



Transportation Today

The State of the Texas Transportation System

April 2019

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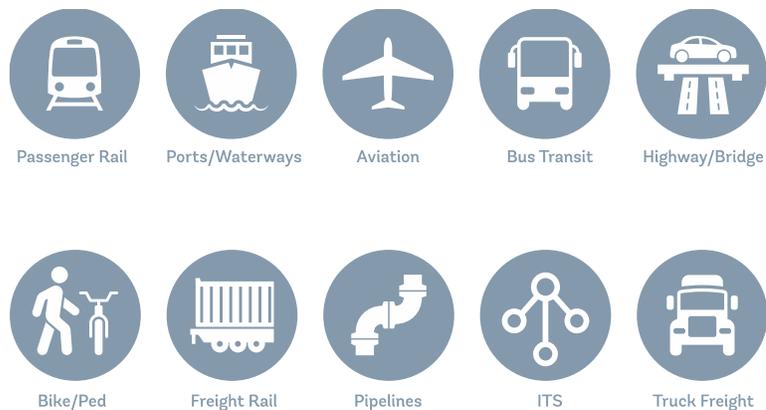
1.0 INTRODUCTION

People often say everything is bigger in Texas and that is certainly true for the roadway network. Texas has the largest public roadway network of any other state in the U.S. with more than 300,000 miles of roads.¹ Texas Department of Transportation (TxDOT) is directly responsible for more than a quarter of the state’s roadways, and these state-owned roads carry nearly three quarters of all travel statewide. Yet highways are only one part of TxDOT’s mission to provide safe, reliable travel choices. The efficient movement of people and goods requires streamlined connections between Texas roads, airports, rail termini, ports, transit system, pipelines, and bicycle/pedestrian facilities (Figure 1).

To keep this extensive network running smoothly, TxDOT’s 33 technical divisions and 25 district offices constantly work to identify more effective strategies to improve system performance. Working alongside regional planning agencies, transit authorities, federal partners, local governments, tribal nations, private industry, stakeholder groups, and the public, TxDOT’s stewardship over the multimodal transportation system helps provide safe, reliable mobility options for more than 28 million (and growing) Texans.

The Texas Transportation Plan (TTP) supports TxDOT in charting a path for all travel modes, transportation technologies, and cross-discipline technical areas to sustain and enhance performance over the long run. Before knowing where we are going, however, we must first understand where we have been. This Transportation Today report provides a glimpse into current TxDOT performance levels, noteworthy trends, and recent initiatives.

Figure 1: Passenger and Freight Travel Modes and Technologies



2.0 TEXAS TRANSPORTATION AT A GLANCE

TxDOT oversees planning and programming decisions for the development, management, and operation of the statewide, multimodal transportation system that serve both Texans and the state’s 68 plus million annual visitors.² Although 71 percent of surveyed Texans drive alone on a daily

¹ FHWA (2017). *Highway Statistics 2017*. Available at <https://www.fhwa.dot.gov/policyinformation/statistics/2017/>.

²Travel Texas. (2018) Available at https://travel.texas.gov/tti/media/PDFs/4_Out-of-State-Travel-to-Texas_3.pdf.

basis³, transportation choices beyond the automobile are critical to improving air quality, reducing fuel consumption, managing congestion, and ensuring that all of the traveling public can get where they need to go reliably and safely. The movement of goods requires freight transport by truck, rail, air, pipeline, and ship; healthy commerce relies on the efficient connection of these modes. Airports, bridges, railroads, and ports are also integral to a comprehensive transportation system, all of which require upkeep and operational enhancements to keep pace with Texas’ growing economy. Table 1 summarizes key characteristics of Texas’s transportation system.

Table 1. Texas Transportation at a Glance

Highway / Bridge	<ul style="list-style-type: none"> • Approximately 200,000 pavement state-maintained lane miles⁴ • 86.3% good or better state-maintained pavement lane-miles⁵ • Approximately 36,000 bridges are owned and maintained by TxDOT⁶ • 91% “B” or better bridges⁷ • 162,674 million vehicle miles traveled annually⁸ • More than 578M person-hours of annual total delay⁹ • More than \$11.6B cost of lost productivity due to congestion annually⁹
Freight	<ul style="list-style-type: none"> • 21,861 center-line miles on the Texas Highway Freight Network¹⁰ • 10,539 miles of railroads on the Texas Multimodal Freight Network¹¹ • 21 ports¹² • 20 commercial international border crossings¹³
Bus Transit	<ul style="list-style-type: none"> • 131 transit agencies¹⁴ • 255 million vehicle revenue miles¹⁵
Passenger Rail	<ul style="list-style-type: none"> • 1,539 miles of Amtrak track¹⁶

³ Transportation Usage Survey Results collected between January 29, 2019 and March 15, 2019 in conjunction with Texas Transportation Plan 2050 Round 1 Public Outreach.

⁴ FHWA (2017). HM-81. State Highway Agency-Owned Public Roads. Available at <https://www.fhwa.dot.gov/policyinformation/statistics/2017/>.

⁵ TxDOT (2017). *Conditions of Texas Pavements*. Full Report. PMIS Annual Report FY 2014:2017.

⁶ FHWA (2017). National Bridge Inventory. Available at <https://www.fhwa.dot.gov/bridge/nbi/ascii.cfm>.

⁷ Ibid.

⁸ FHWA National Highway System Travel. Available at <https://www.fhwa.dot.gov/policyinformation/statistics/2017/pdf/hm44.pdf>. Accessed January 2019.

⁹ Texas A&M Transportation Institute. *2018 Urban Mobility Scorecard Statistics*.

¹⁰ TxDOT. (2017). *Texas Freight Mobility Plan 2017*. Available at <http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2017/plan.pdf>.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

¹⁴ TxDOT (2018). *2018 Texas Transit Statistics Preliminary Report*. Available at http://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2018.pdf.

¹⁵ Ibid.

¹⁶ TxDOT (2016). *2016 Texas Rail Plan*. Available at <https://www.txdot.gov/inside-txdot/forms-publications/publications/final.html>.

	<ul style="list-style-type: none"> • 19 active Amtrak stations in Texas¹⁷
Bicycle / Pedestrian	<ul style="list-style-type: none"> • 25th in national ranking for bicycle friendly states¹⁸ • 45th in national ranking for bike/pedestrian commuters¹⁹
Aviation	<ul style="list-style-type: none"> • 264 general aviation airports²⁰ • 380 miles of runways²¹
Safety	<ul style="list-style-type: none"> • 3,721 reported fatalities on Texas roads in 2017²² • 17,546 reported serious injuries on Texas roads in 2017²²
Environment	<ul style="list-style-type: none"> • 78% decrease in (one-hour) carbon monoxide vehicle emissions between 2000 and 2017²³ • 660,000 gallons of alternative fuels consumed by TxDOT vehicles in fiscal year (FY) 2017²⁴

3.0 DEMOGRAPHIC AND ECONOMIC TRENDS

As the second most populous²⁵ and second largest by land area²⁶ state in the country, Texas and its 28.7 million residents, spread across 268.5 thousand square miles, face unique transportation challenges. During the last 30 years, the state population has increased by 71 percent (Figure 2) with continued growth anticipated through 2050. The sheer magnitude of such numbers, necessitates innovative planning to ensure the Texas transportation system keeps pace a rapidly growing population and economy.

The relationship between transportation and the economy can often be thought of as a ‘chicken-and-egg’ exercise. In truth, both perspectives are correct as Texas’s economy and transportation infrastructure are inextricably linked. Economic activity shapes businesses’ and individuals’ needs for using the transportation system, and these needs provide the foundation for and the expected benefit from transportation investments. At the same time, transportation system performance

¹⁷ Amtrak (2017). State Fact Sheet. Available at <https://www.amtrak.com/state-fact-sheets>.

¹⁸ The League of American Bicyclists (2017). *Bicycle Friendly States Historical Ranking, 2008-2017*. Available at https://www.bikeleague.org/sites/default/files/BFS2017_HistoricalRanking_Chart.pdf.

¹⁹ Alliance for Bicycling and Walking (2016). *Bicycling and Walking in the United States*. Available at https://www.bikeleague.org/sites/default/files/2016BenchmarkingReport_web.pdf.

²⁰ FAA (2018). Form 5010. Available at https://www.faa.gov/airports/airport_safety/airportdata_5010/.

²¹ Ibid.

²² Texas Traffic Safety Task Force (2016). *Solutions for Saving Lives on Texas Roads*. Available at <https://ftp.dot.state.tx.us/pub/txdot-info/trf/trafficsafety/saving-lives.pdf>.

²³ Texas Commission on Environmental Quality Data

²⁴ TxDOT Pocket Facts FY 2017. Available at http://ftp.dot.state.tx.us/pub/txdot-info/gpa/pocket_facts.pdf.

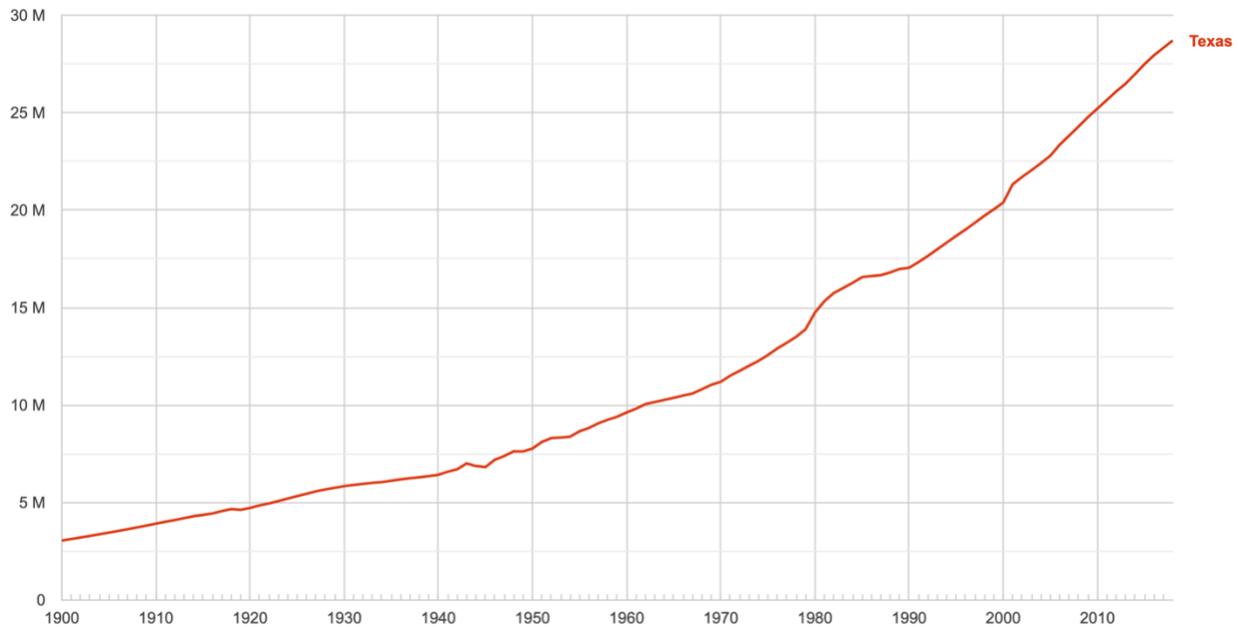
²⁵ U.S. Census Bureau (2018). American Community Survey. Texas Population Estimate.

²⁶ U.S. Census Bureau (2010). Population and Housing Unit Counts, 2010 Census of Population and Housing.

influences the economic competitiveness and fiscal capacity of cities, regions, states, and the nation as a whole.

In 2017, the transportation and warehousing industry was the second largest contributor to the gross state product (GSP) among all Texas industries (Figure 3).²⁷ The freight transportation sector in Texas supports 2.2 million jobs, \$145 billion in wage income and \$215 billion in economic activity in Texas. In part, Texas' national role in moving freight has helped Texas keep unemployment at or below the national average during the past decade (Figure 4). Texas' economy makes up 9 percent of the country's economic value, with a GSP of approximately \$1.7 trillion (Figure 5)²⁸

Figure 2. Texas Population Growth, 1900-2018



Source: U.S. Census Bureau

Rapid growth is the key theme in Texas's economy. For the past 14 years, Texas has been the country's lead state by exports. Texas' exports to Mexico grew in value from \$62 billion in 2008 to \$93 billion in 2016, and Texas exported \$20 billion in goods to Canada in the same year. Mexico, China, and Canada are the largest origins of imports to Texas.²⁹ Trade is a particular part of the economy that relies on Texas's transportation infrastructure, such as the state's 29 official

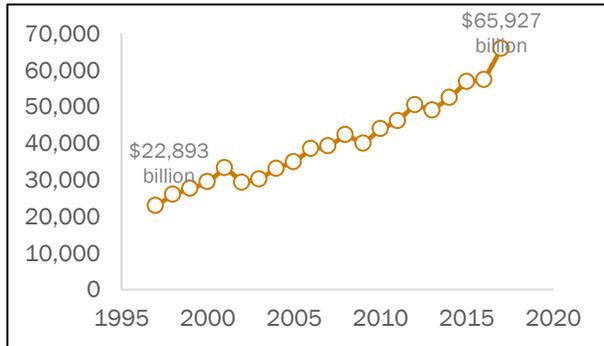
²⁷ U.S. Bureau of Economic Analysis (1997-2017). Regional Data: GDP and Personal Income. Available at <https://www.bea.gov/>.

²⁸ U.S. Bureau of Economic Analysis (BEA). Gross Domestic Product by State. Available at <https://www.bea.gov/data/gdp/gdp-state>.

²⁹ TxDOT. (2017). *Texas Freight Mobility Plan 2017*. Available at <http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2017/plan.pdf>.

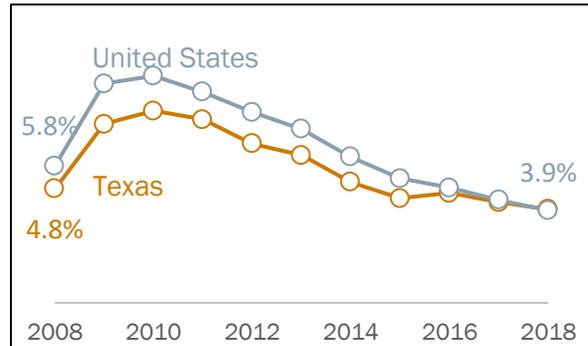
ports that facilitate international trade. These direct links between transportation and the economy underscore the principle that investment in transportation efficiency and infrastructure support Texas’s economic prosperity.

Figure 3. Texas Transportation and Warehousing GSP



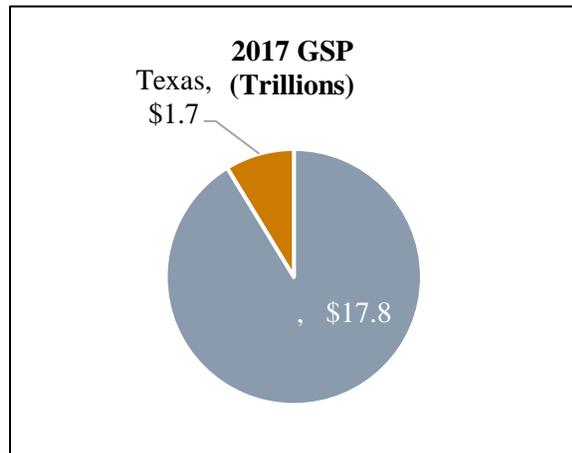
Source: U.S. Bureau of Economic Analysis

Figure 4. Unemployment in Texas and the U.S.



Source: Texas Comptroller³⁰

Figure 5: Texas GSP in Trillions as a share of U.S. GDP, 2017



Source: U.S. Bureau of Economic Analysis (BEA). Gross Domestic Product by State. Available at <https://www.bea.gov/data/gdp/gdp>

3.1 Looking Ahead

Projected economic growth in Texas is matched by a rapidly growing population. The Texas Demographic Center projects an average compounding annual growth rate of approximately 1.6 percent for the period from 2017 to 2050, which means that the Texas population will almost double from 28.2 million in 2017 to 47.3 million in 2050.³¹

With senior population growing especially fast, the Texas Transportation Plan will need to account for the unique travel behaviors and needs of older Texans. Additionally, companies are developing new transportation technologies, such as connected

and automated vehicles, which may mitigate job growth in the state’s thriving freight and trade sectors.

³⁰ Texas Comptroller (2018). *Key Economic Indicators*. Available at www.comptroller.texas.gov/economy/key-indicators.

³¹ Texas Demographic Center (2018). 2018 Population Projections. Accessed December 17, 2018. Available at <https://demographics.texas.gov/Data/TPEPP/Projections/>.

4.0 FREIGHT

The safe and efficient movement of freight is a foundation of the Texas economy. Commerce and quality of life in Texas depend on the daily delivery of millions of tons of goods. These goods are transported on the state’s multimodal network of highways, railways, waterways and ports, inland ports, airports, and pipelines. Freight movement supports more than 2 million full-time jobs and generates \$145 billion in annual wages (Figure 6).³² Moreover, the demand for freight movement will likely grow with the Texas population since more people translates into a greater demand for goods.

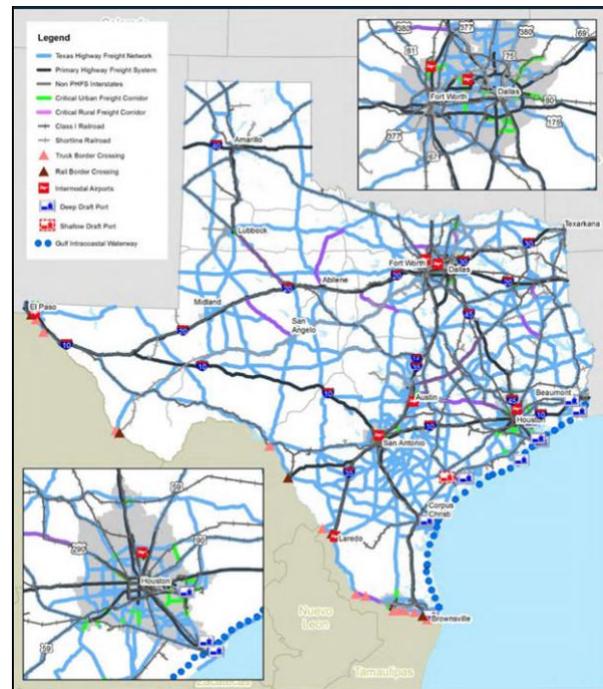
Figure 6. Total Economic Impact of Freight Transportation in Texas



Source: Derived from the Texas Freight Mobility Plan 2017

In 2016, more than 2.2 billion tons of freight moved within Texas, with the largest percentage of movement having both an origin and a destination in Texas, and the remainder either passing through the state or having its origin or destination outside of Texas. Highways moved 16 percent more freight tonnage than railroads, ports, waterways, and air combined.³³ Although the share of freight tonnage moving by air is less than 1/10 of a percent, it moves some of the most valuable and time-sensitive items, giving it a large economic importance.

Figure 7. Texas Multimodal Freight Network



Source: Texas Freight Mobility Plan 2017

TxDOT studied the roads, railroads, ports, and waterways, airports, and international border crossings as part of the development of the *Freight Mobility Plan 2017*. TxDOT’s work produced data-driven outputs that that it is using to improve freight movement in Texas. For instance, its study of the intermodal transportation network allowed it to identify the infrastructure that is most critical to freight movement with large and comprehensive datasets, and it designated

³² TxDOT (2018). Texas Freight Mobility Plan. Available at <http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2017/plan.pdf>.

³³ TxDOT (2018). Texas Freight Mobility Plan 2017 Update Presentation. May, 31, 2018.

them as the Texas Multimodal Freight Network (TMFN). Figure 8 shows a map of the TMFN.³⁴ For more detail on each freight mode, refer to Appendix A.

4.1 **Looking Ahead**

With strong growth in population and e-commerce deliveries forecasted, investments to alleviate congestion and improve multimodal connections will be important for keeping Texas' freight infrastructure safely and efficiently serving Texans and Texas business. More specifically, according to the 2017 Texas Freight Mobility Plan,³⁵ freight transportation in Texas will experience the following needs and challenges through 2045:

- Congestion
- System operations
- Safety
- Asset preservation
- Rural connectivity
- Multimodal connectivity
- International border crossings
- Public awareness/education
- Funding

Resilience of freight network, such as alleviating the limited number of ports of entry, is additionally important to avoid disruption in their role in facilitating international trade.

5.0 **AVIATION**

Texas has an extensive airport network, including 25 commercial service airports, 264 general aviation airports, 23 military airfields, 24 reliever airports, and 56 public heliports.³⁶ In addition to supporting passenger and freight movement across Texas' vast distances, airports provide for emergency medical service, evacuation, recreation, and disaster relief. The airports link Texas to the world, connect rural Texans to urban areas, and provide urban Texans a gateway to the recreational spaces and economic production within rural Texas.

Project Highlight

The I-10 Connect Project near El Paso will address congestion issues near the Bridge of the Americas Port of Entry. The project's goal is to keep passenger vehicles and the numerous commercial trucks that cross the border at the Bridge of the Americas off of local roads and to smooth traffic flow.

Project Highlight

A prominent aviation project was recently completed at the Austin Bergstrom International Airport. This project expanded the number of airport gates from 25 to 34. The total project costs were \$350 million. The expansion will capitalize on and continue to develop the economic benefits the airport provides to the region.

³⁴ TxDOT (2017). *Texas Freight Mobility Plan 2017*. Available at <https://www.dot.state.tx.us/move-texas-freight/studies/freight-plan.htm>.

³⁵ TxDOT (2018). *Texas Freight Mobility Plan*. Available at <http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2017/plan.pdf>.

³⁶ FAA (2019). Form 5010. Available at https://www.faa.gov/airports/airport_safety/airportdata_5010/.

Airports are a significant contributor to the Texas economy, affecting nearly 800,000 jobs in the state and more than \$30 billion in annual payroll (Figure 8).³⁷

Figure 8. 2018 Texas Airport Economic Impact Study Results



Source: TxDOT Aviation (2018). *Texas Airport Economic Impact Study*. Available at <https://www.txdot.gov/inside-txdot/division/aviation/eco-impact-aviation.html>.

TxDOT helps cities and counties obtain and disburse federal and state funds for reliever and general aviation airports included in the *Texas Airport System Plan*. TxDOT also participates in the Federal Aviation Administration’s (FAA) State Block Grant Program to help fund improvements for general aviation airports. Although commercial service airports generate significant revenue to support their operations and maintenance, general aviation airports have limited opportunity to generate self-sustaining revenue. These airports rely on public financing for capital improvements.

5.1 Looking Ahead

There are several trends in aviation that will impact how airports operate in the future and how they will interact with other transportation modes. Many commercial airlines have difficulty hiring enough pilots due to a pilot shortage. Potential impacts of the pilot shortage will be increased activity at general aviation airports as pilot training increases and fewer regional flights due to a lack of pilots for commuter aircraft. Self-driving cars may lead to more congestion at curbside drop-off areas and reduction in parking revenues if passengers choose on-demand self-driving cars for groundside transportation rather than parking at the airport. In addition to drones’ commercial applications, their unauthorized use can interfere with aircraft operations and require increased monitoring and security at airports.

³⁷ TxDOT Aviation (2018). *Texas Airport Economic Impact Study*. Available at <https://www.txdot.gov/inside-txdot/division/aviation/eco-impact-aviation.html>.

6.0 PASSENGER RAIL

With Texas’s population expected to grow to more than 47 million residents in 2050, transportation alternatives will remain important.³⁸ Amtrak furnishes a passenger rail option for intercity travel along its three routes in Texas: the Heartland Flyer daily between Fort Worth and Oklahoma City (partially supported with state funds), the Sunset Limited triweekly between New Orleans and Los Angeles, and Texas Eagle daily between Chicago and San Antonio. Amtrak’s Texas routes serve most of the state’s major urban areas on rail lines that are almost exclusively owned by Class I freight railroads. TxDOT works with private and public partners to provide passenger rail service throughout the state, including more than 1,500 miles of Amtrak track serving 19 stations.³⁹ Because the majority of rail service is provided by the private sector, TxDOT supports passenger rail with long-term planning, service quality monitoring, and facilitation of passenger rail improvements in the state. TxDOT also fosters communication among rail providers, local governments, regional agencies, and Texans about rail needs and solutions.

Project Highlight

In 2017, TxDOT and the Federal Railroad Administration (FRA) completed an FRA-funded study of the feasibility of express passenger rail service between Dallas and Fort Worth. This project, called the “Dallas-Fort Worth Core Express Alternatives Analysis,” complements separate passenger rail lines being planned for each (Dallas to Houston high-speed rail and the Texas-Oklahoma Passenger Rail Study respectively). The study identified two viable corridors for service up to 125 mph.

Amtrak ridership has been roughly steady since 2012 across its three lines. All three Amtrak passenger trains serving Texas reported ridership increases in fiscal year (FY) 2017 over FY 2016 (Figure 10). On-time performance increases the attractiveness of the service for potential passengers, and on-time performance varies widely for Amtrak’s routes, from a high of 85 percent for Heartland Flier to a low of 36 percent for Sunset Limited in FY 2017, as shown in Figure 11. Operating on active freight lines tends to harm on-time performance. Amtrak’s short-term service goals for its lines in Texas include improving on-time performance, improving the fleet, implementing positive train control (PTC) on long-distance lines, and working with state governments to increase frequency on state-supported routes.⁴⁰

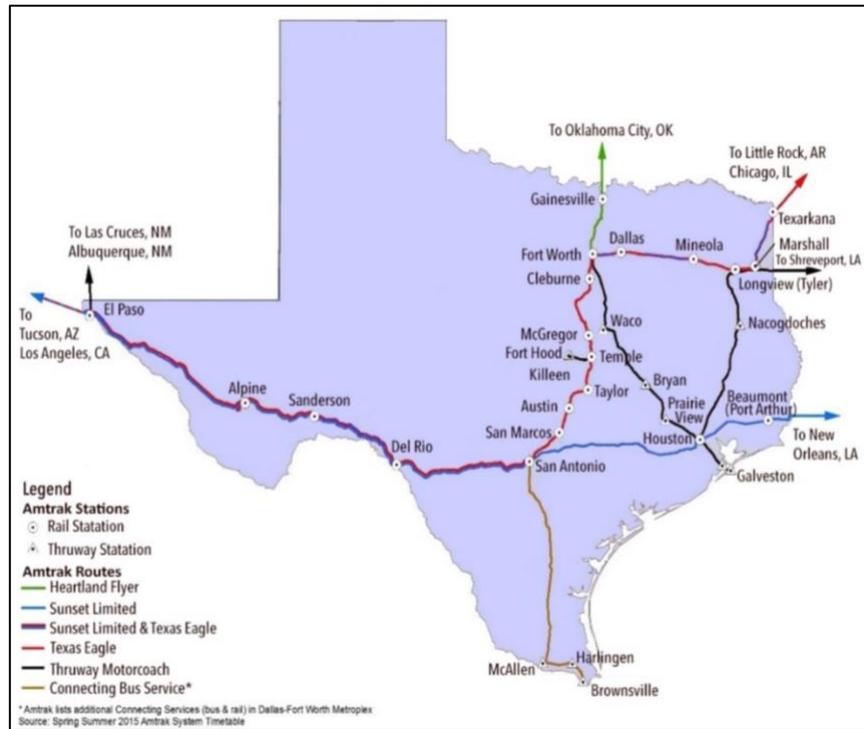
³⁸ Texas Demographic Center, 2018. Available at <http://txsdc.utsa.edu/>. Accessed December 18, 2018.

³⁹ TxDOT (2016). *2016 Texas Rail Plan*. Available at <https://www.txdot.gov/inside-txdot/forms-publications/publications/final.html>. Amtrak (2017). State Fact Sheet. Available at <https://www.amtrak.com/state-fact-sheets>.

⁴⁰ Amtrak. *Amtrak Five Year Service Line Plans, FY 2020 - 2024*. Available at <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/businessplanning/Amtrak-Service-Line-Plans-FY20-24.pdf>.

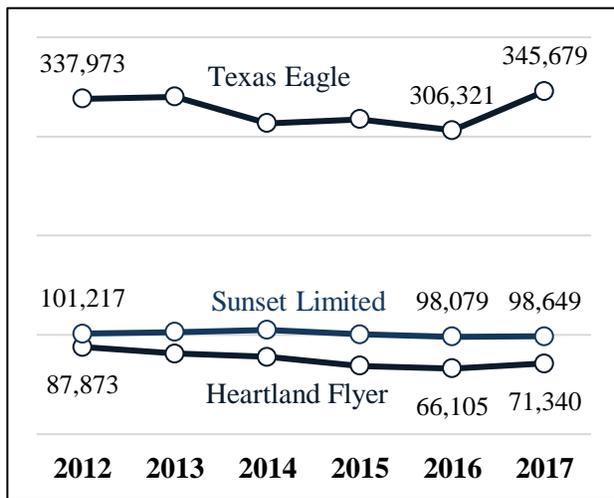
There is currently no high-speed passenger rail operating in Texas, although the Texas Central Railway is exploring the feasibility of building and operating a high-speed rail line in the Dallas to Houston Corridor. The Texas Central Railway is a private company that seeks to build and operate the line with private funding. Construction is estimated to cost \$16 billion. The Texas Central Railway has funded an environmental impact statement (EIS), which is in process.⁴¹

Figure 9. Current Texas Amtrak Routes



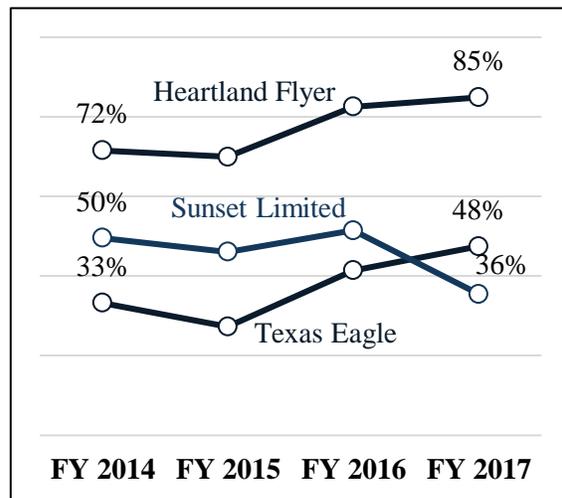
Source: Texas Transportation Institute, 2012

Figure 10. Combined Boardings and Alightings for All Routes Serving Texas by Fiscal Year



Source: Amtrak Market Research and Analysis Department

Figure 11. All-Station On-Time Performance for Routes Serving Texas



Source: Amtrak Monthly Performance Report

⁴¹ TxDOT (2019). "Dallas-Houston High-Speed Rail Project." Available at <https://www.txdot.gov/inside-txdot/projects/studies/statewide/dallas-houston-high-speed-rail.html>.

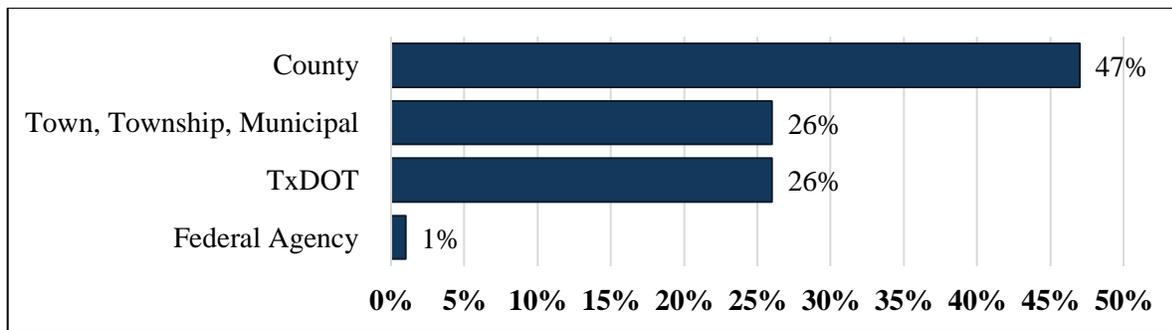
6.1 **Looking Ahead**

Environmental Impact Statements (EIS), which must precede major new rail lines or service, have been completed or are underway for several potential passenger rail corridors, which will facilitate the corresponding plans’ execution. One is the final EIS and Record of Decision funded by the Texas Central Railway for the Dallas-to-Houston Corridor. These documents are expected to be released in 2019, and construction could potentially begin afterwards. Similarly, TxDOT and the Federal Railroad Administration (FRA) released the combined final EIS and record of decision for the *Texas-Oklahoma Passenger Rail Study* in 2017 connecting south Texas with Oklahoma City.⁴²

7.0 **PAVEMENT**

Texas has the country’s largest public road network, with 314,000 miles of road. It is 78 percent larger than California’s public road network, which is the country’s second largest. Texas alone accounts for 10 percent of the country’s lane-miles of public road.⁴³ TxDOT owns and maintains approximately a quarter of Texas roads (by centerline), which totals more lane-miles than any other state department of transportation (DOT). TxDOT’s roads include some of the busiest in the state, with TxDOT roads accommodating 540 million vehicle miles traveled (VMT) daily, about 72 percent of the statewide total.⁴⁴ County governments own and maintain nearly half of the Texas road system, and municipal governments are responsible for most of the rest (Figure 12).⁴⁵

Figure 12. Share of Public Road Ownership (Length in Miles)



Source: FHWA (2017). HM-10. Public Roads: Length by Ownership

⁴² TxDOT and FRA (2017). Texas-Oklahoma Passenger Rail Study Service. Final Environmental Impact Statement and Record of Decision. EIS number: 20170215. Available at <https://cdxnodengn.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=241034>.

⁴³ FHWA (2017). HM-81. State Highway Agency-Owned Public Roads. <https://www.fhwa.dot.gov/policyinformation/statistics/2017/>.

⁴⁴ TxDOT Pocket Facts FY 2017. Available at http://ftp.dot.state.tx.us/pub/txdot-info/gpa/pocket_facts.pdf.

⁴⁵ FHWA (2017). HM-10. Public Roads: Length by Ownership. Available at <https://www.fhwa.dot.gov/policyinformation/statistics/2017/>.

Eighty-six percent of pavement on TxDOT’s ‘on-system’ road network is in “good or better” condition (i.e., a Condition Score of 70 or more on a 100-point scale), and only 5 percent of lane-miles are classified as being below “fair” condition (i.e., below a Condition Score of 50). Statewide, the average condition has improved 2.5 percent since 2002. Good pavement condition is spread throughout the state; the average on-system pavement condition is considered “good or better” in all 25 TxDOT districts.⁴⁶

Project Highlight

TxDOT is reconstructing, widening, and modernizing I-35 near Temple and Waco. TxDOT is communicating with the traveling public about delays and congestion related to the construction process through a wide range of outlets, including automated text messages, social media alerts, and emails. The improvements to I-35 will permit more reliable movement of passenger vehicles and trucks, while also providing aesthetic enhancement with unique murals and signature bridges.

7.1 **Looking Ahead**

Some of the challenges TxDOT faces with maintaining and improving pavement relate to growth of the state-maintained system, as population and economic activity increase, roads age, and truck traffic continues to increase. Though truck traffic related to the energy industry has subsided, energy production in Texas remains high.⁴⁷ If energy production increases in the future and a large number of new wells are completed, it could raise large-truck volumes and accelerate pavement deterioration, particularly on roads around production and related sites. Likewise, growth in truck traffic related to other freight generators, like seaports, airports, and rail intermodal yards, could affect pavement deterioration rates near those sites.

8.0 **BRIDGES**

TxDOT maintains nearly two thirds of the state’s 54,000 bridges, with most of the rest maintained by county or other local agencies.^{48 49} TxDOT’s bridges are on average larger than those owned and maintained by other state, local, federal, or private organizations since the two-thirds of bridges that TxDOT maintains represents more than three-quarters of the state’s bridge deck area. Counties, cities, and other local governments or municipalities own 14 percent of the state’s bridge deck area. Toll authorities own another 8 percent. Other state, federal, local, or private organizations own the remaining bridge deck area in Texas.⁵⁰

⁴⁶ TxDOT (2017). *Conditions of Texas Pavements*. Full Report. PMIS Annual Report FY 2014:2017.

⁴⁷ TxDOT (2017). *Conditions of Texas Pavements*. Full Report. PMIS Annual Report FY 2014:2017.

⁴⁸ Texas DOT (2016). *Report on Texas Bridges: FY 2016*. Available at <https://www.txdot.gov/government/reports/texas-bridges.html>.

⁴⁹ FHWA (2017). National Bridge Inventory. Available at <https://www.fhwa.dot.gov/bridge/nbi/ascii.cfm>.

⁵⁰ Ibid.

Most of Texas’ bridges belong to high condition categories, and the share of bridges in the worst condition categories has declined during the last five years.⁵¹ For example, 91 percent belong to one of the highest two Bridge Condition Score groups (Figure 13). Less than 1/10 of a percent belongs to the lowest group.⁵²

Average bridge condition has been largely stable over the last five years. However, there has been a decline in the share of bridges in the highest and lowest condition categories and growth in the share of bridges in intermediate condition categories, as shown in Figure 14.⁵³ Additionally, the share of traffic on structurally deficient bridges has continuously declined (Figure 15).⁵⁴

Project Highlight

TxDOT is proposing to replace the bridge on FM457 connecting the barrier islands to the mainland across the Gulf Intercostal Waterway. The existing bridge has to be opened to allow ships to pass and is one of the last swing bridges in the state. A new bridge would allow for a continuous connection, particularly during floods and hurricane evacuations, and would reduce maintenance costs. The bridge design has innovation features to protect wildlife and save space.

Figure 13. Number of Bridges in State Condition Score Groups

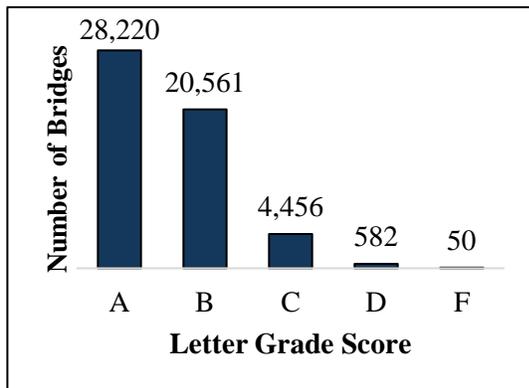
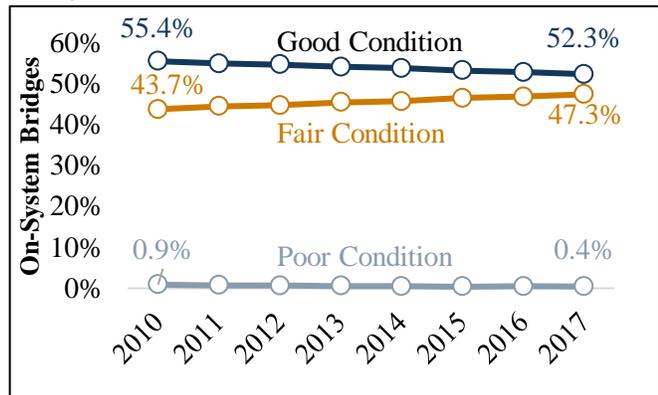


Figure 14. On-System Poor Condition Bridges: 2010 through 2017



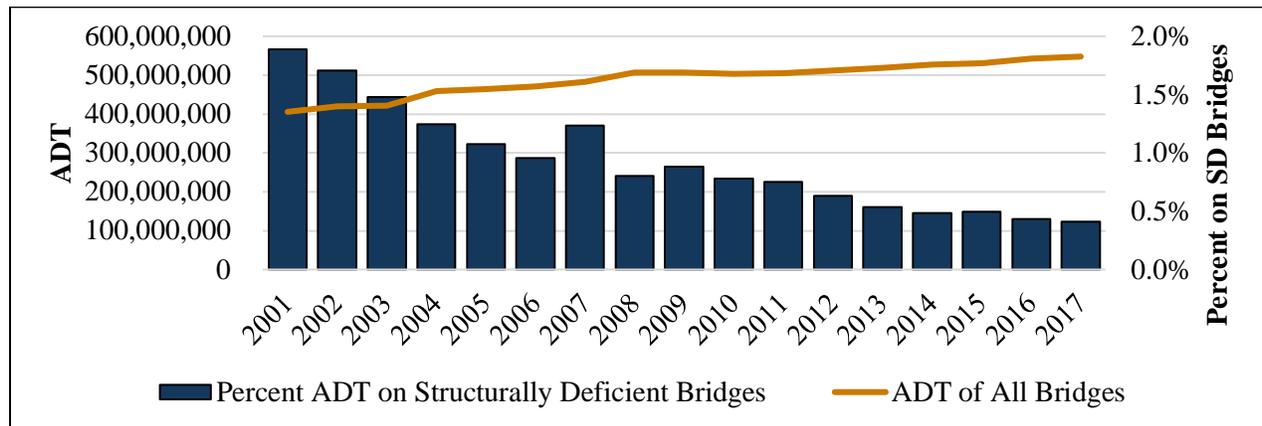
⁵¹ TxDOT (2018). TxDOT Bridges. Available at <https://gis-txdot.opendata.arcgis.com/datasets/txdot-bridges>.

⁵² Ibid.

⁵³ FHWA (2010-2017). National Bridge Inventory. Available at <https://www.fhwa.dot.gov/bridge/nbi/ascii.cfm>.

⁵⁴ FHWA (2017). Bridge Condition by Functional Classification. Available at <https://www.fhwa.dot.gov/bridge/fc.cfm>.

Figure 15. Percent ADT on Structurally Deficient (SD) Bridges in Texas



Source: FHWA (2017). *Bridge Condition by Functional Classification*. Available at <https://www.fhwa.dot.gov/bridge/fc.cfm>.

8.1 Looking Ahead

TxDOT facing several challenges in maintaining its track record of improvements in bridge condition. One is the growing bridge inventory. Between 2006 and 2016, the number of TxDOT-owned bridges increased by 9 percent, and the total statewide number of bridges increased by 8 percent.⁵⁵ If the number of bridges continues to expand, which is likely given Texas’ fast-growing population, funding needs for bridge preservation will likely increase, holding other factors constant. Simultaneously, bridges are aging. Fortunately, TxDOT has a history of replacing old bridges, as shown by the fact that it eliminated or replaced at least 3,114 bridges built before 1970 in the ten years between FY 2006 and FY 2016.⁵⁶ Another challenge will come from increased traffic, particularly truck traffic. Texas’ fast-growing population and the presence of freight-intensive industries like the energy sector generate a large and growing volumes of large trucks. In fact, between 2016 and 2045, it is expected that intra-truck truck ton-miles will grow by 32 percent.⁵⁷ Additional truck movement will accelerate bridge deterioration.

⁵⁵ TxDOT (2016). *Report on Texas Bridges: FY 2016*. Retrieved from <http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy16.pdf>.

⁵⁶ Ibid.

⁵⁷ Center for Transportation Analysis (ORNL) (2018). *Freight Analysis Framework Data Tabulation Tool*. Retrieved from <https://faf.ornl.gov/fafweb/Extraction0.aspx>.

9.0 HIGHWAY MOBILITY

Figure 16. 2018 Urban Mobility Scorecard Statistics



Texas A&M Transportation Institute. Available at <https://mobility.tamu.edu/texas-most-congested-roadways/>.

on state-owned roads alone to complete a trip around the earth every four seconds on average. Delays due to this much activity incur costs that are nearly as enormous. Congestion in Texas costed the equivalent of nearly \$12 billion in 2018 due to lost time and wasted fuel (Figure 16). Total delay in 2018 equaled 66,000 person-years.

State roads accommodate nearly three-quarters of vehicular travel in Texas, and TxDOT plays a major role in addressing congestion. The Texas Clear Lanes program is one of the ways in which the state is fulfilling its role by adding capacity, or lanes, in Texas’ most congested roadways. Through Texas Clear Lanes, TxDOT identifies the state’s most congested chokepoints and works to swiftly build new roads, connection, and capacity. Texas Clear Lanes targets funding for these congestion relief projects in the five largest metropolitan regions.

Congestion is one of the downsides of a booming economy. As jobs relocate to Texas, so do people. When combined with population growth related to births in Texas, the result is more daily vehicle trips. Urban areas of all sizes experience the challenges of population and jobs growth as they increase the number of people traveling. The scale of automotive travel activity is so large that it is hard to comprehend.⁵⁸ The 748 million daily VMT in Texas are enough to travel from the earth to the moon and back again every minute of each day. There is enough activity

Project Highlight

I-20 in Eastland County has experienced congestion, particularly during inclement weather, due to vehicles that climb the hills more slowly than traffic as a whole. TxDOT is realigning and rebuilding portions of I-20 in Eastland County to reduce the hill’s grade, straighten curves, and add a climbing lane for slower vehicles. This \$76 million project will address safety concerns and improve traffic flow.

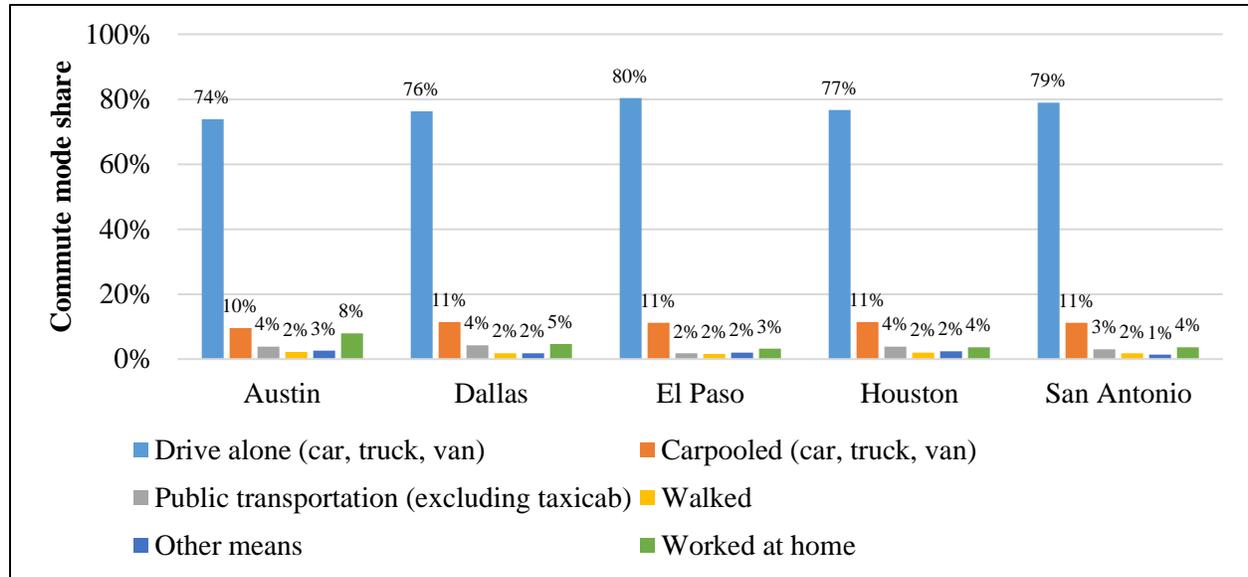
The cities of Houston, Dallas, Fort Worth, and Austin continue to rank among the top 20 most congested cities in the nation in terms of annual person hours of traffic delay.⁵⁹ Ninety-six percent of the top 100 most congested Texas roadways are located in the four largest metropolitan areas

⁵⁸ TxDOT Pocket Facts FY 2017. Available at http://ftp.dot.state.tx.us/pub/txdot-info/gpa/pocket_facts.pdf.

⁵⁹ Bureau of Transportation Statistics (2018). *National Transportation Statistics 2018*. Available at <https://www.bts.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-and-data/national-transportation-statistics/223001/ntsntire2018q3.pdf>.

of Austin, Dallas-Fort Worth, El Paso, Houston, and San Antonio, with additional top 100 most congested routes in Harlingen, Corpus Christi, Bryan-College Station, and Brownsville.⁶⁰ Despite congestion, roughly three-quarters of work travel in the state’s largest metropolitan areas occurs in automobiles with a single occupant. Around 10 percent of commuters carpool, whereas transit, walking, and other commute modes have shares in the low single digits (Figure 17).

Figure 17. Commuter Mode Choice Profile by Major Texas Metropolitan Region



Source: U.S. Census Bureau, 5-year American Community Survey (2013-2017)

9.1 Looking Ahead

In addition to programs such as Texas Clear Lanes that expand capacity, technology can help existing roads accommodate more vehicles more smoothly and safely. For example, TxDOT’s use of intelligent transportation systems (ITS) infrastructure helps TxDOT manage capacity on the system, especially during peak demand.⁶¹ Additionally, new vehicle technologies related to automation and self-driving have the potential to help roads accommodate more vehicles by allowing vehicles to safely move closely spaced or facilitating ridesharing. Conversely, automated vehicles and ridesharing may make driving more convenient and less expensive, causing an overall increase in VMT and raising congestion.⁶²

⁶⁰ Texas A&M Transportation Institute (2018). *100 Most Congested Roadways in Texas - 2018 Report*. Available at <https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-2018-7.pdf>.

⁶¹ TxDOT (2019). *Texas Clear Lanes*. Available at <http://www.dot.state.tx.us/texasclearlanes/>.

⁶² Litman, T. (2019). *Autonomous Vehicle Implementation Predictions: Implications for Transportation Planning*. Victoria Transport Policy Institute. Available at <https://www.vtpi.org/avip.pdf>.

10.0 INTELLIGENT TRANSPORTATION SYSTEM (ITS)

Intelligent transportation systems (ITS) include a wide variety of infrastructure and systems that help roads function safely and efficiently. ITS infrastructure provides for data collection, analysis, and communication that facilitates transportation management with devices including cameras for traffic monitoring and for security, dynamic messaging signs, vehicle detectors (e.g., loops, microwave, video, Bluetooth), weather stations, highway advisory radio, weigh-in-motion stations, traffic signal preemption, communications technology, and many other systems that facilitate transportation management.

Project Highlight

“Smart Work Zones” refer to the use of ITS in road work zones to collect data that allows for better operations around the work zone. TxDOT’s Smart Work Zone program is intended to improve the safety of motorists and work zone personnel, and to reduce construction-related congestion. TxDOT’s Smart Work Zones can leverage several types of ITS, including queue detection, speed monitoring, construction equipment alerts, and incident detection.

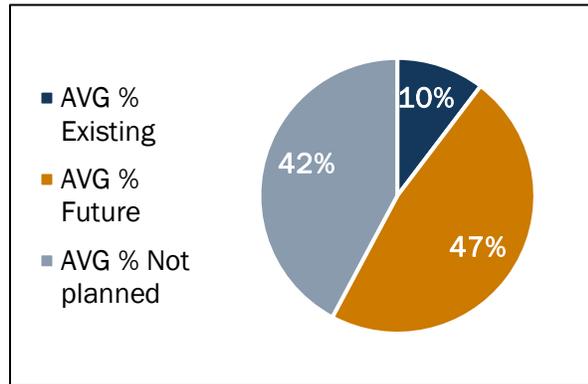
The operations of traffic management centers (TMCs) with staff and systems to collect and analyze data, respond to incidents, and communicate with drivers is another part of ITS. TxDOT operates district-level TMCs to monitor and manage roadways. Among other functions, they continuously collect and analyze data on traffic condition from ITS infrastructure and act to make traffic move more safely and smoothly, for example by dispatching incident management teams. TMCs use advanced transportation management systems (ATMS) to collaborate, to communicate with ITS devices, to respond to traffic and incidents, analyze data, and produce reports. TxDOT districts manage major roadways using an ATMS called Lonestar.⁶³ In addition to TxDOT, cities, counties, transit agencies, and other transportation organizations own and operate ITS devices.

The National ITS Architecture is framework for planning and deploying ITS that creates consistency among the state and local governments that follow it.⁶⁴ The National ITS Architecture lists several dozen ITS service packages related to traffic management and safety, each of which

⁶³ FDOT and TxDOT (2013). SunGuide Software and Lonestar Software: Comparison and Analysis. Technical memorandum. Available at http://sanguidesoftware.com/sanguidesoftware/documentlibrary/DragAndDropFTP/SunGuide_and_Lonestar_Review.pdf.

⁶⁴ USDOT. *National ITS Reference Architecture*. ITS Joint Program Office. Available at https://www.its.dot.gov/research_archives/arch/.

Figure 18. Statewide ITS Service Package Deployment Status



Source: Compiled from Regional ITS Architectures released between 2003 and 2013.

describes the physical objects and functions needed for the TMC to deliver that service (e.g., traffic signal control, traffic surveillance, variable speed limits, queue warnings).⁶⁵ TxDOT began developing regional ITS architecture reports in 2001, and each report identifies the service packages that the given region needs for safety and mobility. The reports specify whether the region already has the service package (“existing”), whether it is planned (“future”) or whether it is needed but not planned (“not planned”). Based on regional reports between 2003 and 2013, only 10 percent of the service

packages that the regions needed were in place. The regions had plans to deploy about half of their remaining service needs, but they had no plans to meet the remaining 42 percent of their service needs (Figure 18). TxDOT prioritized consolidating TMCs across the state to regions with Lonestar capabilities in its 2013 ITS Strategic Plan. As of 2013, only three TxDOT districts had no ITS implementation. The remaining 22 districts either had implemented Lonestar independently or received support from one of the four “primary districts” (i.e., Dallas, Fort Worth, Houston, San Antonio).⁶⁶ In the plan, TxDOT proposed adding two new primary districts (Amarillo and El Paso) and making all the remaining districts be supported by one of these primary districts.

10.1 Looking Ahead

There are several emerging trends that may change the future of ITS. The first is connected and autonomous vehicles (CAVs), for which some infrastructure is already being deployed in Texas cities, primarily for traffic signal communication. CAVs may require new ITS deployments to maximize the technology’s benefits.

Private-sector agreements are another trend. Private companies such as INRIX and Waze have been able to provide increasingly detailed data on traffic and vehicle movements. TxDOT has already begun to realize the benefit of developing public-private partnerships through agreements with INRIX and Waze to inform 511 call centers, TMC congestion maps, crash data, disseminate travel conditions to the public.

⁶⁵ USDOT (2018). “Service Packages.” *National ITS Reference Architecture*. Available at <https://local.iteris.com/arc-it/html/servicepackages/servicepackages-areaspport.html>.

⁶⁶ Seymour, E. et al. (2014). *TxDOT ITS Strategic Plan 2013*. Report No. FHWA/TX-13/0-6672-2-Vol-2. Available at <https://static.tti.tamu.edu/tti.tamu.edu/documents/0-6672-2-Vol-2.pdf>. Accessed March 2019.

11.0 TRANSIT

TxDOT is committed to providing travel options for its users. Transit reduces highway congestion and improves air quality, which are particularly important in major metropolitan regions with the substantial congestion and air pollution. In 2018, Texans took 275 million trips using public transportation trips through services from one or more of several dozen local transit authorities, districts and programs.⁶⁷ Since ticket sales do not cover the full costs of providing transit services, TxDOT invests around \$600 million each year in public transportation. In addition, TxDOT provides financial, technical, and coordination assistance to rural and smaller urban public transportation providers. TxDOT collaborates with local agencies to support safe, reliable transit that increases travelers’ travel options. TxDOT helps local transit providers serving small urbanized areas (i.e., non-metropolitan transit authority (MTA) providers under 200,000 people) meet federal requirements related to reporting on vehicles’ and infrastructure’s condition. For instance, TxDOT prepared a group Transit Asset Management (TAM) plan for some rural transit providers.⁶⁸

Project Highlight

TxDOT values interactive local partnerships as highlighted by recent Regional collaboration with VIA Metropolitan Transit, as well as the City of San Antonio, Bexar County, and the Alamo Regional Mobility Authority, in San Antonio which has yielded congestion relief to major corridors in the region including: Loop 1604 West, I-10 West and US 281 North.

Table 2. Texas Transit Quick Facts

8 metropolitan transit authorities (MTAs) ⁶⁹
31 small urban transit districts and 36 rural transit districts ⁷⁰
56 elderly and disability transit programs (Section 5310) ⁷¹
1.5 percent of work commute trips across Texas used public transportation in 2017 ⁷²

⁶⁷ TxDOT (2018). *2018 Texas Transit Statistics Preliminary Report*. Available at http://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2018.pdf.

⁶⁸ TxDOT (2018). *TxDOT Transit Asset Management Group Sponsored Plan (FY 2019-2023)*. Available at <http://ftp.dot.state.tx.us/pub/txdot-info/ptn/tam-plan.pdf>.

⁶⁹ TxDOT (2018). *2018 Texas Transit Statistics Preliminary Report*. Available at http://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2018.pdf.

⁷⁰ Ibid.

⁷¹ Ibid.

⁷² U.S. Census Bureau. *American Community Survey 5-Year Estimates (2013-2017). Means of Transportation to Work by Selected Characteristics*. Available at <https://factfinder.census.gov>.

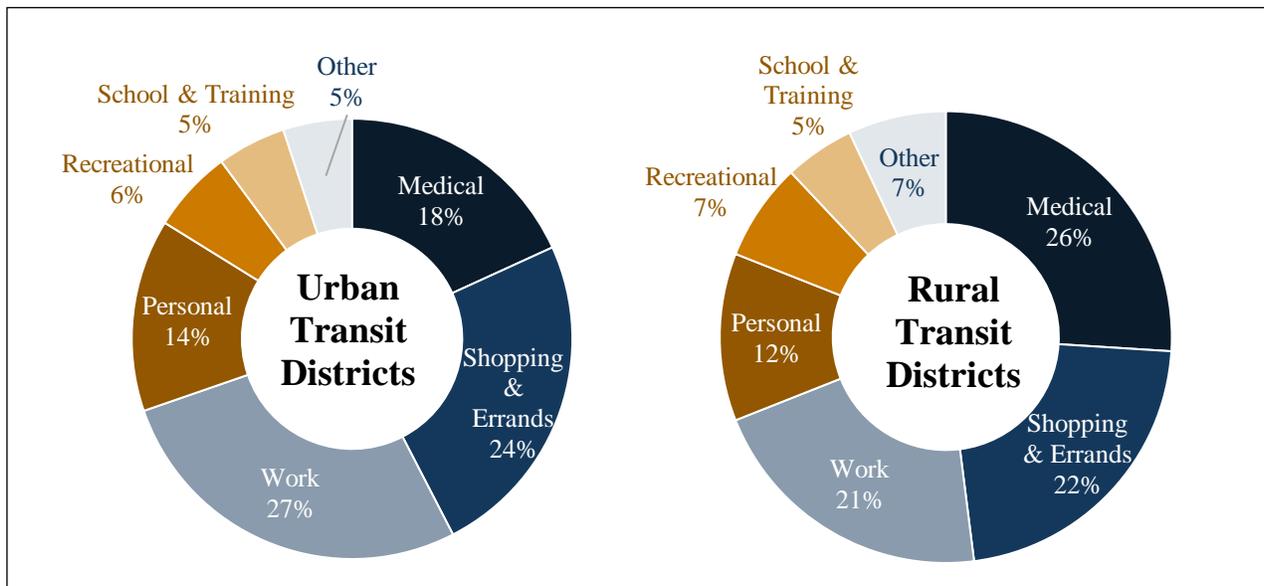
More than 275 million total transit trips in 2018⁷³

For TxDOT-funded transit providers in FY 2017:⁷⁴

- 2,855 transit vehicles (includes buses and vans)
- 30 million rides on public transportation vehicles
- \$177 million in total federal and state apportionments

Texans use transit for many reasons, such as, to travel to work, visit friends and family, access healthcare, shop, attend school, and countless other activities. Work-related commuting is the most common trip type among urban transit riders. In rural Texas, roughly one quarter of trips of the transit trips are for travel to or from healthcare. (Transit ridership is decreasing as a whole statewide, but increasing in the urban areas in Texas. Figure 19 show the breakdown of transit ridership by trip purpose for urban versus rural areas.

Figure 19. Texas Transit Riders' Trip Purposes



Source: 2017 Texas Rider Survey

11.1 Looking Ahead

Transit ridership is likely to remain tied to historical reasons, such as fluctuating gas prices, population growth, congestion, parking fees, and public commitment to supplying transit. Ridesharing's longer-term role in shaping transit ridership remains uncertain and will depend in part on the service's long-term price. CAVs may ultimately decrease ridesharing's price and

⁷³ TxDOT (2018). 2018 Texas Transit Statistics Preliminary Report. Available at http://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2018.pdf.

⁷⁴ TxDOT Pocket Facts FY 2017. Available at http://ftp.dot.state.tx.us/pub/txdot-info/gpa/pocket_facts.pdf.

influence transit ridership through their potential effects on land density and development patterns.⁷⁵

12.0 BICYCLE / PEDESTRIAN

Active transportation modes like bicycling and walking have been linked with cleaner air, health benefits, and lower congestion for the region. Local governments and metropolitan planning organizations (MPOs) are responsible for planning, maintaining, and analyzing most of Texas’ bicycle and pedestrian networks. Nonetheless, TxDOT has expanded its data on active transportation in recent years and taken many steps to make active transportation safer. Texas is in the middle of the pack among states for bicycle friendliness,⁷⁶ although it is trending downward by this measure.⁷⁷ Table 3 summarizes active transportation in Texas.

Project Highlight

The City of Liberty Hill initiated a project focused on the construction of a Bike/Pedestrian Loop in Liberty Hill’s downtown. To complete the project, the city requested \$1.2 million from the Transportation Alternative Set-Aside Program (TASA). TASA is designed for small urban and rural communities to improve their surface transportation systems. The Liberty Hill Loop is estimated to cost \$1.3 million in total, and construction is set to begin after August 2020.

Table 3. Texas Bicycle/Pedestrian Quick Facts

25 th in the country for Bicycle Friendly States
45 th in the country for combined percentage of commuters who bicycle or walk
14percent decrease in bicyclist fatalities between 2016 and 2017
10percent decrease in pedestrian fatalities between 2016 and 2017

Sources: *The League of American Bicyclists, The Alliance for Bicycling and Walking, TxDOT*

About 0.3 percent of Texas commuters ride a bicycle to work, whereas about 1.6 percent walk.⁷⁸ More commuters in large metropolitan regions use active transportation than in the state as a whole. Nationwide, Austin and Houston have the 20th and 30th highest rates, respectively, of use of active transportation, with San Antonio, El Paso, and Dallas close behind. College Station ranked 16th nationally for U.S. cities with the highest share of bicyclists. Arlington was one of

⁷⁵ Mallett, W. J. (2018). “Trends in Public Transportation Ridership: Implications for Federal Policy.” Congressional Research Service. Available at <https://fas.org/sgp/crs/misc/R45144.pdf>.

⁷⁶ The League of American Bicyclists (2017). *Bicycle Friendly States Historical Ranking, 2008-2017*. Available at https://www.bikeleague.org/sites/default/files/BFS2017_HistoricalRanking_Chart.pdf.

⁷⁷ The League of American Bicyclists (2017). *Past Performance*. Available at https://www.bikeleague.org/sites/default/files/BFS2017_PastPerformance_Chart.pdf.

⁷⁸ Alliance for Bicycling and Walking (2016). *Bicycling and Walking in the United States*. Available at https://www.bikeleague.org/sites/default/files/2016BenchmarkingReport_web.pdf.

seven U.S. cities that demonstrated a particularly large increase in bicycle traffic between 2011 and 2016 of 201 percent.⁷⁹

12.1 **Looking Ahead**

TxDOT is continuing to invest in collecting bicycle and pedestrian data to know more about where, how frequently, and why people walk and bicycle. Continued data collection will allow TxDOT and local governments to understand how people travel using active transportation, where to construct new or make improvements to the system, and where to integrate safer designs.

13.0 **SAFETY**

TxDOT’s first priority is to keep travelers safe. For this reason, TxDOT has adopted a vision of “a future with zero traffic fatalities and serious injuries,”⁸⁰ which supports the “Toward Zero Deaths” national strategy.⁸¹ Texas has set up emphasis areas in support of its vision to reduce specific types of crashes, including crashes related to running off the road, distracted driving, driving under the influence (DUI) of drugs or alcohol, crashes at intersections, and crashes involving bicyclists and pedestrians. As Texas’ population and travel activity grow, it will be hard to prevent crashes, fatalities, and injuries from increasing at the same rate. Nonetheless, the combination of many proactive measures has prevented traffic fatalities and serious injuries from growing as quickly as population and traffic activity.⁸²

Project Highlight

In the spring of 2019, TxDOT will begin a project to install high-mast lighting on Highway 69 between Beaumont and Port Arthur. The project will cost \$1.8 million. The installation of the lights will improve safety by enhancing visibility for those traveling on Highway 69.

Local input around safety and mobility concerns shaped the transformation of S.M. Weight Freeway in South Dallas. As part of the redesign, the road is being repurposed from being a high-volume through-traffic corridor to a neighborhood-serving boulevard supporting the neighborhood’s original fabric. Safety was a key consideration in the design, which features new pedestrian crossings, sidewalks, and a 35-mph design speed.

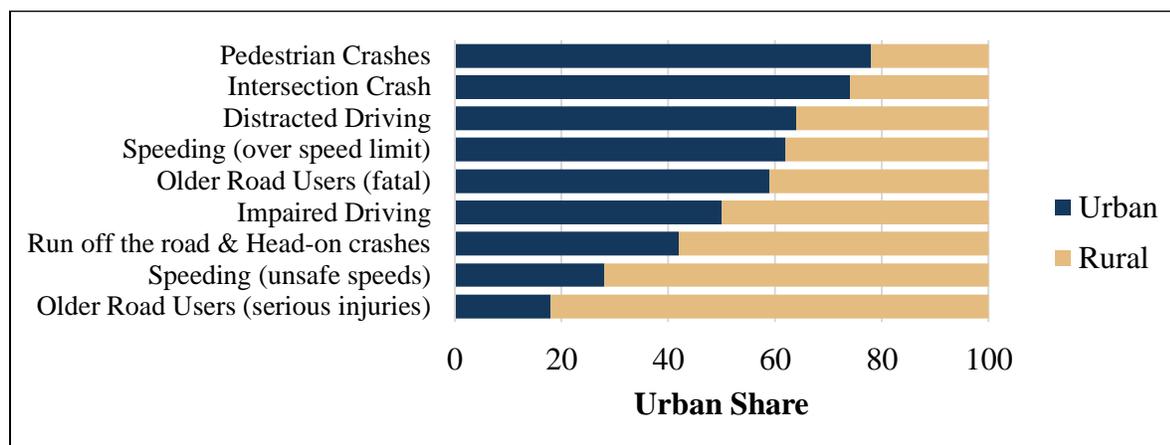
⁷⁹ People Powered Movement (2018). Available at <https://www.peoplepoweredmovement.org/>.

⁸⁰ TxDOT. *Texas Strategic Highway Safety Plan 2017-2022*. Available at <ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/gov/shsp.pdf>.

⁸¹ Toward Zero Deaths (2015). Available at <https://www.towardzerodeaths.org/>.

⁸² This safety snapshot is informed by TxDOT’s CRIS database, TxDOT’s Performance Dashboard (<http://www.dot.state.tx.us/dashboard/promote-safety.htm>), Texas Highway Safety Plan, Texas Strategic Highway Safety Plan (FY 2019 and 2018).

Figure 20. 2010-2016 Traffic-Based Emphasis Areas



Source: TxDOT. Texas Strategic Highway Safety Plan (2018). Available at <http://www.texasshsp.com/wp-content/uploads/2018/11/SHSP-final-spreads.pdf>.

Crashes in Texas cause an average of 10 deaths and 49 serious injuries every day. This equates to 1.35 deaths for every 100 million VMT. Although TxDOT envisions a future with zero traffic fatalities and serious injuries,⁸³ the fatality rate has declined by 22 percent since 2003.⁸⁴ The 7,805 serious injuries that occurred on Texas roads in 2017 equate to 6.68 serious injuries for every 100 million VMT (Table 4). Statewide VMT grew by 12 percent between 2013 and 2017, whereas fatalities grew by nine percent and serious injuries by five percent.

Table 4. Texas Safety Quick Facts

3,721 total fatalities on Texas roads ⁸⁵
17,890 serious injuries on Texas roads ⁸⁶
60% of serious injury crashes take place in urban areas, whereas 40% take place in rural areas. ⁸⁷

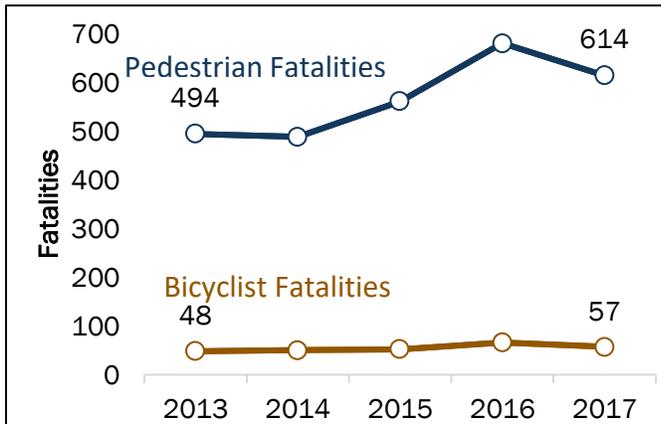
⁸³ TxDOT. Texas Strategic Highway Safety Plan 2017-2022. Available at <ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/gov/shsp.pdf>.

⁸⁴ TxDOT (2017). Comparison of Motor Vehicle Traffic Deaths, Vehicle Miles, Death Rates, and Economic Loss, 2004 – 2017. Available at http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2017/a.pdf.

⁸⁶ National Highway Traffic Safety Administration. Fatality Analysis Reporting System (FARS). Available at <https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars>.

⁸⁷ Texas Traffic Safety Task Force (2016). Solutions for Saving Lives on Texas Roads. Available at <https://ftp.dot.state.tx.us/pub/txdot-info/trf/trafficsafety/saving-lives.pdf>.

Figure 21. Texas Statewide Pedestrian and Bicyclist Fatalities from 2013 - 2017



TxDOT (2017). Texas Motor Vehicle Crash Statistics 2017. Available at <https://www.txdot.gov/government/enforcement/annual-summary.html>.

Between 2013 and 2017, fatalities from DUI and running off the road have increased, whereas there has been the same number or fewer fatalities from most other common crash causes. Crash types are unevenly divided between urban and rural areas. Crashes involving pedestrians and crashes at intersections are mostly in the urban areas, whereas injury crashes related to older drivers and crashes related to speeding are primarily in the rural areas (Figure 20).

Texas had 614 pedestrian fatalities in 2017.⁸⁸ In 2016, Texas has the eighth-highest pedestrian fatality rate in the U.S.⁸⁹

Unfortunately, bicyclist and pedestrian fatalities have been trending upward, increasing 19 percent and 24 percent between 2013 and 2017 (Figure 21). Growth in active transportation and motorized travel may account for some of the increase since over the same time period statewide VMT grew 12 percent.

13.1 Looking Ahead

Projected population growth and VMT will require continued safety-related campaigns. However, new trends and technology will aid TxDOT to focus on different safety emphasis areas. For instance, if ride-sharing increases and automated vehicles become prevalent, the measures that TxDOT will need to take to improve safety may differ from some of today’s emphasis areas.

14.0 RISK AND RESILIENCY

Recent natural disasters in Texas such as flooding damage caused by Hurricane Harvey and wildfires in Bastrop and rural Texas have highlighted the need for TxDOT and other public agencies to prepare for disruptions. Having a transportation system that resists and efficiently recovers in the

Project Highlight
<p>TxDOT helps keep the road system moving, even during major disruptions. In addition to monitoring the condition of roads and bridges, TxDOT deployed district employees to Houston, Beaumont, Yoakum, and Corpus Christy during Hurricane Harvey in 2017 to help with the recovery.</p>

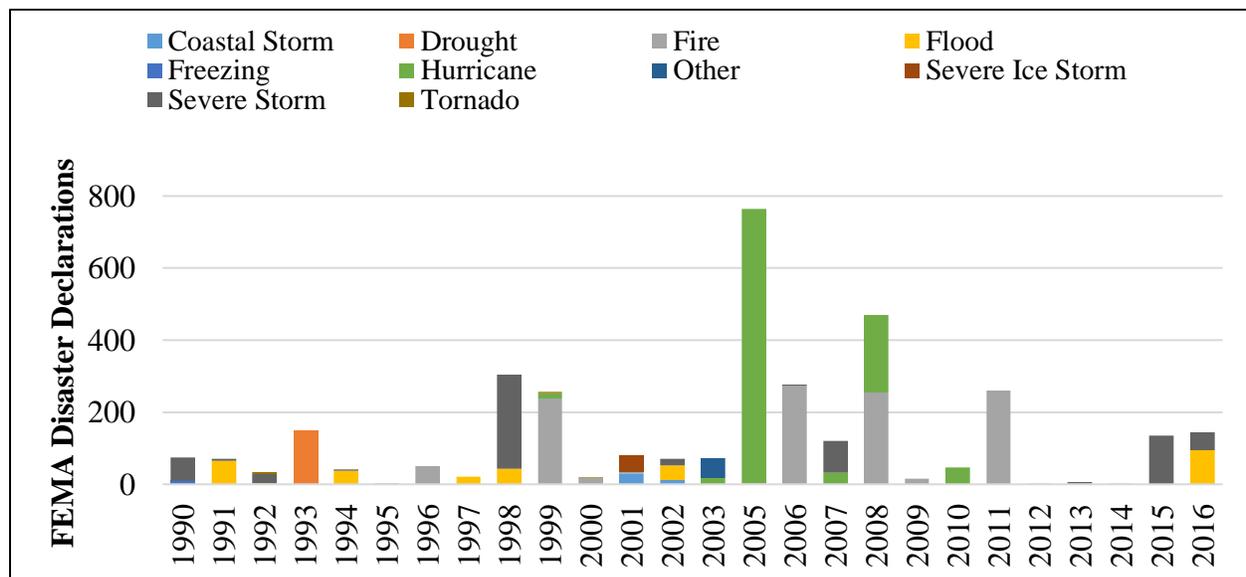
⁸⁸ TxDOT. Available at <https://www.txdot.gov/inside-txdot/forms-publications/drivers-vehicles/publications/annual-summary.html>.

⁸⁹ NHSTA. Fatality Analysis Reporting System (FARS). Available at <https://www-fars.nhtsa.dot.gov/States/StatesPedestrians.aspx>.

face of disruptions will keep Texans safer, facilitate emergency management operations, and limit the extent of economic damages. This document frames disruptions in the context of severe weather, but risk and resiliency measures apply equally to other disruptions, such as other natural disasters, train derailments, hazardous materials spills, and acts of violence.

Figure 22 shows that the composition of weather incidents in Texas that the Federal Emergency Management Agency (FEMA) declares as federal disasters has shifted in the past decades. Although hurricanes have frequently produced federally declared disasters, between 2010 and 2016 severe ice storms have been produced more federally declared disasters in Texas. Flash flooding, wildfires and severe storms are other common disaster prompting federal disaster declaration for Texas.

Figure 22. Texas FEMA Disaster Declarations by Disaster Type



Source: FEMA (2017). *Disasters*. Available at <https://www.fema.gov/disasters/>.

Several trends emerge from the numerous studies and examinations of other states’ transportation resiliency work. In general, state DOT resiliency performance measures emphasize one of three areas: 1) assessing the degree to which transportation infrastructure is located in areas susceptible to severe weather events (e.g., flood zones), 2) measuring the rate of compliance with infrastructure inspections, and 3) measuring the net change in the total amount of environmentally sensitive areas (e.g., wetlands, wildlife habitat). The FHWA also provides guidance on transportation resiliency.⁹⁰

⁹⁰ Dix, B. et al. (2018). *Integrating Resilience into the Transportation Planning Process: White Paper on Literature Review Findings*. FHWA-HEP-18-050. Available at https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/planning/integrating_resilience.cfm.

14.1 **Looking Ahead**

Severe weather destroys property, ruins crops, and threatens lives. The Texas Geographic Society forecasts more than \$20 billion in losses from weather-related disasters over the next five years.⁹¹ Forecasted losses vary significantly county to county, although counties with high forecasts weather-related losses exist in all regions of the state. For losses related to the TxDOT on-system road network, TxDOT forecasted a 50 percent annual likelihood of emergency expenses of \$41 million, and a 5 percent likelihood of emergency expenses reaching \$81 million in any given year. Emergency spending varies widely from year to year. For instance, in 2018 TxDOT spent an estimate \$94 million on emergency spending, much of it related to Hurricane Harvey.⁹²

TxDOT has taken many steps to make the state's transportation system more resilient, many of which the *State of Texas Hazard Mitigation Plan* summarizes⁹³. For example, TxDOT routinely updates its design manuals based on the National Flood Insurance Program's Floodplain Management Requirements. TxDOT has also updated 19 of its safety rest areas in tornado-prone regions with storm shelters specifically designed to protect from tornados.⁹⁴ Texas has more tornados than any other state,⁹⁵ with an average of 140 per year.

15.0 **CONCLUSION**

Texas' transportation network is among the largest and busiest in the country by many measures. Texas road network, which is the largest in the country, to its freight system supporting some two million jobs, the 289 airports in the Texas Airport System, or the 275 million annual transit trips, this multimodal transportation system supports Texans' and their businesses' mobility needs. It is likely that the size, condition, and usage of these modes will change, as Texas' population and economy continue their fast growth, and as businesses and the traveling public adopt new transportation technologies. These changes will challenge TxDOT and its partners to preserve and operate the system components for which they are responsible in ways that are efficient both for the organizations and for travelers, and that support and enhance Texans' opportunity and quality of life.

Although various projects have been spotlighted herein, additional details on existing and committed TxDOT projects can be found by exploring the:

⁹¹ Texas Geographic Society (2018). Community Hazard Assessment and Mitigation Planning System (CHAMPS) '18. Available at <http://www.champ-services.us>.

⁹² TxDOT (2018). *Texas Transportation Asset Management Plan*. Maintenance Division.

⁹³ Texas Department of Public Safety (2018). *State of Texas Hazard Mitigation Plan*. Available at <https://www.dps.texas.gov/dem/Mitigation/txHazMitPlan.pdf>.

⁹⁴ Ibid.

⁹⁵ NOAA (2018). "Annual Averages: Tornados by State." Storm Prediction Center. Available at <https://www.spc.noaa.gov/wcm/>.

- **Unified Transportation Program (UTP):** The UTP is TxDOT’s 10-year plan to guide project development. It includes projects related to highways, aviation, public transportation, and waterways. Please see the searchable UTP project database or an annual UTP report for more details about TxDOT’s transportation programs and included projects on a 10-year time horizon. URL: <https://www.txdot.gov/inside-txdot/division/transportation-planning/utp.html>;
- **TxDOT Project Tracker:** To learn more about more than 11,000 projects ranging from ongoing construction to corridor studies, please see the online TxDOT Project Tracker at http://apps.dot.state.tx.us/apps-cq/project_tracker/;
- **Texas Strategic Highway Safety Plan:** This plan traces coordination among TxDOT, MPOs, and other state agencies to implement steps toward achieving TxDOT’s vision of zero deaths or serious injuries. URL: <https://www.texasshsp.com/>; and
- **State Metropolitan Transportation Plans:** These regional plans provide more information on major projects and initiatives within metropolitan regions across the state. URL: <https://www.texasmpos.org>.

16.0 APPENDIX: ADDITIONAL FREIGHT FACTS

16.1 Highways

Highways are the predominant mode for freight movement within Texas. Trucks, traveling on highways, serve as the first/last mile connection to rail facilities, ports, and airports. Additionally, trucks provide long haul services and deliver goods across the state and beyond. Texas has more than 314,000 centerline miles of public roads, more than any other state.⁹⁶ In 2016, trucks accounted for almost 58 percent of the total tonnage moved in Texas, or almost 1.26 billion tons.⁹⁷

Freight bottlenecks occur at specific locations where traffic congestion frequently impact truck operations. Texas was home to 11 of the top 100 truck bottlenecks in 2018, with the bottlenecks clustered in the major metropolitan areas of Houston, Dallas/Fort Worth and Austin.⁹⁸ Texas also has the highest cost of congestion in the nation, with a total cost more than \$6 billion in 2016.⁹⁹

16.2 Railroads

With more than 10,500 track miles, Texas has more miles of rail than any other state.¹⁰⁰ Three major (Class I) railroad companies operate within Texas: BNSF Railway, Kansas City Southern and Union Pacific. Additionally, there are 49 shortline railroads, which serve as important first- and last-mile connections for the Class I railroads, ports, and industries. Rail accounted for just more than 20 percent of the total tonnage moved in Texas in 2016, or 440 million tons.¹⁰¹ Rail also plays a significant role in cross border freight movement, with five of the seven rail border crossings between the U.S. and Mexico located in Texas.

16.3 Ports and Waterways

Texas has 11 deep-draft and six shallow-draft commercial ports. A deep draft port is defined as a port having a channel depth greater than 30 feet.¹⁰² The ports are connected by the Gulf Intracoastal Waterway (GIWW), which runs from Texas to Florida and was designated as Marine Highway 69 in 2016. Between 2014 and 2016 an average of 80 million short tons per year were transported

⁹⁶ TxDOT. 2017. Roadway Inventory Annual Reports. Available at <http://ftp.dot.state.tx.us/pub/txdot-info/tpp/roadway-inventory/2017.pdf>.

⁹⁷ IHS global insight 2015, TxFAC presentation May 31, 2018.

⁹⁸ ATRI top 100 freight bottlenecks 2018. Available at <http://atri-online.org/2018/01/25/2018-top-truck-bottleneck-list>.

⁹⁹ ATRI, 2018. Cost of Congestion to the Trucking Industry: 2018 Update. Available at <http://atri-online.org/2018/10/18/cost-of-congestion-to-the-trucking-industry-2018-update>.

¹⁰⁰ Available at <https://www.aar.org/data-center/railroads-states/#state/TX>.

¹⁰¹ IHS global insight 2015, TxFAC presentation May 31, 2018. Available at <http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/committees/freight/meetings/2018/0531-presentation.pdf>.

¹⁰² Texas Pocket Facts, 2017. Available at https://ftp.dot.state.tx.us/pub/txdot-info/gpa/pocket_facts.pdf.

along the Texas portion of the GIWW.¹⁰³ As of 2016, there were six ports in Texas that were in the top 50 ports in the U.S. for total tonnage. The Port of Houston had the second highest tonnage of any port in the U.S. in 2016.¹⁰⁴ The ranking by total tonnage and 2016 tonnage for the 10 ports included in the Texas Multimodal freight network can be found in the table below.

Table 5. Port USACE Rankings and 2016 Tonnage

Port	Rank	2016 Tonnage
Beaumont	5	84,528,063
Brownsville	66	7,275,272
Calhoun Port Authority	76	4,896,638
Corpus Christi	6	81,981,061
Freeport	33	19,635,949
Galveston	52	9,880,157
Houston	2	247,981,663
Port Arthur	20	35,198,425
Texas City	15	41,260,475
Victoria	74	5,082,077

Source: USACE (2016). *Principal Ports of the United States*
<https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2093>

16.4 **Airports**

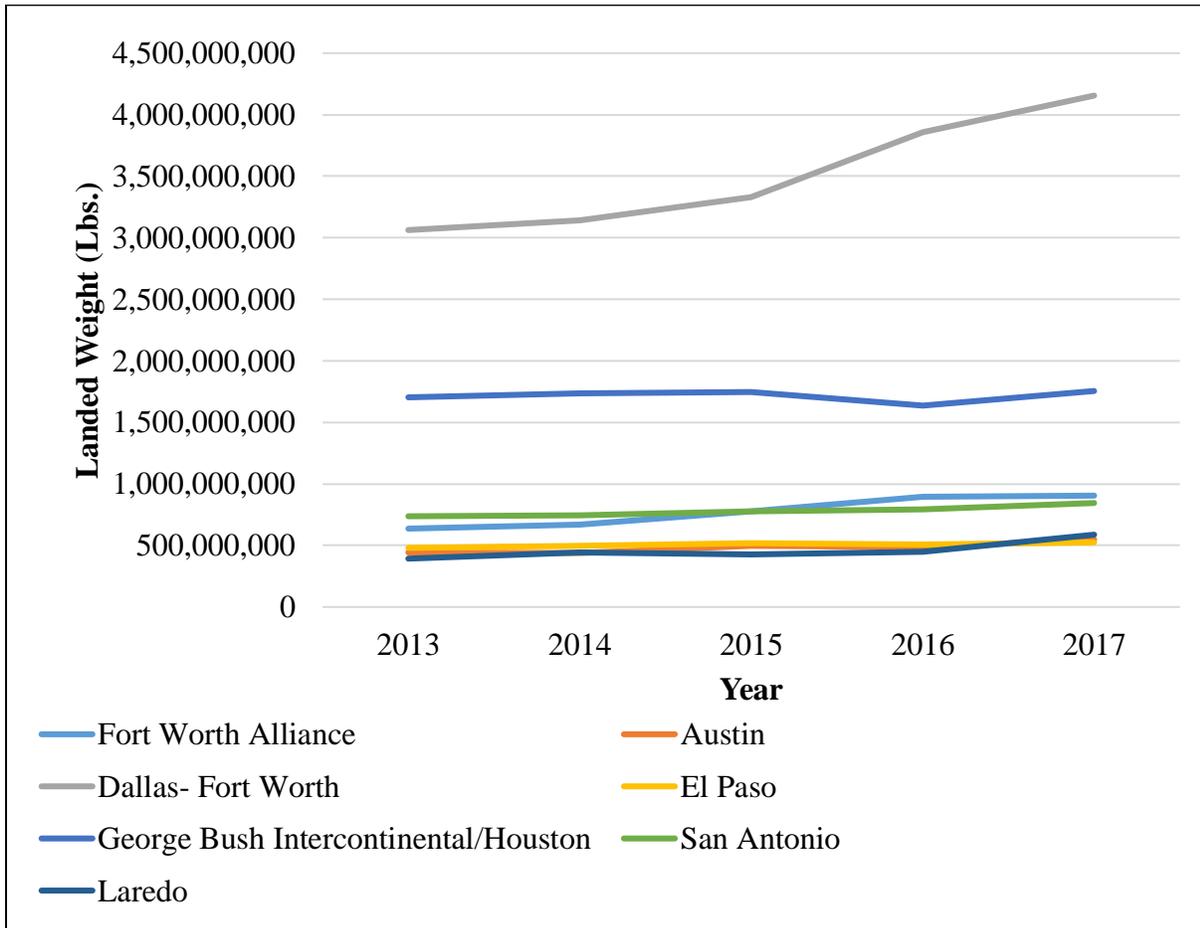
Goods shipped by air tend to be perishable or of high value due to the high cost of shipping via airplanes. Texas has 24 commercial service airports, including seven of the top 50 cargo airports in the U.S. in terms of landed weight in 2017.¹⁰⁵ Landed weight for the airports included in the Texas Multimodal Freight Network for 2013 to 2017 are presented in Figure 23. The landed weights of most airports have increased slightly from 2013 to 2017 with the notable exception of Dallas-Fort Worth International Airport, which has seen a 36 percent increase in landed weight from 2013 to 2017.

¹⁰³ Waterborne Commerce of the United States, Part 2 - Waterways and Harbors Guild Coast, Mississippi River System and Antilles, Institute for Water Resources, Department of the Army Corps of Engineers, 2016.

¹⁰⁴ USACE (2016). *Principal Ports of the United States*. Available at <https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2093>.

¹⁰⁵ FAA (2017). *All-Cargo Airports by Landed Weight*. Available at https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy17-cargo-airports.pdf.

Figure 23. Airports on the Texas Multimodal Freight Network Landed Weight 2013-2017



Source: FAA (2017). All Cargo Airports by Landed Weight. Available at https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/.

16.5 Pipelines

There are 448,446 miles of pipelines in Texas operated by more than 1,280 companies. Pipelines move three commodity groups: crude petroleum or natural gas, petroleum or coal products, and refined chemicals or allied products.