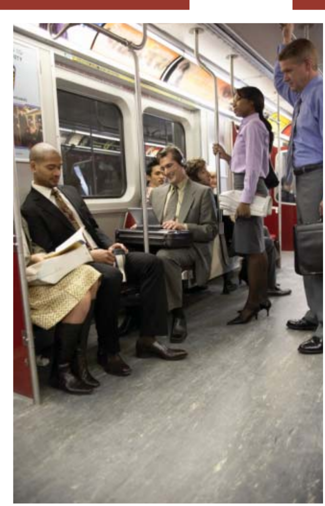

Regional Commuter Rail Connectivity Study

Appendices

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September 5, 2008

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APPENDIX A – STUDY DESCRIPTION

The Houston-Galveston Area Council has conducted this study of a regional commuter rail system and its prospects for providing sufficient connectivity to the urban core of the City. The principal goal and the principal objectives, extracted from the detailed scope of services, are summarized below.

Principal Goal

Evaluate the accessibility and connectivity requirements of implementing commuter rail service along the most feasible corridors in the H-GAC Transportation Management Area (TMA).

Principal Objectives

- Identify the need for regional commuter rail
- Identify/evaluate the impacts on freight rail operations
- Evaluate the accessibility of major activity centers
- Analyze the potential Hub locations
- Develop ridership forecasts
- Rank service options (for corridors and Hub Terminal locations)
- Provide public involvement activities
- Estimate capital and Operating and Maintenance (O&M) costs

To date, the study has resulted in a reasonably comprehensive set of data and information describing the commuter rail mode, and has provided a definition of what a regional commuter rail system would comprise once it matures as an integral part of a multimodal transportation system. However, it must be emphasized that the results are only conceptual, and an advanced planning effort is now required. A continuation of the study process, followed by a schematic design/preliminary engineering process in the corridors selected for initial implementation, will ultimately provide a technical and operational framework from which the commuter rail lines and system infrastructure can be built.

Study Tasks

The scope of services organized the work according to the sequence of tasks illustrated in Figure A-1. The progress of the work program was paced by the necessary completion of the TxDOT Houston Region Freight Rail Study, due to its essential foundational information describing the existing heave rail network on which the commuter rail study was based. When the TxDOT study was completed in 2007, the work on the strategic near term commuter rail prospects task could then be completed. Following completion of that task, the work progressed into the definition of the Principal Corridors task accomplished during the summer and early fall of 2007, while the other remaining tasks followed in a progressive manner.

As indicated in the figure, public involvement has been a continuous process, with a number of public meetings and focused stakeholder meetings occurring throughout 2006, 2007 and 2008.

The progress of this Commuter Rail Connectivity Study has been presented to the Transportation Policy Council at several points during the execution of the work, with the final presentation in June of 2008.

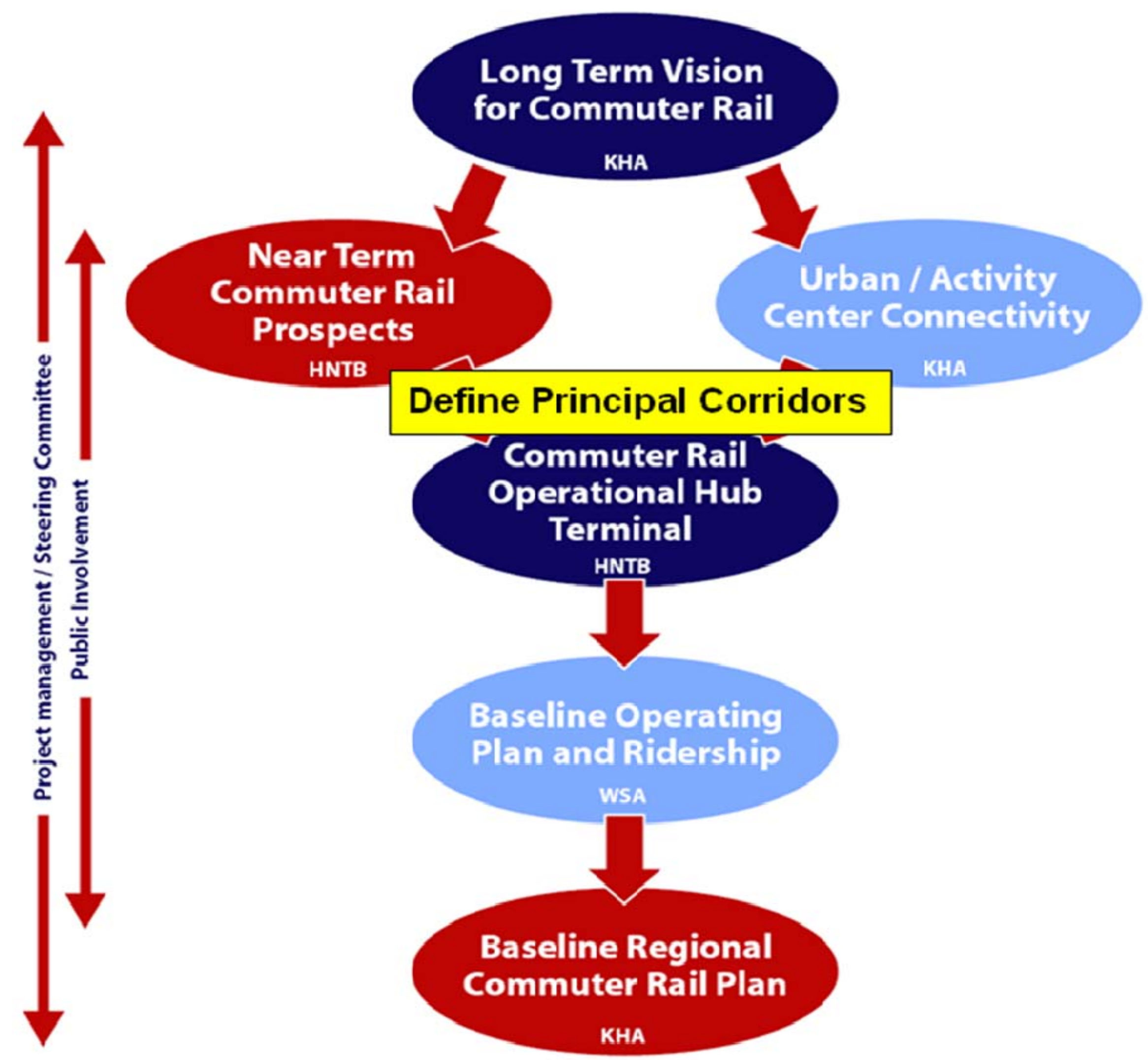

Figure A-1: Flow of Project Work Tasks

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APPENDIX B – COMMUTER RAIL AND CONNECTIVITY

CHAPTER B-1 – COMMUTER RAIL IN HOUSTON

B-1.1 WHAT IS REGIONAL COMMUTER RAIL?

Commuter rail is an effective means of transporting a high volume of passengers over long distances to the immediate vicinity of large urban districts/major employment centers. Commuter rail and light rail are similar in that they both are steel wheel on steel rail systems, but that is where their similarities end.

The following characteristics are typical of commuter rail in comparison to Light Rail.

Commuter rail characteristics:

- Larger trains = more passengers
- Stations are spaced further apart = faster average speeds
- Lower frequency of service, but with a well defined schedule of train departures from every station
- Mixed traffic operations of passenger trains and freight trains on an enhanced railroad network

While stations on a light rail system may be spaced at one-half mile to two-mile intervals, commuter rail stations are commonly placed at five to ten miles of separation. This is required for adequate high-speed operation providing sufficient travel times to serve the function of the commuter rail transit trip to move people who live long distances from the city into the urban core.

Figure B-1: FRA-Compliant Commuter Rail in Fort Worth, TX

Figure B-2: Patrons at a Commuter Rail Station in Fort Worth, TX

Figure B-3 shows example system maps of commuter rail systems that can be found in Chicago, Boston, and Los Angeles from left to right below.

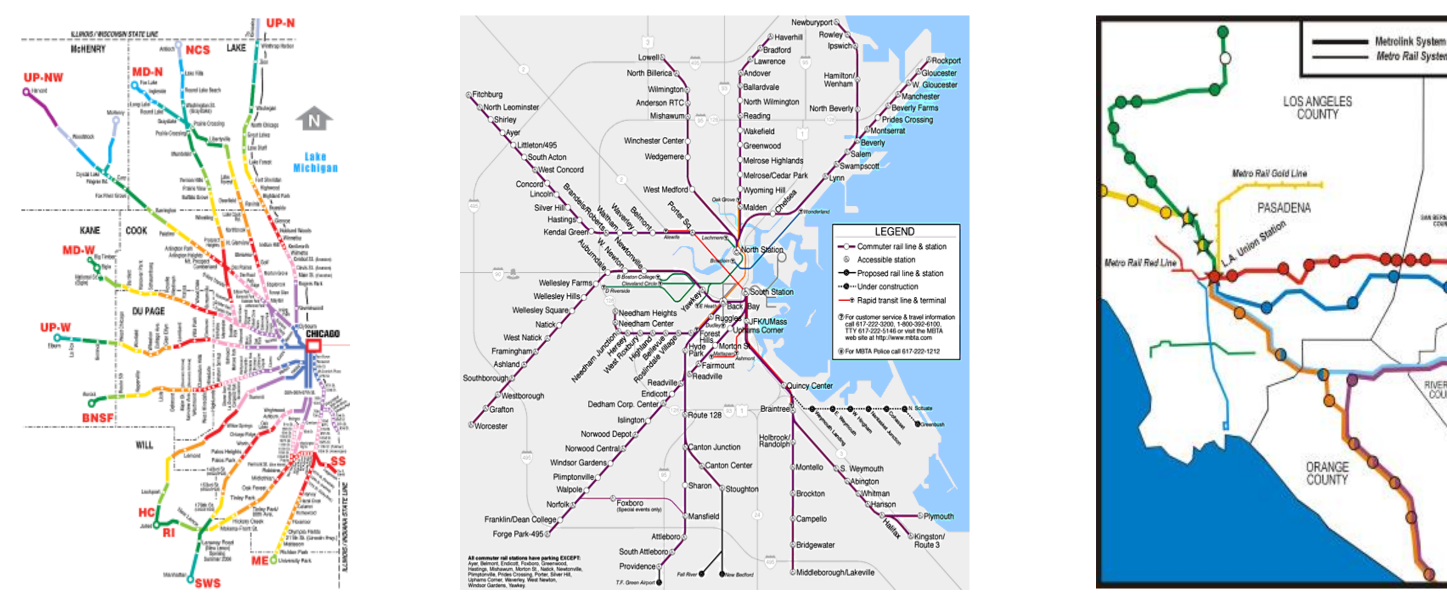


Figure B-3: Commuter Rail System Maps in Chicago, Boston, and Los Angeles

These cities have experienced growth and urban density of the type Houston is experiencing. They have been building long distance commuter rail for a number of years. Los Angeles recently began to aggressively build a regional commuter rail system about 20 years ago, shifting from their more auto-dominated patterns like that of Houston. The reason for their decision was in part due to the amazing growth that was experienced. The implications of Houston's future growth trends are no less daunting from a transportation perspective than were those of Los Angeles.

B-1.2 Growth Trends Conducive to Commuter Rail

The way the Houston Metropolitan Area absorbs its rapidly growing population will have a direct impact on its citizens' quality of life. Recent studies, such as those necessary to complete the 2035 RTP, have highlighted the major problems that this region will face in serving the expanding suburban ring of development with an efficient roadway system.

In light of these very difficult congestion issues, the recent Envision Houston workshops allowed residents to give insight on how they want their city to develop. Citizens chose from three growth options: trend (low density), moderate (medium density), and compact (high density). At the end of these workshops, there was a general consensus that citizens wanted to see more compact, high density growth over the current trend of sprawling, low density growth. The images below illustrate a comparison of these two growth scenarios.

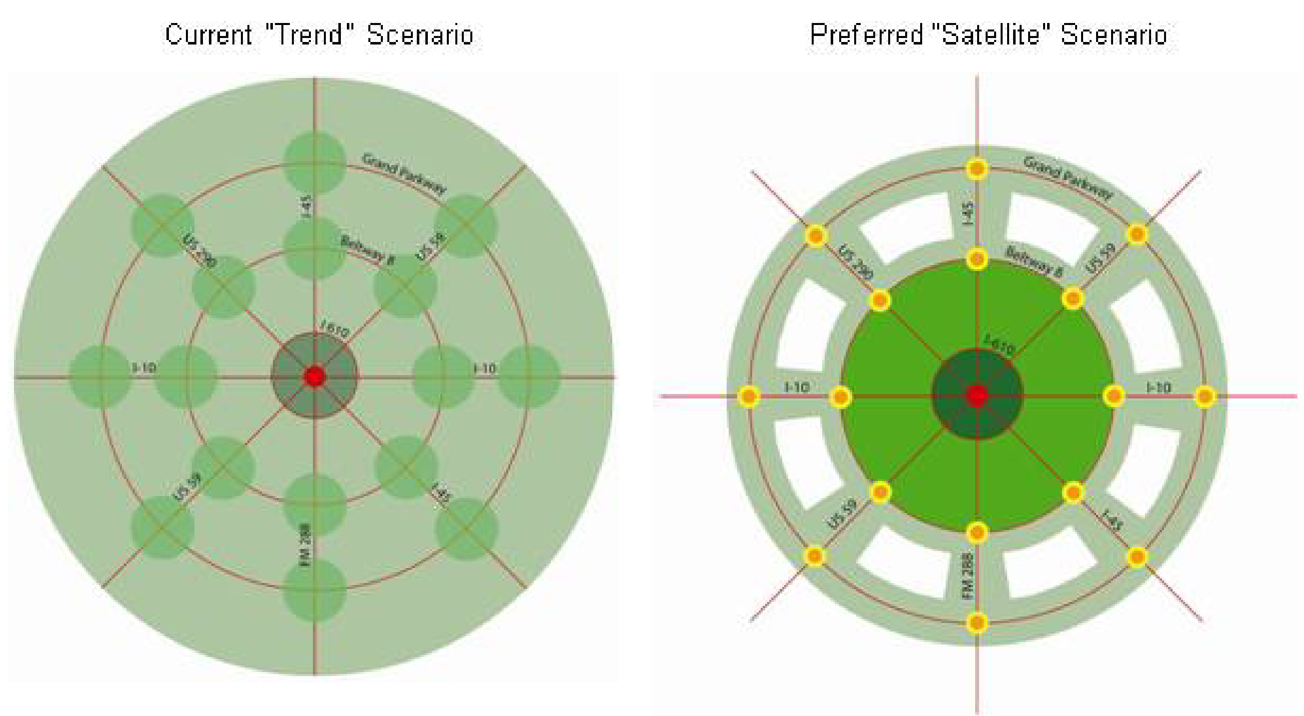


Figure B-4: Alternative Regional Growth Scenarios

The darker colors represent higher densities of development. With a "satellite city" scenario, less land is consumed (more white area), there is a higher overall density of development (darker greens), and higher densities at the major intersections of multimodal transportation corridors (orange and yellow).

In general, the "current trend" growth scenario shows less density of development spread over a larger area. Envision Houston's preferred satellite city growth scenario is being developed further through H-GAC's "Livable Centers" initiative currently underway.

In the satellite city scenario, Houston is projected to have as many as 5 regional employment/activity centers employing 100,000 or more with 5 additional centers in the 60,000 to 100,000 range, and 10 suburbs with populations over 50,000 by the year 2025. These activity centers are to be dispersed over an 8 county region and will not reach their full potential without the proper transportation infrastructure to support and connect them.

Commuter rail is particularly conducive to the preferred "satellite" development scenario since commuter rail stations are integrated into these denser communities and urban centers allow a large number of people to commute from center to center without ever having to travel on the congested freeways. A long distance commuter rail system connects and integrates these dispersed activity centers in an efficient and cost-effective manner while strategically removing commute trips from the most constrained sections of our freeway and tollway system. No matter whether the Houston region continues sprawling outward toward a distributed suburban ring or develops in a more clustered pattern, the role of commuter rail will be very important for sustainable edge communities.

B-1.3 The Commuter Rail Trip

There are three segments of a commuter rail trip:

1. Origin to station,
2. Station to station, and
3. Station to destination.

To make commuter rail successful in Houston, all three segments of this trip must be integrated and easily traversed. While the origin-to-station and station-to-destination segments are much shorter in distance than the commuter rail station-to-station segment, they are all equivalent in importance. **Figures B-5** and **B-6** illustrate the key elements that comprise a commuter rail passenger experience.

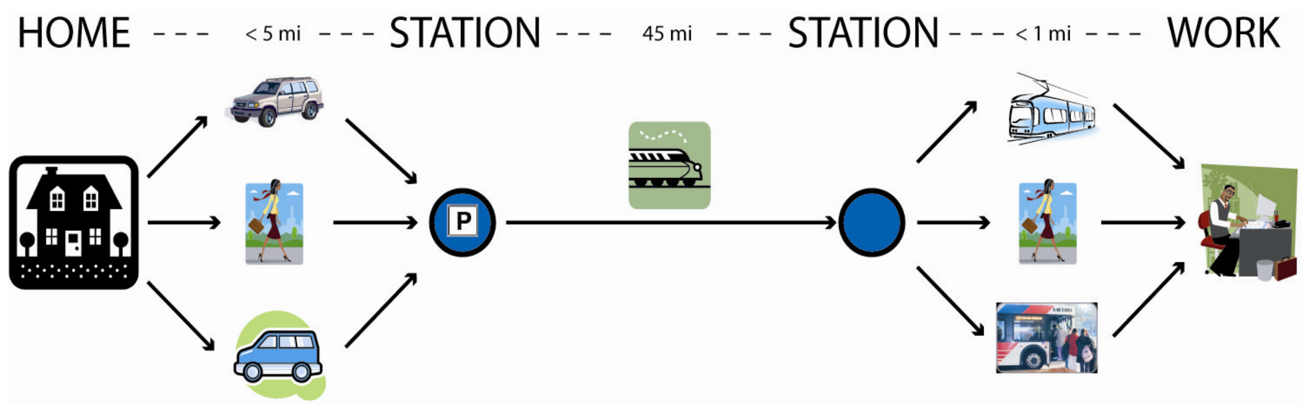


Figure B-5: The Segments in a Commuter Rail Trip

For a typical commute trip, the origin is a place of residence and the destination is a place of employment. From their residence; a person may choose from multiple modes of transportation to reach the commuter rail station. These include walking, biking, taking the bus, carpooling, or driving a personal vehicle. The same is true for the segment from the station to the place of employment which typically involves walking or a form of public transit. For both of these segments, it is vital that all modes of transportation are integrated with carpools, the urban Light Rail Transit (LRT) system, buses, and Bus Rapid Transit (BRT) routes taking passengers to and from the nearby commuter rail trains.

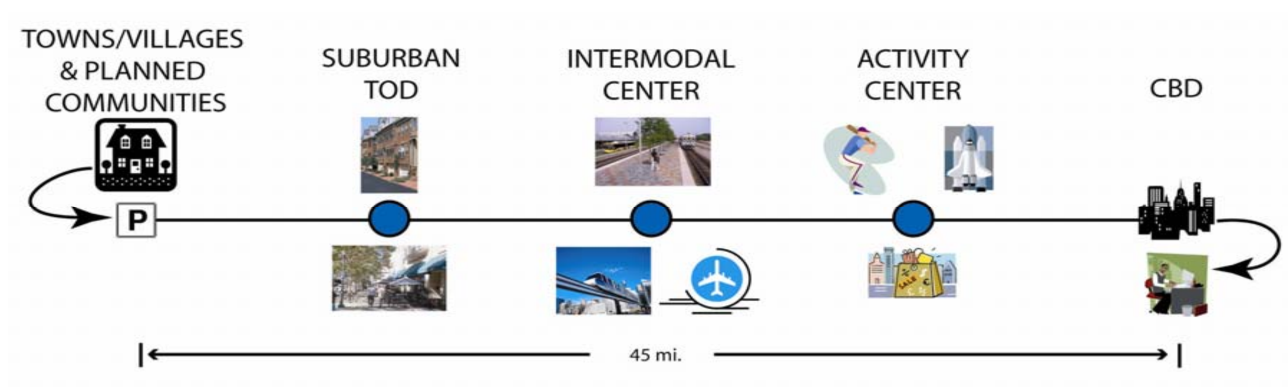


Figure B-6: A Typical Commuter Rail Trip

The decision a passenger makes when choosing to commute by rail relies heavily on the proximity of the ultimate destination to the commuter rail station, since there is not often a personal car option at the end of the trip. Commuter rail stations are therefore best situated in or adjacent to densely developed areas such as the major urban districts and employment centers. The Houston region must begin planning now to ensure that the infrastructure surrounding a future station can support the naturally induced development that is likely to occur. Typical developments include master-planned transit oriented developments (TOD), intermodal centers, activity centers (sporting venues, convention centers, medical centers, shopping centers), and business districts/major employment centers.

Table B-1 provides some examples of existing or future high density developments in the Houston Metropolitan Area that could generate high ridership if adequately served by a commuter rail line:

Table B-1: Examples of High density developments within the H-GAC Region

Urban Districts [1]	Major Employment /Activity Centers	Perimeter Communities
Houston CBD	Bush Intercontinental Airport	Katy
Texas Medical Center	Port of Houston	Woodlands/ Conroe
Uptown/Galleria	Hobby Airport	Sugar Land / Missouri City
Greenspoint	NASA Space Center/Clearlake	Richmond/Rosenberg
Greenway Plaza	Memorial City Mall/Medical Center	Tomball
Westchase	University of Houston - Central	Waller/ Hempstead
Energy Corridor	Reliant Stadium Complex	Cleveland
		Pearland
		Galveston/League City
		Cypress/Jersey Village

1. These urban districts have specific management entities, are quite dense, and have a diverse blend of employment, retail, and residential land uses.

As transit oriented development grows in popularity, a potential rider could actually live and work close to the station on both ends of a commute trip. But even if the home end involves a drive to the station, and the work end involves use of another transit mode, a commuter rail user chooses the train because it provides a superior service than a trip made entirely in a personal vehicle. Typically, this "superior service" means being able to stay off the congested highways allowing the traveler to reach a destination in a timely manner even during the peak hour, and with a consistent travel time every day. Ideally commuter rail lines would balance the travel demand between the various modes available for the commute trip by providing a very good alternative to driving along congested freeways.

CHAPTER B-2 - DEFINITION OF REGIONAL COMMUTER RAIL

Commuter rail will be a very important part of our transportation future here in the Upper Gulf Coast of Texas. However, it is only one part of the total solution that we are pursuing for the Houston Metropolitan Area. A variety of the other transit technologies and types of transit service (also referred to herein as transit "modes") will play equally important roles over the course of time. It is therefore important to articulate the differences between these modes when developing a base case line concept for a regional commuter rail system.

The discussion that follows first addresses a definition of commuter rail in part by comparison to other transit modes. Although the terminology and definitions given may not be universally applicable, for the purposes of this report a specific set of modal definitions are given.

Following the definition of transit modes, the discussion turns to what are identified as the "transit realms" that exist within the region (including the areas that are beyond the 8 county area limits of this Commuter Rail Connectivity Study). With respect to these transit service realms, the discussion addresses the functional purpose that a long distance commuter rail mode would play and how that is distinguished, in particular, from other rail modes that are anticipated to also evolve in Houston.

Finally, the chapter includes an example of the US 290 / Hempstead Corridor as a multimodal corridor where multiple new transit modes will be required to meet the transportation needs over the next 20 years and beyond. This corridor example is indicative of the needs that many other corridors in Houston will experience over the long term.

B-2.1 Comparing Transit Mode Technologies

The definition of the commuter rail transit mode is best understood through a comparison with other transit modes, some of which we are already familiar here in Houston and some with which we are not. From this comparison, a clearer understanding is obtained of the distinguishing role that long distance commuter rail will play. Consider the following definitions of the various transit modes.

B-2.1.1 Local Bus Routes – This is a familiar transit mode that Houston METRO has aptly provided for many years. The local bus routes will continue to evolve as regional rail transit develops within the major corridors radiating out from the center of Houston. Over time, some local bus routes will be adjusted to function more as "feeder" bus routes, a functional application where buses circulate within the communities with routes configured for the specific purpose of bringing passengers to station sites for access to high-capacity transit, including long distance commuter rail.

B-2.1.2 High-Capacity Transit – The general classification of high capacity transit can be applied to a variety of technologies, such as Bus Rapid Transit, Light Rail Transit, or Mini-Metro systems all operating in dedicated right-of-way. Light Rail Transit (LRT) is already in service in Houston as the Main Street Red Line. METRO is expanding this system throughout the urban core of the City. LRT will continue to play an essential role within Houston's rail transit network (see **Figure B-7)**.

All other modes, including commuter rail, will need to interface with the LRT system. Although capable of relatively high speed applications, LRT, as it is currently being deployed within the urban core of Houston, runs in mixed operation with roadway traffic. In other words, LRT in Houston travels both in dedicated lanes along the street system over a portion of the route, and in shared lanes with vehicular traffic over the remainder of the route. Overhead electrification is common for this mode, although diesel-electric hybrid vehicles that do not require this feature are also possible.

Bus Rapid Transit (BRT) is also being planned, initially in the form of the Signature Bus component of the METRO Solutions Plan. Examples of BRT are provided in **Figures B-8** and **B-9**, one already in service and the other shown in conceptual form. One of the key elements typically found in BRT systems is the priority given to the buses at signalized intersections, a feature applied today in the LRT system along Main Street. It is anticipated that BRT technology will be applied both in corridor applications as well as in circulator system applications within moderate to large Urban Districts.

Figure B-7: Houston's Main Street LRT

Figure B-8: Wilshire Blvd BRT in LA

Figure B-9: San Diego BRT Concept

The high capacity transit technology identified herein as "Mini-Metro" systems (also sometimes referred to in some applications as an Automated People Mover or APM system) was studied in the 2004 Advanced Technology Forum conducted by Houston METRO. One of the conclusions of the Forum was that this technology should be considered in the future for application as a circulator system within the largest of Houston's Urban Districts. This mode is not yet part of any specific plans of METRO or any specific urban district, although it has been recently studied in concept by Texas Medical Center as a future Circulator System, along with other technologies such as BRT. **Figures B-10** and **B-11** provide examples of this technology.

Figure B-10: Singapore Mini-Metro System

Figure B-11: New York City Mini-Metro System

B-2.1.3 Express Bus – One of the great legacies of Houston METRO has been the development of an extensive express bus system that connects park and ride lots throughout the region with Downtown and Uptown, a system which is unsurpassed anywhere in the country. This mode typically utilizes high occupancy vehicle (HOV) lanes, a type of facility also being called "managed" lanes when combined with single occupancy vehicles paying a toll for each use of the same dedicated roadway facility. In addition to Downtown, limited Express Bus service is also provided to other selected Urban Districts. The Express Bus system will continue to play a major role in the multimodal future of Houston, and is complementary to long distance commuter rail.

B-2.1.4 Suburban Commuter Line – A distinctly new transit mode which is currently being planned by Houston METRO is identified as the suburban commuter line mode of transit, for purposes of this study. Although this mode could be either bus or rail vehicles operating in dedicated rights-of-way (ROWs), it will be discussed in general as a rail mode.

Figure B-12: Suburban Commuter Line in Austin, TX

For rail vehicle applications under this mode, the technology is defined as a system utilizing lighter rail vehicles, either in the form of DMU (diesel multiple-unit) class or high-speed LRT class technology. An example of this technology is the new system being constructed in Austin, Texas as shown in **Figure B-12**. This technology is similar to an LRT system technology in that the track/guideway is essentially identical to LRT. Although electrification by wayside power rails or overhead electrification is common with this mode around the world, the application of diesel-electric hybrid propulsion systems eliminates the additional cost of electrification. An important distinction of this rail mode is that the vehicles are "non-FRA-compliant", meaning that these trains cannot operate on a rail network that is carrying mixed traffic with both passenger trains and freight trains in operation at the same time.

B-2.1.5 Commuter Rail – Finally, the rail transit mode on which this Regional Commuter Rail Connectivity Study has focused is that of FRA-compliant, diesel locomotive powered trains, often utilizing double-deck high-platform passenger cars in order to carry up to 1,000 people or more on a single train. These trains are certified by FRA to run in mixed traffic with freight trains. New designs for DMU class of FRA-compliant vehicles are being marketed, but current design of the DMU class of commuter rail is still new and relatively unproven. There are many commuter rail systems in service throughout the U.S., including the San Diego Coaster system shown in **Figure B-13**.

Figure B-13: The "Coaster" Commuter Rail in San Diego, CA

B-2.2 Service Characteristics of Transit Modes

In addition to the technology differences between the transit modes described above, distinctions are also relevant with respect to the different passenger service characteristics of each distinct mode. Service characteristics can be considered in a simplified manner in terms of the average travel speed accomplished through a given corridor and the length of trip for a typical patron whom the transit line is able to serve. Another aspect of service is the average headway between trains (typically a key aspect of level-of-service, or LOS criteria); however, this parameter is a function of the required train scheduling needed to serve a given corridor's specific ridership demand. Although commuter rail's headways are longer (typically 20 to 30 minutes between train departures), commuter rail patrons become accustomed to taking a specific train every day and only arrive at the station a few minutes before their train departs. Therefore, headway with respect to commuter rail operations is not a critical point of defining service level, and will not be addressed here for general comparison between modes.

Table B-2 illustrates the different characteristics for the modes in comparison. Commuter rail can be seen to be functionally different in that it is intended for long distance travel with large spacing between stations, as compared to the modal alternatives of Express Bus or suburban commuter lines, both of which also serve commuter home-to-work trips but have shorter station spacing.

Table B-2: Transit Mode Level of Service Characteristics

Transit Access Facilities by Mode	Typical Distance Between Access Points	Typical Total Trip Distance of Patrons
Local Bus Stops	0.1 miles	2 – 3 miles
High Capacity Transit Stations • Urban District Circulator • Urban LRT	 0.25 – 0.5 miles 1 – 2 miles	 1 – 2 miles 5 – 10 miles
Express Bus P&R Lots	5 miles	10 – 15 miles
Suburban Commuter Line Stations	2 – 5 miles	15 – 30 miles
Commuter Rail Stations	5 – 10 miles	30 – 60 miles
NOTE: These characteristics are anecdotal, based on the experience of the consultant.		

One of the important distinctions between the modes has to do with the correlation of length of the line and the distance between station stops. The closer the station stops, the more time a train will spend stopped in stations. The result is that the average travel speed along the route generally increases from top to bottom for the modes given in the table above, with commuter rail providing the highest average travel speed. This means that for very long distances of 30 miles, 60 miles, or greater, only the long distance commuter rail mode can provide a sufficient level of service for most transit patrons. In other words, if the frequency of station stops on a long distance line increases to the frequency of stations common for the suburban commuter line (i.e., 2 to 5 miles apart), then the time to travel the longer distances (i.e., greater than 30 miles) becomes too great and the mode choice of the patron will shift away from transit. For the shorter commuter trips of less than 30 miles, however, transit patrons are usually willing to travel with more frequent station stops until they reach their destination.

The conclusion of the discussion above is that for the Houston Region, there is a distinct "realm" of service for long distance commute trips which is best served by FRA-compliant trains with station stops that are spread much further apart – this is the key factor when distinguishing commuter rail from suburban commuter lines. **Figure B-14** illustrates these points.

An excellent example of a suburban commuter line is the new rail line that Capital Metro is implementing for the Austin region. **Figure B-15** shows the alignment that will connect Downtown Austin with the town of Leander on the north side of the Austin metropolitan area. The total length of the line is 32 miles, and there are nine stations along the route. The technology that is being applied is configured as a DMU (hybrid diesel-electric) class vehicle as shown in **Figure B-12** earlier.

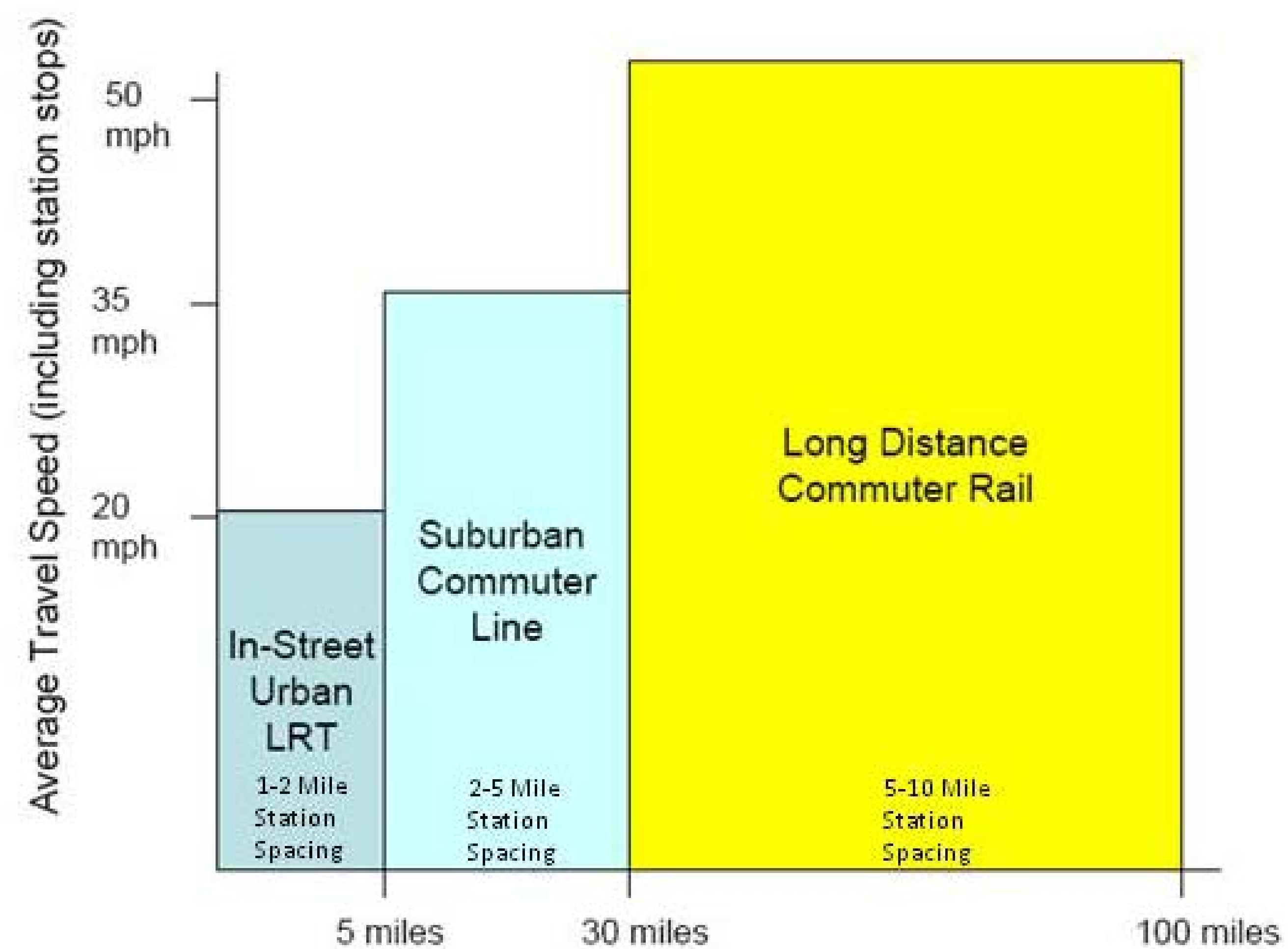


Figure B-14: Trip Length as a Distance from the City Center

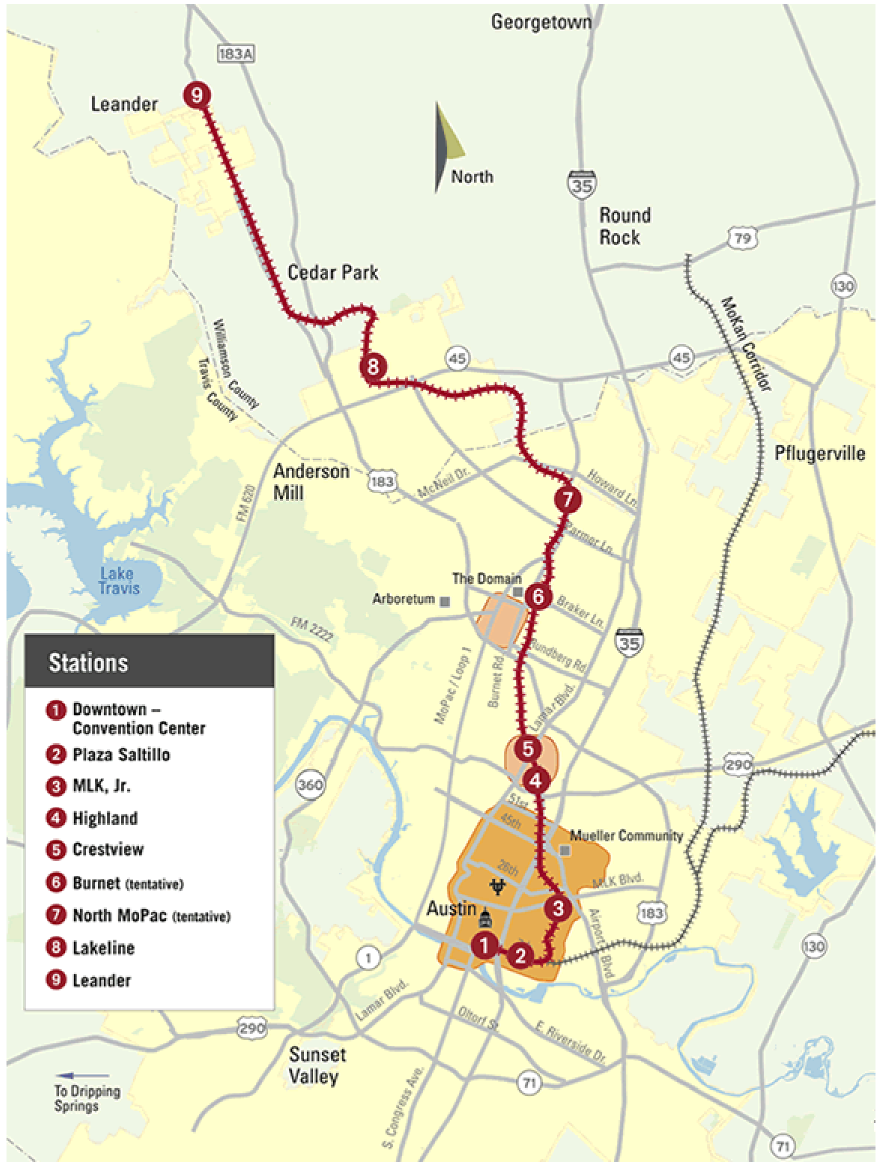


Figure B-15: Capital Metro Suburban Commuter Line Route in Austin, Texas

B-2.3 Transit Mode Service Realms

It is beneficial to discuss the functional purpose of long distance commuter rail as it penetrates through the progressively denser areas into the core of the city. A fundamental premise of this study is that a high quality regional commuter rail service should directly connect to a station in the vicinity of each major urban district within the urban core. Other transit mode infrastructure must also be present to complete the connectivity needed by the commuting transit patron.

The urban area can be viewed as concentric realms of transit service – that of the urban core, the Suburban Ring, and the Exurban Outer Region. Within these transit realms, the distances and density of development lead to variations in the application of transit technology as depicted in **Figure B-16**.

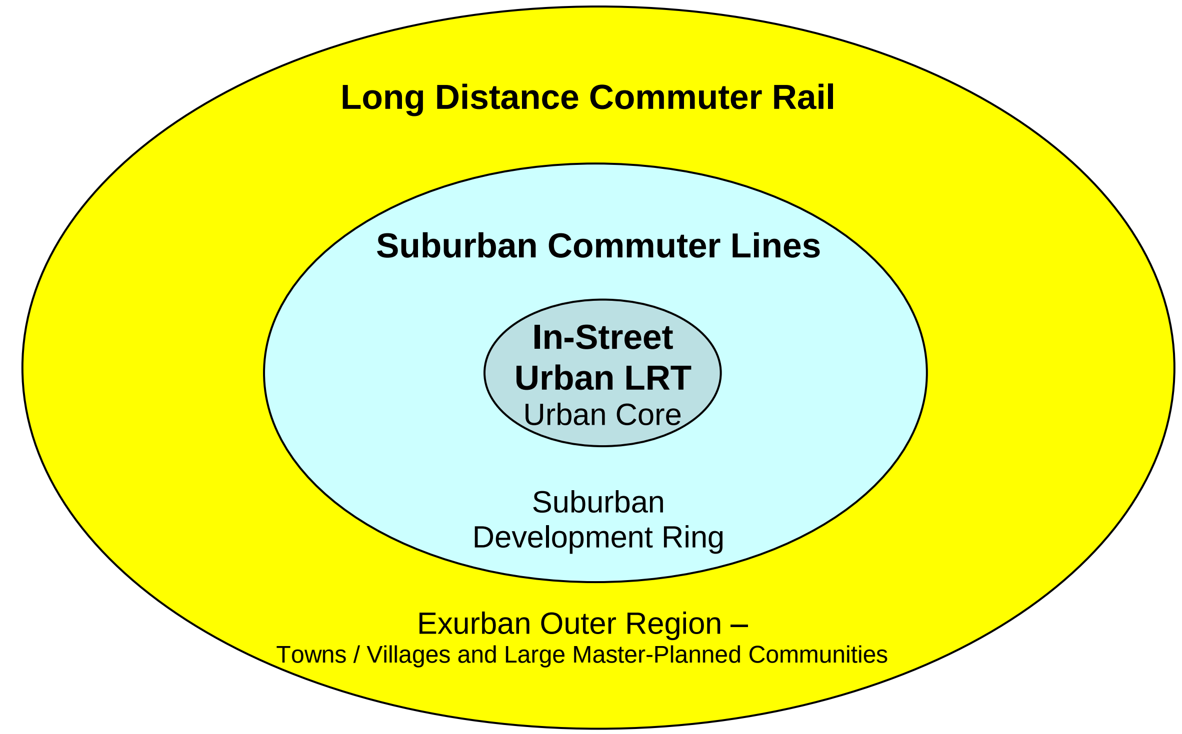


Figure B-16: Three Realms of Transit Service

Between these three realms, there are a variety of transit modes/technologies that could be applied in Houston. The rail technologies defined previously as Light Rail, suburban commuter line, and commuter rail in particular will all have important roles to play within the three transit realms. Although this graphic is certainly a simplistic representation of the different functional applications of the technologies described, it is useful to explain the basic compatibility of all the modes as they work together to form a well-integrated multimodal transit system.

Figure B-17 shows how commuter rail, traveling from long distances outside the city, will penetrate through the Suburban Ring and into the urban core to reach the Urban Districts where many people work and live. In contrast, the suburban commuter lines commonly are designed to interface with the Light Rail system that runs throughout the urban core, often connecting at the point where they meet along the boundary of the urban core and the Suburban Ring.

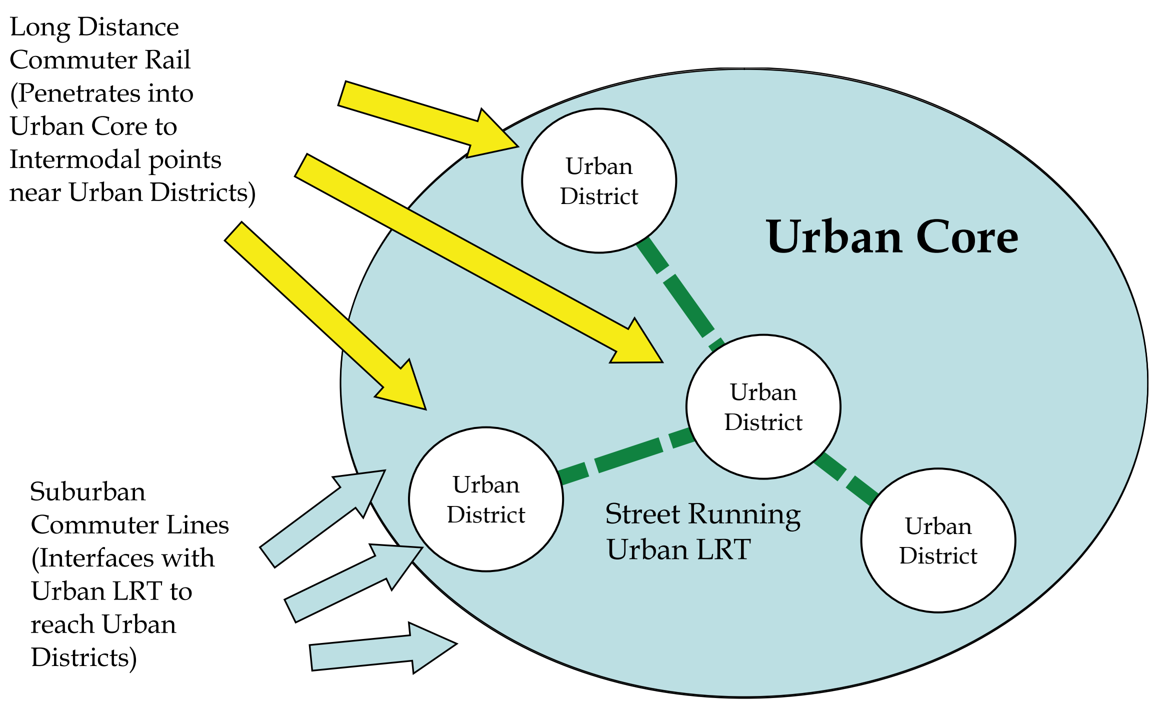


Figure B-17: Connectivity of Commuter Rail and Suburban Commuter Lines

It is important to note that the different transit technologies/modes which are applicable to the different transit realms may actually run in parallel within portions of some travel corridors. This is often required in order to provide adequate levels of service for all patrons throughout the corridor, as discussed above in terms of the frequency of station stops and the resulting impact on average travel speed. This multimodal aspect is discussed further in the section that follows.

The connectivity between long distance commuter rail and the various modes must be efficiently accomplished at the edge of the Urban Districts at stations well inside the urban core. This aspect of "Urban District Connectivity" is addressed in Chapter Three of this Appendix.

B-2.4 Example of Commuter Rail in a Multimodal Corridor

Previous transportation studies have provided important insight into Houston's need for multimodal solutions within major travel corridors. In particular, TxDOT has conducted a series of studies of the US 290 / Hempstead Corridor (see **Figure B-18**) beginning with the Major Investment Study (MIS) that determined the locally preferred alternative for transportation improvements throughout the corridor.

A key conclusion drawn from the MIS project was that the US 290 / Hempstead Corridor will not perform adequately over the long term (20 years and beyond) unless a comprehensive multimodal plan is executed throughout the corridor. This plan now includes freeway improvements, a parallel tollway – generally along the Hempstead Highway alignment, arterial roadway improvements, as well as high capacity transit.

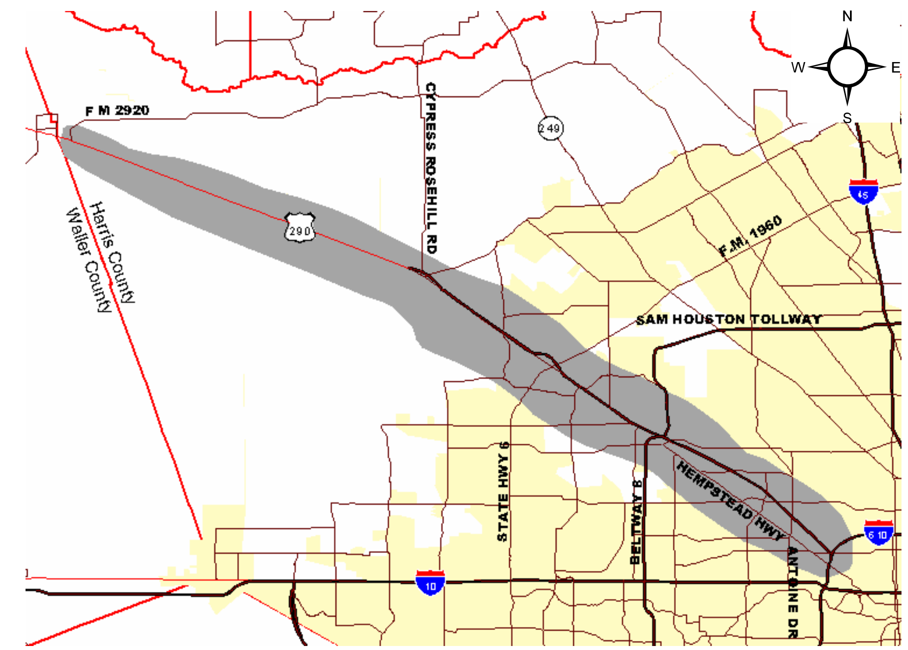


Figure B-18: TxDOT MIS Study Limits for US 290 / Hempstead Highway Corridor

Unless all of these facilities are built to synergistically provide sufficient capacity, the corridor will continue to suffer from major congestion problems even after major infrastructure investments are made. Through the initial stages of the MIS, TxDOT began to recognize the critical importance of all other modes being provided, in addition to the new freeway facilities.

Following the conclusion of the MIS, further study of the corridor by TxDOT affirmed the conclusion of the MIS work which called for a multimodal solution.

Specifically, a recently completed study of future operational conditions throughout the 20 miles of corridor between Loop 610 and Highway 6 has confirmed that in a 20 year timeframe of expected growth in demand, adequate levels of service cannot be sustained throughout the corridor in the peak periods of the day without a combination of:

- new capacity added to the freeway system
- new tollway managed-lane facilities
- new high capacity transit service

The focus of the study was a comprehensive multimodal operations analysis based on the H-GAC travel demand forecasts, so the results are consistent with the basis of all freeway specific planning studies. If all major new infrastructure described above is built within the corridor, along with strategic capacity enhancements along Loop 610, the analysis showed that TxDOT's LOS goals for traffic operations could in fact be adequately achieved in the year 2025. The TxDOT study noted in particular that adding the new transit infrastructure within the multimodal corridor was critically important to achieving this goal.

The TxDOT corridor operational analyses were based on the goal of shifting a percentage of travel demand to the high capacity transit on a uniform basis throughout the corridor. Relevant to this study of a regional commuter rail system was the TxDOT study's assumption that transit mode choice would be equally necessary for person-trips of over 30 miles length (e.g., from Waller to Downtown) as it is for person-trips of under 30 miles length (e.g. from Beltway 8 to Downtown).

Consistent with this commuter rail study's assumptions of concentric transit realms, as described above, the TxDOT study allowed for both long distance commuter rail service through the corridor, as well as suburban commuter line service within the same corridor which would serve trips in the portion of the corridor that are closer to the urban core of the city. In particular, the suburban commuter line served multiple stations between Beltway 8 and Loop 610, whereas commuter rail did not. **Figure B-19** illustrates the assumptions made in the TxDOT operations study, with some practical overlap of service near Beltway 8.

In the TxDOT study, the assumptions defining the exact service limits of the suburban commuter line, as compared to that of versus the long distance commuter rail were purely hypothetical. However, it was a fundamental assumption of the analysis that the long distance trips served by commuter rail service would allow travel all the way to the Downtown area without transfer to another mode.

An intermodal transfer provision at Loop 610 was assumed to provide connectivity with Uptown/Galleria via a short trip on the Urban LRT line. Thus, the multimodal corridor would have commuter rail and the suburban commuter line both running in parallel through the corridor for segments near and inside of Beltway 8, but only the suburban commuter line would have multiple station stops along the length of corridor and thereby serve person-trips originating inside Beltway 8.

This example of the US 290 / Hempstead Corridor's eventual deficiency in capacity, requiring transit to be built in parallel to the freeway and tollway facilities is indicative of conditions that will likely occur over time within all radial transportation corridors penetrating the urban core.

However, it may not be realistically possible in some corridors to provide both FRA-compliant commuter rail services as well as a non-FRA-compliant suburban commuter line (such as may be the case in some corridors due to conditions of highly constrained right-of-way). These cases of single rail-mode corridor solutions will need to be determined on a case by case basis as regional planning studies advance in the years to come. For the purposes of this H-GAC study's goal of defining a conceptual base case commuter rail system, it is assumed that most corridors will eventually justify both long distance commuter rail service and suburban commuter line service, as was concluded in the TxDOT study of a multimodal US 290 / Hempstead Corridor.

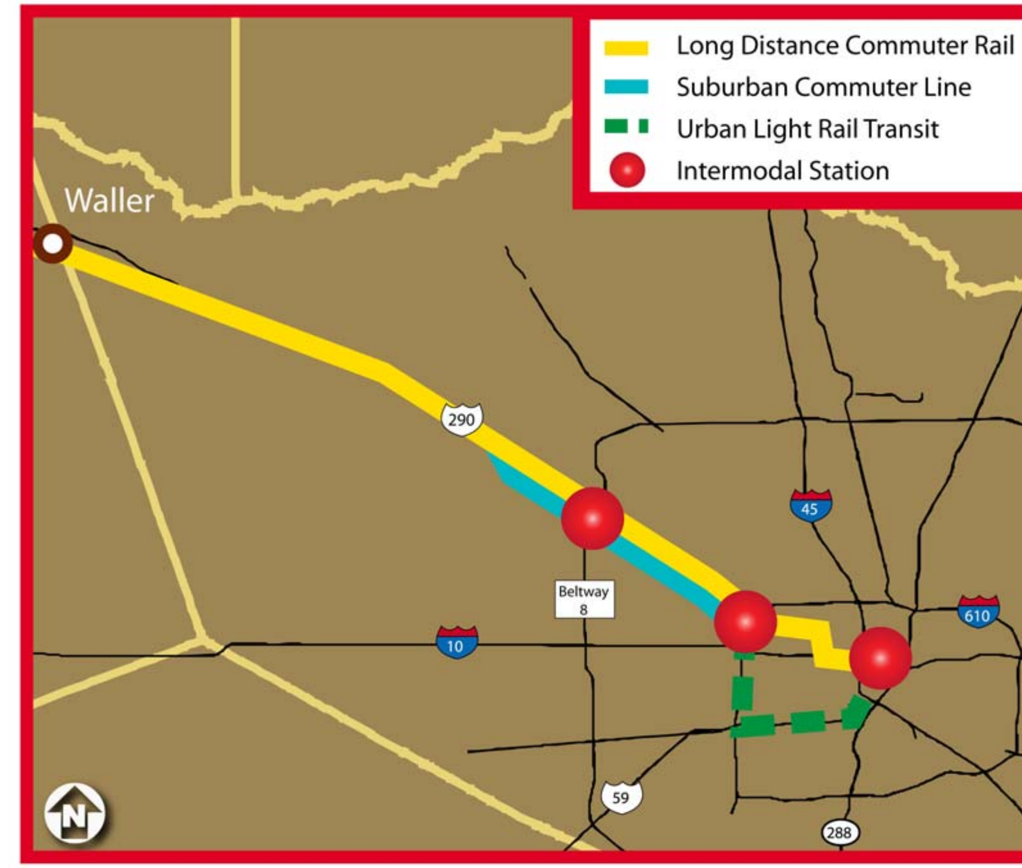


Figure B-19: TxDOT Multimodal Operational Analysis Transit Modes along US 290 / Hempstead Corridor

CHAPTER B-3 – URBAN DISTRICT CONNECTIVITY

The most important aspect of "connectivity" for long distance commuter rail is the transit accommodations at the station location nearest to the ultimate destination of the commuter's trip. As depicted in the illustration in **Figure B-20** below, access to the station on the home end of the trip is typically characterized by travel via personal automobile (or by bicycle / walking in new communities designed as transit oriented development – TOD). However, the office end of the trip is commonly characterized by a need for convenient local transit service or good pedestrian connections, since without these provisions the potential transit patron would probably choose to drive his or her car to work.

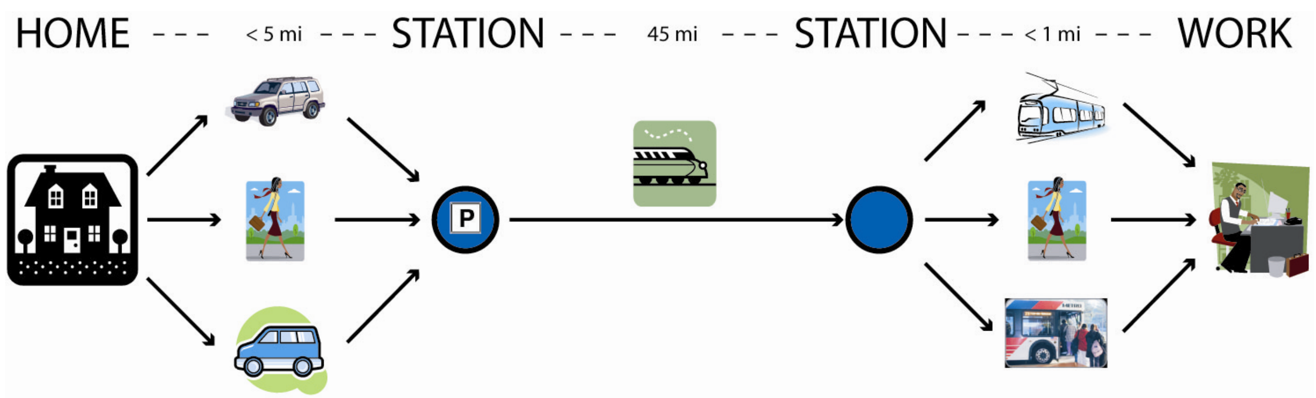


Figure B-20: The Segments in a Commuter Rail Trip

In order to assess the connectivity options at the major Urban Districts within the urban core, specific consideration has been given to five Urban Districts:

1. Downtown,
2. Texas Medical Center,
3. Uptown / Galleria,
4. Greenway Plaza, and
5. Greenspoint (with connections to Bush Intercontinental Airport).

There are certainly other major business districts within the Houston Metropolitan Area, but these five were chosen as the most dense and significant employment destinations currently in existence within the center of Houston.

Consideration has been given to potential commuter rail station locations in proximity to these selected urban districts. **Figure B-21** illustrates station locations serving Greenway Plaza, Uptown/Galleria, and Downtown, which are along a major railroad corridor and which have intermodal connectivity to the Urban LRT System currently being implemented. However, during the period of this study's work, these Urban Districts have not yet finalized their exact interfaces with the Urban LRT system, since the design is still under active development by METRO.

Therefore, an approach has been used that focuses on the other two selected Urban Districts as conceptual examples of good connectivity solutions for both a low density major Urban District and a high density Urban District. The two examples are conceptual development plans provided by Greenspoint (a relatively low density Urban District) and by Texas Medical Center (a very high density Urban District), both with local transit infrastructure that can be adapted to provide long distance commuter rail connectivity within the Urban District.

When analyzing the suitability of connectivity within a district, the following points have been considered.

1. Proximity of the corridors with long distance commuter rail service.
2. Suitable location(s) for a commuter rail station near the Urban District.
3. Sufficient means of moving commuter rail passengers into the heart of the Urban District, especially when considering the potentially large surge flows from commuter trains.
4. The overall multimodal connectivity within the Urban District (Urban LRT transit, pedestrian system, local bus routes, etc.).

B-3.1 Greenspoint / Intercontinental Airport Example

The Greater Greenspoint Management District has been developing and maintaining a local Mobility Conceptual Plan as the area has grown dramatically, and as major new transportation infrastructure has been conceived in recent years. Of particular note is the plan to ultimately extend the METRO LRT System to reach the Bush Intercontinental Airport. This will involve a future extension of the North Line, since the first construction phase of the line will not reach Greenspoint.

The conceptual plan for Greenspoint District is shown in **Figure B-22**, with the LRT line indicated by the dashed blue line passing through middle of the district, and on the north side turning east to extend to the airport (the airport is not shown in this graphic). The master plan has conventional buses operating on local three circulation routes, with connection to the proposed commuter rail intermodal station at the northeast corner of the District. This conceptual commuter rail station is on the Palestine Railroad Subdivision that runs in parallel with the Hardy Toll Road Corridor.

B-3.2 Texas Medical Center Example

A similar conceptual plan for the Texas Medical Center (TMC) also has a circulator system that provides good connectivity to the heart of the urban district. In this case, the size and density of the district (which has been likened to that of Lower Manhattan), combined with the sheer volume of people to be conveyed from the commuter rail station into the Urban District, would likely require a circulator system that has a reasonably high capacity. The conceptual plan that has been contemplated by TMC is shown in the figure, with a conceptual aerial guideway system forming two loops – one connecting the Main Campus on the north with the newly developing South Campus, and the second interconnecting system serving the east-west Mid Campus area. The conceptual commuter rail station shown in the graphic is on the Popp Railroad Subdivision (which is configured currently as an industrial lead track). This railroad subdivision runs alongside FM 521 to the south of 610 South Loop. The conceptual commuter rail station, shown in **Figure B-23**, provides an example of excellent connectivity for purposes of this study.

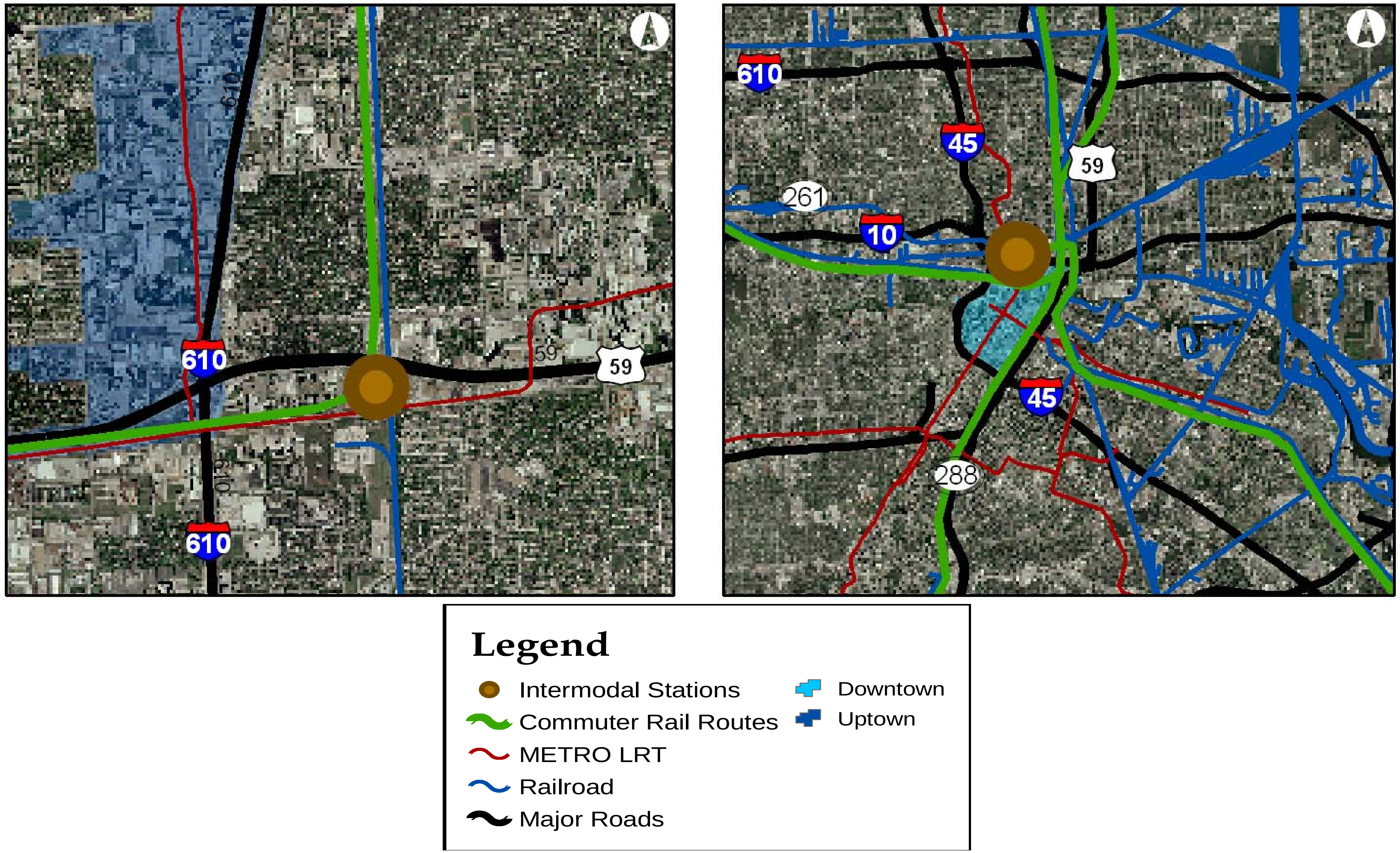


Figure B-21: Potential Commuter Rail Station Locations

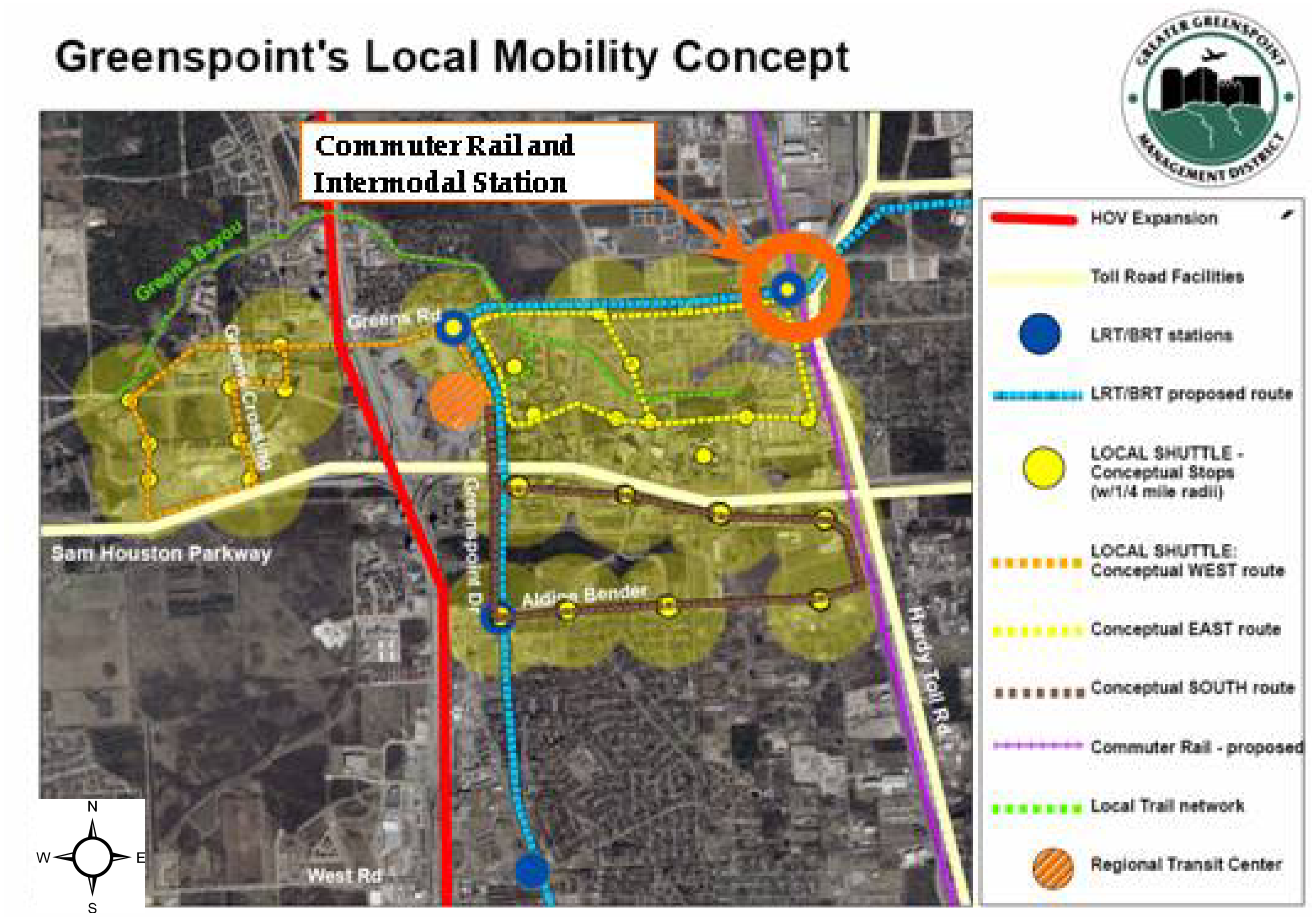


Figure B-22: Greenspoint District Conceptual Mobility Plan

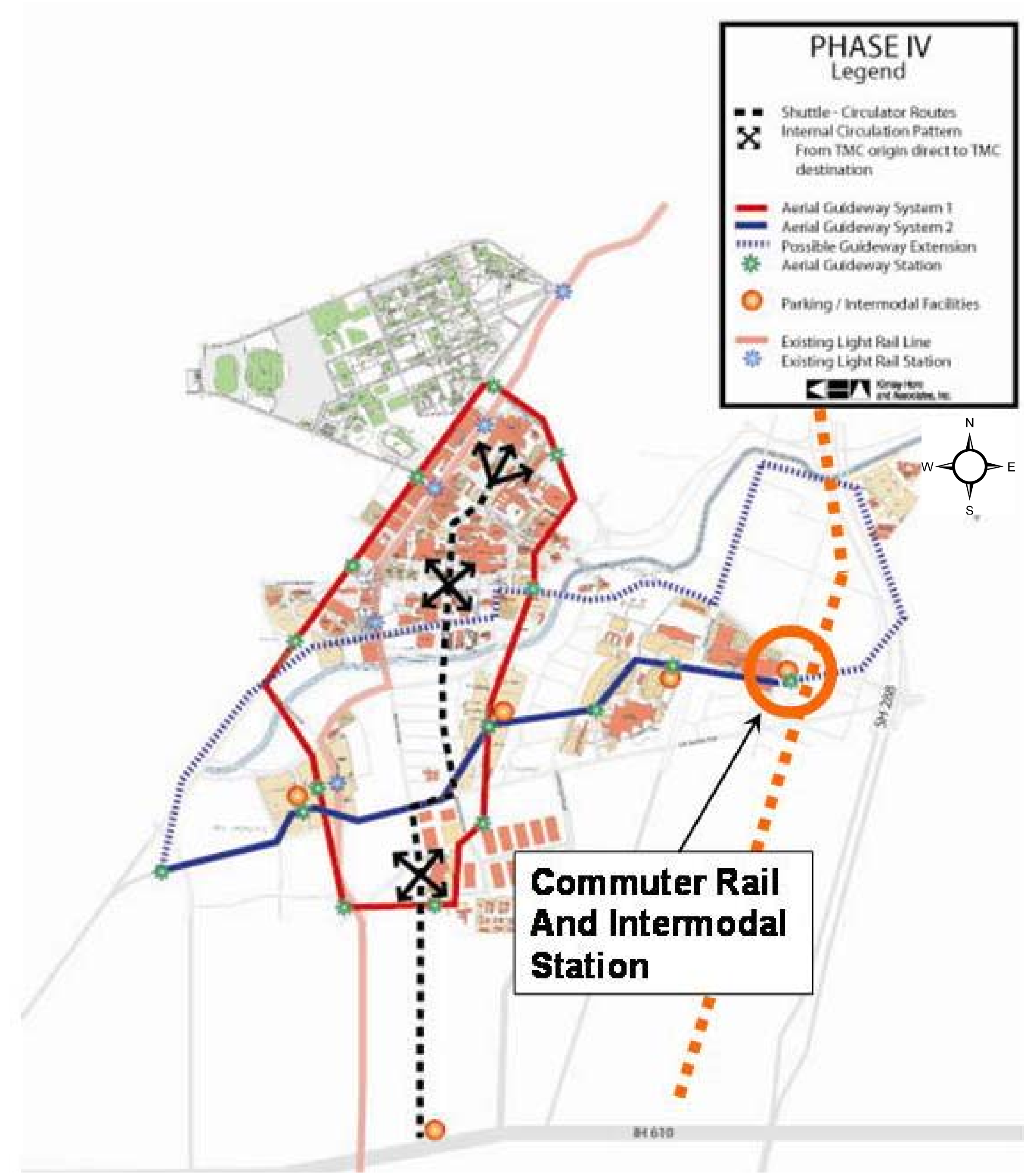


Figure B-23: Texas Medical Center Circulator Conceptual Definition Study
(Currently Not Formally Adopted by TMC)

B-3.3 Generic Concept for Urban Center Connectivity

The examples described above of a low density and a high density Urban District are representative of the range of conditions that other major urban districts will have to address when connecting transit and pedestrian links to a nearby commuter rail corridor. From these examples a generic concept can therefore be described.

Figure B-24 illustrates the essence of the required intermodal transit interface between a regional commuter rail system and a major Urban District. The examples of Urban District connectivity cited above show a very important functional role for a dedicated transit circulator system. Such a circulator system provides the critical transit connections allowing commuter rail patrons to move from the intermodal station on the edge of the District to their ultimate destination within the Urban District. It is also noted that in the Houston / Gulf Coast climate, the provision of a suitable transit interface with a pedestrian system within each Urban District that provides appropriate weather protection features (such as the Downtown tunnel system or the TMC pedestrian sky bridge system) will substantially improve the prospects of commuters choosing transit as their preferred travel mode.

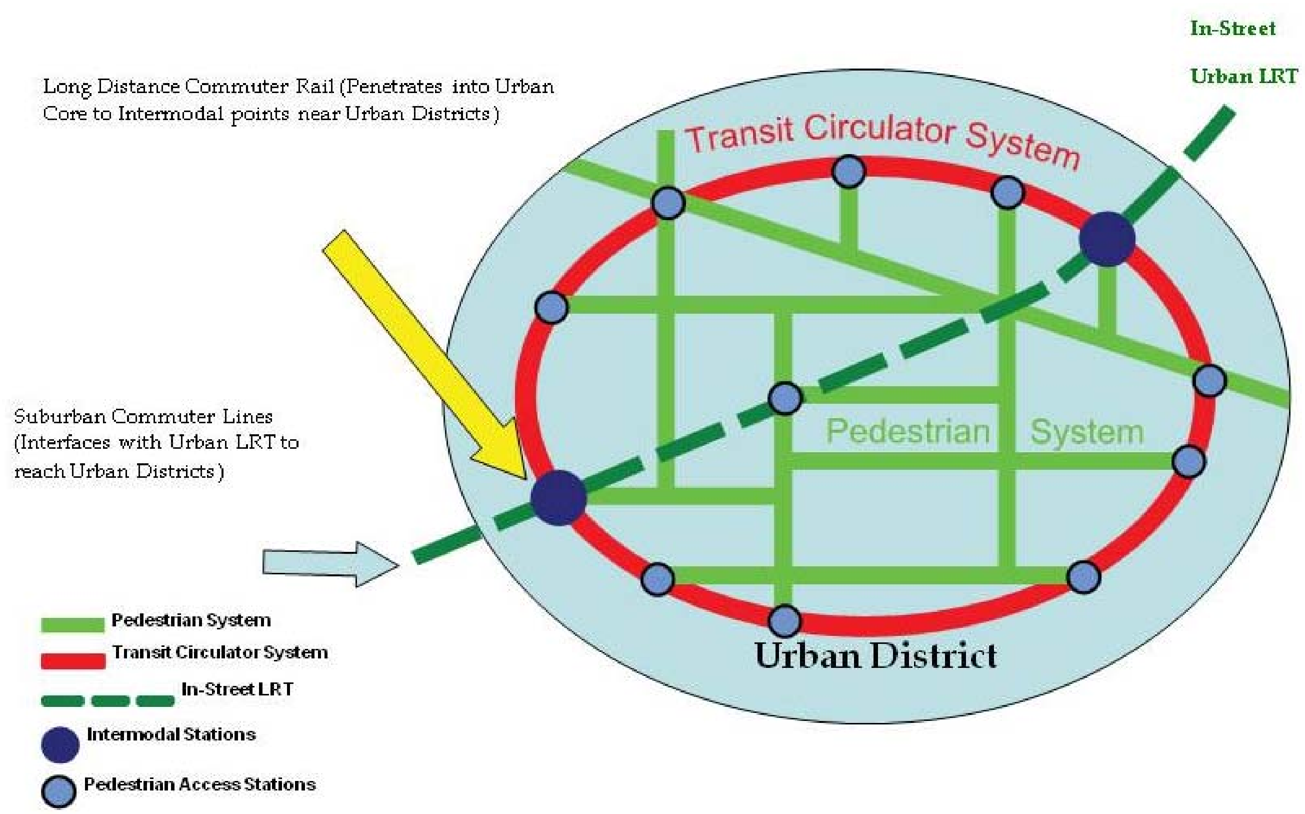


Figure B-24: Interconnectivity within the Urban District

It is therefore concluded that good connectivity between a regional commuter rail system and a major Urban District will depend on effective intermodal interfaces with the Urban LRT system, as well as a convenient pedestrian system. It is also believed that an effective transit circulator system must also be deployed in the largest Urban Districts.

In addition to a long term vision an intermodal master plan that provides for a regional commuter rail system, the connecting elements within each Urban District must also be carefully studied and defined for the future. To fail to plan for these interconnections and modal alignments, and thereby failing to protect their necessary rights-of-way, could seriously hinder the ultimate provision of suitable connectivity when needed in the future. This would, in turn, decrease the effective application of commuter rail as an alternative travel mode for the region.

APPENDIX C – HOUSTON'S REGIONAL HEAVY RAIL NETWORK – CONSIDERATIONS FOR COMMUTER RAIL

CHAPTER C-1 – INTRODUCTION

This appendix summarizes an assessment of the existing Houston region railroad network. The freight rail network has been identified and analyzed with respect to a potential freight/passenger rail interface on the existing network. Potential impacts to freight operations due to passenger rail service have been evaluated, including a review of the impacts to local freight shippers and future industrial development projects in the region requiring rail service.

This appendix also provides an evaluation of potential commuter rail train flow patterns and access routes from outlying Houston areas into the urban core of the city. **Figure C-1** shows the abandoned rail corridors and existing rail corridors within the urban core. This evaluation included the investigation of improvements to the existing rail network that would be beneficial to the implementation of commuter rail service. Some of these improvements have been identified in the Houston Region Freight Study conducted by TxDOT which provided the foundation for information used in this study.

CHAPTER C-2 – RAILROAD NETWORK CONSIDERATIONS

The development of the highway and rail transportation infrastructure in and around the Houston metro area was influenced largely by the growth of the local ports and the geographical layout of Buffalo Bayou, the San Jacinto River, and Galveston Bay. The railroads and roadways were constructed along routes that lead to these areas and the city has grown and expanded along these transportation arteries as Houston has grown to become the nation's fourth largest city.

The railroad history for the Houston area dates back to the middle nineteenth century when numerous railroad companies constructed several hundred miles of track. Portions of the original rail network were abandoned and removed over the years without a significant expansion of the original rail network along with the growth of the region and the Port of Houston. As a result, the railroads are operating on lines that are at or near capacity. Due to forecasted growth in rail tonnage, the freight railroads could become more protective of their operating rights on these tracks.

Economic and population growth has continued to increase for the Houston region, which in turn increases the demands on local modes of transportation. Additionally, while the demand for freight transport has increased, growth along freight routes has left limited right-of-way for expansion for the railroads as well as highway infrastructure, creating major restrictions for capacity expansion of the transportation system.

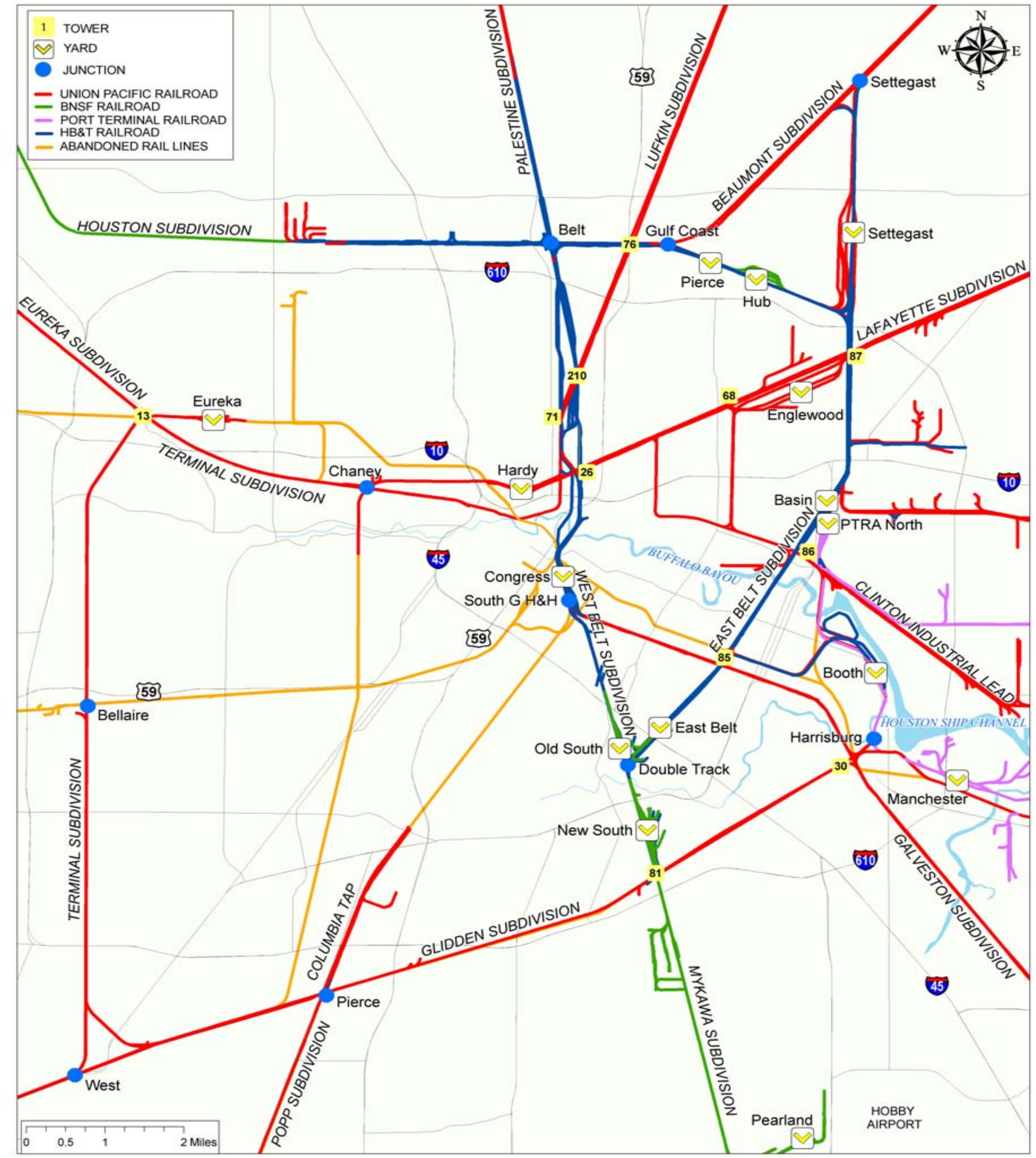


Figure C-1: Existing Houston Rail Network Inside of Beltway 8

(Note: Abandoned rail lines are shown for illustrative purposes and do not imply availability for use.)

Additional material related to the analysis within this appendix can be found in Appendix D, which provides a focused assessment of the urban center of the existing rail network as it relates to future provisions necessary for commuter rail.

C-2.1 Existing Rail Network

Approximately 2,200 trains per week travel within the Houston regional rail network, which is comprised of tracks owned and operated by the Union Pacific Railroad (UPRR), the BNSF Railway Company (BNSF), the Houston Belt Terminal Railroad (H&BT), and the Port Terminal Railroad Association (PTRA). The Kansas City Southern Railway Company (KCS) has the right to operate their trains over many of the UPRR and BNSF tracks as well. The region's infrastructure includes more than 800 miles of mainline tracks and 21 miles of railroad bridges.

The Houston region serves as one of the country's largest freight centers. The volume of freight that is shipped into and out of the Houston region requires a number of major terminals that provide the capability to transfer freight to and from the railroads. Terminals are facilities such as rail yards and intermodal facilities where rail cars are processed.

The freight trains in the Houston Region carry freight cars coming into or leaving Houston, Dayton, Baytown, Bayport, and Beaumont industrial complexes. The freight carried on these trains is mostly for local business. The freight is shipped in carloads and is typically sorted by destination (customer) at one or more of the major Houston yards. This traffic is predominantly local business, for local customers. Most of the trains carry chemicals, and/or heavy bulk commodities like coal, grain, rock/aggregate, and coke. This heavy industrial cargo accounts for 84% of Houston's rail activity. Of the trains in the Houston network simulation model, recently updated for the TxDOT Houston Freight Region Study, less than five percent operate completely "through" the region without having to stop in Houston to pick up or drop off rail cars.

Within the Houston Region, the railroads provide rail service to more than 900 customers. Although not a direct indication of the location of each customer within Houston's Loop 610, **Figure C-2** shows the general locations, excluding those that are along the ship channel or the Port areas, of existing tracks that extend out from the main tracks that could serve rail customers.

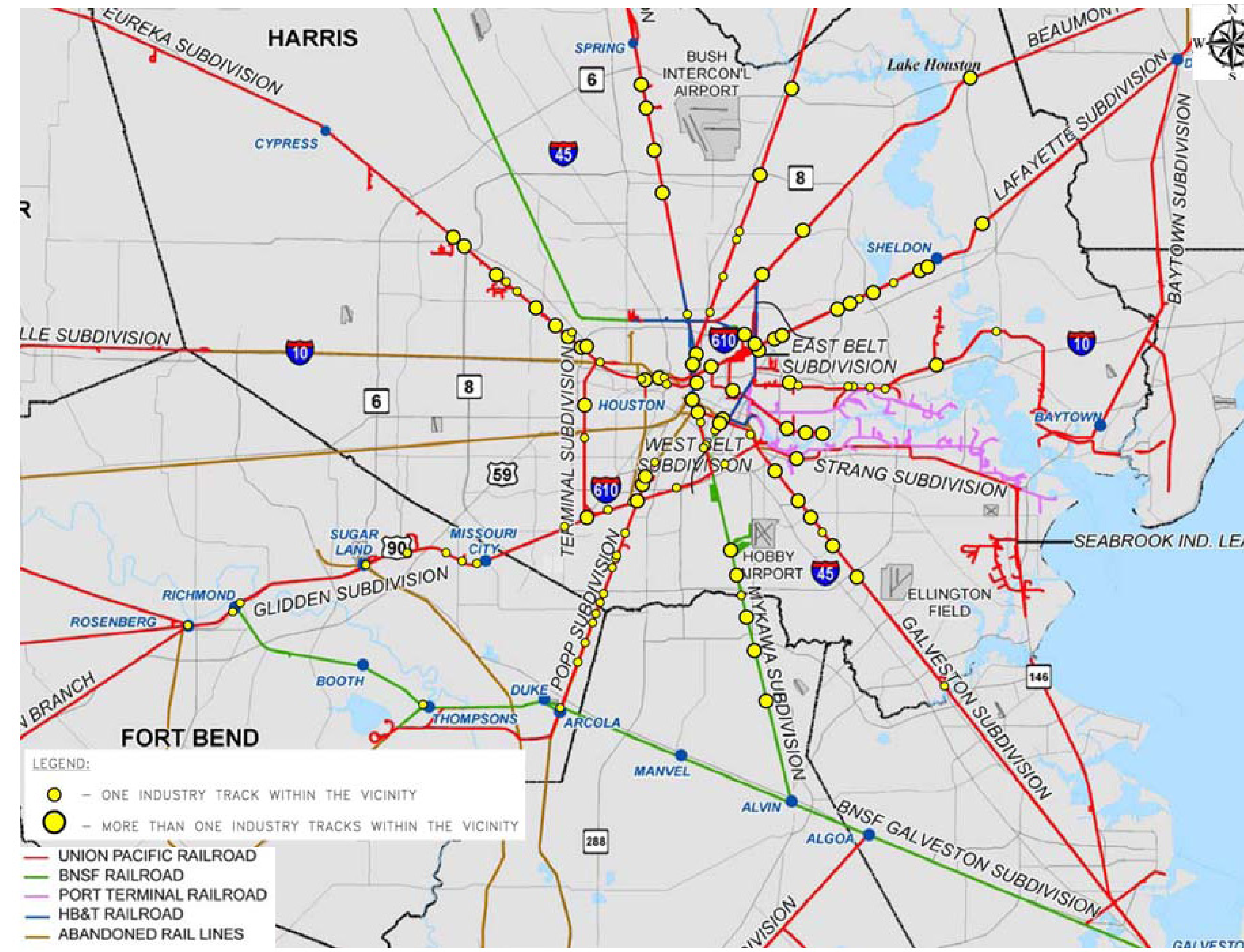


Figure C-2: Approximate Industry/Customer and Spur Track Locations

An inventory of each of the existing rail corridors/subdivisions was conducted to determine the infrastructure and right-of-way that may potentially be available for commuter rail service. Existing railroad corridor right-of-way widths in downtown Houston are shown in **Figure C-3**.

Characteristics identified for each corridor include locations of single or double track, passing sidings, and typical freight train operations on the line. Such characteristics are shown for existing Houston railroad subdivisions in the maps included in Chapter C4 of this appendix. Additionally, typical cross-sections for the existing corridors were analyzed to determine available capacity for potential commuter rail service. Typical freight rail corridor cross-section examples are shown in **Figure C-4** for 50-foot and 100-foot right-of-way widths. A typical section for a barrier separated passenger corridor, as may be warranted along the Terminal Subdivision parallel to Winter Street, is also shown in **Figure C-4**.

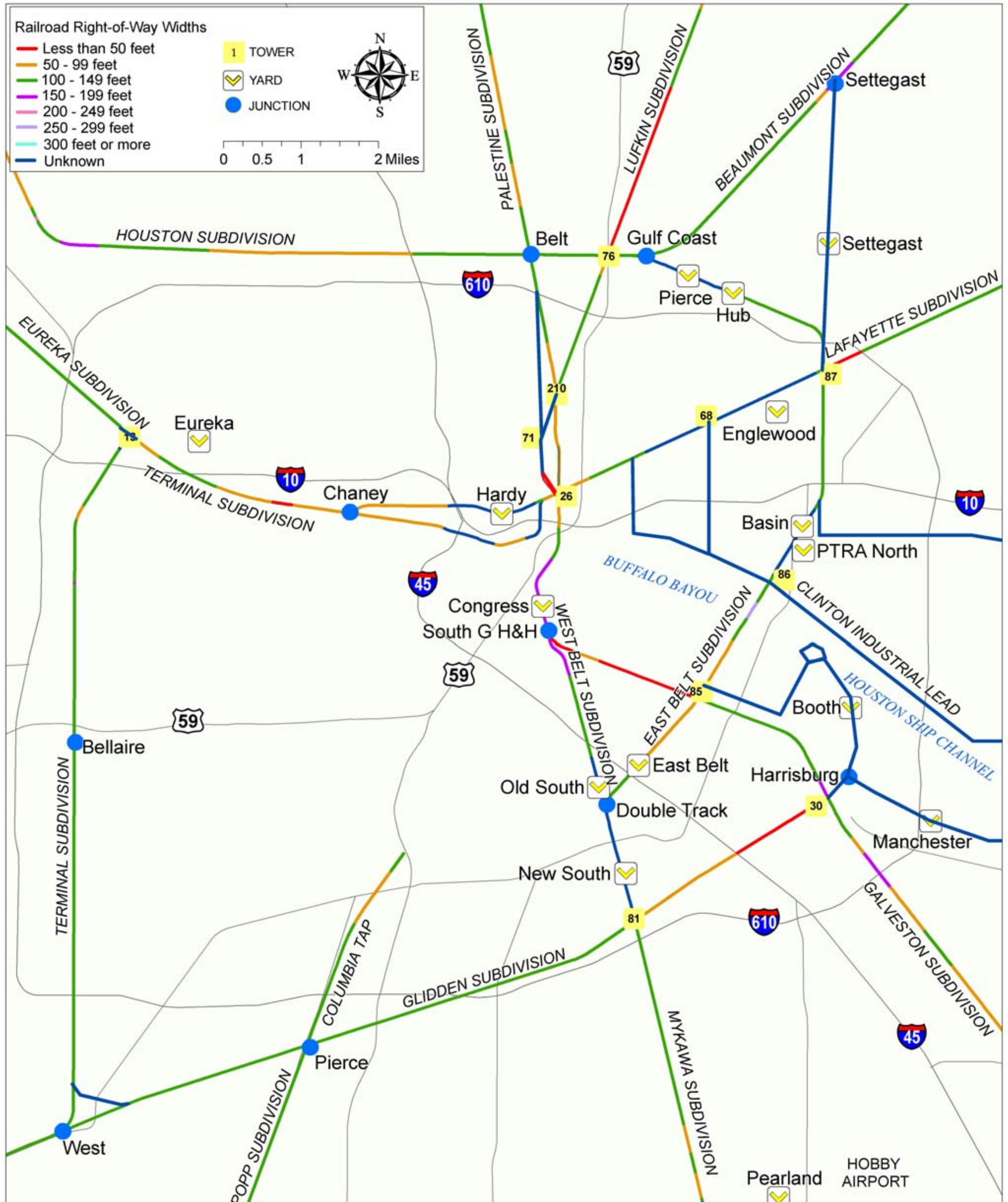
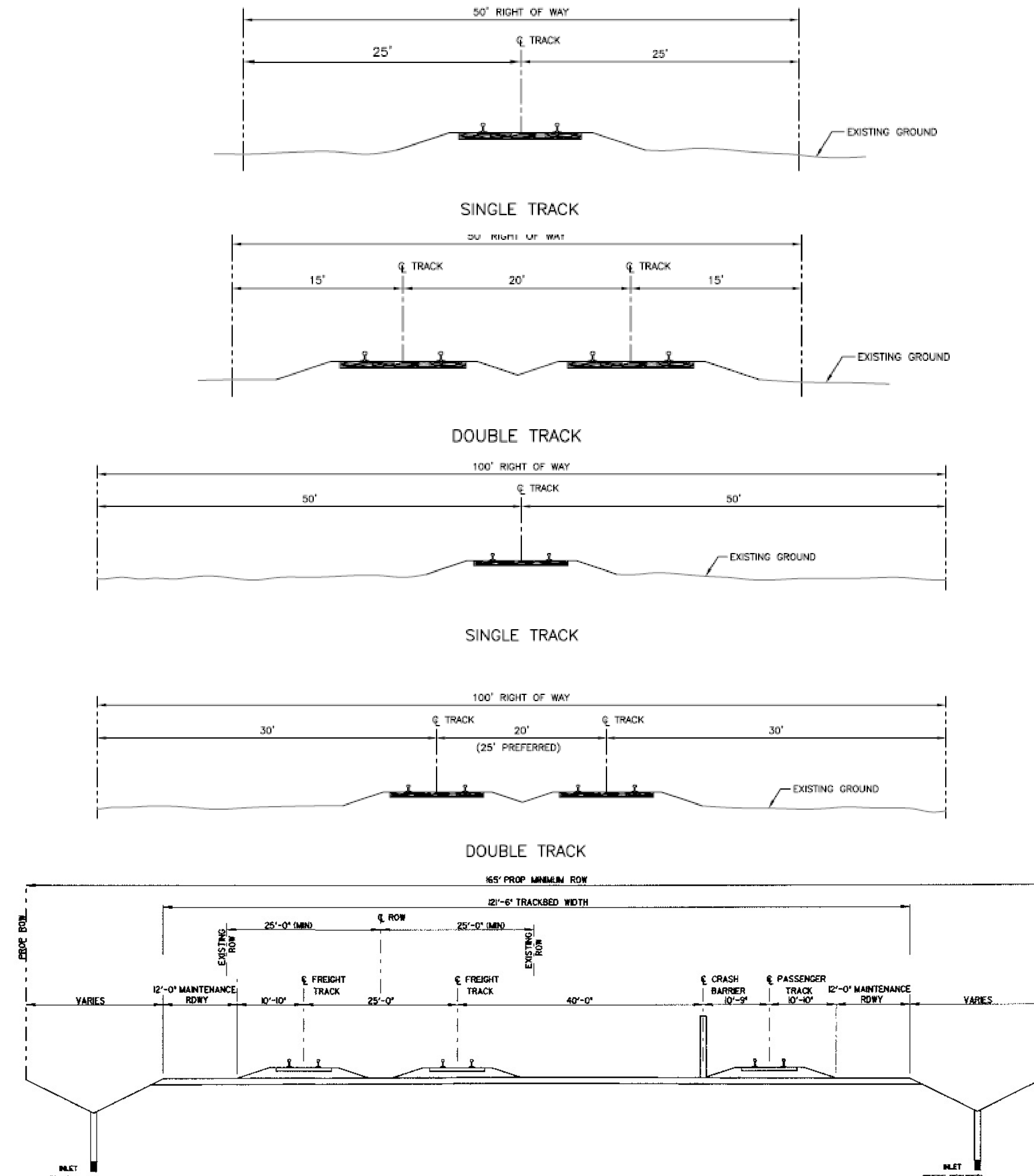


Figure C-3: Existing Railroad Corridor Right-of-Way Widths



BARRIER SEPARATED PASSENGER RAIL

Figure C-4: Typical Cross-Sections

Rail line capacity is a function of many factors, including: bottleneck locations, train schedules, operating practices and rules, delay incidents, signaling, and track characteristics (number of tracks and track condition). Practical capacity quantified by the railroads is typically defined as the maximum number of trains a segment can handle in a given time period and still maintain desirable levels of service.

The capacity of existing rail lines was evaluated in this study using performance measurements such as railroad subdivision lengths, typical trip times with and without congestion, and average train speeds over the subdivision as shown in **Table C-1**. The theoretical trip time shown in the table is based on the maximum allowable train speeds along the corridor assuming no congestion (Service Level A), while the congested trip time was estimated for the condition of extreme congestion and delay (Service Level F). The practical trip time represents the condition of average traffic delays (Service Level C), which is the average of the theoretical and congested trip times. The average speed at Service Level C is calculated from the practical trip time and the length of the subdivision. The modeled average speed is the speed measured from Rail Traffic Controller (RTC), which is a modeling software used to simulate railroad operations. The delta is the difference between the calculated average speed and the modeled average speed.

Table C-1: Existing Conditions Capacity Performance Measurements

Subdivision	Corridor	Approximate Length (miles)	Theoretical Trip Time (Level A)	Congested Trip Time (Level F)	Practical Trip Time (Level C)	Average Speed - Level C (mph)	Modeled Average Speed	Delta
Eureka	US 290	65	133	145	139	28.1	15.8	(12.3)
Houston	SH 249 / FM 1774	70	133	158	146	28.8	18.0	(10.8)
Glidden	US 90A	65	100	128	114	34.3	24.0	(10.3)
UP Galveston	IH 45	46	120	134	127	21.7	22.9	1.2
Mykawa	SH 35	20	24	64	44	27.4	17.6	(9.8)
Popp	FM 521	13	19	38	28	27.6	8.5	(19.1)
Navasota	Kuykendahl / Hwy 149	27	26	53	40	40.9	32.2	(8.7)
Palestine	Hardy Toll Road	50	47	57	52	57.7	22.3	(35.4)

As shown by the negative values for Delta in **Table C-1**, the actual modeled average train speeds on the existing freight rail tracks being considered for possible incorporation of commuter rail were lower than the average speeds that may be deemed practical by the railroads to maintain desired levels of service performance. This data shows that these subdivisions, with the possible exception of the UP Galveston Subdivision, are perceived to not have any latent (excess) capacity available for commuter rail traffic in their present configurations of track.

As a result, infrastructure improvements would be required on the existing freight rail corridors in order to add capacity sufficient to support commuter rail traffic while maintaining service levels to freight customers. Such alternatives may involve a combination of solutions for each prospective route, including the addition of a mainline track to existing corridors adjacent to the freight mainlines, using abandoned rail corridors, constructing elevated structures for the separation of passenger and freight train crossings, and in some areas creating wholly new commuter rail corridors.

C-2.2 Reaching the Urban Core and North Intermodal Terminal Station

The goal of commuter rail service is to connect residential areas distanced from the city with destinations such as major employment/activity centers, major urban/business districts, and intermodal centers to connect commuter rail, light rail, and bus service. It is imperative to the success of commuter rail operations to penetrate the urban core of Houston, with the planning objective of accessing the North Intermodal Terminal Station currently under design by Houston METRO.

The challenges inherent to reaching the urban core consist of restricted available right-of-way and capacity (if any) on existing rail corridors, minimizing impacts to existing freight operations, and providing access to major residential areas while minimizing impacts to residents. The greatest number and largest conflicts exist inside Loop 610 due to the congestion and lack of available right-of-way, as well as the concentration of high train traffic volumes in the area and the slowing and stopping of trains on the mainline tracks due to the current location and operational capacity of large rail yards. The railcar classification activity at the principal railroad yards within Loop 610 is the source of most of the congestion-related delay in the Houston rail network.

As described previously, there is minimal, if any, available capacity on the existing freight rail lines. This is due in part to the high volumes of freight trains operating on those lines and the lack of available sidings or double track locations that allow trains to pass each other. It is not possible to minimize impacts to freight operations without the ability for a commuter train to pull into a siding or second mainline track to allow a freight train to pass or vice versa. Since many freight trains are in excess of 5000 feet long, the locations of double track and sidings greater than one mile in length are shown in the subdivision maps contained in Chapter C4 of this appendix to indicate locations that may be available for the passing of trains.

Due to the few and often far between locations of sidings or double tracks, commuter rail service may require the construction of new tracks adjacent to the existing freight lines where there is sufficient right-of-way. Without available right-of-way in the freight corridors, commuter rail service may require the purchase of additional right-of-way next to the freight corridors, construction of new rail corridors, or the use of abandoned rail corridors.

C-2.3 Commuter Rail Access Routes and Provisions Inside the 610 Loop

The prospective commuter rail flow patterns and access routes throughout the eight county study area were determined based on potential demand for commuter rail service as well as availability of right-of-way and/or capacity. The potential principal access routes studied, as shown in **Figure C-5**, connect the urban core of Houston with areas southeast, south, southwest, west, northwest, north, and northeast of downtown Houston. The routes primarily follow existing rail corridors such as the Galveston (IH 45), Mykawa (SH 35), Popp (FM 521), West Belt (downtown), Glidden (US 90A), Terminal (Bellaire/Memorial Park/IH 10), Eureka (US 290), Houston (SH 249/FM 1774), Palestine (Hardy Toll Road), Lufkin (US 59), and Beaumont (Lake Houston/Huffman) Subdivisions. Additional routes may follow abandoned rail corridors such as the abandoned corridor from Eureka to central Downtown or the abandoned corridor from the end of the Popp Subdivision into Downtown. Lastly, routes along new corridors were investigated such as the IH 10 corridor and the SH 288 corridor.

It is essential to maintain the fluidity of freight rail flow for the servicing of existing freight customers in the region to prevent a significant impact by commuter service operations. As a result, the commuter rail lines inside of the Interstate 610 Loop will need to incorporate flyovers at all crossings with the existing freight lines. For example, commuter rail lines from the southeast along the BNSF Mykawa and UPRR Galveston Subdivisions would include flyovers to cross the UPRR Glidden Subdivision. Additionally, a flyover would be included along the UPRR Terminal Subdivision for the commuter rail line to cross from the west side to the east side of the freight line as well as at the location where a potential commuter rail line on the UPRR Palestine Subdivision would cross the Terminal Subdivision (see **Figure C-14**).

Commuter rail equipment is typically shorter in overall train length and lighter than typical freight trains. Also, with commuter rail equipment capable of traversing steeper grades without adversely reducing operating speeds, the cost of flyover structures tends to be less expensive than structures built to specifically support freight train traffic.

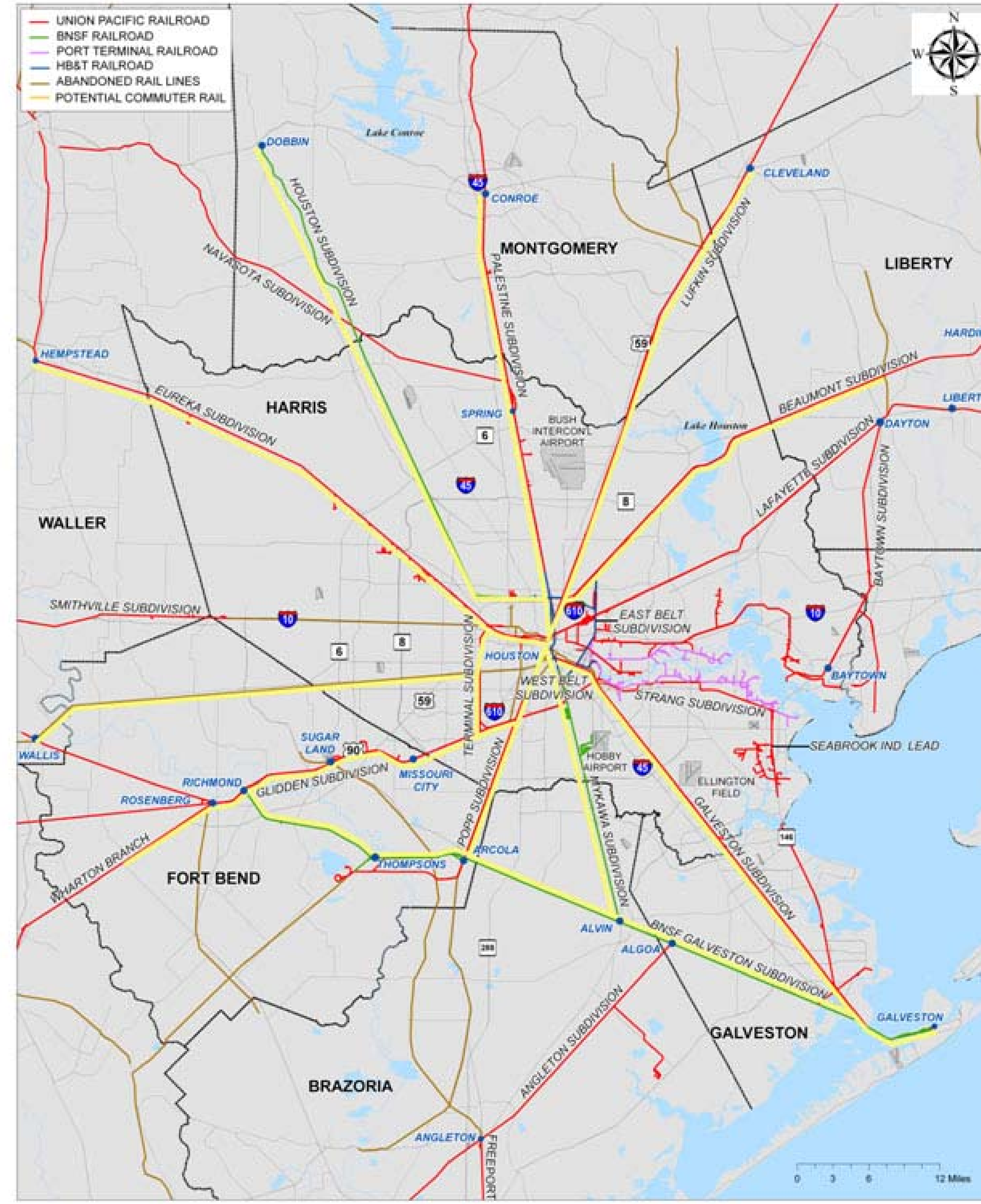


Figure C-5: Potential Commuter Rail Access Routes

CHAPTER C-3 – RAIL CORRIDOR ACCESS ROUTES CONDITIONS

C-3.1 South and Southeast Access Routes

Commuter rail access from the south may originate from the BNSF Galveston Subdivision via new tracks and right-of-way adjacent to the existing Mykawa or Popp Subdivisions. Commuter rail lines in the Mykawa and Popp corridors would require flyovers at the crossings with the Glidden Subdivision at railroad Tower 81/ T&NO Junction (**Figure C-6**) and Pierce Junction, respectively. Both routes would have bidirectional traffic and would access downtown and the Intermodal Terminal via connections with the potential West Belt commuter rail line. The Mykawa Subdivision corridor turns into the West Belt Corridor at Tower 81, and would therefore not require a flyover to connect to the West Belt commuter rail line.

Figure C-6: Railroad Tower 81/ T&NO Junction

The Popp Subdivision route could connect to the West Belt line via two alternative routes as shown in **Figure C-7**. The first route would continue along the Popp Subdivision corridor, which is abandoned north of the Columbia Tap Industrial Lead. This abandoned corridor has remained undeveloped throughout its length with the exception of a warehouse (Grocer's Supply Company) constructed in the abandoned right-of-way just northwest of the US 90/SH 288 interchange as well as a roadway (Velasco Street) constructed inside of the corridor for a distance of more than one mile. Although it is understood this abandoned rail corridor has been designated for a hike and bike trail, an elevated structure could be built above the trail to accommodate commuter trains.

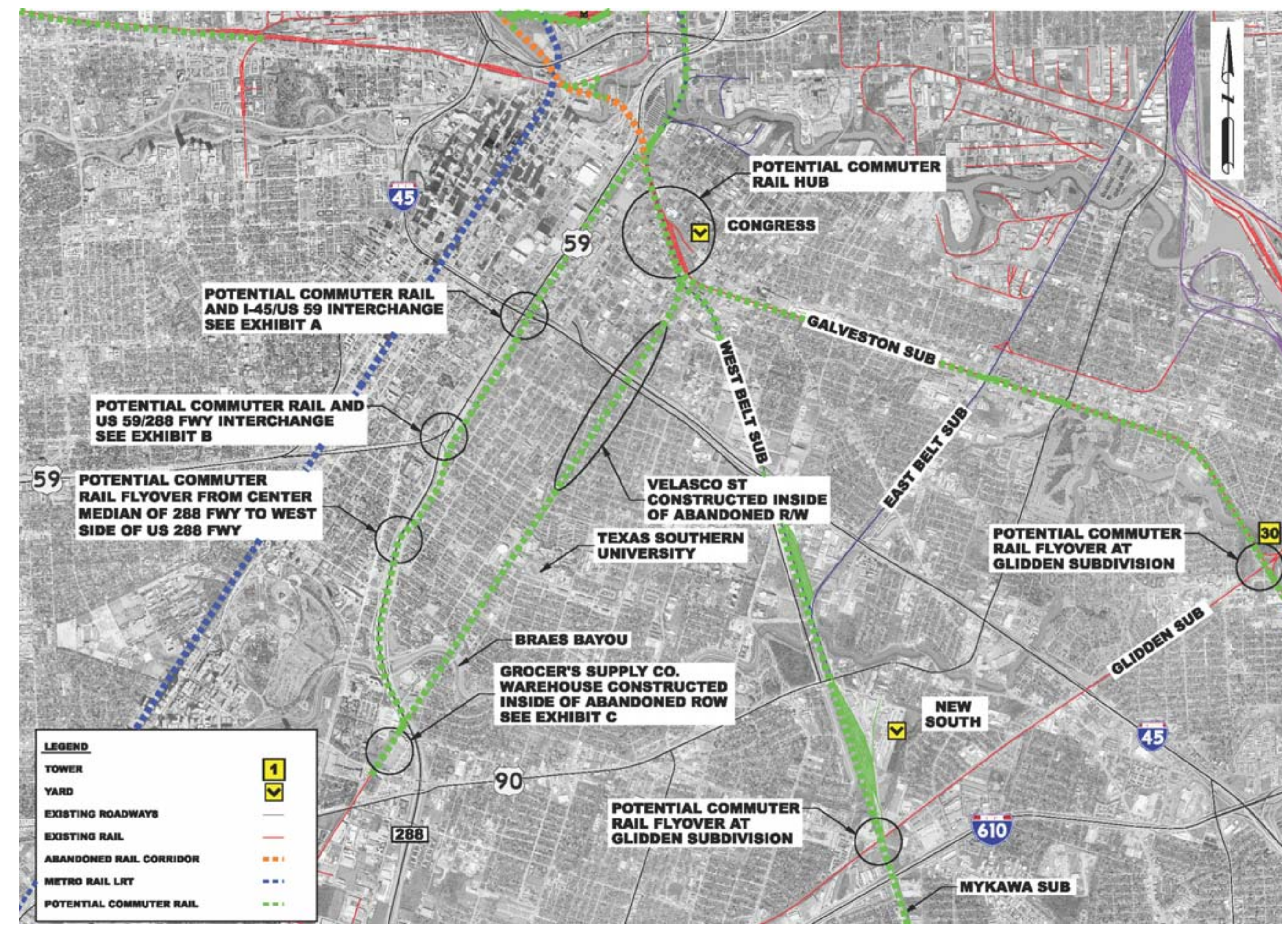


Figure C-7: Connections from Popp Subdivision into Downtown

The second route would follow the abandoned Popp Subdivision corridor north to SH 288 at which point it would require a flyover to the center median of the SH 288 corridor. **Figures C-8, C-9, and C-10** illustrate in more detail the areas along this route option that would require significant flyover structures and coordination between multiple agencies. The route would then require a flyover to cross from the SH 288 center median to the east side of the freeway and would then parallel US 59 to the connection with the West Belt corridor (see

Figure C-10). This route would still cross the warehouse constructed in the abandoned corridor before turning toward the SH 288 corridor. The route would require further coordination at the IH 45 and US 59 and interchanges (see **Figures C-8 and C-9**).

Figure C-8: I-45/US 59 Interchange

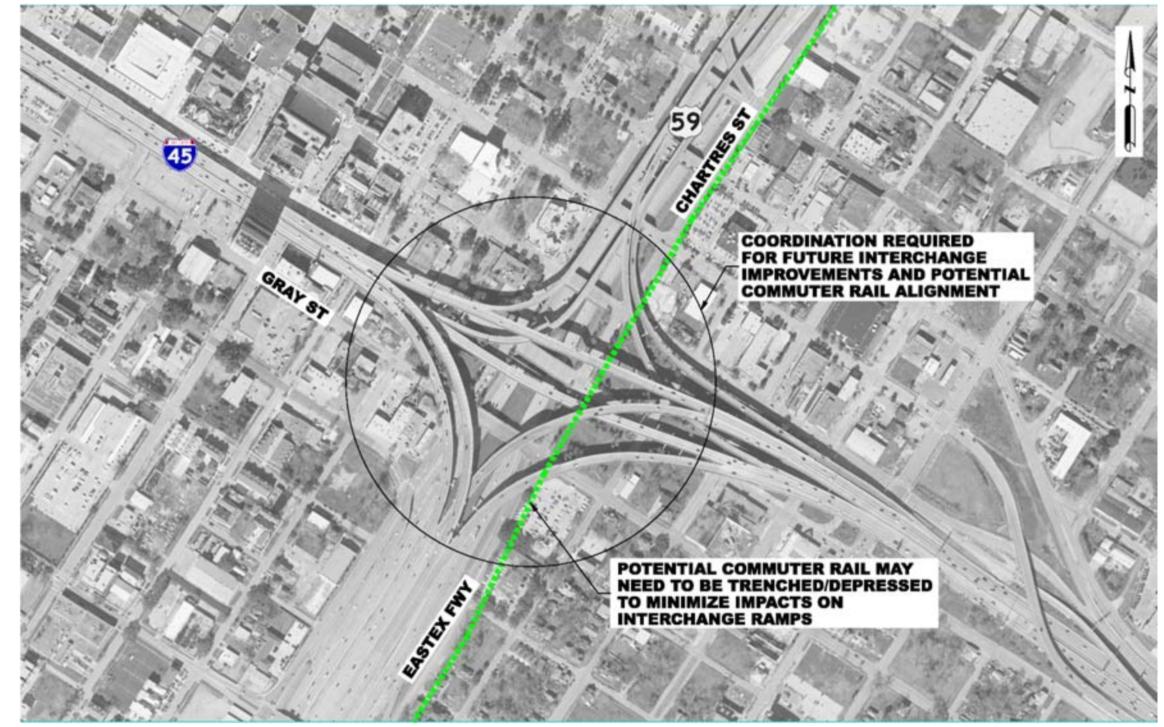


Figure C-9: US 59/SH 288 Interchange

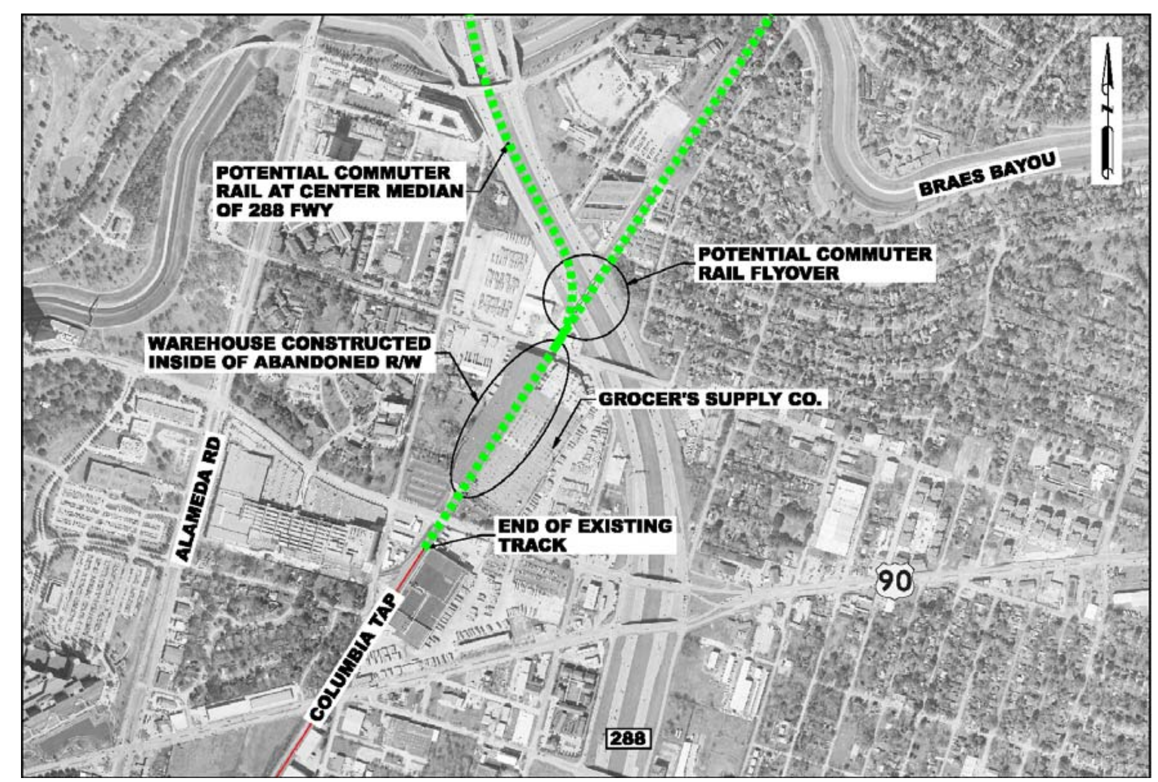


Figure C-10: ROW Conflict and Flyover to SH 288 Corridor

Access routes from the southeast may follow the UPRR Galveston Subdivision corridor. The commuter trains could potentially use the existing freight tracks along the Galveston Subdivision from Galveston to railroad Tower 30, but would require a new line adjacent to the existing tracks for traffic between Tower 30 into downtown. Use of the existing freight tracks would require upgrades to the existing infrastructure, including the construction of passing sidings. This potential route would have bidirectional traffic flow and would access downtown and the Intermodal Terminal via a connection with a potential new commuter rail line to the west of the existing West Belt Subdivision, which would require additional right-of-way. The commuter rail line would require flyovers at the crossing with the Glidden Subdivision at what is known as railroad Tower 30 (**Figure C-11**) and at the connection with the potential commuter rail line in the West Belt Subdivision corridor. After connecting to the West Belt line, the traffic would be able to travel northwest along the abandoned rail corridor or north along the West Belt line to continue on to enter the Intermodal Terminal, as shown in **Figure C-12**, after which the traffic could go in any direction.

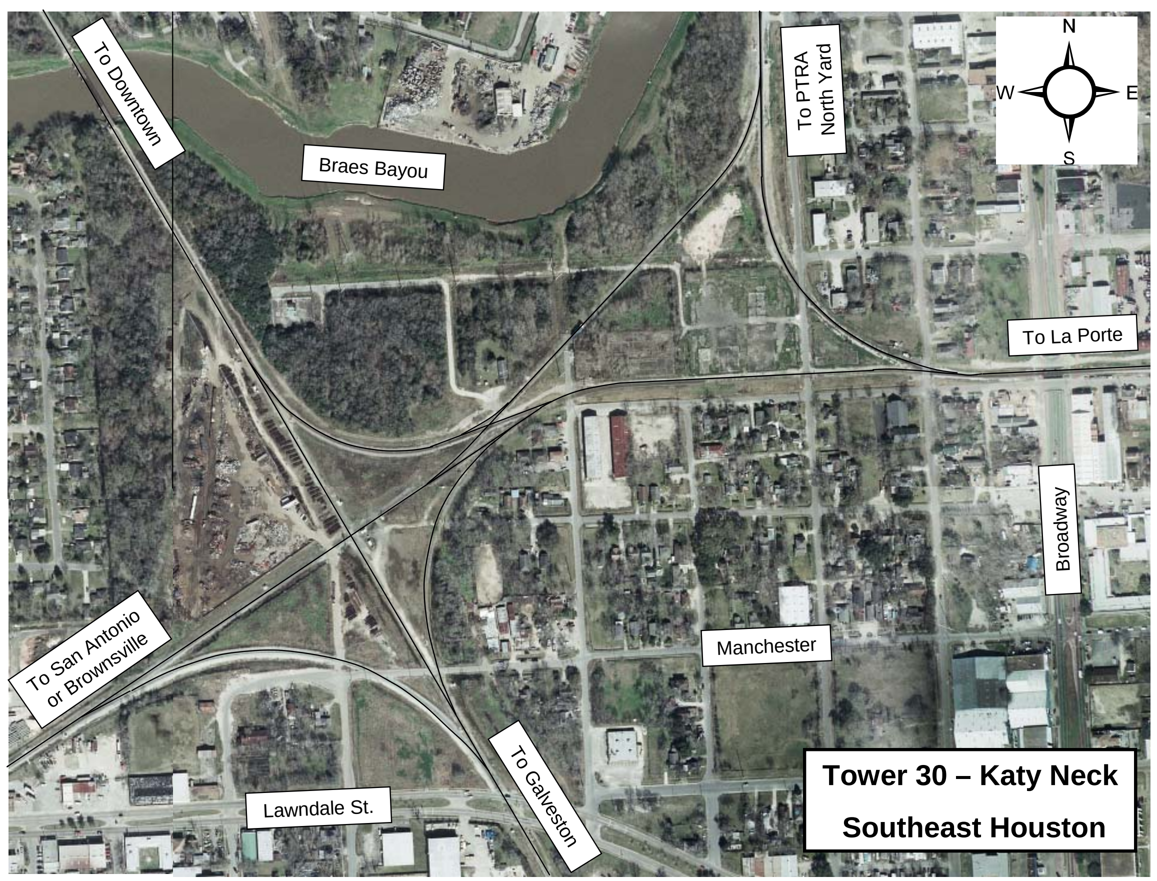


Figure C-11: Railroad Tower 30

Commuter rail from the south may potentially access the NIT from the West Belt Subdivision corridor via two alternate routes. One potential route could connect to a new commuter rail line south of the Terminal Subdivision freight mainline near Tower 26; however, this connection may be complicated by a potential commuter rail grade separation from the Palestine Subdivision corridor near Tower 26. Another route could connect a West Belt Subdivision commuter rail line to the Terminal Subdivision passenger mainline via the abandoned corridor; however, this route may be complicated by the interchange with US 59.

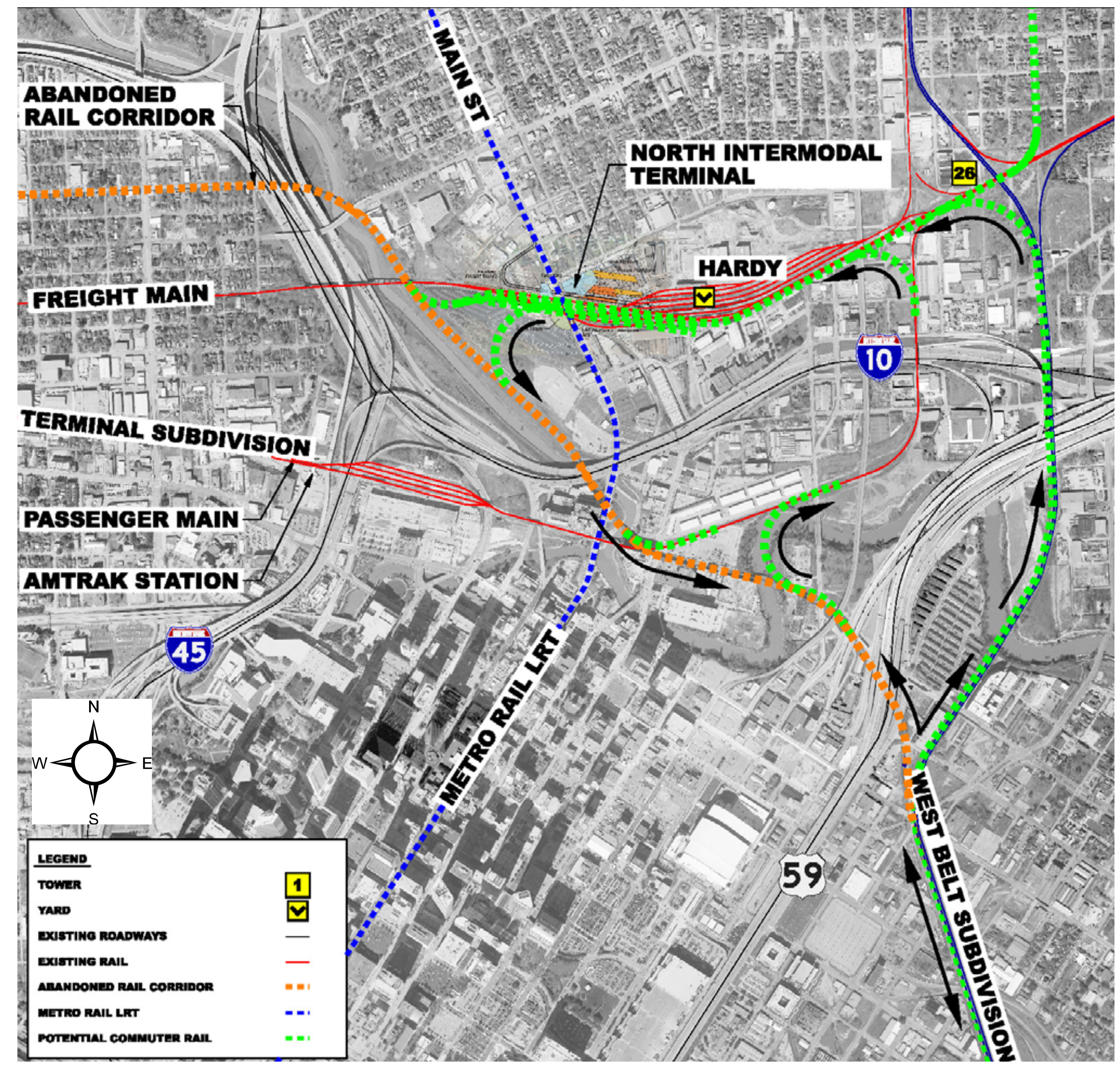


Figure C-12: Intermodal Circulation for Trains from the South, Southeast, and Southwest

C-3.2North and Northeast Access Routes

Commuter rail traffic from the north and northeast may follow the Palestine, Lufkin, and Beaumont Subdivision corridors, potentially on new tracks located adjacent to the existing freight tracks. The **Figure C-13** shows a potential Intermodal Terminal circulation loop for commuter trains from the north. This potential path shows trains entering the downtown area from the north via a new commuter rail east of the West Belt Subdivision freight tracks north of Tower 26, traveling through the Intermodal Terminal, turning south along the abandoned rail corridor, and returning to the West Belt Subdivision via a loop along the Terminal Subdivision passenger mainline.

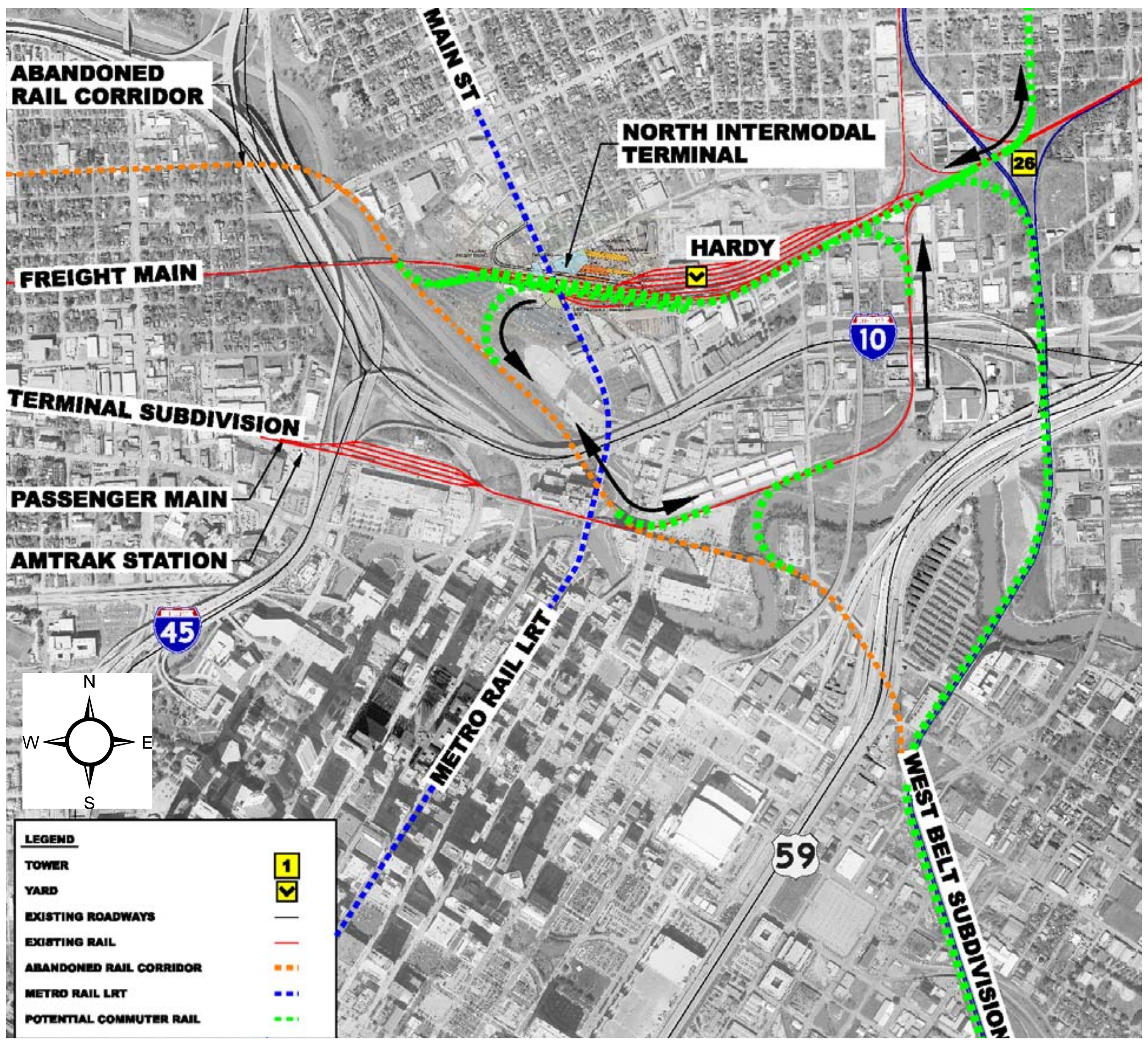


Figure C-13: Intermodal Circulation for Trains from the North and Northeast

The potential new commuter rail lines from the north would have bidirectional traffic flow and could access downtown and the Intermodal Terminal via a connection with a potential new commuter rail line to the east of the existing West Belt Subdivision (north of Tower 26), requiring a new grade separation between the West Belt Subdivision and the Terminal Subdivision east of Tower 26 as shown in **Figure C-14**.

Right-of-way in the Palestine Subdivision corridor is restricted by the Hardy Toll Road, meaning that adding a third line for commuter rail may not feasible directly adjacent to the existing freight tracks. As a result, the alternate route for commuter rail is shown a few blocks east of the existing freight tracks.

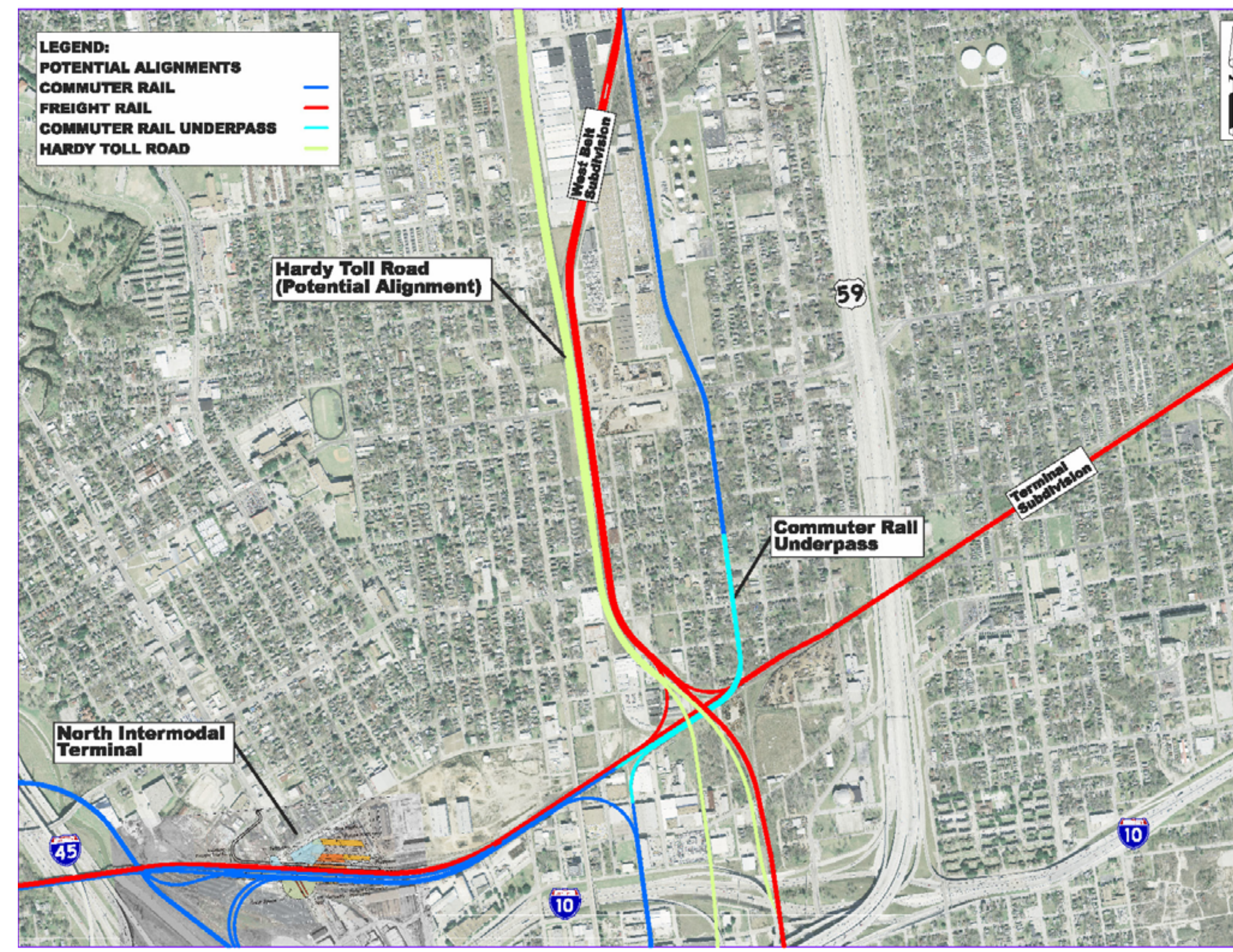


Figure C-14: Potential Commuter Rail Grade Separation at Tower 26

It should be noted that current freight rail flows on the Palestine and Beaumont Subdivisions are outbound, while the Lufkin Subdivision is inbound, indicating the addition of dedicated commuter rail tracks may be necessary. The Palestine, Lufkin, and Beaumont commuter rail routes would require flyovers at the crossings with the East Belt Subdivision at Belt Junction.

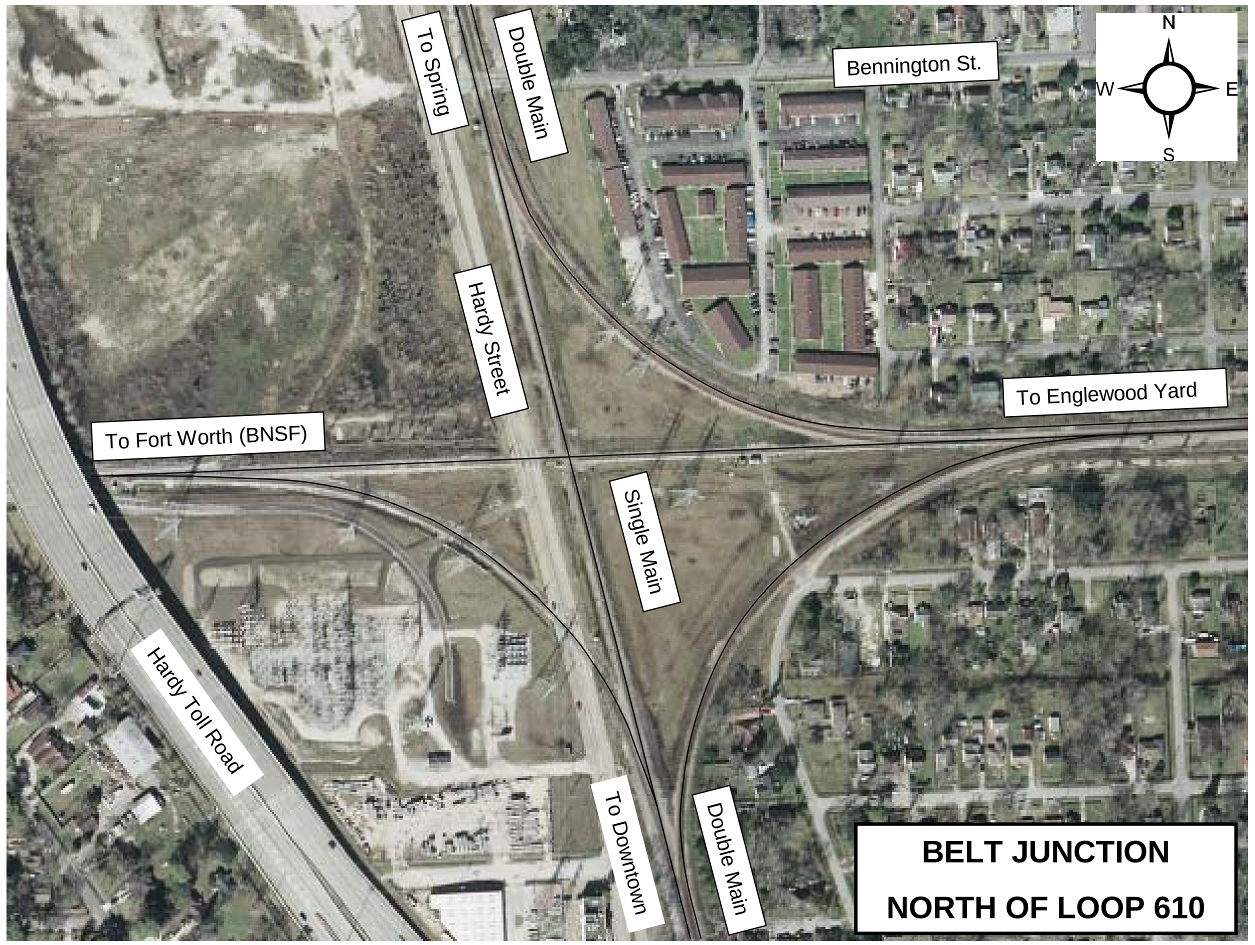


Figure C-15: Belt Junction

C-3.3 Northwest Access Routes

Access routes from the northwest may follow the Eureka Subdivision and Houston Subdivision corridors. Commuter rail traffic on the Eureka Subdivision would travel inbound and could access the Intermodal Terminal via the same three routes discussed for the Terminal Subdivision: along the Terminal Subdivision corridor, the abandoned rail corridor, or the along the IH 10 corridor. Any travel between the Eureka Subdivision and the Terminal Subdivision would require a flyover at Tower 13 to avoid conflicting with the freight traffic on the Terminal Subdivision.

Figure C-18 shows a potential Intermodal Terminal circulation loop for commuter trains from the west and northwest. This potential path shows commuter trains entering downtown on the Terminal Subdivision passenger mainline, traveling through the Intermodal Terminal, and leaving the urban core along the abandoned rail corridor traveling west.

Commuter rail traffic on the Houston Subdivision would be bidirectional and would access downtown and the Intermodal Terminal via a connection with the West Belt Subdivision at Belt Junction. The commuter trains would turn south from the Houston Subdivision corridor onto the West Belt Subdivision corridor entering the Intermodal Terminal from the east, requiring a new connection track between the West Belt Subdivision and the Terminal Subdivision near Tower 26 as shown in **Figure C-14**.

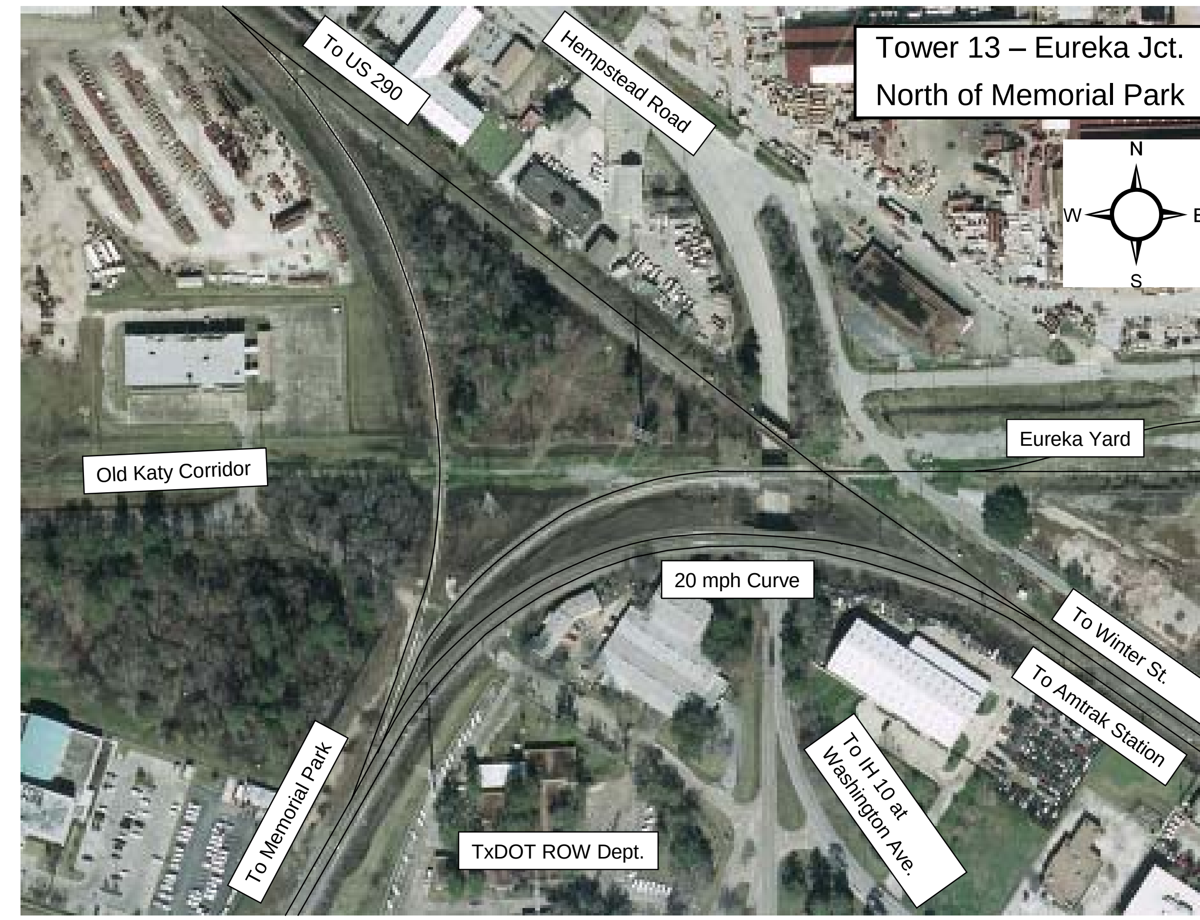


Figure C-16: Railroad Tower 13

Figure C-18: Intermodal Circulation for Trains from the West, Northwest, and Southwest

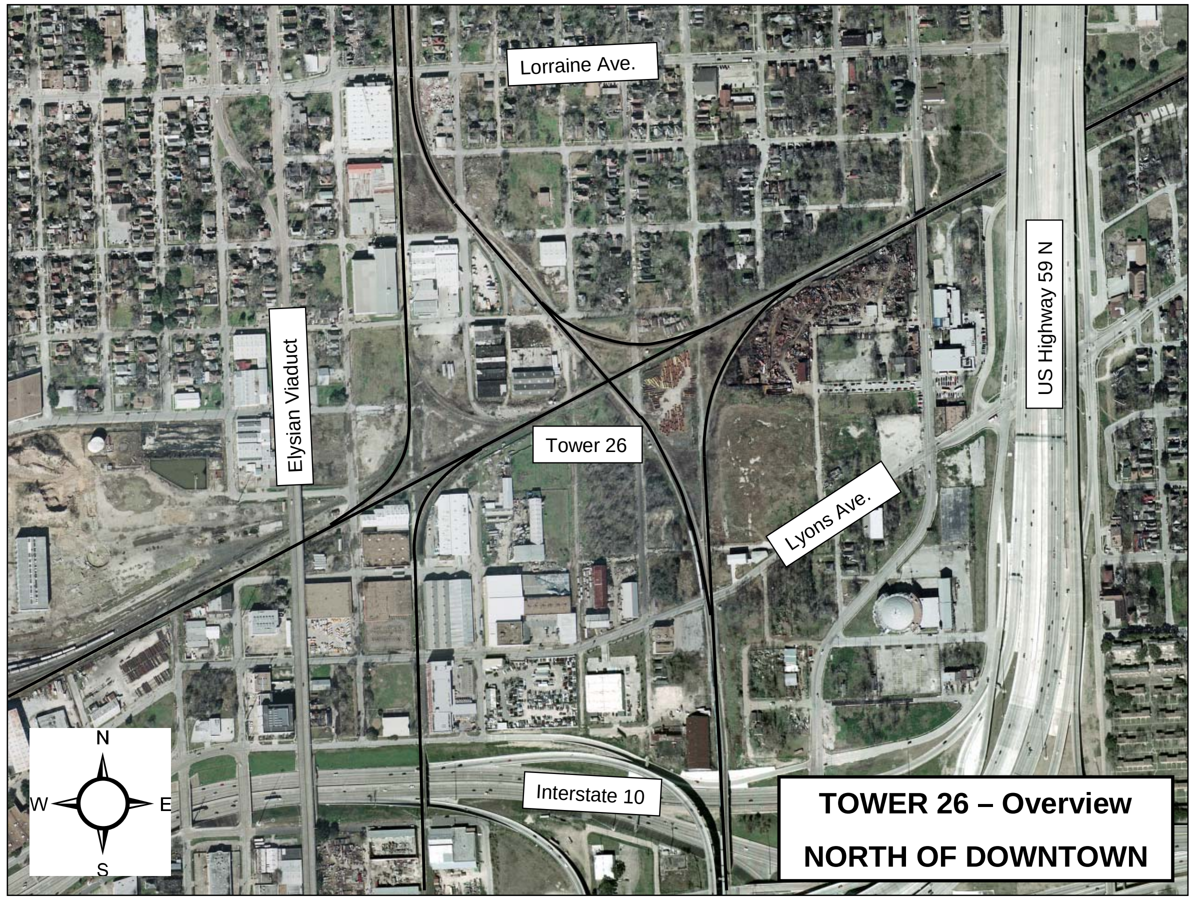


Figure C-17: Railroad Tower 26

C-3.4 West and Southwest Access Routes

Commuter rail access from the west and southwest may follow the Glidden Subdivision corridor and/or the Westpark corridor. The Glidden Subdivision would require new commuter rail tracks and right-of-way alongside freight tracks for the entire length of the corridor. The Westpark corridor would also require new commuter rail tracks for the length of the abandoned rail corridor that runs adjacent to the Westpark Tollway.

These potential routes are anticipated to have bidirectional traffic flows and would access downtown and the North Intermodal Terminal via connections with the Terminal Subdivision. From the Glidden Subdivision, the commuter rail line would turn north onto a potential new commuter rail track west of the existing Terminal Subdivision freight tracks. From the Westpark corridor, the commuter rail line would connect to potential new Terminal Subdivision commuter rail tracks near Bellaire Junction.

The commuter track may require a supporting structure, such as a box culvert, to run above the existing drainage channel located west of the freight tracks (shown below). The commuter rail line may also require a flyover to cross from the west side to the east side of the Terminal Subdivision freight tracks where right-of-way may be available due to an existing utility line corridor. The commuter rail line would continue to follow the Terminal Subdivision, turning east at railroad Tower 13 and continuing along the south side of the existing tracks. Right-of-way is constricted through this area, especially in the residential area along Winter Street.

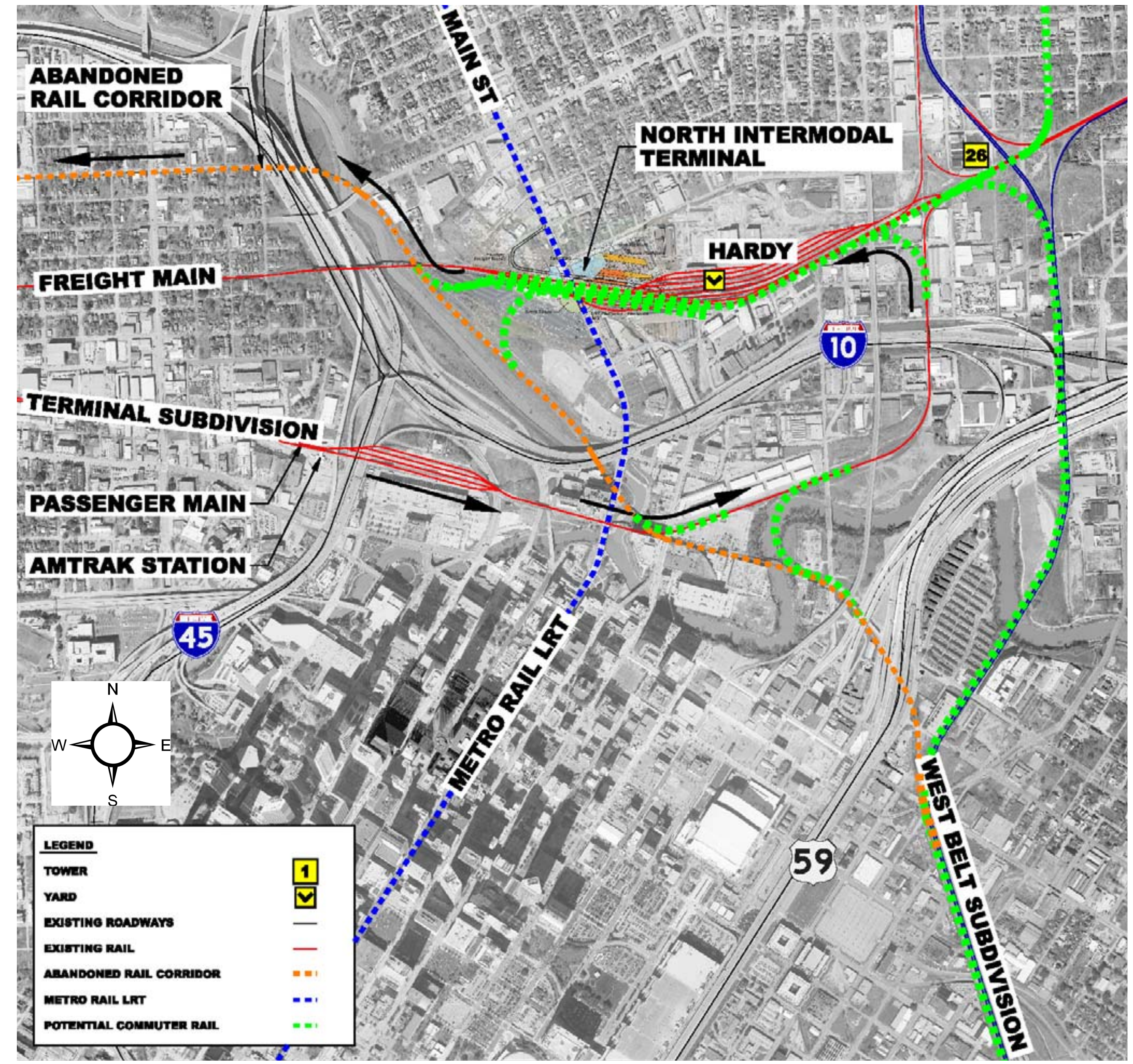


Figure C-18: Intermodal Circulation for Trains from the West, Northwest, and Southwest

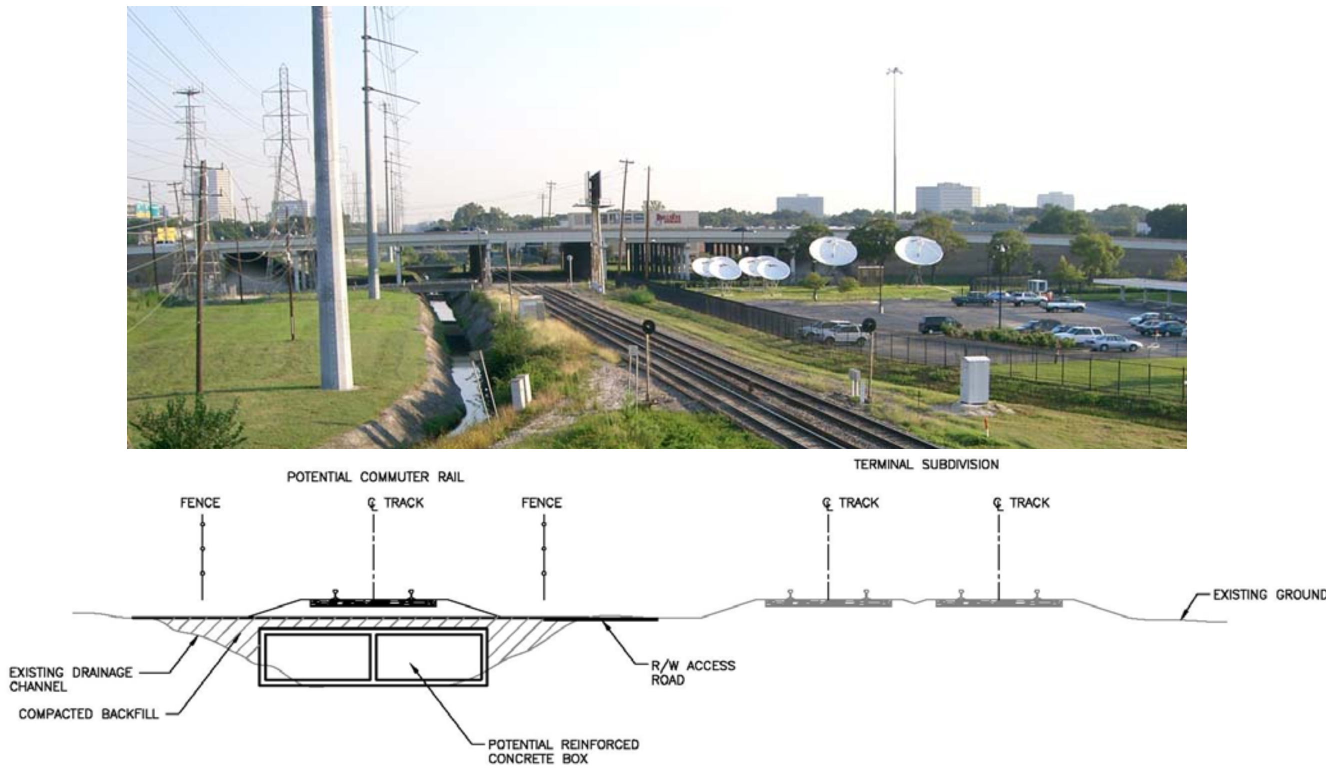


Figure C-19: Terminal Subdivision Freight Tracks and Drainage Channel (Existing Photo and Proposed Conditions)

The commuter rail line could then follow multiple alternate routes into downtown from Tower 13: along the Terminal Subdivision corridor, abandoned rail corridors, or the along the IH 10 corridor. The first alternative is to continue along the south side of the existing Terminal Subdivision tracks to Chaney Junction, where the existing Terminal Subdivision tracks split into a freight mainline and a passenger mainline.

The commuter rail line could then follow the passenger main which connects back into the freight main east of the North Intermodal Terminal or follow along the south side of the freight main, which would enter the Intermodal Terminal from the west. The alignment along the south side of the freight main along Winter Street would include new right-of-way to be obtained and a new freight rail line in addition to a new commuter rail line to be constructed adjacent to the existing freight tracks. A new connection would be required between the passenger main and the Terminal Subdivision just west of Tower 26 to allow commuter trains to enter the Intermodal Terminal from the east and in addition a flyover would be required at Chaney Junction for the commuter rail line to cross the passenger main in order to follow along a new alignment south of the freight main.

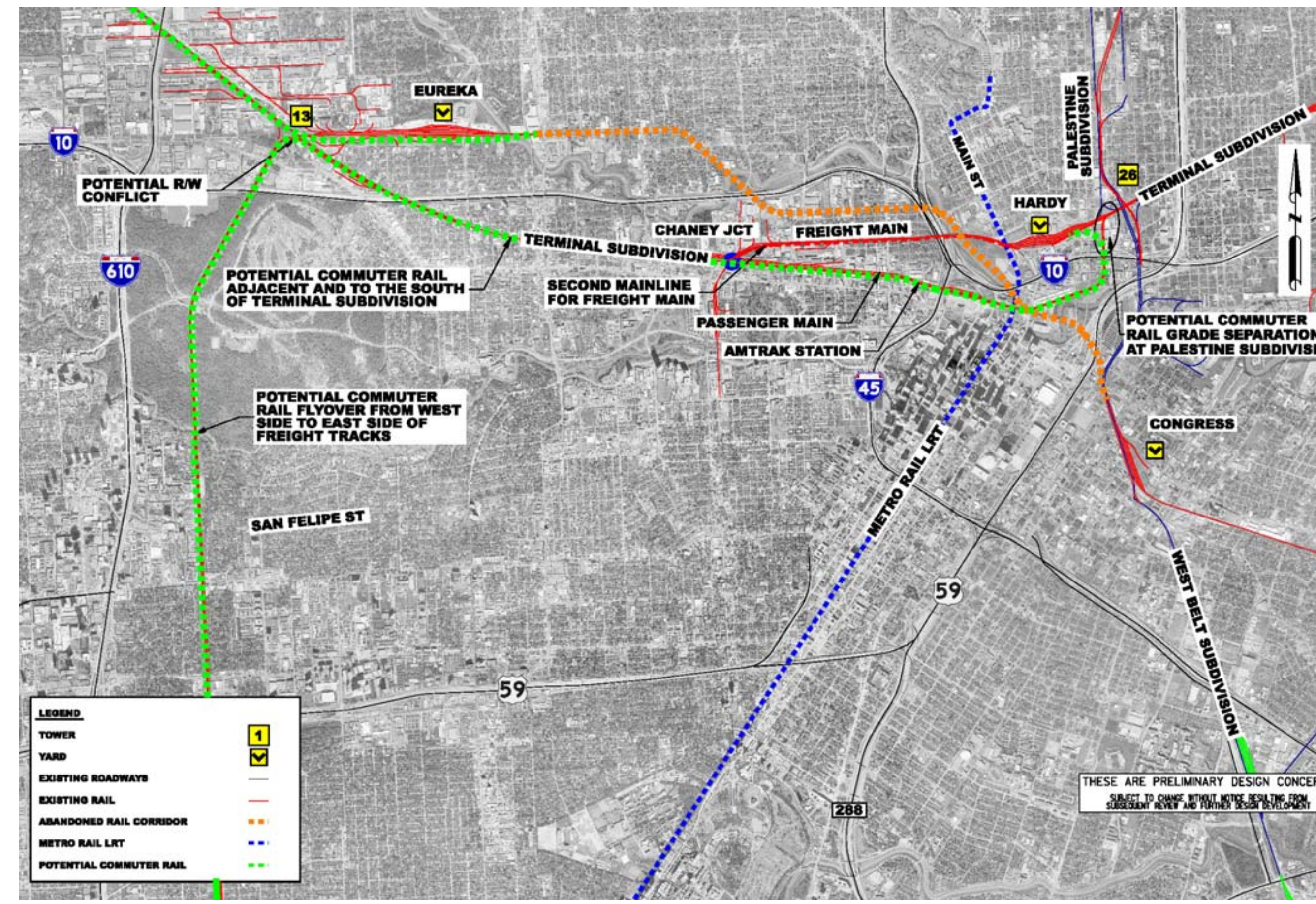


Figure C-20: Terminal Subdivision Passenger Mainline Route

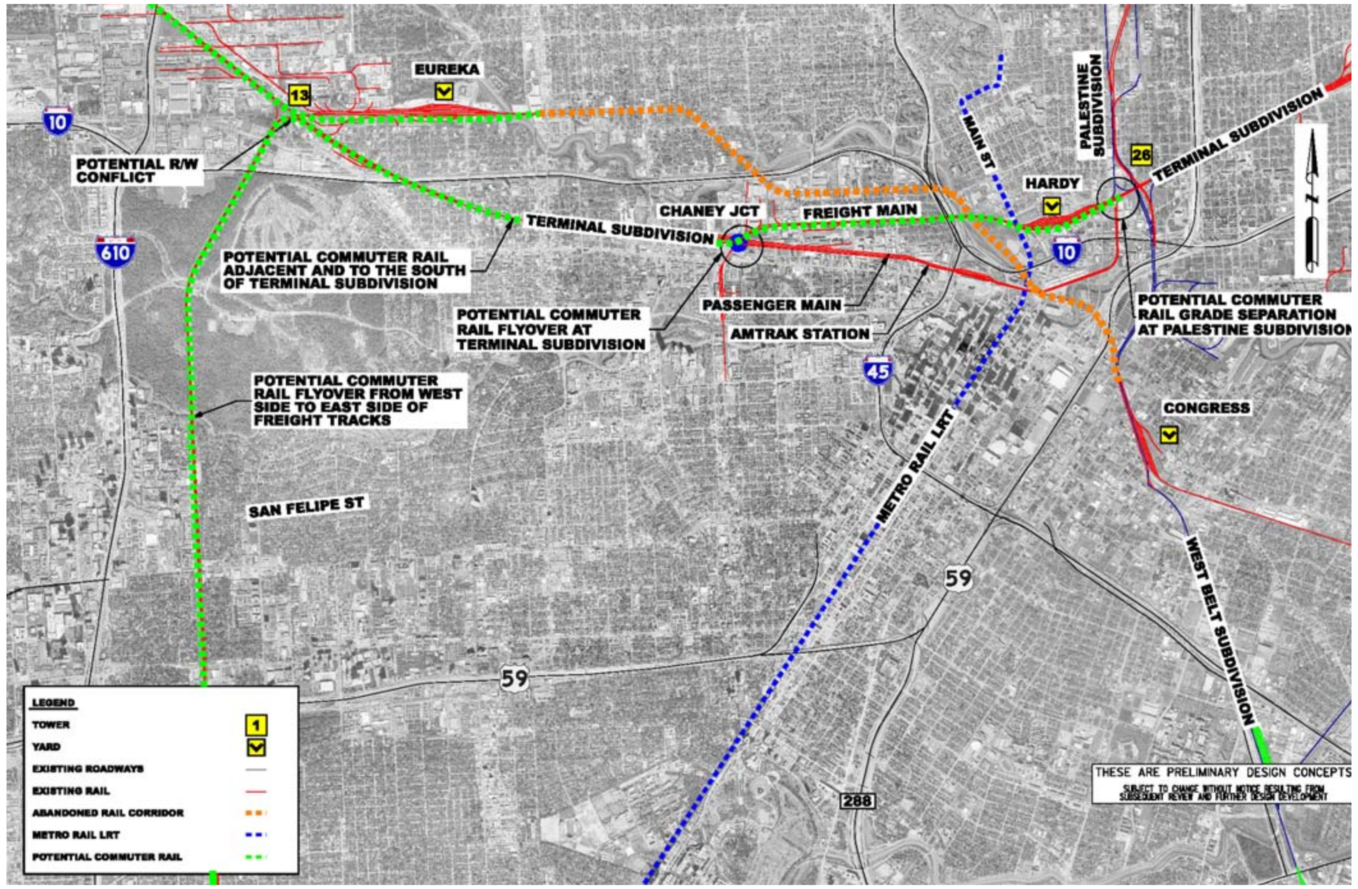


Figure C-21: Terminal Subdivision Freight Mainline Route

Another potential route would require a flyover at railroad Tower 13 where the commuter rail line would follow the abandoned rail corridor that continues from the Eureka Subdivision line. The abandoned corridor passes underneath the freight main of the Terminal Subdivision and can be connected directly into the Intermodal Terminal tracks from the west or from the east via a connection with the Terminal Subdivision passenger mainline. This alternative would minimize impacts to the residential areas and the freight rail operations along the Terminal Subdivision, but it passes through the middle of the Heights District. A possible variation on the abandoned corridor route includes the use of the Yale Street corridor, which turns south from the abandoned corridor to connect to the Terminal Subdivision west of Chaney Junction. This route would require a flyover at Chaney Junction to grade separate the commuter and freight rail tracks.

A third route could follow a potential new rail corridor along the north side of IH 10, which would run between the existing Terminal Subdivision east of Tower 13 and connect to the abandoned rail corridor east of IH 45. The commuter rail line would then follow the abandoned corridor into the Intermodal Terminal from the west. This route would require a flyover as it turns out of the Terminal Subdivision corridor into the new corridor north of IH 10 and would also require multiple new railroad bridges and structures along the new corridor alignment to cross the waterways and freeway interchanges located along the route.

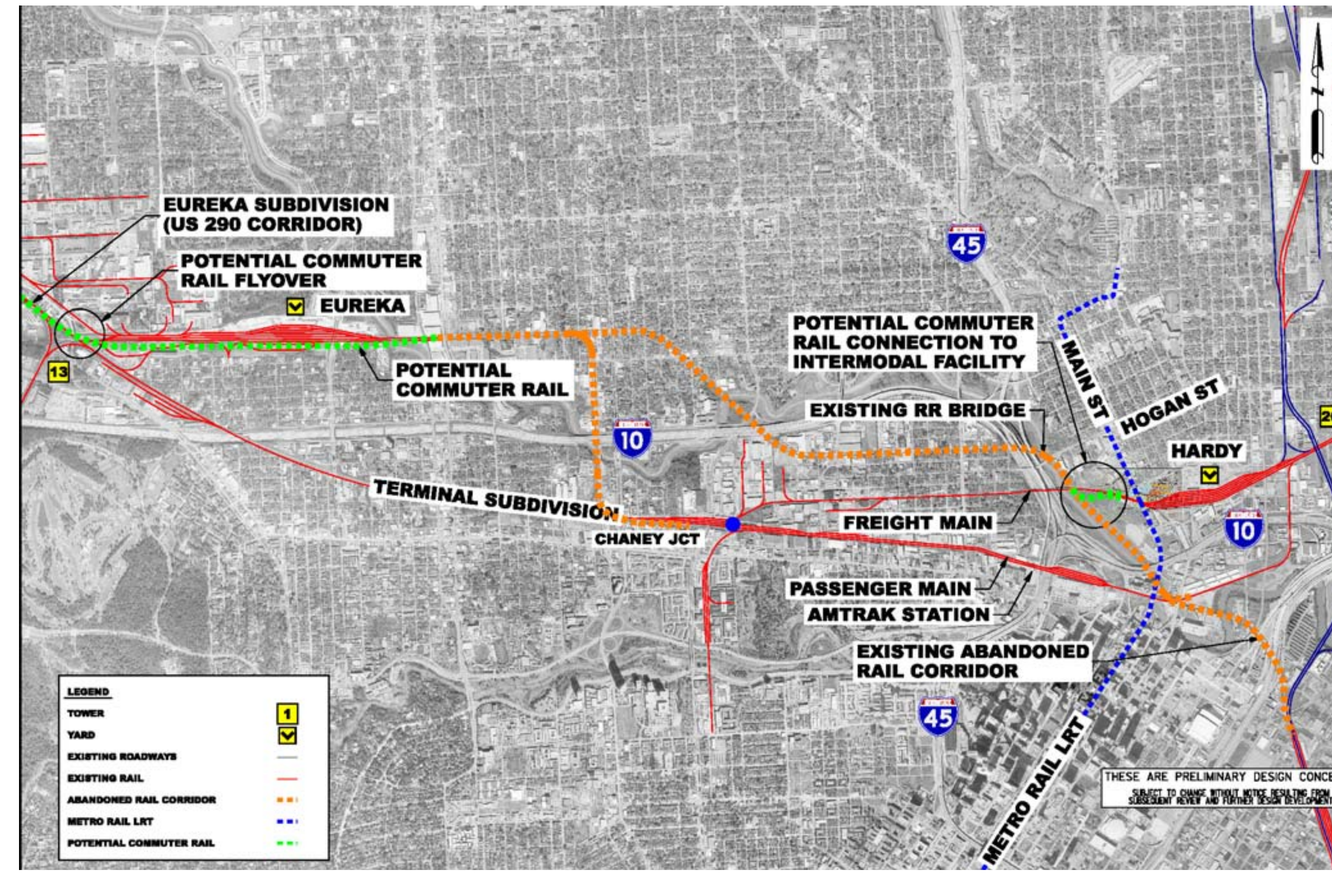


Figure C-22: Abandoned Rail Corridor Route

Figure C-23: Potential I-10 Rail Corridor Route

CHAPTER C-4 – HOUSTON RAILROAD INFRASTRUCTURE EXISTING CONDITIONS

As previously stated, an inventory of each of the existing rail corridors/subdivisions was conducted to determine the infrastructure that may potentially be available for commuter rail service. Locations of single or double track, passing sidings at least one mile in length, and average daily freight train volumes were identified for each rail subdivision in Houston and are shown in the following figures.

UPRR BAYTOWN SUBDIVISION

The UPRR Baytown Subdivision is a predominately single track railroad that runs between Baytown and Dayton, Texas. Rail traffic on the subdivision is bidirectional, with an average daily train count of 10 to 20 trains, most of which provide service to the local industries located on this line. BNSF has authority to operate its trains on the Baytown Subdivision from Dayton to just west of Baytown and has a rail yard just south of Dayton and west of the Sjolander plastics storage facility. Typically, BNSF traffic runs against the normal flow at times during the day in which they do not pose a conflict to normal operations. The Baytown Subdivision contains more than 20 industrial sidings or spur tracks allowing the railroads to serve the many petrochemical companies such as Exxon, Chevron, and Amoco. Due to the large volume of train traffic serving the local industries, instances occur where non-industry serving train traffic is delayed during the performance of normal customer service work.

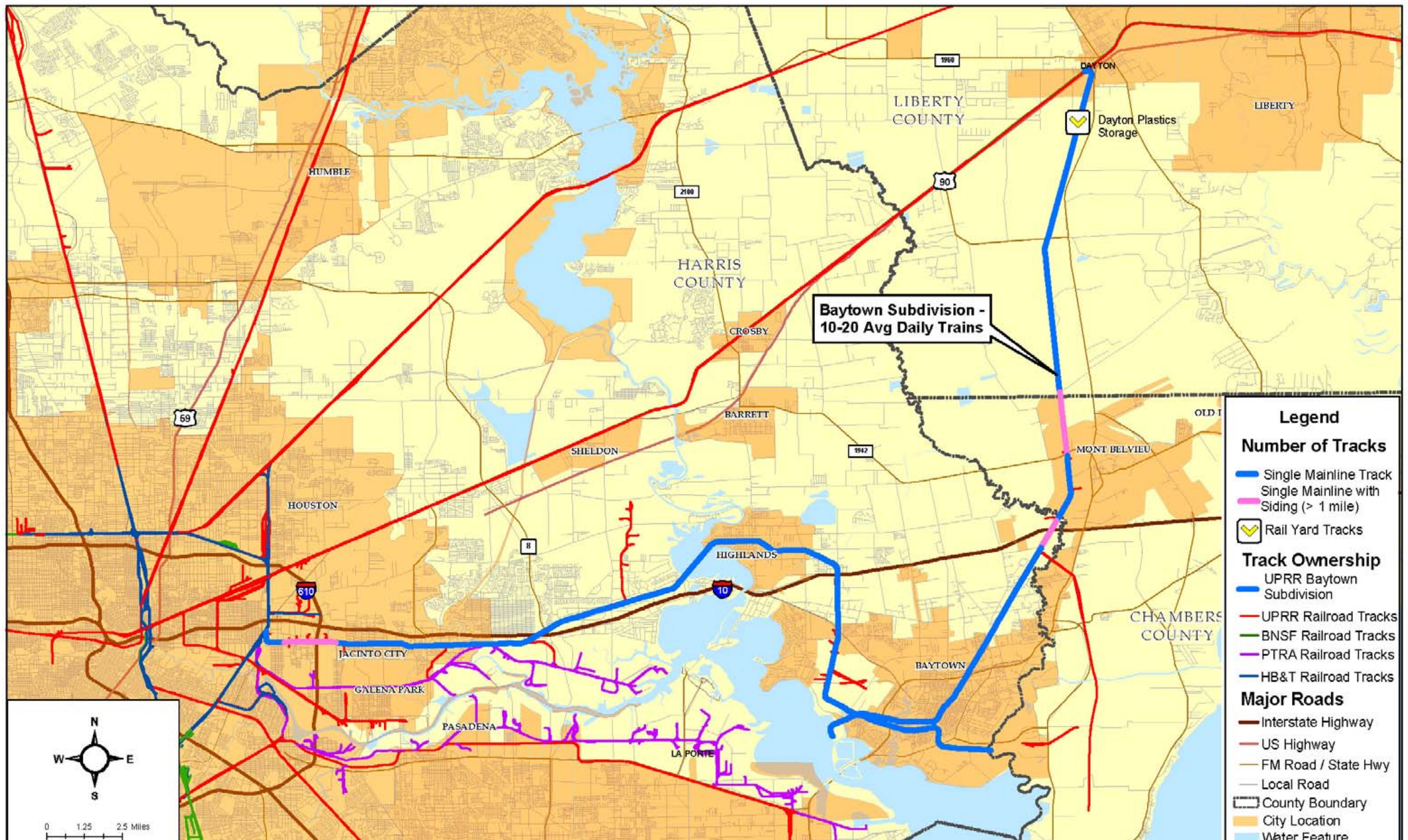


Figure C-24: UPRR Baytown Subdivision

UPRR Beaumont Subdivision

The Beaumont Subdivision is owned by UPRR and runs from Houston, Texas to Livonia, Louisiana and is a predominately single track railroad with limited sidings, normally utilized in a directional manner for eastbound traffic, and averaging around 60 to 70 trains daily near downtown Houston and 15 to 20 trains daily in outlying areas. Currently, there is a single mainline track from Gulf Coast Junction to Settegast Junction located in northeast Houston, turning into a double main line from Settegast Junction continuing north for approximately three miles to Dyersdale. Through traffic eastbound from Gulf Coast Junction gets caught into the mix with train traffic heading to/from Settegast Yard.

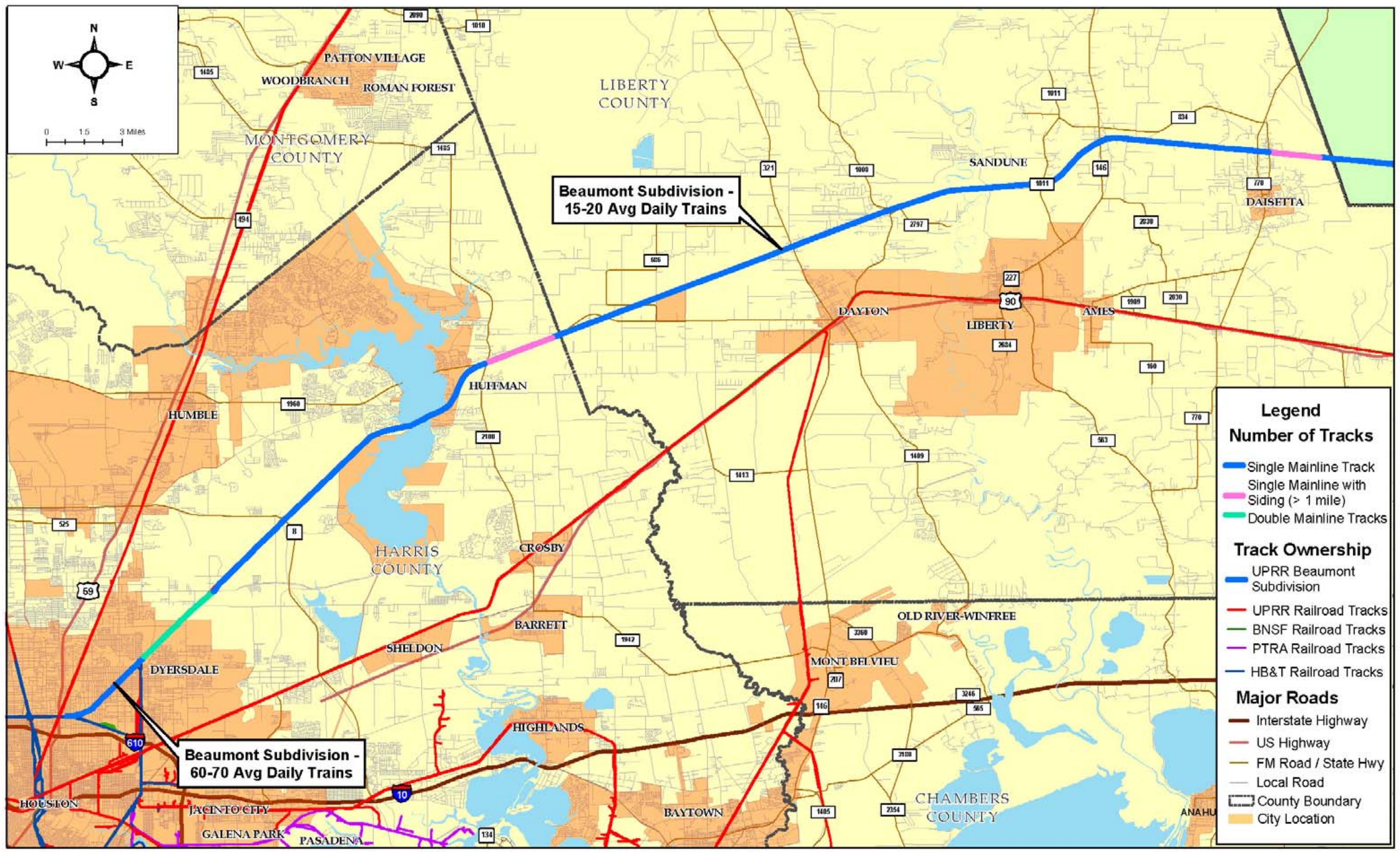


Figure C-25: UPRR Beaumont Subdivision

HB&T EAST BELT SUBDIVISION

The HB&T East Belt Subdivision runs through central Houston and is a double track mainline railroad with frequent locations where a train can cross over from one track to another. The railroad is utilized in a bidirectional manner, with trains dispatched to operate in both directions, averaging between 80 and 90 trains daily, depending upon location. There are numerous sidings, industrial tracks, and yards along this rail line, which is the primary route for access to Settegast Yard from the south.

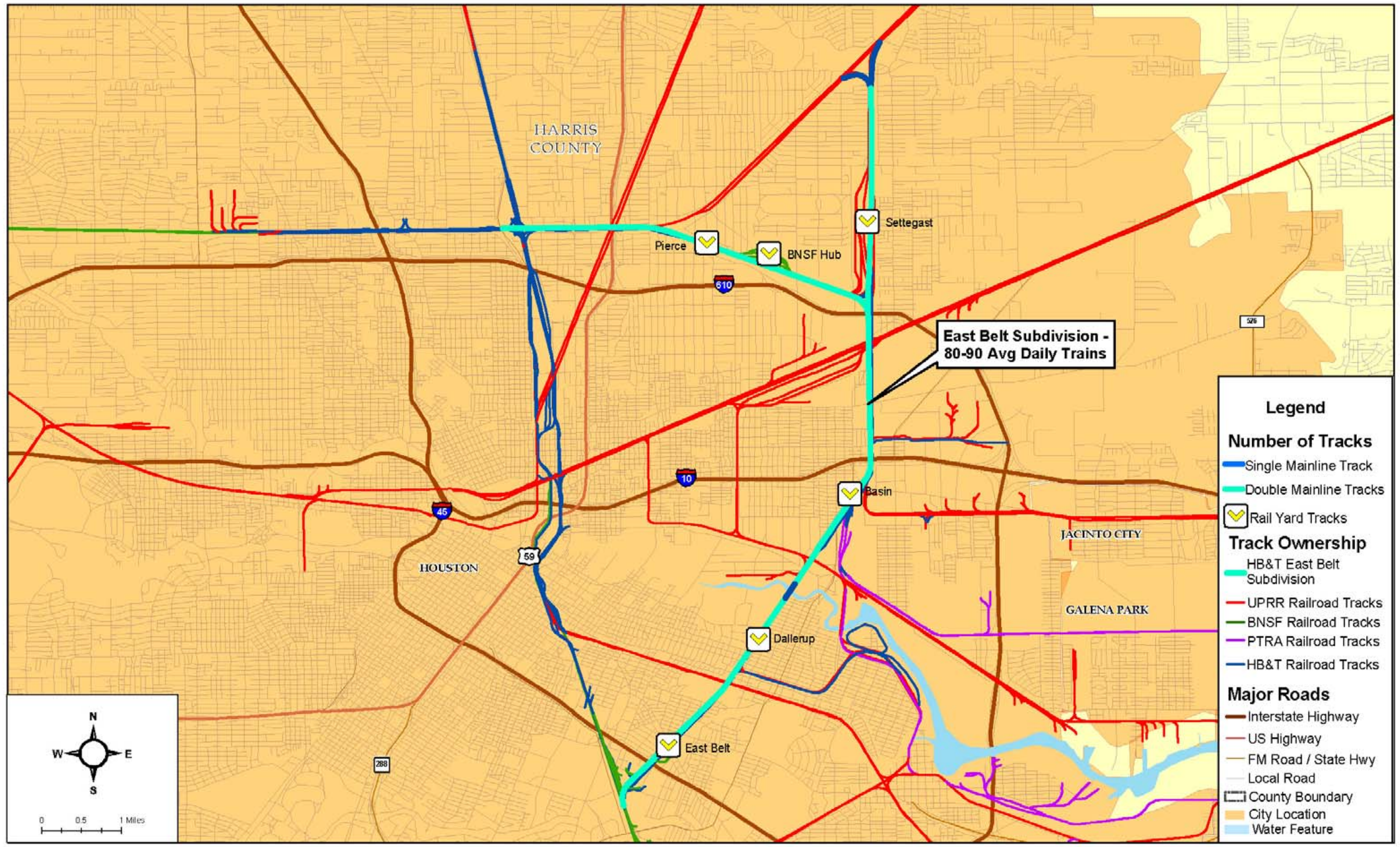


Figure C-26: HB&T East Belt Subdivision

UPRR Eureka Subdivision

The Eureka Subdivision originates in northwest Houston near the intersection of IH 10 and IH 610 and generally follows US 290 northwest to Hempstead. The subdivision is a single track railroad with limited sidings and an average daily train volume of 5 to 10 trains.

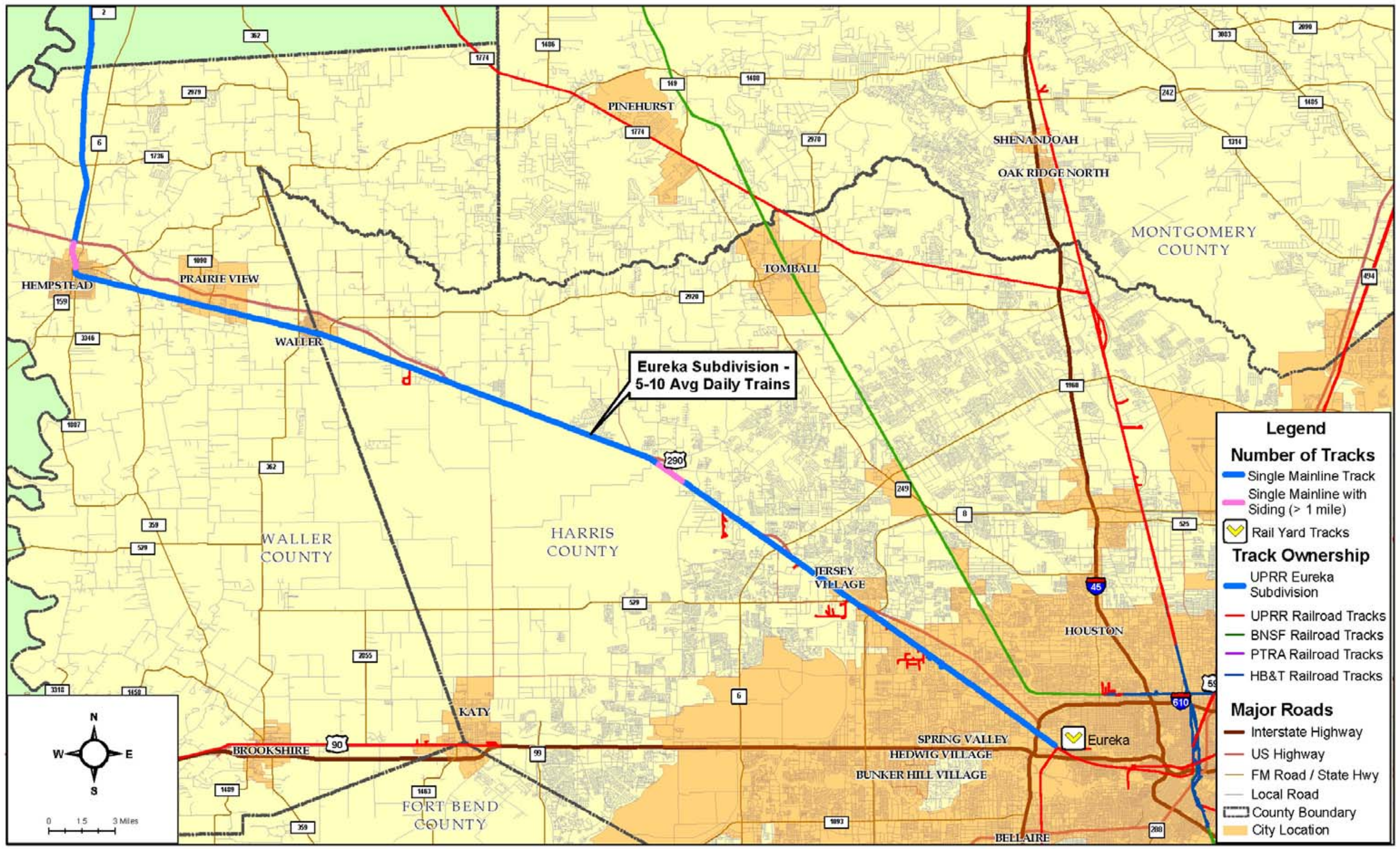


Figure C-27: UPRR Eureka Subdivision

BNSF Galveston Subdivision

The BNSF Galveston Subdivision consists of approximately 216 miles of BNSF owned and operated track with terminus points at BNSF's West Yard in Galveston, Texas, and Temple, Texas. Approximately 80 miles of the Subdivision are located within the study area. The BNSF Galveston Subdivision is predominantly a single-track railroad between Galveston and Tower 17 in Rosenberg. However, there are two main tracks between Alcoa and Alvin, where the BNSF Mykawa Subdivision connects to the BNSF Galveston Subdivision. In addition to the second mainline, there are numerous sidings between Galveston and Rosenberg. UPRR has the authority to operate trains over the BNSF Galveston Subdivision from Rosenberg to Alcoa. BNSF and UP operate 40 to 50 trains per day in a bidirectional manner, mainly between Rosenberg and Alvin.

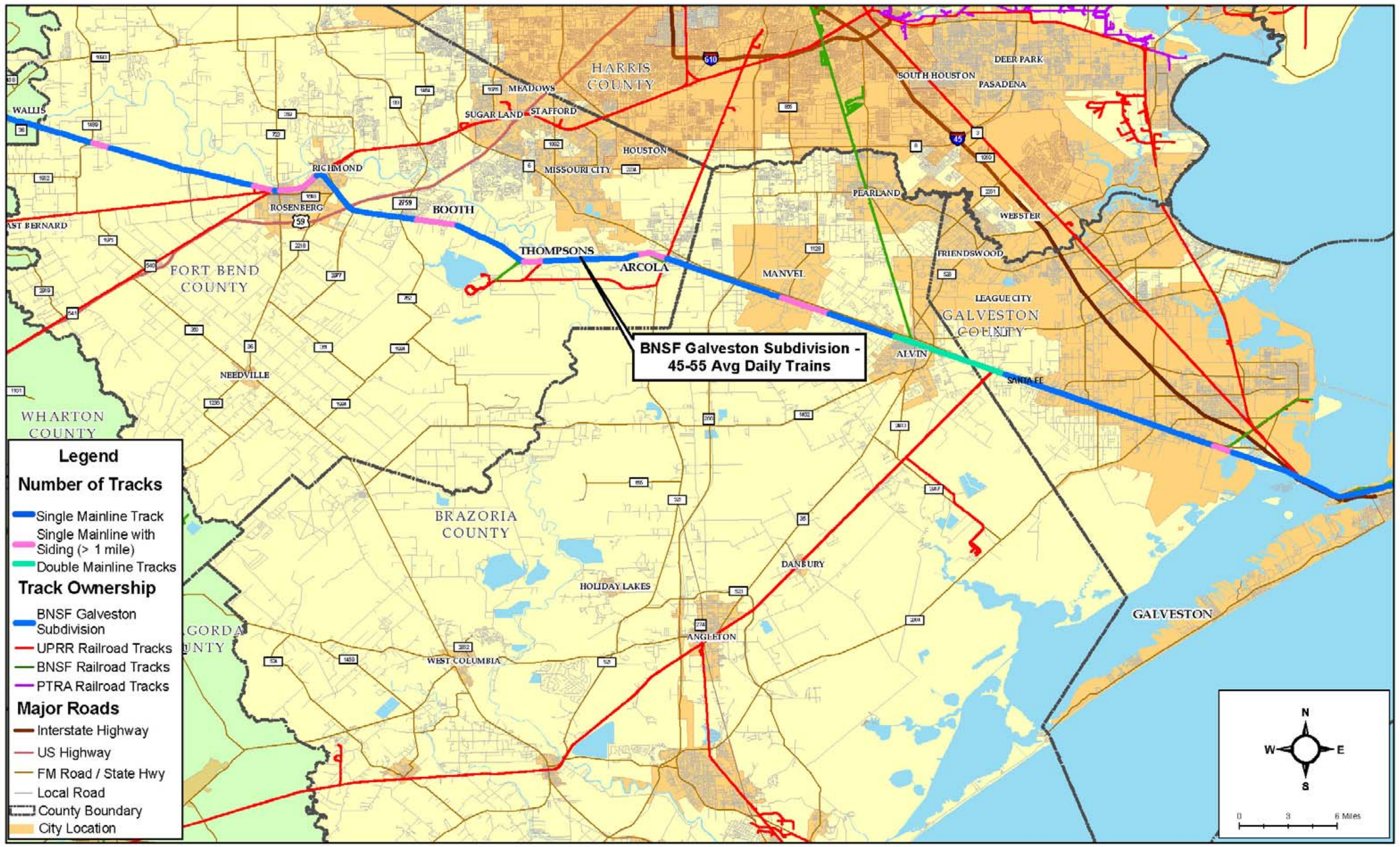


Figure C-28: BNSF Galveston Subdivision

UPRR GALVESTON SUBDIVISION

The UPRR Galveston Subdivision begins at South GH&H Junction, located south of downtown Houston, and essentially parallels IH 45 and SH 3 to Galveston. The UPRR Galveston Subdivision and the BNSF Galveston Subdivision jointly operate over a single track bridge spanning the Galveston Causeway accessing Galveston Island. The rail line is predominantly a single track line with limited passing sidings used in a bidirectional manner. The UPRR Galveston Subdivision averages 15 to 25 trains daily between GH&H Junction and Tower 30 (inside Loop 610), and 5 to 10 trains daily between Tower 30 and Galveston (outside Loop 610).

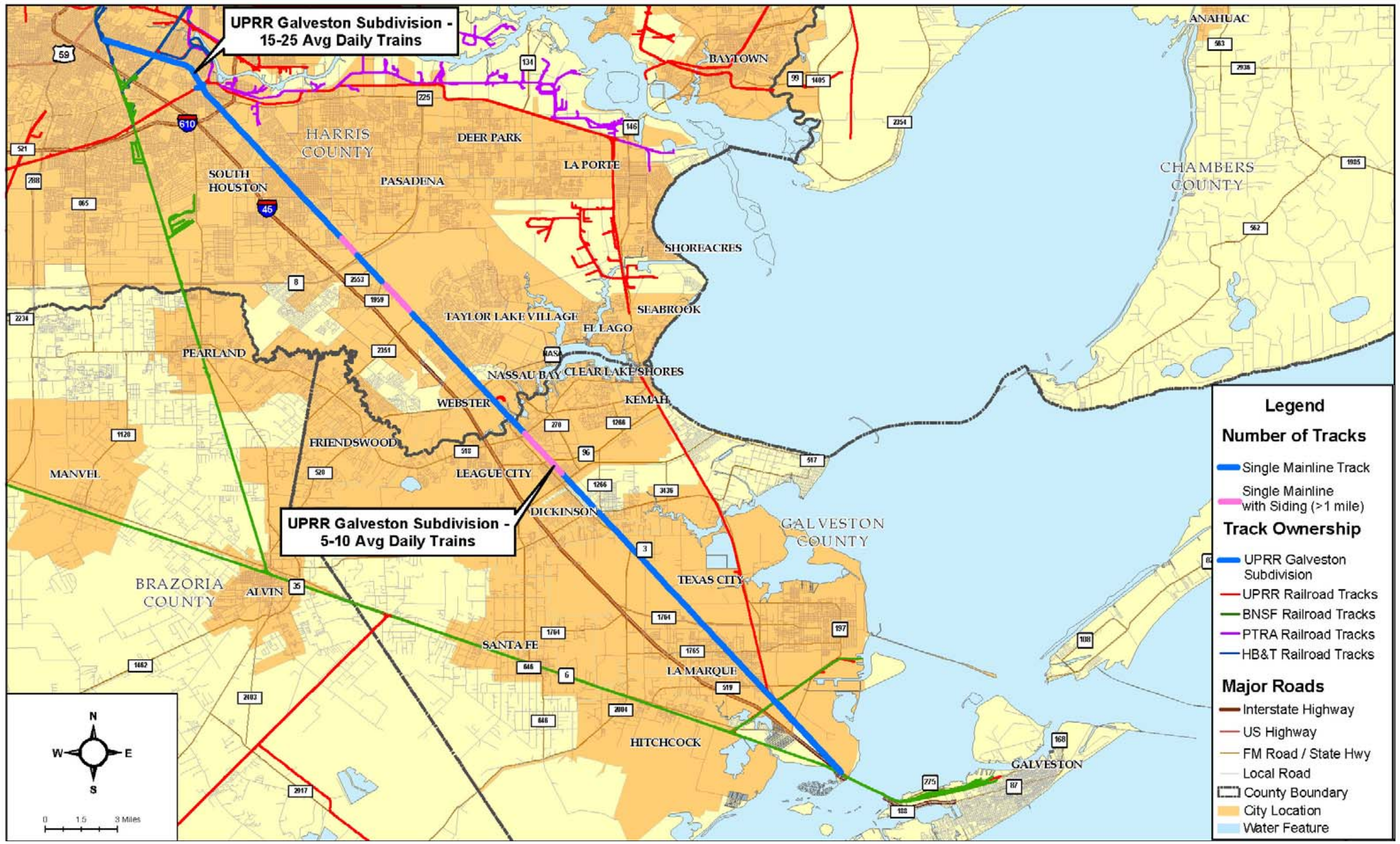


Figure C-29: UPRR Galveston Subdivision

UPRR Glidden Subdivision

The UPRR Glidden Subdivision begins at Harrisburg Junction in Houston and terminates at Kirby Yard east of San Antonio near Randolph Air Force Base. The subdivision is over 210 miles in length; however, approximately 50 miles are within the study area from Houston to Rosenberg. The subdivision is a single track railroad with passing sidings within the study area. A METRO test track runs parallel to the UPRR mainline from a location just east of Fannin Street toward the west for a distance of approximately 9,000 feet. Rail traffic on the Glidden Subdivision is bidirectional with an average daily train count of 30 to 40 trains. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly. The Glidden Subdivision is the main east-west route for UPRR, connecting the Ports of Long Beach and Los Angeles to Houston, and Houston to New Orleans. Due to the large volume of train traffic and the increasing volume of vehicular traffic, vehicular delays are typically experienced in Rosenberg, Richmond, Sugar Land, Stafford, and Missouri City. The proximity of US 90A and the presence of at-grade crossings increase the potential for hazards associated with the rail, vehicular, and pedestrian interface along this corridor.

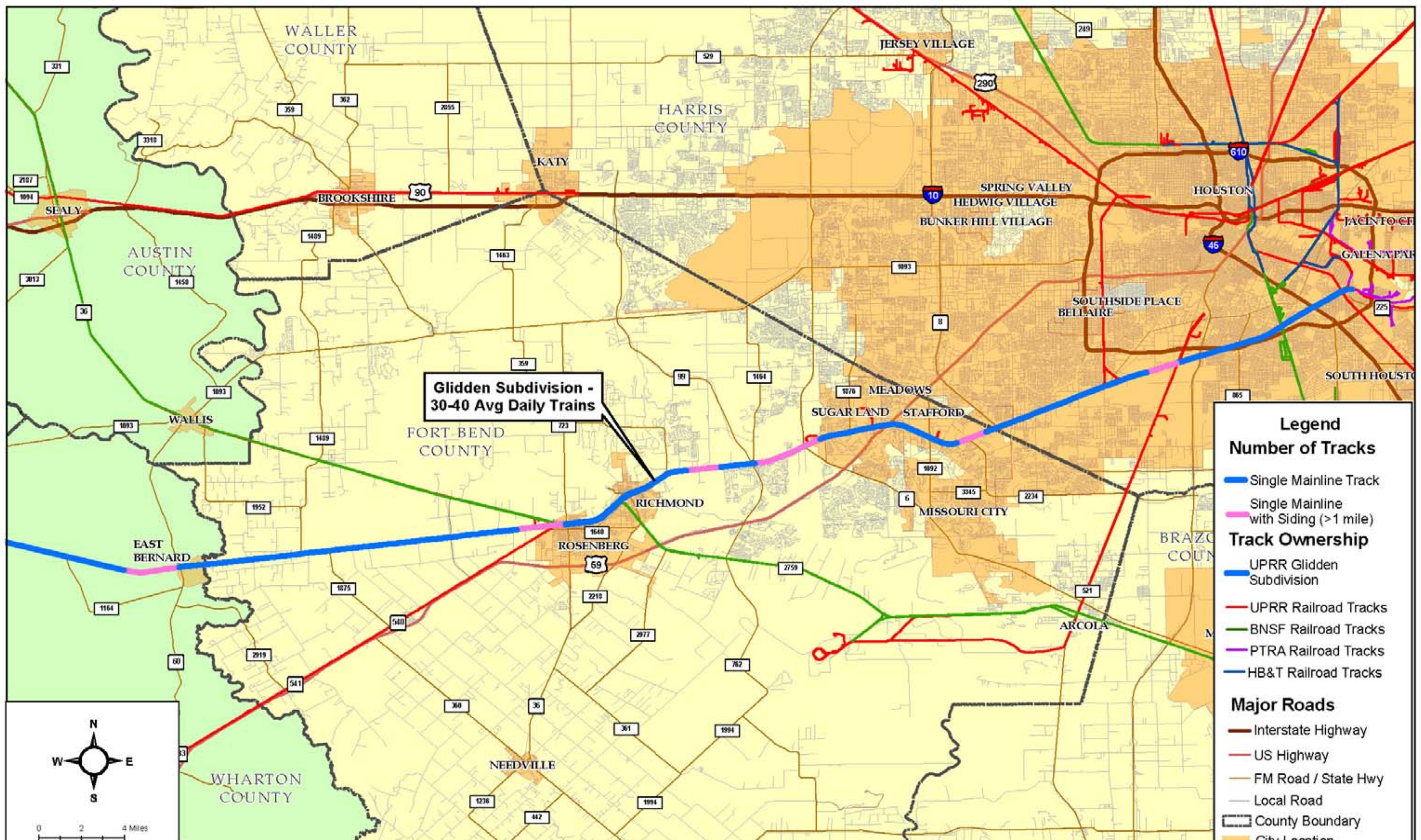


Figure C-30: UPRR Glidden Subdivision

BNSF Houston Subdivision

The BNSF Houston Subdivision consists of approximately 144 miles of BNSF owned and operated track with terminus points at Teague, Texas and northwest Houston; however, only 55 miles of the subdivision is within the study area. Predominantly a single-track mainline with minimal sidings, BNSF operates approximately 10 to 20 trains daily in a bidirectional manner on the Houston Subdivision.

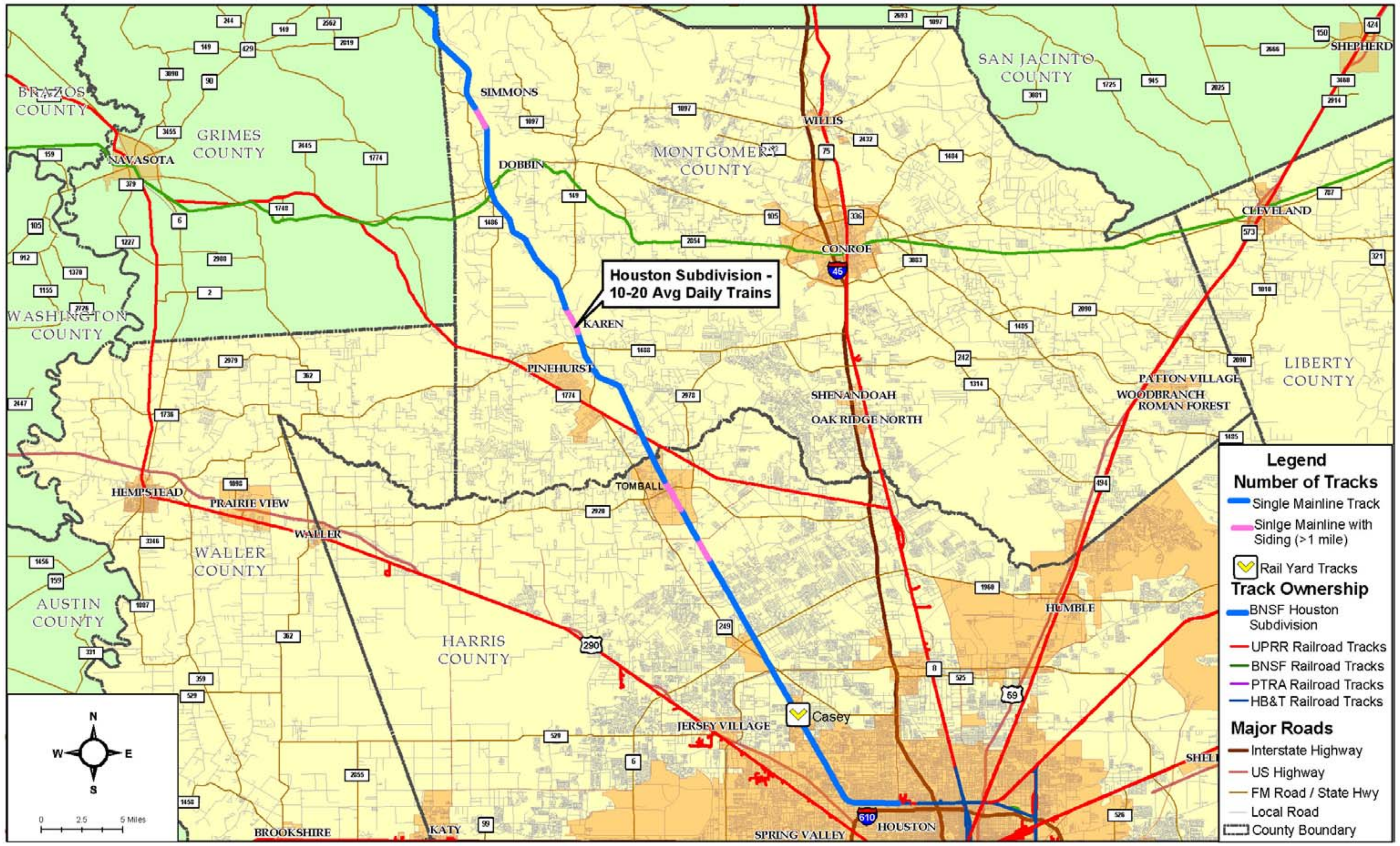


Figure C-31: BNSF Houston Subdivision

UPRR Lafayette Subdivision

The Lafayette Subdivision, owned and maintained by UPRR with 50 percent ownership interest sold to BNSF, is approximately 205 miles in overall length of which approximately 53 miles are within the study area. Predominantly a single track railroad within the study area, there are numerous sidings and industry tracks between Dawes and Dayton. The Lafayette Subdivision is utilized in a directional manner for westbound traffic and averages approximately 35 to 45 trains daily. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly. Due to the large volume of train traffic combined with the numerous local industries served by the railroads, increasing the rail traffic capacity of the Lafayette Subdivision for current and anticipated growth is essential.

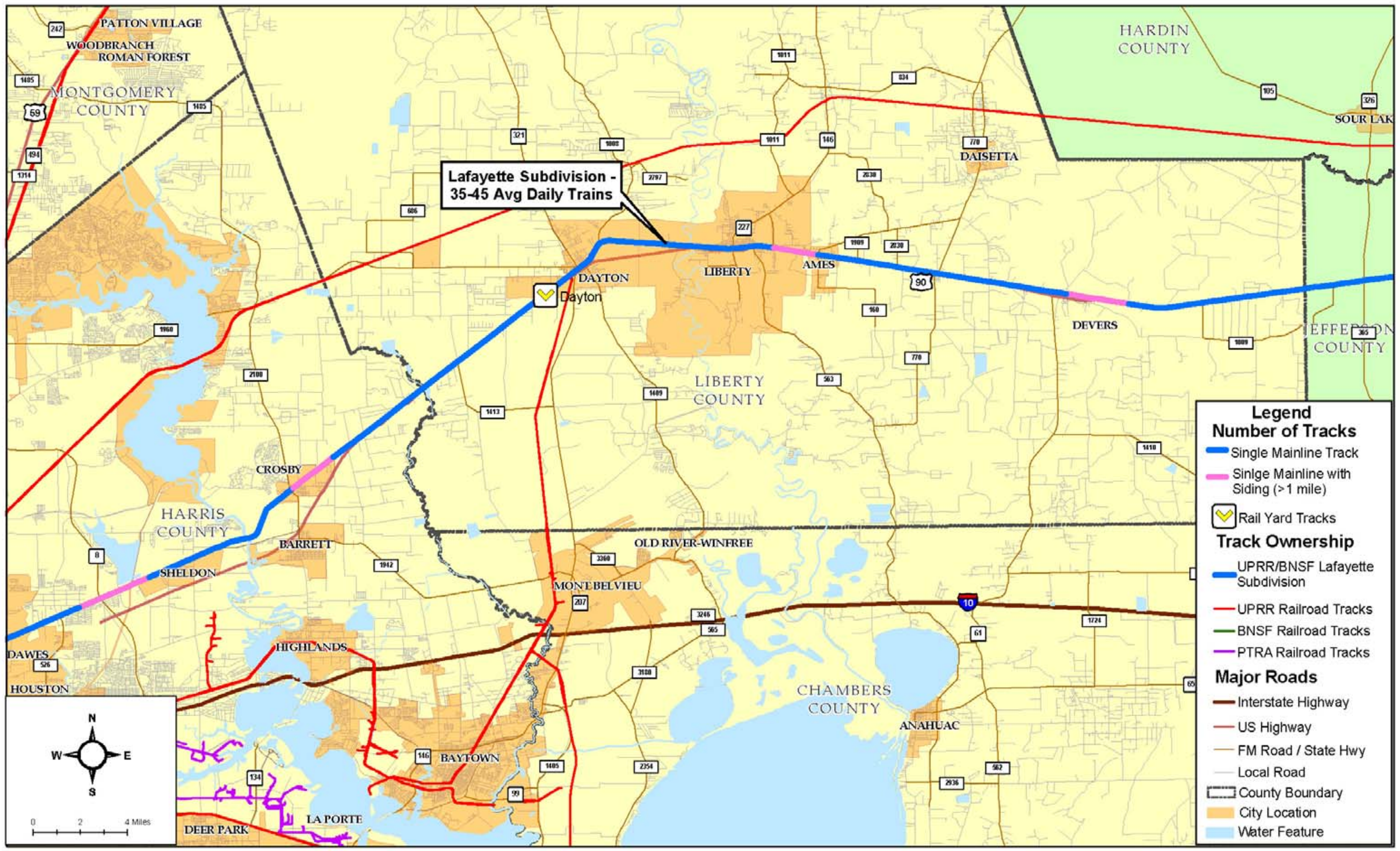


Figure C-32: UPRR Lafayette Subdivision

BNSF Mykawa Subdivision

The Mykawa Subdivision consists of approximately 20 miles of BNSF owned and operated track between Tower 81 (T&NO Junction) near the Mykawa/Griggs Road intersection in south Houston, to Alvin, Texas where the subdivision connects to the BNSF Galveston Subdivision. The Mykawa Subdivision, which parallels Mykawa Road, is predominantly a bidirectional single track railroad with numerous sidings that allow for trains to pass each other. The entire Subdivision is within the study area, with 25 to 35 BNSF and UPRR trains daily. Bordered by Hobby Airport to the east, Mykawa Road to the west and Airport Boulevard to the north, BNSF has two major yard facilities that handle their intermodal and auto operations for the region: Pearland/Mykawa and New South Yards.

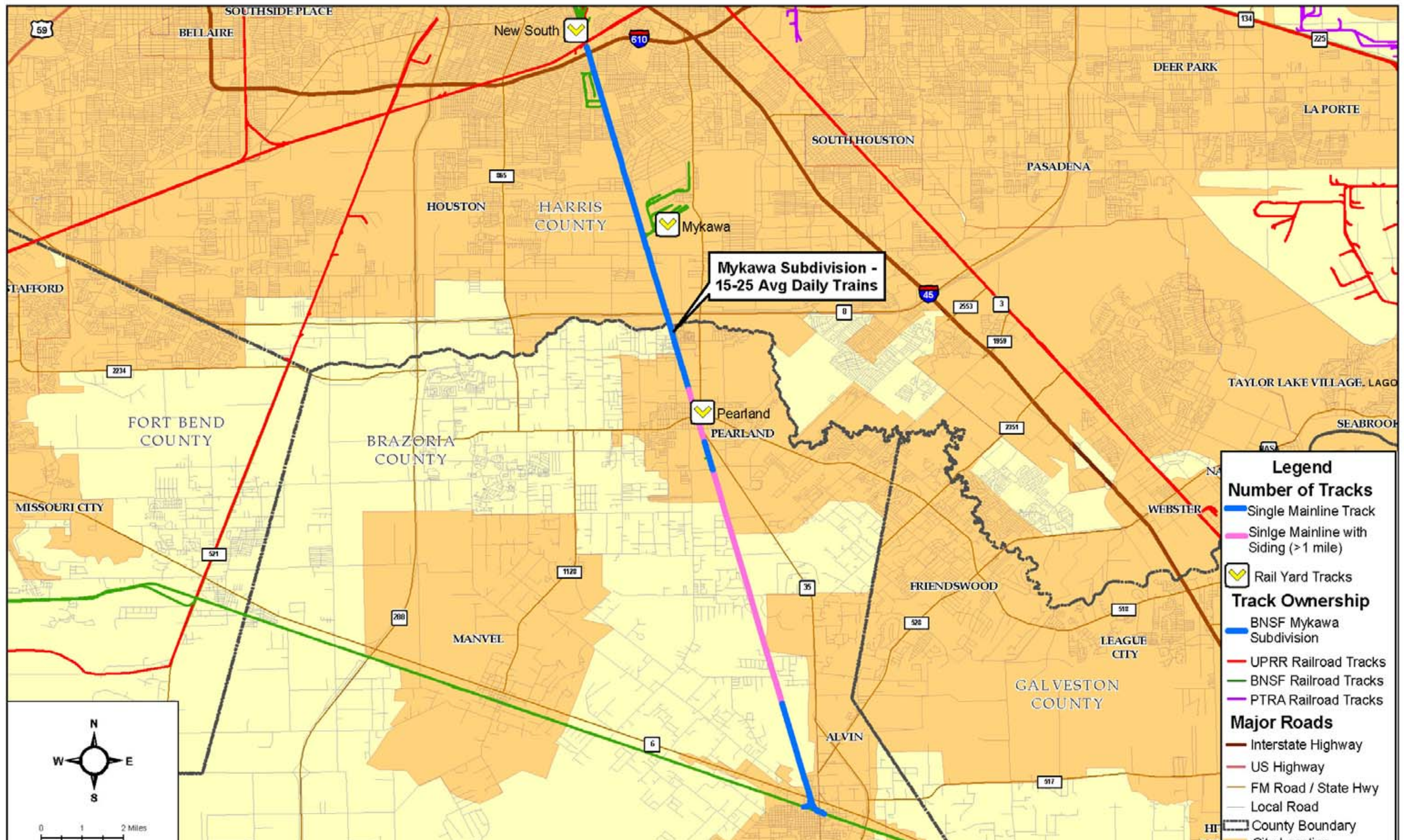


Figure C-33: BNSF Mykawa Subdivision

UPRR Navasota Subdivision

The Navasota Subdivision is approximately 100 miles in length, with terminus points at Spring Junction and Valley Junction near Bryan/College Station. The track is owned and operated by Union Pacific with approximately 27 miles of this line segment contained within the study area. Predominantly a single-track railroad with limited passing sidings, rail traffic is bidirectional with the majority of traffic inbound toward Houston and averages 15 to 25 trains daily. Currently, vehicular traffic may be delayed along the Navasota Subdivision due to the frequency of trains. The pending southern expansion of residential areas such as The Woodlands will increase the overall vehicular travel on effected roadways such as Kuykendahl.

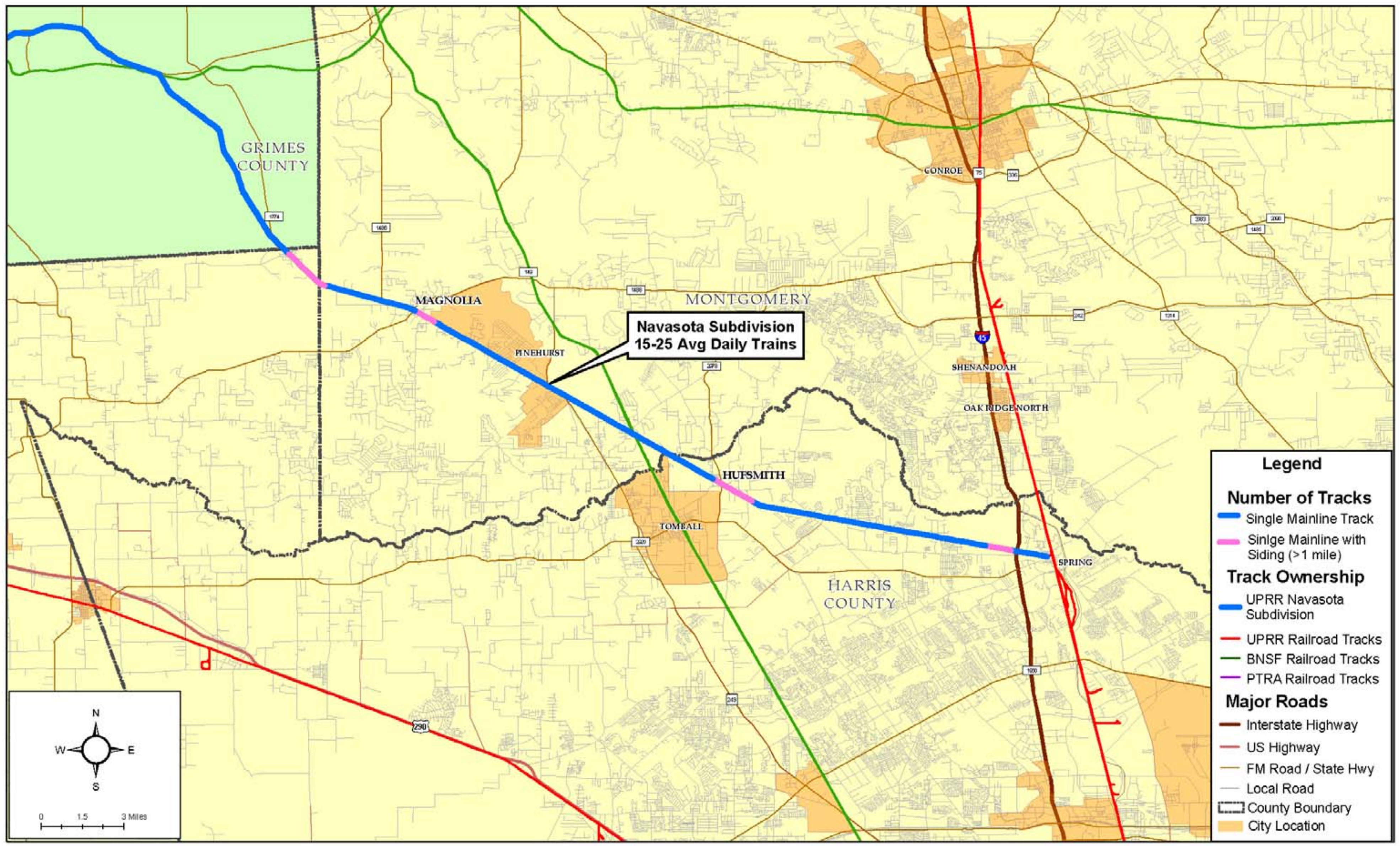


Figure C-34: UPRR Navasota Subdivision

UPRR Palestine Subdivision

The UPRR Palestine Subdivision is approximately 229 miles in overall length, with over 48 miles contained within the study area. This line is predominantly a single track railroad with limited sidings, however, approximately 14 miles of dual track exist between Belt Junction and Spring, Texas. Where the UPRR Navasota Subdivision connects to the Palestine Subdivision, the railroad is utilized in a bidirectional manner, with trains operating both northbound and southbound, averaging around 30 to 40 trains daily. From Spring Junction to Palestine, the predominant flow of traffic is outbound traveling north toward Palestine with a daily average of 8 to 10 trains. UPRR has two rail facilities: Lloyd Yard and the Westfield Auto Facility near Spring, Texas. Westfield is an auto facility for Gulf States Toyota, and Lloyd Yard is a “Storage in Transit” (SIT) Yard that typically stores covered hoppers and tank cars normally filled with bulk materials such as PVC powder, plastic pellets, or another commodity that is typically made in huge quantities so that manufacturing the product may be cost effective. Vehicular traffic at times is delayed along the Palestine Subdivision, particularly in the vicinity of Spring Junction, where the Navasota Subdivision connects to the Palestine Subdivision.

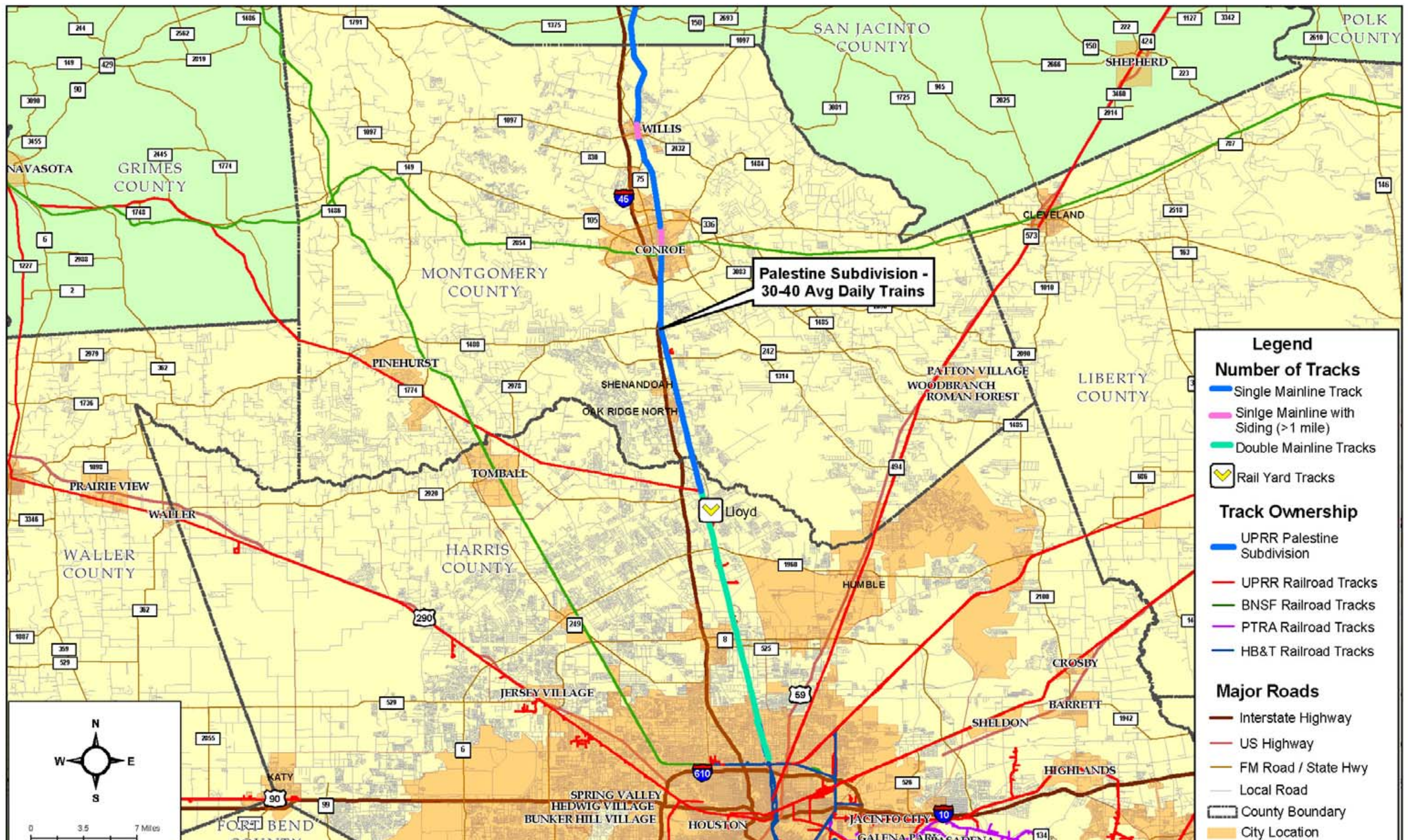


Figure C-35: UPRR Palestine Subdivision

UPRR Popp Subdivision

Approximately 21 miles in length, all of which is within the study area, the Popp Subdivision has terminus points at Pierce Junction, (just south and west of Loop 610 and 288 respectively), and Arcola. The Subdivision is owned and operated by the Union Pacific Railroad and averages two trains daily, which typically consist of coal trains serving Houston Light and Power's (Reliant Energy) Smithers Lake Power Plant. BNSF also accesses the Smithers Lake facility near Thompson, Texas via a line from Arcola. Predominantly a single-track railroad operated with bidirectional traffic, there is an approximately 1.5-mile siding at Fresno, midway between Pierce Junction and Arcola, which permits most trains to pass each other.

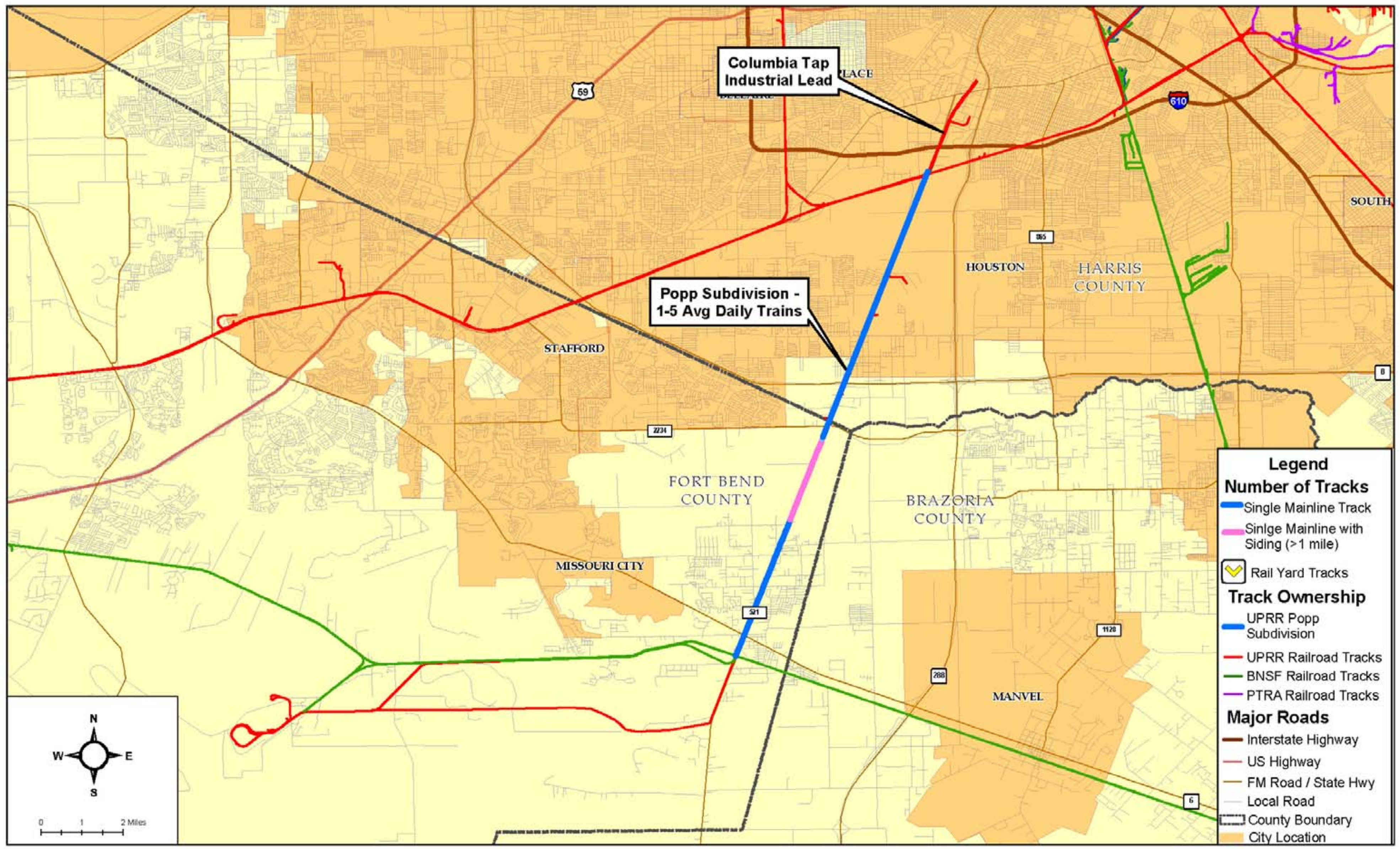


Figure C-36: UPRR Popp Subdivision

UPRR Strang Subdivision

The Strang Subdivision consists of approximately 21 miles of track from Tower 68 near Englewood Yard to Strang. At Strang Yard, the Strang Subdivision becomes the Seabrook Industrial Lead, serving the Bayport Industrial District and the Port of Houston's Bayport Terminal. The entire line segment is within the study area, and is currently owned and operated by UPRR, with trackage rights granted to the PTRA for intermodal movements. The rail traffic along the subdivision consists of approximately 30 trains per day, is bidirectional, and travels to and from Englewood Yard and the Port of Houston. From Deer Park Junction to Strang, this line is operated as two main tracks, the second main track being the PTRA "New" main, although trains of both railroads can use either track. The Port of Houston's Barbours Cut facility, the principal water/rail Intermodal Container Transfer Facility (ICTF) in Houston, is also accessed from the Strang Subdivision. Due to the large customer base served, local or industry trains often occupy the main track prohibiting the passage of additional trains.

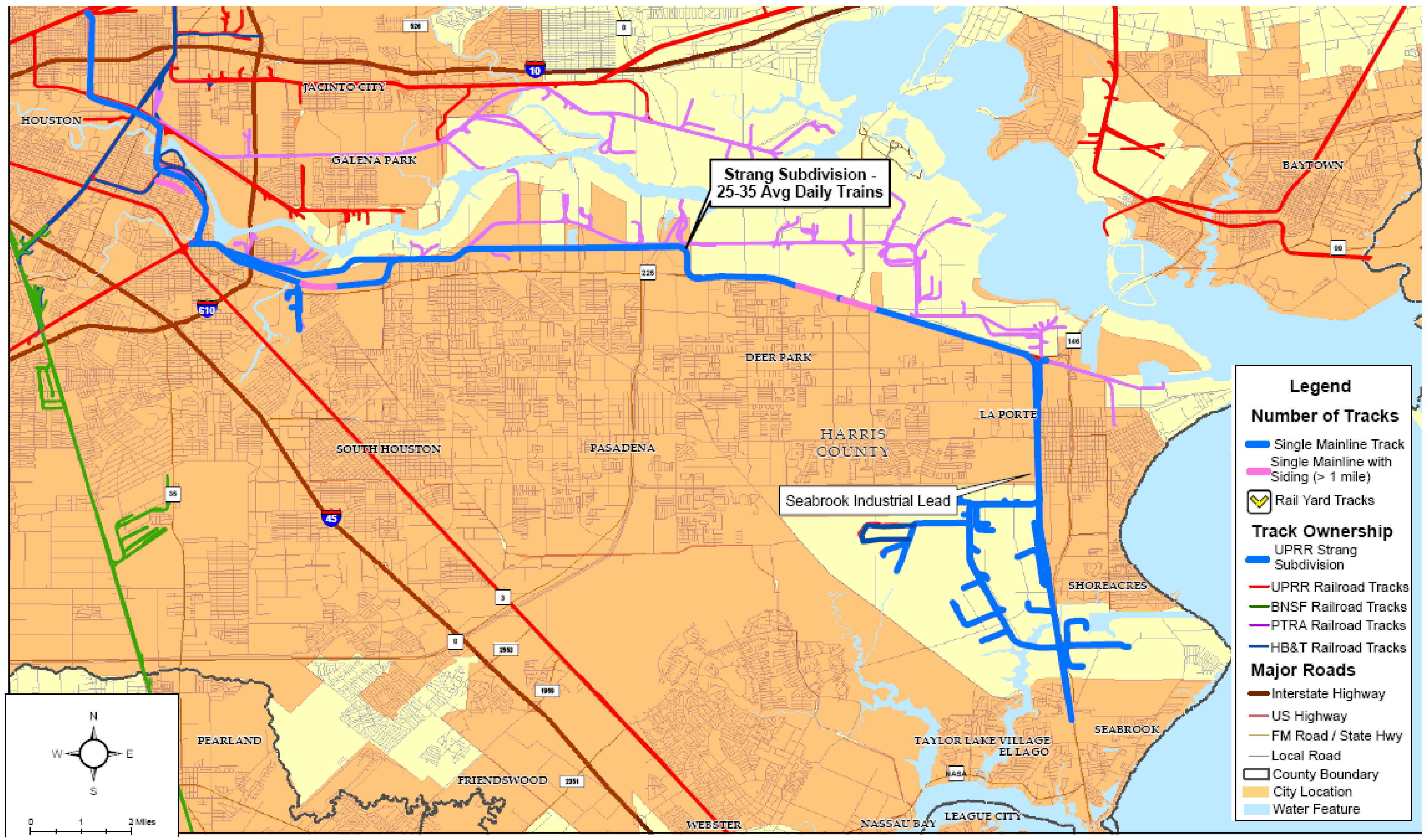


Figure C-37: UPRR Strang Subdivision

UPRR Terminal Subdivision

Approximately 22 miles in length, the Terminal Subdivision has terminus points at West Junction, located near the intersection of US 90 and Willowbend Boulevard. The entire length of the Terminal Subdivision is within the study area. The track is owned and operated by the Union Pacific and runs 20 to 90 trains per day, depending on location. The rail traffic along the Terminal Subdivision is primarily bidirectional, traveling to and from Englewood Yard. The Terminal Subdivision is the primary route used for connecting rail traffic from the West Coast to Houston, and is also used by Amtrak's Sunset Limited, with three trains eastbound and westbound weekly. At Chaney Junction, which is located just north and east of the intersection of Washington Avenue and Studemont Street, the two main tracks separate from each other. The northernmost track referred to as the Freight Main, between Sawyer and Holly Streets, runs down the middle of Winter Street. The southernmost track is referred to as the Passenger Main and parallels Washington Avenue to the north passing by the Amtrak Station. The Freight Main and the Passenger Main reconnect just west of Tower 26.

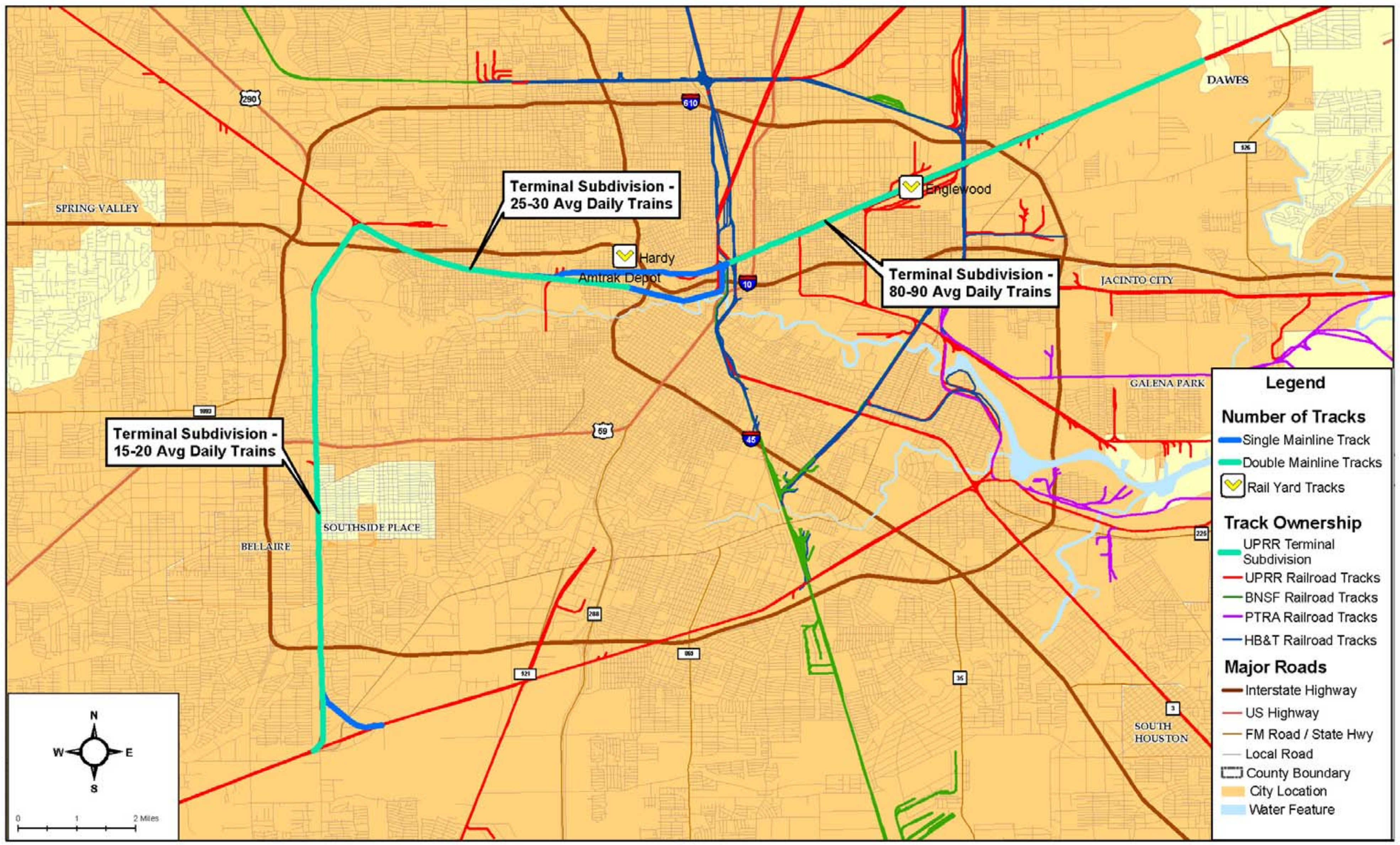


Figure C-38: UPRR Terminal Subdivision

HB&T West Belt Subdivision

Beginning at T&NO Junction (Tower 81), which is located north of the Loop 610 and Mykawa Road intersection, the West Belt Subdivision crosses Brays Bayou near the intersection of North Wayside Drive and Clinton Drive, and then continues toward Belt Junction, which is located just north of Loop 610 between IH 45 and US 59. The West Belt Subdivision is approximately nine miles in overall length, all of which is contained within the study area. The West Belt Subdivision is a double track mainline railroad with frequent locations where a train can cross over from one track to another. The railroad is utilized in a bidirectional manner, with trains dispatched to operate in both directions, averaging between 65 and 75 trains daily, depending upon location. There are numerous sidings, industrial tracks, and yards along this rail line. The West Belt Subdivision is the primary route for access to New South Yard from the south.

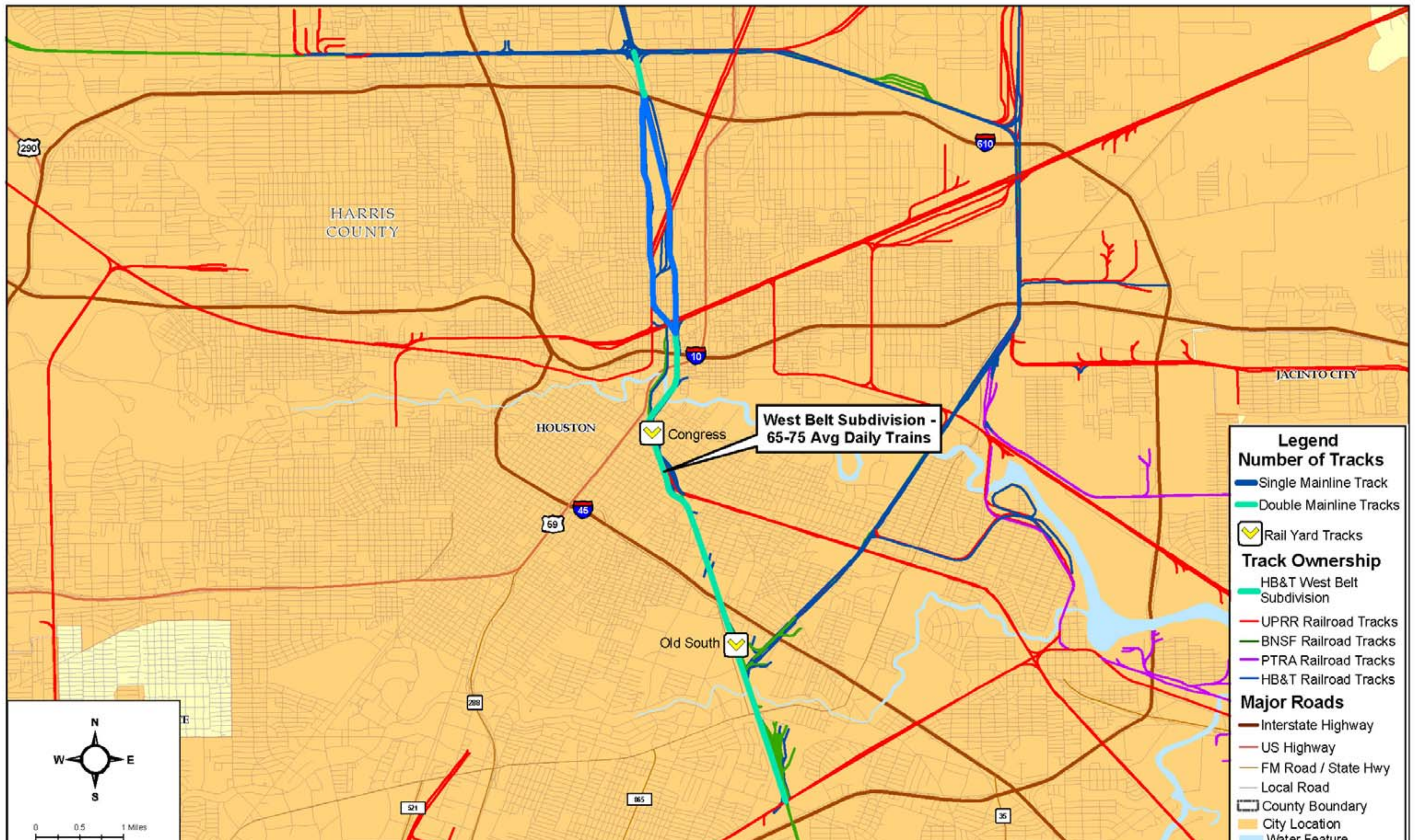


Figure C-39: HB&T West Belt Subdivision

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APPENDIX D – NORTH INTERMODAL TERMINAL CIRCULATION LOOP CONCEPT

A critical aspect of operating a regional commuter rail system involves planning well in advance for the ultimate needs that Houston will have in the center of the rail network, assuming that many routes are in operation. The convergence of multiple trains along multiple routes during the morning commute period will require a continuous flow of trains through all stations until the trains reach an operational hub terminal where they can dwell for longer periods of time (i.e., 5-30 minutes) following completion of their route. Stations that serve as "through" stations along the route need only accommodate a few tracks, since trains stop briefly and then continue in the same direction of travel after passenger boarding and alighting activity has concluded (i.e., 1-2 minutes).

The content of this chapter addresses the special considerations and operational needs at urban core of the rail network, and the related configuration and operations of METRO's North Intermodal Terminal.

D-1.1 North Intermodal Terminal Access and Circulation

The options for implementing dedicated commuter rail tracks inside Loop 610, ultimately providing passenger train access to the proposed North Intermodal Terminal (NIT) near Downtown, will likely require considerable new or reactivated right-of-way and track, with a number of new structures required. However, commuter rail service is plausible within the urban core, and when such infrastructure is in place, the NIT can be functional as the major intermodal facility to serve the Central Business District (CBD). However, the NIT is space constrained and ultimately could serve only as an online station when a large regional system is in operation.

With a sufficient investment in new commuter rail infrastructure, penetrating Houston's urban core with commuter rail is possible. The limited number of platform tracks at the NIT could ultimately serve many trains from all points of the region. Operational concepts, as discussed in the following sections, have therefore been investigated that would serve to facilitate the flow of trains through the NIT.

Each identified route accessing the urban core must be able to reach the NIT and potential commuter rail traffic flow patterns to the downtown area are shown in **Figure D-1.** Traffic along new commuter rail lines adjacent to the Palestine and West Belt RR Subdivisions could connect to the Terminal RR Subdivision near Tower 26 and enter the NIT from the east.

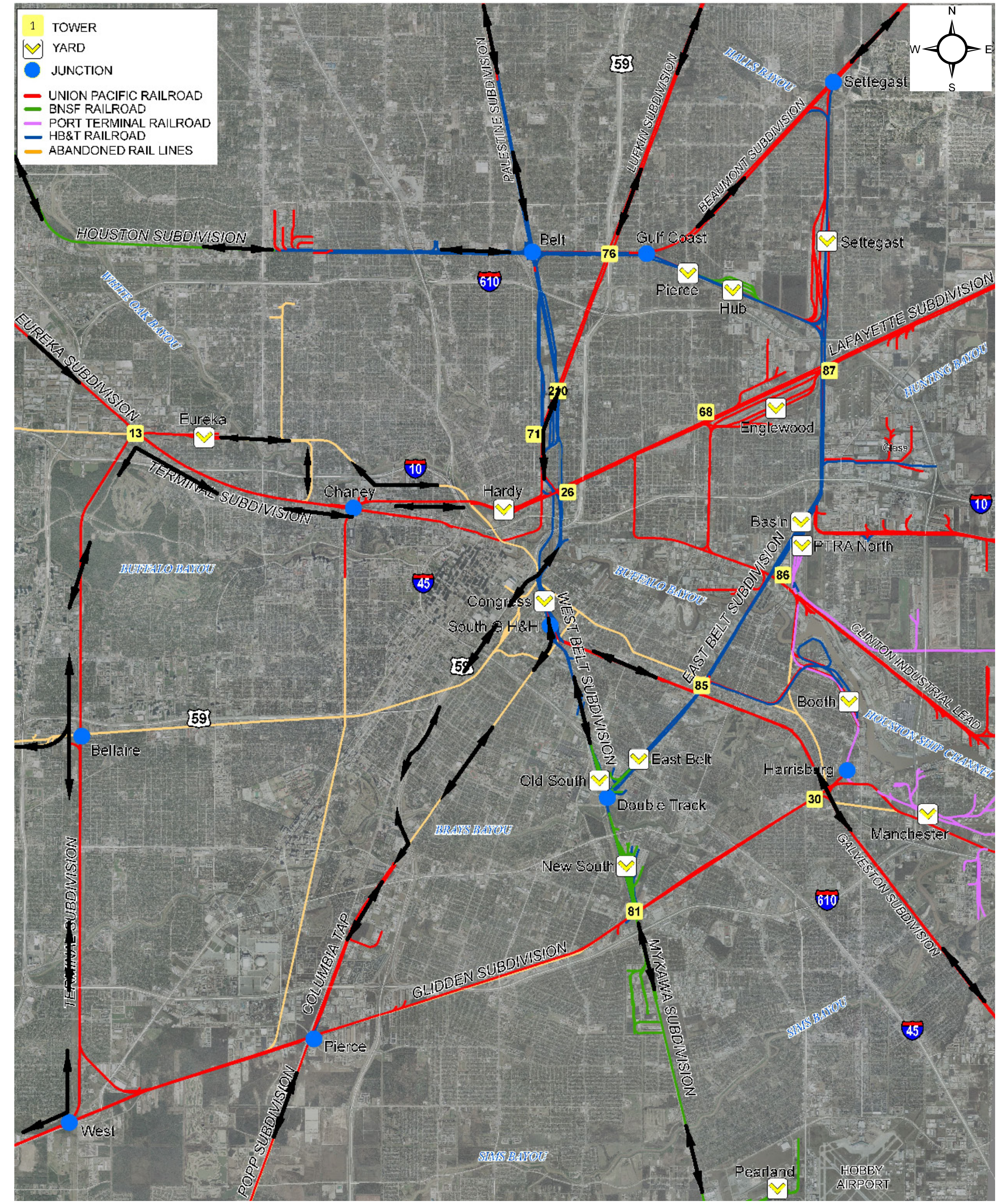

Figure D-1: Potential Commuter Rail Traffic Flow Patterns

The same traffic flow could be achieved via the existing Terminal RR Subdivision passenger main, which is currently used for Amtrak Service. Access from the west and southwest on dedicated passenger tracks would require new right-of-way to be obtained alongside the existing Terminal RR Subdivision freight main. Concepts investigated include the placement of passenger tracks over an existing drainage channel as well as shared right-of-way use with a power line utility easement.

Traffic from the Eureka RR Subdivision could follow the abandoned rail corridor or utilize a new track adjacent to the Terminal RR Subdivision freight main to enter the NIT from the west. Other access routes also approach from the east alongside the Terminal RR Subdivision passenger mainline.

A critical element to the implementability of the identified potential commuter rail routes is the protection of right-of-way needed for the potential access routes. For example, the right-of-way in abandoned RR corridors in the region should be protected to provide potential commuter rail access into downtown. Preliminary analysis shows that commuter rail traffic from the west on the Terminal and Eureka RR Subdivisions as well as traffic from the south on the Popp RR Subdivision, may potentially access the NIT through the use of abandoned corridors.

Additionally, the right-of-way along existing freight rail lines and major roadways, such as SH 288 and the Westpark Tollway, should be protected for potential use as commuter rail corridors. The abandoned right-of-way adjacent to the Westpark Tollway (currently owned by Houston METRO) could potentially be used for a commuter rail line from west of Houston into downtown, which would require a connection to a dedicated commuter rail line adjacent to the Terminal RR Subdivision freight main, as described earlier, with the tracks joining near the Bellaire Junction.

As the converging commuter rail access routes to the "center" of the rail network were studied, the need to "turn" passenger trains was recognized as a critical element when the regional system reaches maturity.

Through the use of new track in abandoned right-of-ways as well as new connecting track at junctions, proposed new track configurations would provide commuter rail traffic flow patterns of train routing referred to as the NIT Circulation Loop. These improvements and circulation patterns shown in **Figure D-2** appear feasible, based on preliminary assessments**.**

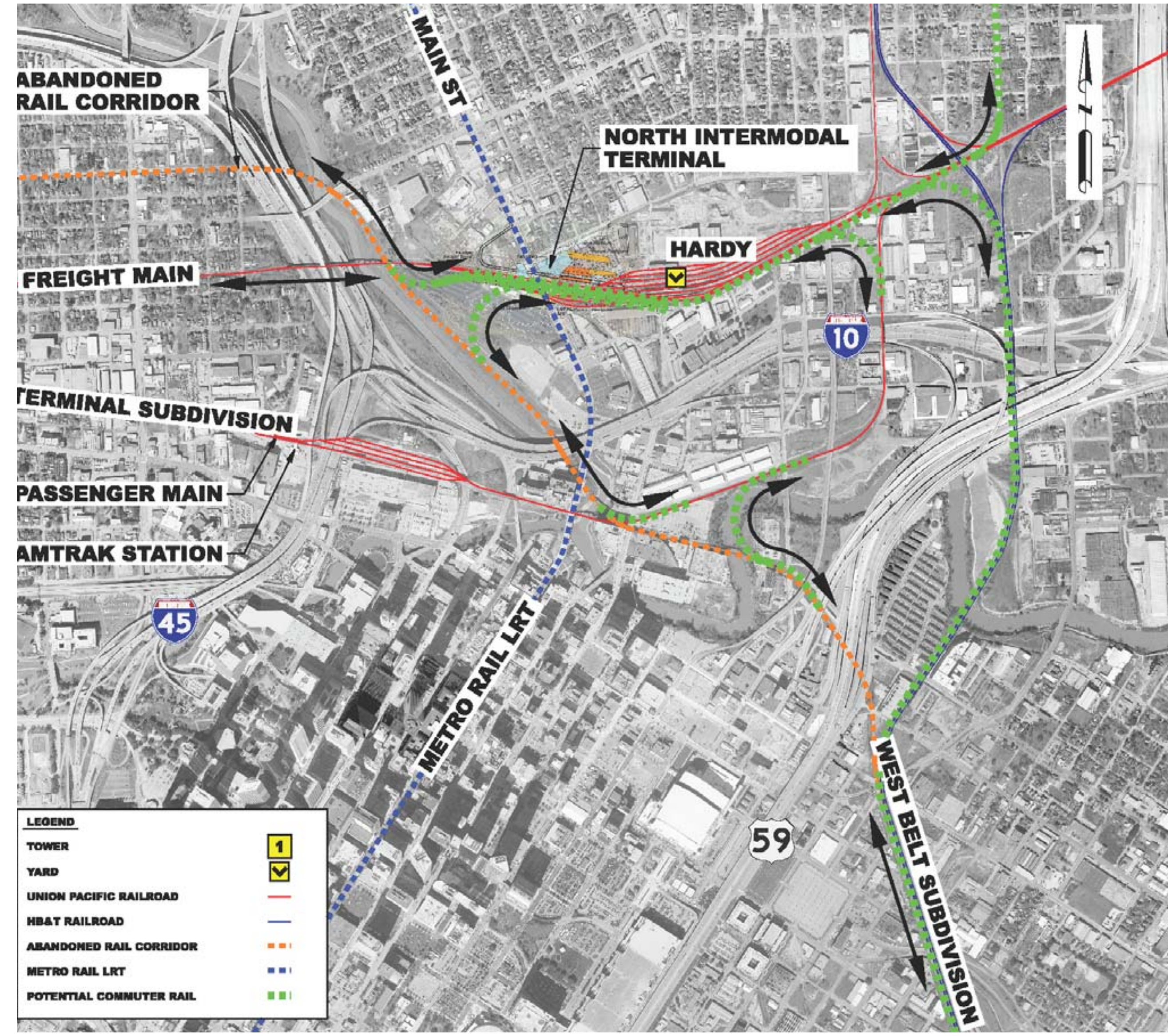

Figure D-2: Potential Commuter Rail Loop Circulation Pattern

In order to maintain an effective circulation path through the proposed NIT loop, new connecting tracks between the different approaching access routes would be required. Of particular note is the connection between the abandoned corridor along the bayou south of the NIT location and the west access tracks, as shown in **Figure D-3**. Adding this connection appears to impact the location or length of the platforms for commuter and other passenger trains, based on the conceptual layouts of the NIT.

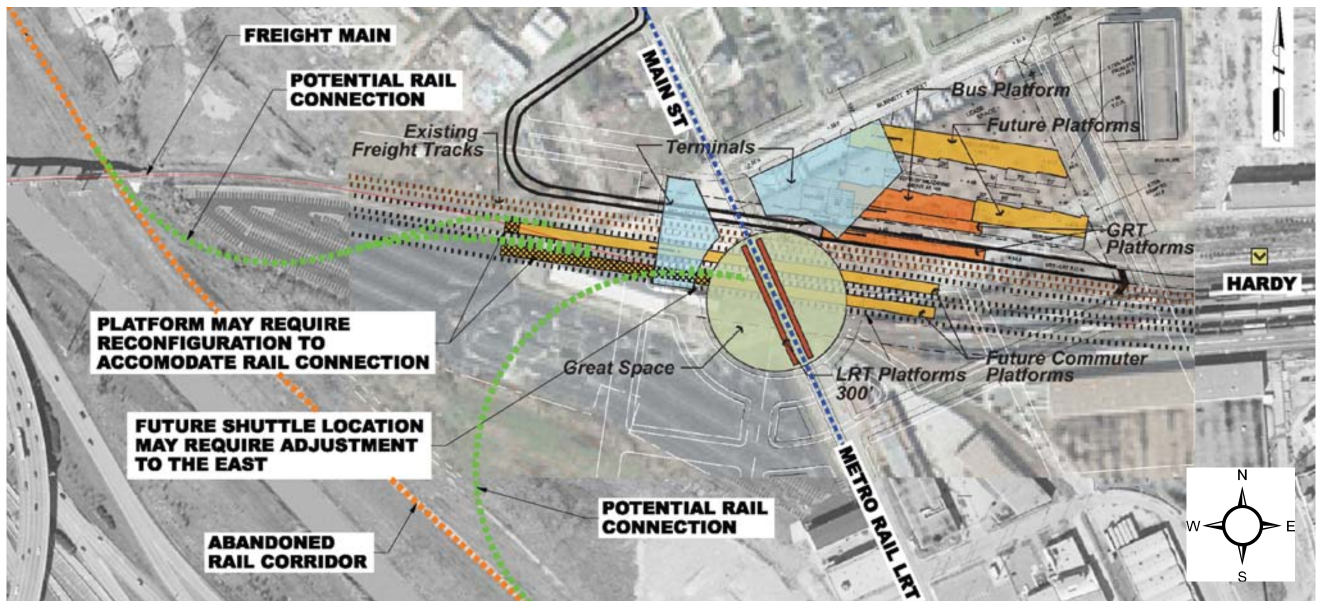

Figure D-3: North Intermodal Terminal Concept Plan (Aerial View)

As shown in **Figure D-4**, both platforms may require reconfiguration, moving them to the east, with the southerly platform being impacted the most. As currently shown, the rail connection would cross the west access track alignment at-grade and may create an operating conflict if all platforms are to be served from that connection. Coordination and design development of the NIT site and associated rail connections are critical to resolve these conflicts, including the requirement for the commuter rail tracks to be placed on the south side of the freight main.

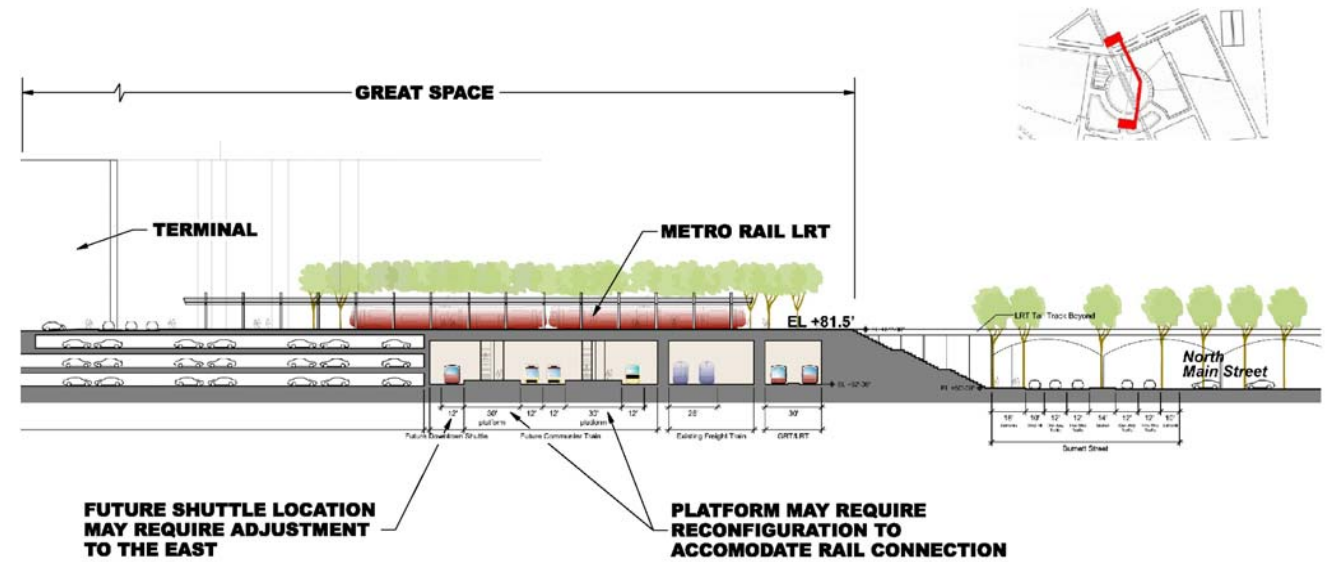

Figure D-4: North Intermodal Terminal Concept Plan (Profile View)

D-1.2 Operational Benefits of Circulation Concept

A circulatory pattern of train operations may be achieved using the existing Terminal RR Subdivision passenger main, reactivated sections of abandoned ROW, and the addition of connection tracks between different RR subdivisions and flyover structures. The resulting NIT circulation "loop" would allow the NIT to function effectively as a "through-station" where trains would not need to be reversed in direction (i.e., push-pull operations), but travel in a loop as illustrated earlier in this Appendix. This circulation pattern would minimize the conflicts associated with push-pull type commuter rail equipment and may reduce the overall need for associated passing tracks along the freight main corridor.

D-1.3 Potential Variations of Principal Access Routes inside Loop 610

As discussed previously in Appendix C, there are multiple alternatives and variations in which the principal access routes described earlier may ultimately reach the NIT. For example, commuter rail in the Popp RR Subdivision corridor may follow abandoned right-of-way, the SH 288 corridor, or a combination thereof before reaching the NIT. Additionally, commuter traffic from the Eureka and Terminal RR Subdivision corridors may follow some combination of an abandoned corridor along Yale Street, an abandoned corridor along Spring Street, the freight rail corridor along Winter Street, and/or the existing Terminal RR Subdivision passenger mainline. Potential commuter rail alignments from west of downtown Houston into the NIT are shown in **Figure D-7**.

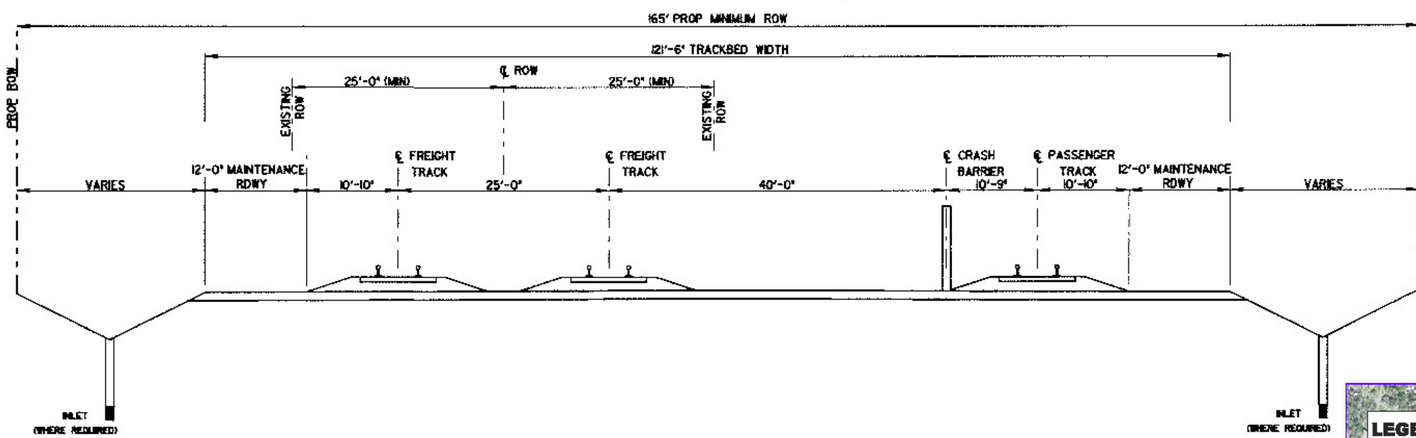

Figure D-5: Winter Street Alignment Typical Section

The conceptual commuter rail alignment along Winter Street was analyzed as a third track separated by a barrier south of two freight tracks as shown in the typical section above in **Figure D-5**. The potential Winter Street commuter rail alignment may follow along the south side of the Terminal RR Subdivision freight tracks into the NIT with a connection to the potential Yale Street alignment via a flyover structure crossing above the freight tracks as shown in **Figure D-7**. The Yale Street alignment follows an abandoned rail corridor between 8th Street and the Terminal RR Subdivision alongside the existing Yale Street right-of-way.

Also shown in **Figure D-7** is the access to NIT circulation loop from the southeast utilizing abandoned right-of-way owned by the City of Houston which may connect underneath US 59 to access routes connecting to Galveston and the Popp RR Subdivision. Further analysis of this alternative would be required to coordinate with the interchange with US 59.

Other potential variations in principal access routes include route alternatives from the Palestine and West Belt RR Subdivisions on the east side of the proposed NIT location. Commuter rail facilities from the north along the Palestine RR Subdivision corridor may potentially utilize abandoned right-of-way a few blocks to the east of the West Belt RR Subdivision freight lines, as shown in **Figure D-6**, to underpass the existing Terminal RR Subdivision freight lines at Tower 26.

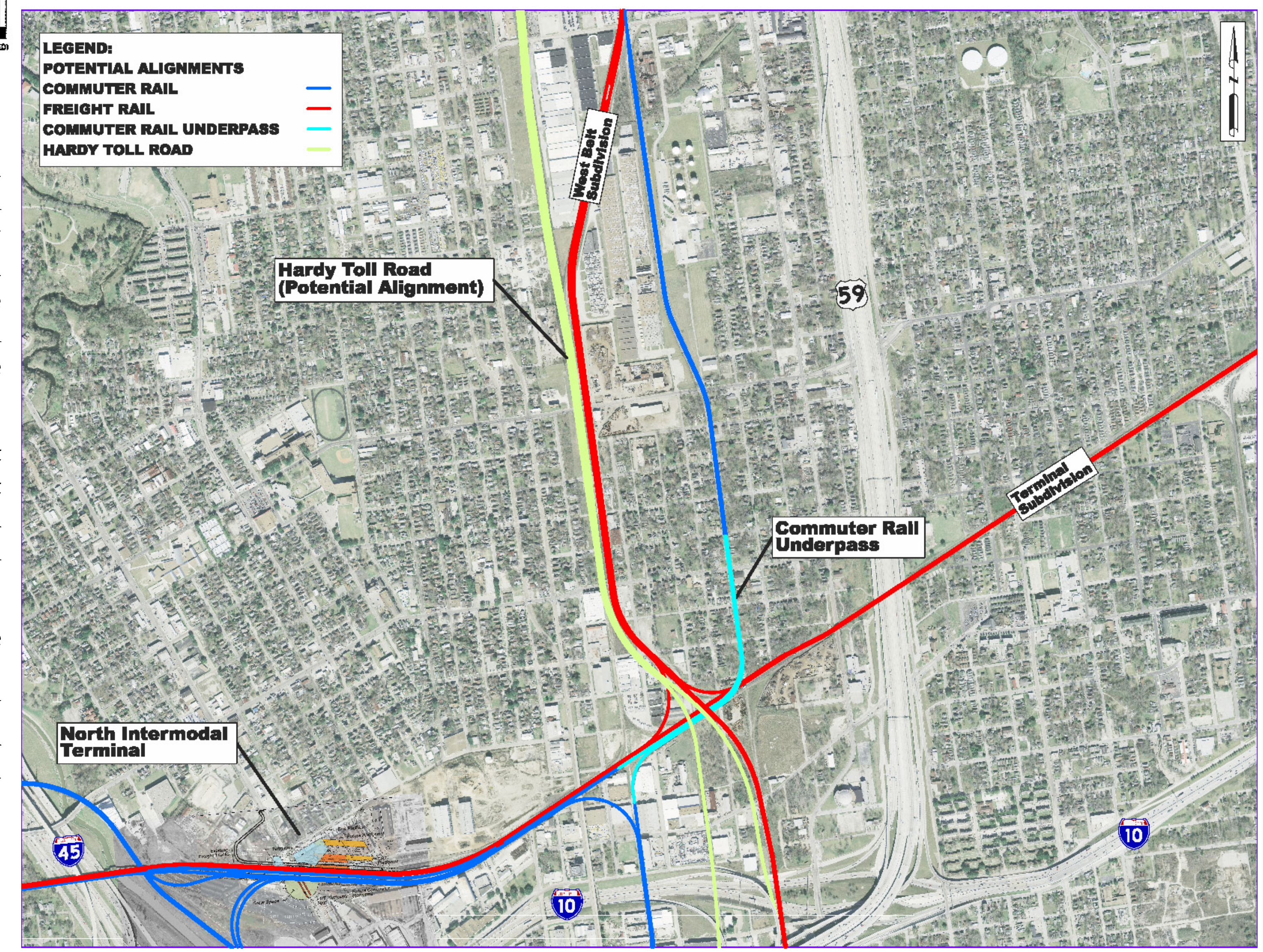

Figure D-6: Potential Commuter Rail Grade Separation at Tower 26

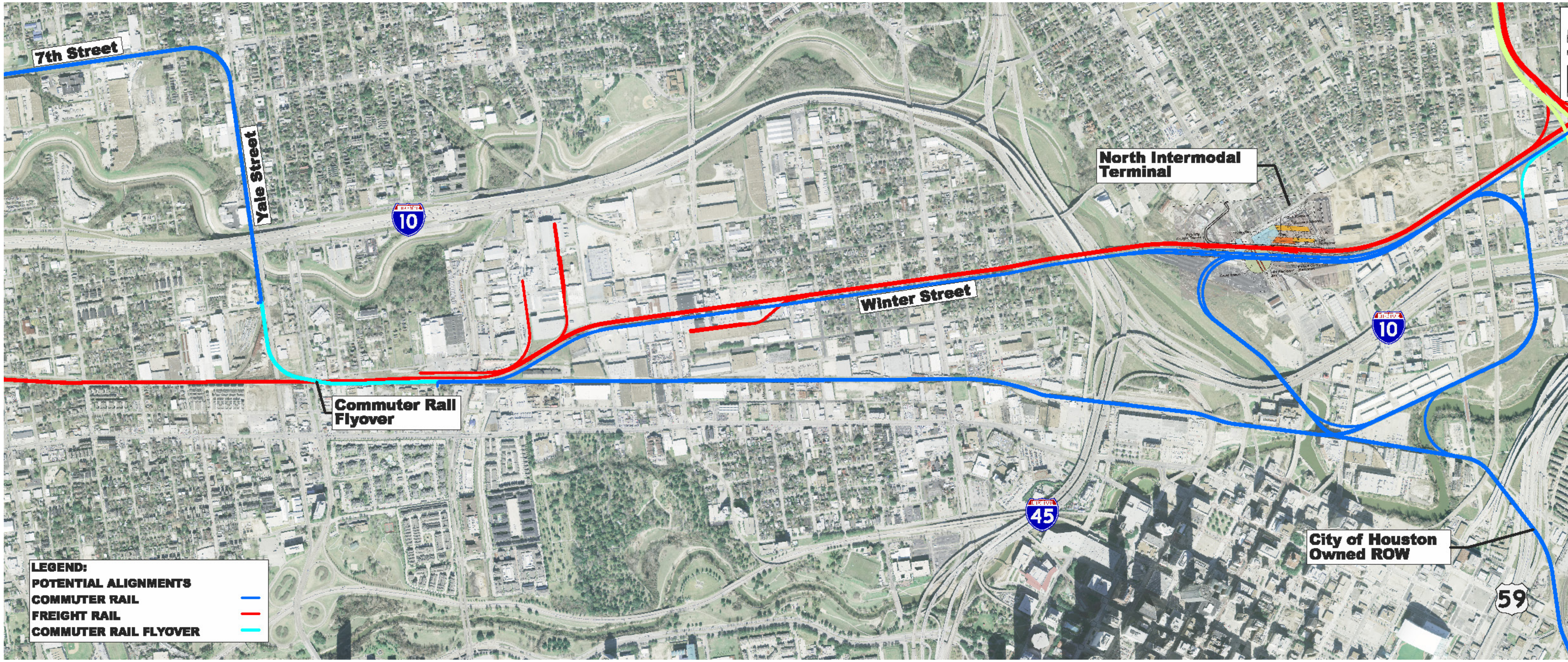

Figure D-7: Potential West Access Routes to NIT Circulation Loop

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APPENDIX E – COMMUTER RAIL RELATIVE DEMAND POTENTIAL

CHAPTER E-1 – INITIAL DEMAND CALCULATIONS

This Appendix summarizes the data, procedures and measures used to estimate the relative demand potential among possible commuter rail corridors in the 8-county Houston-Galveston Area Council (H-GAC) planning area (see **Figure E-1**). There are sixteen radial rail corridors available for consideration and while some corridors have existing rail lines, others have abandoned segments where rail beds may no longer exist. Additionally, many of the available corridors are closely adjacent or overlap one another.

This demand evaluation is one component of a more comprehensive Tier 1 evaluation to identify the most viable corridors and advance them to a Tier 2 evaluation. In addition to demand, the Tier 1 assessment will incorporate supply-side considerations. These include the physical condition of each corridor, competing freight rail demand, the cost to upgrade the corridor to support commuter rail operations, and the ongoing operations and maintenance costs required to provide commuter rail service. Pending an evaluation of all these factors, a smaller group of corridors will move forward into the Stage 2 evaluation. The Tier 2 evaluation will include preparation of a travel demand forecast to estimate commuter rail ridership by line.

E-1.1 Source of Data

H-GAC provided all data used in this analysis. Demographic and travel data were provided for year 2000 and 2035 forecast conditions. The data included:

- trip tables for five trip purposes that quantify the forecast number of trips between each traffic analysis zone[1] (TAZ);
- socioeconomic data (population, households, and employment) for each of the 2,954 TAZs covering an 8-county study area; and
- Geographic Information Systems (GIS) layers representing the TAZs and roadways throughout the 8-county study area.

E-1.2 DATA PREPARATION PROCEDURES

Data preparation procedures included the geographic definition of commuter rail corridors and allocation of demographic and trip data to the corridors for further analysis. These data preparation tasks were conducted using GIS software.

E-1.3 Corridor Definition

The evaluation of commuter rail corridors was limited to radial rail corridors that connect to areas inside the 610 Loop. A total of sixteen radial lines were defined, for the most part, by following existing or abandoned freight rail lines. The sixteen rail lines are shown in **Figure E-2**.
Since the names of the rail corridors are not commonly known, a naming convention was established to help visualize the orientation of each corridor. The first element of the name is a cardinal direction (such as “North-Northeast”) and the second element consists of the nearest parallel highway route or road name (such as “US 59”). For example, for corridor 2, these elements would combine to form the name “North-Northeast US 59 Corridor”. **Table E-1** (next page) lists the corridors, along with their names, lengths, and the railroad companies which own a portion or the entire railroad track corridor.

Figure E-1: Study Area

[1] Traffic analysis zone (TAZ) is a term used to describe blocks of land where development – and hence traffic (trip) generation - may occur. TAZ boundaries normally consist of major streets and highways, but could also include geographic or political boundaries. The size of a TAZ can vary from a fraction of a square mile to multiple square miles. The 8-county Houston region is represented by 2,545 TAZs.

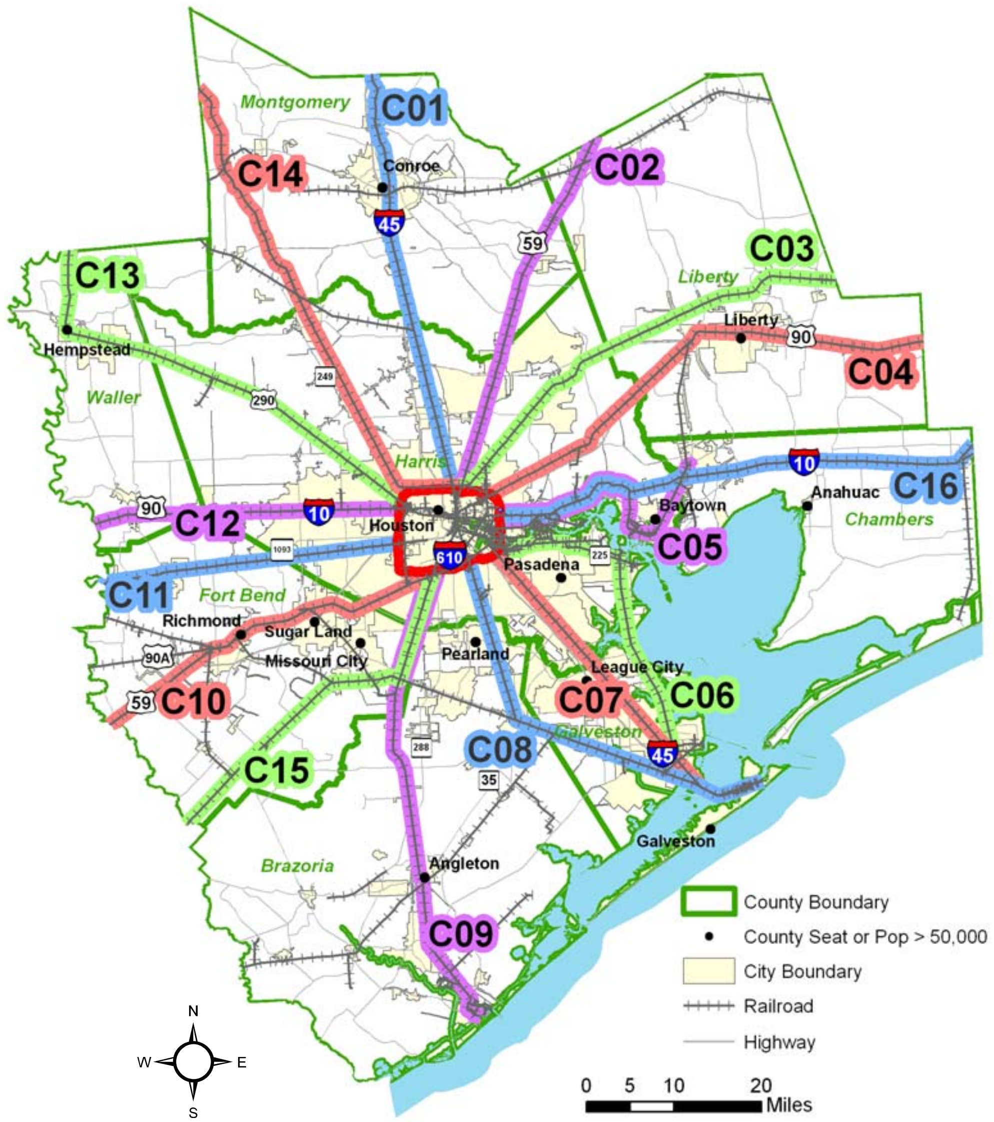


Figure E-2: Candidate Commuter Rail Line Corridors

Table E-1: Corridor Description, Length and Ownership

Corridor	Corridor Name	Length (mi.)	Railroad Ownership
C01	N, IH-45	49.1	HBT and UP
C02	NNE, US 59	43.7	UP
C03	NE, Btw. US 59 & US 90	52.7	HBT and UP
C04	ENE, US 90	56.9	UP
C05	E, IH-10	33.1	PTRA and UP
C06	ESE, SH 225/SH 146	50.6	UP and abandoned
C07	SE, IH-45	43.2	GHH and UP
C08	SSE, SH 35/SH 6	49.0	BNSF, GHH, and UP
C09	S, SH 288/FM 521	55.4	HBT, UP, abandoned, and "new"
C10	WSW, US 90A/US 59	42.9	HBT, UP, and TM
C11	W, FM 1093 (Westpark)	34.1	Abandoned
C12	W, IH-10	35.3	UP and abandoned
C13	WNW, US 290	53.1	UP
C14	NNW, SH 249/FM 1486	59.0	BNSF and HBT
C15	SW, FM 521/1994/442	44.4	BNSF, HBT, UP, and abandoned
C16	E2, IH-10	57.4	PRTA and "new"

Note that there are five corridors in which abandoned railroad tracks were used to define the corridor. In addition, there are two corridors in which, for a portion of their length, there were no existing or abandoned railroad facilities to follow (as indicated by use of the term "new" in the table).

Each rail corridor represents the centerline of a travel shed of the Houston metropolitan area that would logically use the subject corridor. The travel shed can be thought of as a cone with the minimum width of the corridor at the 610 Loop is 3 miles (or 1.5 miles on either side of the track centerline). Heading outbound away from the 610 Loop, the boundaries of each travel shed then diverge at a rate of 1 mile in width for every 5 miles along the corridor centerline. Because of the proximity of the railroad corridor centerlines, the travel sheds for the corridors can and do overlap and are therefore not necessarily mutually exclusive. The resulting corridor travel sheds are shown in **Figure E-3** on the following page.

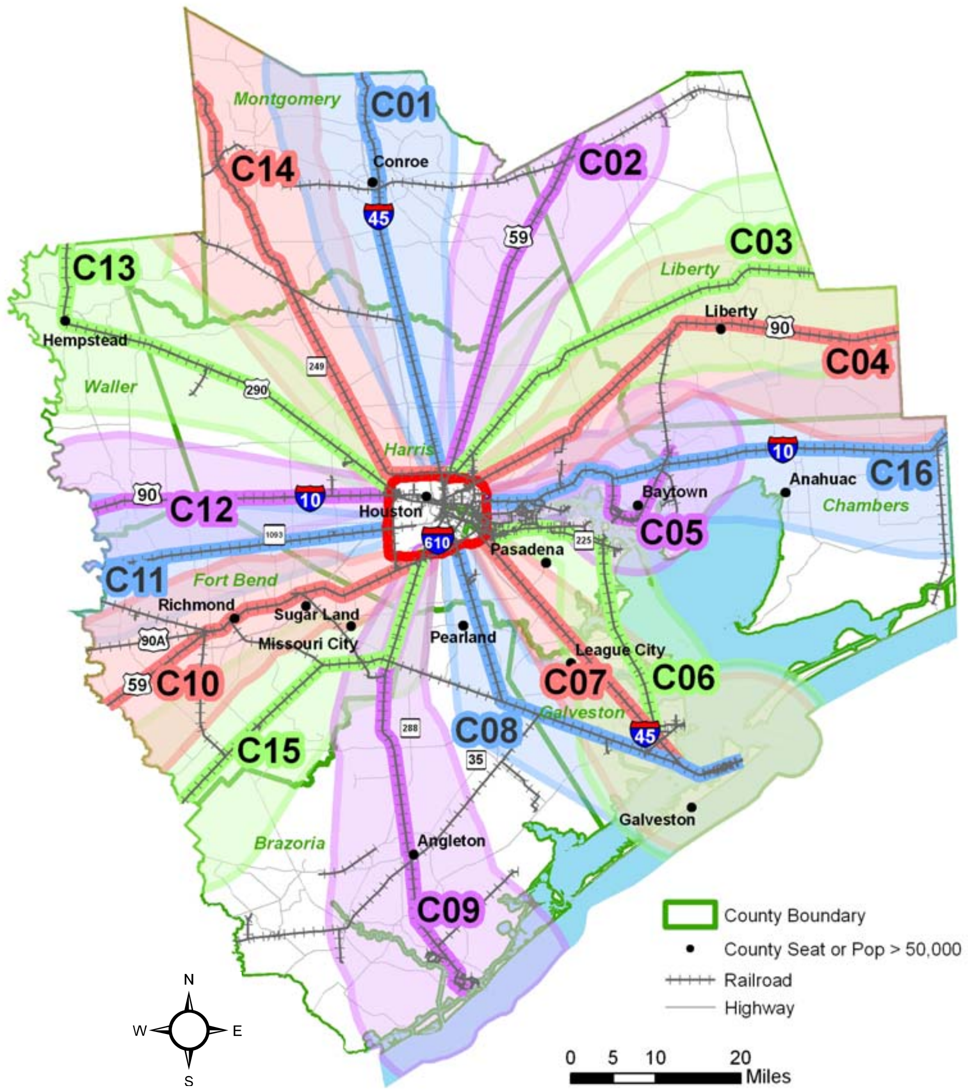


Figure E-3: Commuter Rail Line Travel Sheds

E-1.3.1 Allocation of Demographic and Trip Data to Corridors

For all TAZs located totally within the limits of a corridor, all the demographic and trip data for the TAZ was added to corridor totals. For TAZs that are split by a corridor boundary, the percentage of each TAZ's attribute data (i.e., population, households, employment, and trips) located within each corridor was calculated by using the percentage of each TAZ's road mileage within each corridor. A split based on road mileage is more accurate than one based on TAZ area because more-intense traffic generators (such as stores and office buildings) are normally concentrated next to major roads along the outer boundary of a TAZ. Demographic data from TAZs inside the 610 loop was not included in the demographic data for the rail corridors since the same amount would be added to each corridor.

It should be noted that forecasts of corridor trips were based on trip distribution from the current H-GAC travel demand model, which does not have commuter rail lines as a travel option. In some cases, the distribution of trips along the rail corridors could increase if commuter rail service was included in the H-GAC travel demand model. This affect will be assessed when travel forecasts are developed in the Tier 2 evaluation.

E-1.4 SELECTION OF PERFORMANCE MEASURES

The objective of this Tier 1 evaluation was to identify corridors best suited for commuter rail service and reduce the list of sixteen candidate corridors to a smaller number for further evaluation. Several performance measures were tested to determine whether they would provide mutually exclusive indications of corridor characteristics that support commuter rail ridership. Since the screening criteria are not precise at this evaluation stage, a simple ranking measure may be misleading. Therefore, a composite performance measure was also sought to see whether characteristics of corridors would cause them to "cluster" into two or more groups. It was not known how many of the sixteen corridors would survive the screening process, and no attempt was made to select criteria to produce a given maximum number of corridors for Tier 2 evaluation.

E-1.4.1 Basic Travel Indicators

Several basic travel indicators were extracted from the H-GAC travel demand model database for year 2000 and 2035 conditions. These measures were obtained from the previously-described travel sheds representing each corridor. These corridors were illustrated in **Figure E-3**. Statistics for overlapping areas of two or more corridors were not excluded from the totals for each corridor. However, the degree to which corridors overlap may need to be considered in more detailed corridor analyses. The basic measures and their relevance to commuter rail ridership are as follows:

<u>Total Households in Corridor</u>

The absolute number of households in the corridor is an indicator of the potential number of employees that can be served by a given commuter rail line. Another way of looking at it is this is the number of housing opportunities accessible via commuter rail for employees.

<u>Total Employment in Corridor</u>

The total employment in the corridor is a secondary measure of ridership potential. The primary purpose of commuter rail is to connect employees that live in the corridor to employers in the urban core. However, if employers are also located along the corridor, there is potential for shorter-distance commutes and reverse commutes via commuter rail. This measure focuses on these intra-corridor trips.

Work Trips between Corridor and 610 Loop

As previously noted, the primary purpose of commuter rail is to connect work trips between outlying population centers and central city employment opportunities. This measure is one direct indication of commuter rail market potential.

Total Trips between Corridor and 610 Loop

Given the diverse mix of attraction uses within the 610 Loop, it is possible that commuter rail could also be used for other trip purposes. This statistic is an indication as to what total market may be available for commuter rail, and whether this market is significantly different from the commuter market.

Statistics involving household income were not considered in this Tier 1 evaluation to avoid eliminating corridors based on measures of socioeconomic inequity. However, since the H-GAC travel demand forecasting model associates work trips with households based on income, this factor is indirectly represented in the work trip measure.

E-1.4.2 Rate Measures

Two different rate measures were considered for some of the basic indicators:

Rate per Unit Area

The rate per unit area simply divides the measure by the total area of the corridor. Since the corridor is represented by a travel shed, this rate consists of a "density" measure, such as "households per square mile".

Rate per Centerline Mile

The rate per centerline mile divides the measure by the length of the rail line in the corridor. Rail corridors vary in length from 33 to 59 miles. This resulted in a measure of "intensity", such as "trips per mile of corridor".

The disadvantage of the rate per unit area was that each corridor has a different percentage of total land developed, and the travel shed shape tends to add a lot of extra area at the far outer ends of each rail line where growth may not have occurred by 2035, thus biasing density estimates. The per-mile (intensity) rate is sensitive to the impact that corridor length has on each measure, while avoiding the divergent area issue associated with the density rate. Therefore, the per-mile rate was retained as the preferred rate measure.

E-1.4.3 Growth Measures

Degree of growth between 2000 and 2035 was considered as a separate measure, but was rejected because all the corridors exhibited strong growth factors. Growth in both population and employment ranged from double to quadruple among nearly all corridors over the 35 year period. **Table E-2** summarizes household and employment statistics by corridor, including rankings and growth factors. The corridor with the lowest growth factor of about 50 percent was the FM 1093 corridor (West Park Toll Road). Growth in this corridor was only limited because the corridor was more than two-thirds built out in 2000. Because levels of growth were high in all corridors, measures that involved year 2000 travel indicators or trends between year 2000 and 2035 conditions were not used in favor of year 2035 measures.

E-1.4.4 Selected Performance Measures

The three selected performance measures and rationale for their selection as independent measures are described below.

Demographics (Sum of Households and Employment)

Since the number of employees is often similar to the number of households (around one employee per household), the sum of these measures is a composite indicator of relative corridor demand potential outside the 610 Loop that incorporates a within-corridor travel indicator (corridor employment). Therefore, the employment total does not include employment inside the 610 Loop (nor households).

Work Trips (Sum of Corridor to 610 Loop Work Trips Generated)

The number of work trips between the corridor and the area inside the 610 Loop is a strong indicator of traditional suburb to central city commuter rail ridership potential. Note that this work trip definition excludes trips to employment areas inside the corridor (thus outside 610), which are covered by the previous measure.

Work Trips per Mile (Intensity of Work Trip Generation per Mile)

The intensity of work trips in the corridor is also an indicator of the concentration of demand along the corridor. This measure correlates most strongly with the line ridership potential for the corridor. The line ridership indicates how many passenger train cars would be needed to provide the necessary service capacity. Thus, a high intensity justifies enough ridership to reduce headways between trains, which provides critical mass for optimizing the relationship between convenience (service frequency) and cost (number of train sets required).

Table E-2: Demographic Growth by Corridor and Rankings (2000 to 2035)

No.	Corridor Description Direction, Nearest Hwy	Length (miles)	Area (sq mi)	Number of Households 2000	Number of Households 2035	Households Rank	Number of Employees 2000	Number of Employees 2035	Employees Rank	Growth Factor 2000-2035 HH	Growth Factor Emp	Growth Factor Avg	Growth Factor Rank
1	N, IH45	49.1	626	173,055	399,933	2	212,357	449,376	2	2.31	2.12	2.20	8
2	NNE, US59	43.7	522	93,767	214,901	9	82,107	191,496	10	2.29	2.33	2.31	5
3	NE, Btw. US59 & US90	52.7	783	64,452	192,042	11	34,888	102,732	14	2.98	2.94	2.97	3
4	ENE, US90	56.9	781	34,027	143,231	16	30,247	78,375	16	4.21	2.59	3.45	2
5	E, IH10	33.1	391	73,943	183,759	12	89,178	186,642	11	2.49	2.09	2.27	6
6	ESE, SH225/SH146	50.6	755	158,772	276,592	6	197,818	338,069	6	1.74	1.71	1.72	15
7	SE, IH45	43.2	594	182,125	309,442	3	198,857	361,162	4	1.70	1.82	1.76	13
8	SSE, SH35/SH6	49.0	723	120,007	206,592	10	118,550	231,734	9	1.72	1.95	1.84	12
9	S, SH288	55.4	892	57,380	160,437	14	65,108	137,793	13	2.80	2.12	2.43	4
10	WSW, US90A/US59	42.9	485	162,512	300,211	5	144,706	341,012	5	1.85	2.36	2.09	9
11	W, FM1093	34.1	354	199,350	308,013	4	258,389	393,843	3	1.55	1.52	1.53	16
12	W, IH10	35.3	384	135,433	234,872	8	177,545	306,696	8	1.73	1.73	1.73	14
13	WNW, US290	53.1	608	130,063	266,413	7	180,018	329,595	7	2.05	1.83	1.92	11
14	NNW, SH249/FM1486	59.0	756	227,259	451,637	1	246,660	504,883	1	1.99	2.05	2.02	10
15	SW, FM 521/1994/442	44.4	550	38,271	158,769	15	26,727	96,205	15	4.15	3.60	3.92	1
16	E2, IH10	57.4	783	70,412	173,199	13	76,042	156,720	12	2.46	2.06	2.25	7

HH – Households, Emp – Employment, Avg – Average, ESE – East Southeast, W – West, etc.

Household and employment ranks are based on 2035 statistics. Growth factors are the ratio of 2035 to 2000 households or employment.

E-1.5 ESTIMATION OF CORRIDOR DEMAND INDICATORS

Two corridor demand indicators were developed to indicate relative ridership potential as part of the Tier 1 corridor evaluation. Both indicators incorporate all three performance measures (demographics, trip generation, and trip intensity) discussed previously.

E-1.5.1 Weighted Index

To apply a weighted index, it is necessary to "normalize" the three performance measures to a common scale before the measures can be weighed against one another. For each corridor, the value of each indicator was divided by the maximum value among all corridors to produce an index that could range from zero to one. This way, it is easy to see that a corridor with an index of 0.50 is half as good as the corridor with the maximum index of 1.00. For example, if one corridor has 200,000 households, and the corridor with the maximum number of households has 400,000, then the first corridor index would be 200,000 divided by 400,000, or 0.50, and the corridor index with the highest value would be 400,000 divided by 400,000, or 1.00. By normalizing the performance measures, it becomes easy to weight them together into a single index representing the contributions of each measure.

Figure E- 4 illustrates the normalized index score for each measure by corridor. The corridors are sorted from highest to lowest weighted average score using equal weighting of each of the three indices. Note that the first two measures (demographics and trip generation) favor corridor 14 (NNW – SH 249) as the top corridor, while the third measure (trip intensity) favors corridor 11 (W – FM 1093 Westpark Toll Road). Note that the ranking of corridors under each individual measure would be different. (These rankings will be discussed later in the appendix.) This helps demonstrate the independent contribution of each measure toward the overall result.

In recalling that one objective of this evaluation was to determine whether corridors could be grouped into clusters to help decide how many corridors should move forward, the weighted index was used to evaluate whether the composite index would divide corridors into logical "clusters" and whether there was a meaningful difference between clusters that would support a decision to screen out some of the clusters from further consideration. The index values for the three measures were then equally weighted to produce a weighted index for each corridor. Even though corridors could be ranked based on the resulting weighted index, it should be noted that the measures are not perfect indicators of performance. Therefore, if the weighted indices of several corridors are numerically close, there is no guarantee that the rank of each would be accurate when compared to rankings based on a more-detailed assessment, such as the commuter rail travel demand model forecasts that would be conducted during the Tier 2 evaluation.

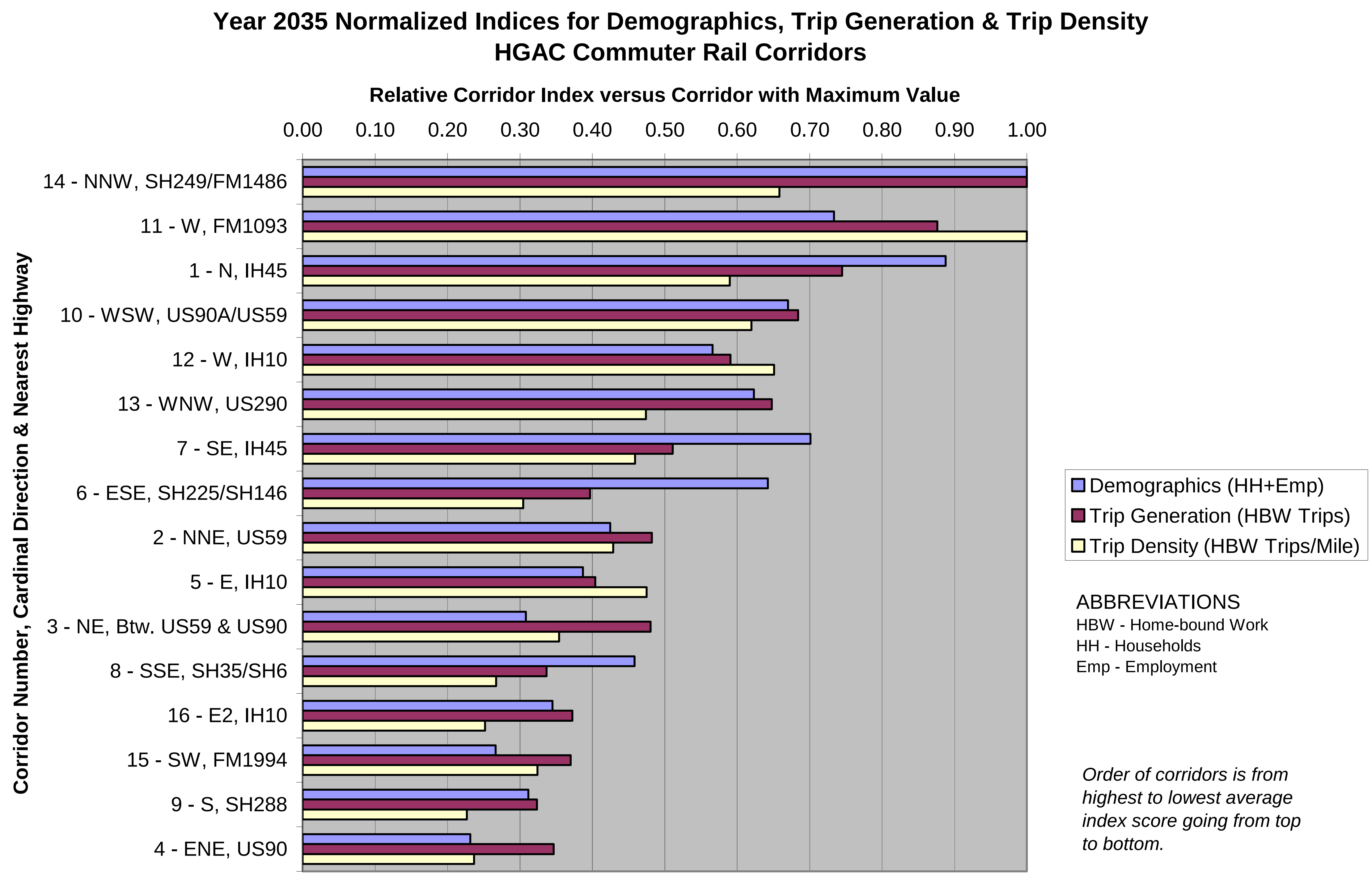


Figure E-4: Weighted Index of Corridor Demand Indicators

Figure E-5 illustrates the weighted index scores for each corridor sorted from highest (best) to lowest. Based on the weighted index score, there is a clear pair of leading corridors (approximately tied), and a relatively distinct corridor in the third and fourth ranked places. However, scores for the next three corridors are close together. Weighted scores beyond the 7th corridor in rank order fall off by greater margins, though the corridors ranked 8th through 10th are scored closely around 0.50.

It is a judgment call as to what weighted index score represents the threshold regarding suitability for commuter rail. However, there is a correlation between the ridership indicators and the performance measures. Therefore, in round figures, a weighted score of 0.50 for a given corridor indicates that the best corridor would perform twice as well the subject corridor.

If a performance threshold of 0.60 were selected, the weighted index would move seven of sixteen corridors into the Stage 2 evaluation. If a threshold around 0.50 were selected, ten of sixteen corridors would move forward.

E-1.5.2 Ranking

To apply the ranking criteria, each corridor was ranked from one to sixteen for each performance measure. Therefore, each corridor ends up with three rankings; one for demographics, one for trip generation, and one for trip intensity. Since ranking can't be combined or averaged, the ranking methodology was based on the number of measures that produced a "top nine" ranking out of sixteen. The indices graphically depicted in **Figure E-4** were the basis for determining the rank of each corridor for each performance measure. **Figure E-6** illustrates a corridor map surrounded by tables summarizing the rankings for each corridor. Both the corridors and surrounding tables are color coded to group them into categories.

Based on the ranking criteria, if all three performance measures must be in the "top nine", then seven corridors are recommended for Tier 2 evaluation. These corridors are highlighted in green. If only two of the three measures must be "top nine", only one additional corridor is added for a total of eight. The yellow corridor (Corridor 2) falls in this category. If one measure is top nine, this adds four corridors, or twelve of sixteen. The orange corridors are in this category. The remaining four corridors in pink ranked 10th or higher (worse) for all three ranking criterion.

Perhaps consistent with expectations, the corridors ranging from southwest direction clockwise toward the northeast direction rank the best. Only the southeast SH 3 / I 45 corridor toward Galveston ranked well among remaining corridors toward the Gulf coast. These directions are known to be the historical high-growth directions for the Houston-Galveston TMA.

E-1.5.3 Conclusion

Both the weighted index and the ranking demand indicators select the same group of corridors as the top seven. The ranking criterion selects Corridor 2 (NE-US 59) as the eighth ranking corridor. The weighted index suggests that Corridor 2 (NE-US 59) and Corridor 6 (ESE-SH 225/SH 146) are roughly tied for the eighth and ninth positions. This demonstrates a level of consistency among the two indicators. Therefore, if either indicator is applied as part of a more comprehensive indexing or ranking evaluation with other factors, they are not likely to produce significantly different conclusions among the corridors with the highest relative demand potential.

E-1.5.4 Recommendations

The recommended approach for Tier 1 should combine quantitative demand indicators from this appendix with other measures to screen candidate corridors for further consideration in Tier 2. Chapter 2 of this appendix discusses some additional factors to consider in the evaluation. Chapter 2 also presents demand-related factors that will be quantitatively assessed as part of the Tier 2 evaluation using the H-GAC Travel Demand Model.

Since decisions regarding implementation are generally dictated by financial resources, implementation costs, service requirements and fare box revenue potential, decisions regarding corridor screening and prioritization will ultimately be based on the development of a business model that identifies the sources and uses of funds necessary to implement and expand the system. Therefore, the Tier 1 screening should not be viewed as a process to permanently eliminate corridors. Rather, it is a process to prioritize corridors such that those most likely to succeed on a near term basis (through the year 2035) are implemented first.

Normalized Average of Demographic, Trip Generation and Trip Density Corridor Indices
HGAC Commuter Rail Corridors

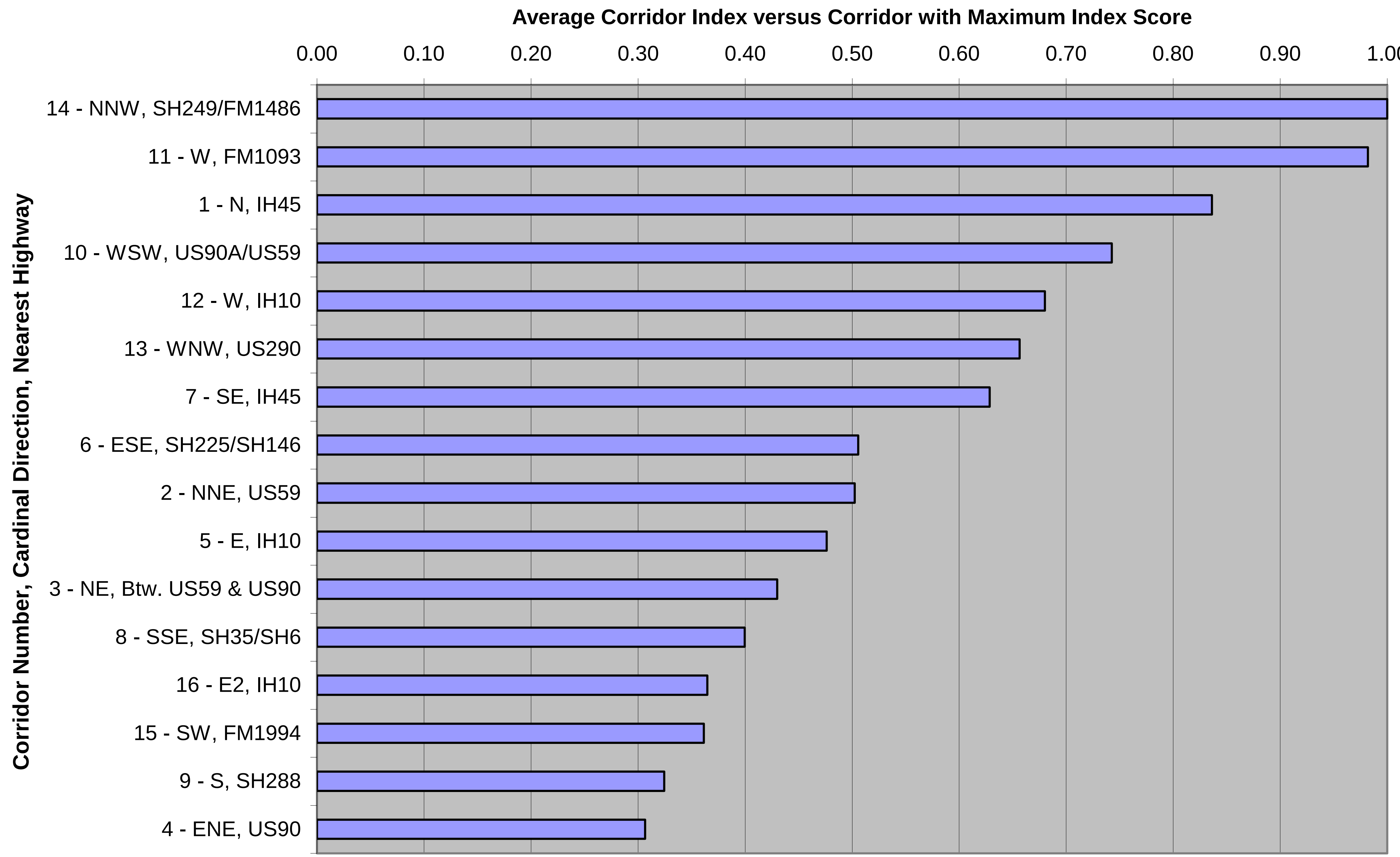
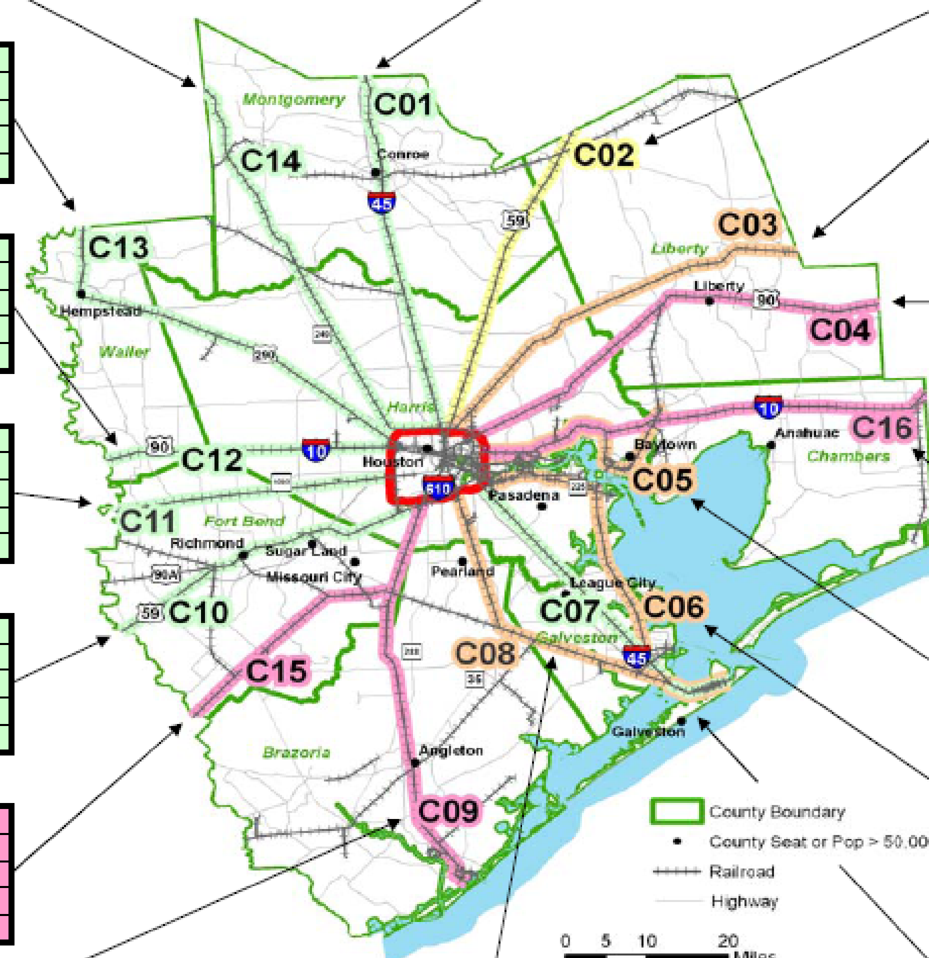


Figure E-5: Normalized Trip Generation and Density Indices

Rank-based Evaluation of Commuter Rail Corridors
HGAC Commuter Rail Corridor Evaluation

Corridor	Description	HH+Emp Rank	HBW Trip Rank	HBW Trips/Mile Rank
14	NNW-SH249	1	1	2
1	N-IH45	2	3	5
2	NNE-US59	10	8	9
13	WNW-US290	7	5	7
3	NE-US59/US90	14	9	10
12	W-IH10	8	6	3
4	ENE-US90	16	14	15
11	W-FM1093	3	2	1
16	E2-IH10	12	12	14
10	WSW-US90/US59	5	4	4
5	E-IH10	11	10	6
15	SW-FM1994	15	13	11
6	ESE-SH225/SH146	6	11	12
9	S-SH288	13	16	16
8	SSE-SH35/SH6	9	15	13
7	SE-IH45	4	7	8



Green - Best Rankings, Yellow - Good Rankings, Orange - Fair Rankings, Pink - Poorest Rankings

Figure E-6: Prioritization of Commuter Rail Corridors Based on Demand Potential

CHAPTER E-2 ADDITIONAL CONSIDERATIONS FOR CORRIDOR SCREENING

Chapter 1 of this appendix presents *quantitative* indicators of relative ridership potential among sixteen rail corridors around Houston. However, the relative potential for ridership is only one measure of performance among corridors. This chapter presents additional considerations regarding corridor screening that could be *qualitatively* considered during the Tier 1 evaluation process. Qualitative considerations may be needed to help make better decisions as to whether corridors that scored or ranked poorly in terms of relative demand might be retained, or whether those that scored or ranked well should be rejected. Most of the demand-related considerations will be addressed quantitatively in greater detail as part of the travel demand forecasting process during the Tier 2 evaluation.

E-2.1 Demand-Related Considerations

Demand-related considerations pertain to desired patterns of travel, regardless of what type of transportation facilities are available to accommodate travel. In addition to the quantitative measures of relative demand potential, the Tier 1 screening evaluation could also consider qualitative consideration of the following factors:

Overlapping Service Areas

Some of the commuter rail corridor travel sheds overlap one another to a considerable degree. Therefore, there would be competition among adjacent rail lines from the same pool of riders. To the extent that this occurs, certain adjacent pairs of corridors may need to be considered as "either-or" choices, where only one of the two can move forward.

Other Major Activity Centers

A corridor may have major attractions outside of the 610 Loop to draw additional riders above and beyond corridor employment measures. Typical attractions include:

- Airports
- Activity Centers other than Downtown, Texas Medical Center (TMC) or Greenway Plaza Districts, such as Uptown, Greenspoint, Westchase, or Energy Corridor
- Medical Centers other than TMC
- Tourist Attractions (NASA, amusement parks, beaches, stadiums, arenas, etc.)

Paired Corridors for Trips through the CBD

In some cases, certain pairs of corridors on opposite sides of the Houston CBD could draw longer trips to the opposite side of the metropolitan area. One example could include tourists traveling from the George Bush International Airport on a north line (Corridor 1 or 2) to NASA or Galveston (via Corridor 7).

E-2.2 Supply-Related Considerations

Supply-related considerations pertain to the nature of the transportation system. There are two categories to consider: competing travel choices, and constraints regarding implementation of a commuter rail alternative.

Other Travel Choices

Factors that affect commuter rail ridership relative to other means of travel in each corridor are described below:

- Mobility – Speed or door-to-door travel time provided by a travel choice
- Reliability – Degree of variation in travel time from day-to-day due to traffic incidents or mechanical failure
- Cost – Cost of travel including tolls, transit fares, parking, fuel, etc., including costs per person trip
- Convenience – Constraints that make a travel choice more difficult to use such as transfer/boarding delays, circuitous movements, carpool/vanpool formation, service headway, compatibility with trip travel purpose, and many others

These factors are evaluated by comparing the service against other choices available in each corridor. These choices must consider interaction among physical facilities and vehicles that operate on these facilities.

Possible mode choices include:

- Single occupant automobile
- Carpool
- Vanpool
- Local or express bus
- Other high-capacity transit service (light or heavy rail)

Possible route choices include:

- Freeways
- Toll Roads
- Managed Lanes
- HOV Lanes / Busways
- Urban Arterial Streets

The following are a few examples of how mode and route choices interact:

- Urban arterial streets or congested freeways provide inferior mobility and reliability versus commuter rail.

- Toll roads improve mobility and reliability, but require a toll fare to achieve this benefit.
- HOV lanes / Busways - toll roads or managed lanes are necessary to achieve superior mobility with express bus service in order to overcome growing corridor congestion.
- Creation of carpools or vanpools can reduce the per-person cost of using toll roads or managed lanes, as well as the cost of central city parking.
- Commuter rail use is also affected by the cost of parking at the destination end, the cost of park-and-ride space at the origin, and the availability of convenient "last-mile" transit connections at the destination end of the trip.

The existing or planned availability of travel choices in a corridor could be qualitatively considered in the prioritization process to help differentiate corridors. However, a travel demand forecast of ridership is necessary to quantify the impact these choices have on ridership. This is part of the Tier 2 evaluation.

Commuter Rail Implementation Constraints

The sixteen corridors evaluated will impose different cost impediments toward viable application of commuter rail. Considerations include:

- Is the rail line complete in the corridor, or is there a gap?
- If the rail line has been physically removed, is contiguous right-of-way still available, or has it been absorbed by other uses.
- What capital costs are needed for completion, upgrades, station areas, bypasses (double track), street overpasses/underpasses, etc.?
- Is the track alignment direct or circuitous?
- How much conflicting freight traffic is in the corridor?
- Can the freight traffic be moved elsewhere?

E-2.3 Corridor Screening Considerations

Directional Clustering

The premise of directional clustering is that at least one corridor should be retained in each major cardinal direction for further evaluation. This would result in the selection of at least eight corridors, and previously-presented index scores and rankings would be used to help select the best corridor for each direction, even if rankings were poor among all corridors in some cardinal directions from downtown Houston.

Split Corridors

Some corridors – such as Corridor 9 (S – SH 288/FM521) and Corridor 15 (SW – FM 521/1994/442) have common track segments near central Houston, then split some distance outside the 610 Loop. The viability of the pair of corridors may be better than each isolated corridor. A separate assessment of corridor groups that split off a common line will be conducted as part of the overall Tier 1 screening analysis.

APPENDIX F: CONCEPTUAL OPERATING PLAN FOR THE PRINCIPAL CORRIDOR SYSTEM

Appearing on the tables that follow are conceptual schedules for a Houston area commuter rail service. The schedules include service for five lines, each with a Houston termination at the North Intermodal Terminal (NIT). **Table F-1** displays eastbound train schedules, with trains originating in Kendleton (US 90A/Glidden Route), Simonton (Westpark Route) and Hempstead (US 290/Eureka Route) for Houston; and with trains departing Houston for Willis (Hardy Toll Road/Palestine Route) and Galveston (Galveston Route). The outer termini for the lines are identified in a **bold typeface**. While there are 33 train numbers, some inbound trains from arriving from the west were schedule to continue on another eastbound route, and when passing through the Houston NIT were counted twice to produce 44 one-way moves. Meanwhile, **Table F-2** shows the westbound schedules.

Table F-1: Conceptual Eastbound Schedules for a Houston Area Commuter Rail Service

EASTBOUND - Read down																																	
STATION	101	103	105	107	109	111	113	115	117	119	121	123	125	127	129	131	133	135	137	139	141	143	145	147	149	151	153	155	157	159	161	163	165
Kendleton	5:20	---	---	---	6:05	---	---	---	6:35	---	---	7:05	---	---	---	7:50	---	---	11:50	---	---	---	---	15:35	---	---	---	---	---	---	---	18:00	---
Beasley	5:34	---	---	---	6:19	---	---	---	6:49	---	---	7:19	---	---	---	8:04	---	---	12:04	---	---	---	---	15:49	---	---	---	---	---	---	---	18:14	---
Richmond	5:48	---	---	---	6:33	---	---	---	7:03	---	---	7:33	---	---	---	8:18	---	---	12:18	---	---	---	---	16:03	---	---	---	---	---	---	---	18:28	---
Sugar Land	6:02	---	---	---	6:47	---	---	---	7:17	---	---	7:47	---	---	---	8:32	---	---	12:32	---	---	---	---	16:17	---	---	---	---	---	---	---	18:42	---
Missouri City	6:13	---	---	---	6:58	---	---	---	7:28	---	---	7:58	---	---	---	8:43	---	---	12:43	---	---	---	---	16:28	---	---	---	---	---	---	---	18:53	---
Simonton	---	---	5:55	---	---	6:25	---	---	---	6:55	---	---	7:25	---	7:55	---	---	11:55	---	---	---	15:20	---	---	---	---	---	---	---	17:55	---	---	---
Fulshear	---	---	6:05	---	---	6:35	---	---	---	7:05	---	---	7:35	---	8:05	---	---	12:05	---	---	---	15:30	---	---	---	---	---	---	---	18:05	---	---	---
Peek Road	---	---	6:15	---	---	6:45	---	---	---	7:15	---	---	7:45	---	8:15	---	---	12:15	---	---	---	15:40	---	---	---	---	---	---	---	18:15	---	---	---
Addicks Road	---	---	6:26	---	---	6:56	---	---	---	7:26	---	---	7:56	---	8:26	---	---	12:26	---	---	---	15:51	---	---	---	---	---	---	---	18:26	---	---	---
Sam Houston	---	---	6:35	---	---	7:05	---	---	---	7:35	---	---	8:05	---	8:35	---	---	12:35	---	---	---	16:00	---	---	---	---	---	---	---	18:35	---	---	---
Bellaire	6:25	---	6:45	---	7:10	7:15	---	---	7:40	7:45	---	8:10	8:15	---	8:45	8:55	---	12:45	12:55	---	---	16:10	---	16:40	---	---	---	---	---	18:45	---	19:05	---
Hempstead	---	5:30	---	5:55	---	---	6:15	6:30	---	---	6:55	---	---	7:25	---	---	10:35	---	---	13:25	---	---	---	---	---	---	---	16:35	---	---	---	---	18:25
Waller	---	5:42	---	6:07	---	---	6:27	6:42	---	---	7:07	---	---	7:37	---	---	10:47	---	---	13:37	---	---	---	---	---	---	---	16:47	---	---	---	---	18:37
Fairfield Place	---	5:54	---	6:19	---	---	6:39	6:54	---	---	7:19	---	---	7:49	---	---	10:59	---	---	13:49	---	---	---	---	---	---	---	16:59	---	---	---	---	18:49
Jarvis Road	---	6:04	---	6:29	---	---	6:49	7:04	---	---	7:29	---	---	7:59	---	---	11:09	---	---	13:59	---	---	---	---	---	---	---	17:09	---	---	---	---	18:59
Eldridge Pkwy	---	6:14	---	6:39	---	---	6:59	7:14	---	---	7:39	---	---	8:09	---	---	11:19	---	---	14:09	---	---	---	---	---	---	---	17:19	---	---	---	---	19:09
Sam Houston	---	6:23	---	6:48	---	---	7:08	7:23	---	---	7:48	---	---	8:18	---	---	11:28	---	---	14:18	---	---	---	---	---	---	---	17:28	---	---	---	---	19:18
Long Point	---	6:36	---	7:01	---	---	7:21	7:36	---	---	8:01	---	---	8:31	---	---	11:41	---	---	14:31	---	---	---	---	---	---	---	17:41	---	---	---	---	19:31
Houston	6:35	6:45	6:55	7:10	7:20	7:25	7:30	7:45	7:50	7:55	8:10	8:20	8:25	8:40	8:55	9:05	11:50	12:55	13:05	14:40	---	16:20	---	16:50	---	---	---	17:50	---	18:55	---	19:15	19:40
Houston	6:45	6:55	---	---	---	---	---	---	---	---	---	---	---	8:50	---	9:15	12:00	---	13:15	14:50	16:40	16:30	17:00	17:00	17:20	17:30	17:40	18:00	18:00	---	18:30	---	19:50
Greens Road	7:02	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9:32	---	---	13:32	---	---	16:47	---	17:17	---	17:47	---	---	18:17	---	18:47	---	---
Spring	7:14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9:44	---	---	13:44	---	---	16:59	---	17:29	---	17:59	---	---	18:29	---	18:59	---	---
Rayford Road	7:26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9:56	---	---	13:56	---	---	17:11	---	17:41	---	18:11	---	---	18:41	---	19:11	---	---
Conroe	7:40	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10:10	---	---	14:10	---	---	17:25	---	17:55	---	18:25	---	---	18:55	---	19:25	---	---
Willis	7:55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10:25	---	---	14:25	---	---	17:40	---	18:10	---	18:40	---	---	19:10	---	19:40	---	---
Lawndale	---	7:06	---	---	---	---	---	---	---	---	---	---	---	9:01	---	---	12:11	---	---	15:01	16:51	---	17:11	---	17:31	---	17:51	18:11	---	---	---	---	20:01
South Houston	---	7:14	---	---	---	---	---	---	---	---	---	---	---	9:09	---	---	12:19	---	---	15:09	16:59	---	17:19	---	17:39	---	17:59	18:19	---	---	---	---	20:09
FM 1959	---	7:23	---	---	---	---	---	---	---	---	---	---	---	9:18	---	---	12:28	---	---	15:18	17:08	---	17:28	---	17:48	---	18:08	18:28	---	---	---	---	20:18
Webster	---	7:32	---	---	---	---	---	---	---	---	---	---	---	9:27	---	---	12:37	---	---	15:27	17:17	---	17:37	---	17:57	---	18:17	18:37	---	---	---	---	20:27
Dickenson	---	7:44	---	---	---	---	---	---	---	---	---	---	---	9:39	---	---	12:49	---	---	15:39	17:29	---	17:49	---	18:09	---	18:29	18:49	---	---	---	---	20:39
La Marque	---	7:56	---	---	---	---	---	---	---	---	---	---	---	9:51	---	---	13:01	---	---	15:51	17:41	---	18:01	---	18:21	---	18:41	19:01	---	---	---	---	20:51
Galveston	---	8:10	---	---	---	---	---	---	---	---	---	---	---	10:05	---	---	13:15	---	---	16:05	17:55	---	18:15	---	18:35	---	18:55	19:15	---	---	---	---	21:05

Table F-2: Conceptual Westbound Schedules for a Houston Area Commuter Rail Service

WESTBOUND - Read up																																
STATION	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164
Kendleton	---	---	---	---	---	9:05	---	---	---	---	---	11:25	---	---	15:00	---	---	17:20	17:40	---	---	---	---	18:15	---	---	---	18:55	19:10	---	---	---
Beasley	---	---	---	---	---	8:51	---	---	---	---	---	11:11	---	---	14:46	---	---	17:06	17:26	---	---	---	---	18:01	---	---	---	18:41	18:56	---	---	---
Richmond	---	---	---	---	---	8:37	---	---	---	---	---	10:57	---	---	14:32	---	---	16:52	17:12	---	---	---	---	17:47	---	---	---	18:27	18:42	---	---	---
Sugar Land	---	---	---	---	---	8:23	---	---	---	---	---	10:43	---	---	14:18	---	---	16:38	16:58	---	---	---	---	17:33	---	---	---	18:13	18:28	---	---	---
Missouri City	---	---	---	---	---	8:12	---	---	---	---	---	10:32	---	---	14:07	---	---	16:27	16:47	---	---	---	---	17:22	---	---	---	18:02	18:17	---	---	---
Simonton	---	---	---	---	8:30	---	---	---	---	9:40	---	---	---	14:00	---	---	17:00	---	---	---	17:35	---	17:55	---	---	---	18:35	---	---	---	19:10	---
Fulshear	---	---	---	---	8:20	---	---	---	---	9:30	---	---	---	13:50	---	---	16:50	---	---	---	17:25	---	17:45	---	---	---	18:25	---	---	---	19:00	---
Peek Road	---	---	---	---	8:10	---	---	---	---	9:20	---	---	---	13:40	---	---	16:40	---	---	---	17:15	---	17:35	---	---	---	18:15	---	---	---	18:50	---
Addicks Road	---	---	---	---	7:59	---	---	---	---	9:09	---	---	---	13:29	---	---	16:29	---	---	---	17:04	---	17:24	---	---	---	18:04	---	---	---	18:39	---
Sam Houston	---	---	---	---	7:50	---	---	---	---	9:00	---	---	---	13:20	---	---	16:20	---	---	---	16:55	---	17:15	---	---	---	17:55	---	---	---	18:30	---
Bellaire	---	---	---	---	7:40	8:00	---	---	---	8:50	---	10:20	---	13:10	13:55	---	16:10	16:15	16:35	---	16:45	---	17:05	17:10	---	---	17:45	17:50	18:05	---	18:20	---
Hempstead	7:05	---	---	---	---	---	---	---	---	---	10:15	---	13:15	---	---	16:15	---	---	---	17:45	---	18:05	---	---	18:25	18:45	---	---	---	19:15	---	20:15
Waller	6:53	---	---	---	---	---	---	---	---	---	10:03	---	13:03	---	---	16:03	---	---	---	17:33	---	17:53	---	---	18:13	18:33	---	---	---	19:03	---	20:03
Fairfield Place	6:41	---	---	---	---	---	---	---	---	---	9:51	---	12:51	---	---	15:51	---	---	---	17:21	---	17:41	---	---	18:01	18:21	---	---	---	18:51	---	19:51
Jarvis Road	6:31	---	---	---	---	---	---	---	---	---	9:41	---	12:41	---	---	15:41	---	---	---	17:11	---	17:31	---	---	17:51	18:11	---	---	---	18:41	---	19:41
Eldridge Pkwy	6:21	---	---	---	---	---	---	---	---	---	9:31	---	12:31	---	---	15:31	---	---	---	17:01	---	17:21	---	---	17:41	18:01	---	---	---	18:31	---	19:31
Sam Houston	6:12	---	---	---	---	---	---	---	---	---	9:22	---	12:22	---	---	15:22	---	---	---	16:52	---	17:12	---	---	17:32	17:52	---	---	---	18:22	---	19:22
Long Point	5:59	---	---	---	---	---	---	---	---	---	9:09	---	12:09	---	---	15:09	---	---	---	16:39	---	16:59	---	---	17:19	17:39	---	---	---	18:09	---	19:09
Houston	5:50	---	---	---	7:30	7:50	---	---	---	8:40	9:00	10:10	12:00	13:00	13:45	15:00	16:00	16:05	16:25	16:30	16:35	16:50	16:55	17:00	17:10	17:30	17:35	17:40	17:55	18:00	18:10	19:00
Houston	---	7:00	7:00	7:20	7:30	7:40	8:00	8:00	8:20	8:30	8:50	10:00	11:50	12:50	---	14:50	---	---	---	---	---	---	16:45	---	---	17:20	---	---	---	17:50	---	18:50
Greens Road	---	6:43	---	---	7:13	---	---	7:43	---	8:13	---	9:43	---	12:33	---	---	---	---	---	---	---	---	16:28	---	---	---	---	---	---	17:33	---	---
Spring	---	6:31	---	---	7:01	---	---	7:31	---	8:01	---	9:31	---	12:21	---	---	---	---	---	---	---	---	16:16	---	---	---	---	---	---	17:21	---	---
Rayford Road	---	6:19	---	---	6:49	---	---	7:19	---	7:49	---	9:19	---	12:09	---	---	---	---	---	---	---	---	16:04	---	---	---	---	---	---	17:09	---	---
Conroe	---	6:05	---	---	6:35	---	---	7:05	---	7:35	---	9:05	---	11:55	---	---	---	---	---	---	---	---	15:50	---	---	---	---	---	---	16:55	---	---
Willis	---	5:50	---	---	6:20	---	---	6:50	---	7:20	---	8:50	---	11:40	---	---	---	---	---	---	---	---	15:35	---	---	---	---	---	---	16:40	---	---
Lawndale	---	---	6:49	7:09	---	7:29	7:49	---	8:09	---	8:39	---	11:39	---	---	14:39	---	---	---	---	---	---	---	---	---	17:09	---	---	---	---	---	18:39
South Houston	---	---	6:41	7:01	---	7:21	7:41	---	8:01	---	8:31	---	11:31	---	---	14:31	---	---	---	---	---	---	---	---	---	17:01	---	---	---	---	---	18:31
FM 1959	---	---	6:32	6:52	---	7:12	7:32	---	7:52	---	8:22	---	11:22	---	---	14:22	---	---	---	---	---	---	---	---	---	16:52	---	---	---	---	---	18:22
Webster	---	---	6:23	6:43	---	7:03	7:23	---	7:43	---	8:13	---	11:13	---	---	14:13	---	---	---	---	---	---	---	---	---	16:43	---	---	---	---	---	18:13
Dickenson	---	---	6:11	6:31	---	6:51	7:11	---	7:31	---	8:01	---	11:01	---	---	14:01	---	---	---	---	---	---	---	---	---	16:31	---	---	---	---	---	18:01
La Marque	---	---	5:59	6:19	---	6:39	6:59	---	7:19	---	7:49	---	10:49	---	---	13:49	---	---	---	---	---	---	---	---	---	16:19	---	---	---	---	---	17:49
Galveston	---	---	5:45	6:05	---	6:25	6:45	---	7:05	---	7:35	---	10:35	---	---	13:35	---	---	---	---	---	---	---	---	---	16:05	---	---	---	---	---	17:35

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APPENDIX G - ECONOMIC DEVELOPMENT POTENTIAL AND ENVIRONMENTAL JUSTICE ANALYSIS OF HUB AND M&SF SITES

CHAPTER G-1 ECONOMIC DEVELOPMENT POTENTIAL OF HUB SITES

G-1.1 A Description of Hub Sites 1 & 2

Hub Site 1, between the Northwest Mall and Northwest Transit Center, is comprised of approximately 161 acres of primarily industrial land (118 acres), with some commercial uses (28 acres). It is situated to the west of the 610 Loop and just south of the Northwest Mall, which has been identified as Hub Site 2 (73.2 Acres). The area is located approximately 4 miles north of Houston's Galleria which is a major employment and commercial center. In 2005 the estimated job density of the Galleria was 20 employees per gross acre.[1] The vicinity surrounding Hub Site 1 and 2 has an employment density of approximately 5 employees per gross acre.

An analysis of the area around Hub Site 1 and 2 sought to identify those parcels that may benefit from an increased intensity of use as a result of the activities surrounding the commuter rail operational hub terminal. This analysis began with creating a ½ mile buffer around the station, to represent a plausible pedestrian commute shed. Second, any existing residential neighborhoods, cemeteries, schools, and any proposed freeway rights-of-way or areas that would still be used for freight purposes were excluded as redevelopable areas. Contiguous areas made up of more than one parcel were prioritized, with the assumption that some parcel assemblage would have to take place.

For the combined analysis at Hub Sites 1 and 2, a total of 346 acres were identified as potentially redevelopable. These consisted primarily of industrial and warehouse space within the immediate vicinity of Hub Site 1 and vacant parcels. Accounting for the approximate station area (Figure 4-16), freeway realignments, and potential detention ponds the net available acreage is approximately 303 acres (**Figure G-1**). Land values in this area vary significantly, depending on existing uses and transportation access. Harris County Assessor's data indicates that lands contained within the Hub Site 1 area are valued significantly lower than land values in the Uptown/Galleria area to the south. Based on this, a significant opportunity to intensify both use and values exists around Hub Site 1 & 2.

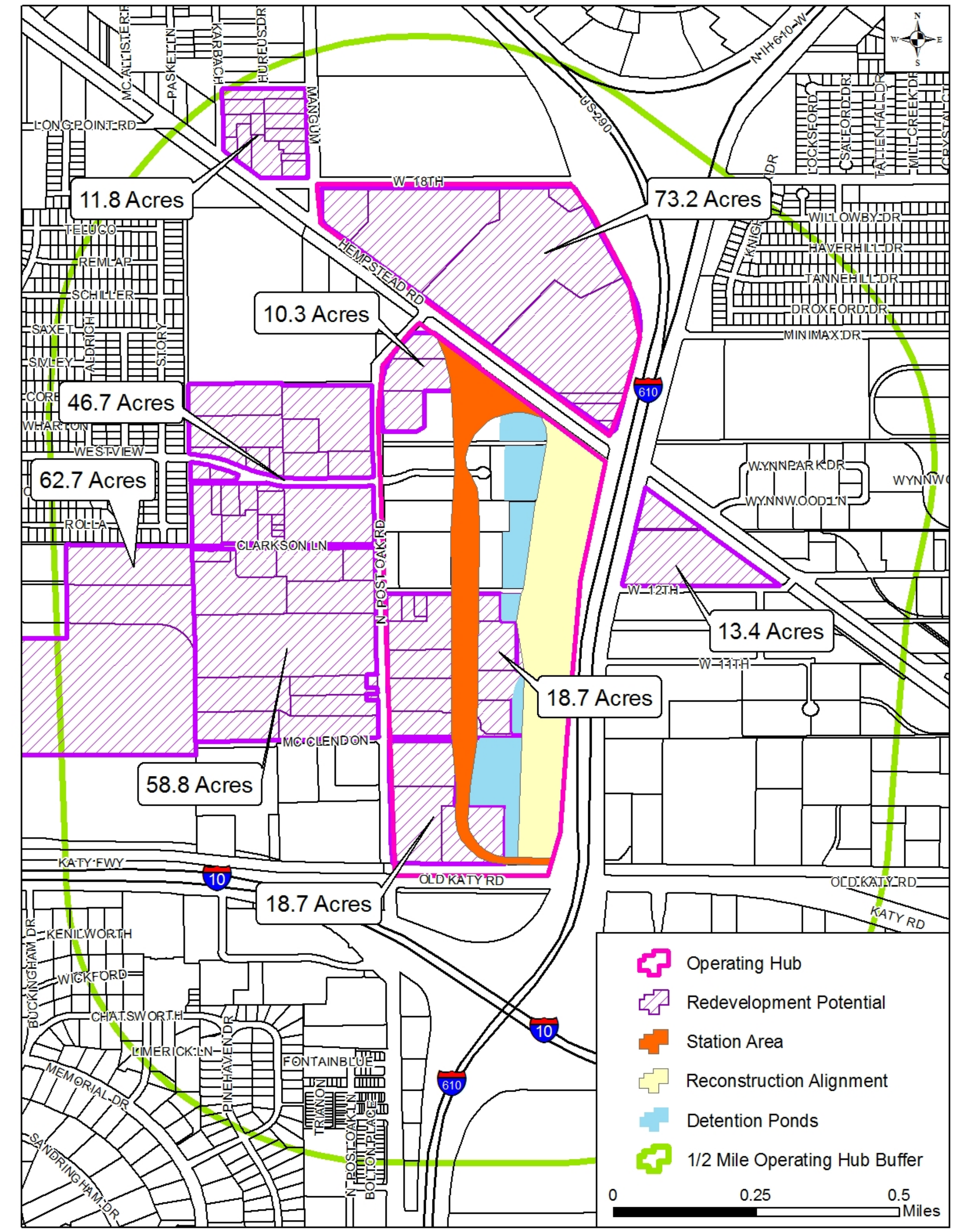

Figure G-1: Redevelopment Impact Area of Hub Sites 1 & 2

[1] Based on a US Census ZIP Code Business pattern analysis. Downtown Houston, in comparison had 56 employees per gross acre.

G-1.2 Pro-Forma Exercise for Hub Sites 1 & 2

A basic pro-forma exercise was conducted to evaluate the redevelopable lands identified in the parcel analysis. Assuming a basic land and remediation cost of $8 per square foot and prevailing rent and construction cost information, several prototypical building types were tested. These building prototypes are constructed on a per-acre basis, meaning they represent more of an approximation of the urban fabric, rather than a specific project. This analysis helps produce and snapshot view of what types of development might be suitable for the Hub Site area. This exercise does have some limitations; it does not account for phasing, but rather applies the prototypes across the site all at once. Second, while it uses pro-forma-like assumptions for construction cost, financing, and other market conditions, it is not meant to form the basis for any specific investment decision.

The development prototypes that performed best in this exercise were commercial and office uses. Assuming Houston-wide office and retail rents of $29 and $23 per square foot respectively, a four-story office and retail complex comprised of 30,000 square feet of office and 10,000 square feet of retail space produced a project profit of approximately 19% (based on 25% equity). On a per acre basis, this produced a total valuation of $12.2 million.

Second-most promising was a more intense office building prototype of 20 stories, with 151,000 square feet of office space and 8,000 square feet of retail; this prototype returned a project profit of 15%. This prototype represented approximately $54 million in valuation.

Mixed-use housing prototypes were less financially successful without significantly higher unit prices than prevail in the Houston area. A five-story residential-only building consisting of 56 units needed an average unit price of $376,000 to achieve an 8.5% for-sale profit. As a rental building ($1.94 per square foot), the same project produced a 22% internal rate of return. This prototype represented approximately $19 million in valuation.

A mixed-use residential high rise building faced the similar challenge of requiring significantly higher sales prices to yield a suitable return. A 20-story building with 243 units and 27,000 square feet of ground floor retail produced a for-sale profit of 10%, and a rental internal rate of return of 23%. For sale unit prices were approximately $442,000.

Finally, a townhouse prototype, consisting of two-story attached homes was tested. These were also similarly expensive given the local housing market, producing a 9% for-sale profit with units priced at approximately $382,000 apiece. The total valuation by acre was $7.3 million.

G-1.2.1 Build-out Scenarios

From this we can produce any number of plausible development scenarios that illustrate job and housing potential in the area. Below is a scenario that focuses more heavily on station-area employment development on the 303 acres identified within the ½ mile buffer for Hub Site 1 and 2. Two illustrative scenarios are outlined below.

Under Scenario 1 the potential for office is sizeable, assuming full build out of the 303 acres of identified parcels in Table A-1 below (including the Northwest Mall site).[2] The total potential for office development is substantial, given that there is currently 7.6 million square feet of office under construction in the Houston metro area.[3]

Table G-1: Build-Out Scenario 1 Analysis Hub Sites 1 & 2

Scenario 1	Prototype Description				Build-out Scenario 1		
Prototype	Jobs / Acre	Housing / Acre	Office Square Feet	Retail Square Feet	Percent of Total Development	Office Square Feet	Retail Square Feet
4-Story Office/ Retail	106	-	29,403	9,801	35%	2,338,641	779,547
20-Story Office	451	-	151,647	7,981	10%	3,446,169	181,377
5-Story Residential	-	56	-	-	25%	-	-
20-Story Residential/Retail	61	243	-	27,459	10%	-	624,006
2-Story Townhouse	-	22	-	-	20%	-	-
					100%	5,784,810	1,584,930

Under Scenario 1 the total jobs potential (primarily office) is around 20,000, whereas housing is approximately 10,000 units. By adjusting the mix of building prototypes could yield a more jobs- or housing-rich build-out scenario.

Table G-2: Housing and Jobs for Scenario 1

Scenario 1		
Prototype	Total Jobs	Total Housing Units
4-Story Office /Retail	8,431	-
20-Story Office	10,249	-
5-Story Residential	-	3,182
20-Story Residential/Retail	1,386	5,522
2-Story Townhouse	-	1,000
Total	20,066	9,704

Under Scenario 2 the emphasis on jobs is much greater. This scenario eliminates townhouse developments and focuses more development potential on office and retail uses. It increases slightly the proportion of high-rise residential buildings (from 10% to 15%), which accommodates a similar number of housing units while also increasing the jobs proportion.

[2] This assumes that 25% of the 303 acres are reserved for civic and right-of-way uses.
[3] Grubb & Ellis Office Market Trends, Q1, 2008.

Table G-3: Build-Out Scenario 2 Analysis Hub Sites 1 & 2

Scenario 1	Prototype Description				Build-out Scenario 2		
Prototype	Jobs /Acre	Housing / Acre	Office Square Feet	Retail Square Feet	Percent of Total Development	Office Square Feet	Retail Square Feet
4-Story Office /Retail	106	-	29,403	9,801	50%	3,340,916	1,113,639
20-Story Office	451	-	151,647	7,981	20%	6,892,338	362,755
5-Story Residential	-	56	-	-	15%	-	-
20-Story Residential/Retail	61	243	-	27,459	15%	-	936,009
2-Story Townhouse	-	22	-	-	0%	-	-
					100%	10,233,254	2,412,402

Under Scenario 2, job potential is 34,622, or nearly twice that of Scenario 1. A greater focus on high density office buildings (from 10% to 20% of the redevelopable lands) helps achieve this.

Table G-4: Housing and Jobs for Scenario 2

Scenario 2 Prototype	Total Jobs	Total Housing Units
4-Story Office /Retail	12,044	-
20-Story Office	20,498	-
5-Story Residential		1,909
20-Story Residential/Retail	2,079	8,283
2-Story Townhouse		-
	34,622	10,192

G-1.3 Summary of Economic Development Potential for Hub Sites 1 & 2

This analysis is designed to give a snapshot of what the existing land value and other conditions might produce in a given redevelopment area. Site-by-site analysis is necessary to establish a more comprehensive understanding of redevelopment potential. In addition whether the economic development emphasis should be on housing or jobs is an important consideration.

Overall, Hub Sites 1 & 2 appear to have significant economic development potential in the form of large parcels with relatively low intensity uses. The scarcity of large parcels inside Houston's already developed areas, particularly near downtown, means this area may be especially suited for redevelopment.

CHAPTER G-2 ECONOMIC DEVELOPMENT POTENTIAL OF EUREKA M&SF SITE

G-2.1 M&SF Site 1 (near Eureka Yard) Description

M&SF Site 1 is located at the intersection of T.C. Jester Boulevard and the Eureka Rail Yard in the northwest end of downtown Houston. M&SF Site 1 is bordered by White Oak Bayou, T.C. Jester Boulevard, and the Eureka Rail Yard, and encompasses an area of approximately 107 acres. To the northwest of the site is a single-family residential neighborhood. To the north and east of the site are also primarily residential areas. The site's eastern edge is the White Oak Bayou and channel. There is no direct street access from the site eastward across the White Oak Bayou. The main road access available to the site is a short frontage road off of T.C. Jester Blvd. To the south of the site, across the rail yard tracks, is a residential area interspersed with small scale retail and commercial land uses.

As a Maintenance and Storage Facility, the economic development strategy for Site 1 should be limited to land uses that will not be in conflict with the operation of the train. Housing development in this vicinity would not be appropriate. Furthermore, because few if any passengers are expected to disembark, the need for retail or office uses is low. Finally, the existing rail yard will continue to operate, thus any intensification of land use should be designed to complement this use and minimize impacts to the surrounding neighborhood.

There are a few parcels adjacent to M&SF Site 1 that could accommodate a somewhat more intense mix of uses. **Figure G-2** highlights those parcels, which altogether represent 28.9 acres of non-contiguous land. The westernmost parcel has one rail spur connecting it to a silo facility. The collection of smaller parcels east of T.C. Jester Blvd that border the track currently house small warehouses. The easternmost parcel is a vehicle and materials storage yard.

Warehouse and industrial space construction in the Houston area tends to take place far beyond the urban core. In the first quarter of 2008 there was no reported construction of industrial or warehouse space in or around the Central Business District (CBD).[4] The trend toward larger floor plans and good access to highway transportation infrastructure is most likely driving force for this trend.

While not directly adjacent to M&SF Site 1, these parcels may be useful for ancillary activities such as equipment storage, warehouses, or a few offices. Land values in this area are most likely significantly lower than those around Hub Sites 1 & 2, which may represent an opportunity for warehouse-type uses. The direct access to I-10 via T.C. Jester Blvd may represent another opportunity for this kind of use. However, road access for the westernmost parcel is limited to T.C. Jester Blvd, which may limit its viability. Recent housing development directly west of this parcel may also represent a conflict if noise and traffic increase.

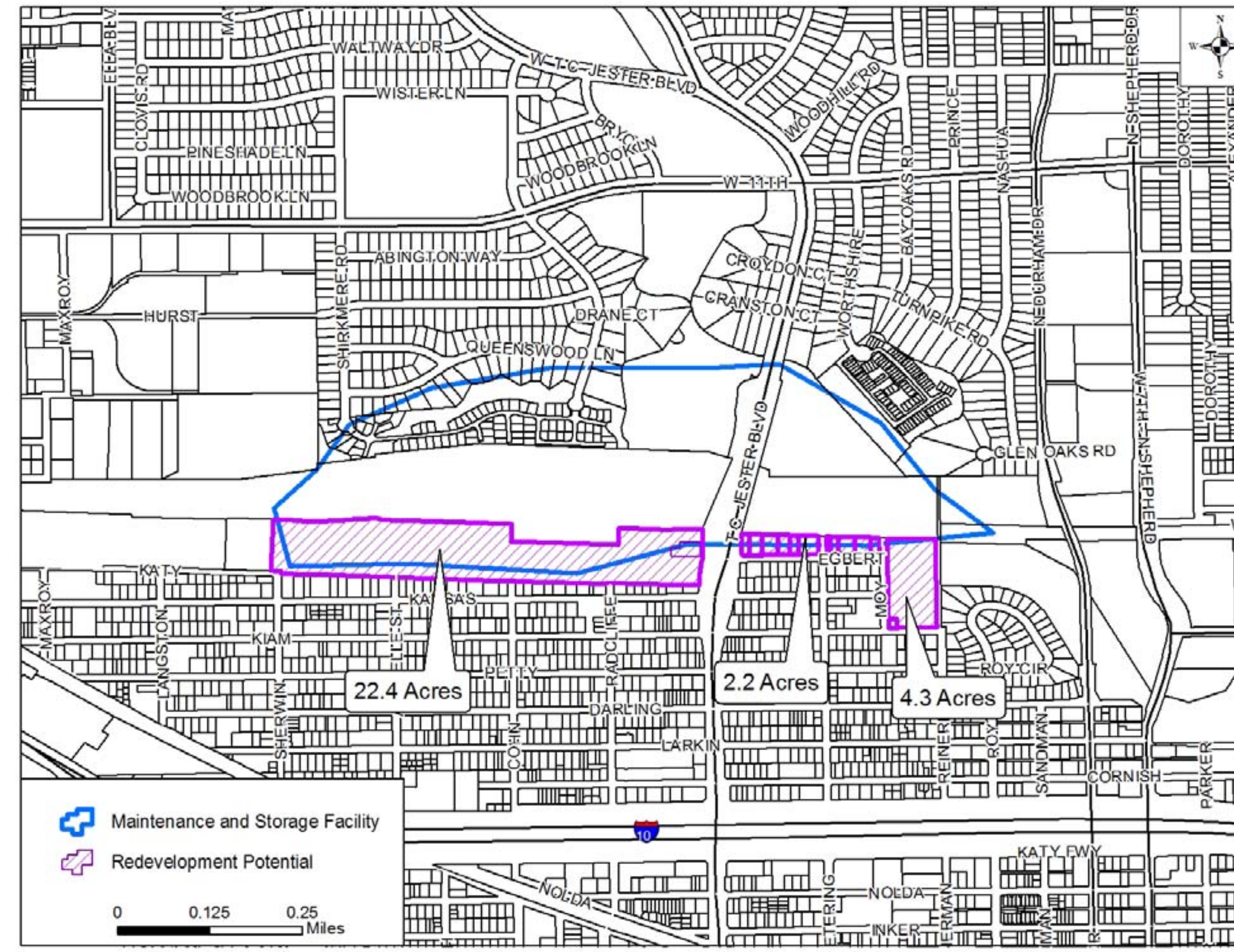

Figure G-2: Eureka M&SF Redevelopment Potential

[4] Grubb & Ellis, Industrial Market Trends Houston, Q1, 2008.

CHAPTER G-3 ENVIRONMENTAL JUSTICE ANALYSIS FOR HUB AND M&SF SITES

This section addresses this project's compliance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. It identifies low-income and minority populations in the project corridor, and the number of building/parcel displacements that will occur under the proposed footprints of the Hub 1 and Hub 2 operating area alternatives and the Eureka Maintenance and Storage Facility Yard Operating Hubs and Maintenance/Storage Facilities sites. Executive Order 12898 applies only to projects that will use federal funds. It is anticipated that Section 5309 "New Starts" funds will be sought from the FTA to pay for a portion of the capital costs of this project.

G-3.1 Affected Populations

The Council on Environmental Quality's (CEQ) guidelines, Environmental Justice: Guidance Under the National Environmental Policy Act, state that agencies should determine the composition of minority populations, low-income populations, and Indian tribes present in the area affected by a proposed action. Areas must be identified where either a minority population represents 50 percent or more of the total population, or where the percentage of a minority population is meaningfully greater than its representation in the general population or other appropriate unit of geographic analysis.

For this analysis, the minority population in the block groups within a half-mile of Hub 1 site, Hub 2 site, and the M&SF Site 1 was compared to that of the populations for the whole of Harris County. The CEQ's guidance defines minorities as individuals who are members of the following population groups: American Indian or Alaskan native, Asian or Pacific Islander, Black or Hispanic. For this assessment, the following population categories were analyzed: White, Black, Latino, and Other. **Table G-5** and **Table G-6** show the percentage of non-white ("minority") residents and the income levels of all residents in the aggregate parcel groupings near Hub 1, Hub 2, and the M&SF 1.

G-3.1.1 Racial Composition -- Findings

A review of the 2000 U.S. Census data indicates that non-white population of Harris County is 57.9% of the County's 3,400,578 population (see **Table G-5**). Also shown in **Table G-5**, the non-white resident population of the Hub 1 site impact area is 38.7% of the impact area's 4,783 total residents. The Hub 2 site impact area accommodates 48.7% non-white population, and of the 8,056 residents of the M&SF 1 impact area, 55.8% are non-white residents.

Each of the three sub area impact areas accommodate a smaller percentage of the non-white population than is the case for the County as a whole, meaning that on the basis of racial composition, the impact areas do not meet the threshold for potential environmental justice impact.

Table G-5: Racial Composition of Harris County and Hub 1, Hub 2 and M&SF 1 Sub Areas

	Harris County	Hub 1	Hub 2	Hub 3 / M&SF 1
White	42.1%	61.3%	51.3%	44.2%
Black	18.2%	2.6%	4.7%	6.0%
Hispanic	32.9%	34.8%	42.5%	48.3%
Other	6.8%	1.3%	1.5%	1.5%

Source: *2000 Census Report*, U.S. Census Bureau

Note: Hispanic persons are not considered a separate race, but may belong to any race.

G-3.1.2 Poverty, Age, Income and Car Ownership – Findings

U.S. Census data from 2000 were also used to identify poverty rate, median age, income and number of households without a car of the impact areas associated with Hub 1, Hub 2, and the M&SF 1, and the whole of Harris County. As shown in Table G-6, poverty rates are higher in Hub 1, Hub 2 and the M&SF 1 than they are for the County as a whole, which indicates that the three sub areas can be classified as meeting the threshold for potential adverse impact to areas of relatively high poverty rates.

Table G-6: Population Characteristics in Hub 1, Hub 2 and M&SF 1 Sub Areas

	Harris County	Hub 1	Hub 2	Hub 3 / M&SF 1
Poverty Rate	14.97%	16.65%	21.48%	25.97%
Median HH Income	$42,598	$52,280	$35,533	$32,577
Median Age	31	40	34	31
HHs with no Vehicle	8.66%	5.90%	9.40%	22.0%

Source: *2000 Census Report*, U.S. Census Bureau

G-3.2 Potential Displacements

A visual inspection of aerial photographs around the Hub and M&SF Sites determined that 55 buildings on 35 parcels would be displaced with development of the Hub 1 site, and 15 buildings on 8 properties would be displaced with development of the Hub 2 site. No displacements would occur at the M&SF 1 with development of a maintenance and storage facility at that site. The displacements that would occur at Hub 1 and Hub 2 would be considered an adverse impact resulting from development of those sites.

Table G-7: Displacements that would occur with development of Hub and MS&F sites

Sites	Buildings Displaced	Parcels with Displacement	Buildings/Parcel
Hub Site 1	55	35	1.6
Hub Site 2	15	8	1.9
Hub 3 / M&SF Site	0	0	0

G-3.3 Potential Impacts by Facility

The Executive Order and CEQ guidance state that public agencies are to consider whether human health effects, in terms of risks and rates, would be significant or above accepted norms if a proposed action were undertaken. **Table G-8** summarizes the potential impacts that may occur with development of the Hub 1, Hub 2, and M&SF Site 1.

Table G-8: Potential Adverse Impacts Associated with Development of Hub and M&SF Sites

	Disproportional adverse impact to populations with high poverty rates	Displacement of homes/businesses
Hub 1	X	X
Hub 2	X	X
Hub 3 / M&SF 1	X	

G-3.4 Summary of Environmental Justice Analysis

Overall, the operations hub terminal and maintenance and storage facility sites have an impact upon the properties immediately surrounding them, however, a much more detailed analysis will need to be conducted as a part of either an Environmental Assessment (EA) or Environmental Impact Statement (EIS) associated with the pursuit of Federal funding for the construction of these sites. Additional considerations to be examined during this phase would include, but are not limited to, the following:

- Level of involvement with and from the communities in affected areas
- Change in level of transit access and service from NB
- Traffic, including changes in emergency response times, and impacts to pedestrians, bicyclist and other transit services
- Air, noise and vibration impacts that would be generated in affected areas
- Construction

APPENDIX H – FUNDING MECHANISMS

Sponsors of a future commuter rail system in the Houston area will likely look to various sources for financing construction, rolling stock acquisition, and ongoing operations and maintenance. This is because commuter rail will not generate sufficient funding from its fare revenue to cover these costs.

There are three generalized sources of funds available: federal, state and local sources. The specifics and the requirements of funding sources tend to change over time. Thus, there is no guarantee that today's funding mechanisms will be in place 10 of 20 years from now. Still, it is reasonable to assume that similar sources would exist in the future.

Federal funding is typically sought for construction and implementation. The largest source of funding for any commuter / regional rail transit improvement would be the FTA Section 5309 New Starts program. While certainly not impossible, securing significant federal capital support could be very difficult given that the competition for New Starts funding is intense. Other funding programs are available through FTA and other federal agencies.

Potential state sources may exist, but would likely be limited. Locally generated funding may provide the most reliable source of ongoing revenue needs.

The listing of funding sources that follows includes major funding sources, for which a commuter rail project in the region may be eligible if it were implemented today. The listing is meant to be illustrative. Depending on the specifics of a final implementation plan for commuter rail in Houston, other sources may become relevant.

All of the funding options discussed below presume at least one public agency authorized to obtain funding for a new Houston area commuter rail service. This could be accomplished by either empowering an existing organization(s) to do so, or by creating a new public agency. The former requires cooperative agreements between the agencies encompassing the service area. The latter assumes a new agency would be created with its own funding or taxing authority.

CHAPTER H-1 – FEDERAL FUNDING OPTIONS

H-1.1 Section 5307 Large Urban Cities Program

This federal funding program can potentially provide federal funding for both capital and operating assistance, as well as for transportation planning purposes. The specific funding purposes can include design, evaluation, and funding of new track, rolling stock, maintenance and storage facilities, signaling systems, and even overhaul of such infrastructure.

According to the FTA Web site, "This program (49 U.S.C. 5307) makes Federal resources available to urbanized areas and to Governors for transit capital and operating assistance in urbanized areas and for transportation related planning. An urbanized area is an incorporated area with a population of 50,000 or more that is designated as such by the U.S. Department of Commerce, Bureau of the Census.

"Eligible purposes include planning, engineering design and evaluation of transit projects and other technical transportation-related studies; capital investments in bus and bus-related activities such as replacement of buses, overhaul of buses, rebuilding of buses, crime prevention and security equipment and construction of maintenance and passenger facilities; and capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software. All preventive maintenance and some Americans with Disabilities Act (ADA) complementary paratransit service costs are considered capital costs.

"For urbanized areas with a population of 200,000 and over, funds are apportioned and flow directly to a designated recipient selected locally to apply for and receive Federal funds. For urbanized areas under 200,000 in population, the funds are apportioned to the Governor of each state for distribution. A few areas under 200,000 in population have been designated as transportation management areas and receive apportionments directly.

"For urbanized areas with populations of 200,000 or more, operating assistance is not an eligible expense. In these areas, at least one percent of the funding apportioned to each area must be used for transit enhancement activities such as historic preservation, landscaping, public art, pedestrian access, bicycle access, and enhanced access for persons with disabilities."

H-1.2 Section 5309 New Start Program

The FTA New Starts program is a well know source of funding for transit system, including all types of rail transit, automated fixed guideway systems, and busway/HOV facilities. This type of funding has a prescribed process of capital investment planning and project development that if successful, results in a full funding grant agreement with FTA. There are necessary commitments of funding from both the federal side and the local side in this funding approach.

According to the FTA Web site, "The New Starts program provides funds for construction of new fixed guideway systems or extensions to existing fixed guideway systems.

"Eligible purposes are light rail, rapid rail (heavy rail), commuter rail, monorail, automated fixed guideway system (such as a "people mover"), or a busway/high occupancy vehicle (HOV) facility, or an extension of any of these. Projects become candidates for funding under this program by successfully completing the appropriate steps in the major capital investment planning and project development process.

"Major new fixed guideway projects, or extension to existing systems financed with New Starts funds, typically receive these funds through a full funding grant agreement that defines the scope of the project and specifies the total multi-year Federal commitment to the project."

Typically, New Starts projects require a major local commitment to funding, also known as the "local match". Per the Website, "The statutory match for New Starts funding is 80 percent Federal, 20 percent local. However, FTA continues to encourage project sponsors to request a Federal New Starts funding share that is as low as possible. The Congressional Conference Report that accompanied the FY 2002 Department of Transportation Appropriations Act instructs 'FTA not to sign any new full funding grant agreements after September 30, 2002 that have a maximum Federal share of higher than 60 percent.'"

H-1.3 Flexible Funding for Highway and Transit

This type of funding allows local agencies to apply two types of funds for either highway or transit purposes, based on local priorities. These funds include certain types of Federal Highway Administration (FHWA) funds as well as certain Federal Transit Administration (FTA) funds. These Surface Transportation Program (STP), Congestion Mitigation and Air Quality (CMAQ), and FTA Urban Formula Funds are described below:

According to the FTA Web site, "Flexible funds are certain legislatively specified funds that may be used either for transit or highway purposes. This provision was first included in the Intermodal Surface Transportation Efficiency Act of 1999 (ISTEA) and was continued with the Transportation Equity Act for the 21st Century (TEA-21) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU). The idea of flexible funds is that a local area can choose to use certain Federal surface transportation funds based on local planning priorities, not on a restrictive definition of program eligibility. Flexible funds include Federal Highway Administration (FHWA) Surface Transportation Program (STP) funds and Congestion Mitigation and Air Quality Improvement Program (CMAQ) and Federal Transit Administration (FTA) Urban Formula Funds." STP and CMAQ programs are discussed immediately below.

"Since the enactment of ISTEA, FHWA funds transferred to the FTA have provided a substantial new source of funds for transit projects. When FHWA funds are transferred to FTA, they can be used for a variety of transit improvements such as new fixed guideway projects, bus purchases, construction and rehabilitation of rail stations, maintenance facility construction and renovations, alternatively-fueled bus purchases, bus transfer facilities, multimodal transportation centers, and advanced technology fare collection systems.

"When FHWA funds are transferred to FTA…for a transit project, the funds are administered as FTA funds and take on all the requirements of the FTA program. Transferred funds may use the same non-Federal matching share that the funds would have if they were used for highway purposes and administered by FHWA.

"In urbanized areas over 200,000 population, the decision on the transfer of flexible funds is made by the Metropolitan Planning Organization (MPO)."

H-1.3.1 Surface Transportation Program (STP)

STP funds are considered to be very "flexible, with the funds distributed in accord with population and programmatic criteria within each state. H-GAC is involved in the allocation of STP funds for projects ranging from all types of public transportation and associated planning initiatives.

According to the FTA Website, "The Surface Transportation Program (STP) (23 U.S.C. 133) provides the greatest flexibility in the use of funds. These funds may be used (as capital funding) for public transportation capital improvements, car and vanpool projects, fringe and corridor parking facilities, bicycle and pedestrian facilities, and intercity or intracity bus terminals and bus facilities. As funding for planning, these funds can be used for surface transportation planning activities, wetland mitigation, transit research and development, and environmental analysis. Other eligible projects under STP include transit safety improvements and most transportation control measures.

"STP funds are distributed among various population and programmatic categories within a State. Some program funds are made available to metropolitan planning areas containing urbanized areas over 200,000 population; STP funds are also set aside to areas with populations under 200,000 and 50,000 persons. The largest portion of STP funds may be used anywhere within the State to which they are apportioned."

H-1.3.2 Congestion Mitigation and Air Quality (CMAQ) Improvement Program

CMAQ funds are tied to projects that improve air quality, usually associated with reducing traffic congestion. Transit projects can qualify for these funds, including work that will improve ridership on transit lines. These funds are allocated by a Formula that is keyed to the severity of air quality problems for a given area.

According to the FTA Web site, "The Congestion Mitigation and Air Quality Improvement Program (CMAQ) (23 U.S.C. 149) has the objective of improving the Nation's air quality and managing traffic congestion. CMAQ projects and programs are often innovative solutions to common mobility problems and are driven by Clean Air Act mandates to attain national ambient air quality standards. Eligible activities under CMAQ include transit system capital expansion and improvements that are projected to realize an increase in ridership; travel demand management strategies and shared ride services; pedestrian and bicycle facilities and promotional activities that encourage bicycle commuting. Programs and projects are funded in air quality nonattainment and maintenance areas for ozone, carbon monoxide (CO), and small particulate matter (PM-10) that reduce transportation-related emissions.

"Funds are apportioned to States based on a formula that considers the severity of their air quality problems."

H-1.4 Railroad Rehabilitation and Improvement Financing (RRIF) Program

The RRIF Program enables the Federal Railroad Administration (FRA) to provide loans and loan guarantees for railroad capital projects, including freight railroads, State and local passenger and commuter railroads, and Amtrak. The projects eligible for this funding include freight intermodal terminals, railroad equipment, track, bridges, and yards/shops.

According to the FRA Web site, "The RRIF program was established by the Transportation Equity Act for the 21st Century (TEA-21) and amended by the Safe Accountable, Flexible and Efficient Transportation Equity Act: a Legacy for Users (SAFETEA-LU). Under this program the FRA Administrator is authorized to provide direct loans and loan guarantees up to $35.0 billion while up to $7.0 billion is reserved for projects benefiting freight railroads other than Class I carriers.

"The funding may be used to:

- Acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, components of track, bridges, yards, buildings and shops;
- Refinance outstanding debt incurred for the purposes listed above; and
- Develop or establish new intermodal or railroad facilities

"Direct loans can fund up to 100% of a railroad project with repayment periods of up to 25 years at interest rates equal to the cost of borrowing to the government.

"Eligible borrowers include railroads, state and local governments, government-sponsored authorities and corporations, joint ventures that include at least one railroad, and limited option freight shippers who intend to construct a new rail connection."

H-1.5 Section 5316 Job Access and Reverse Commute (JARC) Grants

The goal of the JARC program is to improve access to transportation services to employment and employment related activities for welfare recipients and eligible low-income individuals and to transport residents of urbanized areas and non-urbanized areas to suburban employment opportunities. Toward this goal, the Federal Transit Administration provides financial assistance for transportation services planned, designed, and carried out to meet the transportation needs of eligible low-income individuals, and of reverse commuters regardless of income.

According to the FTA Web site, "The Job Access and Reverse Commute (JARC) program has had a dramatic impact on the lives of thousands of welfare recipients and low-income families, helping individuals successfully transition from welfare to work and reach needed employment support services such as childcare and job training activities." JARC was established as part of TEA–21 to address the unique transportation challenges faced by welfare recipients and low-income persons seeking to get and keep jobs.

"With the passage of SAFETEA–LU, JARC funding is allocated by formula to States for areas with populations below 200,000 persons, and to designated recipients for areas with populations of 200,000 persons and above. The formula is based on the number of eligible low-income and welfare recipients in urbanized and rural areas. SAFETEA-LU authorized a total of $727 million for JARC grants from Fiscal Years 2006 through 2009.

"The formula-based program is intended to provide an equitable funding distribution to States and communities as well as stable and reliable funding in order to implement locally developed, coordinated public transit-human services transportation plans. FTA continues to provide maximum flexibility to communities in designing plans and projects to meet the transportation needs of low-income people and welfare recipients."

H-1.6 Transportation Infrastructure Finance and Innovation Act (TIFIA)

The Transportation Infrastructure Finance and Innovation Act of 1998 established a new federal credit program called TIFIA under which the U.S. Department of Transportation may provide three forms of credit assistance – secured (direct) loans, loan guarantees, and standby lines of credit – for surface transportation projects of national or regional significance. Transit projects are eligible. However, a project's eligible costs, as defined under 23 U.S.C 181, must be reasonably anticipated to total at least $50 million, or alternatively, equal 33 1/3 percent or more of the state's federal aid highway apportionments for the most recently completed fiscal year, whichever is less.

H-1.7 Highway Safety Improvement Program (HSIP), Section 148

The HSIP, codified by SAFETEA-LU as section 148 of title 23 U.S.C., is a newly-created "core funding" program administered by the Federal Highway Administration (FHWA). Section 148 establishes a set-aside program totaling $220 million each fiscal year for highway-rail crossing safety. The funds are to be used for crossing safety improvements.

CHAPTER H-2 – STATE FUNDING OPTIONS

At the present time, there is no steady, ongoing source of funding for commuter rail available from the State of Texas. In 2005, the Texas Legislature created the Texas Rail Relocation and Improvement Fund, yet at the time of this reports publication that fund lacks a revenue stream. However, according to the Finance Department of Dallas Area Rapid Transit (DART), state funded grants that can be used for commuter rail projects occasionally are available.[1] In the Dallas area, these grants have been administered by the local Metropolitan Planning Organization. DART is a co-sponsor of the Trinity Railway Express (TRE), the commuter rail service between Dallas and Fort Worth. The other sponsor is the Fort Worth Transportation Authority.

[1] Per a telephone conversation with a DART financial official on May 27, 2008.

CHAPTER H-3 – LOCAL FUNDING OPTIONS

H-3.1 Sales Tax or Bonding

Other than federal transit-supportive programs, the more likely sources of major funding for a future Houston area commuter rail service would be local. Both DART and Houston METRO receive financing through a 1 percent sales tax. In the City of Houston, the sales tax has reached its state-mandated cap of 8.25 percent, with 1 percent used to support the Houston METRO service. However, conceivably the sales tax could be raised in areas outside of Houston (that is, in areas where the sales tax is less than 8.25 percent) to help cover costs of commuter rail serving these communities. Alternatively, action by the state legislature could raise the sales tax above the current 8.25 percent cap, or exempt the 1 percent for transit from counting toward the cap. Communities throughout the H-GAC TMA were previously given the opportunity to opt into the dedication of the 1% sales tax as described above. However, many municipalities, who would benefit from the improvements suggested within the body of this document, chose not to authorize this dedication of sales tax. Without a revision to the statute or a revision in the way that their communities allocate their funding streams, these communities would not be able to provide a revenue source through this mechanism for regional commuter rail service. Meanwhile, an alternative to revenue generation through a sales tax may be bonding for capital cost expenditures.

H-3.2 Support from Jurisdictions Served

To help defray costs related to stations, sponsors of a Houston area commuter rail service could look to the cities and other jurisdictions served. This is a model adopted by the Southern California Regional Rail Authority (SCRRA), sponsor of the Los Angeles area Metrolink commuter rail service. On the Metrolink system, the cities for the most part build and improve the stations[2]. The benefits for the cities have included their ability to influence development at or around station sites and to create stations with city-specific identities.

H-3.3 Public/Private Partnerships

Another potential source of funding for stations could be public/private development. Conceptually, the commuter rail sponsoring authority or a city served might make land available for a station and commercial/office co-development, and then look to a private developer to build the station. The benefit for the developer would come from the commercial/office development, whose attractiveness would be enhanced by the existence of the station.

As for main line improvements required to host commuter rail service, the sponsoring agency could look to the private railroads that own the existing facilities for capital contributions. The benefit for the freight railroads would be that the improvements would enhance capacity on the lines improved, potentially allowing the freight railroads to move their trains more efficiently.

[2] In Riverside County, the Riverside County Transportation Commission built the Metrolink stations.

APPENDIX I: PUBLIC INVOLVEMENT

In accordance with H-GAC's commitment to ensuring an open transportation planning process that supports early and continued involvement, provides complete information, timely public notice, and full public access to key decisions, this project applied a defined Public Involvement Plan (PIP). This PIP is consistent with H-GAC's Transportation Public Involvement Process adopted by the Transportation Policy Council in September of 2003.

PURPOSE

The **purpose** of this specific task has been to finalize and implement an integrated group / stakeholder and public involvement plan (PIP) that supported the development of the Regional Commuter Rail Connectivity Study and was closely coordinated with other planning projects occurring in the Houston-Galveston Area. This PIP served to support the decision making role of the H-GAC Transportation Advisory Council (TAC), Transportation Policy Committee (TPC), the advisory role of the Task Force, and the participatory role of other identified stakeholders and citizens.

METHODOLOGY

The **methodology** evolved during the course of the project work. But throughout the project, the PIP focused on providing information in a timely and easily understandable manner to the general public and stakeholders. The PIP also sought to build ownership into the idea of a well connected regional commuter rail system by engaging the general public and a focused group of stakeholders with public meetings, workshops, one-on-one meetings, and public involvement support materials. The support materials included a newsletter, public presentations, and a web page.

In particular, numerous public meetings and key stakeholder meetings have been held/attended at which presentations have been made by the study team. These presentations have reported on the project status and progressive findings. The list of meetings by classification is given below in Table I-1:

The project website has also been a key element of the PIP, with posting of Oversight Task Force presentations and minutes of meeting, draft materials and reports/white papers as they were developed, early and preliminary drafts of the final report, as well as information on meetings available to the generally public at which the status of the study work would be presented. The website address is www.hgaccommuterrail.com.

Table I-1 List of Stakeholder and Public Meetings

Classification of Meetings	Meeting Description	Date
H-GAC Transportation Committees		
1.	**HGAC Technical Advisory Committee** Project Scope	July 12, 2006
2.	**H-GAC Transportation Policy Council** Briefing on Principal Corridors evaluation	September 28, 2007
3.	**HGAC Technical Advisory Committee** Status overview	March 12, 2008
4.	**HGAC Technical Advisory Committee** Briefing on Findings and Recommendations	June 11, 2008
5.	**Transportation Policy Council** Briefing on Findings and Recommendations	June 27, 2008
Public Meetings		
1.	**HGAC Commuter Rail Connectivity Public Mtg. #1** 290 Corridor (Sponsored by Cy Fair CofC), status review	April 11, 2007
2.	**HGAC Commuter Rail Connectivity Public Mtg. #2** Official project public meeting at H-GAC facilities	July 1, 2008
Stakeholder Meetings		
1.	**Urban District/Major Activity Center Working Group** Connectivity Workshop	December 20, 2006
2.	**BNSF Railroad** VP Passenger Rail Operations, status overview	November 1, 2007
3.	**Gulf Coast Freight Rail District** Exec Dir & Board Chair, status overview	November 26, 2007
4.	**Gulf Coast Freight Rail District** Board, status overview	January 8, 2008
5.	**Union Pacific Railroad and BNSF Railroad** Project Representatives, review of corridors, operations	February 19, 2008
6.	**Union Pacific Railroad** Omaha Senior Staff, status overview	March 4, 2008
7.	**Gulf Coast Freight Rail District** Exec Dir & Board Chair, status overview	March 28, 2008
8.	**Gulf Coast Freight Rail District** Board, Minneapolis Northstar Commuter Rail briefing	April 8, 2008

9.	**Gulf Coast Freight Rail District** Board, Review of Findings and Recommendations	June 10, 2008
Transportation Agencies		
1.	**Texas Department of Transportation** Planning Division Senior Staff, status overview	December 18, 2007
2.	**Houston METRO** Staff, status overview	January 7, 2008
3.	**Houston METRO** Senior Staff, status overview	April 4, 2008
4.	**Texas Department of Transportation** Planning Division Senior Staff, ROW considerations	April 22, 2008
Cities		
1.	**City of Houston** Staff, Principal Corridor assessments	August 6, 2007
2.	**City of Houston** Staff, status overview	January 29, 2008
3.	**City of Houston** Senior Planning Staff, status overview	March 11, 2008
4.	**City of Pearland** City Manager and Staff, status overview	April 11, 2008
5.	**City of Pearland** Council Workshop, Findings and Recommendations	June 23, 2008
6.	**City of Missouri City** City Manager & Staff, Findings and Recommendations	June 23, 2008
Counties		
1.	**Harris County** County Judge, County Engr. and Staff, status overview	February 1, 2008
2.	**Fort Bend County** County Judge and Senior Staff, status overview	April 10, 2008
3.	**Harris County** County Judge and Staff, status overview	April 14, 2008
Other Interest Groups		
1.	**Cy Fair Chamber of Commerce** 290 Passenger Rail Coalition, status overview	December 6, 2006
2.	**Tomball Chamber of Commerce** Transportation Committee, status overview	August 14, 2007
3.	**Greater Houston Partnership**	October 2, 2007
	Transit Planning Committee, status overview	
4.	**North Houston Association** Status overview	January 9, 2008
5.	**Woodlands Chamber of Commerce** Transportation Committee, status overview	April 15, 2008
6.	**Livable Houston/ Smart Growth Initiative** Sponsored by the Gulf Coast Institute and H-GAC	June 25, 2008
Project Oversight Task Force		
1.	**Oversight Task Force Meeting** Status review and consultation	August 31, 2006
2.	**Oversight Task Force Meeting** Status review and consultation	November 6, 2006
3.	**Oversight Task Force Meeting** Status review and consultation	February 12, 2007
4.	**Oversight Task Force Meeting** Status review and consultation	June 20, 2007
5.	**Oversight Task Force Meeting** Status review and consultation	August 15, 2007
6.	**Oversight Task Force Meeting** Status review and consultation	October 4, 2007
7.	**Oversight Task Force Meeting** Status review and consultation	January 29, 2008
8.	**Oversight Task Force Meeting** Status review and consultation	February 27, 2008
9.	**Oversight Task Force Meeting** Review of Findings and Recommendations	June 10, 2008

SUMMARY OF COMMENTS AND RESPONSES

HGAC received public comments on a variety of issues related to the Regional Commuter Rail Connectivity Study during the public comment period between July1 and July 31, 2008. Meeting transcripts, comments received, letters, and H-GAC's responses can be viewed online at www.hgaccommuterrail.com. The following summaries of Issues / responses have been organized first by several general categories, and then by specific corridors beginning with an "Urban Core" corridor representing the conceptual connections inside Loop 610.

General

The Regional Commuter Rail Connectivity Study is considered a visioning document that is not constrained by current operating conditions, funding commitments, or organizational structures. Rather, it looks beyond the present to see the potential future, given sufficient political will and community commitment to see a long distance regional Commuter rail system come to fruition.

There has been no attempt to determine any more than conceptual corridor alignments, operating plans, or specific station locations. Nor has an operating organization been identified that would provide for long distance commuter rail service covering much of the region. These will be steps that will follow this work, refining and improving the concepts presented herein in order to address the following types of issues, which are common to all corridors:

- Mode choice comparisons
- Opportunities for track sharing
- Station Locations
- Environmental concerns
- Refined ridership estimates
- Impacts to sensitive populations (i.e., Environmental Justice analysis)
- Connectivity to other transit options
- Funding opportunities
- Accessibility to pedestrian and bicycle facilities

In fact, the end result will certainly be different from the conceptual as further planning and engineering studies progress. However, this initial look is an important first step toward achieving a realistic and effective new mode of transportation for Houston's future.

Elevated Rail

This study is based, to a large extent, on preceding work performed in the TxDOT Houston Region Freight Rail Study completed in 2007. As such, this study focuses on providing long distance commuter rail service primarily for trip lengths of twenty miles out and further. Emphasis was placed on utilizing the existing freight rail infrastructure. For that reason, alternative modes that are not designed to run in mixed traffic with freight trains were not evaluated. While elevated guideway transit systems address many of the issues associated with penetrating the urban core. In fact, it creates another set of concerns – most notably, the cost of elevated guideway structures are typically three to five times greater than transit guideway at grade. Another concern is the perception of a division of the community by impacted residents. There were aerial alignments assumed in the conceptual Baseline System Plan where there were very restricted circumstances, including grade separation of passenger trains and freight trains, and for the connection of the proposed commuter rail routes from the south into downtown (refer to Chapter 5). However, these elevated structures were kept to a minimum and were placed in locations where their visual impact would be minimized (e.g., over freeway services roads adjacent to elevated freeway sections). This study expects and recommends that any corridor alternatives analysis studies that follow consider above-grade, at-grade, and below-grade solutions to resolve any such connectivity issues and at locations where commuter rail and freight rail may intersect.

Urban Core

Enabling trains to traverse the urban core and provide connectivity to the Major Activity Centers is challenging for all corridors in the region (refer to Appendices C and D). Many of these challenges were created by industry consolidations, development patterns, lack of rail corridor preservation, and growth in freight activity over the last twenty years. The Regional Commuter Rail Connectivity Study recommends an Alternatives Analysis study along each corridor to identify issues such as those mentioned above under the General discussion, as well as issues in the urban core related to:

- Accommodation of pedestrian and bicycle facilities
- Major Storage Facility and Operations Hub locations (refer to Chapter 4)
- Inter-corridor connectivity options for all transit opportunities

The recommendations of the TxDOT Texas Freight Rail Study, which preceded the Regional Commuter Rail Connectivity Study made five specific recommendations to relieve freight congestion in the urban core. We believe these recommendations are essential to any successful attempt to cross-connect any corridor commuter rail line in the future through and to the urban core. It is our understanding that the Gulf Coast Freight Rail District is presently seeking funding to begin implementing some of those critical recommendations. This funding will most certainly include some Federal funding, and as such, all neighborhoods will be given ample opportunity to review and comment on any potential impacts to their neighborhoods.

State Highway 3 / Galveston Corridor

The State Highway 3 (SH 3) corridor is an excellent candidate for implementation of long distance commuter rail service. The corridor provides the best opportunity for reverse commutes within the region anchored by the Houston metro area on one end and the City of Galveston, a major tourist destination and prominent medical center on the other end. Additionally, there are several educational and employment clusters nestled among three fast growing communities along the route.

Despite its great potential, the SH 3 corridor has unique challenges connecting to the urban core due to the fact that the many freight rail lines serving the Port of Houston area are already at capacity-constrained limits, even with only freight traffic. The Gulf Coast Freight Rail District is charged with the task of improving freight efficiencies, removing bottlenecks, and developing institutional frameworks to allow trains to move more freely, which would in turn potentially enable Commuter rail service in the portions of the Corridor within the Urban Core. However, the results of these actions could result in the taking of additional right-of way or shared capacity resulting in less freight traffic.

As an alternative alignment for the SH3 / Galveston commuter rail route through the urban core of Houston, the Baseline System Plan proposes in this study does not enter the East End community of Houston (refer to Chapter 5). Rather, it turns southwest to run alongside the Glidden Subdivision until it meets the propose commuter rail alignment within the SH35 corridor. There it turns north to travel along right-of-way already owned by TxDOT (the SH35 tollway route inside Loop 610) to reach I-45 South adjacent to the University of Houston Main Campus, and then continuing downtown from the south on an elevated guideway over the I-45 service roads.

The City of Galveston, working with its consultant team lead by The Goodman Corporation has secured funding to perform an Alternatives Analysis on this corridor. This study is designed to address issues such as those identified above under the General category of comments and responses.

Comments/questions received by H-GAC concerning this corridor have been forwarded to the City of Galveston and the Consultants who are conducting the Alternatives Analysis.

Southern Corridors

FM 521; SH 35/Mykawa; SH 288

These three radial corridors were not originally included in the Principal Corridor analysis, in part due to the preliminary assessment of a lower ridership potential from this portion of the region. However, through the course of the following study, consultation with key stakeholders, and analysis, two of these corridors were included in the final Baseline System Plan, with one of the corridors actually comprising a variation from the original route assumptions. These assessments are summarized below.

The FM 521 corridor was developed as an optional route to overcome the challenges associated with providing passenger rail service in the US 90A Corridor utilizing the Glidden Subdivision railroad itself. This corridor was the corridor that had a variation from the initial concept, instead turning the route to the southwest. This route first considered during the ridership demand modeling phase of the study, where it was found that it performed reasonably well (refer to Chapter 3). This route would serve the southern end of Fort Bend County, providing a much needed commuter transit connection to the south end of the urban core (in particular the Texas Medical Center) from a part of the region that is beginning to see major growth trends. The challenges associated with this alignment, however, are significant. It is a longer, more circuitous route, adding to the cost in travel time and resources. Finally, it does not serve the communities of Sugar Land, Stafford, and Missouri City with the most direct route to the Texas Medical Center portion of the Urban Core where many people living in that part of the region area employed (when compared to the US90A corridor).

The State Highway 35 (SH35) and the Mykawa Subdivision railroad corridors are both in close proximity and intersect in Pearland. SH 35 did not have a pre-existing railroad corridor and therefore was not part of the initial analysis of the railroad network. Rather, the nearby Mykawa Subdivision railroad corridor (adjacent to Mykawa Road) was analyzed in the early parts of the study. The Mykawa corridor's existing freight traffic, with significant projected growth of future freight service to and from the south, resulted in this corridor being excluded from consideration of the Baseline System Plan. However, TxDOT's planning for the parallel SH 35 includes future plans for a potential tollway with multimodal service components with the expanded right-of-way. In fact, TxDOT already owns the future SH35 tollway right-of-way between Loop 610 and I-45 South. Our study substituted the SH 35 corridor for the Mykawa corridor in the final Baseline System analysis (refer to Chapter 5). This route would provide direct connections between the high-growth Pearland/Alvin area on the south, Hobby Airport, and the urban core that include the University of Houston main campus.

SH 288 was not considered in the Commuter Rail Connectivity Study because of the absence of a continuous freight rail network and because it showed little ridership potential in the initial analysis (refer to Appendix E). However, just like the SH 35 corridor, future opportunities for commuter rail could be considered as part of any planned multimodal improvements or upgrades to the highway facility. This corridor traveling directly to the south has long-term commuter potential between the urban core and the southern communities of Manvel, Angleton, Lake Jackson, and Freeport.

The study recommends that corridors not in the Baseline System, but under consideration for expansion or upgrade, include right-of-way preservation for long-distance commuter rail and/or other transit considerations. It is further recommended in the Regional Commuter Rail Connectivity Study that each corridor in the Baseline System needs additional study using the Alternatives Analysis methodology to review issues such as those identified in the General issues category discussed above.

US 90A Corridor

Fort Bend County is one of the fastest growing counties within the Houston-Galveston Area Council's (H-GAC) eight county Transportation Management Area (TMA). Demographics and population forecasts led to the Regional Commuter Rail Connectivity Study's consideration of long distance commuter rail in this corridor as part of the initial Principal Corridors analysis (refer to Chapter 2). In particular, consideration was given to the strong connection between these southwest communities and the commercial and medical employment centers in the urban core.

Several conditions combine to preclude the US 90A Corridor from consideration for near-term implementation of commuter rail service using the existing freight rail infrastructure, primarily because the Union Pacific (UP) railroad needs all available capacity to meet projected freight service demand. These conditions include:

- The 1990's industry consolidation occurred resulting in some trains being rerouted onto this corridor from other railroad subdivisions;
- The track network and right-of-way expansion is constrained by the US 90A roadway; and
- Freight movements are growing at a rate of about five percent annually and are expected to intensify.

The Gulf Coast Freight Rail District will soon begin an evaluation of a Fort Bend County Bypass alignment which could reroute freight train traffic off the US 90A Corridor, and thereby create opportunities to provide travel relief in the 90A corridor through deployment of long distance commuter rail service. The challenges associated with the Bypass concept include a very large cost for the new rail infrastructure, the fact that it will increase the distance traveled by freight train locomotives, and its potential to interrupt service to existing freight customers along the corridor.

It is recommended in this study that each corridor in the Baseline System undergo additional studies using the federal Alternatives Analysis methodology to review issues such as those identified in the General category of comments given above.

One of the short-term options is to pursue studies to determine the best transit option for each community along the corridor, including alternative suburban commuter line routes and connections based on the assessment that the freight right-of-way cannot be shared. In particular, part of the corridor is in METRO's service area and may be considered for an alternative form of transit independent of the UP right-of-way, such as the study describes as the suburban commuter line mode (refer to Appendix B).

US 290/Hempstead

The US 290/Hempstead corridor is a high growth corridor that has strong public support for commuter rail implementation. The corridor is currently facing several mobility challenges and is often viewed as a candidate for multimodal solutions. These solutions could include long distance commuter rail, in combination with suburban commuter lines or light rail transit (LRT).

Current transit facilities within the corridor consist of a 13.5 mile, reversible, high occupancy vehicle (HOV) lane located in the center of US 290.. METRO park and ride facilities are linked to the US 290 high-occupancy-vehicle (HOV) lane at three locations.

The Union Pacific (UP) railroad owns the Eureka subdivision [track and right-of-way] adjacent to Hempstead Highway, and has publicly stated its willingness to allow commuter rail operations between Hempstead and Eureka Yard (near TC Jester) and possibly further northwest to College Station. UP is also open to discussions about development of commuter rail service eastward between Eureka Junction and the Amtrak Station near downtown along the passenger main portion of the Terminal Subdivision (adjacent to Center Street). However, UP insists that such considerations be given only if passenger train operations do not encumber the operation of its freight trains along the freight main portion of the Terminal subdivision (refer to Appendix C and D).

The railroad alignment through the US 290 / Hempstead corridor is a single track with limited sidings and average daily train volumes of 5 to 10 trains. Further, this corridor is also a candidate for location of a hub terminal and maintenance and storage facility, two significant components of a commuter rail system (refer to Chapter 4).

The location of the proposed operational hub terminal and maintenance and storage facility (at or near the Northwest Transit Center), and the provision of connectivity to the Central Business District (CBD) is particularly challenging and possess many of the same concerns that relate to the urban core. This study recommends an alternative analysis study along this corridor to identify issues described above under the General category and the Urban Core category of comments and responses.

The opportunity to develop commuter rail along the US 290/Hempstead corridor to the Northwest Transit Center has a shorter time-frame possibility, whereas penetrating the urban core might take considerably longer given the freight traffic constraint issues. The recommendations of the TxDOT Texas Freight Rail Study, which preceded the Regional Commuter Rail Connectivity Study, made five specific recommendations to relieve freight congestion in the urban core. We believe these recommendations are essential to any successful attempt to cross-connect any corridor commuter rail line in the near term. It is our understanding that transportation stakeholders along this corridor are presently seeking funding to perform an in-depth study of this corridor's serious need for transit relief. This funding will most certainly include some Federal funding, and as such, all neighborhoods will be given ample opportunity to review and comment on the transit future of this corridor. It is also our understanding that Harris County is interested in the immediate pursuit of a more limited commuter rail "demonstration project" within this corridor.

Northern Corridors
SH 249; IH-45 N; US 59 N

The SH 249 Corridor is the only northern-oriented corridor to be included in the recommended Baseline System (refer to Chapter 5). Though not providing direct access to Conroe and only 'backdoor' access to the Woodlands, the route has decent ridership potential and lacks major conflict with freight rail traffic outside of Loop 610. This corridor scored well in both the Principal Corridor and Baseline System analyses. Initially, it was thought this corridor might share some of the same ridership catchment as the US 290 corridor. Additional analysis revealed the ridership remained strong when it was included in the system with the US 290 corridor, showing both corridors in the Northwest quadrant of the region may be viable for simultaneous Commuter rail service (refer to Chapter 3). Furthermore, the proximity of the SH 249 corridor to the preferred Operational Hub Terminal site would indicate a possible early implementation prospect for a regional system.

The IH--45/Hardy corridor was identified as a leading candidate for commuter rail development in the first phase of the study (refer to Chapter 2 and 3). However, Union Pacific indicated heavy freight traffic precludes the corridor's use for commuter rail in the near future. Barring some change in Union Pacific policy, or a shift in freight traffic, acquiring new right-of-way would be the only option at a very high cost.

It should be noted that this study has focused on providing long distance commuter rail service primarily for trip lengths of twenty miles out and further. Emphasis was placed on utilizing the existing freight rail infrastructure. For that reason, alternative modes that are not designed to run in mixed traffic with freight trains were not evaluated since commuter rail service, as evaluated in this study, must be compatible with continued freight rail uses. Railroad companies own the track and commuter rail service can operate only through a contractual agreement with the railroads.

Because of high potential ridership in the IH 45 corridor, even thought commuter service along the railroad network is not feasible as discussed above, it should remain under consideration for potential alternative transit development.

The US 59N Corridor was removed from consideration as a candidate for early implementation (i.e., not part of the Baseline System Plan) during the vetting of the Principal Corridors for the same reasons as the IH 45/Hardy corridor above. The growth potential of this corridor, both in population and employment opportunities, suggests future consideration for alternative transit mode development.

However, in the long term there may continue to be opportunities for long distance commuter rail service in both the IH-45 N/Hardy corridor and the US 59 N corridor, but only if the freight rail operations significantly change. Further long range studies of both the freight rail system by the Gulf Coast Freight Rail District and public transit service by other agencies will be important steps toward determining these long term prospects.