Regional Commuter Rail Connectivity Study

Executive Summary

Prepared for :

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In association with:
HNTB Corporation
Wilbur Smith Associates
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Executive Summary for

REGIONAL COMMUTER RAIL CONNECTIVITY STUDY

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H-GAC

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FINDINGS AND RECOMMENDATIONS

A long-distance commuter rail system can provide an important part of the future multimodal transit network that the Houston-Galveston region will require as several million more people move into the metropolitan area. The study of such a commuter rail system for the Houston-Galveston metropolitan region has shown that an FRA compliant, long-distance rail system is feasible to develop. Such a system would be compatible with the existing freight rail system, and could be implemented in a way that does not unreasonably hinder the necessary growth of the freight rail system.

As the work on the H-GAC Regional Commuter Rail Connectivity Study draws to a close, the price of gasoline is reaching all-time high levels with much higher prices predicted by many. The reality of our limited natural resources, the region's desire to make efforts to reduce the growth in our carbon emissions, and the economic situation facing the population of our region is causing a consideration of practical changes in our choice of transportation modes. It is this critical time in Houston's history that this study finds a timely state of affairs in which to present its findings.

The discussion below addresses the conclusions reached during the course of this two year study, as well as the recommendations of additional planning and design studies, necessary steps to be taken by transportation and governmental agencies, and important public interest initiatives needed to carry the prospects forward toward implementation. Not all conclusions and recommendations have necessarily been part of the specific study work, but the technical assessments and planning considerations have highlighted some things that are important to advance or preserve in order to prepare the way for the implementation of a regional commuter rail system. As such, they are included as part of the conclusions and recommendations to be considered by regional leaders.

The detailed Findings and Recommendations are given in Chapter 6 of the full report, and a summary of the points is given below.

Recommendations

1. Move the study of commuter rail into advanced planning in order to establish a plan for a comprehensive freight and passenger rail system.
2. Conduct engineering studies of priority corridors, establishing a timeline for implementation of a complete, regional long distance commuter rail system within 10 to 15 years.
3. Identify the best early implementation corridors, such as US 290 and SH 3.
4. Protect commuter rail alignments and associated dormant right-of-way inside Loop 610.
5. Coordinate with TxDOT and HCTRA where near term roadway improvements provide commuter rail alignment opportunities.
6. Establish interagency / governmental task force to coordinate difficult alignments inside Loop 610.
7. Preserve right-of-way for the proposed operational hub terminal near the Northwest Transit Center and for the proposed maintenance and storage facility at Eureka rail yard.

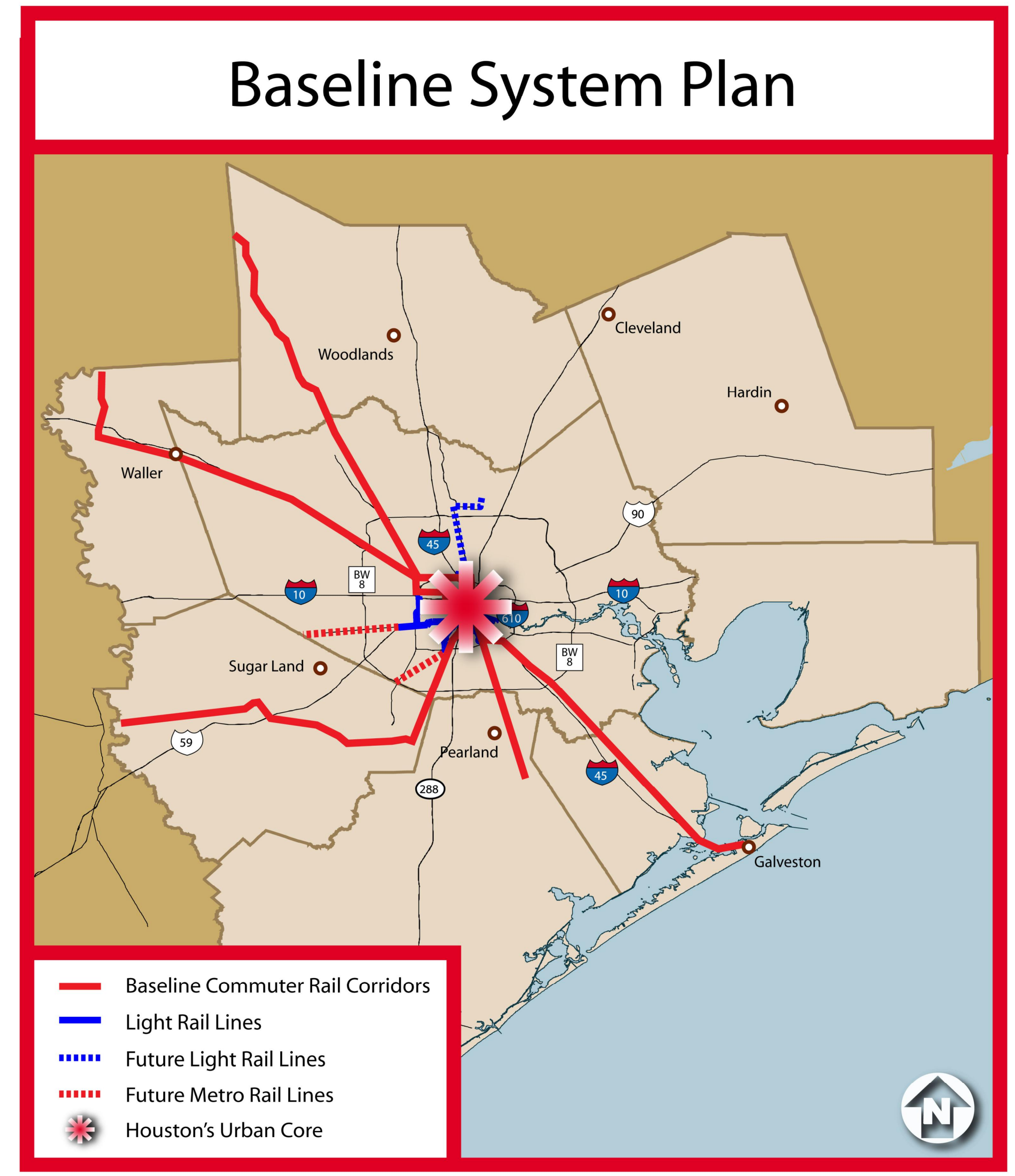

Figure ES-1 Baseline System Plan

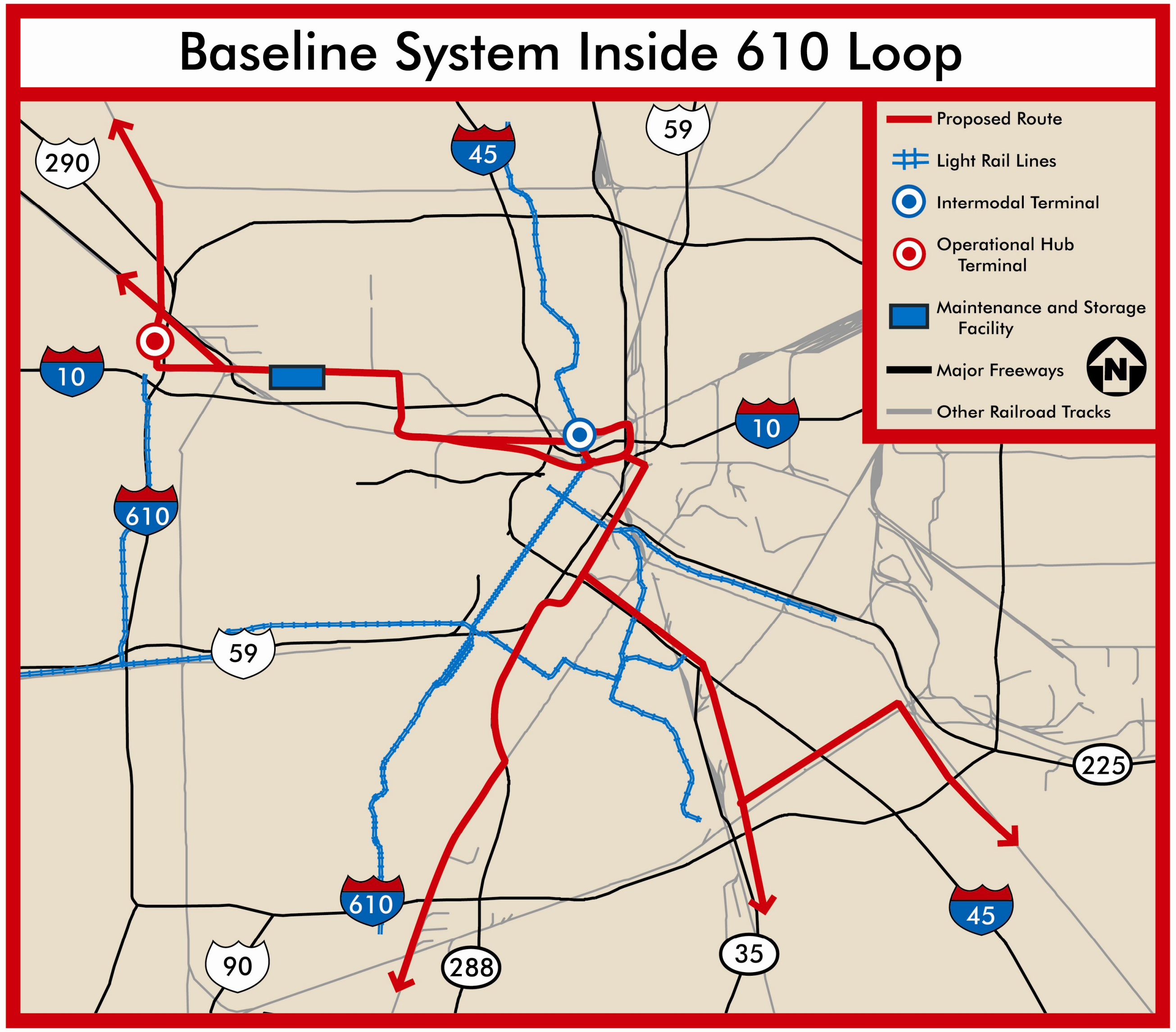

Figure ES-2 Baseline System Inside 610 Loop

Findings

1. METRO Solutions LRT system and Signature bus rapid transit system are essential for connecting major urban districts and employment centers with long distance commuter rail.
2. Implementing commuter rail will be difficult in freight rail corridors, and there are some corridors so constrained by freight rail traffic that other transit options should be considered.
3. The liability constraints currently imposed on the freight railroads will require changes to state law and possibly local ordinances in order to allow passenger service to be provided on the railroad's property and infrastructure.
4. It is feasible to improve and expand freight rail right-of-way and track/signaling infrastructure such that commuter rail trains can operate with freight trains.
5. Dedicated commuter rail routes inside 610 Loop are feasible, generally placing passenger and freight trains on segregated tracks.
6. An overall upgrade to a higher level of train control and signaling will be needed for all corridors served by commuter rail.
7. Design criteria must be established with the freight rail companies as a general basis for progressing the planning and engineering of upgrades to the infrastructure.
8. Near term decisions are needed on the location and configuration of the operational hub terminal and the maintenance and storage facility in order to provide for the ultimate regional system.
9. Urban districts must plan for suitable systems to circulate and distribute commuter rail ridership arriving at the district.
10. Environmental impacts are manageable, and the economic development potential is large.
11. Public/private development of infrastructure and facilities will foster Class 1 railroad company participation, public support and political viability.
12. The conceptual regional system ridership is (conservatively estimated) 40,000 riders a day for a fully developed system with five lines in service.
13. The conceptual regional system has an order-of-magnitude cost of about $3 Billion (2008 dollars) when fully built out with five lines.
14. The public comments and expressions of opinion concerning the concept of a regional commuter rail system have been positive overall, and summaries of the related issues and responses are included in Appendix I.

STUDY APPROACH AND BACKGROUND

APPROACH

The Regional Commuter Rail Connectivity Study has taken a fresh approach from past considerations of long-distance commuter rail in Houston, Texas. The look has been long range in terms of both the scale of the system and the timeframe in which it would evolve. The work builds on various studies that have preceded it, and draws from many sources of information and advice. It 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 the necessary community commitment, to see a long-distance regional commuter rail system come to fruition.

Further, this study has maintained a "systems-level" approach in that an entire operating system has been studied, as compared to a "corridor-level" approach. The results and conclusions of this study, therefore, offer a complete conceptual definition of a long-distance passenger rail system that carries commuters from the far reaches of our region into the urban core of Houston. When taken as a whole, this document provides a conceptual system plan through which strategic decisions by the governmental entities and transportation agencies can be evaluated over the course of time, particularly with respect to related development and Right-of-Way (ROW) use. Over the course of the next 50 years, the overall access to our urban core will be dramatically affected by decisions made today. Hopefully, through presentation of this conceptual system plan for a regional commuter rail system, this study will help guide these decisions.

Figure ES-3: The "Coaster" Commuter Rail in San Diego, CA

Figure ES-4: FRA-Compliant Commuter Rail in Fort Worth, TX

Guidance of this study's investigations has been given by an oversight Task Force comprised of representatives from various public agencies, urban districts, state/county/local municipalities, railroad companies, and research institutes. This guidance has been invaluable for maintaining the study's focus on feasible and implementable concepts. A fundamental concept, maintained throughout this study, has been that the commuter rail system will work in concert with the existing and future freight rail system. This means that passenger trains will share track with freight trains in locations where it is possible to provide sufficient capacity and operational fluidity for both, while providing dedicated track and facilities for passenger trains in locations where maintaining capacity and fluidity of freight operations requires this complete separation. **Figure ES-3 and ES-4** show passenger trains of a class of technology which is certified by the Federal Railroad Administration (FRA) for operations in mixed traffic with freight trains, this is also referred to as being "FRA compliant".

There has been no attempt in this early stage of studies to determine any more than conceptual corridor alignments, operating plans, or specific station locations. Nor has an operating organization been identified that would provide long-distance commuter rail service covering much of the region. These will be steps that follow this work, refining and improving on the concepts presented herein. In fact, the end result will certainly be different than 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.

BACKGROUND

Houston is at a crossroads, and decisions made in the near term will greatly affect our long term future in terms of commuter rail – a mode of transit that does not yet exist in Houston. The purpose of this report is to provide a definition of a regional long-distance commuter rail system, and to envision how such a system could help serve the tremendous need for efficient transit service throughout the very large metropolitan area around the Houston-Galveston Region. Although the study area was limited to the 8-County area surrounding Houston and Galveston, the concepts developed in this study would allow commuter rail to extend well beyond the study area.

A second dimension of this study is to address connectivity between transit modes within the urban core which will be essential for commuter rail to be fully successful. A given factor that has been assumed is the completion of the urban light rail transit (LRT) system (part of the METRO Solutions Plan, Phase II), which will tie together the major urban districts within the urban core. The study's purpose is also to define on a conceptual basis the connectivity solutions needed within Urban Districts in general to serve commuter rail.

The additional 3.5 million residents projected to move into the Houston-Galveston Region by 2035 will severely congest our region's transportation infrastructure if the current trend of development continues and the region remains auto-dependent. Even with the 2035 Regional Transportation Plan funded and built, the Houston-Galveston Region will see a projected 10% increase in congestion compared to today's level. It is necessary that other modes of transportation be investigated and implemented with the purpose of reducing the strain that congestion has on the region's economy and its ability to grow.

In light of this coming growth, a number of local transportation agencies are discussing the reality that the freeway and tollway system is not keeping up with the growth of our region. Currently all major freeway corridors are in planning, design, construction or have recently initiated operation of new freeway/tollway capacity. If funding becomes available over the next ten to fifteen years, all of this new capacity could be coming online. However, most of the freeways will be reaching capacity constrained conditions again within a few years after the new capacity is in place. Other means and modes are needed to move people through the most constrained portions of our radial travel corridors.

Figure ES-5 was taken from the recently published 2035 Regional Transportation Plan for the Houston-Galveston Region. The figure illustrates, in red, the level of congestion forecasted for the region even with the implementation of the roadway and transit projects contained within the 2035 Regional Transportation Plan. The graphical image is clear – the Houston region must begin to aggressively build high capacity transit that will carry people over long-distances and provide adequate mobility within the urban core of the City.

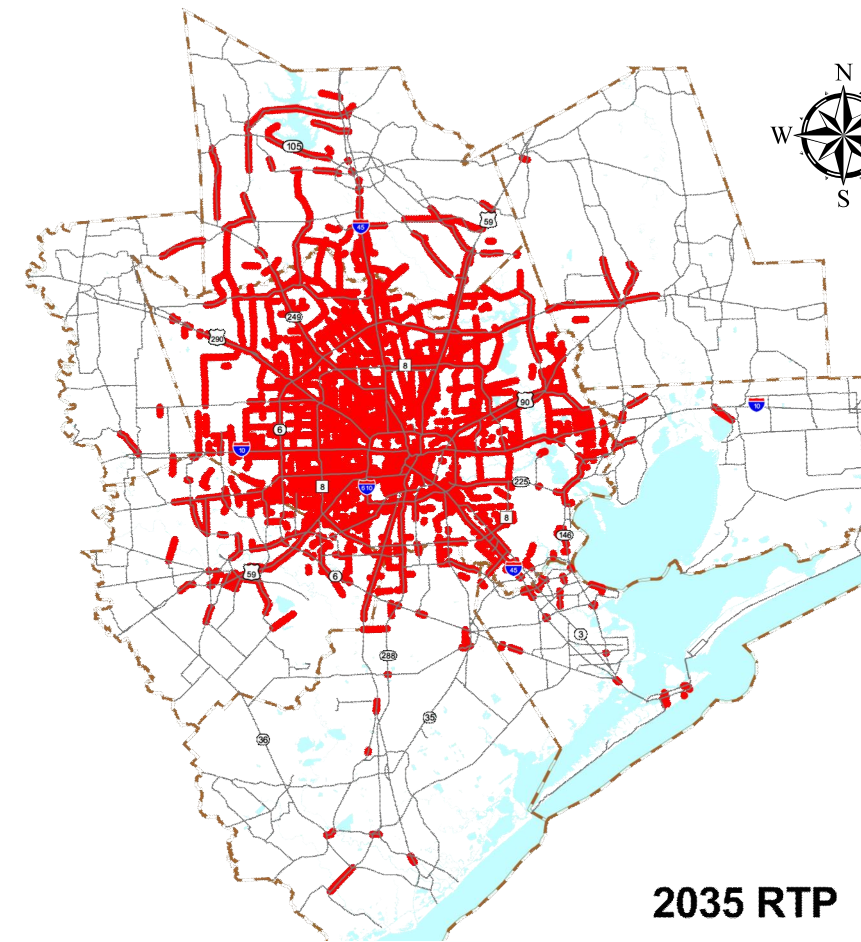

Figure ES-5: Congestion with Implementation of 2035 RTP

Figure ES-6 illustrates the current conditions in the urban core where the interchanges are the greatest freeway system constraint. The capacity constraints of the interchanges that intercept the 610 Loop and the capacity of the 610 Loop itself, define the challenge of commuting to work across this barrier of congestion. A similar condition is developing at the interchanges around the outer Beltway 8 system, and a design reality is that even new interchanges are limited by capacity constraints. A strategic plan which adds capacity into the urban core along the radial corridors is critically important to our future mobility. It is this strategic purpose that drives the concepts proposed herein for a regional commuter rail system.

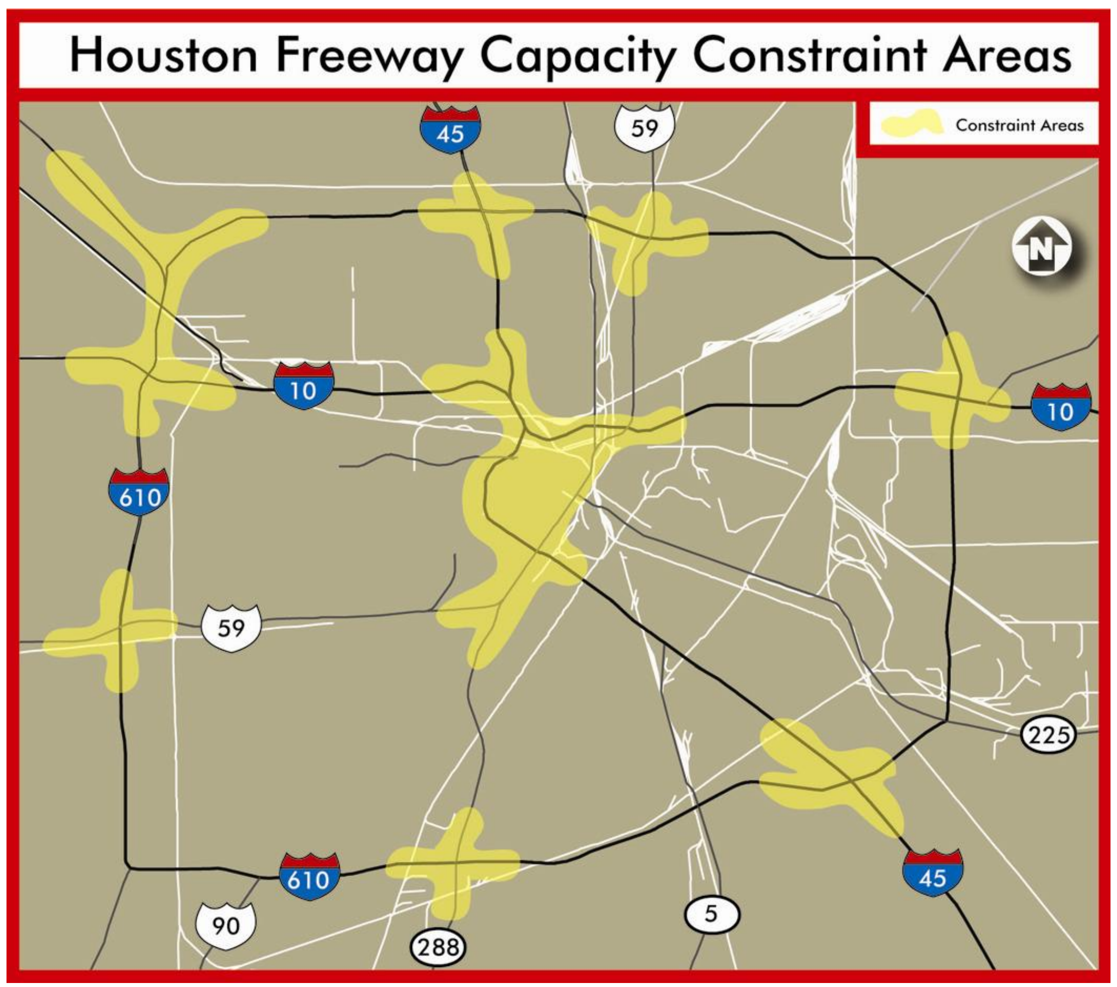

Figure ES-6: Houston's Freeway System's Most Critical Areas of Capacity Constraint

The figure also shows the railroad tracks and abandoned rights-of-way which are also configured in a similar radial pattern to that of the freeway system. This fact reveals a strategic source of potential new transportation infrastructure that could supplement our roadway system. A fundamental premise of this study is that a long-distance regional commuter rail system utilizing the railroad network of tracks could be a major part of the future intermodal transportation system that will be needed for filling the gap of the travel corridor capacity deficiencies.

In fact, TxDOT recently completed the US 290 Major Investment Study (MIS) and subsequent operational studies which have concluded that the combination of an improved freeway and arterial roadway system, combined with a new tollway and multiple passenger rail systems (i.e., commuter rail and light rail), will be needed through the corridor. Only the combined capacity of all the modes (i.e., freeway, tollway, arterial streets, suburban commuter lines, and long-distance commuter rail) will provide sufficient capacity to adequately serve all of the person-trip demands through the US 290/Hempstead Highway corridor over the medium term (i.e., the next twenty years of growth) and beyond. These challenges and proposed solutions that TxDOT has defined for the US 290 Corridor are representative of the challenges and solutions to be faced over the long term in every other radial corridor.

In addition to the benefits the benefits to capacity within a given corridor provided by commuter rail, the benefits of a regional long-distance commuter rail system within the Houston-Galveston Region include:

- **Reduction of Vehicle Miles Travelled** in single occupancy vehicles, as well as an associated reduction in gasoline consumption
- **Increase Economic Vitality** of the major urban districts and major activity centers served by the commuter rail system
- **New Economic Development** around the station sites
- **Increased Travel Mode Choices** for commuters throughout the corridors where commuter rail is implemented

Foundational Work For This Commuter Rail Study

A preceding study on which this work has been based is the TxDOT Houston Region Freight Rail Study, completed in 2007. This previous study compiled a tremendous wealth of information about the existing freight rail network. The Houston urban core has grown up around and integrated with the Houston Terminal, as our central railroad system is called by the freight railroads. The flow of freight to or from the Houston business, manufacturing, and industrial complex, as well as the Port of Houston, is an essential part of our economy and must be protected from any detrimental action that imposes significant capacity impacts. For this reason, the operational capacity constraints that are inherent to the Houston heavy rail network were of great importance to understand and accommodate in this regional commuter rail study. The TxDOT study provided this source of freight rail industry information, capacity restrictions, infrastructure improvement requirements, and general context.

PRINCIPAL CORRIDOR SELECTION

An important task of the study scope of services required the determination of a set of "Principal Corridors" at the mid-point of the work program. This step was not necessarily intended to judge the highest priority corridors for commuter rail, nor was it intended to limit the consideration of other "secondary" corridors for near term implementation. Rather, it was a means to limit the number of representative corridors that would be carried into the tasks dealing with ridership analysis, operations planning, and capital cost estimating. The nature of the study overall is to establish a conceptual baseline for a regional long-distance commuter rail system. In developing the study toward this objective, the Principal Corridors selection phase defined a concept that was representative of a mature regional system. This Principal Corridor concept therefore served to provide a common understanding of what a regional commuter rail system would generically "look" like, and also provided an estimated cost for purposes of beginning the pursuit of federal, state and local funding sources necessary to begin the implementation of a regional system.

Most importantly, the definition of a set of Principal Corridors has allowed a dialogue to begin among the transportation agencies and with the Class 1 Railroads concerning specific corridors that could potentially be implemented in the near to medium term without detrimental impact on the freight rail movements within the region. This chapter provides an explanation of the process followed in determining the Principal Corridors that were studied further.

Determination of Candidate Corridors

Originally, there were eighteen railroad subdivisions/corridors that were considered as candidates for the implementation of FRA-compliant passenger trains. These corridors were first assessed as to their suitability for a regional commuter rail system in terms of whether they were part of a radial type of corridor pattern that could serve the movement of passengers into the urban core.

Some of the railroad subdivisions were found to be necessary connecting parts, in combination with other radial subdivisions, to route commuter rail to the major Urban Districts inside Loop 610. For example, the "Terminal Railroad Subdivision" which is contained entirely within Loop 610 was integral to several other radial alignments which would connect to the Terminal Subdivision in order for trains to reach Downtown Houston. Although corridors like these are not Principal Corridors themselves, the Terminal and West Belt Railroad Subdivisions were deemed "inherently" studied since they are components of other Principal Corridors.

The early assessments included an analytical review of the "demand potential" for commuters to use a long-distance commuter rail system. **Figure ES-7** illustrates the demand potential analysis results in a color-coded fashion.

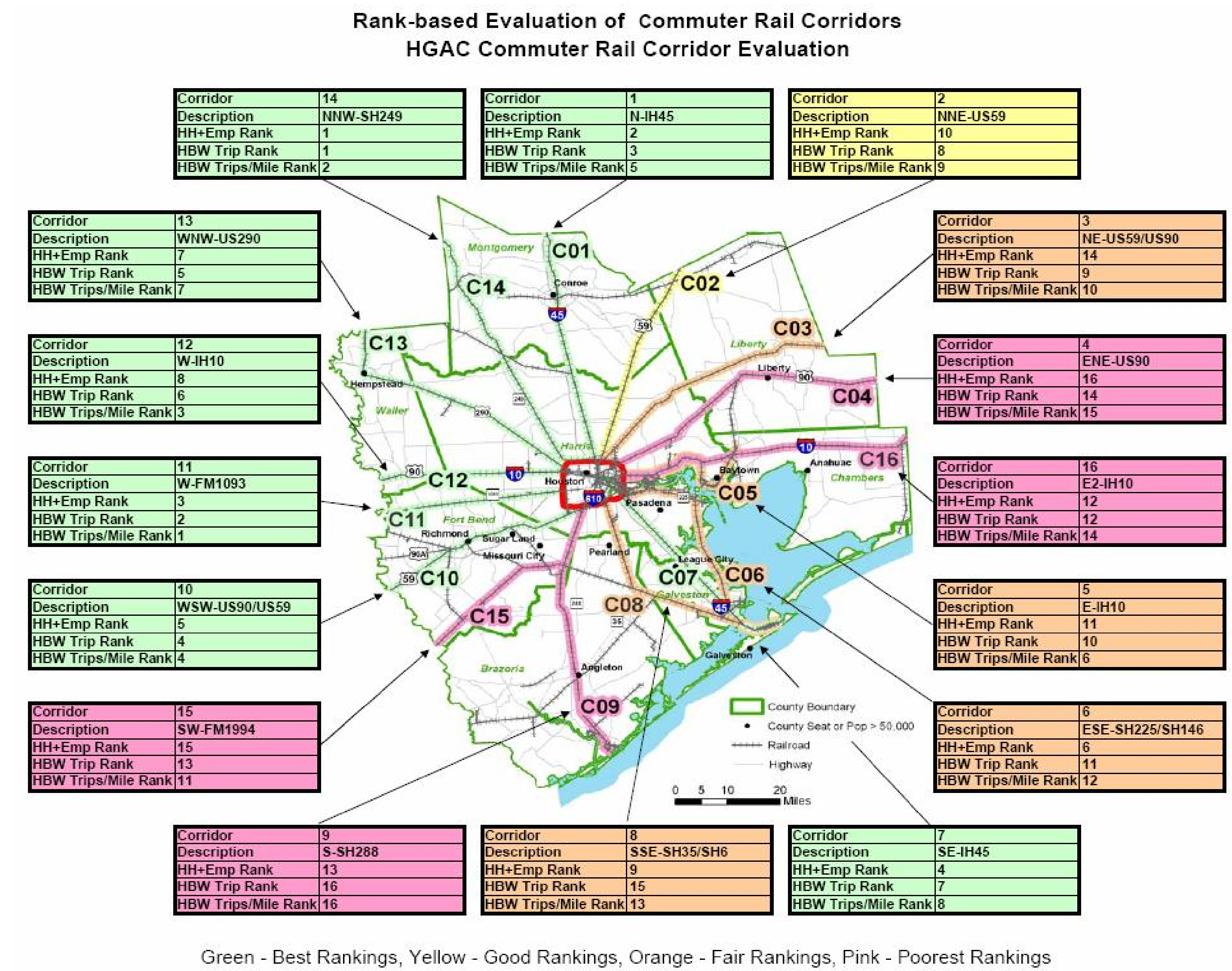

Figure ES-7: Relative Rank of Commuter Rail Corridors within the Region

These first level assessments resulted in a reduction of the total corridors to be considered in the more detailed comparative evaluation. The "short list" of corridors taken into the comparative evaluation process is given in **Table ES-1** and shown in **Figure ES-8**.

Table ES-1: Short List of Alternatives Considered for Principal Corridors

Travel Corridor Description	Railroad Subdivision Name
US 290	Eureka
Hardy Toll Road	Palestine
SH 249 / FM 1774	BNSF Houston
SH 3 / IH 45 South	UP Galveston
US 59 North	Lufkin
US 90A	Glidden
Westpark Toll Road	Bellaire
SH 35	Mykawa
Lake Houston / Huffman	Beaumont
FM 521	Popp

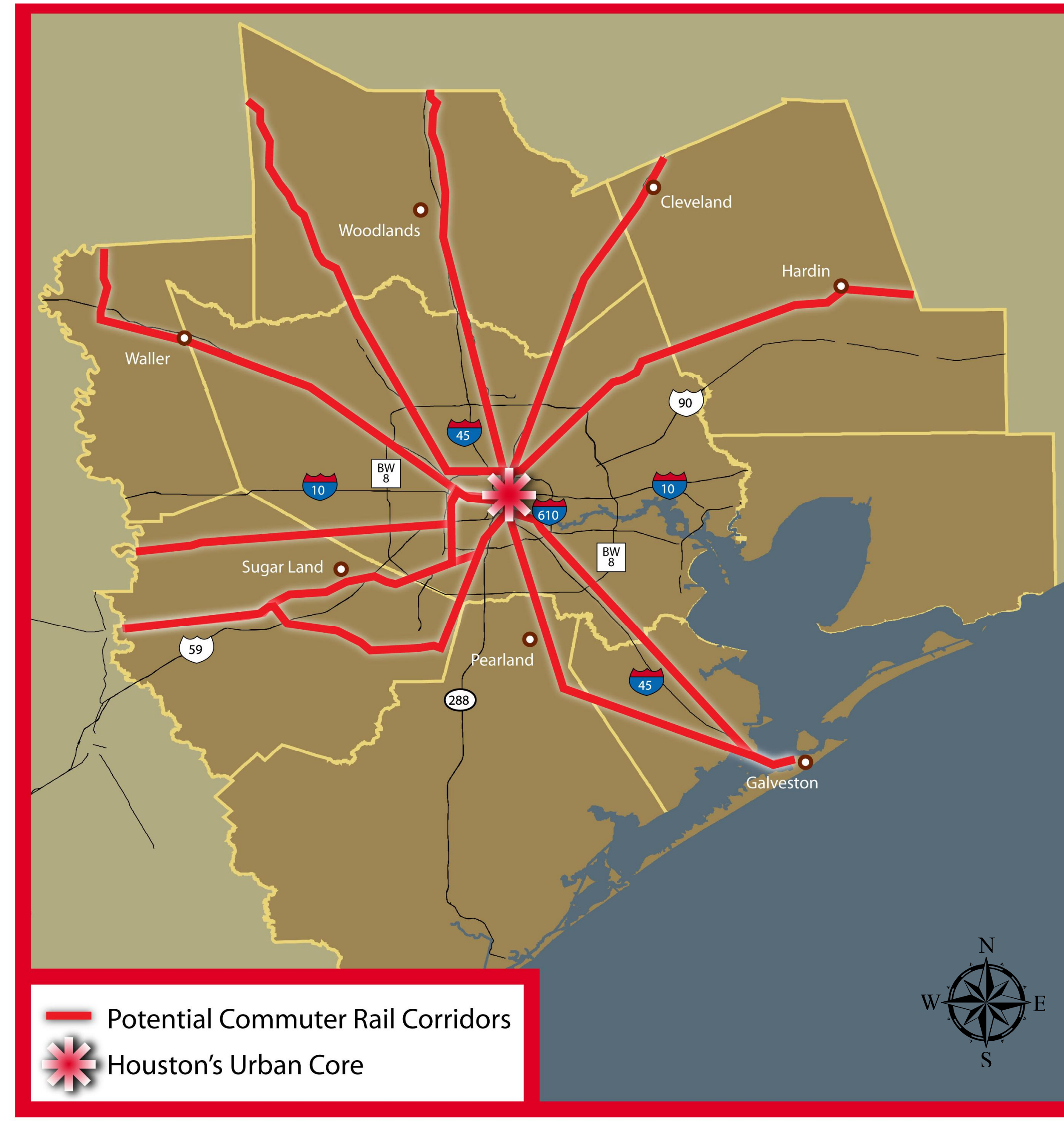

Figure ES-8: Potential Commuter Rail Corridors in the H-GAC TMA

Comparative Evaluation of Candidate Corridors

An initial set of twelve evaluation criteria categories was defined, and a process was undertaken to assess the suitability of these evaluation criteria in light of the fairly coarse level of corridor analysis possible under this study scope of work. Working with the project Oversight Task Force, the study team reduced the set of evaluation criteria to the following five categories.

- 2035 Demand Potential
- Capital Costs per Mile
- Implementability
- Urban Center Connectivity
- Economic Development Potential

The evaluation matrix was then established for each of the ten corridors, with numerical scores determined for each of these categories. For example, the scoring under the evaluation category called 2035 Ridership Demand Potential, each corridor was scored from 1-5 with 1 indicating the least demand potential while 5 indicated the highest demand potential.

As a result of the considerations and associated refinements to the scoring as described above, the five corridors selected as the study Principal Corridors are listed below, and shown in **Figure ES-9** at right:

1. US 290
2. Westpark
3. Hardy Toll Road
4. US 90A
5. SH 3 / IH 45 South

This Principal Corridor concept is representative of a mature long-distance commuter rail system that could operate on existing or revitalized freight rail Right-of-Way (ROW) and heavy railroad infrastructure. Again, the 8-County boundary of this study area is an artificial limit to such a system. The system described throughout the remainder of this report could actually reach much further into the exurban areas to carry commuters over a much longer distance.

Figure ES-9: Principal Corridor Conceptual System

RIDERSHIP AND OPERATIONS ANALYSIS

Once the Principal Corridors were defined as a representative hypothetical system, the study efforts moved into a more detailed analysis of ridership potential. The assumptions described above remained for this phase of analysis, in particular the assumption that a long-distance commuter rail system would primarily serve home-to-work trips originating outside of Beltway 8 with destinations near or within the 610 Loop – the urban core.

RIDERSHIP FORECAST METHODOLOGY

The Houston-Galveston Area Council (H-GAC) regional travel demand model was the analytical tool utilized during this study to forecast commuter ridership on the rail corridors considered in this study.

The five Principal Corridors were assumed for the hypothetical regional commuter rail system analyzed in the Tier 1 ridership analysis performed for this study.

The Tier 1 modeling focused on forecasting ridership for the Principal Corridors to determine an order of magnitude ridership forecast for a mature and well connected regional commuter rail system.

A second set of ridership studies were also performed under the designation of Tier 2 studies. These studies tested a few selected alternative system configurations in which new corridors were added and some segments of the Principal Corridors were removed. The Tier 2 studies were designed to evaluate the sensitivity of the regional commuter rail ridership forecast when considering alternative corridor scenarios.

The planning horizon year for the ridership forecast is Year 2035. The model network was based on H-GAC's 2035 Regional Transportation Plan (RTP). The bus system plan and other light rail lines; existing, planned, or in design by METRO; are included in the 2035 H-GAC networks. Additionally, the highway network (auto mode) included HOV lanes, but was modeled to represent a peak period level of congestion. It is standard practice to reflect peak period highway congestion when comparing to peak period transit travel times. Finally, Year 2035 population and employment forecasts were utilized as input to the travel forecasts.

TIER 1 RIDERSHIP FORECASTS FOR THE PRINCIPAL CORRIDOR SYSTEM

The 2035 peak period travel demand forecast for the base case commuter rail ridership analysis with five Principal Corridors is summarized in **Table ES-2**.

Table ES-2: 2035 Forecast Weekday Peak Period Ridership
Principal Corridor Commuter Rail System

Commuter Rail Route Roadway (RR Subdivision)	**Weekday Peak Ridership (Total Daily Boarding both directions)**			
	HBW	**HBNW**	**NHB**	**Total**
US 290 (Eureka)	6,017	562	325	**6,904**
SH 3 / IH 45 South (UP Galveston)	9,537	1,017	323	**10,877**
Westpark	5,588	925	295	**6,808**
US 90A (Glidden)	6,033	1,078	344	**7,455**
Hardy Road (Palestine)	8,252	623	119	**8,994**
System Total	**35,427**	**4,205**	**1,406**	**41,038**

Source: H-GAC Regional Travel Demand Model, 2008

HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

The estimated ridership for the base case commuter rail system is approximately 41,000 one-way trips per weekday day with a high of 10,900 trips per day on the SH 3/ IH 45 South route and a low of 6,800 riders per day on the Westpark route. As seen, home-based work trips constitute almost 90 percent of the total commuter trips. This is a strong indicator of traditional suburb to central city long-distance commuter rail ridership potential. For the purposes of the Principal Corridor selection screening analysis, the primary rationale of commuter rail is to connect work trips between outlying populations in the cities, towns, villages, and large master-planned communities (i.e., exurban areas) and the urban core employment centers. This measure is one direct indication of commuter rail market potential.

These estimates are deemed to be conservative (low) for a mature system in light of the following:

- Assumptions about complementary land-use development patterns near the stations were limited in this first analysis
- The relative price of travel by automobile, including fuel costs, inherent to the travel demand model were based upon observations contained within the most recent Benchmarking process, conducted in 2003
- Commuters with trips that originate from beyond the 8-County study area were not explicitly analyzed as potential commuter rail users, and it is likely that such long-distance trips will actually form a significant share of the ultimate ridership
- The full implementation of the improvements listed within the 2035 RTP were assumed for modeling purposes, however, recent funding short-falls and increased construction and ROW acquisition costs through many of the proposed corridors may lead to a smaller amount of projects being constructed

Optional Configuration Tier 2 Ridership Forecast

In addition to the Principal Corridor Commuter Rail system, two other system configuration alternatives were analyzed for preliminary ridership. These alternatives are listed below and illustrated in **Figures ES-10** and **ES-11**:

1. Base Case Principal Corridor system with an alternative routing replacing the US 90A (Glidden RR Subdivision) Corridor Route with an Optional Route serving the exurban areas of Ft. Bend County and Rosenberg via the BNSF Galveston RR Subdivision and then connecting to the Popp Industrial Lead Freight Line along FM 521;
2. Base case system with SH 249 and US 59 North corridor commuter routes added.

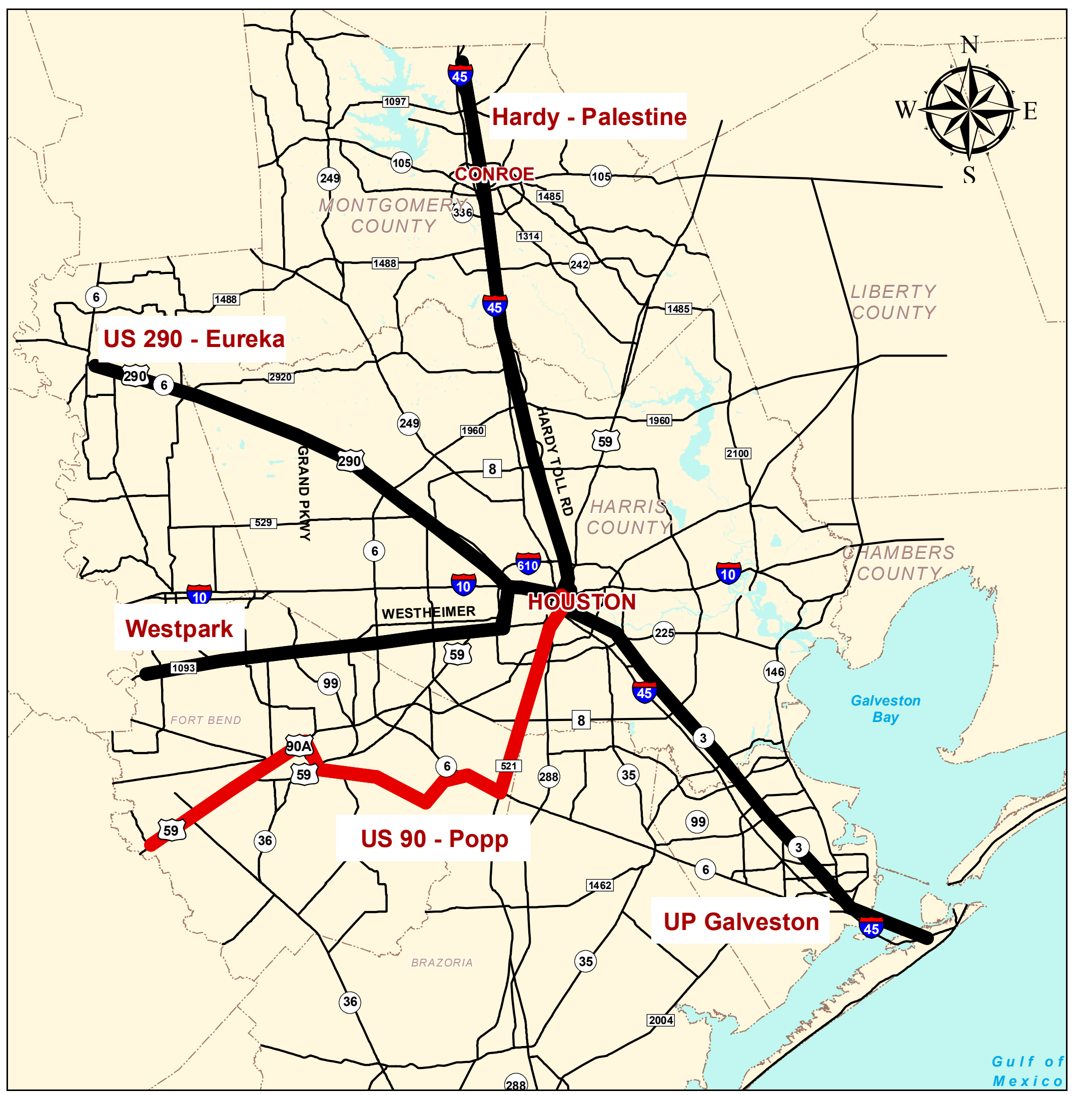

Figure ES-10: Tier 2 Modified Case No. 1: Base Case with Popp-Fort Bend Alternative

The Fort Bend County / FM 521 / BNSF Houston RR Subdivision / Popp RR Subdivision alternative resulted in a lower overall system ridership of 37,000 passengers per day, as shown in **Table ES-3**. The model is indicating that this alternative routing is more circuitous than the direct route along the US 90A corridor, and traverses different areas of the city with lower overall boardings in the H-GAC model. One reason for this could be that the overall travel time savings are not as great compared to making the trips by auto due to the more circuitous routing. However, the fact that the route also traverses past Sienna Plantation and the western edge of Pearland with a good connection to the Texas Medical Center could induce new trips that are not currently represented in the regional Travel Demand Model.

The addition of commuter routes along the SH 249 (BNSF Houston RR Subdivision) and the US 59 North (Lufkin RR Subdivision) Corridors had the effect of increasing overall system ridership to over 51,000, as shown in **Table ES-4**. This indicates that these corridors also have a commuter trip market that could see some benefit from commuter rail. Perhaps more significantly, the addition of these two corridors did not decrease the overall ridership of other north/northwest commuter rail routes, the US 290 corridor and the Hardy corridor. Furthermore, the additional connectivity of routes appears to increase the reverse commute ridership; for example, the SH 3 / IH 45 South Route ridership increased by approximately 5-percent.

Table ES-3: 2035 Forecast Weekday Peak Ridership

Base Case with Popp-Fort Bend Alternative

Commuter Rail Routes Roadway (RR Subdivision)	**Weekday Ridership (Total Weekday Boardings Both Directions)**			
	HBW	**HBNW**	**NHB**	**Total**
US 290 (Eureka)	5,850	576	317	**6,743**
SH 3 / IH 45 South (UP Galveston)	9,461	994	316	**10,771**
Westpark	5,533	893	293	**6,719**
Fort Bend County / FM 521 (Popp/BNSF Galveston)	4,188	189	76	**4,453**
Hardy Road (Palestine)	7,676	614	116	**8,406**
System Total	**32,708**	**3,266**	**1,118**	**37,092**

Trip Purposes: HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

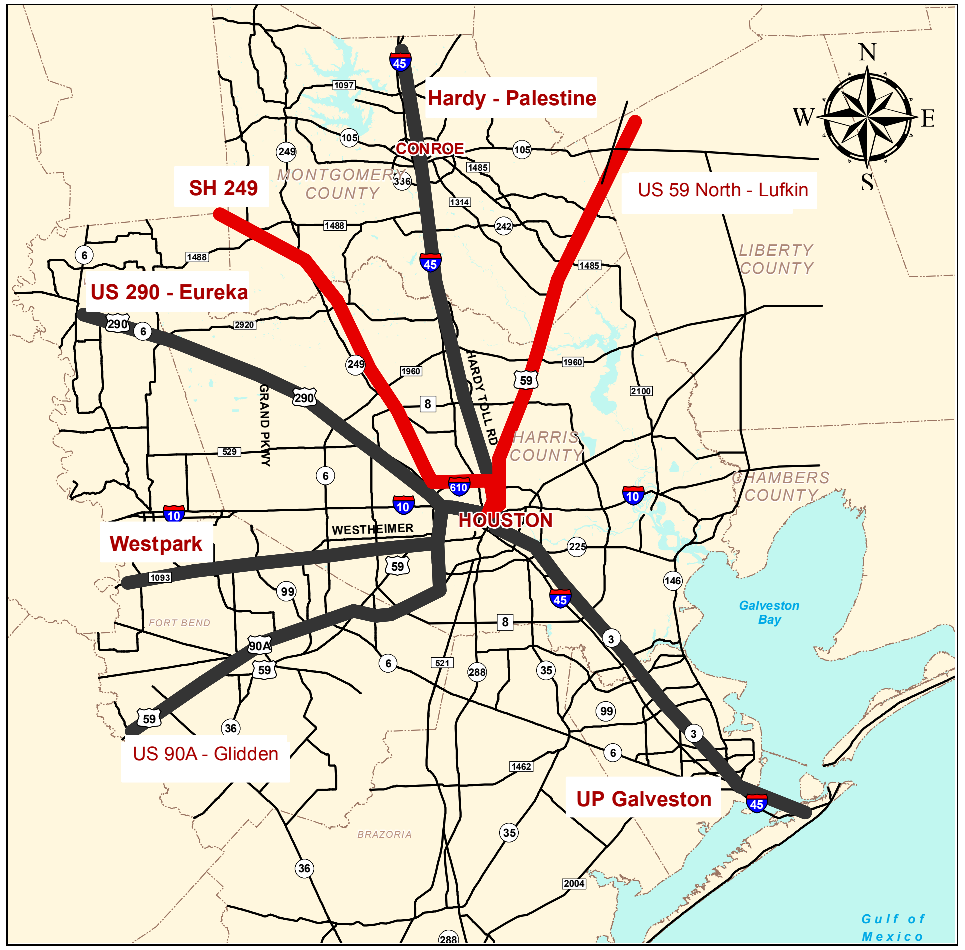

Figure ES-11: Tier 2 Modified Case No. 2: Base Case with SH 249 and US 59 North Alternatives

Table ES-4: 2035 Forecast Weekday Peak Ridership
Base Case with SH 249 and US 59 North Alternative

Commuter Rail Routes Roadway (RR Subdivision)	**Weekday Ridership (Total Weekday Boardings Both Directions)**			
	HBW	**HBNW**	**NHB**	**Total**
US 290 (Eureka)	5,821	749	380	**6,950**
SH 3 / IH 45 South (UP Galveston)	9,800	1,071	334	**11,205**
US 90A (Glidden)	5,999	1,109	354	**7,462**
Westpark	5,757	954	306	**7,017**
Hardy Road (Palestine)	7,942	678	124	**8,744**
US 59 North (Lufkin)	4,047	425	92	**4,564**
SH 249 /FM 1774 (BNSF Houston)	4,793	299	74	**5,166**
System Total	**44,159**	**5,285**	**1,664**	**51,108**

Trip Purposes: HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

Preliminary Operating Plans

An essential part of the forecasting of ridership is the operational characteristics and mode of travel choice parameters assumed as inputs to the regional travel demand model. A preliminary operating plan was therefore conceived and key parameters were determined. The following described the overall operating conditions for a conceptual regional Commuter Rail System.

Routes and Trains

A system configuration consisting of the five Principal Corridor Commuter Rail routes was used to define the preliminary base case operating plans. The routes, their outlying termini and their frequency of operation (headways) during the peak commuting period appear in **Table ES-5**.

Table ES-5: Preliminary Operating Plans

Commuter Rail Routes (RR Subdivision)	Outlying Terminal	Peak Period Headway
US 290 (Eureka)	**Hempstead**	**20 minutes (6 trains)**
SH 3 / IH 45 South (UP Galveston)	**Galveston**	**20 minutes (6 trains)**
Westpark	**Simonton**	**30 minutes (5 trains)**
US 90A (Glidden)	**Kendleton**	**30 minutes (5 trains)**
Hardy Road (Palestine)	**Willis**	**30 minutes (5 trains)**

If peak period, peak direction trains were the only service provided, 27 trainsets would be required, all operating inbound during the morning peak, laying over during the day, and operating outbound during the evening peak. The study team's conceptual scheduling for these trains added mid-day and reverse peak service on a limited basis, utilizing the same number of trainsets. The team's experience on other commuter systems has shown that the availability of mid-day and reverse direction trains increases the opportunities for use and results in greater ridership on the peak trains as well as the off-peak service.

Rolling Stock

The type of rolling stock assumed is conventional locomotive-hauled equipment, consisting of a locomotive, trailing bi-level coaches and a bi-level cab car, allowing the operator to move from one end of the train to another and run the train from either end in a "push-pull" configuration. Push-pull's operational advantage is that it obviates the need to turn the locomotive (moving the locomotive from one end of the train to the other). Photographs of typical locomotive-hauled trainsets appear in **Figures ES-12 and ES-13** on the right. The rolling stock type shown is in service on the Metrolink system in Los Angeles and the Trinity Railway Express in Dallas-Fort Worth.

Ticketing and Transfers

As noted, train riders would buy tickets and/or passes using Ticket-Vending Machines (TVMs) at their origin stations. They would also be able to buy their fare instruments through the Internet, through the mail, or at a ticket window at the key intermodal stations. A typical commuter rail fare assumed for the analysis was $6 one way.

At the key intermodal stations, commuter rail riders would be able to transfer to METRO's Urban LRT system. To facilitate transfers, the connection from one mode to the other needs to be as seamless as possible. In other commuter rail systems, this seamless environment is accommodated in two important ways. First, free transfers between commuter trains and local area transit such as the LRT system are provided. Second, station planners design barrier-free access realized through such concepts as a cross-platform transfer. Examples of such a transfer can be seen below in **Figure ES-14**, showing images of a connection between a Caltrain station platform and a Santa Clara Valley Transportation Authority (VTA) light rail train at Mountain View and showing the transfer connection between a Trinity River Express (TRE) commuter rail train and a Dallas Area Rapid Transit (DART) light rail train.

Figure ES-14: Cross Platform Transfer Station Examples

Figure ES-12: Typical Locomotive hauled Train

Figure ES-13: Station Boarding of a Locomotive-hauled Train

OPERATING FACILITIES

Essential elements of a regional commuter rail system are the facilities where the trains are removed from revenue service; cleaned, maintained and stored; and then placed back into revenue service. These facilities include both large and small site requirements, as described below.

A few trains are often stored overnight at the outlying end-of-line storage facilities along each route. These outlying facilities serve the first train traveling inbound in the morning and the last train traveling outbound at night. The outlying operating facilities are usually relatively small and typically comprise siding track suitable to accommodate only two or possibly three trains at a time. These facilities are located in areas where land is more available and potential sites are therefore not a concern of this top level study.

A much larger set of operating facilities is required at the center of the rail network when serving a large regional system. The two functional types of facilities which are needed at the center of the system are an operational hub terminal (Hub) and an associated maintenance and storage facility (M&SF). The Hub facility is a true "terminal" station where routes begin and end – a place where trains are placed into revenue service and where they are removed from service. A much longer dwell time is typical for trains when they reach this Hub (as compared to the "on-line" stations along the mainline route). During this extended dwell, the train operators may exit the train or change ends to prepare the train to be moved to a storage facility.

Potential Locations

The potential locations identified for a Hub or M&SF consist of the Northwest Mall, the area between Northwest Mall and the Northwest Transit Center, Eureka Yard, Hardy Yard, Congress Yard, Old South Yard – i.e., the area south of the junction of I-45 and Spur 5 (the future 35 Freeway), New South Yard, and Mykawa Yard. Each potential location was evaluated based on the site's location relative to (and availability of) railroad right-of-way and infrastructure, level of freight rail activity in the area, and the associated impacts on freight rail operations should the site be converted to commuter rail use.

The general locations evaluated for Hub and M&SF locations are listed in **Table ES-6** and shown in **Figure ES-15.** Each Hub and M&SF site was evaluated as to its proximity to existing railroad tracks. In particular, the assessment was made in consideration of the railroad subdivisions exhibiting the heaviest freight rail activity and the associated capacity (or lack of capacity) of those subdivisions to serve a focused commuter rail operation at that location. The Hub sites were also considered in terms of their connectivity to the METRO Phase II LRT System network (note that this LRT system is shown in **Figure ES-14**). Potential locations were evaluated to assess the surrounding land use, environmental constraints, economic development potential, and environmental justice implications.

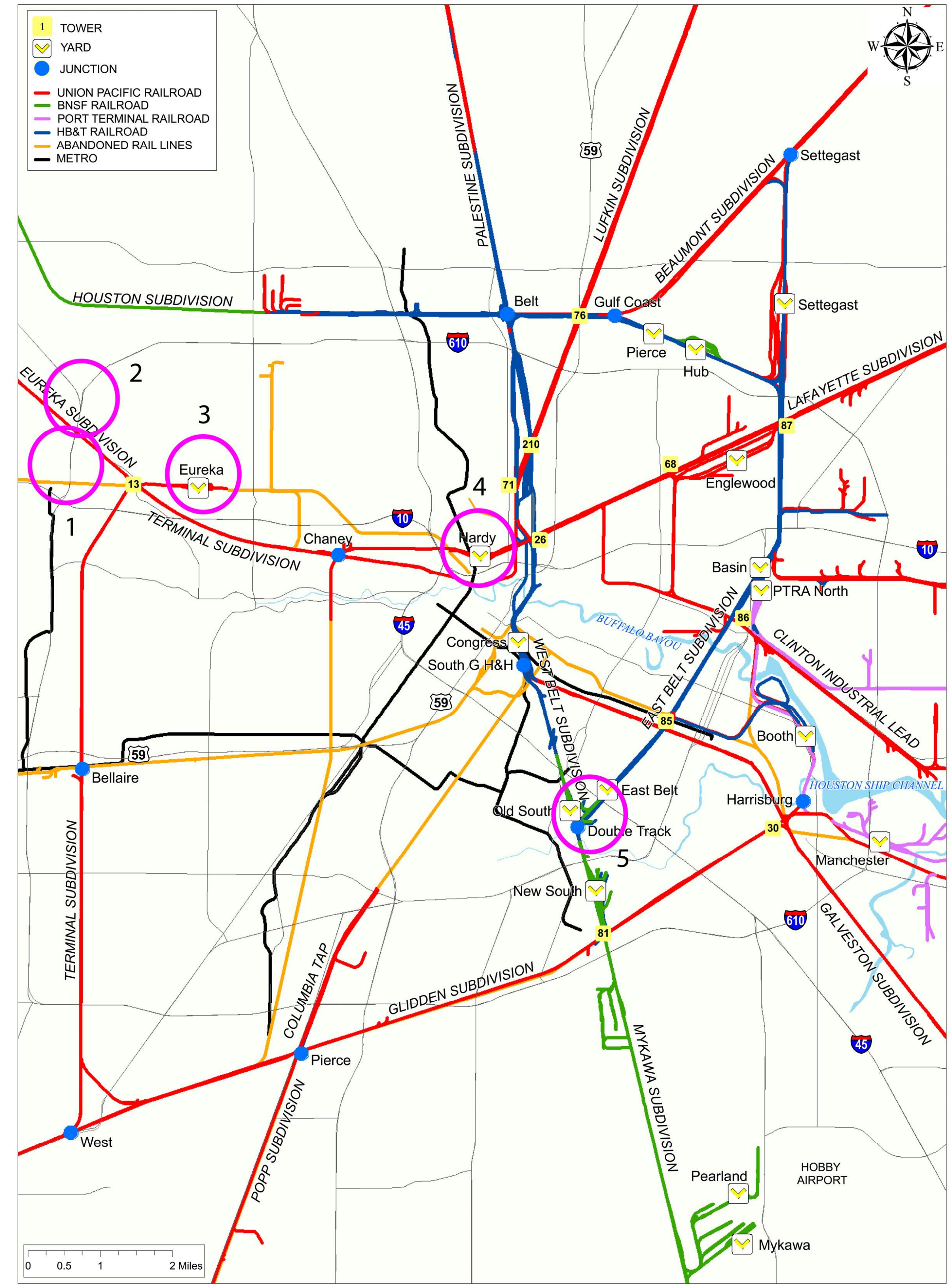

Figure ES-15: Potential Operational Hub Terminal Locations

Table ES-6: Potential Hub and M&SF Locations

Project Area	Location
Hub 1	Between Northwest Mall and the Northwest Transit Center
Hub 2	Northwest Mall
Hub 3	Eureka Yard
Hub 4	Hardy Yard
Hub 5	Old South Yard
M&SF 1	Eureka Yard
M&SF 2	Congress Yard
M&SF 3	New South Yard
M&SF 4	Mykawa Yard

PRELIMINARY ASSESSMENT OF POTENTIAL SITE LOCATIONS

In order to eliminate unnecessary analysis, a preliminary assessment was made of the operational hub terminal locations. The evaluation criteria used to varying extents in this assessment were as follows:

Freight Railroad Operational Impacts – This assessment has been performed to assess the operational impacts on the freight rail – one of the principal objectives of the study. The information provided by the Class 1 Freight Railroads concerning their operations, and the associated analysis of the capacity constraints of the railroad subdivisions, were the primary aspects considered in this evaluation.

Multimodal Transportation Connectivity – The existing and planned transit, freeway/tollway and arterial street infrastructure around the potential Hub locations was evaluated, in accord with the principal goal of the study – to evaluate accessibility and connectivity of commuter rail facilities.

Environmental Considerations – The environmental analysis of each Hub and M&SF location included an evaluation of potential impacts to threatened and endangered species, historic structures, hazardous materials, and wetlands.

Economic Development Potential – An analysis was performed of the area around selected Hub sites in order 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.

Environmental Justice – The analysis 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 sites.

A preliminary assessment examined the operational impacts that each particular operation hub terminal (Hub) location, and the closest maintenance and storage facility (M&SF) site, would have on freight operations in the vicinity. This preliminary assessment also considered the connectivity of the Hub site with other modes of transportation, as well as a high-level examination of the environmental impacts. From the preliminary assessment, a short list of most feasible sites was determined, which included Hub Sites 1, 2, and 3 with the corresponding M&SF Site 1.

A second round of analysis was then conducted on the three Hub sites, all of which are on the west side of the urban core. An analysis of the prospects for economic development around each site was conducted given that this ranking was a identified as a key factor for the consideration of these sites since it provides an opportunity for public-private partnerships.

In the third step, Hub sites 1 and 2, both located immediately to the west of the 610 Loop, were evaluated for environmental justice considerations. The analysis of environmental justice issues will need to be examined more fully during the Environmental Assessment or Environmental Impact Statement phase of project development for the Hub. Additionally, the Hub 1 site was noted to have the potential to be developed as a large train-yard that would serve a number of boarding platforms and also to constructed as a "double-ended" station as indicated in **Figure ES-16**.

For the combined analysis of 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 ES-16**), freeway realignments, and potential detention ponds the net available acreage is approximately 303 acres (**Figure ES-17**). Land values in this area vary significantly, depending on existing uses and transportation access and were found to generally range from low to medium values when compared to other properties along the 610 West Loop.

Overall, Hub Sites 1 and 2, as shown in **Figure ES-17,** appear to have significant economic development potential in the form of large parcels with relatively low intensity uses.

Regarding the environmental justice analysis, the operations hub terminal Sites 1 and 2, and the associated maintenance and storage facility Site 1 do have an impact upon the properties immediately surrounding them. However, future studies of a more precise station site are expected to determine that any environmental justice impacts will not be significant enough to disqualify the sites discussed above from consideration for Federal funding.

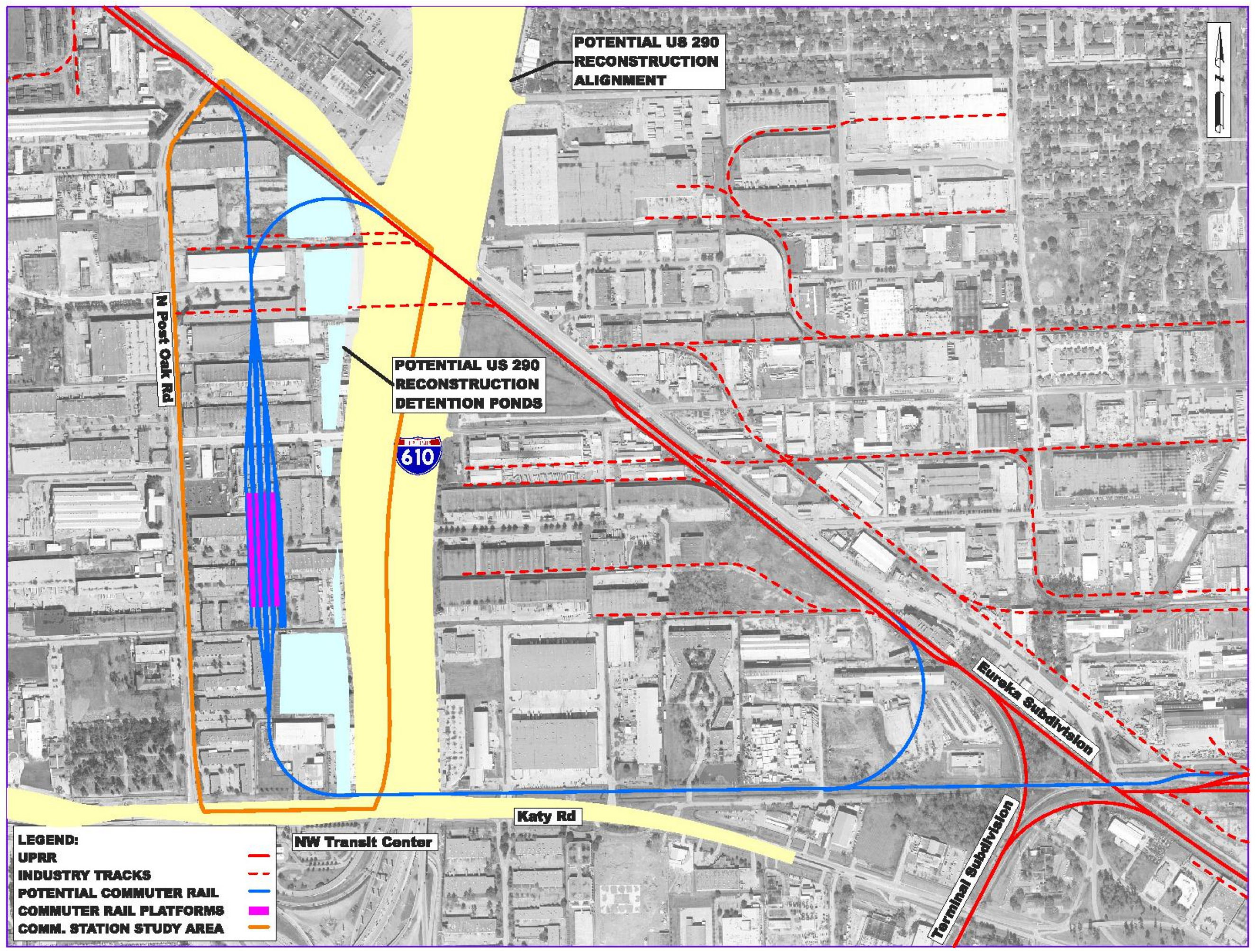

Figure ES-16: Potential Hub Site 1 Track Layout

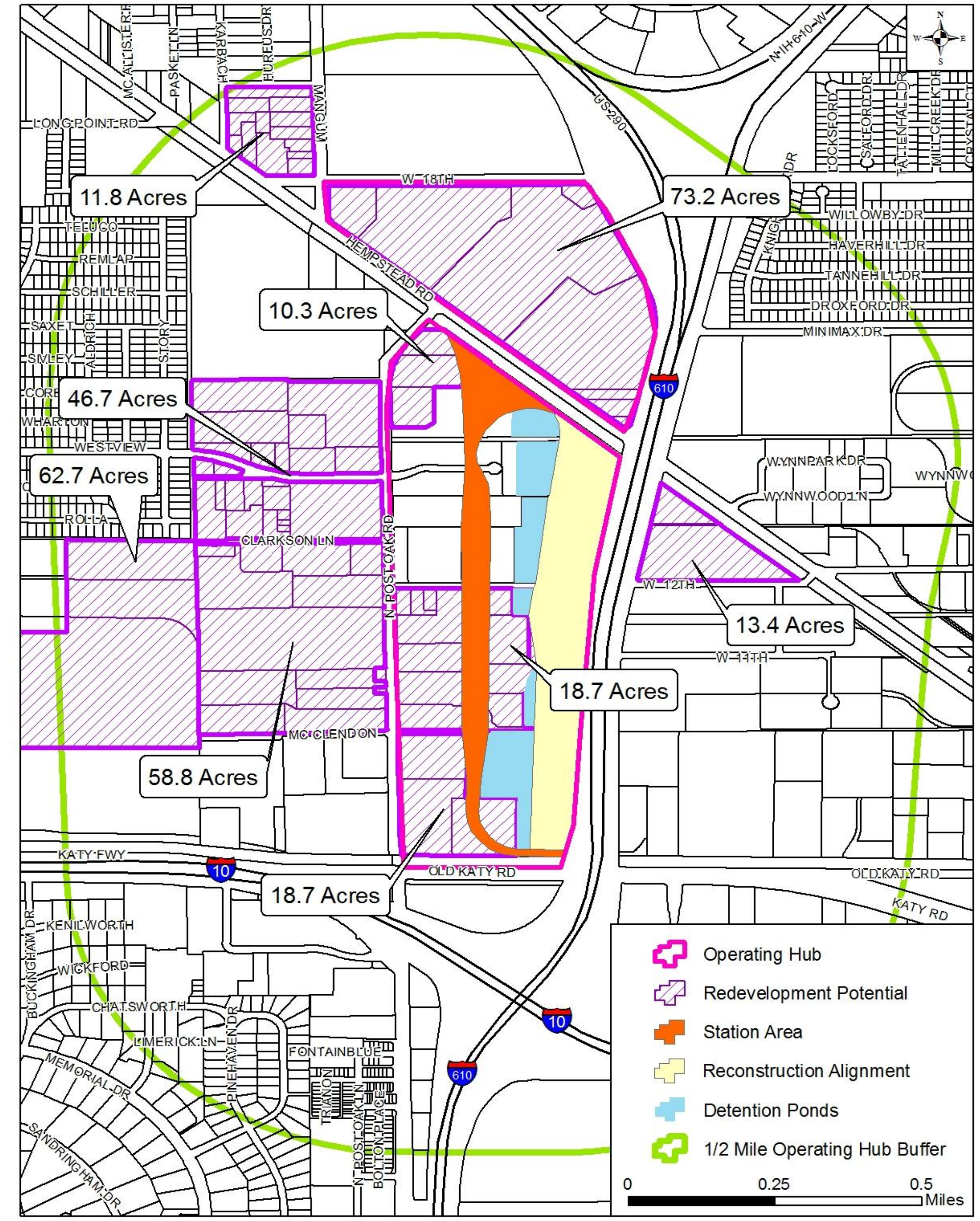

Figure ES-17: Potential Redevelopment Impact Area of Hub Sites 1 & 2

RANKING OF OPERATING FACILITY SITES

In the final ranking of the Hub Sites, a similar scoring and ranking process was performed to that used in selecting the Principal Corridors.

Based on the evaluation process discussed above, and the scoring and ranking process described in the report, the preferred site for the operational hub terminal was determined to be Hub 1, the site north of the Northwest Transit Center and south of Northwest Mall. The associated maintenance and storage facility that is the preferred location is M&SF 1, the site located at Eureka Yard.

BASELINE SYSTEM PLAN FOR COMMUTER RAIL

A Baseline System Plan that would serve the Houston metropolitan area and surrounding Upper Gulf Coast has been defined, based on the implications and assessments given to the Principal Corridor system. These assessments have been drawn from comments on the Principal Corridor conceptual system as it has been vetted among key stakeholders, transportation agencies, local counties and municipalities, and the general public. As a result of comments received and new information gained from this process, the key considerations for a Baseline System Plan have been derived. It is anticipated that a full System Plan will evolve from the information in this report as future studies build on the concepts presented.

Therefore, the Baseline System Plan described below provides a roadmap for decision makers, when combined with the representative service scope, defined operating facilities, and capital and operating costs derived from the conceptual Principal Corridor system. In particular, the financial program required to implement a regional commuter rail system is framed by these concepts, operational implications, and cost parameters.

Table ES-7 summarizes the route operations and the associated financial performance of commuter rail routes serving the five Principal Corridors – a representative regional system shown in **Figure ES-18**. The financial indicators shown (2008 dollars) reflect a steady state of operations supporting the forecasted 2035 ridership for a system performing at a level of operations achieved by a mature system (as compared to a new start-up commuter rail system).

Table ES-7: Principal Corridor Commuter Rail System Operating and Financial Summary

Daily Train Trips	88
Weekday Riders	36,010
Annual Revenue	$55,094,960
Annual Operating Costs	$89,304,264
Annual Operating Subsidy	$34,209,304
Farebox Recovery Ratio	62%
Capital Costs[1.]	
Outlying Station Costs[2.]	$248,000,000
Line Improvement Costs[2.]	$1,570,820,000
Distributed Costs Between Lines[3.]	$531,940,000
Maintenance and Storage Facility	$140,000,000
Rolling Stock	$428,490,000
Total	$2,919,250,000

1. 2008 dollars
2. These are infrastructure improvement costs, without distinction of which agency or private entity may actually contribute to the funding.
3. Distributed costs are the capital costs of segments inside Loop 610 which serve multiple lines.

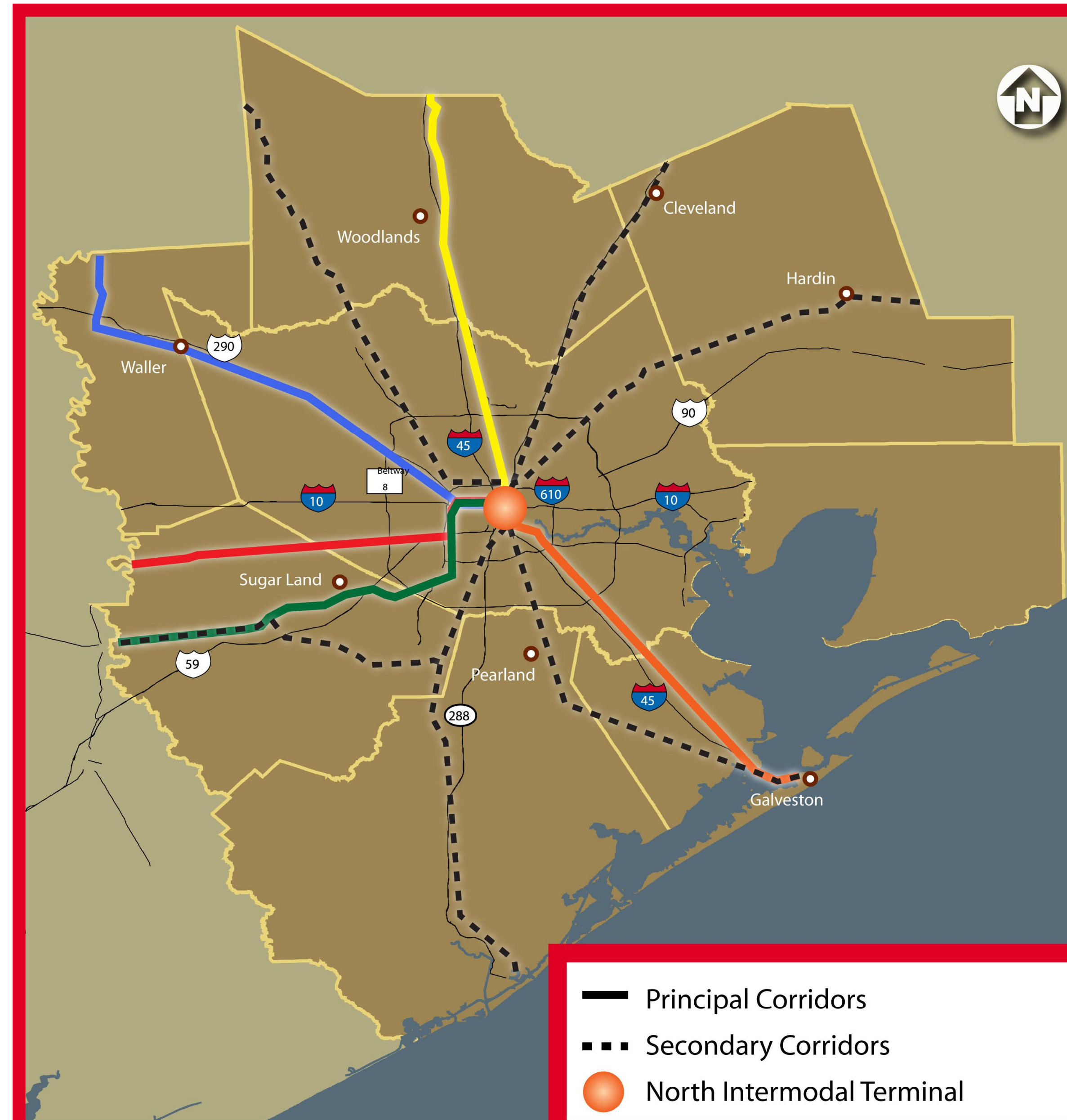

Figure ES-18: H-GAC Commuter Rail Principal Corridor Conceptual System

Table ES-7 also shows the estimated capital costs for the Principal Corridor conceptual system. A subsequent capital cost assessment of the final recommended Baseline System concept revealed that the total cost of roughly $3 Billion was essentially the same as the Principal Corridor System, even though the five corridors in each of the two system plans are not identical. A general conclusion of the capital costs studies is that — for conceptual planning purposes — the cost for the rail and signaling infrastructure improvements outside of Loop 610 will be approximately $1 Billion, the cost of the rail and signaling infrastructure inside Loop 610 will be approximately $1 Billion, and the cost of stations, maintenance and operating facilities and rolling stock will be approximately $1 Billion.

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 federal funding options include STP and CMAQ funds.

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

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, allowing the freight railroads to move their trains more efficiently.

All of the funding options discussed herein 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.

The possible distribution ranges of funding for these potential sources are given in **Table ES-8**. However, the example shown is not considered to be a complete list of possible funding sources.

Table ES-8: Potential Funding Sources for a Regional Commuter Rail System

• Federal Funding	30% to 60%
– 5307 Large Urban Cities Program	2% - 4%
– 5309 FTA New Starts Program	25%-50%
– STP, CMAQ, FTA Urban Formula Funds	3% - 6%
• State Funding	10% to 20%
– Texas Rail Relocation and Improvement Fund	
• Local Funding	30% to 60%
– Sales Tax / Transportation Related Fees	5% - 10%
– Local Jurisdiction (Counties and Municipalities)	5% - 10%
– Public/Private Partnerships	
o Stations/TOD o Private Railroads	20%-40%

BASELINE SYSTEM DEFINITION

During the course of presentation and discussion of the system concept defined herein as the Principal Corridor system, a variety of comments and suggestions have been received from key stakeholders, decision makers, and interested persons of the general public. The insight gained from this interactive dialogue has proven invaluable to assessing which corridors are realistic for first implementation. In particular, the operational needs and planning initiatives of Houston METRO, the Gulf Coast Freight Rail District (GCFRD), and the Class 1 Railroads has been paramount to the consideration of first build corridors. Based on this information, the following is a description of the resulting Baseline System Plan.

Of critical concern is the fact that several freight rail corridors are currently operating at or near their capacity, and as long as the current freight rail network remains the same with the terminal functions occurring around the existing rail yard configuration, some corridors cannot be realistically considered for implementing commuter rail. These corridors are the Glidden, Terminal, Palestine, and Mykawa Subdivisions. If, at some time, some of the rail yards are relocated (considerations for which the freight rail companies are currently examining) some of these corridors may re-emerge as prospective corridors for long-distance commuter rail service.

Other factors include the interest of Houston METRO in implementing suburban commuter line service in some corridors using non FRA-compliant technology. Such implementation would provide near to medium term service to some corridors.

Table ES-9 summarizes the considerations used to identify the corridors included in the Baseline System Plan. With these considerations, the recommended corridors in the Baseline System Plan are as follows:

- **US 290 / Eureka Subdivision Corridor** – This high growth corridor has strong public support for commuter rail implementation, and with the initiation of several major roadway construction programs within the corridor over the next 15 to 20 years, the congestion is expected to get worse before it gets better. It also appears that there is political will to pursue the initiation of some type of commuter rail service in this corridor in the near term.
- **SH 3 / Galveston Subdivision Corridor** – Commuter rail has been actively studied and promoted in this corridor by the City of Galveston. In fact, the initiation of some type of commuter rail service in this corridor is viewed by many as likely, and federal funding to initiate this service is already being pursued.
- **SH 249 / BNSF Houston Subdivision Corridor** – This corridor was not part of the original Principal Corridor system definition. It actually scored well in the related Principal Corridor selection process, but the Oversight Task Force deliberations concluded that it may be redundant service coverage with the US290 corridor. But the Tier 2 ridership studies did find that the ridership remained strong even when it was included in the system along with the US290 corridor, showing that both of these corridors in the Northwest Quadrant of the region were viable for simultaneous commuter rail service. Furthermore, the proximity of the corridor to the preferred Hub terminal site would indicate that a direct connection to the recommended site of the operations hub terminal is possible as part of an early implementation program for a regional system.
- **South Fort Bend / BNSF Galveston/Popp Subdivision Corridor** – This corridor was also considered in the Tier 2 ridership modeling, and it performed reasonably well under the assumptions used in the study. This alignment would provide service from the southern end of Fort Bend County, and most importantly it would provide long-distance service connecting to the edge of the Texas Medical Center district.
- **SH 35 Tollway Corridor** – This corridor was studied by TxDOT for freeway improvement, with consideration of other multimodal service provisions. Since this new tollway facility was not an existing or previous freight rail alignment, it was not specifically included in the Principal Corridor evaluations (although the nearby Mykawa Subdivision was included). In light of TxDOT's interest in providing a ROW for commuter rail, the direct service provided in the corridor to the high growth Pearland area, and the fact that an early implementation inside Loop 610 is plausible, this corridor was also included in the Baseline System Plan.

Table ES-9: Baseline System Corridor Considerations

Principal Corridor Ranking	Principal Corridor	Corridor Description	Capacity Constrained Freight Optns	Regional Areas Served	METRO Surb. Commuter Rail Alt. Planned	Baseline System Plan Corridor
1	Eureka	US 290	No	Cypress / Waller Co.	Yes	Yes
2	Westpark	Westpark	No	West Houston / Harris Co.	Yes	No
3	Palestine	Hardy Toll Road	Yes	N. Harris / Montgomery Co	Unknown	No
4	Glidden	US 90A	Yes	Fort Bend Co	Yes	No
5	BNSF Houston	SH 249 / FM 1774	No	NW Harris / Montgomery Co	Unknown	Yes
6	UP Galveston	SH 3	No	Galveston Co	Unknown	Yes
7	Lufkin	US 59	Yes	NE Harris / E Montgomery Co	Unknown	No
8	Mykawa	SH 35	Yes	Brazoria Co	Unknown	No
9	Beaumont	Lake Hou. / Huffman	Yes	NE Harris / Liberty Co	Unknown	No
10	Popp	FM 521	No	Fort Bend Co	Unknown	No
New	--	SH 35 Tollway	No	Brazoria Co	Unknown	Yes
New	Galveston/Popp	SH 6 / FM 521	No	Fort Bend Co	Unknown	Yes

Designates Principal Corridors analyzed for ridership, operational impact, and cost
Designates Corridors in the Baseline System Plan

Should the current operating scenario of the Class-One Railroads change in a significant manner, other corridors may also become viable for future long-distance commuter rail service. When considering the major growth in freight operations expected to occur, the addition of commuter rail service in other corridors may only be possible by relocating the current freight system's track and infrastructure. **Figure ES-19** shows this proposed Baseline System Plan as envisioned at the end of this H-GAC study. The Baseline System is envisioned to arrive at the Hub Terminal west of 610 Loop and at METRO's North Intermodal Terminal, where essential connectivity is provided by METRO's Urban LRT system, thereby providing superior access to our region's largest Activity Centers.

Overall, the Baseline System comprised of these five corridors would provide a level of regional coverage that is similar to that of the Principal Corridor system (refer to **Figure ES-18**). With the new development areas served along the BNSF Galveston Subdivision (e.g., Siena Plantation and west Pearland area), and the TxDOT SH 35 corridor, the ridership is anticipated to remain in the order of the forecasted 40,000 riders a day (however, no compatible ridership studies for this system configuration have been done).

This Baseline System Plan is anticipated to be supported by the Class 1 Freight Rail companies as a commuter rail system that can be accommodated without serious detrimental impact on the future growth of freight rail service. This assumes, of course, that major track and signal infrastructure improvements are made in the Baseline System corridors such that simultaneous passenger and freight service is accommodated, especially the parts of the system inside 610 Loop.

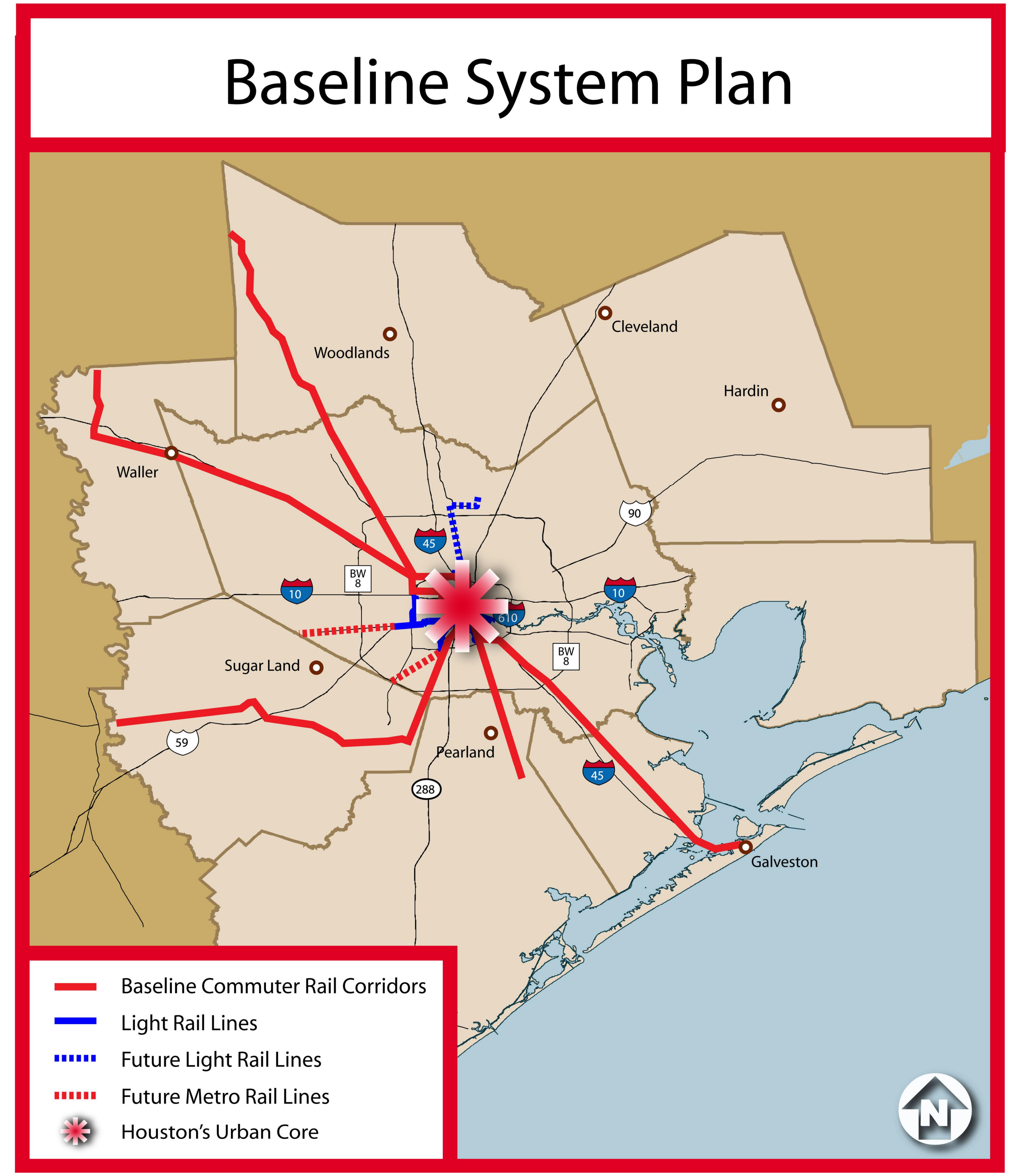

Figure ES-19: Baseline System Plan

Regarding the specific alignment considerations inside of Loop 610, this part of the system infrastructure will be most difficult and costly of the system elements to implement, especially with the extent of grade separated aerial structures that would be required along the service roads of I-45 and US 59. **Figure ES-20** shows the new connecting links as well as the new track to be implemented along-side the freight tracks. With the new corridors added to the configuration of the commuter rail network through the Urban Core, there will also need to be a substantial amount of abandoned ROW re-established for rail service, and certain connecting pieces of the ROW will need to be purchased and/or reconfigured for rail service.

Of particular note is the addition of the new "Hub Loop" that provides a double-ending of the operational hub terminal, as shown previously in **Figure ES-16**. This feature will allow trains to be dispatched to the M&SF while traveling in either direction out of the operations hub terminal's train yard. When combined with the North Intermodal Terminal loop in downtown and the M&SF facility located in the middle of these two loop tracks, the operational flexibility provided by the Baseline System is exceptionally good. If these aspects of the Baseline System Plan can in fact be achieved, the rail system infrastructure should be able to service a future commuter rail system much large than what is represented here, with many more trains serving a broader regional coverage, as well as extensive intercity passenger rail service.

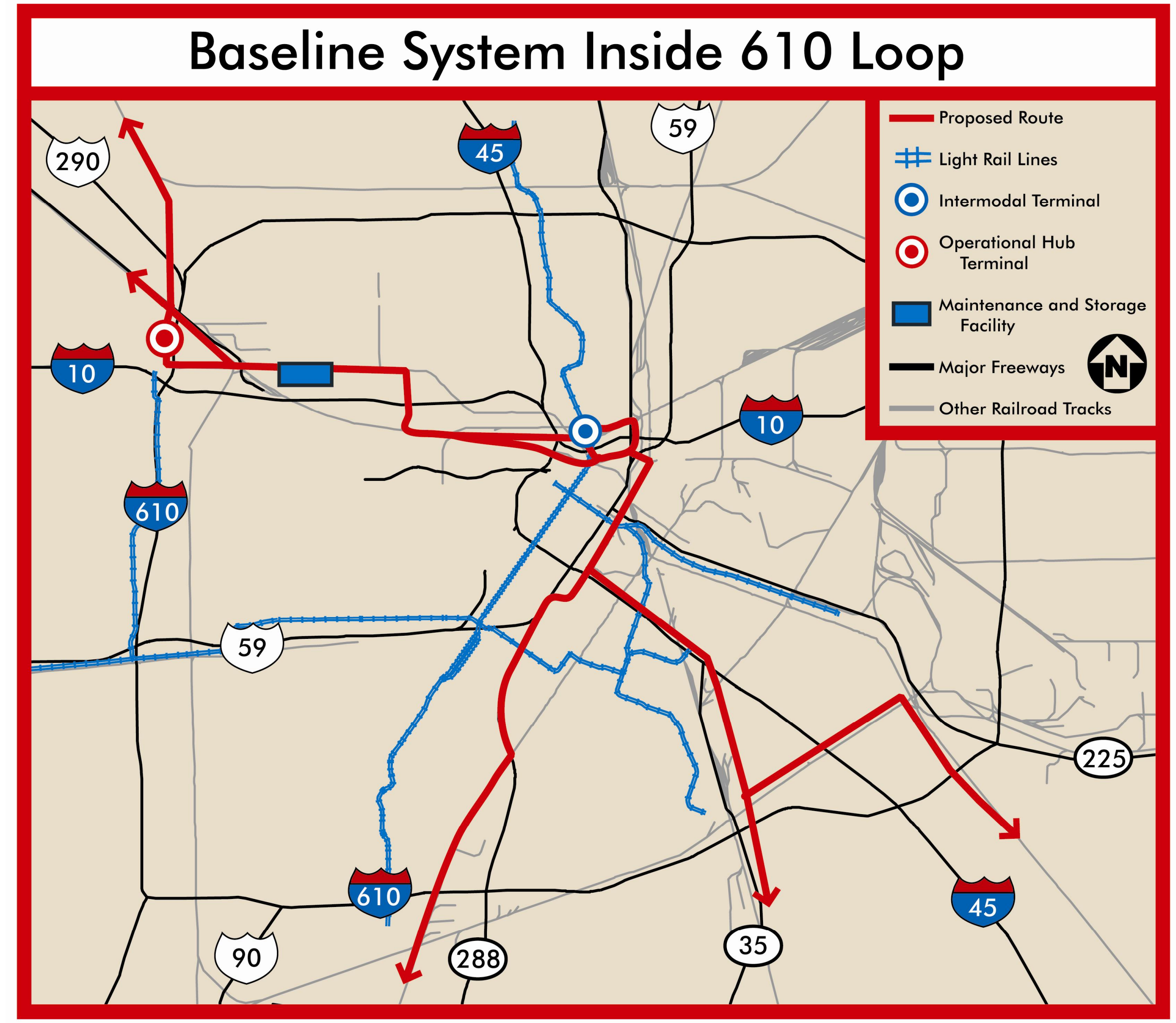

Figure ES-20: Baseline System Plan Inside 610 Loop