2019 – 2022

Transportation Improvement Program

Appendix B

FAST Act Compliance
and
Performance Measures - System Evaluation Report

Updated October 2019

Fixing America's Surface Transportation Act

Fixing America's Surface Transportation Act's (FAST Act) final planning rules for the Metropolitan Planning Process, the Transportation Improvement Program, and the Regional Transportation Plan (RTP) became effective on May 27, 2018. The FAST Act builds on the changes made by MAP-21 including provisions to make surface transportation more streamlined, performance-based, and multimodal, and to address challenges facing the U.S. transportation system, including safety, maintaining infrastructure condition, reducing traffic congestion, improving efficiency of the system and freight movement, protecting the environment, and reducing delays in project delivery.

The FAST Act requirements include inclusion of new planning factors, consideration of intercity bus connections, transit asset management, resiliency, and federally required performance targets. H-GAC adopted performance measure targets with the performance-based planning process within the time constraints required by FHWA. As a data clearinghouse, H-GAC will provide regional data to the Texas Department of Transportation when updates become available. The planning factors and their compliance are identified in detail.

PLANNING FACTORS

FAST Act Requirement	FAST Act Provision	Issues Addressed in 2019-2022 TIP	Where Addressed
Public Participation	23 CFR 450.316(a)	H-GAC's Public Participation Plan (PPP) was updated in 2017 to expand the list of stakeholders to be engaged in transportation planning process.	Public Participation Plan http://www.h-gac.com/transportation-public-outreach/documents/h-gac-public-participation-plan.pdf
Memorandum of Understanding	23 CFR 40.314(h)	The Memorandum of Understanding was executed between H-GAC, TxDOT and the region's transit providers.	Memorandum of Understanding http://www.h-gac.com/transportation-policy-council/meeting-agendas/documents/2018/may/ITEM-09-Interagency-MOU.pdf
Consultation and Cooperation	23 CFR 450.316(b)	2019-2022 TIP was developed with continued consultation and cooperation with state and local officials and takes into consideration the planning activities of other agencies and organizations within the MPO region.	• Public Participation Plan • Disaster Preparedness • Travel and Tourism
Resiliency and Reliability	23 CFR 450.206(a)(9)	2019-2022 TIP incorporates an assessment of the vulnerability of transportation assets to extreme weather events and identifies initiatives to improve resiliency and increase the reliability of the regional transportation system.	• Resiliency and Reliability

FAST Act Requirement	FAST Act Provision	Issues Addressed in 2019-2022 TIP	Where Addressed
Stormwater Impacts	23 CFR 450.206(a)(9)	2019-2022 TIP identifies roadways susceptible to impact by stormwater and includes a choice of projects and strategies aimed at mitigating these impacts.	• Resiliency and Reliability
Disaster Preparedness	23 CFR 450.316(b)	2019-2022 TIP identifies local emergency management operations serving the Houston-Galveston metropolitan region, details the designated hurricane evacuation routes and the Zip-Zone map.	• Disaster Preparedness
Travel and Tourism	23 CFR 450.206(a)(10)	2019-2022 TIP includes a review of opportunities to engage in recreational travel and tourism in the planning region and considers strategies to promote growth in this transportation sector.	• Travel and Tourism • Public Participation Plan
Intercity Buses	23 CFR 450.216(b) & 23 CFR 324(f)(2)	2019-2022 TIP examines the existing intercity bus services in the region and identifies opportunities to expand these services and grow additional routes and operations.	• Intercity Buses
Performance Measures	23 CFR 450.324(f)(3)	2019-2022 TIP includes the federal performance measures linked to the vision, goals, and project prioritization, establishes targets and documents the condition and performance of the transportation system.	• Performance Measures System Evaluation Report

IMPROVE RESILIENCY AND RELIABILITY

One of the FAST Act planning factors is to improve the resiliency and reliability of the transportation system and reduce or mitigate storm water impacts of surface transportation. Resiliency is defined as: "the ability of transportation infrastructure to maintain operations and be able to recover from disasters".

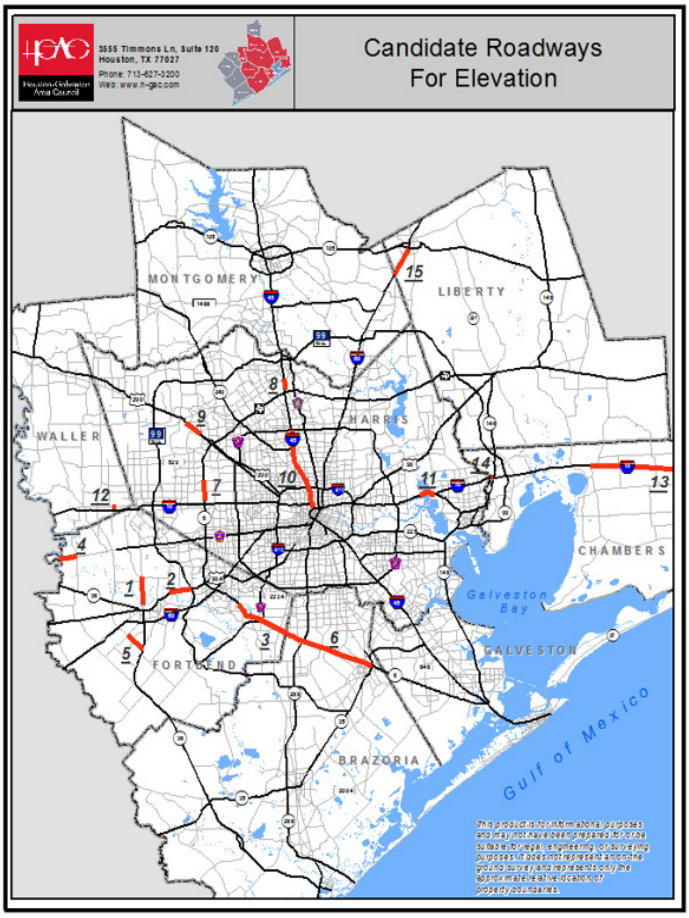

Figure 1 - Possible Roadway Elevation Segments

It is expected that due to a changing climate, weather events will intensify and occur with greater frequency. H-GAC has ongoing resiliency planning efforts which propose strategies to mitigate the effects of flooding and other extreme weather impacts, and processes in place to regularly update reports.

In 2017, Hurricane Harvey had a major impact on transportation networks and severely disrupted the movement of people and goods across the H-GAC's Metropolitan Planning Area. All 22 of Houston's major bayous spilled over their banks, with some exceeding 10 ft. above the channel banks. Additionally, Houston's two major reservoirs, Addicks and Barker, were quickly inundated by rainfall and their levels reached the top of their emergency spillways. The Brazos River in Fort Bend County, which drains an area larger than 45,000 square miles, quickly entered major flood stage as its water level exceeded the previous record stage by almost 2 ft and flooding along the Brazos River in Ft. Bend County overwhelmed protective levees in some areas. North of the city, the San Jacinto River also flooded.

Because of their importance to public safety, mobility, the state's and region's economy, TxDOT and local governments have identified a list of roadways which should be considered for additional flood mitigation, shown in Table 1 (TxDOT) and Table 2 (City of Houston). Many of these roadways were also flooded by one or more recent flood events (Tax Day Flood, Memorial Day Flood, Hurricane Ike, Tropical Storm Allison, etc.). Table 1 corresponds to the Figure 1 map that shows state roadway segments in need of elevation above flood levels. Project numbers do not correspond to priority.

The cost estimates shown in Table 1 reflect the potential cost to elevate the identified state roadway segments above flood levels. At a value of almost $2.6 billion, it should be noted that roadway elevation may not be the only, best or preferred strategy for mitigation of flooding on these critical roadways. Improved capacity for regional and/or localized flood detention, improvements to reservoir capacity, reservoir management & other flood control strategies may be examined as well. The City of Houston identified roadways for flood prevention, repair and elevation are estimated at approximately $73 million.

State Roadways Identified by TxDOT as Candidates for Repair, Elevation or Other Flood Prevention Treatments					
Project #	County	Roadway	Limits	Estimates	Description
1	Fort Bend	FM 723	Brazos River to FM 359	$100,000,000	Elevate pavement
2	Fort Bend	US 90 A	FM 359 to SH 99	50,000,000	Elevate pavement and replace bridges
3	Fort Bend	SH 6	Fort Bend County Line to FM 1092	250,000,000	Elevate pavement and replace bridges
4	Fort Bend	FM 1093	Brazos River to FM 1489	75,000,000	Elevate pavement
5	Fort Bend	Spur 10	SH 36 to Cottonwood School	60,000,000	Elevate pavement
6	Brazoria	SH 6	SH 35 to Fort Bend County Line	450,000,000	Elevate pavement and replace bridges
7	Harris	SH 6	Addicks Dam to Clay Road	200,000,000	Bridge roadway through reservoir
8	Harris	I 45 N	Cypresswood to Parramatta	250,000,000	Elevating pavement and rebuild two intersections
9	Harris	US 290	Skinner Road to Telge Road	200,000,000	Elevating pavement and rebuild two intersections
10	Harris	I 45 N	I-10 to BW 8	TBD	Elevate pavement and replace bridges
11	Harris	I 10 E	Monmouth to Spur 330	2,000,000	Elevate pavement and replace bridges
12	Waller	I 10	1000' East and West Petterson Road	75,000,000	replace and build urban intersection
13	Chambers	I 10	SH 61 to FM 1406	635,000,000	Elevate pavement and replace bridges
14	Chambers	I 10	0.75 mi West of SH 146 to SH 146	32,000,000	Elevate pavement
15	Liberty	US 59	SL 573 to Montgomery Co/L	180,000,000	Elevate pavement and replace bridges
			Total Estimate	**$2,559,000,000**	
	Source: Texas Department of Transportation Houston and Beaumont Districts				

Table 1 – State roadways identified by TxDOT as candidates for repair, elevations or other flood prevention treatments

Roadways Identified by the City of Houston as Candidates for Repair, Elevation or Other Flood Prevention Treatments					
Project #	County - City	Roadway	Limits	Estimates	Description
1	Harris - Houston	Gellhorn	IH-10 to IH-610	$5,700,000	Mitigation effort to maintain accessibility to food distribution centers
2	Harris - Houston	IH-610 @ Stella Link	at 610 intersections	TBD	Mitigation effort for underpass to remain accessible during rain events
3	Harris - Houston	IH-610 @ Kirby	at 610 intersections	TBD	Mitigation effort for underpass to remain accessible during rain events
4	Harris - Houston	IH-610 @ Fannin	at 610 intersection	TBD	Mitigation effort for underpass to remain accessible during rain events
5	Harris - Houston	Normandy	at Greens Bayou	$2,400,000	Bridge elevation over Greens Bayou
6	Harris - Houston	Woodforest	at Greens Bayou	$9,600,000	Bridge elevation over Greens Bayou, and causeway or other mitigation to remove roadway from 100-year floodplain
7	Harris - Houston	Kress	at I-10	TBD	Connection for freight mobility during rain events
8	Harris - Houston	I-10 @ Patterson	at I-10	TBD	Mitigation effort for Transportation Operations Facility to remain accessible during rain events (issue on I-10 feeder)
9	Harris - Houston	Katy Road	at Railroad underpass	TBD	Mitigation effort for TranStar to remain accessible during rain events
10	Harris - Houston	Navigation and 75th	Intersection	TBD	Mitigation effort to provide access for industry and freight mobility
11	Harris - Houston	Oates Road	I-10 to 90A	$6,528,000	Mitigation effort to remain accessible during rain events or elevate roadway out of 100- year floodplain
12	Harris - Houston	Will Clayton Blvd	Kenswick to Airport Terminal	$14,400,000	Causeway or other mitigation effort for IAH to remain accessible during rain events
13	Harris - Houston	Greens Road	John F. Kennedy Blvd to US 59	$24,000,000	Causeway or other mitigation effort for IAH to remain accessible during rain events
14	Harris - Houston	Main Street	Holcombe intersection	$360,000	Flood Warning System
15	Harris - Houston	Elgin	Railroad intersection	$360,000	Flood Warning System
16	Harris - Houston	Allen Parkway	Montrose intersection	$360,000	Flood Warning System
17	Harris - Houston	Allen Parkway	Waugh intersection	$360,000	Flood Warning System
18	Harris - Houston	Fannin	Holcombe intersection	$360,000	Flood Warning System

Roadways Identified by the City of Houston as Candidates for Repair, Elevation or Other Flood Prevention Treatments					
Project #	County - City	Roadway	Limits	Estimates	Description
19	Harris - Houston	6514 Jensen	Railroad intersection	$360,000	Flood Warning System
20	Harris - Houston	1700 Jensen	Railroad intersection	$360,000	Flood Warning System
21	Harris - Houston	3500 Kelley	Railroad intersection	$360,000	Flood Warning System
22	Harris - Houston	5800 Elysian	Railroad intersection	$360,000	Flood Warning System
23	Harris - Houston	7506 Hardy	Railroad intersection	$360,000	Flood Warning System
24	Harris - Houston	5405 Mesa	Railroad intersection	$360,000	Flood Warning System
25	Harris - Houston	4899 Old Galveston Road	Railroad intersection	$360,000	Flood Warning System
26	Harris - Houston	Houston Ave	Memorial Drive intersection	$360,000	Flood Warning System
27	Harris - Houston	Shepherd Drive	Memorial Drive intersection	$360,000	Flood Warning System
28	Harris - Houston	Houston Ave	Railroad intersection	$360,000	Flood Warning System
29	Harris - Houston	North Main St.	Railroad intersection	$360,000	Flood Warning System
30	Harris - Houston	Clinton Drive	Railroad intersection	$360,000	Flood Warning System
31	Harris - Houston	Yale Street	Railroad intersection	$360,000	Flood Warning System
32	Harris - Houston	Lawndale	Railroad intersection	$360,000	Flood Warning System
33	Harris - Houston	Broadway	Railroad intersection	$360,000	Flood Warning System
34	Harris - Houston	75th Street	Railroad intersection	$360,000	Flood Warning System
35	Harris - Houston	Harrisburg	Railroad intersection	$360,000	Flood Warning System
36	Harris - Houston	Forest Hill	Railroad intersection	$360,000	Flood Warning System
37	Harris - Houston	Wayside	Lawndale intersection	$360,000	Flood Warning System
38	Harris - Houston	Polk	Railroad intersection	$360,000	Flood Warning System
39	Harris - Houston	Franklin	Commerce Underpass	$360,000	Flood Warning System
40	Harris - Houston	Old Spanish Trail	Railroad intersection	$360,000	Flood Warning System
41	Harris - Houston	Studemont	Railroad intersection	$360,000	Flood Warning System
			Total Estimate	**$72,708,000**	

Table 2 - Roadways identified by City of Houston Public Works as candidates for repair, elevations or other flood prevention treatments

Expected Impacts to Transportation Infrastructure

Due to its low-lying coastal geography and semi-tropical climate, the Houston-Galveston region is vulnerable to extreme weather events like heat, drought, tropical storms, and flooding. The risk of these extreme events impacting the region's population, economy, and transportation infrastructure is expected to worsen because of the amplification of related stressors – land use changes, population growth, congested transportation systems, and climate change. Transportation systems and infrastructure are vulnerable to extreme weather. In fact, with sea level rise, temperature increases, and increasingly frequent and severe storms, it can be expected that transportation services and infrastructure will suffer more frequent disruptions or permanent damage which would seriously impede the movement of goods and people throughout the region. A summary of expected impacts is shown in Table 3.

Expected Climate & Extreme Weather Impacts to Transportation Infrastructure		
Climate Variable	**Projection**	**Impact on Transportation Infrastructure**
Relative Sea Level	Over the last century, sea level at Galveston has risen more than 26 inches, which is significantly greater than the global average. In the next 50 years, Gulf Coast sea levels are expected to rise by 1 to 6 feet.	A 4-foot increase in relative sea levels would put a quarter of the region's interstates, 10 percent of rail lines, and nearly 75 percent of port facilities at risk.
Temperature	On average, the region already experiences more than 100 days above 90 °F per year. Average temperatures could increase 2° to 4°F by 2050. Temperature increases will be most severe in highly urbanized areas due to the heat island effect.	Higher temperatures will result in higher construction and maintenance costs. At temperatures above 90°F, highways, bridges, and rail lines deteriorate more quickly. Extreme heat can cause immediate damage such as buckling.
Hurricanes and Tropical Storms	Expected to become from frequent and powerful as the Atlantic Ocean and Gulf of Mexico warm.	Associated extreme rainfall, strong winds, and coastal flooding will damage infrastructure, cause road and evacuation route closures, and overwhelm storm drains.
Precipitation	Heavy rainfall events and droughts have increased; this trend is expected to continue with longer dry periods between extreme rain events.	Heavy precipitation can result in flash floods with impacts ranging from inconveniences (temporary road closures and transit service disruptions) to permanently destroyed infrastructure. Extreme rain events are also correlated to a higher incidence or crashes and delays.
Sources: • Transit and Climate Change Adaptation: Synthesis of FTA-Funded Pilot Projects, August 2014, FTA • The Gulf Coast Study Summary, Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: The Gulf Coast Study, Phase 1 Completed in 2008, FHWA • Gulf Coast Climate Change Adaptation Pilot Study, August 2013, FTA • Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I, March 2008, The Climate Change Science Program		

Table 3 - Impact of Extreme Weather Events on Transportation Infrastructure

Understanding the region's risk to extreme weather, in 2010, H-GAC and local partners established resiliency as a regional priority in the "Our Great Region 2040" plan and adopted increasing the region's resiliency to disaster and a changing environment as a major goal. H-GAC planning reports such as "Our Region 2040" and the "Foresight Panel on Environmental Effects" analyze the impacts of weather on the region and its transportation system.

Regional Response to Resiliency Federal Requirements

To meet federal requirements, H-GAC staff is incorporating resilience into its transportation planning in the following ways:

a. **Transportation Vulnerability Assessment Study**

In 2018, the Houston-Galveston region was selected to participate in Federal Highways Administration's (FHWA) Resiliency and Durability Pilot Project. As part of this project, H-GAC will work with federal, state, and local partners to conduct a vulnerability assessment of transportation assets in the MPO region.

The vulnerability assessment will use FHWA's Vulnerability Assessment Scoring Tool (VAST) and methodology and will include consideration of exposure, sensitivity, adaptive capacity, economic impact, and risk. Resiliency recommendations will be developed based on vulnerability assessment results. Results will also be used to help prioritize funding decisions for future transportation projects.

Work on the Resiliency and Durability Pilot Project commenced in Winter 2018 and should be completed by late Summer 2020. More information about the Transportation Vulnerability Assessment can be found at www.hgacmpo.com/resiliency.

b. **Working Group**

In 2019, H-GAC will form a transportation resiliency working group with the initial goal of developing a multi-year strategy to meet resiliency-related federal requirements and identify additional resiliency efforts that will reduce risk and improve safety in the region. Through the working group, H-GAC will host workshops, coordinate resiliency work with emergency management (preparedness and response) efforts, develop a plan to reduce and mitigate storm water impacts on surface transportation and more.

c. **Texas Resiliency and Planning Workshops**

H-GAC has participated in several resiliency workshops hosted by FHWA, TxDOT, the Texas A&M Transportation Institute (TTI), and other metropolitan planning organizations. The purpose of these workshops has been to exchange information, data sources, and resiliency strategies. As part of its transportation resiliency agenda, H-GAC works to foster dialogue about mitigating vulnerability regionally.

d. **Cedar Bayou Initiative**

The Cedar Bayou Initiative is a partnership of public and private sector stakeholders in the Cedar Bayou watershed. Its purpose is to identify and pursue priority projects to improve flood management, resiliency, and transportation goals throughout the Cedar Bayou watershed and the greater Chambers, Liberty, and Harris Tri-County area. Projects identified in 2018 can be grouped into three major categories:

- Dredging and other improvements to the main channel of Cedar Bayou, its tributaries and drainage channels.

- Stormwater infrastructure, detention, and runoff quality improvement.

- Improvements to transportation infrastructure to reduce flooding and improve evacuation capacity.

e. **Designing for Impact**

H-GAC is involved in the "Designing for Impact" study which is exploring strategies to reduce the impact of stormwater on the Houston-Galveston region's infrastructure. Working through a voluntary partnership of engineers, developers, architects, landscape architects, municipal and county representatives, the project identifies the Low Impact Development strategy as an effective and economically advantageous approach to addressing the regions' stormwater problems.

Disaster Preparedness

Through programming and partnerships, H-GAC has addressed extreme weather preparedness, mitigation, and evacuation. H-GAC, the Texas Division of Emergency Management (DEM), and 85 local governments collaborated to develop a comprehensive Regional Hazard Mitigation Plan[1]. The plan identifies regional hazards and vulnerabilities and includes over 300 mitigation projects that could be implemented within the region.

To address aspects of resiliency and reliability that include preparedness and evacuation, the "Together Against the Weather[2]" outreach campaign was initiated. The "Together Against the Weather" campaign was created to help individuals with disabilities and other special needs plan for disruptions caused by hurricanes, floods, and other weather-related emergencies. The program encourages the formation of supportive partnerships involving family members, community organizations, health care providers, and emergency management personnel, and suggests strategies for addressing challenges that commonly arise during periods of emergency evacuation. Together Against the Weather offers several tool kits that include educational videos presented in English, Spanish, Vietnamese, and Chinese. Links are also provided to state, county, and municipal offices of emergency management. More information is available at: http://www.togetheragainsttheweather.com/index.shtml.

As a web clearinghouse, it provides service providers, emergency management officials, churches, and healthcare providers with materials to help at-risk populations in the event of a major landfalling hurricane. Available resources include preparedness information, evacuation route maps, and Office of Emergency management links. A goal of preparedness for natural disasters is also found in the Comprehensive Economic Development Strategy (CEDS[3]) and emphasizes less expensive approaches to reducing vulnerability such as using natural landscape for absorbing floodwaters and storm surge and making wiser decisions regarding building locations. For protecting key assets, the recommended approach is one that carefully targets structural solutions to keep costs lower. Another supporting

[1] Regional Hazard Mitigation Plan: http://www.h-gac.com/community/community/hazard/hazard_mitigation_plan.aspx
[2] Together Against Weather campaign: http://www.togetheragainsttheweather.com
[3] Comprehensive Economic Development Strategy https://www.h-gac.com/gulf-coast-economic-development-district/documents/CurrentCEDS.pdf

strategy is to assist local governments to conduct economic vulnerability assessments, encompassing vulnerability to natural disasters. Along with reducing vulnerability risk, preparedness strategies involve speeding the rate of recovery to improve safety and quality of life.

H-GAC provides interactive mapping tools such as the Regional Flood Information viewer (see Fig. 2) displaying critical facilities including transportation, high-density areas, and vulnerable populations.

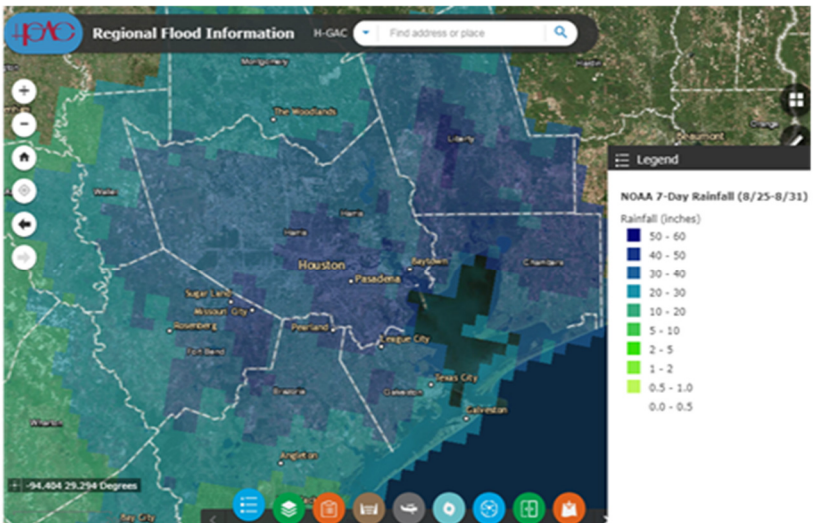

Figure 2 - 7-Day Rainfall Totals from Hurricane Harvey

H-GAC also administers the Homeland Security Planning program that promotes regional planning and response to man-made and natural disasters. The Regional Homeland Security Coordinating Council (RGSCC) assists and advises elected officials in their decision-making responsibilities on matters related to regional homeland security issues. H-GAC is working closely with individual counties in the development of Hazard Mitigation Plans and will continue to aid and assist in the process of updating these plans.

Evacuation Plan

Evacuation routes are designated by the Texas Department of Public Safety (DPS) in coordination with local counties and municipalities. These routes are designated to evacuate part or all of the region in the event of natural or man-made emergencies or other threats to public safety. The Houston-Galveston region has 24 signed state roadways designated as evacuation routes (Figure 3). These evacuation routes are described in a Texas DPS Emergency Evacuation Traffic Management Plan. Houston TranStar serves as the regional emergency center and houses multi-agency operations that manage traffic incidents and respond to regional emergencies such as hurricanes and floods.

H-GAC coordinates with counties, municipalities, and the state to manage the database of regional evacuation routes and is responsible for periodic updates to the Emergency Evacuation Traffic Management Plan. H-GAC also administers the Regional Evacuation Viewer – a secure web application which provides near real-time updates of evacuation resource deployment and other related information. Users of the viewer can access current Evacuation Traffic Management Plans by county, city or corridor.

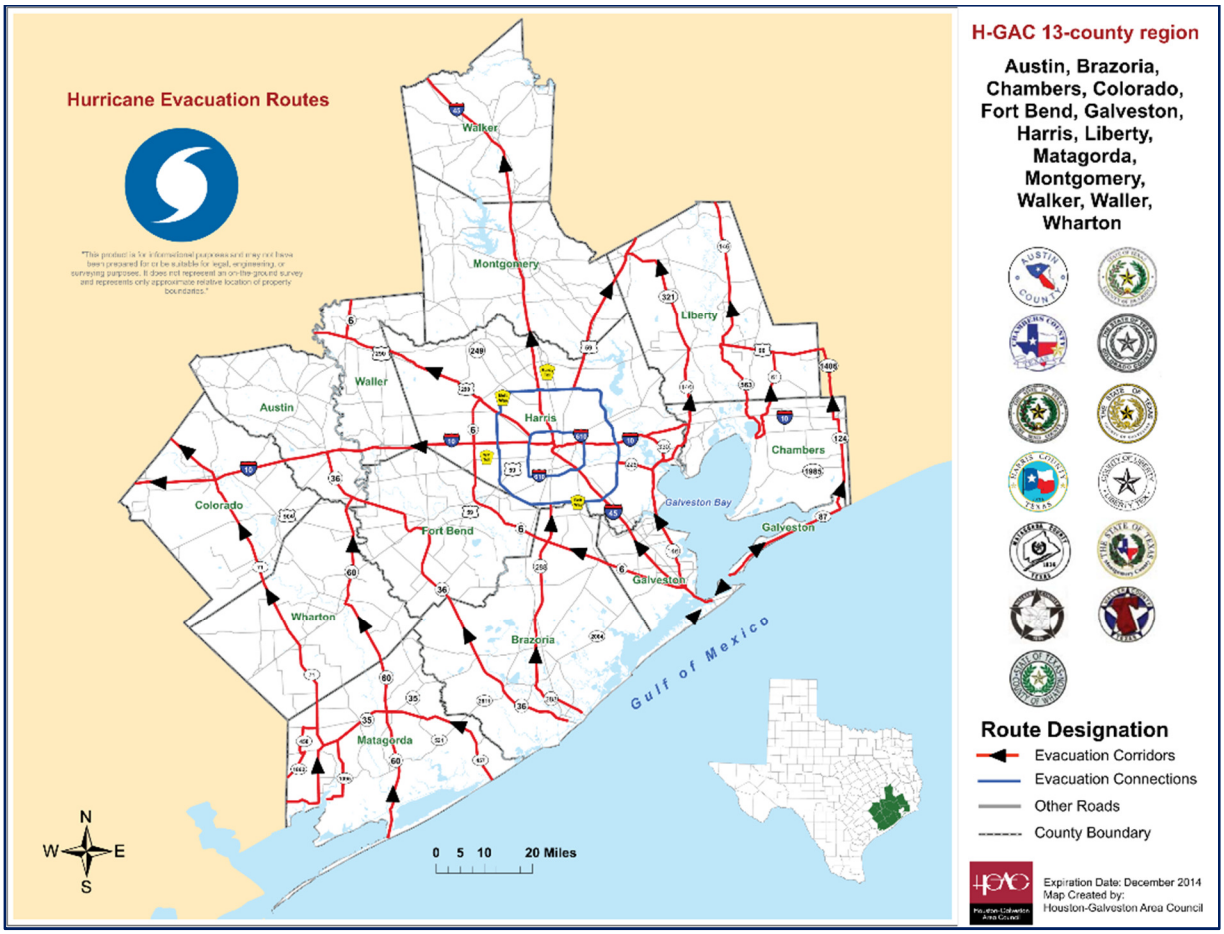

Figure 3 - H-GAC Hurricane Evacuation Routes

Hurricane Surge Zone Map

Each year, H-GAC produces a Hurricane Surge Zone Map ("Zip-Zone Map") for distribution to the public (Figure 4). The Zip-Zone Map is a public information tool which shows the parts of the region that are most at risk for hurricane-related storm surges over a basemap of postal zip codes. The Hurricane Surge Zone Map also indicates designated evacuation corridors and evacuation connections. Designation as an evacuation route is one criterion used in the RTP for prioritizing capital improvement projects. It is a critical safety issue that regional evacuation routes have adequate capacity to handle the high levels of traffic that often ensue in a regional emergency.

The Zip-Zone map can be used by elected officials and emergency management personnel to conduct a phased evacuation of coastal counties based on the zip codes of the residents.

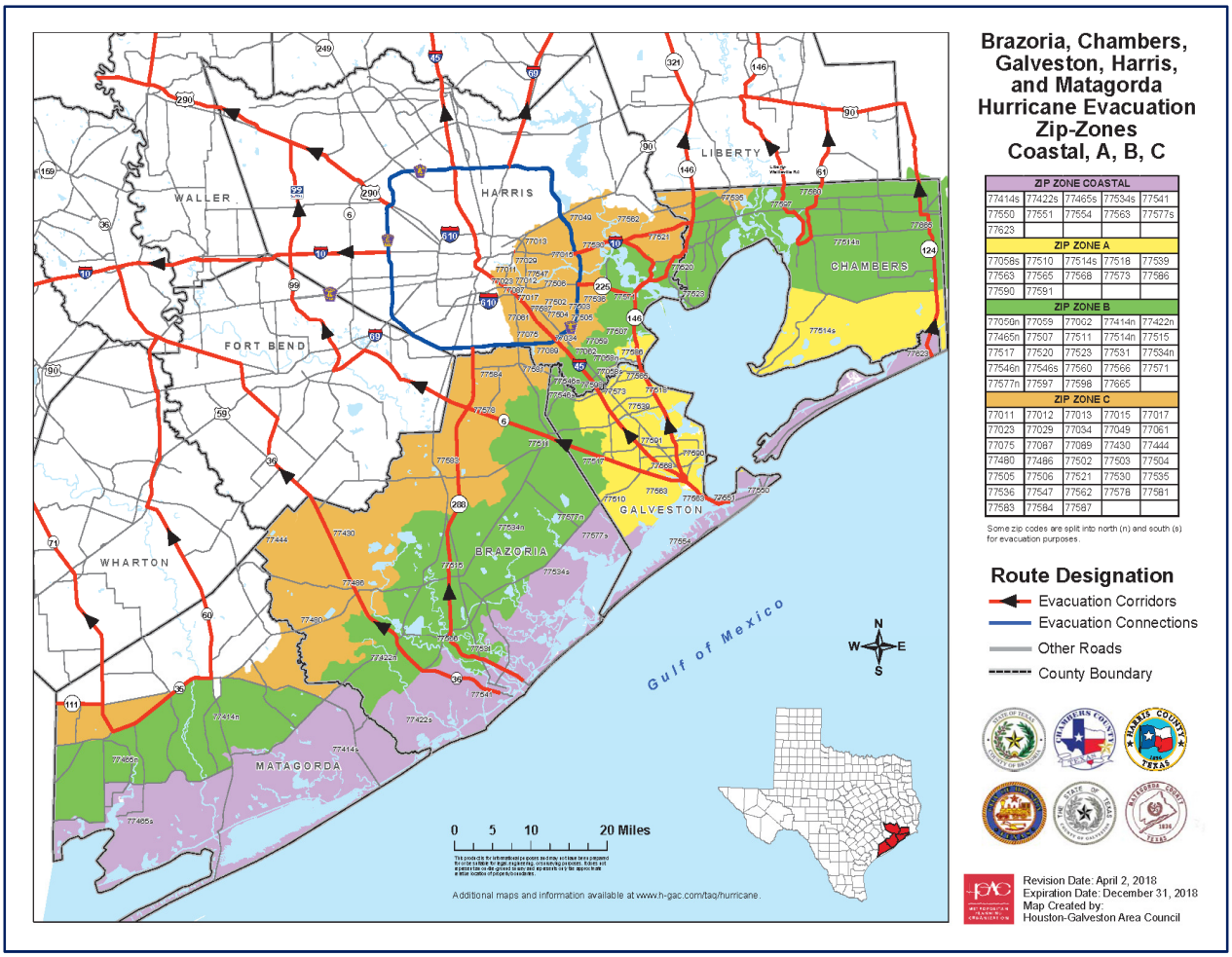

Figure 4 - H-GAC Hurricane Evacuation Zip Zone Map

ENHANCE TRAVEL AND TOURISM

Transportation is an integral part of tourism industry. The H-GAC MPO participated in a consortium to develop the Our Great Region 2040 plan, which included a 24-partner coordinating committee, government advisory committee, members of the public, local leaders and regional workgroups. Transportation strategies related to tourism travel for the H-GAC MPO to lead in implementing include[4]:

- Optimize existing transportation network through a FIX IT First strategy and by using technology and improved incident management to maximize system capacity.
- Create a regional framework for expanding transit across the Region.
- Develop and implement policies to improve transit, pedestrian, and bicycle access between and within activity centers, connecting residents to job centers.
- Include economic, safety, and quality of life costs and benefits of transportation projects in funding prioritizations.

Travel and tourism is a a growing industry for our region. It brings a lot of money and helps with the economy. On an annual basis, the Metrop pitan Statistical Area attracts 14.8 million vistors which generates $1.1 billion in local and sales tax revenue. Travelers are primarlily local and visual arts, festivals, sports, (special events such as the Super Bowl, final Four, PGA Golf, as well as College and Professional Football, Baseball and Basketball), and world renowned cuisine, as well as to attractions such as the Kemah Boardwalk, The Houston Livestock Show and Rodeo, Houston Zoo, Brazoria National Wildlife Refuge, George R. Brown Convention Center, museums, shopping malls, NASA space center, and Galveston Cruise Terminals, (see Figure 5). Galveston Island saw 6.5 million vistors in 2016 and almost 14 percent of these were cruise travelers, an increase of 5 percent from the previous year.[5] In addition to this, people come from around the world for medical treatment in what is perhaps the number one medical Center on Earth, with over 10 Million patient visits in a typical year.[6] Travel originating from outside of the region is also generated from a significant business presence that includes five Fortune 500 companies and many high-density employment centers. The tourism industry alone employed 129,000 in 2016.[7]

The 2045 Regional Transportation Plan has substantial investments dedicated to improve roadways, transit and bicycle and pedestrian capacity that provide access to major attractions such as universities, medical facilities and other essential destinations as mentioned above. The Economic Development Strategy (CEDS) and "Our Great Region 2040" plan regard tourism as regional needs and provide strategies and recommendations for further travel and tourism improvements. The region has also seen a host of local planning activities supported by Economic Development Administration grants and similar funding geared toward furthering economic development to attract business and encourage tourism.[8] Programs are being implemented by the City of Houston, Bay City, Conroe , Dayton, Galveston, and others.

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[4] http://www.ourregion.org/download/OurGreatRegion2040-FINAL.pdf (pages 30 and 31)
[5] https://www.chron.com/neighborhood/bayarea/news/article/Galveston-hits-record-high-tourism-revenues11175775.php
[6] http://www.tmc.edu/wp-content/uploads/2018/07/TMC_FactsFiguresOnePager_07052018-1.pdf
[7] http://www.houstontx.gov/council/c/committee/20150625/tourismmasterplan.pdf
[8] http://www.h-gac.com/community/CEDS/regional-economic-development-plan.aspx (page 16)

An engagement process soliciting the feedback of public officials and members of the public was utilized to form a SWOT analysis, helping to shape the goals and stratgies of the CEDS. These goals have been aligned with the 'Our Great Region 2040", including the preservation of natural resources especially along waterways to promote recreation and teourism opportunities. One of the strategies suporting natural resource preservation recommends the creation of a regional campaign to promote eco, costal and wildlife tourism options across the region. Another strategy encourages developing a regional toolkit to capitalize on future growth sectors including tourism. [9]

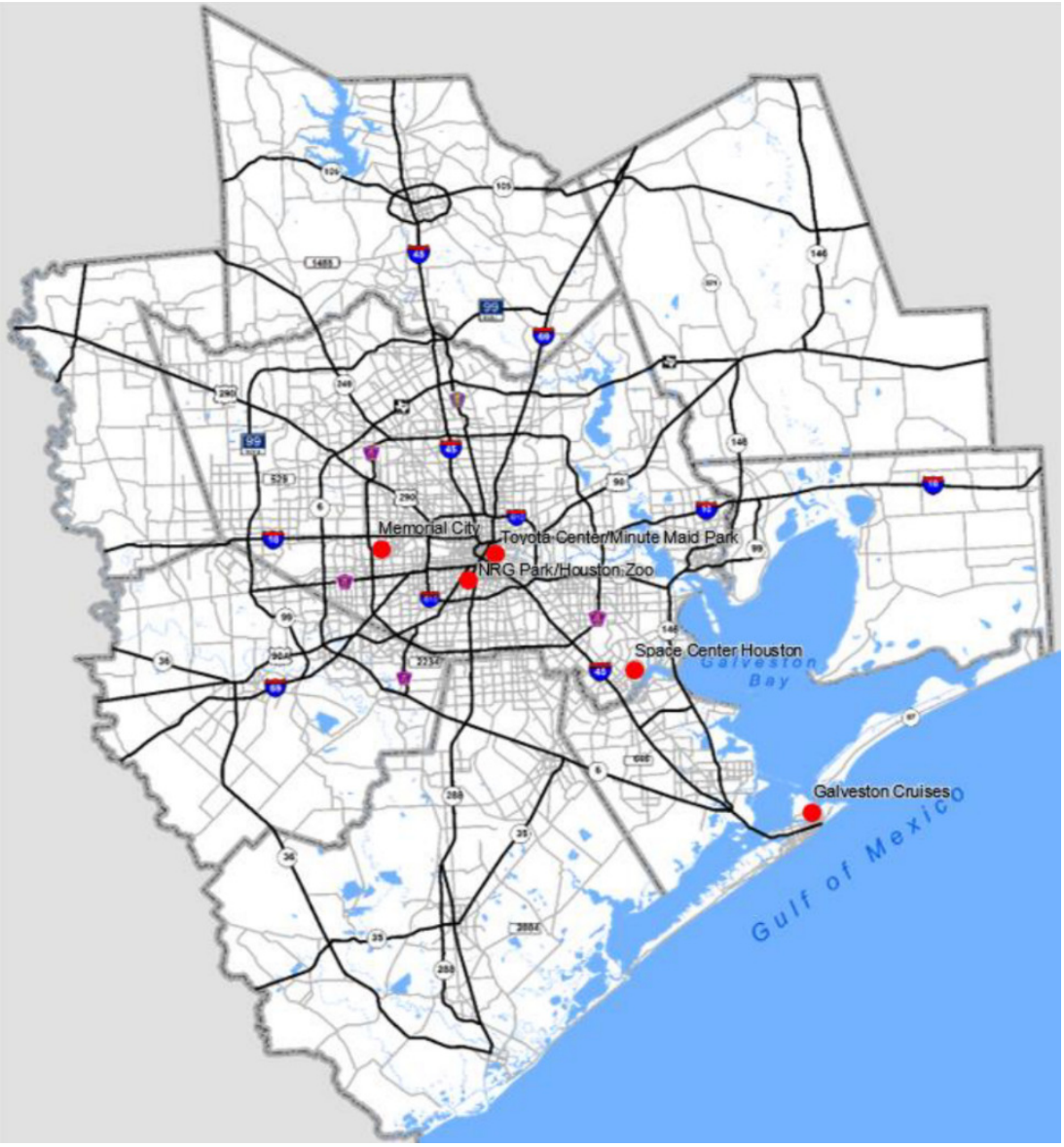

Figure 5 – Travel and Tourism Destinations

[9] http://www.h-gac.com/community/CEDS/documents/CurrentCEDS.pdf (page 20)

INTERCITY BUS INITIATIVES

Federal planning guidelines now require the "consideration of the role that intercity buses may play in reducing congestion, pollution and energy consumption in a cost-effective manner and strategies and investments that preserve and enhance intercity bus systems including those that are privately owned and operated".[10]

The Houston-Galveston region has been the location of an innovative intercity bus project between the Brazos Transit District and a private organization for several years. The Charles Wilson Veterans Administration (VA) Shuttle bus provided 12,389 passenger trips in 2017 for disabled veterans traveling from Lufkin, Texas to medical appointments at the VA hospital in the Texas Medical Center in Houston. The veterans are transported daily along the 248 mile route (round trip) at no-cost to them (Figure 6).

Figure 6 - Charles Wilson VA Shuttle

There are several other emerging opportunities in the Houston-Galveston region, based on prior planning studies, to establish similar mobility options for veterans and many others along other major freeway corridors into Houston. Those opportunities would involve developing new working and planning relationships with representatives of over-the-road private carriers such as Greyhound and Trailways to incorporate intermediate stops along their established routes.

Several areas have been identified as potential locations for intermodal terminals in the region which would facilitate those intermediate stops. One potential location is along the Interstate 10 East Corridor, near State Highway 146, between Houston and Beaumont. That location was identified in the Liberty and Chambers counties Transit Plans as a nexus between north-south and east-west travel patterns that could benefit from a multi-modal transfer facility.[11]

Passengers through that proposed facility could be provided with options to transfer to-and-from local and express buses in addition to access to carpools, vanpools, taxis and other multimodal options.
Another potential location for an intermodal terminal was identified in the Interstate 45 North Freeway corridor in Huntsville. That location was recommended in the Walker County Transit Plan which envisioned moving the current Greyhound bus terminal from a small facility located near the center of historic downtown Huntsville, to a larger multimodal facility closer to the I-45 freeway corridor. [12]

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[10] [23 U.S.C. 134(i)(2)(H)]
[11] Liberty County Transit Plan, Houston-Galveston Area Council (H-GAC), 2009; Chambers County Transit Plan, H-GAC, 2009.
[12] Walker County Transit Plan, H-GAC, 2012.

A longer-range planning study, the Regional Transit Framework Study, identified multiple roadway corridors within the Houston-Galveston region that could evolve to include various express bus services between the counties and smaller cities in the region as shown in Figure 6.[13]

The termini of those express bus corridors, identified on the map as enhanced transfer points, could be planned to include smaller facilities to accommodate more intra-regional travel options. Eventually, those express bus or cross-county routes could be designed to provide feeder bus services to larger multimodal terminals along the interstate highway system.

In addition to the proposed multimodal facilities and feeder bus routes another option for future planning considerations would develop a regionally coordinated fare system. In that coordinated fare system potential customers for the intercity bus services could pre-purchase their fares for each segment of their trip, from origin to destination. That concept of a coordinated or seamless fare system could include travel options for more than one service provider or more than one mode of transportation.

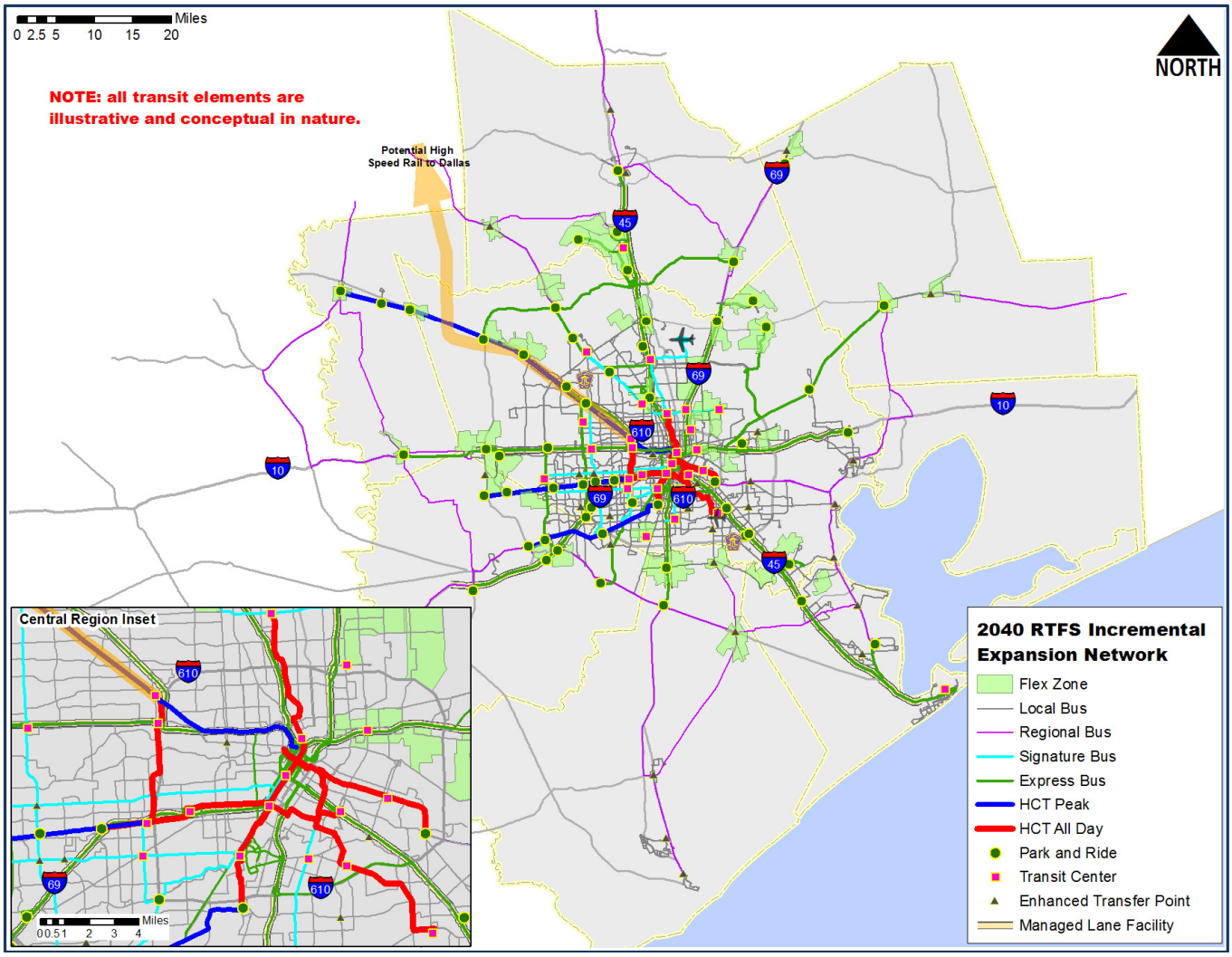


Figure 6 - Incremental Expansion Composite Scenario

[13] H-GAC Regional Transit Framework Study—2017 Interim Report

PERFORMANCE MEASURES SYSTEM EVALUATION REPORT

Introduction

The Moving Ahead for Progress in the 21st Century (MAP-21) and the Fixing America's Surface Transportation (FAST) Act legislations introduced Transportation Performance Management into the Federal Highway Program addressing the challenges facing the transportation system on a national level, including:

- Improving safety
- Maintaining infrastructure condition
- Reducing traffic congestion
- Improving the efficiency of the system and freight movement
- Protecting the environment

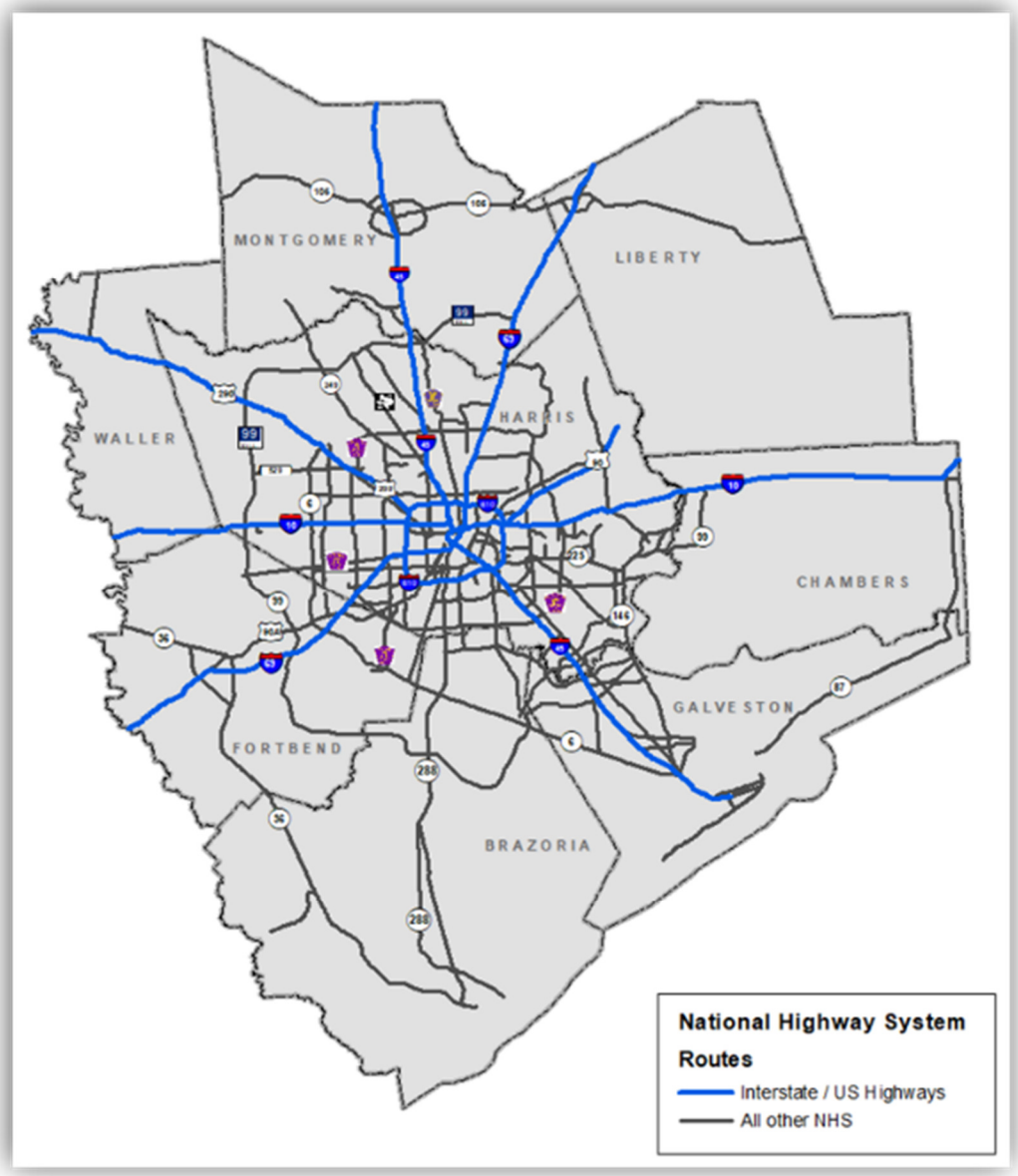
The objective of Transportation Performance Management is to focus federal funds on the achievement of national goals, increase accountability and transparency, and improve investment decision-making through performance-based planning and programming of transportation projects. The federal rulemaking requires the establishment of goals for which Metropolitan Planning Organizations, and state Departments of Transportation will be required to set targets, report on and make progress towards targets for numerous federal performance measures. H-GAC has the responsibility for these measures in a variety of key performance areas, such as Safety, Pavement and Bridges, Reliability, Congestion, Air Quality and Transit Asset Management.

Fixing America's Surface Transportation (FAST) Act's final planning rules for the metropolitan planning process and the Regional Transportation Plan (RTP) became effective on May 27, 2018. The FAST Act builds on the changes made by the Moving Ahead for Progress in the 21st Century, including provisions to make surface transportation more streamlined, performance-based, and multimodal, and to address challenges facing the U.S. transportation system. Metropolitan Planning Organizations may support the state targets or establish their own regional targets. During 2018, H-GAC adopted performance targets with the performance-based planning process required by FHWA. The final set of performance targets were adopted on October 26, 2018. During the formulation of the planning targets, extensive collaboration occurred between the Texas Department of Transportation, public transportation providers and H-GAC.

Transportation Performance Management (TPM) is not a new concept to H-GAC. Many of the federal Performance Measures align and compliment H-GAC's existing performance measures. Performance management is a powerful analytical tool for tracking regional performance over time and can illustrate how the greater Houston region compares to other regions nationwide. Target setting, tracking and reporting of Performance Measures are conducted in a relatively short timeframe, from one to four years. TPM gives transportation planners the opportunity to link the short-term performance to long-range priorities for the region. One of the positive results of Performance Management is a heightened awareness by transportation planners for a renewed focus on key performance areas that will remain at the forefront for years to come. Additionally, it improves accountability and transparency when reporting to the public.

Emphasis on the National Highway System

The federal Performance Measures place a strong emphasis on the National Highway System (NHS). The NHS is a network of critical highways important to the nation's economy, defense and mobility that link major airports, ports, public transportation facilities, rail and truck intermodal terminals. The Regional Transportation Plan 2045 is focused on all major roads of the region's transportation system, not just the National Highway System. In the H-GAC 8-county region, there are 8,784 lane miles on the National Highway System.



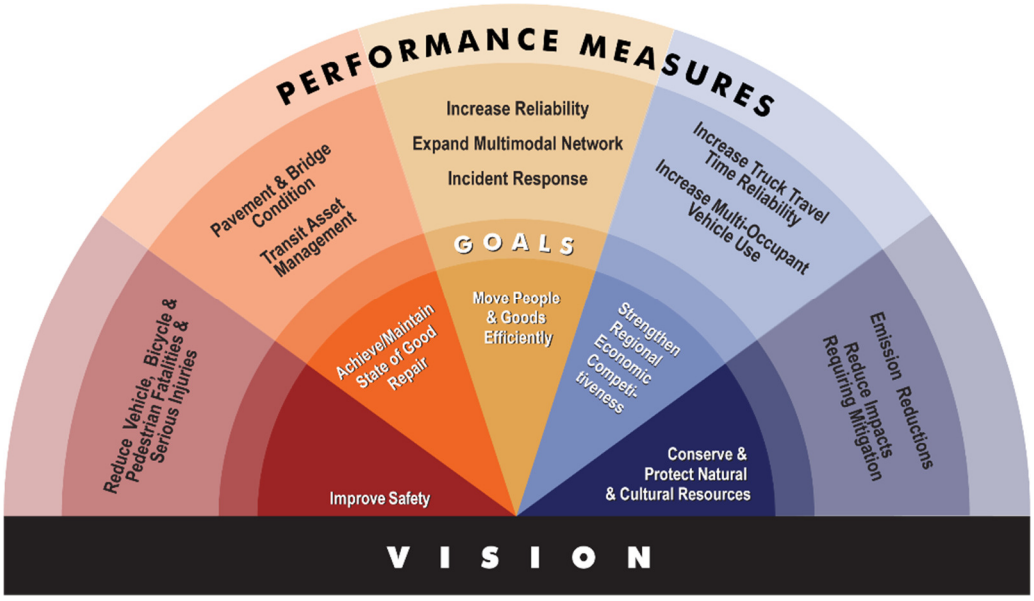
TRANSPORTATION PERFORMANCE MEASURES AND THE 2045 RTP

The federal government passed two transportation bills, the Moving Ahead for Progress in the 21st Century (MAP-21) in 2012 and the Fixing Surface Transportation in the 21st Century (FAST Act) in 2015. Among other things, they require metropolitan planning organizations to establish performance-based planning practices. In order to comply with MAP-21 changes, MPOs across the country adopted and implemented programs and performance targets, and set priorities based on performance measures.

According to the laws, performance will be judged on a system-wide level, and should be tied to project prioritization. As such, the 2045 RTP proposes certain performance measures to represent this principle at a regional level. Because MAP-21 requires that transportation system challenges be addressed through a data driven, performance-based approach, measures selected were chosen mainly because they were focused on system performance and assets, sensitive to various transportation modes, and had a nexus to the established goals.

Several challenges exist for some of the performance measures such as the lack of available, useable or consistent data. H-GAC and TxDOT are addressing these deficiencies to improve data collection methods and expand collection efforts to data suitable to accurately set performance targets. For example, TxDOT is adapting their pavement collection methods to align with the federal criteria. Additionally, H-GAC is exploring new data collection for the System Performance measures. As required by the federal measures, H-GAC will periodically review, analyze performance measure data, and will report how target progress has been achieved by the MPO for the target years of 2020 and 2022.

The following section describes each measure, the manner in which it is measured, and the desired outcome for each measure. Given the broad scope and time horizon of the plan, these performance measures identify various factors that encompass topics including asset management, congestion, safety, environment, and economic competitiveness that will help assess progress towards meeting the plan's vision and goals. While the desire is to see a dramatic improvement in each performance measure area, limited funding and other factors that influence system utilization, the desired outcomes for the performance measures cannot be reduced in absolute terms.



FHWA and FTA Performance Measures

Category	Performance Measure	Applicability	Reporting Frequency
Highway Safety	Number of fatalities	All public roads	Annually
	Rate of fatalities		
	Number of serious injuries		
	Rate of serious injuries		
	Number of non-motorized fatalities and serious injuries		
Pavement and Bridge Condition	Percentage of pavements of the Interstate System in Good condition	Interstate System	Biennially with four-year performance periods
	Percentage of pavements of the Interstate System in Poor condition		
	Percentage of pavements of the non-Interstate NHS in Good condition	Non-Interstate NHS	
	Percentage of pavements of the non-Interstate NHS in Poor condition		
	Percentage of NHS bridges classified as in Good condition	National Highway System (NHS)	
	Percentage of NHS bridges classified as in Poor condition		
Highway System Performance	Percent of the person-miles traveled on the Interstate that are reliable (LOTTR)	Interstate System	Biennially with four-year performance periods
	Percent of the person-miles traveled on the Non-Interstate NHS that are reliable (LOTTR)	Non-Interstate NHS	
	Truck Travel Time Reliability (TTTR) Index	Interstate System	
	Annual Hours of Peak Hour Excessive Delay Per Capita	National Highway System (NHS)	
	Percent of Trips that with Non-Single Occupant Vehicles	Urbanized area	
	Total Emissions Reduction	Urbanized area	
Transit Asset Management	Rolling Stock	The percentage of revenue vehicles that exceed the Useful Life Benchmark (ULB)	Annually
	Equipment	The percentage of non-revenue service vehicles that exceed the ULB	
	Facilities	The percentage of facilities that are rated less than 3.0 on the Transit Economic Requirements Model (TERM) Scale	
	Infrastructure	The percentage of track segments (by mode) that have performance restrictions	

The investments identified in the 2040 RTP were guided by a vision and supported by the goals and strategies. This framework articulated the regional needs and priorities in four key areas of transportation investments.

1. Mobility
2. Alternative Modes
3. Air Quality
4. Planning

The 2045 RTP Vision, Goals, and Strategies were established by the Transportation Policy Council (TPC), Technical Advisory Committee (TAC), and relevant TPC and TAC subcommittees. Building on the investment area structure established in the 2040 RTP, the TPC established 21 investment categories aligned with the 2045 RTP goals and strategies, as priority areas of investments. Table 2, shown below, illustrates the linkage between the 2040 RTP Investment Type, 2045 RTP Investment Strategy, 2045 RTP Investment Categories and the performance measures and targets they directly contribute towards achieving.

Table 2.

Investment Type	RTP Strategy	Investment Category	Performance Measures					
			Safety	Pavement & Bridge	Reliability	Freight (Truck Travel Time)	Congestion/ Air Quality	Transit Asset Management
Mobility. Alternative Modes, Air Quality	Expand, Manage, Maintain	Major Investments	●	●	●	●	●	●
Mobility	Expand	Roadway Added Capacity/New Construction	●	●	●	●		
		Innovative Freight Movement	●	●	●	●	●	
	Manage	Incident Management (Towing)	●		●	●	●	
		Incident Management (MAP)	●		●	●	●	
		Access Management/Safety/Grade Separations	●	●	●	●	●	
		Intelligent Transportation System Infrastructure	●	●	●	●	●	
	Maintain	Infrastructure Resiliency	●				●	
		Roadway Reconstruction and Rehabilitation	●	●				
Alternative Modes	Expand, Manage, Maintain	Active Transportation	●				●	
	Expand	Transit Expansion (Vehicle Purchase)	●		●	●	●	●
		Transit Passenger Facilities	●		●	●	●	●
	Manage	Transit Priority Infrastructure	●		●	●	●	
		Transit Regional Fare Collection	●		●	●	●	
	Maintain	Transit Passenger Facility State of Good Repair	●		●		●	●
Air Quality	Expand	Regional ITS (TranStar)	●		●	●	●	
		Pilot Commuter Transit			●	●	●	
		Regional Vanpool			●	●	●	
	Manage	Commute Solutions			●	●	●	
	Maintain	Clean Cities/Clean Vehicles					●	
Planning	Expand, Manage, Maintain	Sub-Regional Planning						

Out of twenty-one Investment categories, nine categories were recommended to be programmed and funded annually for the 10-year period from FY 2019 through FY 2028, identified in Table 3. This was approved in a cooperative process by consulting with the local governments and agencies, the Transportation Policy Council, the Technical Advisory Committee, and relevant subcommittees.

Table 3.

2040 RTP Investment Type	2045 RTP Strategy	2045 RTP Investment Category
Mobility	Manage	Incident Management (Towing)
		Incident Management (MAP)
Alternative Modes	Manage	Transit Regional Fare Collection
Air Quality	Expand	Regional ITS (TranStar)
		Pilot Commuter Transit
		Regional Vanpool
	Manage	Commute Solutions
	Maintain	Clean Cities/Clean Vehicles

<u>2018 Call for Projects Evaluation Criteria:</u>

The 2018 Call for Projects evaluation and selection criteria were developed in a cooperative manner by consulting with local agencies, the Transportation Policy Council (TPC) , the Technical Advisory Committee, and relevant subcommittees. All projects submitted through the 2018 Call for Projects (2018 CFP) were evaluated based on 50% score (100 points) given to its benefit/cost ratio and 50% score (100 points) given to various planning factors. The benefit cost analyses were calculated within a spreadsheet template that evaluated the project's benefits in three major areas:

- Safety – reduction in crashes
- Delay – reduction in travel delay
- Emissions – reduction of on-road vehicle emissions

The remaining 50% of the score was based on multiple planning factors with a direct linkage to performance measures and the RTP goals and strategies and relative to each investment category. Planning factors for highway and transit projects include, but are not limited to, the improvement to multimodal level of service; freight system priority/evacuation route, life cycle maintenance strategies, corridor level of travel time reliability, reduction in vehicle miles traveled, connectivity to employment, transit reliability, transit vehicle and facility life cycle maintenance strategies.

The 2018 Call for Projects application submittal period began on September 4th and concluded on October

31, 2018. During this period, H-GAC received a total of 193 applications from various local partners and TxDOT. Out of 193 project applications, a total of thirty-six (36) projects in various investment categories were recommended for funding for the 10 year period, between FY 2019 and FY 2028. The TPC approved projects across thirteen Investment Categories, listed in Table 4, through the competitive Call for Projects process.

Table 4.

2040 RTP Investment Type	2045 RTP Strategy	2045 RTP Investment Category
Mobility, Alternative Modes, Air Quality	Expand, Manage, Maintain	Major Investments
Mobility	Expand	Roadway Added Capacity/New Construction
		Innovative Freight Movement
	Manage	Access Management/Safety/Grade Separations
		Intelligent Transportation System Infrastructure
	Maintain	Infrastructure Resiliency
		Roadway Reconstruction and Rehabilitation
Alternative Modes	Expand, Manage, Maintain	Active Transportation
	Expand	Transit Expansion (Vehicle Purchase)
		Transit Passenger Facilities
	Manage	Transit Priority Infrastructure
	Maintain	Transit Passenger Facility State of Good Repair

Transportation Improvement Program and the Project Selection Process

The project selection process utilized during development of the 2019-2022 TIP assessed major investment-level applications based on the 2045 RTP's five goals and performance measures. By incorporating 2045 RTP goals into short-range programming activity, the performance measures have achieved a strong coordination between the region's vision for the future and the investments made today.

HIGHWAY SAFETY

Safety is a top regional priority. Although motorists are the largest group of system users injured or killed in crashes, pedestrians and cyclists are also at risk. Addressing this goal will not only benefit regional health, but the community's quality of life and economic competitiveness. A safe regional transportation system operates reliably, delivers goods and services on time, and returns users home at the end of their trip.

The Houston-Galveston Regional Safety Plan sets a baseline for safety crash data, analyzes regional trends, and is used to inform performance target setting. The report data serves as a baseline for subsequent years to measure whether there was significant improvement compared to previous years. The Texas Strategic Highway Safety Plan estimates the probable number of fatalities and serious injuries for the target year of 2022. Federal rulemaking requires Metropolitan Planning Organizations to either support state targets or establish their own specific targets for the five safety performance measures for all public roads in the MPO planning area, within 180 days after the State establishes statewide targets. The MPO then reports targets to the State, when requested. Statewide, when at least four out of five targets are met or the outcome for the performance measure is better than the baseline performance for the year prior to the target year, a determination of significant progress will be made.

During safety target setting discussions of the Transportation Policy Council (TPC) and the Transportation Advisory Committee, aspirational goals for the long-term were expressed. While the H-GAC region is forecasted to experience a high level of economic and population growth, subsequently, it results in a rise in travel, crashes and fatalities. For the purposes of short-term target setting, the targets were set to reflect the probable amount of fatalities and serious injuries. However, the increasing trends in fatalities and crashes do not reflect the intent and commitment of the TPC to improve traffic safety in the Houston-Galveston region. H-GAC has committed to participate in advancing crash reduction strategies through the Regional Safety Plan and will annually assess progress on Safety Performance Measures. H-GAC's Transportation Policy Council approved a resolution to support the State's adopted safety targets for the five performance measures. H-GAC set targets that represent a two percent (2%) reduction from the trend line projection in the five (5) safety performance measures for the period from 2017 to 2022. The decline is expected to begin gradually in 2018 and progress to the two percent (2%) reduction by the target year 2022.

Performance Measures	2017	2018	2019	2020	2021	2022
Number of Fatalities	0.0%	0.4%	0.8%	1.2%	1.6%	2.0%
Rate of Fatalities (per 100 million Vehicle Miles Traveled)						
Number of Serious Injuries						
Rate of Serious Injuries (per 100 million VMT)						
Number of Non-Motorized Fatalities & Serious Injuries						

Fatalities

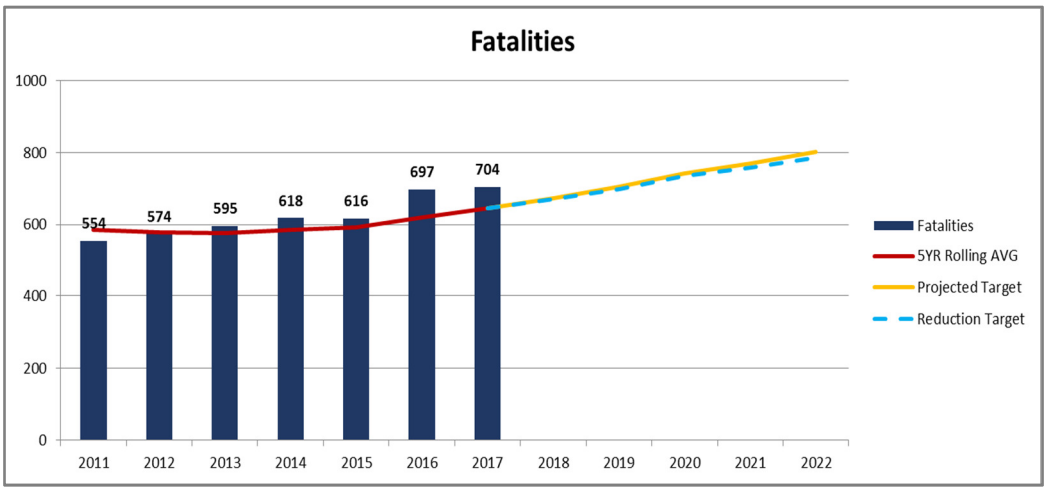
Measure – Five-year rolling averages of the number and rate of vehicular fatalities in the H-GAC region.

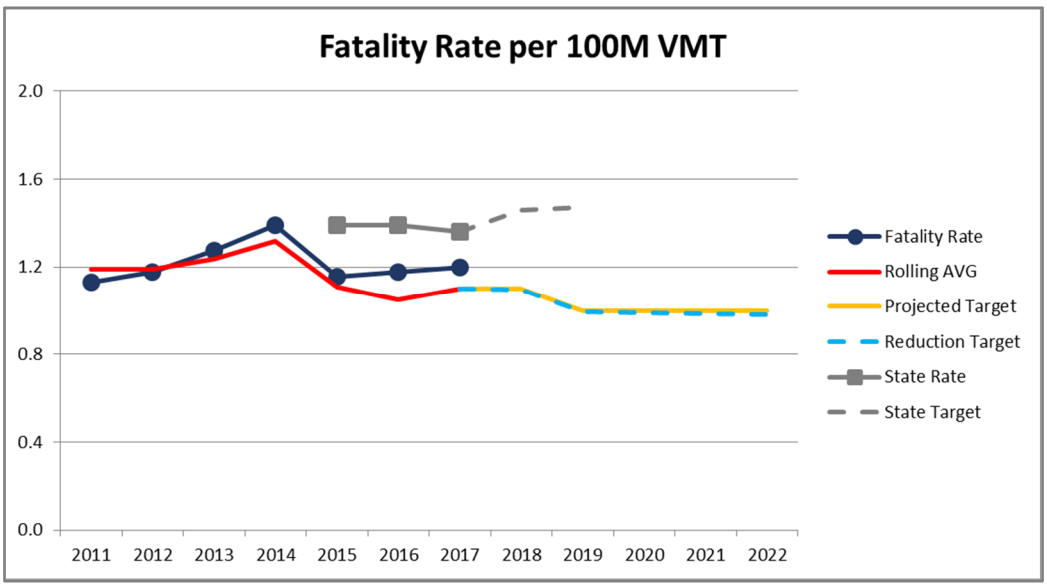
Methodology – Fatality numbers and rates are obtained from the national Fatality Analysis Reporting System (FARS). Fatality rates are calculated per 100 Million Vehicle Miles Traveled in the region.

Applicability – All public roads and highways

Reporting Frequency - Annually

Condition and Targets – H-GAC adopted the State's safety targets for the number and rate of fatalities. The target is a 2% reduction from the trend line projection over a 5-year period. The values in the chart are statistics for the 8-county H-GAC region.





Serious Injuries

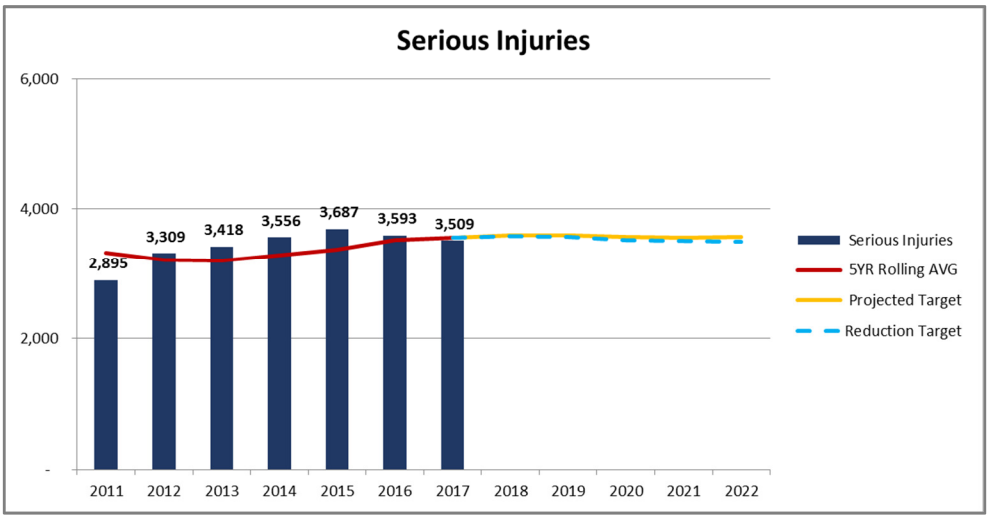
Measure – Five-year rolling averages of the number and rate of vehicular serious injuries in the H-GAC region.

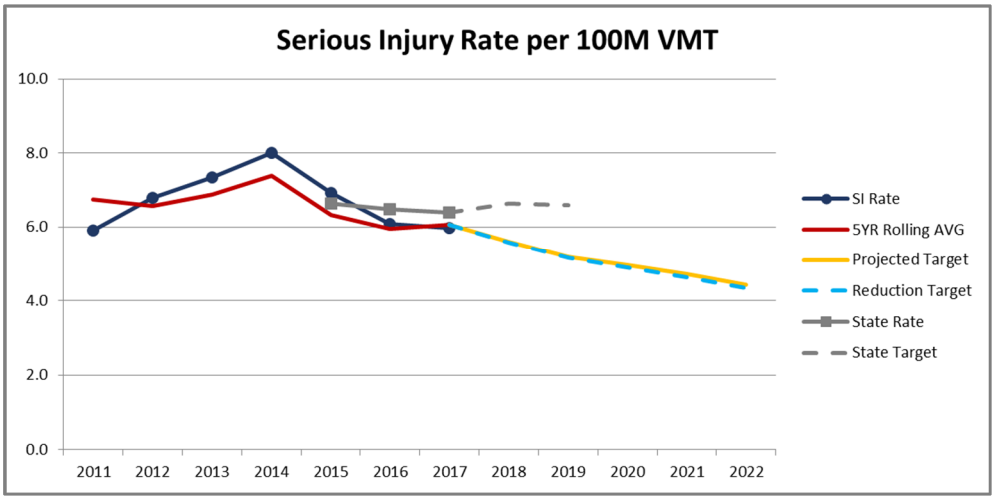
Methodology – Serious injury numbers and rates are obtained from the Texas Crash Records Information System (CRIS) databases. Serious injury rates are calculated per 100 Million Vehicle Miles Traveled (VMT) in the region.

Applicability – All public roads and highways

Reporting Frequency – Annually

Conditions and Targets - H-GAC adopted the state's safety targets for the number and rate of serious injuries. The target is a 2% reduction from the trend line projection over a 5-year period. The values in the chart are statistics for the 8-county H-GAC region.





Non-Motorized Fatalities and Serious Injuries

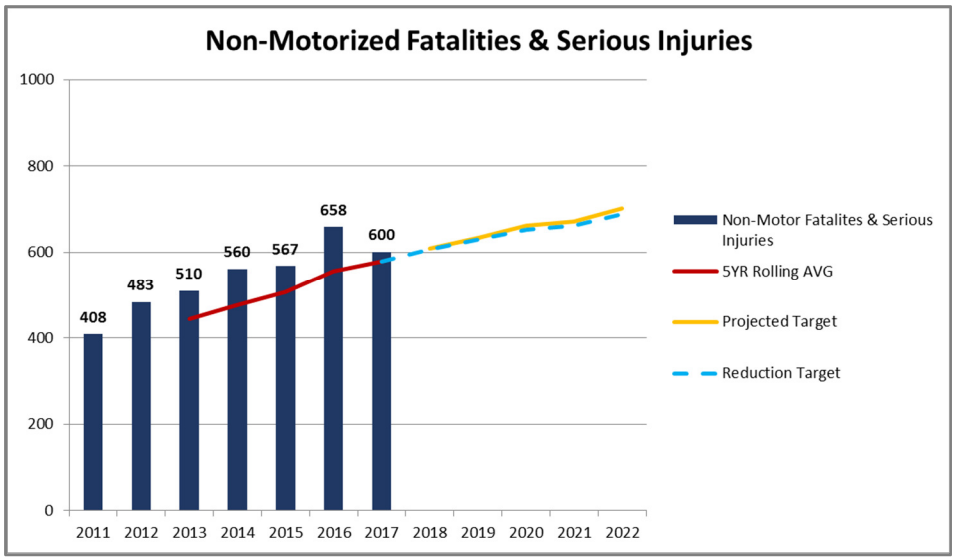
Measure – Five-year rolling average of the number non-motorized fatalities and non-motorized serious injuries for bicyclists and pedestrians in the H-GAC region.

Methodology – Serious injury numbers and rates are obtained from the national Fatality Analysis Reporting System (FARS) and the Texas Crash Records Information System (CRIS) databases.

Applicability – All public roads and highways

Reporting Frequency – Annually

Conditions and Targets - H-GAC adopted the State's safety targets for the number of non-motorized serious injuries. The target is a 2% reduction from the trend line projection over a 5-year period. The values in the chart are statistics for the 8-county H-GAC region.



Integrating Safety Performance Measures into the Transportation Planning Process

"The Regional Safety Plan was developed as a comprehensive plan that addresses the region's safety issues and offers feasible solutions. It serves as a framework for strategies and implementation actions to leverage safety programs and resources to the greatest extent possible. The performance measure targets in this plan are tangible goals for the region to work towards to support the State of Texas' crash reduction efforts, and its strategies support the State Highway Safety Plan and federal safety initiatives." *(Source: 2018 HGAC Regional Safety Plan)*

Adopted in 2018, the Regional Safety Plan identifies five traffic safety focus areas. These focus areas were crash types with the highest percentage of fatalities in the region. The Transportation Safety Committee has been charged with developing implementation plans to address the focus areas over the next four years. The MPO will continue to publish an annual State of Safety Report to assess progress toward

reducing the number of crashes, fatalities, and serious injuries throughout the region. In addition, the MPO will launch a series of intersection safety audits at high crash frequency intersections to identify crash characteristics and develop low-cost recommendations to address traffic safety issues at each location. The MPO will continue to coordinate its efforts with federal, state, and local partners to leverage resources and maximize results to enhance traffic safety in the Houston-Galveston area.

H-GAC incorporates performance measures into its programming activities by designating safety as one of the five foundational goals of the Regional Transportation Plan. Furthermore, H-GAC integrates the safety targets in the form of quantifiable strategies and goals within the regional transportation planning process. The primary method for the programming of projects is the Call for Projects issued by H-GAC. Embedded in the Call for Projects (CFP) selection criteria, the safety benefit cost analysis template indicates the number of crashes that will be reduced for each CFP project. Linking the programming of projects to quantifiable performance targets validates the success of performance-based planning.

2019 – 2022 TIP and 2045 RTP transportation investments targeting safety improvements

H-GAC, along with state and local government partners, has made significant investments in transportation infrastructure improvements through the 2019-2022 Transportation Improvement Program (TIP) and the 2045 Regional Transportation Plan. H-GAC adopted the Regional Safety Plan in 2018 to recommend crash reduction strategies. Additionally, a total of 68 projects were approved by the TxDOT Traffic Operations Division at a cost of $39.2 million (Safety Funds) from FY 2019 to 2022.

In 2018, H-GAC developed a Regional Safety Plan that identifies traffic safety focus areas, recommends crash reduction strategies and countermeasures. The fiscally-constrained 2045 RTP recommends a significant level of investments in ITS and safety projects and programs. This combined effort of planning, programming of projects, implementation of the safety plan, and critical transportation investments are expected to support and contribute to achieving the safety performance targets while greatly enhancing traffic safety for the region. The fiscally-constrained 2045 RTP recommended approximately $579 million of investments in ITS and Safety projects and programs. These investments are not part of the Corridor-based Major Investments of the 2045 RTP.

RTP 2045 STRATEGIES	STRATEGY 1 MANAGE [System Management and Operations]	STRATEGY 2 MAINTAIN [Asset Management]	STRATEGY 3 EXPAND [Transportation Network Capacity]	TOTAL
REGIONAL INVESTMENT PROGRAMS				
ITS/Safety: *(Includes certain roadway improvements, installation of computerized traffic control systems, Incident Management)*	$517,457,158	$62,269,438	NA	$579,726,596

Safety Resources
Highway Safety Improvement Program https://safety.fhwa.dot.gov/hsip/
Strategic Highway Safety Plan https://www.texasshsp.com/
Regional Safety Plan https://www.h-gac.com/transportation-safety/documents/2018-Draft-Regional-Safety-Plan.pdf
Transportation Safety Committee (formerly the Regional Safety Council) http://www.h-gac.com/taq/transportation-committees/RSC/default.aspx

PAVEMENT CONDITIONS

Ensuring the preservation of pavements and bridges is critical to safety, the movement of goods and people, economic development. While the demand on the transportation system is greater than ever, pavements and bridges are steadily deteriorating due to traffic, weather and time. In effect, this highlights the importance for an emphasis on asset management and the preservation of pavement. "Pavement preservation programs and activities employ a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet road user expectations." *(source: PL 112-141, Moving Ahead for Progress in the 21st Century Act.)*

Implementing pavement asset management, along with performance target setting, provides an opportunity for moving the transportation system to a state of good repair, protects our investments in the transportation roadway system and stretches taxpayer dollars, as far as possible. An asset management program can improve system resiliency in the aftermath of extreme weather events, such as Hurricanes Harvey and Ike, changing climate conditions, and shifts in the regional economy.

Roadways on the National Highway System, (NHS) are mostly owned, maintained, and operated by the Texas Department of Transportation; however, a portion of the NHS is under the jurisdiction of cities, counties, and toll authorities. Federal Performance Asset Management prescribes the establishment of pavement targets for all roadways on the interstate and non-interstate highway system, regardless of ownership. While the federal performance measures are focused on National Highway System, H-GAC is concerned with the conditions of all pavements and bridges. In the state of Texas, there are 69,000 National Highway System lane miles; approximately, 12% are located in the H-GAC region.

Pavement condition data is a critical component of any pavement management system. TxDOT is responsible for collecting the necessary measurements and inspections to determine the conditions ratings defined by the federal performance measures rules. The federal criterion bases the pavement condition on the International Roughness Index (IRI), rutting, cracking and faulting. Essentially, the IRI is the overall ride quality of a roadway. The pavement analysis is based on distress ratings and ride quality measurements. TxDOT used historical measurements of pavement and bridge conditions to establish statewide targets.

Federal transportation bills require TxDOT to implement transportation asset management practices and set performance targets to a desired condition. The federal performance measures place a high priority on maintaining the good pavements and on raising the pavements in poor condition to a state of good repair. A good condition pavement rating suggests that no major investment is necessary, and conversely, a fair condition suggests that major reconstruction of the pavement is needed.

The pavement condition thresholds applicable to Interstate System roadways are shown in the table below.

Interstate System Rating Thresholds			
	Good	Fair	Poor
IRI (in/mile)	< 95	95 - 170	> 170
Cracking %	< 5	5 - 10	> 10
Rutting (in)	< 0.2	0.2 - 0.4	> 0.4
Faulting (in)	< 0.05	0.05 - 0.15	> 0.15

The calculations of the pavement performance for Interstate System roadways are explained in the table below.

Rating the Interstate National Highway System			
Overall Condition Rating	3 metric ratings (IRI, Cracking, Rutting) for ACO, (IRI, Cracking, Faulting) for JCP	2 metric ratings (IRI and Cracking) CRCP	Measures
Good	All three metrics rated "Good"	Both metrics rated "Good"	% Lane Miles in "Good" Condition
Poor	≥ 2 Metrics rated "Poor"	Two metrics rated "Poor"	% Lane miles in "Poor Condition
Fair	All other combinations	All other combinations	% Lane miles in "Fair" Condition

The historical pavement condition data from the Texas Department of Transportation's Pavement Management Information System (PMIS) were translated into the corresponding pavement condition measures for MAP-21/FAST Act requirements. The data was used to develop the historical trends for pavement condition measures. A five-year moving average was used to calculate the performance targets.

The calculations of pavement condition for the Non-Interstate National Highway System roadways are defined in the table below. Unlike the Interstate System, when rating the condition of Non-Interstate NHS roadways, only the International Roughness Index (IRI) is measured.

Rating the Non-Interstate National Highway System			
	Good	Fair	Poor
IRI (in/mile)	< 95	95 – 170	➢ 170
Measure	Percent Lane Miles in "Good" Condition	Percent Lane Miles in "Fair" Condition	Percent Lane Miles in "Poor" Condition

The historical pavement condition data from TxDOT's Pavement Management Information System (PMIS) was used to develop the historical trends for pavement measures. A five-year moving average was used to develop the performance targets. Despite the fact that historical trends indicate pavement conditions are declining over time, H-GAC chose to adopt flat targets with the goal of maintaining current conditions and a desire for aspirational goals that indicate improvement of pavement conditions in the long-term.

States and MPOs must establish two and four-year targets and may adjust targets at the Mid-Performance Period Progress Report due in October 2020. The first performance period began January 1, 2018 and ends on December 31, 2021.

Pavement Conditions – Interstate and Non-Interstate National Highway System

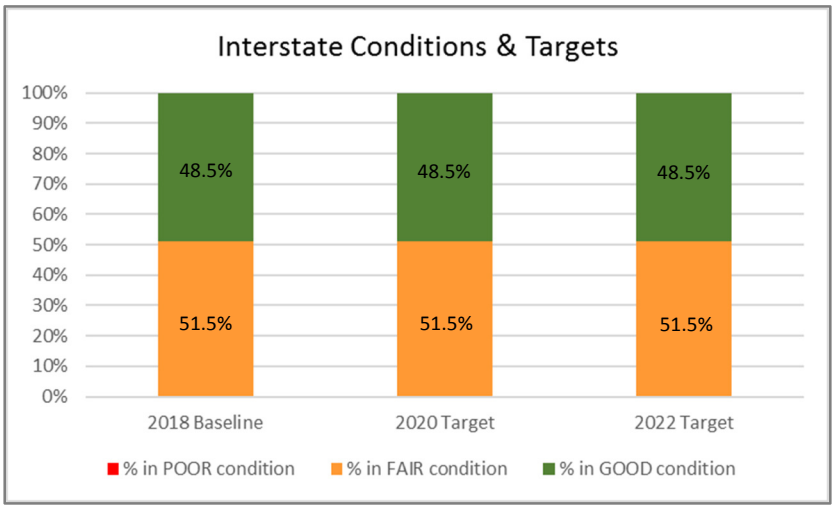
Measure – Percentage of pavements of the interstate and non-interstate National Highway System with a condition rating of "good" and "poor" relative to the ride quality.

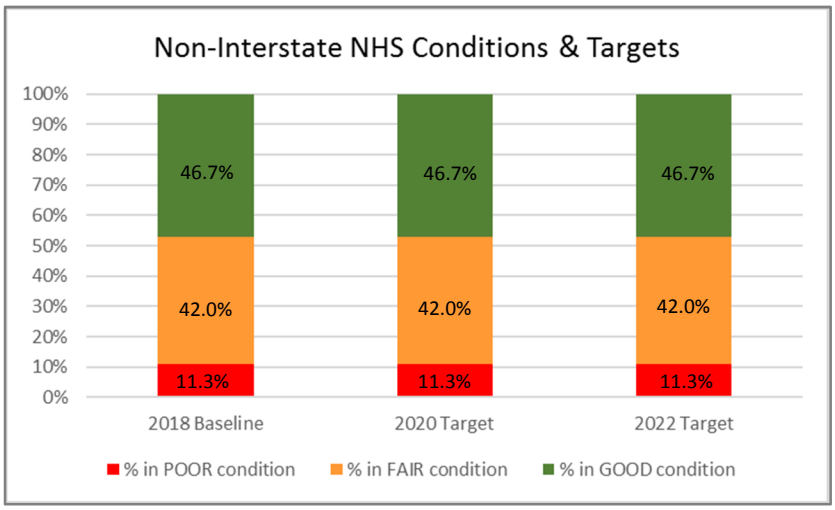
Methodology – Pavement conditions are based on the evaluation scores of the International Roughness Index (IRI), rutting, faulting and cracking. The condition scores are obtained from the Highway Performance Monitoring System (HPMS) and TxDOT's Pavement Management Information System (PMIS) databases.

Applicability – Interstate highways and Non-interstate highways of the National Highway System

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions – While the historical trends indicate pavement conditions are expected to decline by the year 2022, H-GAC chose to adopt flat targets. For Interstate highways, H-GAC adopted targets of 48.5% in good condition and 0.0% in poor condition for the years 2020 and 2022. For the Non-Interstate National Highway System (NHS), H-GAC adopted 46.7% in good condition and 11.3% in poor condition for the years 2020 and 2022. The values in the chart below reflect the statistics for the 8-county H-GAC region.





BRIDGE CONDITIONS

Asset management seeks to optimize lifecycle costs by setting and sustaining a desired target condition with the goals of improving the durability and extending the life of the region's bridges.

Performance measures and targets are applicable to all bridges on the National Highway System (NHS), which include on and off-ramps connected to the NHS within a State, and bridges carrying the NHS that cross a State border, regardless of ownership. A portion of the NHS system is under the jurisdiction of cities, counties, and toll authorities. For the approximately 2,500 bridges in the H-GAC region, 88% are owned by TxDOT and 12% are owned by other entities. The consideration of bridge performance targets should be determined from asset management analyses to achieve a state of good repair over the life cycle of assets.

Bridge conditions are based on the National Bridge Inventory evaluation ratings for the bridge's deck, superstructure, substructure and culvert. The condition rating of good, fair or poor are determined by the lowest rating of the deck, superstructure, substructure or culvert. For example, if the lowest rating of one or more of the four bridge components is less than or equal to four, the bridge's classification is rated as poor.

	Good	Fair	Poor
Bridge Inventory Rating	≥ 7	< 7 and > 4	≤ 4

The bridge targets are expressed in the percent of total bridge deck area. Deck area is computed using the structure length and deck width. For culverts, the deck area is calculated using the approach roadway width and structure length.

The historical pavement condition data was gathered from the Texas Department of Transportation's (TxDOT) Bridge Inventory. TxDOT surveys all bridges on the National Highway System and reports the conditions to the National Bridge Inventory. Historical bridge condition trends are based on a trend-line analysis. While the historical trends indicate bridge conditions are slowly declining, H-GAC chose to adopt flat targets for the years 2020 and 2022. Due to the lengthy lead time associated with environmental clearance, right of way purchase, design and the construction of a bridge, any new bridge being considered right now will have little or no influence on bridge conditions for the next three to five years. Despite the fact that historical trends indicate bridge conditions are declining in the future, H-GAC chose to adopt flat targets with the goal of maintaining current conditions and a desire for aspirational goals that indicate improvement of bridge conditions in the long-term.

States and MPOs must establish two and four-year targets and may adjust four-year targets at the Mid-Performance Period Progress Report due in October 2020. The first performance period begins January 1, 2018 and ends on December 31, 2021.

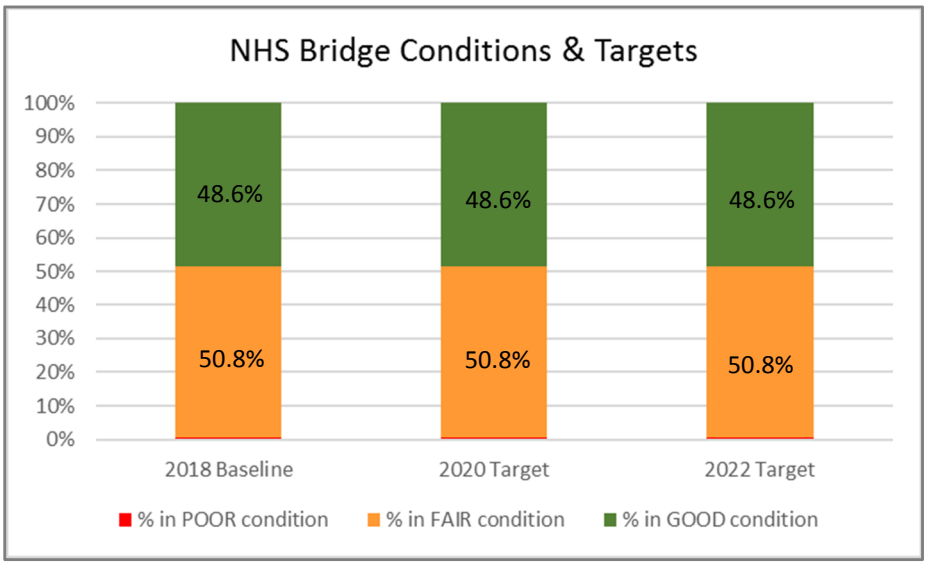
Measure – Percentage of bridge deck area of the National Highway System with a condition rating of "good" and "poor".

Methodology – Bridge deck conditions are based on the evaluation scores of the National Bridge Inventory.

Applicability – Bridges on the National Highway System

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions – While the straight-line trend historical data indicates bridge conditions are expected to decline by the year 2022, H-GAC chose to adopt flat targets of 48.6% of bridges in good condition and 0.6% in poor condition for the years 2020 and 2022. The values in the chart below reflect the statistics for the 8-county H-GAC region.



Integrating Pavement and Bridge Performance Measures into the Transportation Planning Process

Both the short and long-range planning processes afford the opportunity for advancing the transportation system to a State of Good Repair. One of the core strategies of the Call for Projects is Maintain Asset Management: to improve and preserve the condition of existing transportation infrastructure at the least practicable cost through the application of sound asset management techniques. The RTP 2045 project evaluation system was designed to be performance-based when prioritizing projects for the region. To highlight the significance of maintaining pavement and bridge infrastructure, the Call for Projects designated a separate category for Rehabilitation and Reconstruction aimed at improving the State of Good Repair for the region's infrastructure. Additionally, investments in the RTP investment category, Infrastructure Resiliency, will contribute to improved conditions of the transportation system.

Given the fiscal constraints of transportation funding, performance-based planning can help identify the best cost-effective projects to so the investment decisions in our transportation system will be allocated to the highest priorities of the pavement or bridge asset preservation program. In addition to designated reconstruction and rehabilitation projects, every added capacity, new construction, Complete Street, grade separation and access management project will contribute to achieving the pavement and bridge performance targets. As a result, the projects programmed in the RTP 2045 are expected to have a positive impact on achieving the pavement and bridge performance targets.

The challenge with transportation asset management is that H-GAC has the responsibility to report progress, but MPOs don't control the management of the transportation assets. Not all NHS roadways are owned and maintained by the TxDOT. For the non-interstate NHS roadways, 66% are owned by TxDOT and 34% are owned by other agencies. For the interstates, 100% are state-owned. H-GAC is coordinating NHS pavement data sharing between TxDOT and Non-TxDOT agencies

H-GAC facilitates the dialogue and discussion between TxDOT and local agencies to serve as the conduit for information sharing. In addition, H-GAC is facilitating the coordination with other agencies, data sharing, understanding how each agency measures and collects data, discussing uniform data collection, and understanding the future investment plans for NHS roadways with TxDOT. Currently, the TxDOT is committed to expanding their data collection to align with the federal measures. One of the positive outcomes of Transportation Asset Management is that it affords the opportunity is to focus and collaborate with all agencies responsible for the maintenance of our critical transportation network.

Of particular challenge, the tremendous increase in population and truck traffic, expected in the Houston-Galveston region over the next twenty-five years, will add additional wear and tear will impact the targets for pavements and bridges.

2019 – 2022 TIP and 2045 RTP transportation investments targeting pavement and bridge improvements

H-GAC, along with state and local government partners, has made significant investments in transportation infrastructure improvements through the 2040 Regional Transportation Plan and the 2019-2022 Transportation Improvement Program (TIP) and the 2045 Regional Transportation Plan. The investments of new roadways, roadway expansions, preventive maintenance, rehabilitation, and bridges are expected to contribute towards achieving the Pavement and Bridge Performance Targets. A combined effort of planning, programming of projects, collaborative data sharing, and critical transportation investments are expected to support and contribute to achieving the asset management targets for pavement and bridge while moving the system to a State of Good Repair. In the 2019-2022 TIP, a total of $13,512,997 is programmed for Category 1, Preventive Maintenance and Rehabilitation.

H-GAC has made strategic investments in transportation infrastructure improvements through the 2045 RTP. The fiscally-constrained 2045 RTP recommends a significant level of investments in pavement and bridges. The fiscally-constrained 2045 RTP recommended approximately $48 billion of investments for State of Good Repair projects and programs. Other types of projects, such as new roadways and highways, thoroughfare expansions, reconstructions, Complete Streets and other improvements are expected to make additional contributions toward the State of Good Repair.

RTP 2045	Strategy 2 - MAINTAIN [Asset Management]
Corridor-Based Major Investments & Regional Investment Programs	$48,464,706,593

Pavement and Bridge Resources

Condition of Texas Pavements: Pavement Management Information System (PMIS) Annual Report - https://library.ctr.utexas.edu/Presto/content/Detail.aspx?ctID=UHVibGljYXRpb25fMTE2MTA=&rID=MjcwODU=&ssid=c2NyZWVuSURfMTQ2MDk=

Texas Transportation System Performance Results: Pavement Condition - https://www.txdot.gov/inside-txdot/division/federal-affairs/preliminary-performance/pavement-conditions.html

Texas Transportation System Performance Results: Bridge Condition - https://www.txdot.gov/inside-txdot/division/federal-affairs/preliminary-performance/bridge-conditions.html

Texas Transportation Plan 2040 - https://www.txdot.gov/inside-txdot/division/transportation-planning/statewide-plan/2040/plan.html

National Bridge Inventory - https://www.fhwa.dot.gov/bridge/nbi.cfm

SYSTEM PERFORMANCE

The System Performance Group contains a set of performance measures aimed at evaluating and improving the overall performance of the National Highway System. These measures place focus on personal travel, as well as, freight, reducing congestion and tailpipe emissions, and increasing multi-occupant vehicle use. Improving the system performance of the transportation network means there will be more reliable and less congested roadways, an increased use of alternative transportation modes and an increase in multi-occupant commuting vehicles, resulting in less vehicle emissions.

Reliability

One of the goals of System Performance Measures is to assess the reliability of the National Highway System (NHS). Travel reliability is when the travel time of a roadway remains consistent. Reliability measures the difference of travel time, across hour and day, for both personal travel and freight, and examines peak travel over a year's time. Essentially, the measure of travel reliability compares a bad day of traffic to a normal day.

The three (3) travel time reliability performance measures are:

- Personal travel time on the interstate
- Personal travel time on the non-interstate roadways of the National Highway System
- Truck travel time on the interstate

The Reliability measures utilize two metrics:

- Level of Travel Time Reliability (LOTTR) ratio for personal travel. LOTTR measures the difference of travel time across hour and day. Expressed as a ratio, LOTTR is the ratio of travel time in a bad condition in relationship to the travel time in an average condition. LOTTR ratios below a 1.50 threshold are labeled as "reliable". The measure is calculated separately for the interstate and the non-interstate segments of the National Highway System.
- Truck Travel Time Reliability Index (TTTR) for truck travel on the interstate highways.

Measure (LOTTR) – Percentage of person-miles traveled on the National Highway System that are reliable, as defined by the measure, the Level of Travel Time Reliability (LOTTR). LOTTR is a ratio of the 80th percentile (bad day of traffic) to the 50th percentile (normal) travel time for a roadway segment. A ratio below 1.5 is considered to be "reliable"; and a ratio of 1.5 or greater are "unreliable".

Reporting is divided into four time periods:

- Weekdays 6 a.m. to 10 a.m.
- Weekdays 10 a.m. to 4 p.m.
- Weekdays 4 p.m. to 7 p.m.
- Weekends 6 a.m. to 8 p.m.

If the roadway segment is unreliable during any one of the four time periods, the roadway segment is labeled as "unreliable".

Methodology – Reliable person-miles are calculated using data from the National Performance Management Research Data Set (NPRMDS) which contains travel time by roadway segment every 15 minutes. The average occupancy value used for the Houston-Galveston region is 1.69.

Developed in collaboration with the twenty-five Texas Metropolitan Planning Organizations, the Texas Transportation Institute (TTI) calculated Level of Travel Time Reliability (LOTTR) targets for the entire state. Their methodology is based on an assumed growth of regional travel demand, but does not consider potential travel time improvements from upcoming projects in the Transportation Improvement Program and the Regional Transportation Plan, such as added capacity projects, the Tow & Go Program and TranStar. The methodology assumes that anything close to being unreliable now is expected to be unreliable in the future. The NPRMDS data was collected by HERE Technologies from 2014 to 2016. In 2017, FHWA changed the vendor to INRIX which created data inconsistencies for target setting.

The range for reliable is 0% to 50% and unreliable is 51% or greater (times than average). For example, for a trip that normally takes 60 minutes, on a bad day of traffic, it will take 90 minutes or more (60 mins. x 50% = 90 mins.), therefore, the trip is considered to be unreliable. The higher the percentage, the more reliable it is. Based on the TTI methodology used across the state, for the Houston region, currently, 63% of person-miles traveled on the Interstate are reliable and is forecasted to be 50% reliable by 2022, with less reliability. As illustrated in the table below, the Non-Interstate National Highway System roadways in the region are more reliable than the Interstate.

Applicability – All roadways on the National Highway System

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions (LOTTR) - Despite the fact that the TTI methodology indicates that reliability conditions for personal travel are worsening, H-GAC chose to adopt flat targets with a desire for aspirational goals that indicate better reliability in the long-term.

Performance Measure	Baseline	2020 Target	2022 Target
Percent of Person-Miles traveled on the Interstate that are Reliable / (LOTTR)	63%	63%	63%
Percent of Person-Miles traveled on the Non-Interstate NHS that are Reliable / (LOTTR)	73%	73%	73%

Freight movement is assessed by the Truck Travel Time Reliability (TTTR) Index on the interstate. The truck reliability measure considers factors that are unique to the freight industry, such as the use of the transportation system during all hours of the day and the need to consider impacts to the system in planning for on-time deliveries and arrivals. Recognizing the importance of on-time deliveries, this measure assesses the reliability of freight movement on the interstate with a high standard of making on-time deliveries, 95% of the time.

Measure (TTTR) – Truck Travel Time Reliability ratio is calculated by dividing the 95th percentile travel time (very bad day of traffic) by the 50th percentile (normal) travel time for each roadway segment of the interstate. The TTTR index is generated by multiplying each segment's largest ratio of the five time periods by its length, then dividing the sum of all length-weighted segments by the total length of the interstate.

Reporting is divided into five time periods:

- Mondays through Fridays:
  - Morning peak 6 a.m. to 10 a.m.
  - Mid-Day 10 a.m. to 4 p.m.
  - Afternoon peak 4 p.m. to 8 p.m.
- Weekends
  - 6 a.m. to 8 p.m.
- Overnights for all days
  - 8 p.m. to 6 a.m.

Methodology – The TTTR index is calculated using data from the National Performance Management Research Data Set (NPRMDS) which contains travel time by roadway segment every 15 minutes.

Developed in collaboration with the twenty-five Texas Metropolitan Planning Organizations, the Texas Transportation Institute (TTI) calculated Truck Travel Time Reliability targets for the entire state. The methodology is based on an assumed 2% annual growth of truck unreliability, but does not consider potential travel time improvements from upcoming projects in the Transportation Improvement Program and the Regional Transportation Plan, such as added capacity projects, the Tow & Go Program and TranStar. The NPRMDS data was collected by HERE Technologies from 2014 to 2016. In 2017, FHWA changed the vendor to INRIX which created data inconsistency problems for target setting.

Based on the TTI methodology used across the state, for the Houston region, the baseline for Truck Travel Time Reliability (TTTR) index is 2.1. The truck index is the amount of time a truck driver needs to add to a median trip length to arrive on-time, 95% of the time. For example, for a truck trip of 30 minutes, using the regional baseline of 2.1, a total time of 63 minutes would need to be scheduled for the truck to arrive, on-time, 95% of the time. (30 mins x 2.1 baseline = 63 mins)

Applicability – Interstate highways

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions - Despite the fact that the TTI methodology forecasts freight reliability conditions are worsening, H-GAC chose to adopt flat targets with the goal of maintaining current conditions and a desire for aspirational goals that indicate better truck reliability in the long-term. Better estimates and targets may be updated after two years when improved data-sets are available.

Performance Measure	Baseline	2020 Target	2022 Target
Truck Travel Time Reliability Index on the Interstate	2.1	2.1	2.1

Congestion

FHWA established two performance measures to assess traffic congestion applicable to metropolitan planning organizations who receive Congestion Mitigation Air Quality (CMAQ) funding.

- Annual Hours of Peak Hour Excessive Delay Per Capita
- Percent of Non-Single Occupancy Vehicle Travel

Annual Hours of Peak Hour Excessive Delay (PHED) – This measure refers to the additional time spent in congested traffic, in addition to the regular peak hour congestion, based on an established speed threshold. The federal threshold for excessive delay on a roadway is 60% of the speed limit. On a segment with a speed limit of 60 mph, the excessive delay (60% of 60 mph) would be 36 mph. Peak periods are defined as Monday through Friday 6:00 a.m. to 10:00 a.m. and 3:00 p.m. to 7:00 p.m.

Measure (PHED) – Annual Hours of Peak Hour Excessive Delay (PHED) per capita - This is the number of extra travel time spent in peak traffic, under excessive delay conditions, annually.

Methodology – The PHED is calculated using all vehicle data from the National Performance Management Research Data Set (NPRMDS) which contains travel time by roadway segment every 15 minutes, with volumes in the Highway Performance Monitoring System (HPMS) and occupancy factors.

TxDOT enlisted the Texas Transportation Institute (TTI) to establish a statewide methodology and recommend future year targets for all MPOs in the state for the System Performance Group. TTI calculated the base-year measurement from observed data and formulated future year targets. The TTI methodology does not include estimates for the impact of project investments and congestion mitigation projects that H-GAC is implementing at a regional level.

Applicability – National Highway System in urbanized areas

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions - Based on the feedback received by TAC members during the October 2, 2018 TAC Workshop, staff has proposed to use the TTI methodology for the baseline and set targets for 2020 and 2022 to be same as the 2018 baseline numbers for Percent of Trips that are Non-Single Vehicle Occupancy Travel. H-GAC adopted flat targets. Better estimates and targets may be updated after two years when improved data sets are available.

Congestion Performance Measure	Baseline	2020 Target	2022 Target
Annual Hours of Peak Hour Excessive Delay per capita	14	14	14

Percent of Trips that are in Non-Single Occupancy Vehicles (Non-SOV) – The goal of this measure is focused on reducing congestion by increasing the number of work trips where commuters are sharing a ride with others. In the H-GAC region, 78.9% of commuters drive alone and 21.1% of commuters are sharing a ride, such as carpooling, using regional vanpool, riding public transportation, walking, bicycling and other means.

Measure (Non-SOV) – Percent of Trips that are Non-SOV, based on work commute types

Methodology – Percent of Trips that are Non-SOV is calculated from H-GAC's travel demand model and compared with the U.S. Census American Community Survey data.

Applicability – All roadways in the urbanized areas of the 8-county H-GAC region.

Reporting Frequency – Biennially with four-year performance periods

Targets and Conditions – Based on the feedback received by TAC members during the October 2, 2018 TAC Workshop, staff considered using the TTI methodology for the baseline and set targets for 2020 and 2022 to be same as the 2018 baseline numbers for the Percent of Trips that are Non-Single Vehicle Occupancy Travel. For the Percent of Non-Single Occupancy Vehicle measure, staff utilized the H-GAC travel demand model for target setting. Based on the model data and calculations, staff projected the mode share for Non-SOV to grow due to strategies implemented at the regional level. In light of the H-GAC region's forecast of high levels of economic and population growth, resulting in more travel and commuters, H-GAC chose to adopt flat targets with a desire for aspirational goals that indicate an increase in multi-occupant vehicle use in the long-term.

Congestion Performance Measure	Baseline	2020 Target	2022 Target
Percent of Trips that are Non-Single Vehicle Occupancy Travel	20.1%	20.1%	20.1%

Air Quality / On-Road Mobile Source Emissions Measures

FHWA established air quality performance measures to assess vehicle emissions with a goal of reducing emissions resulting in better air quality. Metropolitan Planning Organizations (MPO) with a population over 1,000,000 that receive Congestion Mitigation Air Quality (CMAQ) funding are required to set targets for on-road mobile source emission reductions and to develop a CMAQ Performance Plan. The reporting period is biennially, with four year performance periods.

Due to new requirements resulting in the FAST Act, MPOs that receive Congestion Mitigation and Air Quality Improvement (CMAQ) funds must work with state DOTs to develop performance management targets for the Nitrogen Oxide (NOx) and Volatile Organic Compound (VOC) emissions reduced by projects programmed with CMAQ funding. For the Houston-Galveston region, this includes targets for NOx and VOC emissions. In response to this requirement, the Texas Department of Transportation reached out to the MPOs in Texas nonattainment regions for collaboration in the development of emissions reduction estimates. Through consultations with H-GAC and two other nonattainment MPOs, an alternative methodology was developed. The baseline and performance targets shown in the table below were developed using current projects and their actual emissions from projects in the 2019-2022 Transportation Improvement Program. The baseline and targets are documented in the CMAQ

Performance Plan, located at http://www.h-gac.com/transportation-improvement-program/project-resources.aspx. The four-year emission reduction target from CMAQ funded projects is a conservative estimate, as once the 2018 Call for Projects are submitted and approved, more CMAQ funded projects are likely to be added which will increase the expected emissions reduced.

Targets and Conditions – H-GAC adopted the emission reduction baseline and performance targets for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), expressed in kilograms per day.

On-Road Mobile Source Total Emission Reductions			
Performance Measure	**2018 Baseline**	**2020 2-Year Target**	**2022 4-Year Target**
Emission Reductions NO_x (kg/day)	453.741	1,419.426	1,883.294
Emission Reductions VOC (kg/day)	66.850	169.301	200.809

Integrating System Performance Measures into the Transportation Planning Process

Moving People and Goods Efficiently and Strengthen Regional Economic Competitiveness are two of the five foundational goals of the Regional Transportation Plan, H-GAC is integrating the System Performance targets in the form of quantifiable strategies within the regional transportation planning process. H-GAC incorporates performance measures into its programming activities through the core strategy, Manage, as related to system management and operations.

The RTP 2045 project evaluation system was intended to be performance-based for prioritizing projects for the region. The primary method for the programming of projects is the Call for Projects. Fifty percent of the project's score is calculated from benefit cost analyses in three key areas: reduction of travel delay, on-road vehicle emissions reductions, and safety improvements to reduce crashes. With a heightened focus on the improving the performance of the transportation system, the benefit cost analysis types have a direct linkage to the reliability, congestion and air quality performance measures.

2019 – 2022 TIP and 2045 RTP transportation investments targeting improvements to System Performance

H-GAC, along with state and local government partners, have made strategic investments in transportation infrastructure and programs through the 2045 RTP. The fiscally-constrained 2045 RTP recommends a significant level of investments for System Performance. A combined effort of planning, programming of projects, improved data collection, and critical transportation investments are expected to support and contribute to achieving the targets for System Performance.

Reliability and Congestion – The fiscally-constrained 2045 RTP recommended approximately $37 billion of investments of Corridor-based Major Investments and Regional Investment Programs from the 2045 RTP Strategy 1, Manage for addressing Reliability and Congestion, as shown in the table below.

RTP 2045	Strategy 1 - MANAGE [System Management and Operations]
Corridor-Based Major Investments & Regional Investment Programs	$37,004,441,916

Additionally, a total of $4.52 billion is programmed in the 2019 – 2022 Transportation Improvement Program which is expected to contribute towards achieving the Reliability and Congestion targets.

2019 – 2022 Transportation Improvement Program	
Category 2 – Metropolitan and Urban Area Corridor Projects	$1,703,128,254
Category 4 – Statewide Connectivity Corridors Projects	$737,080,000
Category 5 – Congestion Mitigation and Air Quality Improvement	$349,942,972
Category 7 – Surface Transportation Block Group	$686,862,183
Category 12 – Strategic Priority	$1,058,020,000
Total	$4,535,033,409

Air Quality – Total Emission Reductions - The fiscally-constrained 2045 RTP recommended approximately $46.7 billion of investments of in the categories of ITS/Safety, Local High Capacity Transit, Pedestrian/Bicycle, Transit Capital Program and Air Quality projects and programs for improving air quality and achieving the performance targets, as described in the table below. These investments are not part of the Corridor-based Major Investments of the 2045 RTP.

RTP 2045 STRATEGIES	STRATEGY 1 MANAGE [System Management and Operations]	STRATEGY 2 MAINTAIN [Asset Management]	STRATEGY 3 EXPAND [Transportation Network Capacity]	TOTAL
REGIONAL INVESTMENT PROGRAMS				
Air Quality Related	$254,598,000	NA	NA	$254,598,000
ITS/Safety: *(Includes certain roadway improvements, installation of computerized traffic control systems, Incident Management)*	$517,457,158	$62,269,438	NA	$579,726,596
Local High Capacity Transit: *(Includes non-corridor light rail, park and ride, transit centers, demand management strategies)*	$15,908,231,556	$99,598,227	$13,790,549,267	$29,798,379,050
Pedestrian/Bicycle: (Includes on-street facilities, hike and bike trails and paths, and reconstruction)	$130,247,249	$51,178,297	$1,626,470,674	$1,807,896,220
Transit Capital: (Includes all other new or expanded facilities, services, and vehicles)	$4,272,120,809	$2,404,429,566	$7,669,280,587	$14,345,830,962
TOTAL	$20,082,654,772	$2,617,475,528	$23,086,300,528	$46,786,430,828

Air Quality

Additionally, a total of $425 million is programmed in the 2019 – 2022 Transportation Improvement Program which is expected to contribute towards achieving the air quality targets.

2019 – 2022 Transportation Improvement Program	
Category 5 – Congestion Mitigation Air Quality (CMAQ)	$349,942,972
Category 9 Flex – TAP/TASA	$75,188,277
Total	$425,131,249

TRANSIT ASSET MANAGEMENT

The Moving Ahead for Progress (MAP-21), Final Rule 49 USC 625 established a strategic and systematic process of operating, maintaining, and improving public capital assets effectively through their entire life cycle. This rule became effective October 2016 and includes the definition of "Transit Asset Management Plan" (TAM) and "State of Good Repair". Additionally, the rule establishes performance measures for equipment, rolling stock, infrastructure, and facilities asset categories to assist when making investment decisions. Transit providers that receive federal funds and either own, operate or manage capital assets used in providing public transportation are required to develop and implement TAM Plans and submit performance measures, annual condition assessments, and targets to the National Transit Database. Sub-recipients and Tier II providers (that operate one hundred or fewer vehicles) have the option to develop a group TAM Plan with the Texas Department of Transportation (TxDOT) or develop their own plan.

Transit Asset Management Plans contain the capital asset inventories for rolling stock, equipment, non-revenue vehicles, facilities and rail infrastructure. Rail infrastructure applies to METRO only. Investment prioritizations, decision support tools, as well as, risk mitigation, maintenance, acquisition and renewal strategies are the core activities of the TAM Plans.

The majority of the assets in our region belong to Tier I provider METRO. The Tier II providers that receive FTA Section 5307, 5310 & 5311 funding can either set their own targets, as direct recipients, or opt to be included in TxDOT's Group Plan. Colorado Valley Transit was the only provider that opted to be included with TxDOT's Group Plan. H-GAC collaborated with TxDOT, Tier I, and Tier II providers to set regional targets, as required by the Final Rule.

Tier I transit providers:

- METRO (Harris County Metropolitan Transit Authority)

Tier II transit providers:

- Brazos Transit District
- Colorado Valley Transit
- Connect Transit
- Conroe Connection Transit
- Fort Bend County Transit
- Galveston Island Transit
- Harris County Transit
- The Woodlands Transit

The Regional Transit Coordination Committee held meetings during 2017 and 2018 to discuss the process required to formulate TAM Plans and targets. In May 2018, the Transportation Policy Council (TPC) approved an interagency Memorandum of Understanding between the region's transit operators, TxDOT,

and H-GAC to facilitate regional collaboration and promote a performance-based planning process.

H-GAC staff led the coordination efforts for target setting and TAM Plan development with the Regional Transit Coordination Subcommittee (RTCS) in 2018. The RTCS established a TAM Plan Working Group with the objective of developing H-GAC regional targets and to promote State of Good Repair of capital assets. The working group formulated a methodology for the regional targets in the four areas of rolling stock, equipment, facilities, and infrastructure. The TAM Plan Working Group endorsed a methodology for setting the region's targets based on a weighted average of asset management scores for Tier I and Tier II transit providers for their rolling stock, equipment, facilities and rail infrastructure.

Based on the weighted average method, the regional targets were presented and approved by the Regional Transit Coordination Subcommittee. The Technical Advisory Committee and the Transportation Policy Council approved H-GAC's regional transit targets, as described in the following table.

Transit Asset Management Performance Measures and
Targets by Asset Category

Asset Category & Performance Measures	FY 2018	FY 2020	FY 2022
Rolling Stock – Revenue Vehicles - Age % of revenue vehicles that have met or exceeded their ULB			
Tier I Target	10%	10%	10%
Tier II Target	19%	16%	17%
TxDOT Target	15%	15%	15%
Regionwide Target	11%	11%	11%
Equipment – Non – Revenue Vehicles – Age % of non-revenue vehicles that have met or exceeded their ULB			
Tier I Target	46%	46%	46%
Tier II Target	0%	0%	0%
TxDOT Target	15%	15%	15%
Regionwide Target	46%	46%	46%
Facilities – All buildings/Structures – Condition- % of facilities have a condition rating below 3.0 TERM			
Tier I Target	54%	54%	54%
Tier II Target	75%	67%	60%
TxDOT Target	15%	15%	15%
Regionwide Target	55%	55%	54%
Infrastructure – Fixed Rail Guideway, tracks, signals & systems - % of rail infrastructure with performance (speed) restrictions, by mode			
Tier I Target	0%	0%	0%
Regionwide Target	0%	0%	0%

Note: Useful Life Benchmark (ULB) is the expected lifecycle of a capital asset for a transit provider's operating environment, or the acceptable period of use in service for a transit provider's operating environment. Transit Economic Requirements Model (TERM) Scale: Facility condition assessments reported to the NTD have one overall TERM rating per facility. TERM Rating –Excellent – (4.8-5.0); Good – (4.0-4.7); Adequate – (3.0-3.9); Marginal – (2.0-2.9); Poor (1.0-1.9)

Integrating Transit Asset Management Performance Measures into the Transportation Planning Process

Both the short and long-range planning processes afford the opportunity for advancing the transportation system to a state of good repair. Two the core strategies of the Call for Projects applicable to Transit Asset Management are: 1). Maintain Asset Management: to improve and preserve the condition of existing transportation infrastructure at the least practicable cost through the application of sound asset management techniques; and 2). Expand Multimodal Network Capacity: add capacity across all modes of travel with a focus on the interconnections between different networks and services that provide users with greater choices. The RTP 2045 project evaluation system was designed to be performance-based when prioritizing projects for the region. To highlight the significance of managing the assets of the transit programs, the Call for Projects designated four transit investment categories: Transit Priority Infrastructure, Transit Facility State of Good Repair, Transit Passenger Facilities, and Transit Expansion for vehicle purchases. The Transit Investment Strategies for the RTP 2045 are:

Transit Investment Strategies		
MANAGE ***System Management & Operations***	***MAINTAIN*** ***Asset Management***	***EXPAND*** ***Transportation Network Capacity***
• Regional Fare Collection • Transit Priority Infrastructure	• Vehicle Replacement and Overhaul • Facility State of Good Repair	• Passenger Facilities (Park & Ride/Pool, Transfer Points/Super Stops, Shelters) • Vehicle Purchase

Given the fiscal constraints of transportation funding, performance-based planning can help identify the best cost-effective projects to so the investment decisions in our transportation system will be allocated to the highest priorities of the Transit Asset Management (TAM) program. As a result, the projects programmed in the RTP 2045 are expected to support and contribute towards achieving the TAM performance targets.

2019 – 2022 TIP and 2045 RTP transportation investments targeting improvements to Transit Asset Management

Regional transit provider's TAM Plans summarize revenue rolling stock vehicles, including buses and light rail vehicles, non-revenue service vehicles, light rail track maintenance right of way assets, public facilities, and operating facilities. TAM Plans have outlined how each provider will monitor, update and evaluate the TAM plan to ensure continuous improvement. On an annual basis, transit providers will track their agency's progress toward the targets, report on their progress, and have the option to revise their targets, if needed.

Funding will be used to focus on transit asset management and planning, life cycle and safety of equipment, vehicles and other assets and infrastructure used by transit agencies, such as buses and vans, building and other rail assets. Through the implementation of TAM Plans, each of the region's transit providers are carefully evaluating their funding for projects that will contribute to achieving their individual transit asset management performance targets. As a result, TAM Plans are expected to have a significant impact toward achieving the Transit Asset Management targets.

H-GAC, along with state and local government partners, have made strategic investments in transit projects and programs through the 2045 RTP. The fiscally-constrained 2045 RTP recommends a significant

level of investments for transit operations and asset management. A combined effort of collaborative planning, programming of projects, and critical investments in the region's transit system are expected to support and contribute to achieving the targets for Transit Asset Management. The fiscally-constrained 2045 RTP recommended approximately $14 billion of investments in the Transit Capital category to achieve a State of Good Repair over the life cycle of transit assets. These investments are not part of the Corridor-based Major Investments of the 2045 RTP.

RTP 2045 STRATEGIES	STRATEGY 1 MANAGE [System Management and Operations]	STRATEGY 2 MAINTAIN [Asset Management]	STRATEGY 3 EXPAND [Transportation Network Capacity]	TOTAL
REGIONAL INVESTMENT PROGRAMS				
Transit Capital: (Includes all other new or expanded facilities, services, and vehicles)	$4,272,120,809	$2,404,429,566	$7,669,280,587	$14,345,830,962

Additionally, a total of $ 79.4 million is programmed in the 2019 – 2022 Transportation Improvement Program which is expected to contribute towards achieving the Transit State of Good Repair performance targets.

2019 – 2022 Transportation Improvement Program	
FTA Section 5337 – State of Good Repair	$24,670,384
FTA Section 5339 – Bus & Bus Facilities	$54,688,429
Total	$79,358,813