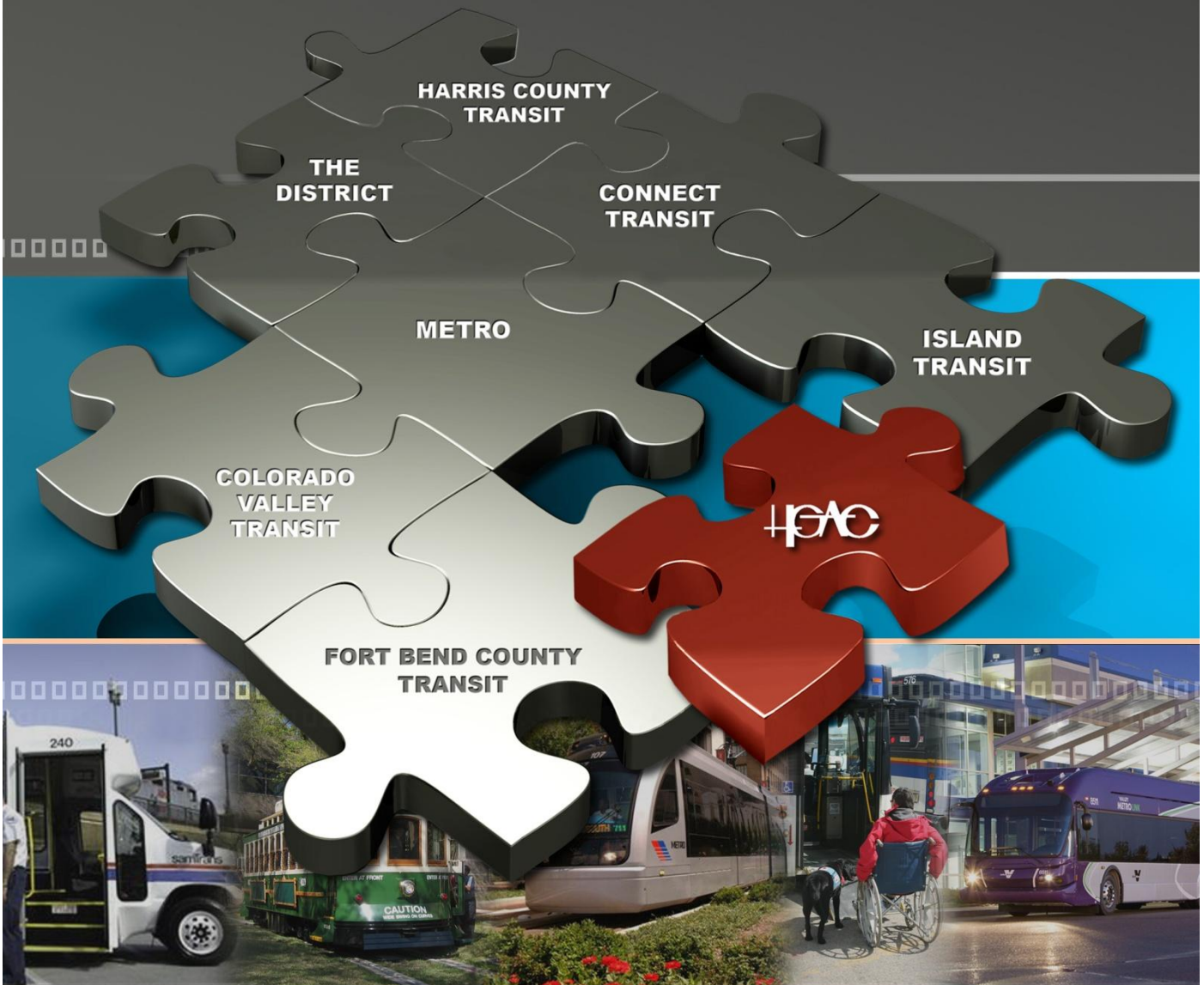


H-GAC REGIONAL TRANSIT FRAMEWORK STUDY – CONCEPTUAL REGIONAL TRANSIT SCENARIO OPTIONS

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HDR

Regional Transit Framework Study Conceptual Regional Transit Scenario Options

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Conceptual Regional Transit Scenario Options

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1.0 INTRODUCTION

The Regional Transit Framework has two overall goals: 1) identify near-term, mid-range and long-range transit investments to be included in the financially constrained element of the Regional Transportation Plan and 2) create a long-range vision for public transportation in the region. Four alternative transit scenarios that include alternative approaches to addressing the region’s future transit needs will be developed to support these goals.

The technical analyses conducted as part of this study have helped identify the region’s existing and projected regional transit needs and deficiencies, which will be addressed in the alternative regional transit scenarios. This working paper provides a brief summary of the findings from the previously completed working papers developed as part of this study, recommended service modes and standards for the services to be included in the alternative transit scenarios and a conceptual description of the four alternative transit scenarios. Combined, these elements provide the structure for developing the alternative transit scenarios.



2.0 SUMMARY OF REGIONAL TRANSIT DEFICIENCIES AND NEEDS

The *Transit Deficiencies and Needs* report completed as part of this Framework Study identified six general regional transit deficiencies:

- *Unserved Growth Areas* – There are no existing or planned transit services/investments in some areas of the region that are projected to grow significantly between now and 2035
- *Unserved Developed Areas* – There are no existing or planned transit services/investments in some areas of the region that are already developed
- *Underserved Developed Areas* – The level of existing or planned transit service in some areas of the region that are already developed are insufficient to meet projected demand
- *Congestion Impacting Transit Services* – Projected traffic congestion levels in some transportation corridors will significantly impact the efficiency of transit services
- *Congested Roadways* – Projected traffic congestion in some transportation corridors will significantly impact the efficiency of overall travel within the region
- *Transit Capital Deficiencies* – Expanded transit services potentially lack required support infrastructure such as operation and maintenance (O&M) facilities and park-and-ride facilities (including capacity at existing facilities)

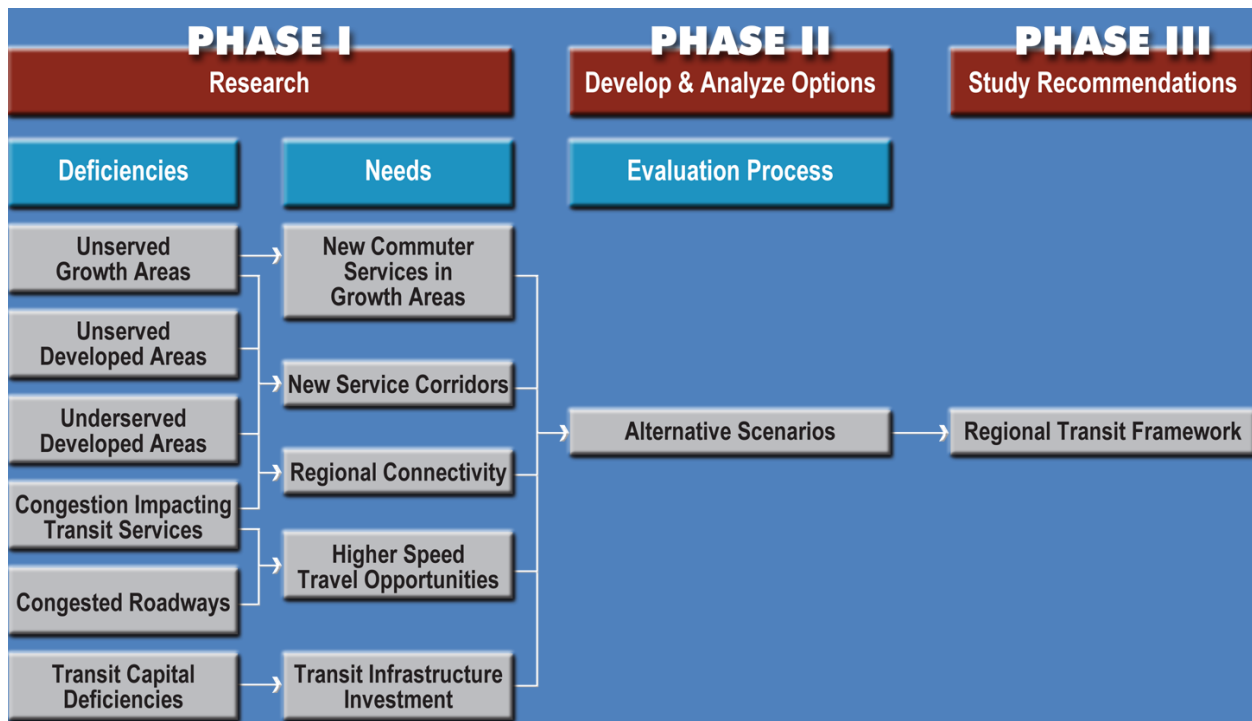
From the general deficiencies, a list of regional transit needs were identified and classified into five categories:

- *New Commuter Services in Growth Areas* – New commuter based services will be needed to meet the demand of the projected population growth in suburban communities and other emerging population growth centers
- *New Service Corridors* – Transit investments will be necessary in corridors with no current transit services to provide existing and developing areas with transit access
- *Regional Connectivity* – Network of coordinated local and regional transit services to provide seamless regional travel
- *Higher Speed Travel Opportunities* – Investments in right-of-way improvements or other transit priority measures will be needed to reduce the impact of traffic congestion
- *Transit Infrastructure Investments* – New investments in transit infrastructure, including vehicular fleet and facilities (i.e. bus stops, O&M facilities, park-and-ride facilities, etc.), will be necessary to support existing and expanded transit service operations

Figure 1 shows the relationship between the regional transit deficiencies and regional transit needs. The list of identified needs will serve as a guide for developing the alternative regional transit scenarios being developed as part of this Framework Study.



Figure 1: Relationship of the Regional Transit Deficiencies and Needs



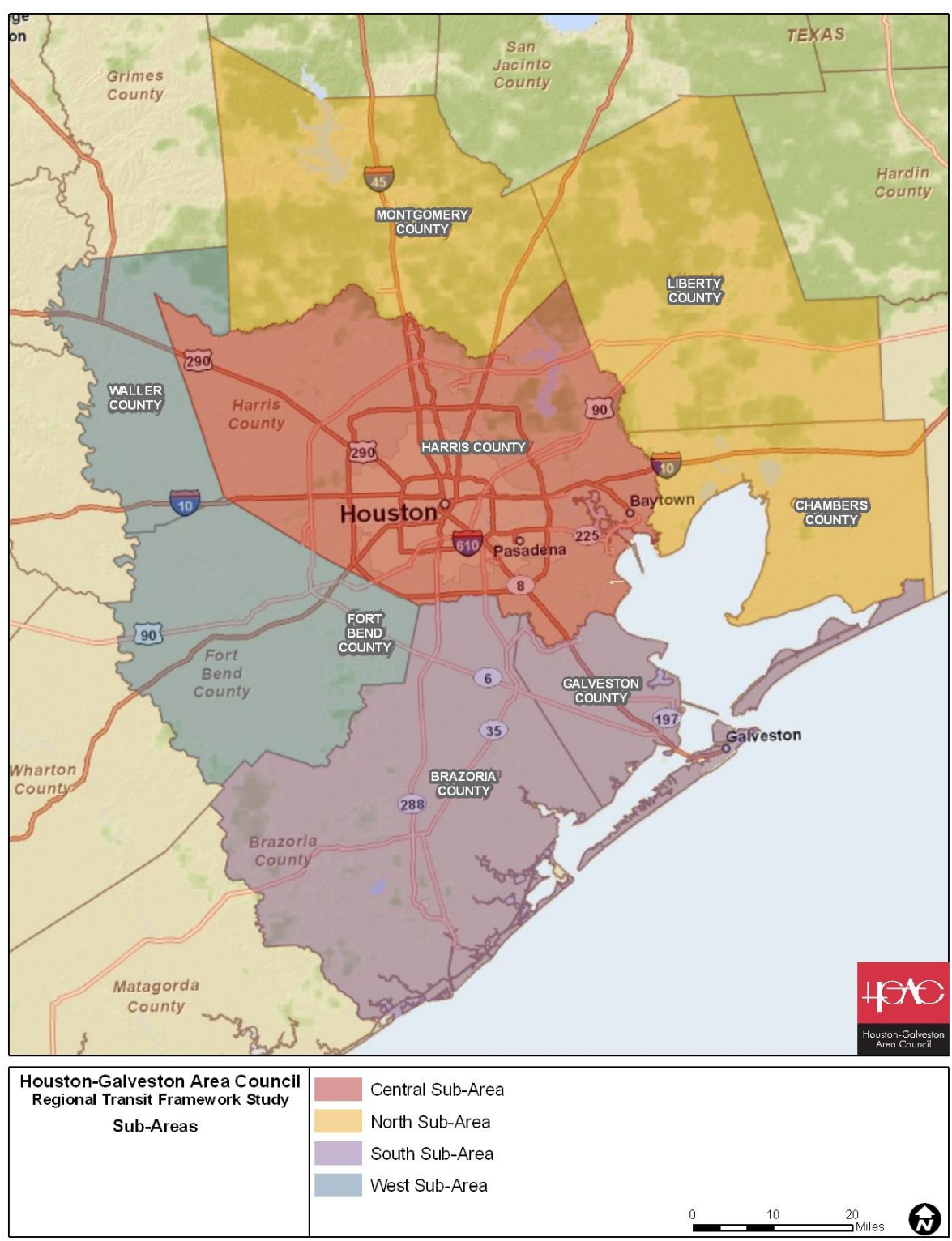
Source: H-GAC Project Team, 2009

2.1 POTENTIAL TRANSIT NEEDS BY SUB-AREA

Building from the general transit needs identified in Section 2.0, more specific transit needs, as well as potential options to address the needs have been identified for each of the four planning sub-areas (see **Figure 2**). The transit needs identified for each sub-area are based on the technical analyses identified in previous reports, while the potential options to address the needs provide a general blueprint for transit service and capital elements to be included in the alternative transit scenarios. **Table 1** provides a detailed list of the specific transit needs by sub-area, as well as potential options for addressing the needs.



Figure 2: H-GAC Planning Sub-Areas



Source: H-GAC Project Team, 2010





Table 1: Transit Needs and Solutions by Sub-Area

County	Transit Need	Potential Options to Address Transit Need
North Sub-Area		
Montgomery	Service between Conroe and the Woodlands	Add service from Woodlands Town Center to Conroe
	Increase regional connectivity	Extend transit services north to Huntsville
	Growth in southern Montgomery County and Northwest Harris County	Add service between Tomball and the Woodlands
	Existing commuter service from the Woodlands operates in congested corridor (I-45)	Extend commuter service up SH-249 to Magnolia
	Address employment growth in the Woodlands	Extend HOV lanes to the Woodlands
	Direct connections between area college campuses	Implement commuter rail from Conroe to Houston CBD
Liberty	Transit connectivity from Cleveland to employment centers	Add service from eastern Harris County to the Woodlands
	Transit connections between Liberty-Dayton-Ames and regional employment centers	Link Lone Star College campuses and Sam Houston State in Huntsville
	Increase regional connectivity	Add service from NW Harris and SW Montgomery Counties to College Station
Chambers	Limited, uncoordinated demand-response service within the County	Build park-and-ride in Cleveland
	Transit connections between population centers and regional employment centers	Add commuter service to Townsen Park-and-Ride
	Increase regional connectivity	Construct proposed park-and-ride in Dayton for commuter service to Houston, Baytown, and Beaumont
Chambers	Limited, uncoordinated demand-response service within the County	Construct transit center at I-10 and SH-146 to connect routes
	Transit connections between population centers and regional employment centers	Implement new coordinated demand response service
	Increase regional connectivity	Add service from Mont Belvieu to Houston, Baytown, and Beaumont
Chambers	Limited, uncoordinated demand-response service within the County	Construct transit center at I-10 and SH-146 to connect routes
	Transit connections between population centers and regional employment centers	Construct transit center at I-10 and SH-146 to connect routes





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County	Transit Need	Potential Options to Address Transit Need
Central Sub-Area		
Harris	Existing transit services experiencing overcrowding	Increase capacity in select corridors with increased service frequency or higher capacity transit modes
	Increase transit travel times	Increase transit operating speeds by implementing new higher speed transit modes
	Increase access to jobs	New and expanded local circulator routes in high density areas of Pasadena, Baytown, La Porte, and Clear Lake
	Increase access to Texas Medical Center (TMC)	Provide coordinated or ride-matching van pool or park-and-ride service to TMC for far eastern and western Harris County residents
	Increase connectivity to adjacent communities	Provide commuter service from Harris county to surrounding counties, especially Fort Bend, Montgomery, and Galveston counties Provide mid-day park-and-ride service on some existing routes
	Expand transit services for transit dependent citizens outside of METRO's current service area	Continue METRO Rides program Expand paratransit services to new areas
	Increase access to community services	Implement route-deviation or flex route services in existing areas, developed areas, and future growth areas with limited or no transit service
	Expand parking access for commuters	Construct new park-and-ride facilities at SH-225 and I-10 East Develop new park-and-pool lots near Tomball and Crosby
	Enhance regional transit connectivity	Implement regional Smart Card technology
	Improve passenger amenities	Construct more sheltered bus stops and expand lighting to existing bus stops
West Sub-Area		
Fort Bend	Local circulation in high density areas of the county	Implement new fixed route local bus service in Sugarland, Richmond, and Rosenberg Add service between University of Houston Sugarland, First Colony Mall and Sugarland Town Center and other high activity centers along SH-6
	Local circulation in lower density areas of the county	Expand demand response service to more areas
	Access to employment centers in Harris County	Increase commuter connectivity between Fort Bend County and employment centers in Harris County
	Connections to University of Texas Medical Branch (UTMB)	Coordination of Fort Bend County Transit and Colorado Valley Transit District (CVTD) to provide service to UTMB
	Increase regional connectivity	Provide new local transit services between Fort Bend, Waller, and Harris Counties
	Expanded parking access for commuters	Develop the proposed park-and-rides in Fort Bend County (currently 3 proposed)
	Local capacity to manage transit fleet requirements	Construct proposed Maintenance Facility in Fort Bend county and locate possible sites for additional future





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County	Transit Need	Potential Options to Address Transit Need
Waller	Inter-city and inter-county connections	facilities Reinstate local service that has been discontinued (due to funding), extend service to connections along US-290
	Access to transit centers and park-and-rides facilities	Implement transit services with direct connection to existing transit facilities along I-10 and US 290 corridors
	Early morning and late evening transit service is limited	Extend transit hours on new and existing transit services
	Weekday and weekend service for Prairie View A&M University students	Reinstate local service that has been discontinued (due to funding) Extend service to Cypress and FM-1960 area for jobs, retail, and other weekend activities
South Sub-Area		
Brazoria	Improved access to employment centers in Harris County	Implement new express/park-and-ride service between Pearland and TMC/Downtown Houston
	Increase regional connectivity	Develop new services to connect to Harris County
	Growth in Pearland area requiring local transit service needs	Create a circulator service within the Pearland area with focus on connections to FM-518
	Fixed route transit service in Southern Brazoria County	Expand new fixed route transit services recently implemented in Angleton, Clute, Freeport, and Lake Jackson
	Local circulation in lower density areas of the county	Improve demand response in rural areas
	Increased travel speed in SH-288 corridor	Add high occupancy vehicle (HOV) lane to SH-288
	Local capacity to manage transit fleet requirements	Construct bus operations and maintenance facility
Galveston	Local capacity to manage transit fleet requirements	Create park-and-ride between League City and Downtown Houston
	Increase regional connectivity	Develop new services to connect to Harris County
	Growth in League City area requiring local transit service needs	Develop new circulator service in League City area
	Service frequency and service options on Galveston Island are limited	Restore service to pre-Hurricane Ike conditions Restore trolley service to pre-Hurricane Ike conditions
	Improve connections between Galveston County mainland and Galveston Island	Create more park-and-ride service between mainland and the Island (League City area)
	Improve passenger amenities	Construct more sheltered bus stops
	Local capacity to manage transit fleet requirements	Bus storage and maintenance facility

Source: H-GAC Project Team, 2010





3.0 RECOMMENDED REGIONAL TRANSIT CHARACTERISTICS

The analysis of potential high capacity transit corridors (Working Paper #6) and regional transit needs and deficiencies identified the need for a variety of transit service modes in the H-GAC region. This chapter provides a description of applicable regional transit service modes and transit service standards.

3.1 TRANSIT SERVICE MODES

A total of seven transit modes are being considered in this framework study based on applicability to the H-GAC region. Each of the seven transit modes have unique operating characteristics depending on the different purposes and markets served. A comparison of the transit modes are shown in **Table 2**. The following subsections provide detailed descriptions as well as examples from peer regions and elsewhere of each of the transit modes.

Table 2: H-GAC Transit Service Modes

Service Mode	Purpose/Market Type	Technology	Corridor Characteristics	Passenger Access
Demand Response	ADA needs/senior citizens/rural access/general public	Van or mini-bus	Within ¾ mile of fixed route bus service; Rural areas with no fixed route bus service	Curb-to-curb
Regional Connector	Long-distance, market/trip focused	Standard bus, including mini-bus	Rural roads, arterial streets, and freeways	Limited locations within the route's alignment
Regional Fixed Route Bus	Regional and local access	Standard bus	Arterial streets	Approximately every quarter mile
Arterial BRT	Enhanced-speed, high-demand local or regional access	High capacity bus	Arterial streets	Approximately every mile
Express Bus	Enhanced-speed, moderate-volume commuter or regional access (peak only)	Premium bus	Mostly freeways, HOV lanes, and, managed lanes	At park-and-ride facilities and a minimal number of non-parking facilities
HCT Peak Period	Higher-speed, high demand regional access	High capacity bus or commuter rail	Dedicated or semi-dedicated guideway	At park-and-ride facilities and a minimal number of non-parking facilities
HCT All Day	Higher-speed, high demand regional access	High capacity bus, heavy rail, light rail, modern streetcar, automated people mover, monorail, maglev	Dedicated or semi-dedicated guideway	Approximately every half- to one-mile

Source: H-GAC Project Team, 2010





Table 3 shows each of the transit technologies and identifies the common propulsion types as well as the general passenger market and service characteristics.

Table 3: Transit Technologies

Technology	Common Propulsion Types¹	General Passenger Market and Service Characteristics
Van	Petroleum, Diesel	Low capacity technology operating in mixed traffic generally used for vanpools or demand response service. Stop distances vary based on needs.
Mini-Bus	Petroleum, Diesel	Low capacity technology operating in mixed traffic generally used for demand response or regional connector service. Stop distances vary based on needs.
Standard Bus	Diesel, Diesel-Electric, Natural Gas, Electric Catenary	Medium capacity, medium speed technology, mostly operating in mixed traffic used for fixed route bus service. Stop distances vary based on needs.
Premium Bus	Diesel, Diesel-Electric, Natural Gas, Electric Catenary	Medium capacity, medium speed technology operating in semi-exclusive and mixed traffic generally used for peak-direction, peak period service. Stop distances are generally long in outlying areas and short in central business districts.
High Capacity Bus	Diesel, Diesel-Electric, Natural Gas, Electric Catenary	High capacity, high speed technology where at least 50 percent of the service operates in an exclusive guideway. Stop distances vary based on needs.
Commuter Rail	Diesel, Diesel-Electric, Electric Catenary	High capacity, higher speed technology operating on existing railroad tracks. Generally provides service to a central city from outlying suburbs. Stops are spaced long distances apart.
Heavy Rail	Electrified Third Rail	High capacity, high speed rail technology operating in an exclusive right-of-way either above or below city streets. Short stop distances within a central city and adjacent suburbs.
Light Rail	Electric Catenary	Lower capacity and lower speed than heavy rail, but higher capacity and higher speed than modern streetcar. Generally operates at-grade on city streets.
Modern Streetcar	Electric Catenary	Low capacity, low speed technology operating in mixed traffic. Short stop distances.
Automated People Mover	Electric	Low capacity, low speed technology operating in an exclusive right-of-way above city streets. Short stop distances.
Monorail	Electric Third Rail	Medium capacity, medium speed technology operating on a single rail above city streets. Stop distances are short.
Maglev	Magnetic Levitation	Higher capacity, technology operating in an exclusive right-of-way. Speed varies based on implementation purpose (urban circulation or inter-city transportation). Technology is primarily proposed as a long distance, high speed travel option (e.g. inter-city transportation).

Source: H-GAC Project Team, 2010

¹The most common propulsion types are provided; however, other propulsion types may be used.



3.1.1 Demand Response

Demand response, also known as paratransit or dial-a-ride, provides on-demand, shared ride, curb-to-curb service to people with disabilities, senior citizens, the general public, and/or persons who live in rural areas. This service requires transit riders to call a central reservation service, up to seven days in advance, to schedule a pick-up and drop-off time on a particular day. The common vehicle type for this service is generally a van or mini-bus. While demand response service is required to be provided within three-fourth a mile of a fixed route bus, this service may also provide service where no fixed route bus service exists at the discretion of the transit operator.

A total of seven demand response operators provide service in the H-GAC region. All of the operators provide service Monday through Friday, with a handful of operators providing weekend service. The hours of operation, reservation requirements, fares, and transfers vary by operator.

Demand Response Examples in Other Regions

The Metropolitan Atlanta Rapid Transit Authority (MARTA) operates a demand response service called MARTA Mobility. MARTA Mobility is a curb-to-curb, shared-ride, on-demand service that operates within three-fourth a mile of fixed route bus service within the MARTA service area. The days and hours of operation are the same days and hours of operation as the MARTA fixed route bus service. Advanced reservations of at least one day are required.

In the Dallas-Fort Worth region, Dallas Area Rapid Transit (DART) operates three types of demand response service: paratransit service, on-call service, and FLEX service. Paratransit service is an on-demand, shared-ride, curb-to-curb service for people with disabilities that are unable to use the fixed route bus or rail service. The paratransit service is provided within $\frac{3}{4}$ mile of the DART fixed route bus system. The days and hours of operation are the same as the DART fixed route bus system. Advanced reservations of one to four days are required. On-call service is an on-demand, shared-ride, curb-to-curb service for the general public. Service is provided in eight areas with weekday service available from approximately 5:00AM to 8:30PM. FLEX service is a fixed route bus service that has the ability to deviate from the fixed route within a particular service area and provides service to the general public. The six FLEX routes are limited to their respective area with four of the routes operating Monday through Friday, one route operating Monday through Saturday, and one route operating seven days a week. Weekday hours of operation are from approximately 5:30AM to 8:00PM. Advanced reservations of up to one hour are required for the FLEX service to deviate from the fixed route.

The Regional Transportation District (RTD) operates two demand response services in the Denver region: access-a-Ride and call-n-Ride. Access-a-Ride is an on-demand, shared-ride, curb-to-curb service that provides access to people with disabilities who are unable to use the fixed route bus system. This service area is three-fourth a mile from an RTD fixed route bus and operates the same days and hours as the fixed route bus system. Reservations are required up to three days in advance. Call-n-Ride is an on-demand, shared-ride, curb-to-curb service that takes the general public to and from destinations within a specific service area.



There are 19 Call-n-Ride areas and service is provided Monday through Friday from approximately 5:30AM to 8:00PM. Advanced reservations up to two hours are required to use the deviating portion of the service.

3.1.2 Regional Connector

Regional connector service is a two-way, long-range, market-focused service. This type of service is different from traditional express or park-and-ride service because its primary purpose is not limited to commuter trips. Regional connector service may operate five to seven days a week, depending on the markets that the route is serving and generally connects to a transit center or other transit service node allowing passengers access to multiple transit services. Fixed route bus (including mini-bus) is the common vehicle type for the regional connector service, which typically operates on rural roadways, arterial streets, and freeways. Service frequency ranges from peak-only to all day operation with passenger access available at select locations.

The H-GAC region currently operates two regional connector services. METRO operates Airport Direct, which provides 30 daily trips, 7 days a week between George Bush Intercontinental Airport and downtown Houston. Fort Bend Transit operates the TREK EXPRESS which provides high frequency, peak-period, peak-direction service Monday through Friday between Sugar Land and Greenway Plaza/Uptown.

Regional Connector Examples in Other Regions

In 2009, Miami-Dade Transit (MDT) began operating the Airport Flyer in the Miami-Fort Lauderdale region. This service operates between Miami Beach, Florida and Miami International Airport with an intermediate stop at the Earlington Heights Metrorail Station, providing access to the Metrorail system as well as several Metrobus routes. Thirty-four daily trips are provided seven days a week with 30-minute service.

In the Denver region, the RTD operates a regional route, known as Route N, with service between the Town of Nederland and the Boulder Transit Center in Boulder, Colorado. This service operates seven days a week with hourly service on the weekdays and service every two hours on the weekends. Thirteen daily trips are provided Monday through Friday, ten daily trips on Saturday, and nine daily trips on Sunday. This service provides rural residents access to the greater regional transit system. The RTD also operates five routes called skyRide, which provide service from various locations in the Denver region to Denver International Airport. Three routes operate approximately 20 daily trips, seven days a week with hourly service. One route operates nearly 45 daily trips, seven days a week with service every 45 minutes. Another route operates more than 60 daily trips, seven days a week with 15-minute service.

Valley Metro operates two regional connector routes in the Phoenix, Arizona region: the Wickenburg Connector and the Phoenix/Gila Bend Connector. The Wickenburg Connector provides service between the City of Wickenburg, Arizona and the Arrowhead Towne Center Transit Center in Glendale, Arizona. Service is provided Monday through Saturday with four daily trips Monday through Friday and two daily trips on Saturday. No Sunday service is



provided on this route. The Phoenix/Gila Bend Connector provides service between the community of Ajo, Arizona and the Desert Sky Mall Transit Center in Phoenix, Arizona. Service is provided Monday through Saturday with five daily trips Monday through Friday and two daily trips on Saturday. No Sunday service is provided on this route. Both routes were specifically designed to connect rural communities located a significant distance outside of the Urbanized Area with metropolitan Phoenix.

The Utah Transit Authority is the primary transit operator in the Salt Lake City, Utah region. This agency operates a regional connector route between Brigham City, Utah and the Ogden Transit Center in Ogden, Utah where passengers have the ability to connect to several bus routes and the commuter rail service, called the FrontRunner. This route operates hourly service Monday through Saturday with 14 daily trips on the weekdays and 12 daily trips on Saturday. No Sunday service is provided on this route.

3.1.3 Regional Fixed Route Bus

Regional fixed route bus is a two-way service that provides local and regional access to transit riders on the arterial street network. Regional fixed route bus service generally operates on both weekdays and weekends. Fixed route bus is the common vehicle type for this service with passenger access approximately every quarter mile.

In the H-GAC region, more than 80 routes are operated by six transit agencies. The vast majority of bus routes operate inside Beltway 8, with service provided by the Metropolitan Transit Authority of Harris County (METRO). Island Transit and METRO generally provide local bus service seven days a week, while Brazos Transit District, Colorado Valley Transit, Connect Transit, and Harris County Transit provide weekday service only. Of the 67 local bus routes operated by METRO, 55 have a weekday frequency of 30 minutes or better and a service span ranging between 13 and 22 hours. Local bus routes operated by agencies other than METRO generally have weekday frequencies of 60 minutes and a service span ranging between 10 and 14 hours.

Regional Fixed Route Bus Examples in Other Regions

The RTD operates more than 100 local bus routes in the Denver region with 14 of those routes providing transit service throughout the multiple jurisdictions within the RTD service area. Of the 14 routes that operate this regional service, 11 routes operate seven days a week, 1 route operates Monday through Saturday, and two routes operate Monday through Friday. On the weekdays, these routes operate approximately 15 to 19 hours a day with the majority of routes operating 30-minute peak and 60-minute off-peak frequency. Of the 12 routes that operate on the weekends, 8 of the routes operate 30-minute all day frequency and the remaining 4 routes operate 60-minute all day frequency.

In the Dallas-Fort Worth region, DART operates more than 100 local bus routes. Of the routes operating within the DART service area, 18 of those routes provide transit service throughout multiple jurisdictions within the service area. The majority of these routes provide service seven days a week, while one route operates Monday through Saturday and one route operates



Monday through Friday. On the weekdays, these routes operate for approximately 19 hours, with peak frequencies ranging approximately between 15 minutes and 30 minutes and off-peak frequencies approximately ranging between 30 minutes and 1 hour. On the weekends, these routes operate with all day frequencies ranging approximately between 30 minutes and 1 hour.

3.1.4 Arterial BRT

Arterial BRT is a two-way service that operates at higher speeds than regional fixed route bus by taking advantage of limited stops as well as other time-saving measures, including signal priority systems, queue jumpers, and semi-exclusive shared lanes. This service is designed to serve high-demand local and regional markets on arterial streets with passenger access approximately every mile. Fixed route bus is the common service type for this Arterial BRT service.

Currently, the H-GAC region provides one Arterial BRT service, called the Quickline Bellaire. The Quickline Bellaire is a nine-mile, limited stop service with branded bus stations and vehicles, and takes advantage of next bus technology. This service is operated between Ranchester Station and the TMC Transit Center in the morning and evening peak time periods only, with service every 15 minutes. In addition to the Quickline Bellaire, Phase II of METRO Solutions identifies an additional of 40 miles of Signature Bus/Suburban Bus Rapid Transit service which will have defined stops or stations, special branding, and utilize queue jumper lanes. The following future corridors are identified for Signature Bus/Suburban Bus Rapid Transit service:

- Southeast Transit Center to Texas Medical Center;
- Uptown Houston to US-90A Commuter Rail Line;
- Gessner Route; and
- US-249/Tidwell Route.

Examples of Arterial BRT in Other Regions

In November 2009, Community Transit (Seattle region) began operating an Arterial BRT line called the SWIFT. The SWIFT service is a 17-mile route that provides service between the Aurora Village Transit Center in Shoreline, Washington and Everett Station in Everett, Washington. This service utilizes a combination of transit-only lanes and general traffic lanes with signal priority. The SWIFT includes other BRT elements such as uniquely branded buses and stations, off-board fare collection, and frequent service. On the weekdays, the SWIFT operates 19 hours a day providing 10-minute frequency in the morning, mid-day and evening, and 20-minute late- night frequency. On the weekends, service is provided 18 hours a day with 20-minute all day frequency.

In the San Diego region, the San Diego Metropolitan Transit System (SDMTS) began operating an interim phase of an Arterial BRT line in June 2009, called the Super Loop. The Super Loop currently is a 6-mile loop with 9 stations that provides service to the University City area of San Diego. When construction is complete (estimated Fall 2010), the Super Loop will be approximately 8 miles in length with 15 stations, and include BRT elements such as signal



priority, real-time bus information, and special branded stations. Service is provided seven day a week, 16 hours a day, with 10-minute peak and 15-minute off-peak and weekend frequency.

ABQ Ride is the primary transit agency in the Albuquerque, New Mexico region. This agency operates three Arterial BRT routes (Red, Blue, and Green), branded the RapidRide. The RapidRide routes have stations approximately every mile and have several BRT elements including special branded buses and stations, signal priority, and frequent service. Service is provided on the Red and Green lines seven days a week. On the weekdays, service is provided 16 hours a day with 15-minutes peak and 20-minute off-peak service. On Saturday, service is provided for 15.5 hours with 20-minute peak and off-peak and 30-minute early morning service. On Sunday, service is provided for 12 hours with 30-minute service. Service is provided on the Blue line Monday through Saturday. On the weekdays, service is provided 16 hours a day with 20-minute peak and 30-minute off-peak service. On Saturday, service is provided for 13 hours with 45-minute all day service.

The Massachusetts Bay Transportation Authority is the operator of Arterial BRT in the Boston, Massachusetts region, know as the Silver Line. The Silver Line includes several BRT elements such as exclusive guideway, dedicated right-of-way (reserved lanes), branded buses, and off-board fare collection. The Silver Line is comprised of four routes operating in two sections: Waterfront and Washington Street. The Waterfront section has two routes that provide service between the South Station (Red Line subway connection) and Logan International Airport or the Design Center, operating in a tunnel, reserved lanes, and mixed traffic. The Waterfront routes operate seven days a week, operating 19.5 hours a day with frequency ranging between 10 and 15 minutes on the weekdays and operating 18.5 hours a day with frequency ranging between approximately 10 and 30 minutes on the weekends. The Washington Street section has two routes that provide service between Dudley Station to either South Station (Red Line subway connection) or Downtown (Green Line subway connection), while operating in reserved lanes. The Washington Street routes operate seven days a week, operating 19 hours a day with frequency ranging between 6 and 20 minutes on the weekdays and operating 18.5 hours a day with frequency ranging between 6 and 20 minutes on the weekends.

3.1.5 Express Bus

Express bus is an enhanced-speed, moderate-volume commuter or regional service that operates primarily on the region’s freeways system, including HOV lanes, and managed lanes. Express bus operates between park-and-ride locations and employment centers throughout the region. Service is generally provided Monday through Friday during the morning and evening peak time periods where routes may provide peak-direction and/or reverse-commute service. Fixed route bus is the common vehicle type for express bus with passengers generally accessing this service from park-and-ride facilities and a minimum number of non-parking locations.

A total of 38 express bus routes operate in the H-GAC region with 32 routes operated by METRO, 5 routes operated by the Brazos Transit District, and 1 route operated by Island Transit. Twenty-eight of METRO’s express bus routes provide service to downtown Houston, while four routes provide service to the TMC. Two-way peak service is provided on 27 express bus routes, midday and late evening service on five routes, and late evening service on two



routes. The Brazos Transit District has two routes that provide service exclusively to downtown Houston; two routes that provide service to downtown Houston, the TMC, and Greenway Plaza; and one route that provides suburb-to-suburb service. Island Transit operates one route that provides service between Texas City and Galveston, with peak period, peak-direction service, and one trip in the midday.

Express Bus Examples in Other Regions

The RTD operates a total of 22 express bus routes in the Denver region. Sixteen of the routes operate peak period, peak-direction service; four routes operate peak period, peak-direction and reverse-commute service; one route operates two-way all day service; and one operates early morning and late afternoon service. Of the 22 express routes that operate in the region, 19 provide service to downtown Denver, 2 routes provide connections to light rail, and 1 route provides service to Denver International Airport. Twenty express bus routes operate Monday through Friday, one operates Monday through Saturday, and one route operates seven days a week.

DART operates ten express routes in the Dallas-Fort Worth region with nine of the routes providing suburb to downtown Dallas service. All routes operate Monday through Friday with four routes providing all day service; four routes providing peak period, peak-direction and reverse-commuter service; and two routes providing peak period, peak-direction service.

Sound Transit operates 24 express bus routes with 14 of the express routes providing service between the suburbs to downtown Seattle, 10 routes providing service between suburban areas to suburban employment centers; and 1 route providing feeder service to the Sounder commuter rail line. Thirteen routes provide service Monday through Friday and eleven routes provide service seven days a week. Fourteen routes provide two-way all day service; seven routes provide peak period, peak-direction service; and two routes provide peak period, peak-direction and reverse-commute service. Route 599 provides peak period, peak-direction and reverse-commute service which serves the Lakewood Station and Tacoma Dome Station. This route has a timed transfer with commuter rail giving transit riders the ability to connect to the Sounder.

3.1.6 HCT Peak Period

High Capacity Transit (HCT) Peak Period is a higher-speed, high-volume commuter or regional service, when compared to express bus. Like express bus, service is typically provided between park-and-ride locations and employment centers. The difference between the two services is that while express bus operates in mixed traffic, HCT Peak Period operates solely in an exclusive guideway. HCT Peak Period service typically operates Monday through Friday during the morning and evening peak time periods, traveling in the peak direction. Fixed route bus or rail vehicles (e.g., commuter rail) are the common vehicle types for this service, which would operate in a dedicated guideway. Passenger access is typically available at park-and-ride facilities and a minimum number of non-parking locations. Currently, HCT Peak Period type service does not operate in the H-GAC region. However, there are current efforts underway to study commuter rail feasibility within the region.



HCT Peak Period Examples in Other Regions

As stated previously, HCT Peak Period service can utilize either buses or rail vehicles. H-GAC region does not currently provide this service, but numerous bus and rail examples exist in other cities.

In the Miami-Fort Lauderdale region, MDT operates an HCT Peak Period service called the Busway Flyer. This service operates on the South Miami-Dade Busway (Busway) which began operation in 1997. The Busway is a 13-mile exclusive guideway that connects Florida City, Florida with the Dadeland South Metrorail Station in Kendall, Florida. The Busway Flyer operates Monday through Friday with 21 morning inbound (to Metrorail) trips and 19 evening outbound (from Metrorail) trips. Frequency is approximately every 10 minutes. The cost for using this service is the same as a one-way local fare.

Sound Transit operates HCT Peak Period or commuter rail service in the Seattle region, known as the Sounder. The region currently operates two commuter rail lines with the north line providing service between Seattle and Everett, and the south line providing service between Seattle and Tacoma. Both lines provide service Monday through Friday. The north line is 35 miles in length with 4 stations (including the King Street Station in Seattle). The Sounder operates four morning inbound (to Seattle) peak trips and four evening outbound (from Seattle) peak trips. Amtrak also provides one additional morning roundtrip and one additional evening roundtrip. The south line is 39 miles in length with 7 stations. The south line provides a total of nine morning and nine evening peak trips, with two of the morning and evening trips operating in a reverse-commute (from Seattle) manner. Fares are based on distance traveled.

Capital Metropolitan Transportation Authority (Capital Metro) is the primary transit provider in the Austin, Texas region and operates one HCT Peak Period or commuter rail line called the Red Line. The 32-mile line has 9 stations and began operation in March 2010 to provide service between Leander, Texas and the Downtown Station in Austin, Texas. This commuter rail service is unique because it operates mainly on freight tracks with a small portion operating in the streets of downtown Austin. The rail vehicles that operate on this line are called Tram-Trains, which offer the flexibility of operating in both freight right-of-way and on local streets. The cost of riding the commuter rail line is based on the distance traveled. Service is provided Monday through Friday, operating six peak period, peak-direction trips and between three and four reverse-commuter trips.

In the Minneapolis, Minnesota region, Metro Transit operates one HCT Peak Period or commuter rail called the Northstar Line. The Northstar Line began operation in November 2009 providing service between Big Lake, Minnesota and downtown Minneapolis (providing a connection to the Hiawatha light rail line). This commuter rail line is approximately 40 miles in length with six stations. Fares are charged based on the distance traveled. Service is provided seven days a week with weekday service having five peak period, peak-direction trips and one reverse commute trip. On the weekends, three daily trips are provided.

The Port Authority of Allegheny County is the primary transit operator in the Pittsburgh, Pennsylvania region and operates multiple routes on three busways. The 4.3-mile, 10 station



South Busway was constructed in 1977. The South Busway provides a connection between the Mount Washington Transit Tunnel and downtown Pittsburgh. The East Busway (commonly known as the Martin Luther King, Jr East Busway) is 9.1 miles in length with 10 stations and was constructed in two phases with the first phase (6.8 miles) opening in 1983 and the second phase (2.3 miles) opening in 2003. The East Busway provides a connection between Swissvale, Pennsylvania and downtown Pittsburgh. The West Busway is 5.1 miles in length with 6 stations and was constructed in 2000 providing a connection between Carnegie, Pennsylvania and the Sheraden neighborhood of Pittsburgh, Pennsylvania. All three of the busways are served by multiple routes that provide all day or peak period, peak-direction service. The East Busway routes (EBA and EBS) operate the entire length of the East Busway providing service between Swissvale, Pennsylvania and downtown Pittsburgh. These routes provide 83 peak inbound (to Pittsburgh) trips and 74 peak outbound (from Pittsburgh) trips.

3.1.7 HCT All Day

HCT All Day is a higher-speed, high demand regional service. While regional fixed route and arterial BRT service generally operate in mixed traffic, HCT All Day provides a time-saving element by operating solely in an exclusive guideway. This service typically operates in both directions, seven days a week. Fixed route bus or rail vehicles (e.g., light rail) are the common vehicle types used for this service. Passenger access is available at stations located approximately every half-mile to one mile apart.

In addition to addressing transportation needs HCT All Day service and related modes that operate in a fixed guideway such as light rail, have demonstrated the ability to provide significant economic development benefits. In a study¹ sponsored by DART, economic benefits associated through proximity to light rail transit are estimated to exceed \$4 billion in the Dallas-Fort Worth region.

METRO operates one HCT All Day service in the Houston-Galveston region. METRO operates a 7.5-mile light rail line (known as the Red Line) between the University of Houston-Downtown and the Reliant Park area, with a connection to the additional transit services at the Downtown Station. Service is provided seven days a week with weekday service operating between 4:30AM and 11:40PM (2:20AM on Fridays) offering 6-minute peak/midday, 12-minute evening, and 20-minute night service. In addition to the Red Line, Phase II of METRO Solutions identifies an additional of 30 miles of light rail service. The following future corridors are identified for light rail service:

- East End Corridor
- North End Corridor
- Southeast Corridor

¹ *Assessment of the Potential Fiscal Impacts of Existing and Proposed Transit-Oriented Development in the Dallas Area Rapid Transit Service Area*, Dallas Area Rapid Transit, November 2007.



- University Corridor
- Uptown Corridor

HCT All Day Examples in Other Regions

MARTA operates HCT All Day service on four heavy rail lines in the Atlanta, Georgia region. All four of the rail lines (Red, Gold, Green, and Blue) intersect in downtown Atlanta at Five Points Station and generally operate within the I-285 beltway, locally known as the Perimeter. The Red and Gold lines operate in a north-south direction and provide a connection to Hartsfield-Jackson Atlanta International Airport. The Green and Blue lines operate in an east-west direction. Service is provided seven days a week with weekday service operating between 5:00AM and 1:00AM offering 12-minute peak, 15-minute off-peak, and 20-minute late night service.

DART operates three light rail lines that provide service to the northeastern cities and southwestern neighborhoods of the Dallas-Fort Worth region. All three lines (Red, Blue, and Green) intersect at four light rail stations in downtown Dallas. Service is provided seven days a week with weekday service operating between approximately 4:30AM and 1:00AM offering 10-minute peak and 20-minute off-peak service.

King County Metro is the operator of the South Lake Union Streetcar in the Seattle region. The South Lake Union Streetcar opened in December 2007 and connects the South Lake Union neighborhood of Seattle with downtown Seattle. This line is 1.3 miles in length and has a total of 11 stations with some of the stations serving both northbound and southbound directions. Service is provided seven days a week at 15-minute intervals Monday through Thursday from 6:00AM to 9:00PM, Friday and Saturday from 6:00AM to 11:00PM, and on Sunday from 10:00AM to 7:00PM.

In the Miami-Fort Lauderdale region, MDT operates an automated people mover system, known as Metromover. Metromover is an elevated circulator system that operates three routes (Government Loop, Omni Loop, and Brickel Loop) around downtown Miami on 4.4 miles of fixed guideway with 20 stations. The three routes connect at Government Center, providing access to Metrorail and Metrobus. Service is provided seven days a week from 5:00AM to 12:00AM, with varying frequencies (approximately 1.5 minutes in the peak to 3 minutes in the off-peak).

Monorail is another type of HCT All Day service. In the Seattle region, the City of Seattle operates the Seattle Center Monorail providing service between Seattle Center and Westlake Center (downtown Seattle) allowing transit riders the ability to connect to streetcar, light rail, and local and express bus. This 1.2-mile line operates seven days a week from 9:00AM to 11:00PM with 10-minute daily frequency. In the Las Vegas, Nevada region, the Las Vegas Monorail Company operates the Las Vegas Monorail. The Las Vegas Monorail is 3.9 miles in length with 7 stations providing service just east of the Las Vegas Strip between MGM Grand (at the southern end of the Las Vegas Strip) to Sahara (at the northern end of the Las Vegas Strip). Service is operated seven days a week from 7:00AM to 2:00AM with an extra hour of operation Friday through Sunday. The frequency of the monorail system is between 4 minutes and 12 minutes.



The Lane Transit District (LTD) is the primary operator of transit services in the Eugene, Oregon region. LTD operates an HCT All Day service known as the Emerald Express (EmX Green Line) providing service between Eugene Station (Eugene) and Springfield Station (Springfield) with 60 percent of the route operating in an exclusive guideway. The EmX Green Line is a 4-mile route with 10 stations operating seven days a week. On the weekdays, service operates approximately from 5:30AM to 11:00PM with 10-minute peak and midday frequency, and 20-minute off-peak frequency. On Saturday, service is provided approximately 7:00AM to 11:00PM with 20-minute all day frequency. On Sunday, service is provided approximately 8:00AM to 8:00PM with 20-minute all day frequency.

The Los Angeles County Metropolitan Transportation Authority (LCMTA) is the provider of transit services in the Los Angeles County region. The LCMTA operates one HCT All Day service called the Metro Orange Line which provides service between West Hollywood and Warner Center. The Orange Line opened in October 2005 and was designated a color similar to the LCMTA rail lines because this service operates with characteristics that are similar to the agency's rail system. The route is 14 miles in length with 14 stations and operates in a transitway. Service is provided seven days a week from approximately 3:45AM to 1:30AM. On weekdays service is every 4 to 5 minutes in the peak, 6 to 10 minutes in the off-peak, and 15 to 20 minutes in the early morning and late evening. On the weekends, service is provided approximately every 10 to 15 minutes during the peak and midday, and every 20 minutes in the early morning and late evening.

In China, the Shanghai Maglev Transportation Development Company, Ltd operates an HCT All Day service which utilizes maglev technology. Maglev is a technology that uses a series of magnets to propel a transit vehicle along a fixed guideway. In 2004, the initial operating segment of the Shanghai Maglev Train was opened between Shanghai Pudong International Airport and the edge of downtown Shanghai, allowing a connection to the Shanghai Metro subway system. The 19-mile segment takes approximately 8 minutes and operates at a maximum speed of approximately 270 mph. An extension to the maglev system has been proposed between Shanghai and the City of Hangzhou (southwest of Shanghai). The extension would be approximately 120 miles in length and reach a top speed near 280 mph. Construction is expected to start in 2010 with an estimated completion of 2014.

3.2 RECOMMENDED MINIMUM REGIONAL TRANSIT SERVICE STANDARDS

The H-GAC project consultant team has developed recommended minimum regional transit service standards for each of the modes that would be modeled in the transit scenarios. In some cases, increased service frequency and service span may be warranted for some services. A detailed description of the recommended service standards by service mode is provided below and summarized in **Table 4**.

3.2.1 Demand Response

Recommended demand response service standards call for service seven days a week with a service span of 18 hours on weekdays and 12 hours on weekends. The same minimum service standards are recommended for rural, suburban and urban areas.



3.2.2 Regional Connector

Similar to demand response service, the recommended minimum service standards for regional connectors is uniform for rural, suburban and urban areas. Hourly (60 minutes) headways are recommended seven days a week with a service span of 20 hours Monday through Saturday and 18 hours on Sunday.

3.2.3 Regional Fixed Route Bus

Recommended minimum service standards for regional fixed route bus service are the same for rural, suburban and urban areas with the exception of service headways. Service is recommended seven days a week with a service span of 20 hours on Monday through Saturday and 18 hours on Sunday. Thirty minute (30) minimum weekday peak period headways and sixty (60) minute off-peak/weekend headways are recommended in rural areas. Thirty minute (30) minimum weekday and weekend headways are recommended in suburban areas. Finally, in urban areas fifteen minute (15) minimum peak headways and twenty minute (20) off-peak headways are recommended on weekdays, with twenty minute (20) headways and thirty minute (30) headways on Saturday and Sunday respectively.

3.2.4 Arterial BRT

Similar to regional fixed route bus service, the recommended minimum service standards for arterial BRT service are the same for rural, suburban and urban areas with the exception of service headways. Service is recommended seven days a week with a service span of 20 hours on Monday through Saturday and 18 hours on Sunday. Twenty minute (20) minimum headways are recommended in rural areas seven days a week. In suburban and urban areas, ten minute (10) minimum peak weekday headways and fifteen minute (15) headways are recommended during the weekday off-peak and on weekends.

3.2.5 Express Bus

Minimum recommendations for express bus service include a weekday service span of 8 hours: 4 hours in the AM peak and 4 hours in the PM peak. A minimum twenty minute (20) headway is recommended in rural areas, while 10 minute headways are recommended in suburban and urban areas. Based on needs, express bus service may be operated in three modes: one-way peak period, peak direction; two-way peak period; and two-way all day.

3.2.6 HCT Peak Period

The recommended minimum service span for HCT Peak Period service is nine hours Monday through Friday. The nine hour service span consists of four hours in the morning peak, four hours in the evening peak, and one hour in the midday to provide greater flexibility for commuters. Minimum recommended service headways are twelve minutes (12), with one-way or two-way service depending upon projected demand.





3.2.7 HCT All Day

Recommended minimum service standards for HCT All Day service vary between rural, suburban, and urban areas. Service is recommended seven days a week with a service span of 20 hours on Monday through Saturday and 18 hours on Sunday. Twenty minute (20) minimum headways are recommended in rural areas all day, seven days a week. Twelve minute (12) minimum headways are recommended in suburban areas all day, seven days a week. Finally, in urban areas, six minute (6) minimum headways are during peak hours on weekdays and twelve minute (12) minimum headways are recommended during off-peak hours on weekdays, Saturdays, and Sundays.

Table 4: Recommended Minimal Regional Service Standards by Mode

Service Mode	Weekday					Saturday			Sunday		
	Peak Headway (min)	Base Headway (min)	Peak Service Span (hr) ¹	Service Span (hr)	Total Daily Trips	Base Headway (min)	Service Span (hr)	Total Daily Trips	Base Headway (min)	Service Span (hr)	Total Daily Trips
Demand Response											
Rural	N/A	N/A	N/A	18	N/A	N/A	18	N/A	N/A	12	N/A
Suburban	N/A	N/A	N/A	18	N/A	N/A	18	N/A	N/A	12	N/A
Urban	N/A	N/A	N/A	18	N/A	N/A	18	N/A	N/A	12	N/A
Regional Connector											
Rural	60	60	N/A	20	40	60	20	40	60	18	36
Suburban	60	60	N/A	20	40	60	20	40	60	18	36
Urban	60	60	N/A	20	40	60	20	40	60	18	36
Regional Fixed Route Bus											
Rural	30	60	8	20	56	60	20	40	60	18	36
Suburban	30	30	8	20	80	30	20	80	30	18	72
Urban	15	20	8	20	136	20	20	120	30	18	72
Arterial BRT											
Rural	20	20	8	20	120	20	20	120	20	18	108
Suburban	10	15	8	20	192	15	20	160	15	18	144
Urban	10	15	8	20	192	15	20	160	15	18	144
Express Bus											
Rural	20	N/A	8	8	24	N/A	N/A	N/A	N/A	N/A	N/A
Suburban	10	N/A	8	8	48	N/A	N/A	N/A	N/A	N/A	N/A
Urban	10	N/A	8	8	48	N/A	N/A	N/A	N/A	N/A	N/A
HCT Peak Period											
Rural	12	N/A	9	9	45	N/A	N/A	N/A	N/A	N/A	N/A
Suburban	12	N/A	9	9	45	N/A	N/A	N/A	N/A	N/A	N/A
Urban	12	N/A	9	9	45	N/A	N/A	N/A	N/A	N/A	N/A
HCT All Day											
Rural	20	20	8	20	120	20	20	120	20	18	108
Suburban	12	12	8	20	280	12	20	200	12	18	180
Urban	6	12	8	20	360	12	20	200	12	18	180

Source: H-GAC Project Team, 2010



4.0 CONCEPTUAL TRANSIT SCENARIOS

As previously stated, the Regional Transit Framework has two overall goals: 1) identify near-term, mid-range and long-range transit investments to be included in the financially constrained element of the Regional Transportation Plan and 2) create a long-range vision for public transportation in the region. Based on these two overall study goals, concepts for four alternative regional transit scenarios are being proposed for consideration. These scenarios will provide alternative approaches to addressing regional transit deficiencies and needs based on defined criteria including potential funding and expenditure thresholds. This chapter provides a general description of potential concepts for each of the scenarios. Specific funding and expenditure thresholds for each of the scenarios will be defined separately. The draft preliminary scenario concepts are described below.

4.1 SCENARIO 1 DRAFT CONCEPT – INCREMENTAL EXPANSION

This scenario would be cost constrained based on reasonably projected funding levels of existing and likely future revenues. Scenario 1 would conceptually balance future regional transit investments based on the region’s highest transit priorities and reasonable distribution of resources. This scenario would be consistent with the overall study goal for identifying regional transit investments consistent with the financially constrained Regional Transportation Plan. Conceptually, this scenario would more or less be an incremental expansion of the existing transit services operating in the eight-county Houston-Galveston area.

4.2 SCENARIO 2 DRAFT CONCEPT – MAXIMIZE TRANSIT ACCESS

Scenario 2 would distribute regional transit investments in existing and future population and employment centers throughout the region to maximize overall transit access. This scenario would be cost constrained based on a targeted funding level. The funding level target could be based on peer regions per capita investment levels, or a predefined expansion factor such as a predetermined increase in service provided (i.e. 30 percent increase in regional revenue miles). Conceptually, this scenario would include an expansion of the existing transit services in the region and include direct transit connections within and between existing and projected population and employment activity centers throughout the region, including those in rural, suburban, and urban areas.

4.3 SCENARIO 3 DRAFT CONCEPT – MAXIMIZE TRANSIT MODE SHARE

Similar to Scenario 2, this scenario would be cost constrained based on the same targeted funding level. In addition, Scenario 3 would also include expanded transit services throughout the region; however, it would include focused transit investments in high priority corridors to maximize regional transit mode share. Conceptually, this scenario would include local area circulation with feeder services connecting population and employment centers with transit services operating in the region’s high priority corridors.



4.4 SCENARIO 4 DRAFT CONCEPT – TRANSIT PRIORITY

Scenario 4 would provide the community with a financially unconstrained alternative that seeks to meet the regional transit deficiencies and needs identified through the Framework Study planning process. This scenario will serve as a comparative alternative to the financially constrained scenarios. Similar to the financially constrained scenarios, services would be provided throughout the region in all areas (rural, suburban, and urban); however, this scenario would include maximized service levels consistent with defined service standards by modal type. In addition, direct connections will be maximized to increase effectiveness through the reduction of transfers; however, service efficiency may be reduced compared to the other scenarios as multiple direct services to the same destination (from different origins) can result in overlapping services.



5.0 NEXT STEPS

The elements described in this report provide the primary building blocks for developing the Framework Study’s four alternative transit scenarios. The process of developing the alternative transit scenarios will be initiated with the identification of the appropriate mix of transit service modes throughout the eight-county region, including specific modes for the initial HCT analysis corridors. After the initial transit scenarios are developed, the scenarios will be evaluated through use of the H-GAC regional travel demand model to identify the relative impact of each scenario and to determine if the scenarios meet their general objectives. Specific variables to be evaluated for each scenario may include overall effectiveness (total ridership), estimated transit mode share in select corridors, and estimated average travel time savings in select corridors. Using the results from the travel demand model and community input, the scenarios may be refined to better meet the defined scenario objectives and the community’s expectations.

