highway Safety Software to predict crashes along I-37 for both a No Build scenario with no changes to the corridor and a Build scenario with proposed capacity, mobility, and safety alternatives. The results indicated that predicted crashes are expected to decrease with implementation of the proposed improvements compared to the existing conditions for both the base (2020) and design (2040) years. Total crashes are expected to decrease by 7.53 crashes (12.8 percent) per year for the base year and by 13.44 crashes (14.3 percent) per year for the design year.

Introduction

The Transportation Research Board's Safety Performance and Analysis (ACS20) User Liaison Subcommittee has an on-going initiative focused on practical application of the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) (i.e., "using the HSM in the real world"). The Federal Highway Administration (FHWA) also administers the HSM Implementation Pooled Fund, which includes 22 States focused on projects to help further HSM implementation. Development of HSM case studies will assist practitioners in performing data-driven safety analysis using the advanced methods described in the HSM. The primary purpose of this and other HSM case studies is to highlight noteworthy applications of HSM methods, focus on common challenges, and feature agencies that overcame those challenges. These case studies serve as a source of lessons learned and noteworthy practices to help guide practitioners applying the HSM.

Background

This case study describes a safety analysis the Texas Department of Transportation (TxDOT) performed for an Interstate Access Justification Report (IAJR) to replace and upgrade an important and environmentally sensitive portion of interstate 15 miles west of Corpus Christi, TX. Interstate 37 (I-37) is a major connection between San Antonio and Corpus Christi, and the I-37 corridor in Nueces County and San Patricio County is a mix of urban and rural area types. The Nueces River bridge is a focal point for north/south traffic between these two urban areas, and the bridge required replacement. TxDOT used McTrans' Highway Safety Software™ (HSS) module to predict crashes along a segment of I-37 from the Redbird Lane cross street overpass to the US 77 Interchange, shown in figure 1, and conduct a data-driven analysis of several proposed improvements in and around the Nueces River bridge.



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Note: The white location pins, white/black dashed line, north arrow, route markers, and county names and boundaries were added by the authors to delineate the project bounds.

Figure 1. Graphic. I-37 project location.

Purpose and Need

The *Corpus Christi Metropolitan Transportation Plan 2015-2040* projects population in Nueces and San Patricio counties to grow 18 percent between 2015 and 2050. The Corpus Christi Metropolitan Planning Organization also anticipates daily trips to grow more than 50 percent between 2006 and 2040. As a key regional facility, the I-37 corridor is an important freight route, critical hurricane evacuation linkage, and the only crossing of the Nueces River within 25 miles. This corridor is also part of the National Primary Highway Freight System. US 77, which connects to I-37 at the end of the project area, is a part of the Texas Highway Freight Network. Several planning studies, including the *I-37 Corridor Study Report, I-69 to I-410*, identified the need for mainline widening and the replacement of the Nueces River Bridge. As a

result, TxDOT planned a widening project along this stretch of interstate to accommodate greater traffic demand, necessitating additional travel lanes and several key design changes, including environmentally sensitive alterations to the Nueces River Bridge.

To support the proposed design changes and better understand the safety impacts of this vital mobility project, the project team performed a safety analysis based on the planned series of capacity, mobility, and safety improvements along the corridor, including:

- Replacing the existing Nueces River Bridge.
- Widening I-37 from six lanes to eight lanes, providing one additional lane in each direction.
- Installing shoulder rumble strips.
- Reconstructing exit and entrance ramps for local access.
- Providing a vertical clearance of 18 ft 6 inches for underpasses along I-37.
- Making minor profile adjustments to the frontage roads.

These improvements require an IAJR, which includes a safety analysis of the existing conditions and proposed improvements.

Project Description

- **Sponsoring agency:** TxDOT.
- **Project location:** Nueces County and San Patricio County, TX.
- **Project bounds and length of project:** I-37 from Redbird Lane to US 77 Interchange (2.6 miles).
- **Facility type(s):** Multilane interstate freeway.
- **Area type:** Rural and urban.
- **Project status (as of October 2021):** Under construction.

Safety Performance Analysis

This section provides an overview of the safety analysis methods for the existing conditions and proposed improvements and the final results.

Analysis Overview

For the analysis, TxDOT obtained 8 years of crash data (2010 through 2017) from TxDOT's Crash Records Information System (CRIS) and used the Statewide Traffic Analysis and Report System (STARS II) to obtain annual average daily traffic (AADT) information. Table 1 displays the historical crash data for the I-37 corridor by year used in the analysis. TxDOT initially mapped historic crashes and calculated crash rates to screen for high safety priority locations.

Table 1. Historical crash data by year for the I-37 corridor.

Year	Total Crashes	Crash Rate (per 100 million vehicle miles traveled)
2010	40	75.09
2011	38	76.85
2012	50	103.51
2013	71	141.99
2014	63	114.12
2015	47	81.46
2016	45	81.81
2017	64	111.24
Average	**52**	**102.87**

Analysis and Results

TxDOT's crash analysis noted crash clusters along the study corridor with the most significant cluster occurring south of the I-37/US 77 interchange (38 percent of all crashes that occurred during the study period). This location involves a narrowing from four to three southbound lanes as I-37 approaches the Nueces River Bridge. Furthermore, the three northbound lanes in this location involve a shared center lane where I-37 and US 77 split (figure 2). This crash analysis supported the design decision to widen I-37 from three to four lanes in both directions to avoid a lane drop in the southbound direction and segregate traffic into two lanes for both diverging routes.

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Note: The white circles, black numbers, and route markers were added by the authors to display the number of crashes at each location.

Figure 2. Graphic. Crash cluster locations with road narrowing (2010-2017).

Additional analysis of contributing crash factors also noted:

- Two-thirds of all crashes involved a single vehicle traveling straight as the first harmful event and manner of collision.
- Rain and wet road conditions comprised over 50 percent of all crashes.
- Nearly 40 percent of all crashes were speed related.
- The majority of crashes (approximately 66 percent) resulted in no injuries, followed by crashes that resulted in a possible injury (approximately 17 percent). Four percent of crashes involved a fatality or serious injury.

The study team compared the crash rate along the I-37 corridor with the statewide average crash rates for urban and rural area types. The study corridor was originally built as a rural freeway, but it is increasingly accommodating urban traffic. Given the transitional nature of this shorter corridor (from the more urban development south of the river to the more rural land use north of the river), TxDOT used both metrics to assess the corridor's performance relative to peers. Table 2 indicates the I-37 crash rates were higher than the statewide average rural rates for all years. The I-37 crash rates were higher than the statewide average urban crash rates for 2010 through 2014, but lower than the statewide average urban crash rates for 2015 through 2017. This comparison to both contexts helped illustrate the critical safety need as part of this primarily widening project.

Table 2. Study area crash rate compared with statewide average urban and rural crash rates.

Year	I-37 Crash Rate (per 100 million vehicle miles traveled)	Urban Statewide Average Crash Rate (per 100 million vehicle miles traveled)	Rural Statewide Average Crash Rate (per 100 million vehicle miles traveled)
2010	75.09	74.34	40.65
2011	76.85	67.71	39.95
2012	103.51	90.90	46.81
2013	141.99	95.23	53.53
2014	114.12	113.17	55.35
2015	81.46	148.09	58.98
2016	81.81	150.96	52.77
2017	111.24	146.40	53.90
Average	**102.87**	**110.85**	**50.24**

Before performing the crash prediction analysis, TxDOT applied crash modification factors (CMFs) to the existing crash numbers to assess potential crash reductions for implemented improvements. The two most important treatments included CMFs for increasing the number of lanes (0.74; CMF ID #8336) and installing shoulder rumble strips (0.89; Torbic et al., 2009). As noted in the existing conditions analysis, the transition from four to three lanes was a suspected contributor to crashes south of the US 77 interchange. Based on observed crash numbers, the addition of a travel lane in each direction is expected to result in a reduction of 2.8 crashes per year. Furthermore, as most crashes along the I-37 corridor involved a single vehicle, TxDOT anticipated shoulder rumble strips to produce substantial safety benefits. Based on the number of roadway departure crashes on the corridor, TxDOT expected the rumble strips to reduce crashes by 2.4 per year. Combined, both countermeasures should reduce crashes along the study corridor by 5.2 per year.

To conduct its predictive analysis, the project team used crash and traffic data for analysis in HSS, which is a module in McTrans' Highway Capacity Software™ (HCS) package version 7.7. This downloadable, locally installed software package is widely used for capacity analysis projects, but the HSS package can effectively apply the HSM Part C Predictive Method. HCS provides a broad suite of traffic simulation tools, and the data inputs and results of HSS are consistent with the HSM. Agencies that wish to implement the HSS would need the same inputs as other HSM-related tools and software. TxDOT used the default safety performance functions (SPFs) in the HSS to predict crashes based on the traffic volume for the base year (2020) and the projected traffic volume for the design year (2040). TxDOT predicted base and design year crashes with the existing conditions, a No Build option where no improvements are implemented, as well as for a Build scenario that included the proposed improvements (table 3).

Table 3. Predicted crashes for the existing conditions and proposed improvements by severity.

Scenarios	Number of Predicted Total Crashes per Year	Number of Predicted Fatal and Injury Crashes per Year	Number of Predicted Property Damage Only Crashes per Year
Base Year (2020) Existing Conditions	58.65	19.36	39.29
Base Year (2020) Proposed Improvements	51.13	17.35	33.78
Design Year (2040) Existing Conditions	94.28	30.29	63.98
Design Year (2040) Proposed Improvements	80.84	26.24	54.60

For both the base (2020) and design (2040) years, predicted crashes are expected to decrease with implementation of the proposed improvements compared to the existing conditions. Predicted total crashes are expected to decrease by 7.52 crashes (12.8 percent) per year for the base year and by 13.44 crashes (14.3 percent) per year for the design year.

Documentation and Use of Analysis Results

The project team completed the analysis as part of an IAJR. Based on the historic crash review, TxDOT identified target countermeasures that addressed the corridors specific issues (e.g., lane drops, traffic weaving, and single vehicle crashes). Additionally, TxDOT's review of crash rates further reinforced that the character of the corridor was shifting from rural to increasingly urban, and that the widening and capacity improvements were justified. Finally, the predictive methods applied in HSS also showed a safety benefit to the proposed improvements and provided TxDOT with the confidence that the mobility improvements would also produce safety benefits.

Key Takeaways and Future Enhancements

Although TxDOT is in the process of developing Texas-specific SPFs, it relied on default, uncalibrated HSM models for the purposes of this analysis. The HSM Part C predictive methods were developed using data from States other than Texas, which could impact the accuracy of the predictions. Because of this, the HSM recommends applying calibration factors to the crash predictions to adjust the predicted crashes to local conditions. The project team did not have a calibration factor at the time of project development. As such, the project team focused on the relative comparison of crash predictions rather than the absolute value.

Conclusions

The I-37 corridor is an important freight route, critical hurricane evacuation linkage, and the only crossing of the Nueces River within 25 miles. The project team performed a safety analysis for implementing a series of capacity, mobility, and safety improvements along the corridor, which included replacing the existing Nueces River Bridge, widening I-37 from six to eight lanes, reconstructing entrance and exit ramps, providing an 18-ft 6-inch vertical clearance for underpasses, and making minor profile adjustments to frontage roads. Based on a review of existing crashes, TxDOT was able to make targeted improvements that addressed the corridor's most critical safety needs. To assess anticipated future crashes based on the projected growth in traffic, the project team used HSS to implement the HSM Part C Predictive Method and compare predicted crashes for the existing geometric conditions to the predicted crashes for the proposed design conditions with improvements. The safety analysis indicated that the proposed corridor design is expected to reduce crashes when the improvements are implemented. While TxDOT would have preferred to use calibrated or State-specific SPFs in its analysis (as opposed to uncalibrated models from the HSM), ongoing research in this area will produce Texas-specific SPFs for TxDOT to use in future safety analyses across the State.

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