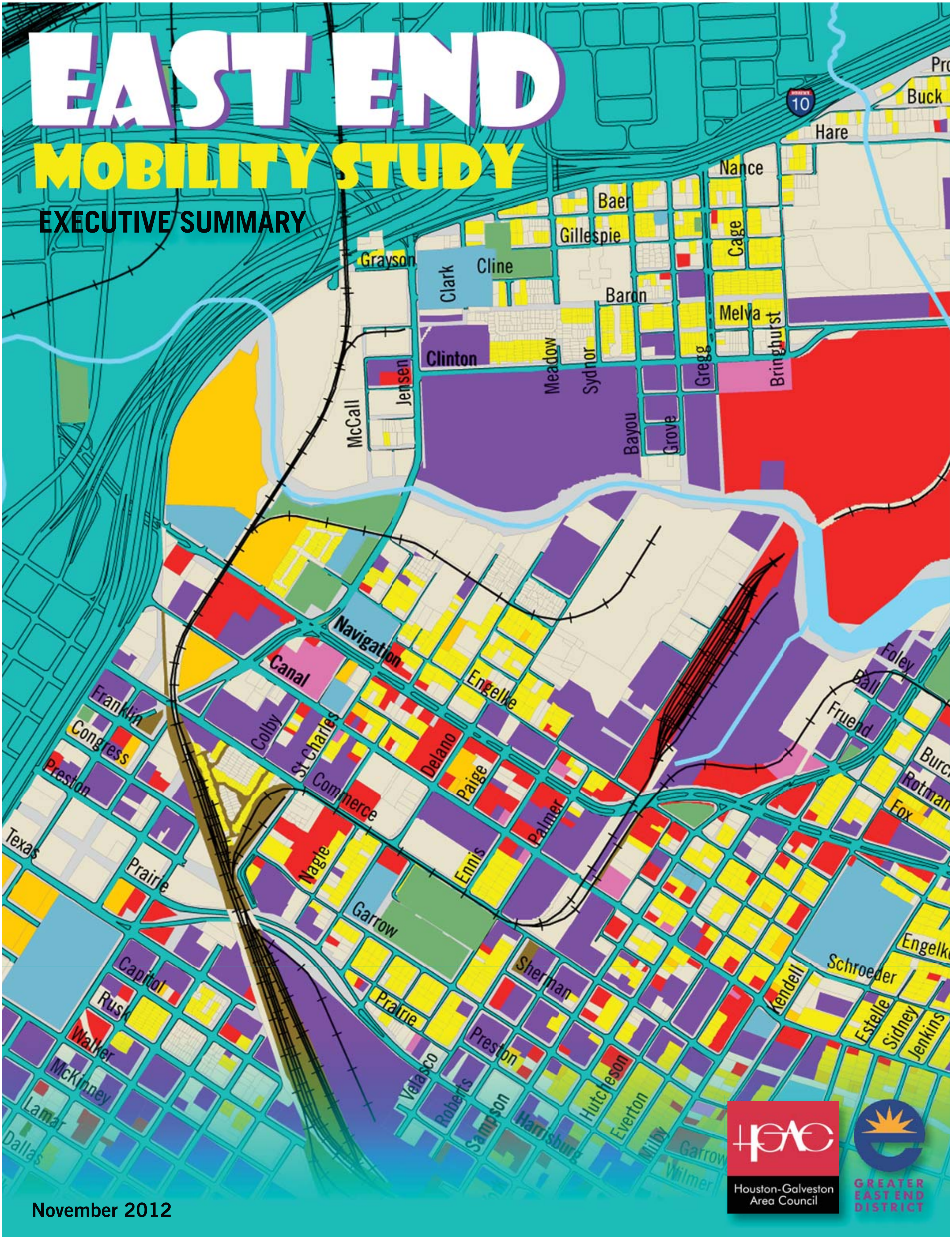
EAST END

MOBILITY STUDY

EXECUTIVE SUMMARY



November 2012

Houston-Galveston Area Council

GREATER EAST END DISTRICT


GREEN LINE Theater District
Magnolia Park
Transit Center
Magnolia Park Transit Center
METRORAIL
METRO
Tickets
AUTOBUS
CHICKE

Rendering courtesy of METRO

Executive Summary

The East End Mobility Study, covering an historic community near Downtown in the City of Houston, represents a significant opportunity to assess and define the local mobility needs and develop improvement opportunities to support and stimulate development in the future.

The study area is bounded by IH-10 on the north, US 59 on the west, IH-45 on the south, and Lockwood Drive on the East. It contains large sections of four Superneighborhoods: the Greater Fifth Ward, the Second Ward, Downtown/East Downtown and Greater Eastwood. Two management districts are also active in the study area.

The area has been the subject of several studies in the recent past, and this study builds on the findings of those reports to coordinate mobility planning regionally and leverage funding and partnership opportunities locally. This effort is a component of the Subregional Planning Initiative Program (SPI), developed by the Houston-Galveston Area Council (H-GAC), to create a holistic and strategic approach to transportation planning.

Several historic neighborhoods are located in the study area. The area has long been defined by its transportation network, including the Port of Houston and rail lines that connect to central Houston and nearby rail yards. Much of the early population consisted of railroad and industrial workers and their families. The population has since stabilized at approximately 20,000 people, with accompanied changes in locations of employment, the decline of the streetcar system, increase in automobile use, and the development of the interstate highway system

Today, significant infrastructure improvements are driving new development in the study area. The East End, already an area of very high transit usage, will soon benefit from the expansion of the METRO light rail system. Many of the City's highest ridership bus lines pass through the study area, and many know the area for walking and biking, as several major off-road and on-road bicycle routes pass through the study area. At the same time, significant barriers to mobility exist: multiple rail lines, freeways, bayous, and gaps in multimodal networks. This report has identified and quantified existing strengths and challenges; and also identified improvement opportunities to leverage the strengths and address the gaps.

Steering Committee & Goals

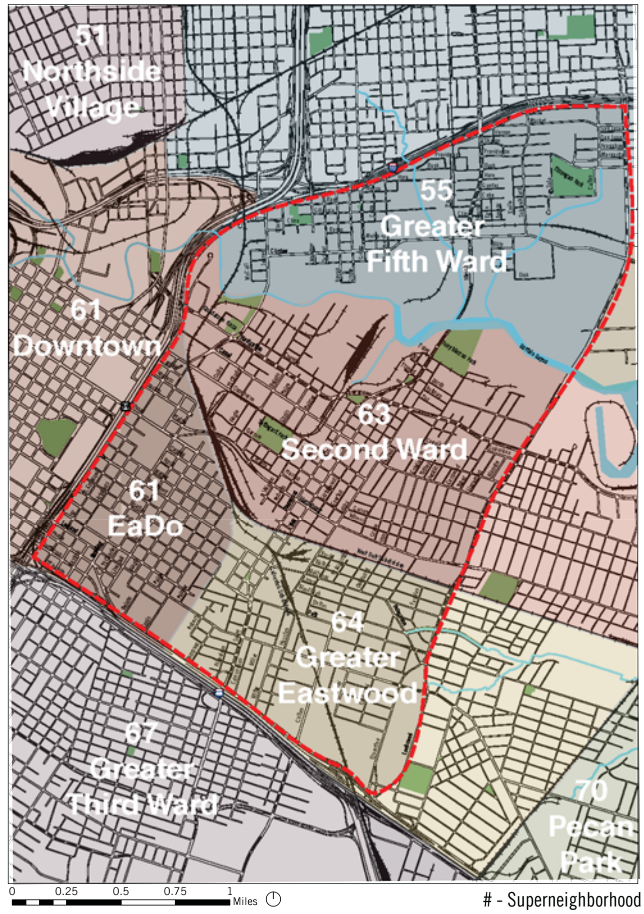
The project Steering Committee included members from the Greater East End Management District, the City of Houston's Public Works Department and the Department of City Planning, the Gulf Coast Rail District, METRO, TxDOT, and H-GAC. With input from the Steering Committee, the following goals adopted for the study:

East End Mobility Study Goals

1. **Address short and long-term capacity constraints and opportunities** by assessing the traffic impacts of growth and development and developing recommendations
2. **Address barriers to mobility and increase connectivity** between neighborhoods and major activity centers and destinations
3. **Enhance multi-modal trip alternatives** (e.g., walking, biking and transit) by providing improved transportation choices
4. **Prioritize transportation infrastructure investments that support the development objectives** identified through previous neighborhood and regional plans
5. **Reduce safety concerns** within study area for all travel modes

This set of goals served as a guide to determine the scope and priority of the improvement opportunities developed through the course of this project. An in-depth needs assessment and existing conditions analysis was performed to identify gaps to achieving the goals for the study.

Figure 1: Study Area



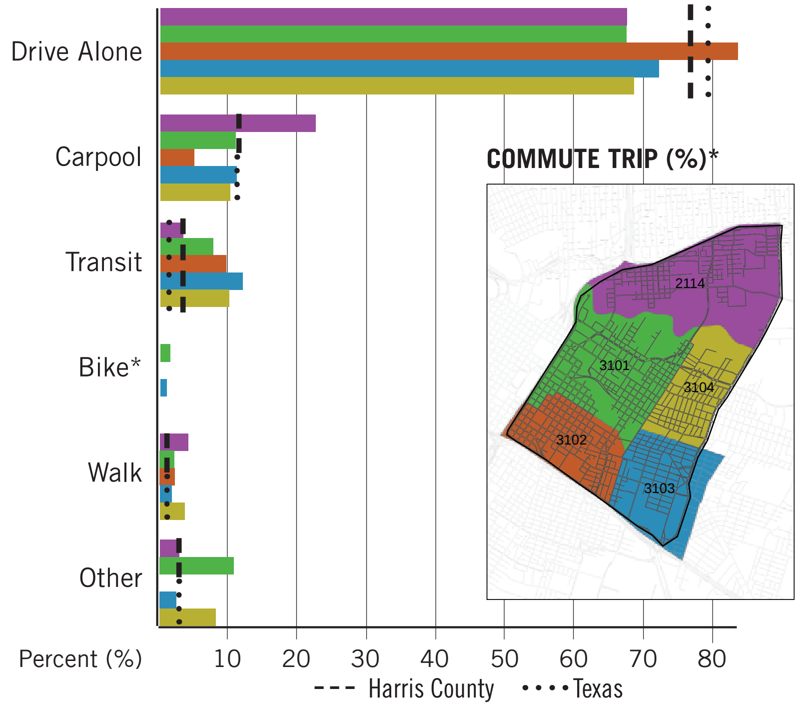
Study Overview

To identify mobility gaps and opportunities to address them, a comprehensive picture of future mobility in 2035 was constructed. This picture analyzed transportation and land-use jointly. Two land-use scenarios were constructed and the estimates of population and employment for these scenarios refined travel demand projections for the study area. The results of this analysis showed that most of the roadways already have sufficient capacity to handle projected growth between the present and year 2035.

With the future picture in view, recommendations were made to accomplish the project goals. The related investment estimates differ by type of opportunity and timeline. To implement all Short-term recommendations would cost approximately $3.3 million. Medium-term would be $8.6 million, and Long-term $42.8 million. The difference in Long-term costs is mainly due to the proposed realignment of the Navigation/Commerce intersection. The total cost of all recommendations would be approximately $55 million dollars.

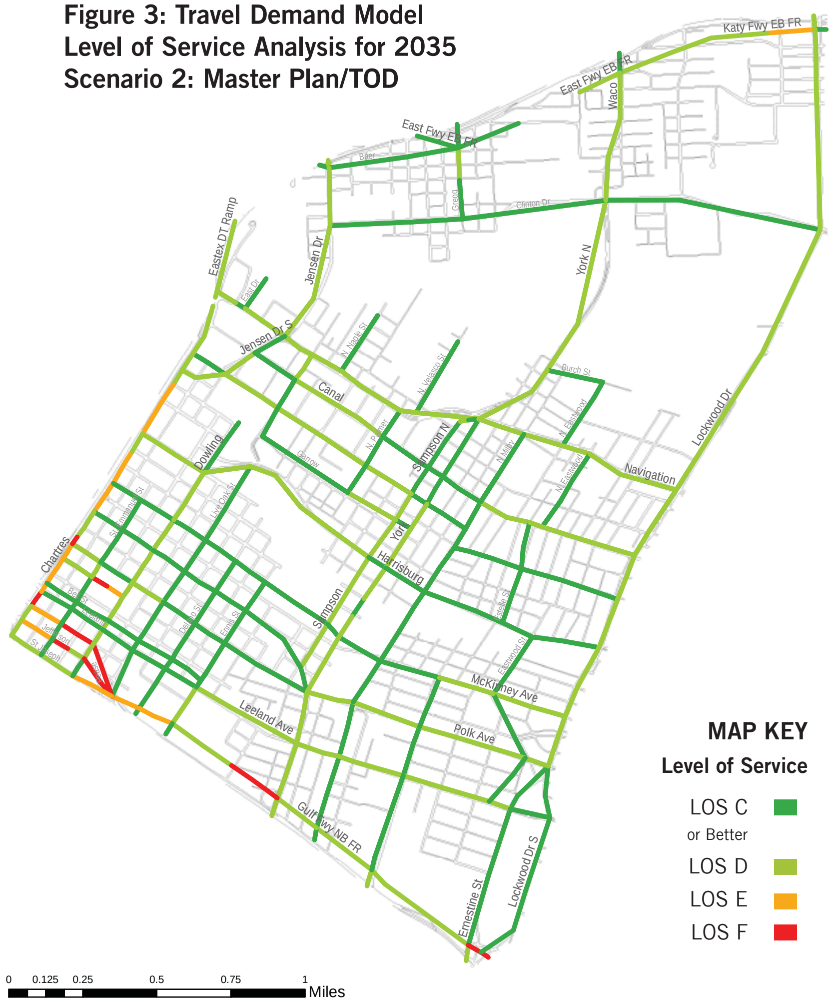
The most expensive type of opportunity would be Roadway improvements, a total of $44 million. The most extensive Roadway improvement would be the realignment of the intersection at Navigation and Commerce. Comparatively, Transit improvements account for $478,000 and Pedestrian/Bicycle improvements for $10 million. The most extensive Pedestrian/Bicycle improvement would be developing designs to accommodate all levels of bicycle use at the West Belt rail line underpass.

Figure 2: Existing Study Area Commute Modes



* Bike: Study Area (0.6%), Harris County (0.3%), Texas (0.2%)

Figure 3: Travel Demand Model Level of Service Analysis for 2035 Scenario 2: Master Plan/TOD



Improvement Opportunities

The analysis of projected traffic operations and in-depth analysis of multimodal transportation objectives for the study area enabled the development of a set of improvement opportunities to achieve the study goals. The transportation improvements were developed as a set of nested networks serving motorists, transit users, pedestrians, bicyclists, and the adjacent development. Each type of user requires a complete network to effectively utilize and take advantage of the public infrastructure; considering them separately ensured that each was accommodated. Categories and improvement opportunities are summarized below and shown on Figure ES4. Working with the steering committee, project costs prioritization and implementation strategies were developed for each improvement opportunity. These are detailed in the full East End Mobility Report.

ROADWAY & INTERSECTION

These improvements primarily impact the mobility of passenger vehicles and trucks. They address capacity bottlenecks, intersection and roadway geometry, and network connectivity. The improvements identify opportunities to better align the roadway cross sections, operational characteristics, and capacity with the desired land use context and projected traffic volumes while maintaining acceptable roadway Level of Service (typically LOS D or better).

R1: Improve key intersection operations (e.g., Navigation at Sampson / York, Jensen/Runnels, and Canal; Dowling at IH-45 / Pease)

R2: Improve connectivity for all modes between the Second Ward / Fifth Ward neighborhoods and EaDo / Downtown

R3: Assess multi-modal mobility impacts of East End Master Plan recommendations on Navigation Boulevard and adjacent roadway network

R4: Assess Sampson/York one-way pair multi-modal operations including potential benefits and challenges of conversion to two-way operations

R5: Improve Chartres Street as both a gateway to the East End and Downtown and as a barrier to mobility

TRANSIT

These improvements support increased transit service levels and ridership within the study area. Potential improvements focus on both enhancing existing service and eliminating barriers to access for potential transit users.

T1: Develop Enhanced Transit Corridors for both east-west and north-south travel

T2: Identify mobility improvements that would support and integrate with East End Urban Circulator implementation

PEDESTRIAN & BICYCLING

These improvements primarily benefit walking and bicycling through the development of enhanced pedestrian and bicycle networks, including locations where shared or dedicated facilities would provide improved connections to activity centers or address the crossings of major barriers. Improvements were also identified to provide improved navigation and directions for people travelling in the study area and heading to major destinations.

PB1: Pedestrian improvements to support transit, address barriers and encourage more walking trips

PB2: Comprehensive area bicycle improvements that connect the Columbia Tap, MKT, Harrisburg and Buffalo Bayou Trails and Major Destinations

PB3: Implement a regional wayfinding system targeting pedestrian-bicyclist connections as well as automobiles

DEVELOPMENT

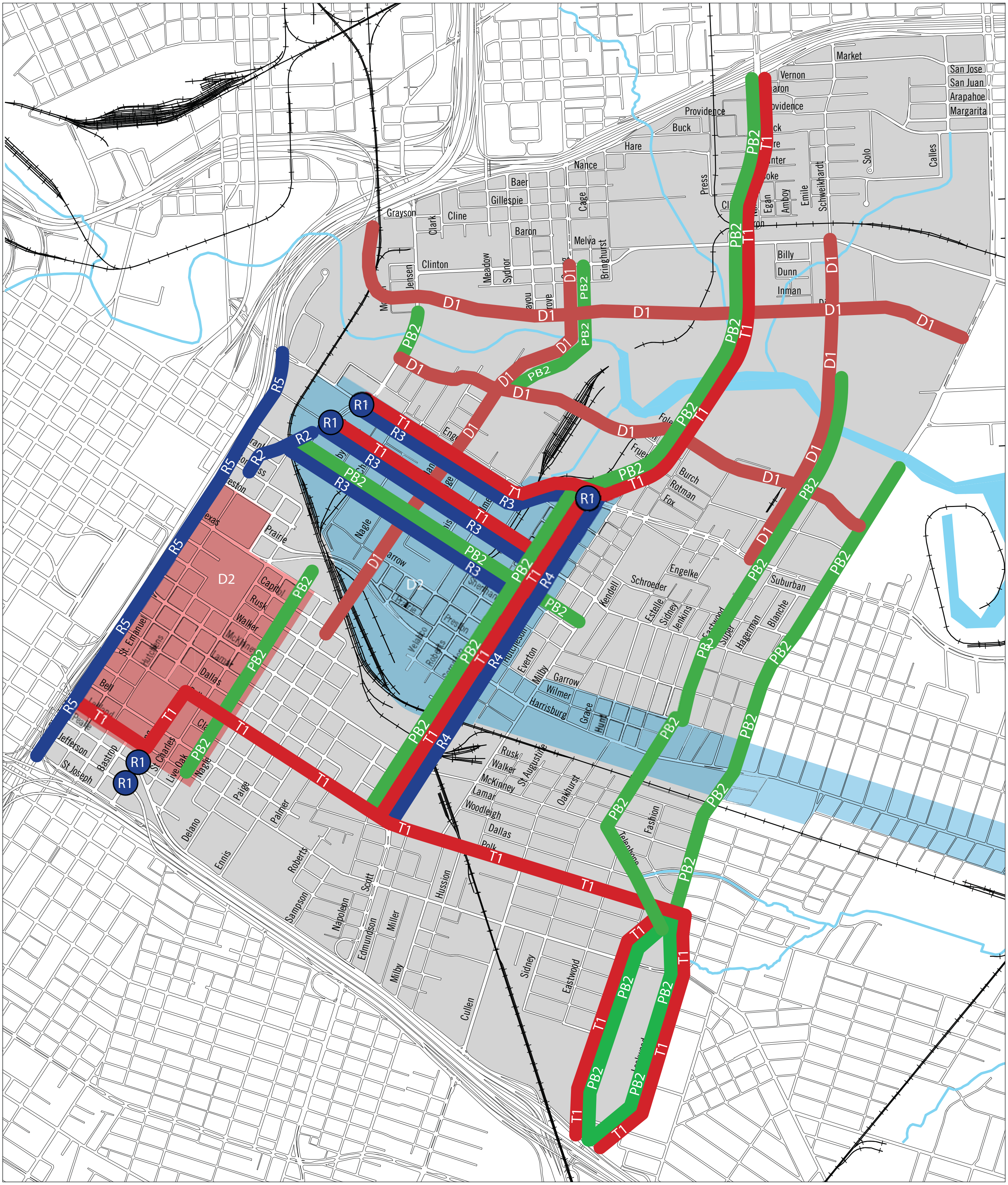
These improvements pro-actively support enhanced mobility and access to accommodate and support development as it occurs. Opportunities include enhancements to the roadway network as well as issues such as parking that may not be major mobility factors now but that will become more important as development and traffic increases.

D1: Support high level of connectivity in future roadway network (e.g., new collectors for thoroughfare plan)

D2: Develop parking management approach for activity centers

NOTE: Improvements T2, PB1, and PB3 do not show up on Figure ES2 as they are regional in nature. More specific figures addressing these improvements are provided in the detailed project descriptions in Chapter 4 of the East End Mobility Report.

Figure 4: Improvement Opportunities



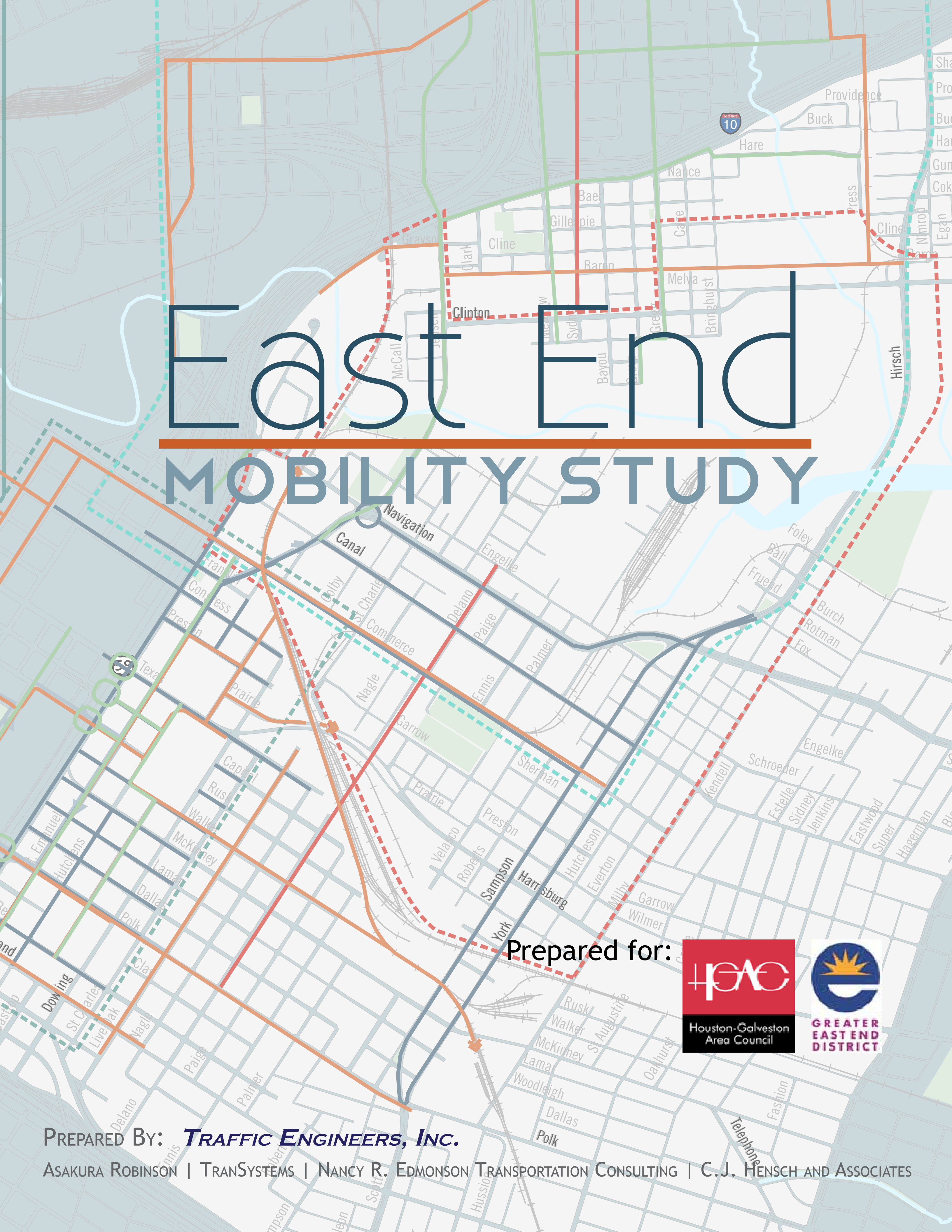
R1 Corridor Improvement

PB1 Intersection Improvement

0 0.25 0.5 0.75 1 Miles

Prepared By: *Traffic Engineers, Inc.*

Asakura Robinson | TranSystems | Nancy R. Edmonson Transportation Consulting | C.J. Hensch and Associates



East End

MOBILITY STUDY

Prepared for:

Houston-Galveston Area Council

GREATER EAST END DISTRICT

PREPARED BY: ***TRAFFIC ENGINEERS, INC.***

ASAKURA ROBINSON | TRANSYSTEMS | NANCY R. EDMONSON TRANSPORTATION CONSULTING | C.J. HENSCH AND ASSOCIATES

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East End

MOBILITY STUDY

Index


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Executive Summary

The East End Mobility Study represents a significant opportunity to assess and define the mobility needs for the East End, a historic community near Downtown in the City of Houston. This study will develop mobility improvement opportunities to support and stimulate development in the area into the future.

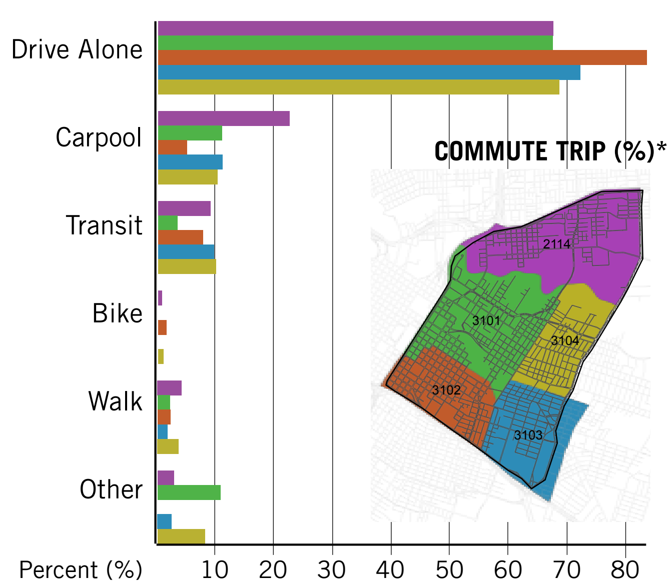
The study area is bounded by IH-10 on the north, US 59 on the west, IH-45 on the south, and Lockwood Drive on the East. It contains large sections of four Superneighborhoods: the Greater Fifth Ward, the Second Ward, Downtown/East Downtown and Greater Eastwood. Two management districts are also active in the study area.

The area has been the subject of several studies in the recent past, including the East End Livable Centers Study, the Greater East End Master Plan, the Downtown/EaDo Livable Centers Study, the Fifth Ward Pedestrian and Bicyclist Study, and the West Belt Rail Subdivision Study. This study builds on the findings of those reports to coordinate mobility planning regionally as well as to leverage funding and partnership opportunities.

This study is a component of the Subregional Planning Initiative Program (SPI) that has been developed by the Houston-Galveston Area Council (H-GAC) to create a holistic, strategic approach to transportation planning. The initiative is intended to provide an in-depth examination of the relationship of land-use and transportation infrastructure in an area and identify improvement opportunities to best meet the development and mobility goals of the community.

Several historic neighborhoods are located in the study area just outside Downtown and along Buffalo Bayou. The area has long been defined by its transportation network, including the Port of Houston and the rail lines that connect through the area to central Houston and nearby rail yards. Much of the early population of the area consisted of railroad and industrial workers and their families. From a population high of more than 42,000 in 1950, the population declined significantly until the 1990s and has now stabilized at approximately 20,000. The decline of population in the study area accompanied changing patterns and locations of work, the decline of the streetcar system, increases in automobile use, and the development of the interstate highway system, which significantly decreased population and traffic through the study area. This population decline creates opportunities to rethink use of the transportation infrastructure because of current excess capacity.

Today, significant infrastructure improvements are driving new development in the study area. Already an area of high transit usage and walking and biking, the East End will soon benefit from the expansion of the METRO light rail system. Bus ridership is high and many of the City's highest ridership bus lines pass through the study area. Several major off-road and on-road bicycle routes pass through the study area, supporting cycling trips. At the same time, significant barriers to mobility exist. Some barriers are tied to the very transportation infrastructure that has historically defined the area: the rail lines, freeways, and bayous. Other barriers exist in the form of gaps in bicycle, pedestrian, and automotive networks. This report has identified and quantified existing strengths and challenges; it has also identified improvement opportunities to boost and leverage the strengths and address the gaps.



A project Steering Committee was formed and included members from the Greater East End Management District, the City of Houston's Public Works Department and the Department of City Planning, the Gulf Coast Rail District, METRO, TxDOT, and H-GAC. With input from the Steering Committee, the following goals were developed and adopted for the study:

Goals for the East End Mobility Study

1. **Address short and long-term capacity constraints and opportunities** by assessing the traffic impacts of growth and development and developing recommendations

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4. **Prioritize transportation infrastructure investments that support the development objectives** identified through previous neighborhood and regional plans

5. **Reduce safety concerns** within study area for all travel modes

To identify mobility gaps and opportunities to address them, a comprehensive picture of future mobility in 2035 was constructed. This picture was painted by heeding the theme of the Subregional Planning Initiative to analyze transportation and land-use jointly. Two land-use scenarios were constructed: a baseline scenario that continued existing development trends and a "high-growth" scenario that assumed the completion of higher density residential development as identified in previous planning studies as well as additional transit-oriented development around light rail stations and open space along Buffalo Bayou. The estimates of population and employment for these scenarios were used to develop and refine travel demand projections for the area. The results of this analysis showed that most of the roadways already have sufficient capacity to handle projected growth between the present and year 2035 (see Figure ES1; Roadways at LOS D or better (green) roads are projected to accommodate traffic at acceptable or better levels-of-service in 2035).

Figure ES1 Travel Demand Model Level of Service Analysis for 2035 Scenario 2: Master Plan/TOD

The analysis of projected traffic operations in 2035 enabled a comparison of existing and projected mobility and development provisions against the project goals. Where gaps were evident, potential improvement opportunities were sought to address them. In the development of improvement opportunities, the transportation network was thought of as a nested network serving motorists, transit users, pedestrians, bicyclists, and the adjacent development. Each type of user requires a complete network to effectively utilize and take advantage of the public infrastructure; considering them separately ensured that each was accommodated. Categories and improvement opportunities are summarized below and shown on Figure ES2.

ROADWAY & INTERSECTION

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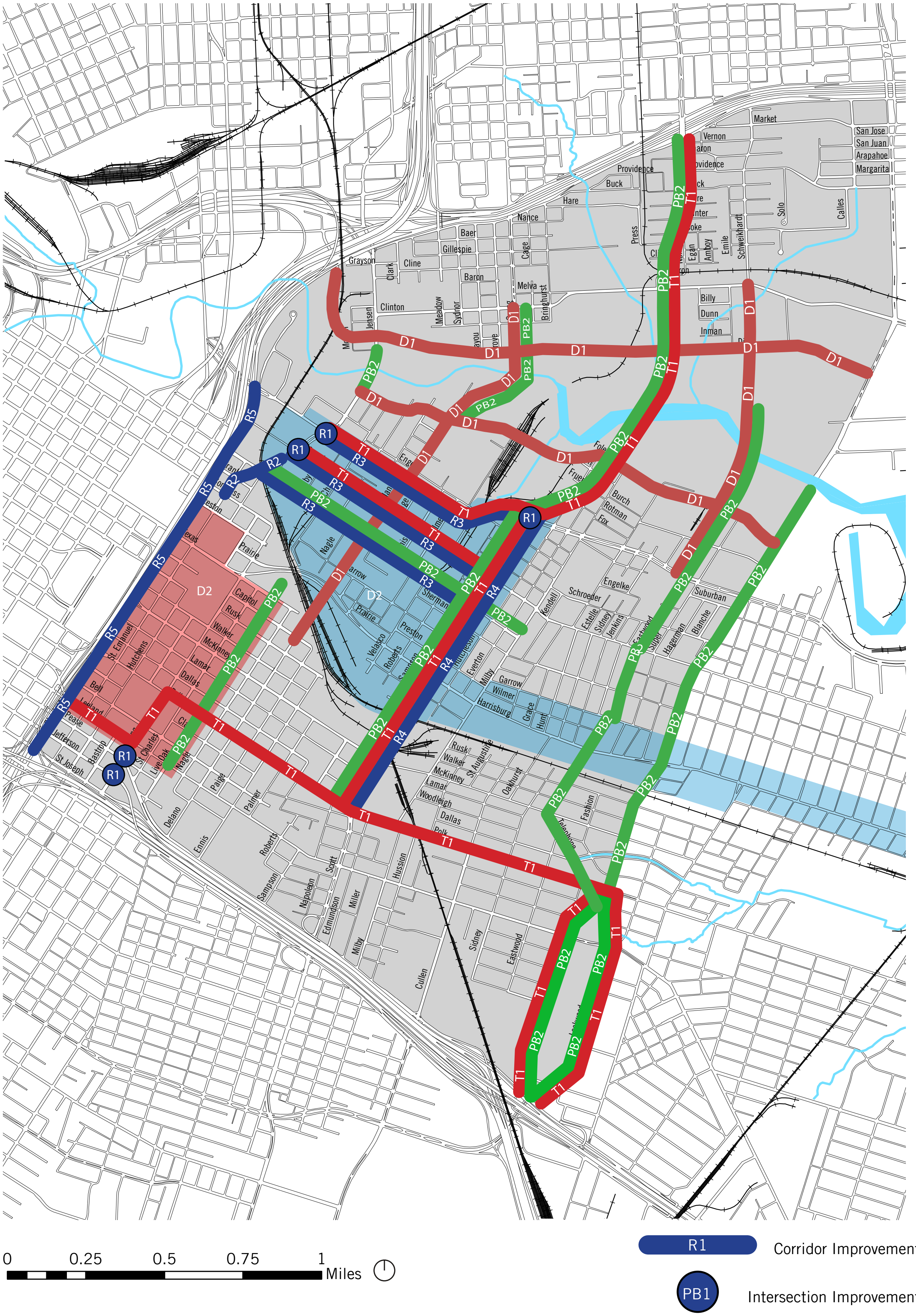
Figure ES2 Improvement Opportunities



Within each improvement opportunity, specific implementation projects were identified to fully realize the opportunity. Thirty-five implementation projects were identified. Various projects within a single improvement opportunity are sometimes complementary paths towards achievement of the improvement; other times they represent phases of implementation.

An implementation strategy was developed to define a clear path forward in terms of phasing and funding. The implementation strategy includes an estimate of project costs. It also includes a schedule for implementation based on a prioritization of projects. Priorities were established based on 1) project cost, 2) ability to satisfy project goals, and 3) local support.

Three priority categories have been utilized:

Short-term – Project with low-costs or previously identified funding that do not require extensive right-of-way or coordination with other projects and that can be implemented in **one to two years**. These are typically at or near "shovel-ready" project status.

Medium-term Medium-cost projects or higher-cost projects with particular importance to achieving the East End's mobility goals that can be implemented in **two to five years**.

Long-term – Typically higher-cost projects that will involve coordination with other projects and with several stakeholders and regulatory agencies. These projects are recommended for implementation in **five or more years**.

Tables ES1 (short-term), ES2 (medium-term), and ES3 (long-term) provide the complete prioritized list of projects and include the following information about each project:

Project description – A brief description of the major elements of each project.

Cost – Estimated cost of the implementation project based on planning-level conceptual designs.

Ease of implementation – A qualitative assessment of the overall ease of implementation for a project. This assessment includes consideration of cost, community support, right-of-way requirements, regulatory hurdles, coordination with other projects such as freight rail grade separations, and overall project scope. A project with high ease of implementation could theoretically be implemented quickly and inexpensively once a sponsor is identified.

Ease of implementation is represented as:

Ease of Implementation		
◔	LOW	Harder
◑	MEDIUM-LOW	
◕	MEDIUM-HIGH	
●	HIGH	Easier

Goals Supported – Identifies the primary goals addressed by each project.

Benefits – Summarizes the mobility benefits associated with each implementation project and associated improvement opportunity.

The projects identified in this report have been developed to achieve of the project goals for the East End community. They are expected to improve mobility for all modes of travel, including vehicle, transit, walking, and biking and improve safety along roadways and at intersections. They are expected to support and accommodate economic development. If implemented according to the strategies and schedules presented in this report, the proposed set of improvement opportunities should bolster the natural benefits of the East End including:

- Proximity to Downtown, University of Houston, Texas Southern University, and other important regional employment centers
- Major transit investments in the East End and Southeast light rail lines along with strong existing bus service
- A relatively extensive network of on-street and off-street bicycle facilities
- A roadway network that was built for substantially higher population levels than exist today
- Major destinations such as BBVA Stadium and significant future development opportunity sites

The improvements will support and accommodate not only the existing residents and businesses, but also residents and businesses that will likely be attracted to the East End in the future.

Table ES1 Short-term Implementation Schedule

Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-4	Close Westbound Pease at Dowling	$10,000	●	5 - Reduce Safety Concerns	Improve safety of intersection by removing unneeded movement from Pease Street at Dowling Street
R2	R2-1	Reconfigure the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street so that Navigation Boulevard is aligned with St. Emanuel Street	$485,000	◑	2 - Address Barriers 5 - Reduce Safety Concerns 4 - Support Development	Create a continuous north-south connection between EaDo and the East End; improve comprehensibility of roadway network
R3	R3-1	Modify Navigation Boulevard cross section	$1,500,000	◑	4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; aligns with visions set out in East End Master Plan; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-2	Modify cross sections of Canal Street and Commerce Street with pavement markings and minor pavement repair.	$155,000	◑	4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R4	R4-1	Modify cross sections on York Street and Sampson Street with pavement marking modifications	$42,900	◕	1 - Capacity Constraints/ Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; maintains acceptable LOS for vehicular traffic
T1	T1-1	Develop Canal Street, Polk Street, and Sampson Street / York Street as priority transit corridors	$379,000	◕	2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
T2*	T2-1	Support East End urban circulator implementation	$0	◕	2 - Address Barriers 4 - Support Development	Coordinates across projects for leverage and to minimize obstacles and disruption
PB1	PB1-1	Implement pedestrian realm improvements on Navigation Boulevard, Sampson Street, and York Street	$249,000	◕	2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports East End Master Plan recommendations; supports transit facilities
PB2	PB2-1	On-street bicycle facility improvements	$116,000	◕	2 - Address Barriers 3 - Multimodal Trips	Connects the Eastwood Transit Center, Harrisburg Light Rail Line, Harrisburg Rails-to-Trail, Columbia-Tap Bike Rails-to-Trail, and Buffalo Bayou bike trails; improves access to UH
PB2	PB2-6	On-street bicycle improvements from Downtown/EaDo Livable Centers study and 5th Ward Special Districts study	$344,000	◕	2 - Address Barriers 3 - Multimodal Trips	Bicycle proposals from other projects tie into the existing bicycle network and facilities proposed in this report
PB3	PB3-1	Implement a signage and wayfinding program for the area using standard signage from the MUTCD	$96,000	◕	2 - Address Barriers 3 - Multimodal Trips	Low-cost option for improving bicycle access in the area; can encourage regional cohesion because of better ties between neighborhoods
D1	D1-1	Add corridors to MTFP to support high level of connectivity	$0	◑	2 - Address Barriers 3 - Multimodal Trips	Enhances network connectivity and connection between East End and 5th Ward; supports coordination across future development, potentially creating value for impacted property owners
D2	D1-2	Create Parking Benefits Districts along St. Emanuel Street and Harrisburg Boulevard	$0	◕	2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area

* T2 is identified as a priorty project for short-term, medium-term and long-term priority.

Table ES2 Medium-term Implementation Schedule

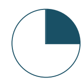
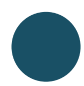
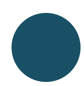
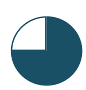
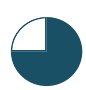
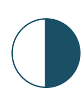
Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-1	Roundabout at intersection of Navigation and Jensen	$1,120,000		5 - Reduce Safety Concerns 1 - Capacity Constraints/ Opportunities	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R1	R1-5	Traffic signal or roundabout at intersection of Chartres and Runnels	$421,000		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R3	R3-3	Reconstruct Canal Street with cross section that emphasizes vehicular mobility and parking (Navigation to York)	$2,000,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-4	Reconstruct Commerce Street with cross section that emphasizes vehicular and bicycle mobility (US 59 to Harrisburg Rail to Trail)	$3,700,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R5	R5-1	Improvements to signage, wayfinding, and pavement markings along Chartres Street	$97,000		2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
T1	T1-2	Develop Navigation Boulevard as a priority transit corridor	$99,000		2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
PB1	PB1-2	Implement pedestrian realm improvements on the other Primary Corridors	$217,000		2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports transit facilities
PB2	PB2-7	Off-street bicycle improvements identified in Downtown/EaDo Livable Centers study	$760,000		2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities near Dynamo Stadium and other destinations
PB3	PB3-2	Implement a district-branding signage and wayfinding program	$246,000		2 - Address Barriers 4 - Support Development	Can simultaneously offer direction to important destinations while also helping create an identifiable brand for the area
D2	D2-2	Create Parking Benefits Districts along Navigation Boulevard, Canal Street, and Sampson Street as development warrants them	$0		2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area
D2	D2-3	Create a Parking Management District in the East End/ Third Ward and EaDo once development and parking demand warrants them	$0		2 - Address Barriers 3 - Multimodal Trips	Coordinated approach to parking that can satisfy parking needs with minimal parking infrastructure

Table ES3 Long-term Implementation Schedule

Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-2	Improvements to intersection of Canal and Navigation	$146,300	◔	5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities; decrease safety concerns related to vehicles accessing Hutchins Street
R1	R1-3	Intersection improvements or roundabout at intersection or Navigation and York	Costs are included in project R4-2	◑	5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R2	R2-2	Extend Franklin Street east to join with the intersection of Dowling Street and Congress Street.	$3,000,000	◔	2 - Address Barriers 4 - Support Development	Improve connectivity between Downtown, EaDo, and the East End; simplifies entering/exiting Downtown
R2	R2-3	Modify West Belt Rail Study proposal for a grade separation at the intersection of Navigation Boulevard and Commerce Street to align Navigation Boulevard with St. Emanuel Street.	$22,480,000*	◔	2 - Address Barriers	With modification, will provide continuous north-south link along Jensen, Navigation, and St. Emanuel; will provide bicycle connections along Navigation and Commerce; will improve access between Downtown, EaDo, and the East End
R4	R4-2	Convert York Street and Sampson Street to two-way roads	$1,260,000 (with signal) $1,900,000 (with roundabout)	◑	1 - Capacity Constraints / Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; improves access to businesses and other destinations; maintains acceptable LOS for vehicular traffic
R5	R5-2	Enhance and potentially redesign Chartres Street to make it a safer and more attractive gateway into Downtown and the East End	$5,700,000	◔	2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
PB1	PB1-3	Implement pedestrian realm improvements on the Secondary Corridors	$1,900,000	◑	2 - Address Barriers 3 - Multimodal Trips	Improves local access between neighborhoods and primary corridors, including business-intense corridors and transit corridors
PB2	PB2-2	Include bicycle facilities along Lockwood Drive when the road is reconstructed	$500,000	◔	2 - Address Barriers 3 - Multimodal Trips	Provides logical connection between Eastwood Transit Center, Harrisburg Light Rail, Harrisburg Rails-to-Trail, and Buffalo Bayou bike trails; if implemented during roadway reconstruction, costs would be minimized
PB2	PB2-3	Complete Buffalo Bayou trail network	$580,000	◔	2 - Address Barriers 3 - Multimodal Trips	Completing the trail system along Buffalo Bayou will provide a dedicated "bicycle highway" that is comfortable for all users between the East End, Downtown, and the Heights.
PB2	PB2-4	Pedestrian and bicyclist bridges over Buffalo Bayou	$1,890,000	◔	2 - Address Barriers 3 - Multimodal Trips	Will improve connectivity between the East End and the Fifth Ward; will support pedestrian- and bicycle-friendly development along Buffalo Bayou
PB2	PB2-5	Develop underpass designs at West Belt rail line to accommodate all levels of bicycle experience	$2,440,000	◑	2 - Address Barriers 3 - Multimodal Trips	Consideration of bicycle facilities on grade separations that are already proposed can leverage construction money to provide quality bicycle improvements
PB2	PB2-8	Off-street bicycle improvements identified in Fifth Ward Special Districts study	$1,033,800	◑	2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities to neighborhoods and schools north of Buffalo Bayou

* (cost is for original underpass design; proposed modifications may have marginal additional costs)

Introduction

The East End Mobility Study represents a significant opportunity to assess and define the mobility needs for a historic and critical part of the urban fabric of the City of Houston and to develop recommendations to support the continued development of the region into the future. The East End's diversity in land uses and close proximity to Houston's Central Business District make it an attractive location for future development. However, significant barriers exist that limit intra-neighborhood mobility and consequently diminish many of the very traits that make the East End attractive for living and working.

The study area is comprised of four City of Houston Super Neighborhoods (SN): Greater Fifth Ward (SN 55), Second Ward (East End) (SN 63), Downtown / East Downtown (EaDo) (SN 61) and Greater Eastwood (SN 64). These neighborhoods are typically defined by natural and infrastructure barriers including Buffalo Bayou, major rail corridors, and interstate highways.

Several management districts, including the Greater East End Management District and the East Downtown Management District, are active within the study area and focus on community development and improving economic activity. Additionally, several ongoing and recently-completed projects will strongly influence future activity in the study area. These projects include the construction of two new Light Rail lines as well as the new BBVA Compass Stadium for the Houston Dynamo.

H-GAC Subregional Planning Initiative Program

The Houston-Galveston Area Council (H-GAC), in recognition of the need for a more holistic, strategic approach to planning has developed its Subregional Planning Initiative Program (SPI) to help achieve regional and community goals through the integration of transportation and land use planning and its coordination with local plans, projects, and development strategies. This initiative provides an in-depth examination of the complex inner workings of a particular subregion by identifying the goals and priorities of the community, assessing the existing conditions, and developing recommendations and implementation strategies to achieve the identified goals and priorities.

The Greater East End Management District, in an effort to successfully implement the recommendations outlined in the East End Master Plan and Livable Centers studies, applied to H-GAC as a sponsor for this project.

Study Area Overview

The study area for the East End Mobility Study is located just east of the City of Houston's Central Business District and is approximately five square miles in size. The limits of the project area are IH-10 on the north, US 59 on the west, IH-45 on the South, and Lockwood Drive on the east.

Major neighborhoods within the study area include sections of the following Super Neighborhoods as shown in Figure 1.1.

- SN 55 - Greater Fifth Ward
- SN 63 - Second Ward (East End)
- SN 61 - Downtown / East Downtown (EaDo)
- SN 64 - Greater Eastwood

Major roadway corridors within the study area include (from north to south) Clinton Drive, Navigation Boulevard, Canal Street, Commerce Street, Harrisburg Boulevard, McKinney Street, Polk Street and Leeland Street; (from west to east) Chartres Street, Dowling Street, Jensen Drive, Scott Street, Sampson Street, York Street, Hirsch Road, and Lockwood Drive.

Other major non-automotive corridors within the study area include:

- Buffalo Bayou, a major waterway through the City of Houston, extending west through Downtown and connecting Downtown to the Ship Channel
- West Belt Subdivision and the GH & H Subdivision rail lines
- Future METRO light rail East End and Southeast lines currently under construction
- The Columbia Tap and Harrisburg Hike and Bike Trails

The study area contains a broad mix of land uses, from single family residential to commercial and industrial, as well as some areas that are currently undeveloped. There are several pockets of green space in the study area including Settegast Park, Finnegan Park, Guadalupe Plaza and Tony Marron Park.

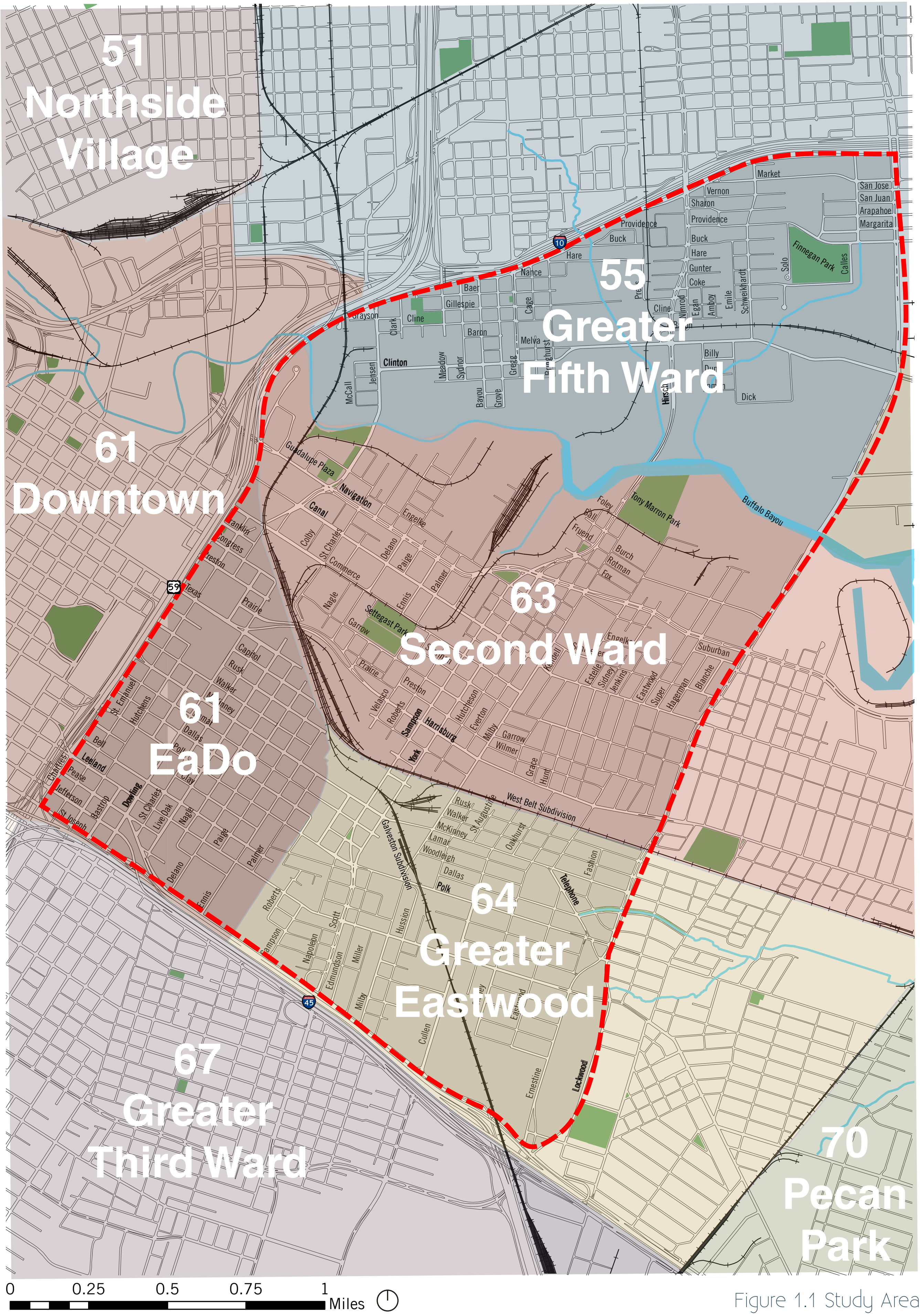


Figure 1.1 Study Area

History

The East End Study Area represents a set of historic neighborhoods located along Buffalo Bayou between the Downtown Central Business District and the Port of Houston Ship Channel. This location has caused the study area to experience many of the development trends and historical events in Houston's evolution as a region. As shown in Figure 1.2, the study area is comprised of portions of three of the six Wards (Fifth, Second and Third) that were established as early political and organizational boundaries when the City of Houston was founded in the 1830s and expanded though the 19th Century. Early settlers in the area were largely German and what is now Canal Street was known as German Street.

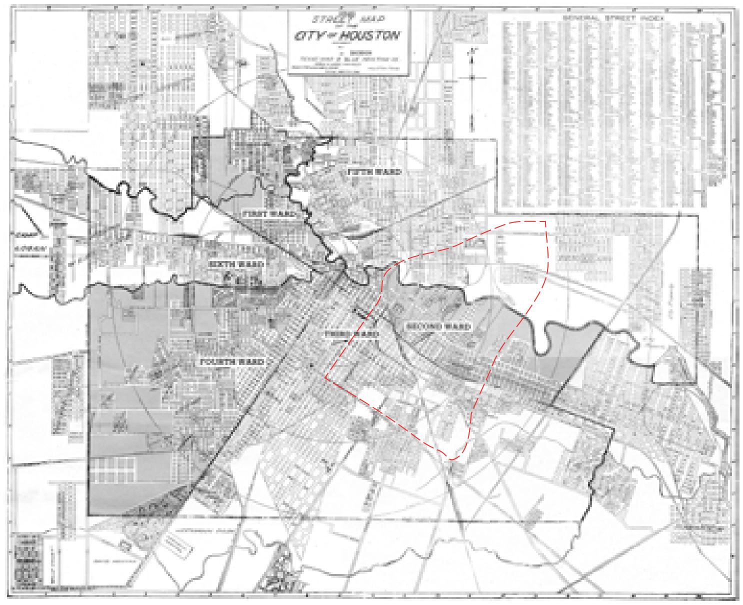


Figure 1.2 Historical Houston Map (1920)

By 1853, the Buffalo Bayou, Brazos, and Colorado Railroads had begun operation and by the 1860s Houston had become a hub of commerce and trade, especially for cotton. The region's role as the location where railroads connected inland routes to ports along Buffalo Bayou and in Galveston and Beaumont was critical to this growth. After the Civil War, Houston was known as "the city where 17 railroads meet". Many of these rail corridors, such as what are now known as the West Belt and Galveston Subdivisions, are still active and traverse the East End to this day.

Significant early development in the East End study area was residential, frequently as housing for employees of the railroads, industrial sites, and shipping companies in the study area. At this point the grid network of roadways had been established around the rail corridors. Shipping along Buffalo Bayou remained strong and efforts to bring an modern port inland to Houston were accelerated. By 1900, as a major Hurricane had significantly damaged Galveston Island and the Port of Galveston, the needs for an inland port became more important.

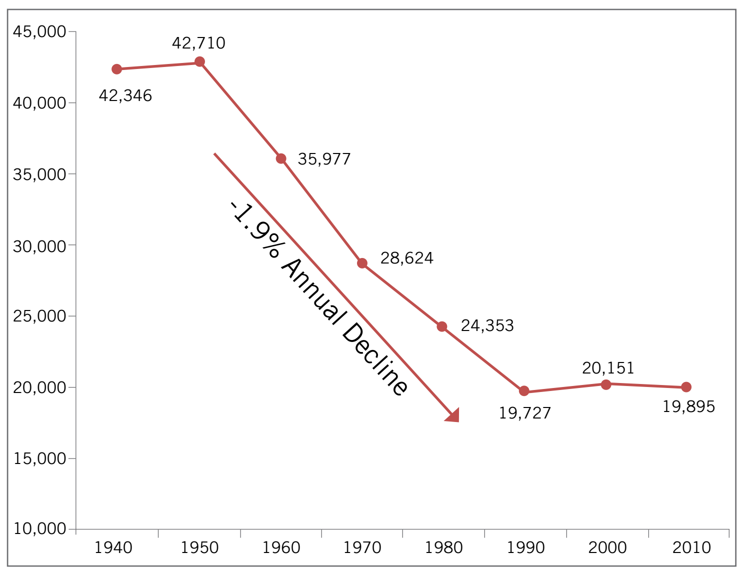


Figure 1.3 1940-2010 Historical Population Trends - Study Area from US Census

With its discovery in the early 1900s, oil began to rival cotton as the largest commodity for the new port. Goods movement benefited from a joint effort between local officials and the United States Government to dredge the Houston Ship Channel to allow larger ships to use the passage and reach a growing number of oil refineries. It was also during this period that Eastwood, one of the nations first "Master Planned Communities", was developed in the study area's southeast region. Other neighborhoods developed in Houston around this time were Montrose and the Heights.

Streetcars played a large role in transportation in this period in Houston and peaked in use and popularity in the 1920s. They began to steadily decline due to the growth of jitneys and the personal automobile and the last streetcar in operation stopped service around 1940.

Economic growth continued, and with that population increased in the study area through World War II to reach its peak of 42,710 in the 1950 Census.

From the late 1940s through 1950, the development pattern of Houston began to change. In 1950, Navigation Boulevard represented the US 90 corridor through the eastern part of Houston (Figure 1.4). After 1950, the interstate freeway system began development, personal vehicle ownership grew rapidly and population began to migrate westward from Downtown. The alignment of US 90 also moved outside of the study area. As shown in Figure 1.3, population in the East End began a steady decline and, by 1970, population was down to 28,600 residents. Industrial development also picked up during this time providing another reason for people to move away from the area. In 1970, the majority of the interstate system was established in Houston and had surrounded the study area on three sides (Figure 1.5). This changed travel patterns in the area as people could access the East End employment base from further away and residents had access to more of the region via the highway system. Freight movement also began to use more truck and other heavy vehicles on area roadways.

While growth in Houston remained strong, the study area population continued its decline through 1990 to approximately 20,000 residents. This represents a 1.9 % decline in population annually over the period from 1950-1990 while the City of Houston grew 2.5% per year over the same period. At the same time demographics shifted due to inflows of new residents, to where today over 50% of the study area is Hispanic.

Infrastructure improvements have continued in and around the study area. In 2004, 64 years after the last street car was operated in Houston, METRO, the local transit agency, opened its first light rail system along the Main Street corridor from the Texas Medical Center to Downtown. The East End area will benefit from the expansion of that system with the East End and Southeast lines traveling through the area and the proposed University Line terminating at the Eastwood Transit Center. Along with that, the City was able to leverage its railroad history by converting the Columbia Tap and Harrisburg/Sunset railroad corridors into active, shared use, pedestrian and bicyclist facilities. New development has also started to come into the study area with some newer townhomes concentrated in the EaDo and Eastwood areas. The BBVA Compass Bank Stadium will also open in 2012 and provide a home field for professional and college level sporting events. Many hope it will become a catalyst to continued area growth.

Figure 1.4 Houston Roadway Map (1950)

Figure 1.5 Houston Roadway Map (1970)

Previous Studies

Several studies have recently been completed that provide valuable inputs into the development of this mobility study. Plans that have been gathered and reviewed include:

- East End Livable Centers Study (Goodman Corporation, 2009)
- Greater East End Livable Centers Master Plan (Civic Design, Inc., 2011)
- Downtown/EaDo Livable Centers Study (Morris Architects, Inc., 2011)
- Buffalo Bayou and Beyond (Thompson Design Group Inc./ EcoPlan, 2002)
- Fifth Ward Pedestrian and Bicyclist Special Districts Study (LAN, 2011)
- Gulf Coast Rail District West Belt Study (HNTB, 2011)

These plans have identified both potential development opportunities that will inform future land use scenarios as well as multi-modal infrastructure recommendations that will inform transportation network scenarios and mobility and access improvements.

Many of the major transportation recommendations of these reports are summarized in Figures 1.6-1.11 on the following pages. These recommendations will impact mobility and accessibility within the study area and will be considered in the scenarios developed for this study.

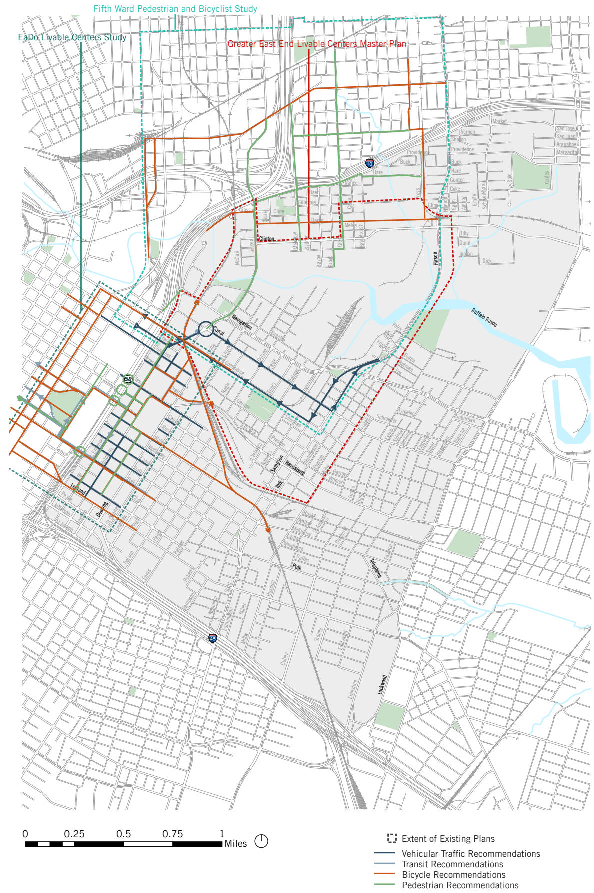


Figure 1.6 Previous Study Area Locations

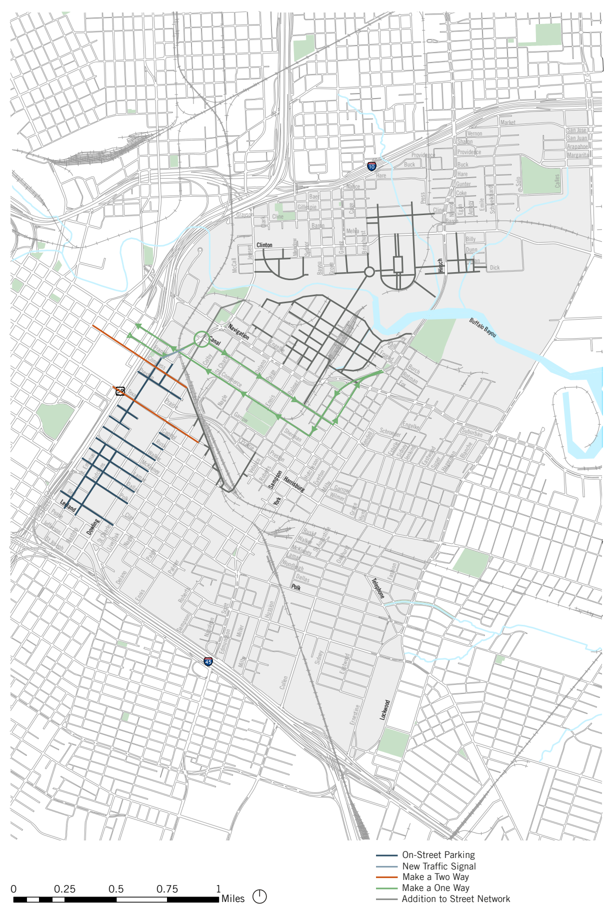


Figure 1.7 Vehicular Traffic Recommendations

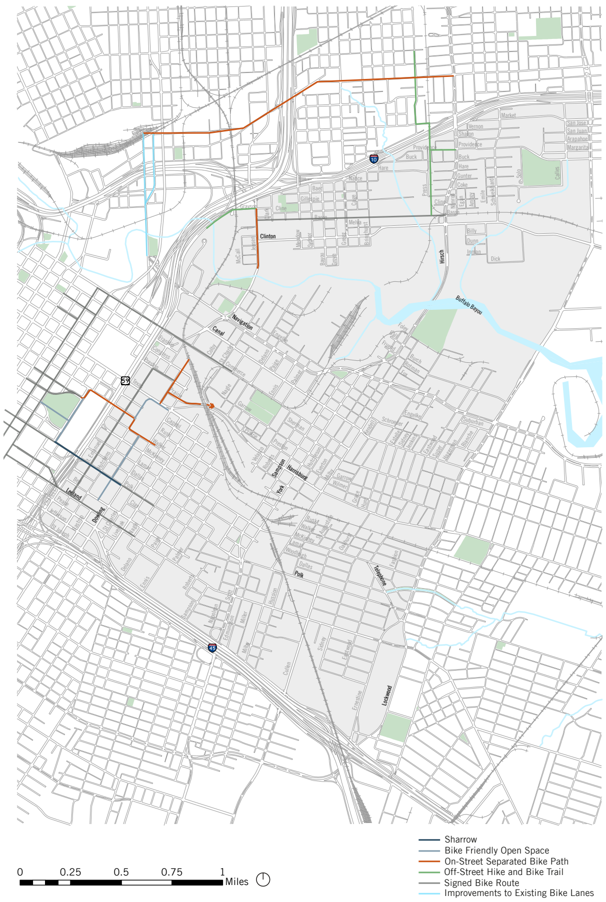


Figure 1.8 Bicyclist Recommendations

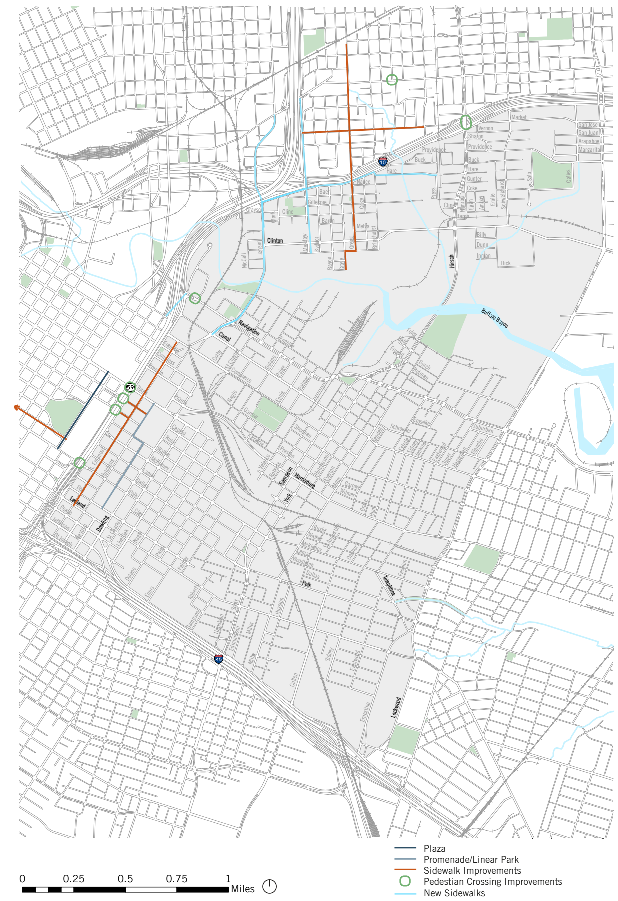


Figure 1.9 Pedestrian Recommendations

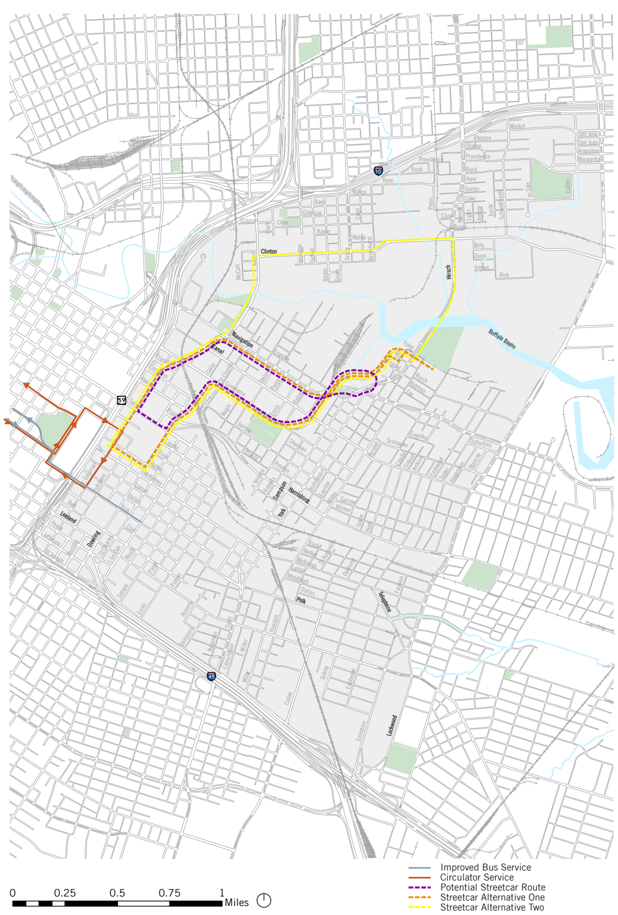


Figure 1.10 Transit & Circulator Recommendations

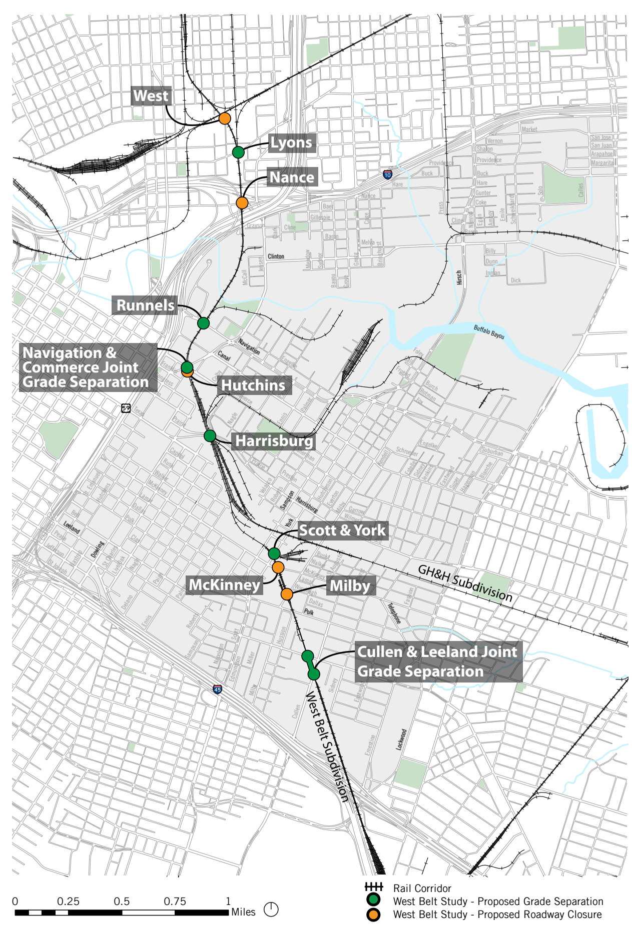


Figure 1.11 West Belt Freight Rail Recommendations


Hilton

Chapter 2

Existing Conditions

Existing conditions across multiple factors were collected for the study area. These were used to assess the status of existing transportation options that are available to travelers. Land use conditions were also captured to assess how existing and potential future development will impact mobility and access. An understanding of existing conditions enables a full assessment of transportation needs within the study area and is critical for identifying priority locations for future improvements.

Existing conditions factors that were assessed include:

- Study Area Demographics
- Employment and Journey to Work Information
- Roadway Network and Fact Base
- Traffic Control and Safety Information
- Connectivity and Major Barriers
- Transit Services - Bus and Light Rail
- Freight and Commuter Rail
- Land Use and Development

Study Area Demographics

Table 2.1 compares demographics of the study area including individual Census Tracts (Figure 2.1) with those of Harris County and the State of Texas based on the most recent data available from the Census. Several key insights from the information are worth highlighting. These trends are likely to continue to evolve as redevelopment takes place within the study area and major investments such as the East End and Southeast METRO light rail lines are opened.

Key insights include:

- Median Household Income for the study area is only 72% of the Harris County region. The portion of households living below the poverty level is nearly double the county average with the largest concentration of below poverty level populations located in the Fifth Ward and North EaDo/West Second Ward areas (Tracts 2114 & 3101).
- The South EaDo/West Eastwood area (Tract 3102) has seen a significant uptick in median household income with the 2010 estimated median income over $62,000. While this is the smallest census tract based on population it represents the location where several new single family attached housing developments (e.g., town houses) have been built or redeveloped since 2000. This area has smaller household sizes, with fewer children, and a much higher level of educational attainment than the surrounding areas.
- Renters make up a majority (61%) of the occupied housing in the study area, and vacancy rates are nearly double the county average.
- There is an education gap between the study area and the overall county with an 11% gap in population holding a two- or four-year college degree versus Harris County.
- Residents of the study area have a higher likelihood to commute using a mode other than driving alone. The study area mode split for transit, walking, and biking, is two to three times the county average for these modes.
- Higher mode shares for non-single occupancy vehicle modes is likely linked to the low median household income, access to high quality transit routes, proximity to destinations, and significant share (20%) of households that do not own a vehicle.

Many of these factors have the potential to influence the transportation options that will best serve the study area. For example, the low vehicle ownership rates is likely linked to a higher degree of transit ridership or pedestrian trips for residents in the study area.

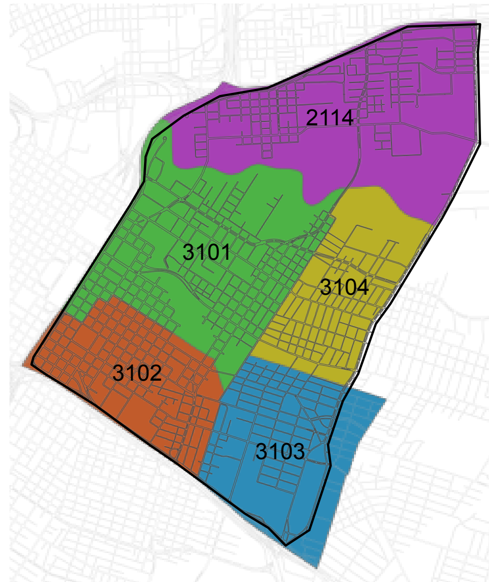
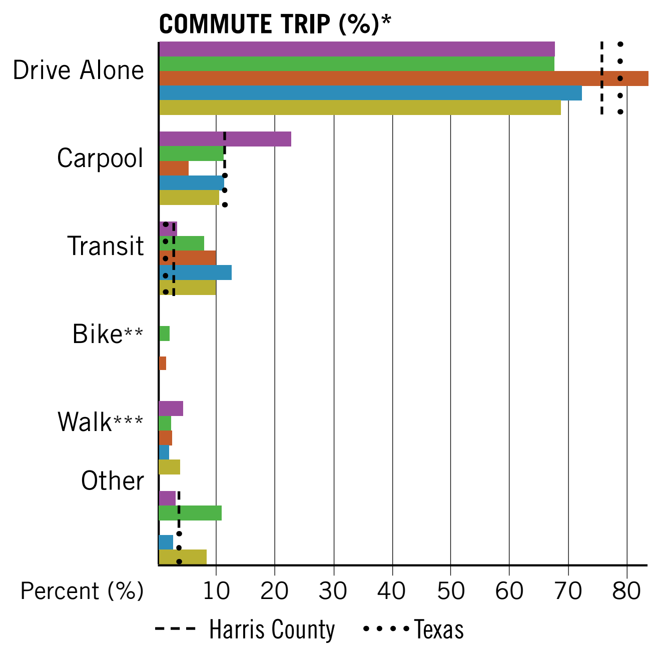
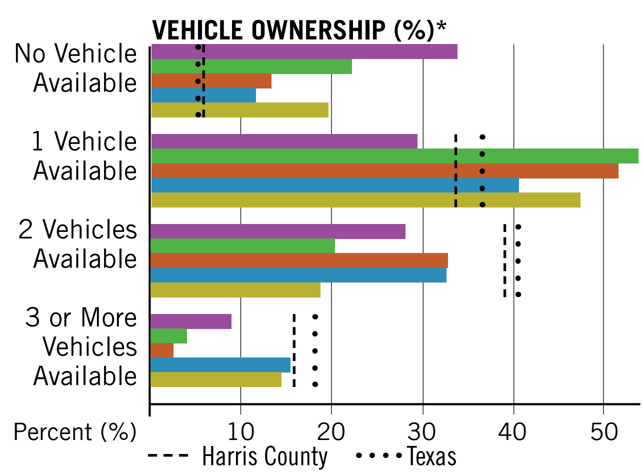


Figure 2.1 Study Area Census Tracts



** Bike: Study Area (0.6%), Harris County (0.3%), Texas (0.2%)
*** Walk (%): Study Area (2.6%), Harris County (1.8%), Texas (1.9%)



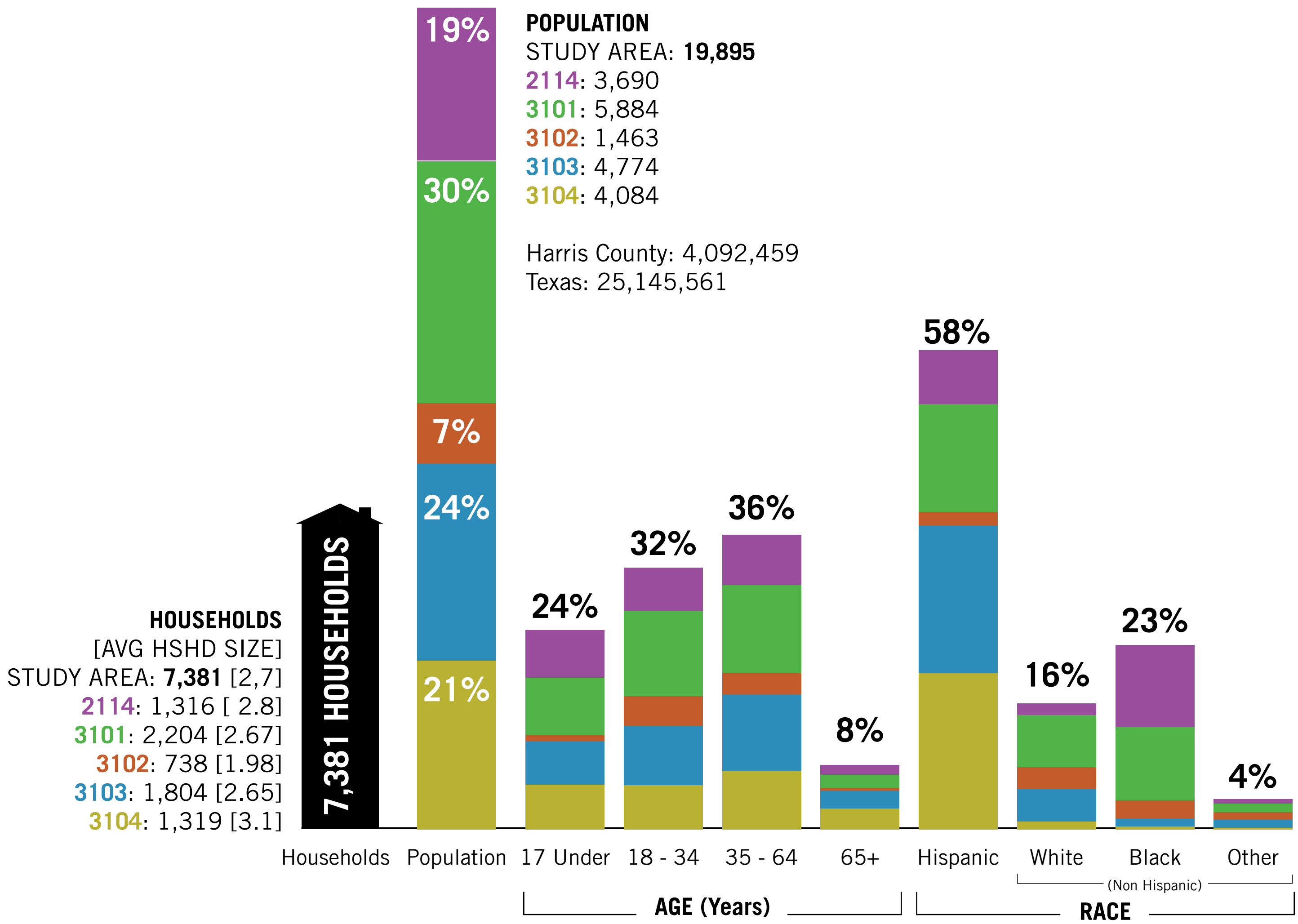


Table 2.1 Study Area Demographic Information

Statistic	Study Area	Census Tract					Harris County, Texas	Texas
		2114: Fifth Ward	3101: North EaDo/West Second Ward	3102: South EaDo/West Eastwood	3103: East Eastwood	3104: East Second Ward		
Economic*								
Median Household Income	$36,802	$34,458	$32,478	$62,778	$40,481	$26,753	$51,444.00	$49,646.00
Unemployed	10.5%	19.1%	14.1%	3.8%	7.4%	6.5%	7.3%	7.0%
Below Poverty Level	28.7%	31.4%	41.2%	22.5%	17.7%	23.4%	16.8%	16.8%
Ownership								
Households that Own	39.0%	37.3%	25.3%	62.5%	43.8%	43.6%	53.8%	63.7%
Households that Rent	61.0%	62.7%	74.7%	37.5%	56.2%	56.4%	43.2%	36.3%
Vacancy	19.0%	16.8%	14.1%	19.6%	27.5%	17.3%	10.2%	10.6%
Housing Type*								
Single Family Detached	52.0%	58.0%	29.5%	56.4%	62.6%	59.7%	57.5%	65.6%
Single Family Attached	7.6%	5.4%	9.4%	19.6%	3.3%	7.6%	3.7%	2.6%
Apartment (2-9 units)	19.1%	16.2%	12.0%	14.2%	25.5%	25.2%	10.3%	10.2%
Apartment (10-49 units)	9.8%	15.5%	16.9%	7.6%	4.1%	3.4%	18.3%	9.9%
Apartment (50+ units)	11.3%	4.0%	32.2%	2.2%	4.4%	4.0%	7.5%	3.9%
Other	0.2%	0.9%	0.0%	0.0%	0.0%	0.0%	2.8%	7.9%
Highest Level of Education Achieved*								
No High School	21.8%	14.9%	24.3%	3.0%	20.1%	35.5%	12.0%	10.0%
Some High School	17.1%	21.1%	15.1%	13.5%	15.0%	20.6%	10.4%	10.0%
High School Graduate	20.1%	25.9%	16.6%	12.7%	21.2%	21.4%	24.1%	26.0%
Associates Degree	16.7%	9.6%	14.4%	22.8%	22.6%	15.2%	20.3%	22.0%
Some College	4.0%	1.2%	5.2%	4.4%	5.1%	3.5%	5.5%	6.3%
College Degree	12.2%	15.3%	15.4%	17.7%	11.7%	3.9%	18.2%	17.3%
Grad School	8.0%	11.9%	9.0%	25.9%	4.3%	0.0%	9.5%	8.5%

Source: US Census, 2010 unless noted by* which are from 2005-2010 ACS Estimates: 5 year

Land Use

Figure 2.2 at the right shows the existing land use based on data from the Harris County Appraisal District (HCAD). As shown, the largest active land use by square footage is industrial, the majority of which is focused along Buffalo Bayou and the major freight rail corridors such as the West Belt Subdivision. Residential is the next largest active use, with the heaviest concentration being single-family neighborhoods on the eastern side of the study area. Several multi-family developments have also been developed in the study area. Additionally, commercial uses make up over 10% of the study area.

The other major land use type in the study area is vacant, which provides significant opportunity for redevelopment.

Table 2.2 below provides a breakdown of the land use data from both HCAD and the H-GAC Land Use model. This model provides the basis for future land use scenarios to be developed through the course of this study.

Table 2.2 Land Use Distribution

	2002 HCAD		2011 HCAD		H-GAC 2010*	
Land Use	SF (MM)	%	SF (MM)	%	SF (MM)	%
Single-Family Residential	18.6	17.2%	20.3	18.8%	24.3	24.0%
Multi-Family Residential	2.1	2.0%	3.4	3.1%		
Commercial	5.4	5.0%	11.6	10.7%	15.8	15.6%
Office	0.4	0.3%	0.7	0.6%		
Industrial	34.8	32.2%	34.6	32.0%	33.5	33.0%
Government/Medical/Education	7.1	6.5%	6.4	5.9%	6.5	6.4%
Transportation/Utilities	1.4	1.3%	2.2	2.1%		
Parks/Open Space	1.7	1.6%	2.1	2.0%	1.7	1.7%
Undeveloped	36.6	33.9%	26.8	24.8%	7.0	6.9%
Undevelopable					11.0	10.9%
Other					1.6	1.5%
Total	108.1	100%	108.1	100%	101.4	100%

*HCAD and H-GAC use different land use categories. The H-GAC Single-Family Residential line contains both types of Residential; Commercial includes Commercial and Office. HCAD does not use Undevelopable or Other.

Map Key

- Single Family Residential
- Multi Family Residential
- Commercial
- Office
- Industrial
- Civic
- Trans./Utilities
- Open Space
- Undeveloped

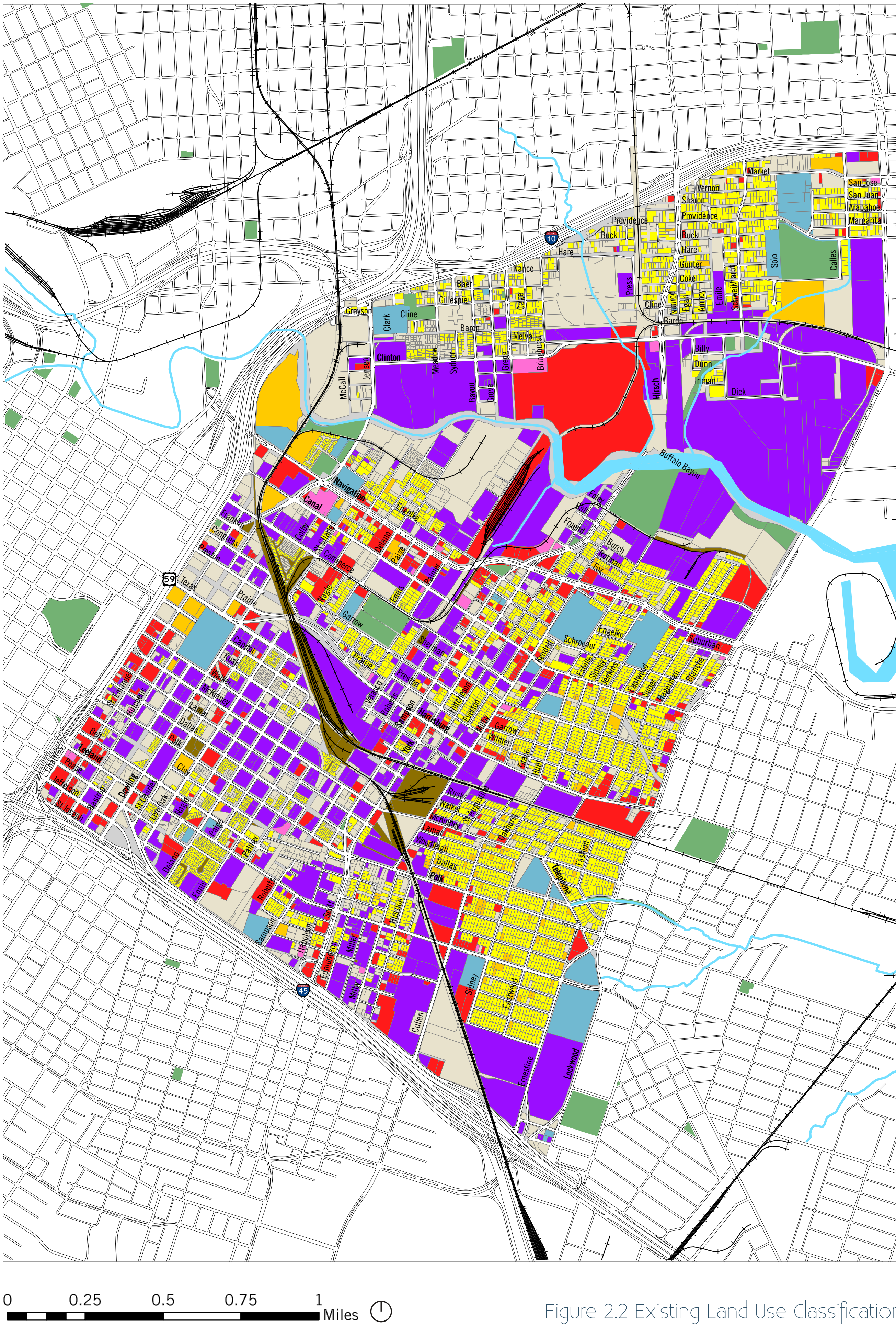


Figure 2.2 Existing Land Use Classifications

Source: City of Houston Planning Department, 2011

Population and Employment

Based on the 2010 Census information and demographic modeling performed by H-GAC, existing population and employment characteristics for the study area were analyzed. As of the 2010 Census, the population for the study area was 19,885. The population slightly declined (-1.3%) from the 2000 Census population of 20,151 and continues a relatively flat population level since 1990. Prior to 1990, population had been on a steadily-declining trend for several decades from peak population in 1950 of over 42,000 residents.

Figure 2.3 at right shows the density of population by Traffic Analysis Zone (TAZ) based on the H-GAC demographic model for 2011. This model estimates population based on land use and census data on average household size. As shown, the densest location for population is in the multi-family apartment units that have been constructed over the past 10 years in the northwest corner of the study area on the opposite side of US 59 from Minute Maid Park. Other areas with higher densities are the residential neighborhoods of the East End and Eastwood, east of York Street, between Polk Street and Canal Street, which are predominantly single-family residential. It is expected that as development occurs within the study area that residential densities will increase, in particular around the light rail stations and as new development occurs in the Second and Fifth Ward Super Neighborhood areas in the northern part of the study area.

Employment in the study area was also analyzed based on the H-GAC demographic model (Figure 2.4). As shown in the adjacent figure, jobs are primarily clustered in the EaDo area, closest to Downtown, with some other pockets along Harrisburg Boulevard.

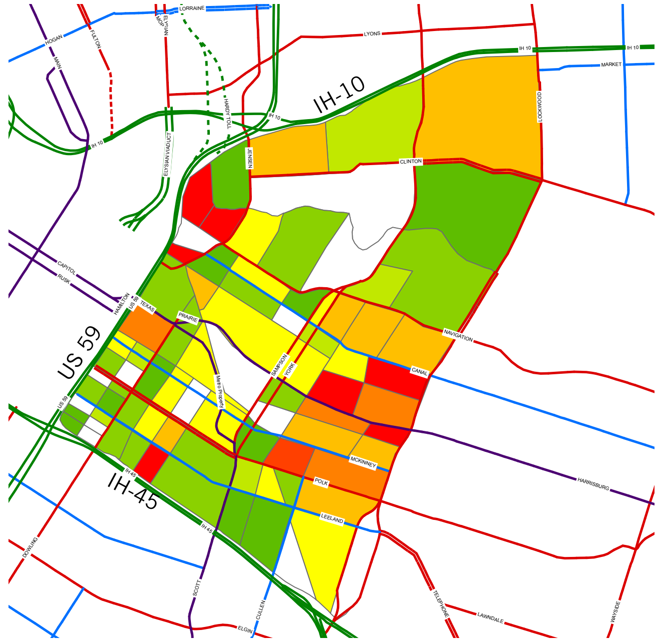


Figure 2.3 Estimated Population Density (2011)

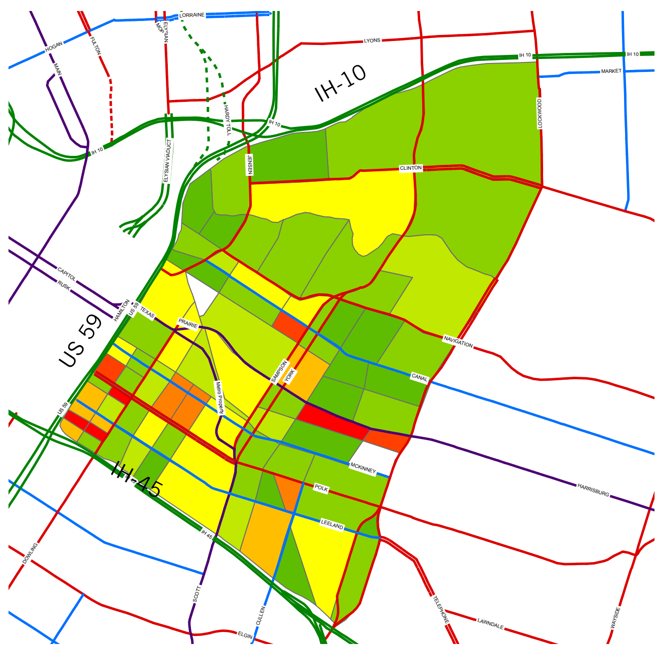


Figure 2.4 Estimated Employment Density (2011)

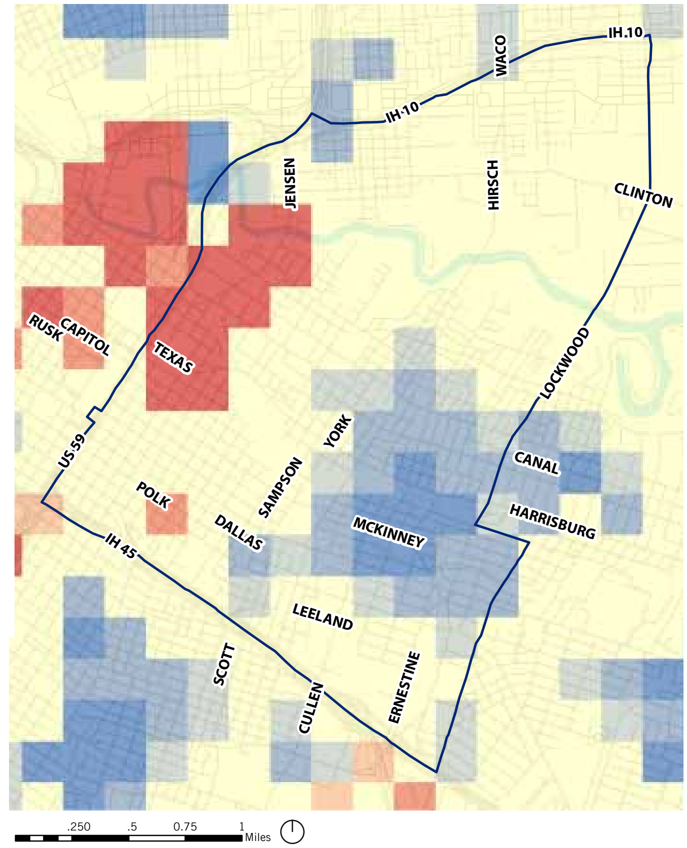
Map Key

Person per Acre

0	11 - 15
1 - 2	15 - 17
3 - 5	17 - 21
5 - 8	21 +
8 - 11	

Historical hotspot analysis developed by the City of Houston Planning Department (Figure 2.5) for the period of 2000-2010 shows that the majority of the development activity, (as measured by population change) within the study area was concentrated on the western portion of the study area between roughly Harrisburg Boulevard and Buffalo Bayou on both sides of US 59.

The existing single family neighborhoods in the Greater Eastwood area were lower in terms of new development as they are relatively stable and built out.



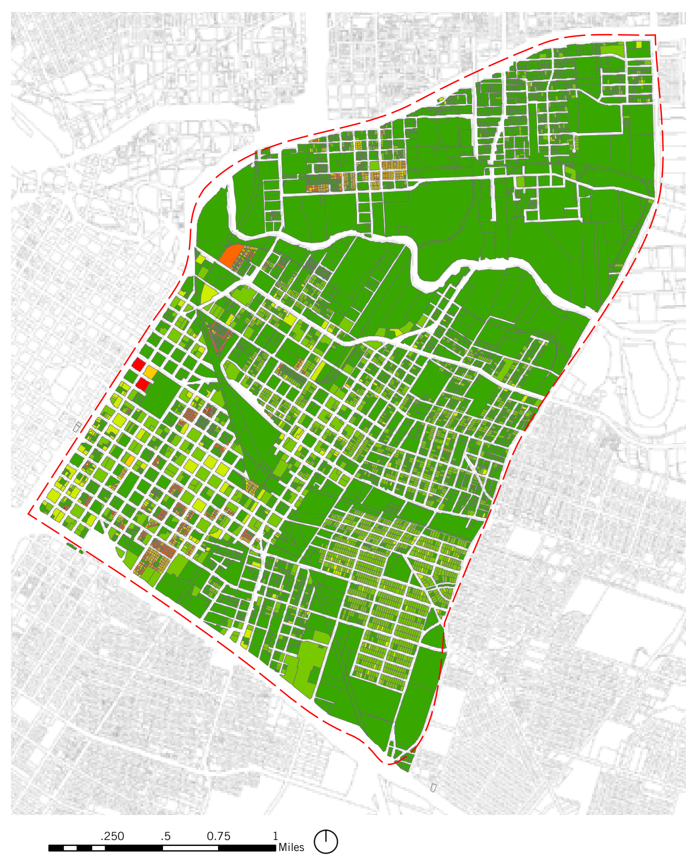
Map Key

Population Change

High Population Growth		>2.58 Std. Dev.
		2.58 - 1.96 Std. Dev.
		1.96 - 1.65 Std. Dev.
		1.65 - 1.65 Std. Dev.
		-1.65 - -1.96 Std. Dev.
		-1.96 - -2.58 Std. Dev.
Low Population Growth or Decline		< -2.58 Std. Dev.

Figure 2.5 Hot Spot Analysis (2000 - 2010)

Figure 2.6 shows a land value analysis for the combined value of the land and improvements for various parcels throughout the study area. For the most part, land values are below $29 per square foot in the majority of the study area. Land values increase closer to East Downtown where several multi-family parcels are valued at over $200 per square foot. This analysis indicates that there is a significant opportunity to increase land values in the study area with continued quality investment and development.



Map Key

Land & Improvements per Square Foot

- $.01 - $15
- $ 16 - $30
- $31 - $70
- $71 - 110
- $111 - 199
- >$200

Source: Planning and Development Department, City of Houston

Figure 2.6 Market Value (2011)

Journey to Work

Journey to work data from the 2000 Census was analyzed to assess where commuting traffic was likely to be generated. Commuting trips are one of the major components of traffic to, from, and within a study area and typically coincide with roadway peak hour travel. An assessment of origins and destinations of commuter trips can highlight the need for connections along major corridors and may support improvements to transit service to align with demand. Having many jobs located close to residential areas has the potential to minimize trip distances as it may increase the likelihood of walking and bicycling as attractive mode choices.

As shown in Figure 2.7, the data indicate that the largest concentration of commute trips originating from the study area are destined for major employment centers near the study area, including:

- Downtown, which employs nearly double the population as that of the next largest tract
- The census tracts within and east of the East End study area, particularly those south of Buffalo Bayou
- Texas Medical Center
- Greenway Plaza
- The area along US 290, just outside of the IH-610 loop
- Uptown/Galleria Area

Table 2.4 Major Employers in the Study Area

Ranking	Name	Industry	Employees
1	CORPORATE BRAND FOODS AMERICA	Manufacturing	1,200
2	MAXWELL HOUSE COFFEE CO	Manufacturing	620
3	OAK FARMS DAIRY	Manufacturing	450
4	HARRIS COUNTY DETECTIVE BUREAU	Public Administration	303
5	TYSON FOODS INC	Manufacturing	300
6	FREEDMAN FOOD SVC	Wholesale Trade	285
7	FINGER FURNITURE CO INC	Retail Trade	250
8	FREEDMAN MEATS INC	Wholesale Trade	250
9	WESTBROOK MANUFACTURING	Manufacturing	250
10	AUSTIN HIGH SCHOOL	Educational Services	235
11	HAHN & CLAY INC	Manufacturing	235
12	HARRIS COUNTY CONSTABLE'S OFC	Public Administration	224
13	ELECTRONIC POWER DESIGN INC	Retail Trade	201
14	PREMIERIMS INC	Professional, Scientific, and Technical Services	200
15	CONTINENTAL SILVERLINE	Manufacturing	200
16	DAN-LOC BOLT & GASKET INC	Manufacturing	200

Source: 2011 ESRI Analyst

Additional employment destinations are scattered throughout the region with most located near or adjacent to the study area or along major freeways. Table 2.3 shows the industry employment breakdown for the East End Study area residents. Table 2.4 shows a list of the employers in the study area with over 200 employees.

The study area has a significant number of jobs and a mix of professional, industrial, education, and retail centers. Major commuting trips to the study area are more evenly distributed across the Houston region (Figure 2.8 shows all tracts generating greater than 40 trips), with the majority of the employment met by local residents or from the adjacent areas primarily east and south of the study area.

Table 2.3 Resident Employment by Industry

East End Study Area Residents Employment by Industry, 2010 Census	
Industry	Share of Jobs
Agriculture, forestry, fishing and hunting, and mining	1.8%
Construction	11.4%
Manufacturing	11.7%
Wholesale trade	4.8%
Retail trade	10.4%
Transportation and warehousing, and utilities	5.7%
Information	2.6%
Finance, insurance, real estate, and rental and leasing	6.6%
Professional, scientific, management and administrative services	14.8%
Educational, health and social services	16.6%
Arts, entertainment, recreation, accommodation and food services	6.5%
Other services (except public administration)	5.0%
Public administration	2.1%

Source: 2010 US Census

Map Key

Daily Commute Trips
From Study Area

- 40-124
- 125-315
- 316+

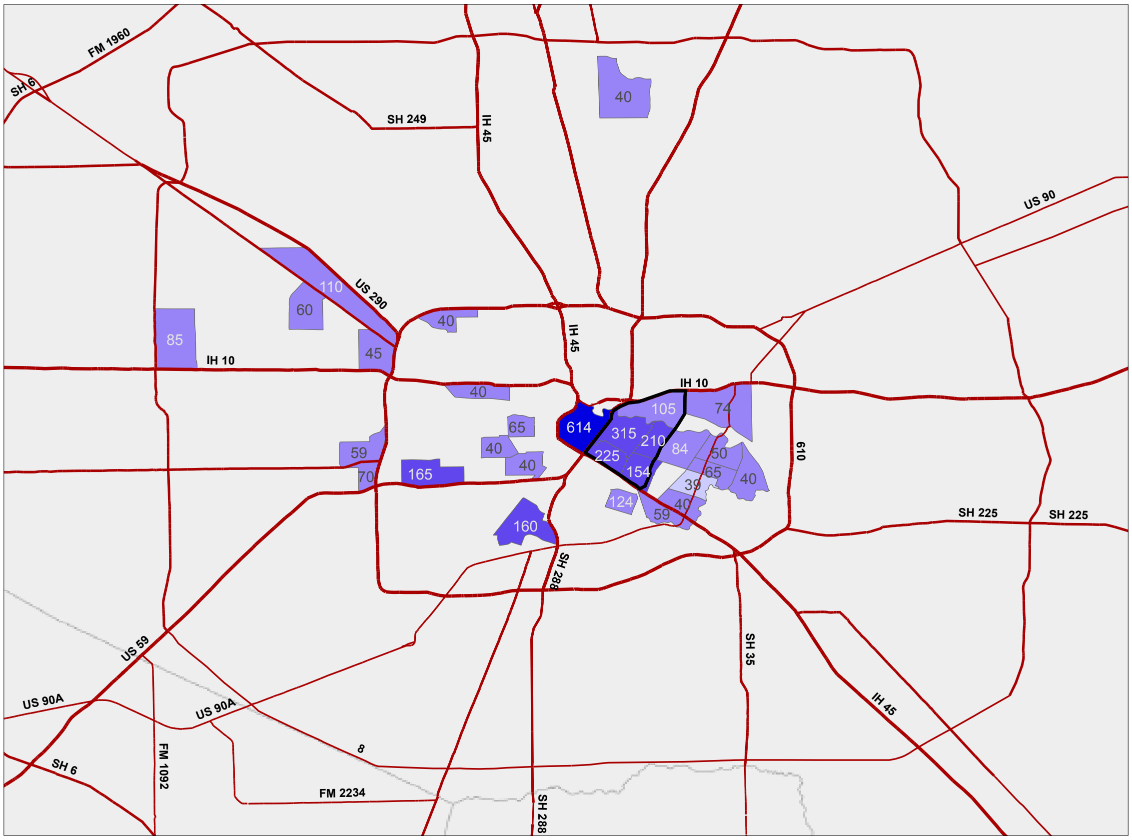


Figure 2.7 Major Job Locations for Study Area Residents

Map Key

Daily Commute Trips
To Study Area

- 40-79
- 80-165
- 166+

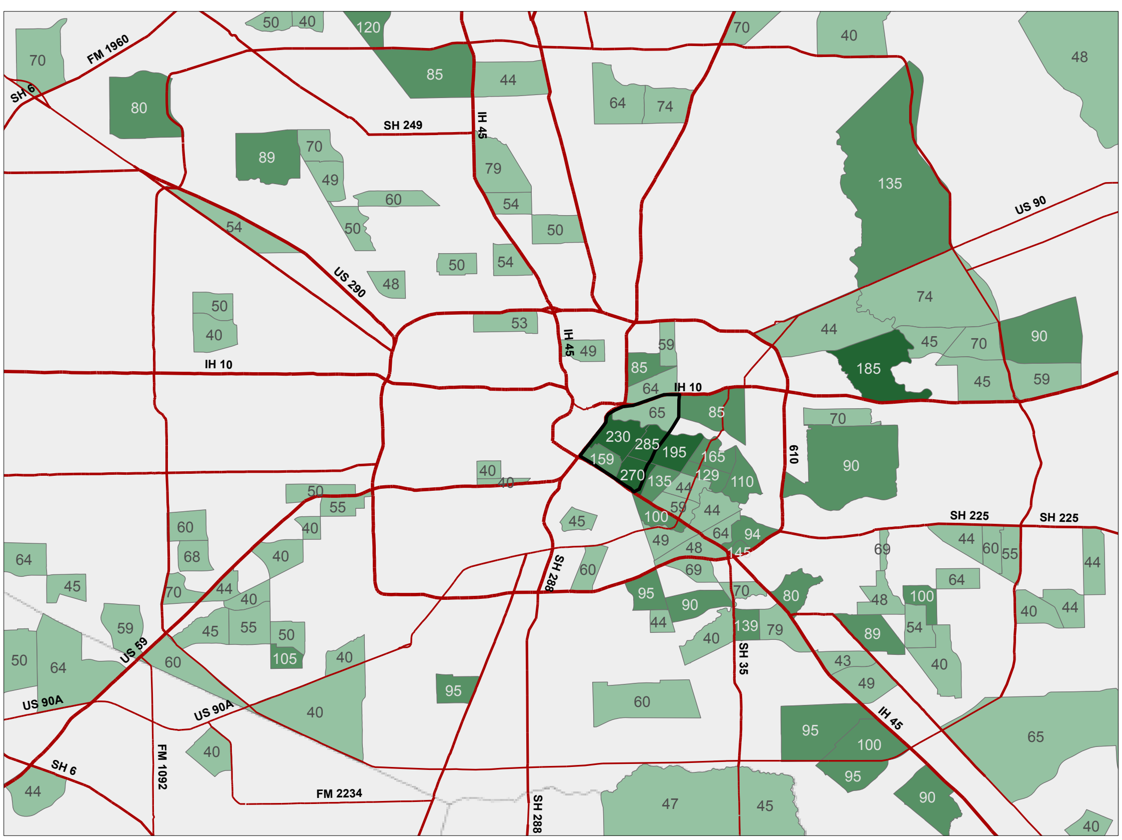


Figure 2.8 Major Residence Locations for Study Area Employees

Source: US Census, Long Form 2000

Major Destinations

The East End is a region made up of several distinct neighborhoods and many activity centers and traffic generators. Figure 2.9 shows the location of many of the major destinations in the study area. The study area contains numerous historic places of worship and two of the oldest cemeteries in Houston. Places of worship are clustered in the oldest residential areas of the neighborhood, including the Second and Lower Fifth Wards.

Major parks in the study area include Settegast Park, Guadalupe Plaza Park and Tony Marron Park in the Second Ward, and Finnigan Park in the Lower Fifth Ward. Recent trail projects have increased access to the north and south sides of Buffalo Bayou. Master plans include proposals that would increase the green space along the bayou, replacing some of the industrial uses. New green space includes a current plan to extend a promenade south from the BBVA Compass Stadium six blocks on Bastrop Street.

The Second and Lower Fifth Wards also contain a number of elementary, middle, and high schools. Houston Independent School District Schools in the area include:

Elementary Schools

- Bruce Elementary
- Dodson Elementary
- Henderson, N. Q. Elementary
- Lantrip Elementary
- The Rusk School (K-8)

Middle/Intermediate Schools

- Project Chrysalis Middle School (Internal Charter)
- The Rusk School (K-8)

High Schools

- Austin High School
- Wheatley High School

Other area schools include:

- Ripley House, Public Charter (PK-5)
- Cage Elementary, Public Charter (PK-5)
- Our Lady of Guadalupe School, Private (PK-8)
- East Early College High School, Public Charter (9-12)

Guadalupe Plaza

Settegast Park

Wheatley High School

Opening in the spring of 2012, BBVA Compass Stadium will be a major destination in the study area. The stadium is home to the Houston Dynamo Major League Soccer club and to Texas Southern University's Football team.

Map Key

BBVA Compass Stadium
Schools
Places of Worship
Cemeteries
Parks

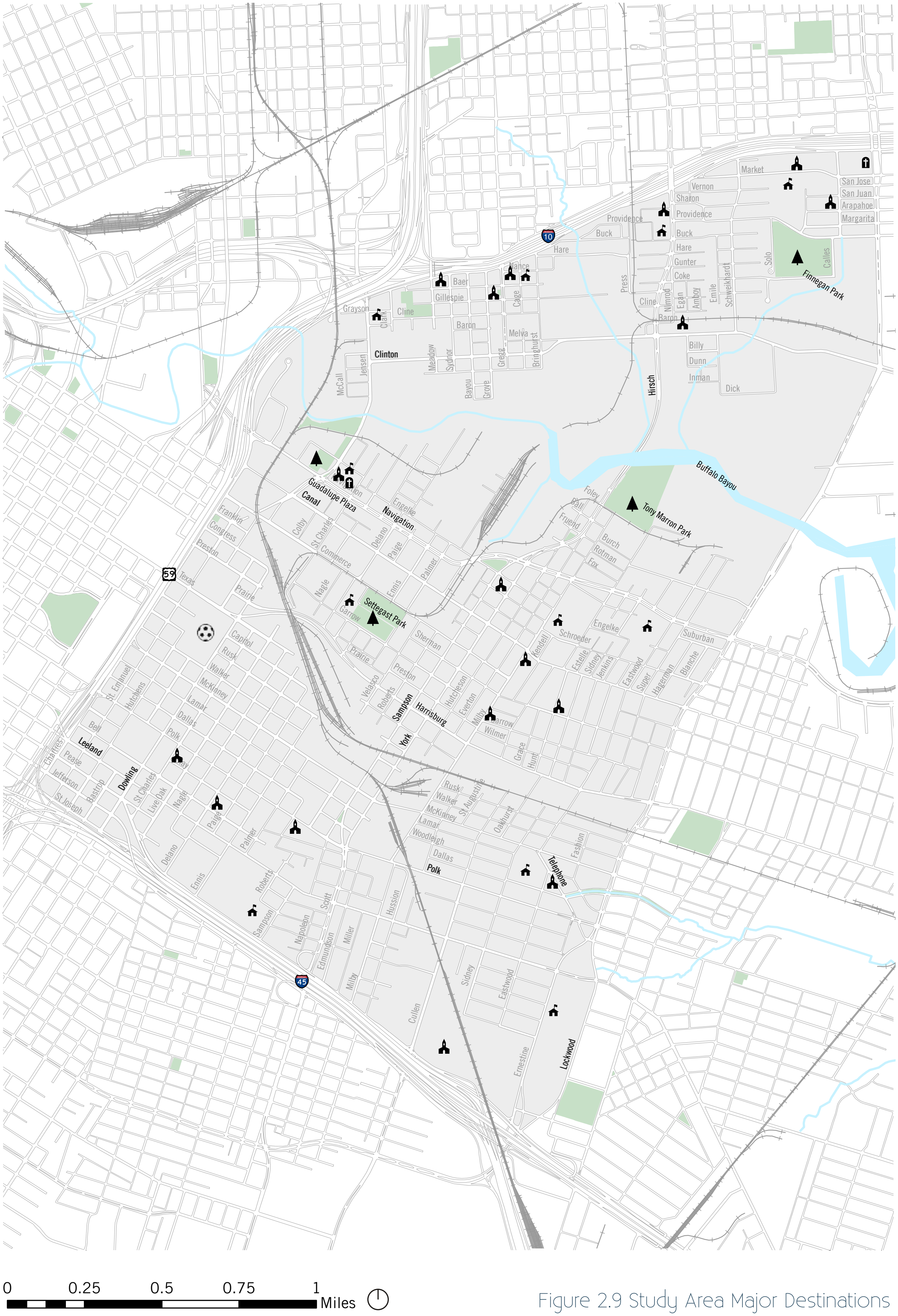


Figure 2.9 Study Area Major Destinations

Major Thoroughfares and Existing Volumes

The City of Houston maintains the Major Thoroughfare and Freeway Plan (MTFP) to document the existing and proposed street hierarchy, right of way (ROW), and travel lanes for major roads within the city. It is used as a tool for guiding street design, R.O.W. dedications, building set-backs, and other facets of development as outlined in the City of Houston Infrastructure Design Manual and Code of Ordinances. The current street hierarchy system is as follows:

- **Principal Thoroughfare**: More than five miles long; connects freeways and other principal thoroughfares; more than 30,000 vehicles a day; usually spaced one-half to one mile apart.
- **(Major) Thoroughfare**: More than three miles long; connects freeways and principal thoroughfares; more than 20,000 vehicles per day; usually spaced one-half to one mile apart.
- **Major Collector:** One to two miles long; connects thoroughfares and locals streets; more than 5,000 vehicles per day; less than one mile spacing.
- **Local**: Less than one mile long; carries little traffic; provides access to homes and local businesses; accommodates on-street parking and pedestrians.
- **Transit Corridor Street:** Roadways adjacent to the existing and planned METRO Light Rail that have alternative development standards (wider sidewalks, lower setbacks) to promote more transit-friendly development

Figure 2.10 shows the major thoroughfares within the East End Study area. It also shows traffic data that has been collected for major roadway segments classified on the MTFP within the study area. These data are 24-hour daily traffic information based on City of Houston counts from 2009 and some additional counts completed in October 2011. As shown, the thoroughfares within the study area carry significantly lower traffic volumes than what is typically considered the threshold for that designation (e.g., greater than 20,000 ADT for Thoroughfare; greater than 30,000 ADT for Principal Thoroughfare).

Transit Corridor Streets
- Harrisburg Boulevard
- Scott Street
- Texas Avenue

Principal Thoroughfare
- Navigation Boulevard
- Lockwood Drive

Major Thoroughfares
- Clinton Drive
- Dowling Street
- Jensen Drive
- Polk Street
- Sampson Street
- York Street

Major Collectors
- Canal Street
- Cullen Street
- Leeland Avenue
- McKinney Street

A roadway fact book profile was developed for major roadway segments within the study area to summarize key information about each corridor. This information can help support future recommendations for any of the corridors in the study area.

Factors include:

- Traffic control
- Adjacent land uses
- Classification on MTFP
- Existing R.O.W.
- Pavement width/Cross-section
- Posted speed limit
- Presence of transit
- Sidewalks
- Bicycle Facilities
- Corridor photos

The full set of Roadway Fact Base information can be found in Appendix A1.

Map Key

Freeway
Major Thoroughfare
Major Collector
Transit Corridor Street
Proposed
To Be Widened

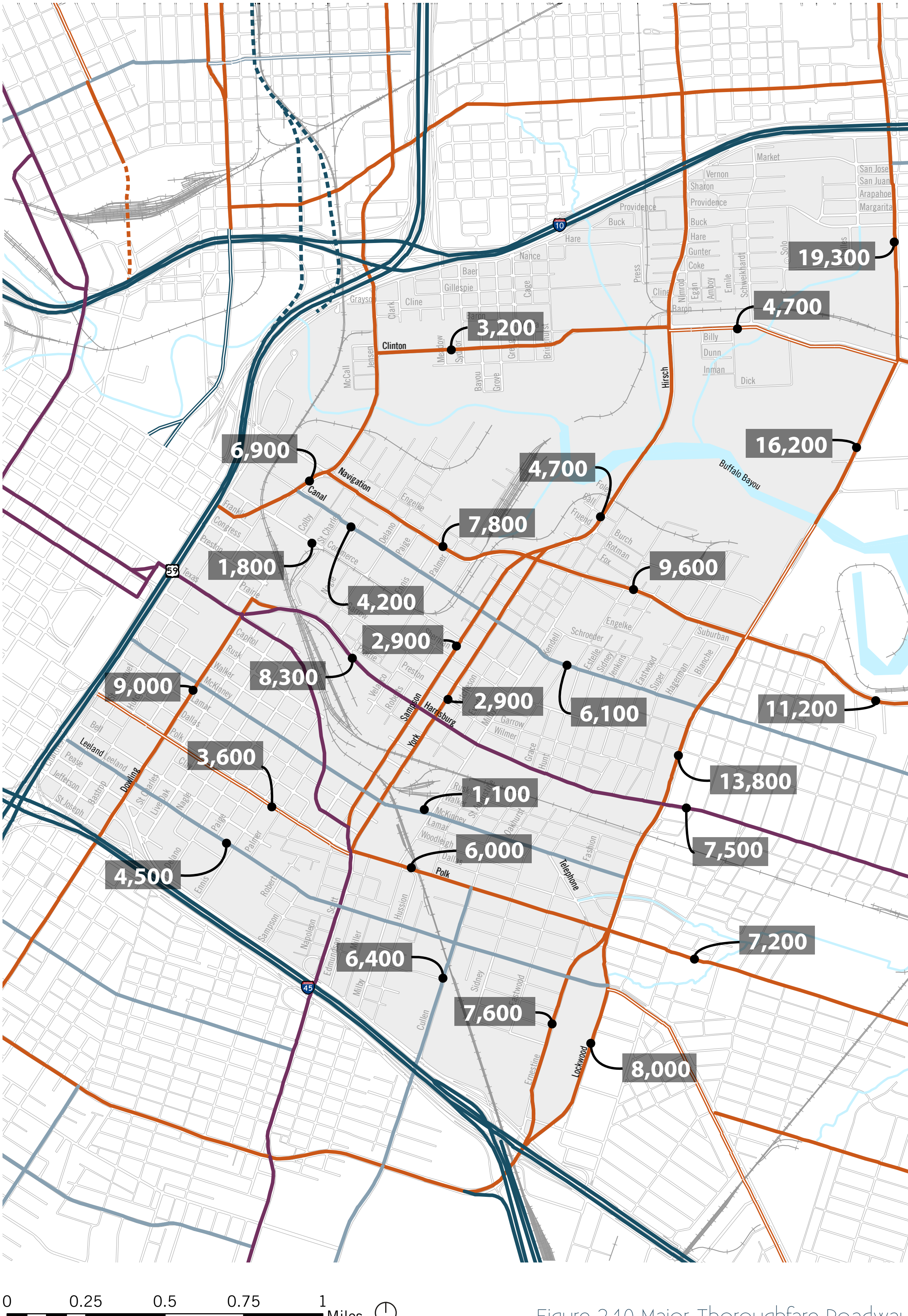


Figure 2.10 Major Thoroughfare Roadways and Traffic Counts

Alignment with Major Thoroughfare Plan

The City of Houston's Major Thoroughfare and Freeway Plan (MTFP) is a guide for growth maintained by the Planning Commission. The annually updated document is a planning tool used to address issues of congestion, mobility and plans for future development in the city. At the request of the City of Houston, the 2011 MTFP was compared to current roadway conditions in the East End; Figure 2.11 shows the comparison of the two. The roadways are color coordinated according to the street hierarchy system. The colors that are shown in lighter shades of green, red, blue and purple are streets in the East End where the current roadway cross section does not match the MTFP. With the exception of Canal St between Navigation Blvd and N. Milby St, all streets shown in lighter shades have fewer lanes than indicated on the MTFP.

The following is a list of locations where the MTFP does not match current field conditions:

- Navigation Boulevard is a four lane roadway through the study area; the MTFP lists Navigation Boulevard as a six-lane Principal Thoroughfare

- Canal Street between Navigation Boulevard and N. Milby Street is classified as a two-lane Major Collector; it is currently operating as a four-lane roadway.

- Polk Street is currently a two-lane road with striped bike lanes through the study area; it is listed on the MTFP as a four-lane Major Collector.

- Harrisburg Boulevard, currently under construction as a transit corridor, is designed to operate as a two-lane road after the installation of the light rail line; additional lanes will be available at intersections to address capacity constraints; the MTFP lists Harrisburg Boulevard as a four-lane roadway Major Thoroughfare.

- According to the MTFP, Lockwood Drive is classified as a six-lane Principal Thoroughfare. Links along Lockwood Drive and Ernestine Street on the figure that are shown in light red are two lanes in each direction though additional capacity is available at most major intersection for turning movements.

Map Key

Aligned with MTFP		Not aligned with MTFP
	Principal/Major Thoroughfare	
	Major Collector	
	Transit Corridor	

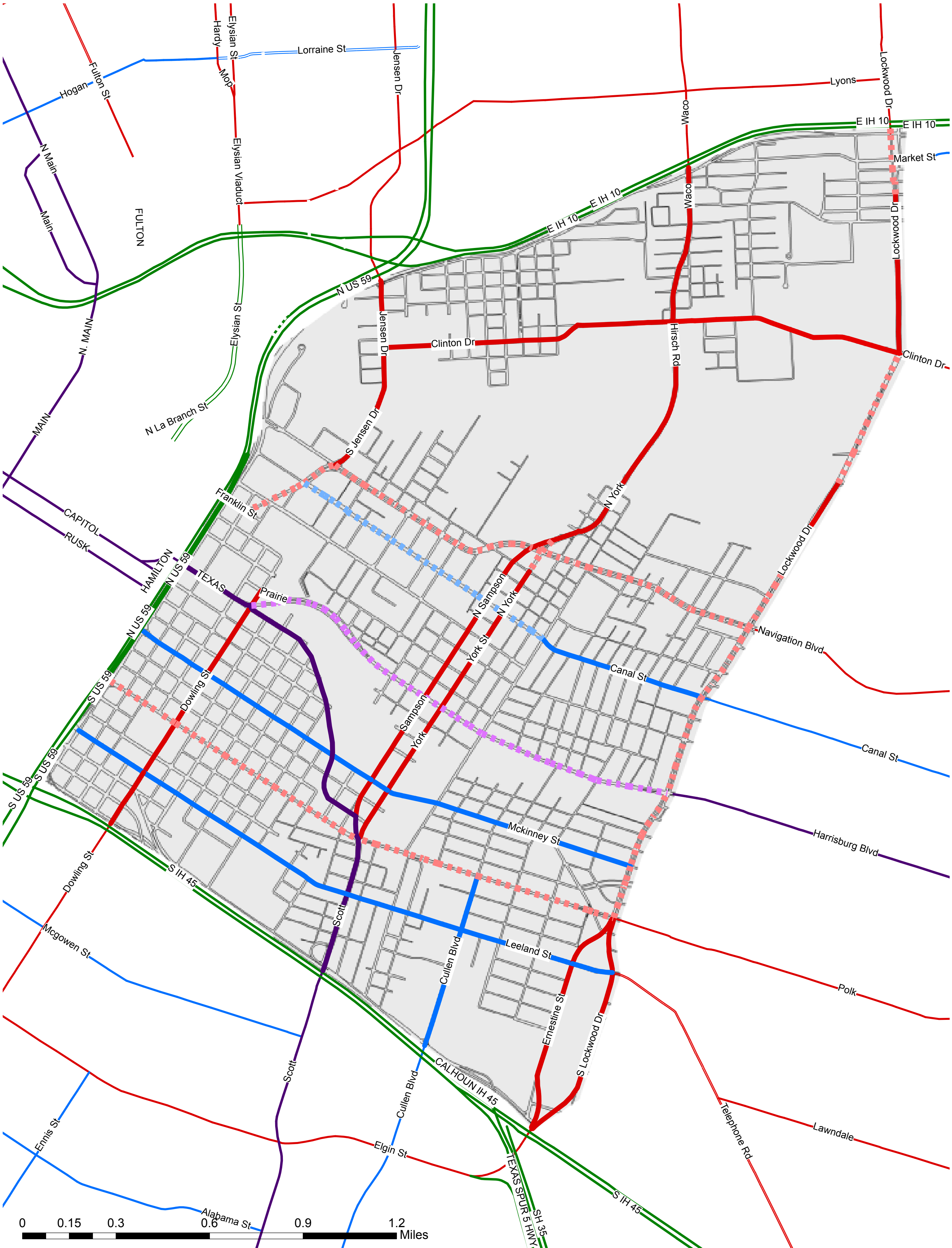


Figure 2.11 Major Thoroughfare Alignment with Existing Roadways

Freeway Access

The East End study area is bounded by three major Houston freeways including IH-10 on the north, IH-45 on the south, and US 59 on the west. The close proximity of the East End to the three freeways is a potential asset to the area and much of the vehicle traffic within the area is generated by trips to and from the freeway system. While access is fairly high for the study area, it can be difficult to determine the best route to reach a particular freeway from the study area. This is particularly true closer to Downtown as access to US 59 can be challenging, especially when travelling southbound. Figures 2.12 & 2.13 show the current freeway access points to and from the study area.

Connectivity between IH-10 and the study area is good, particularly to the Greater Fifth Ward. There are three IH-10 East entrance and exits and two IH-10 West entrance and exits that access the study area. The multiple access points to and from IH-10 allow for the northern section of the study area to have easy access to not only IH-10 but US 59 as well.

The connectivity between areas near IH-45 south of the study area and the East End, particularly the Eastwood and EaDo section of the study area, is also good. Access to IH-45 south is provided by four streets within or near the study area: Jefferson Street, Pierce Street, Scott Street and Ernestine/Lockwood Drive. Access from IH-45 north is also provided by four streets: Pease Street, St. Joseph Parkway, Scott Street, and Lockwood Drive. These multiple access points provide travel options between the study area and southeast Houston.

Access to and from along IH-45 north of the study area is more limited. Access to IH-45 North is provided by ramps at Scott Street and Cullen Street providing easy access for residents of Eastwood, but causing residents of EaDo to back-track. To access IH-45 North from EaDo would require using an entrance ramp at Scott Street or traveling west of along St. Joseph Parkway or other east-west roads. Access from IH-45 southbound is only provided by an exit ramp at Cullen Street.

Connections between the East End and US Highway 59 are restricted. Access to US 59 North is supplied by two entrance ramps, one from Chenevert Street in Downtown and a ramp about a mile north of the study area. The Chenevert ramp can be accessed from the East End by Congress Avenue or Commerce Street. The ramp north of the study area can be accessed from Meadow Street and the US 59 North frontage road, north of IH-10. Meadow Street, Congress Avenue and Commerce Street are not major connectors within the East End, resulting in no direct connections between US 59 northbound and the study area. Signage also makes finding the correct route difficult for motorists.

Access to US 59 South is also limited. There are two ramps near the study area that access US 59 South. One ramp is north of the study area at Schwartz Street and is accessible from the Fifth Ward neighborhood north of the study area. The second ramp, south of the study area, is at Hamilton and Webster. This ramp provides is the primary access point for EaDo and Eastwood. There is also an indirect connection to US 59 South from IH-10 east: drivers can enter IH-10 East from the San Jacinto ramp in Downtown and then use the US 59 South ramp from IH-10 East. Because of the limited number of ramps onto US 59 near the study area, the most direct access to the freeway from the north and southeast sections of the study area is via a connection from IH-10 or IH-45 to US 59.

The lack of direct ramps onto US 59 South creates the potential for cut-through traffic, particularly in EaDo. Motorists desiring to access US 59, SH 288, or IH-45 from the north parts of the study area must all travel through EaDo on St. Emanuel Street or Dowling Street to access those freeways on the south side of EaDo. Traffic related to sporting events at Minute Maid Park and BBVA Compass Stadium, conferences at the George R. Brown Convention Center, and music events at venues in EaDo must all also use this route or cut through downtown. An additional access point to US 59 South would enable that traffic to access all of the major freeways south of EaDo without creating the undesirable effects of cut-through traffic.

Access from US 59 to the study area is provided from two southbound ramps and three northbound ramps. The southbound ramps are located at Jackson Street within Downtown and at the McGowen and Tuam exit southwest of the study area. There is one northbound exit ramp southwest of the study area at Gray and Pierce and one exit ramp is adjacent to EaDo at Polk Street. The last possible access point from US 59 north to the area is the Lyons Avenue and Quitman Street exit north of IH-10. Drivers traveling to the northern section of the study area would frequently be better served connecting to IH-10 East and then exiting.

The limited access points to and from US 59 can result in connectivity issues between north and southwest Houston and the East End, especially EaDo. The stronger connection between the study area and IH-10 and IH-45 help improve connections between the East End and areas along US 59. Direct connections between the study area and the freeways can be limited, but the connections between the freeway's themselves is very good, allowing a driver to access any of the three freeways and being able to connect to any of the others with little difficulty.

Map Key

- Freeway
- IH-10
- US 59
- IH-45
- Hardy Tollroad

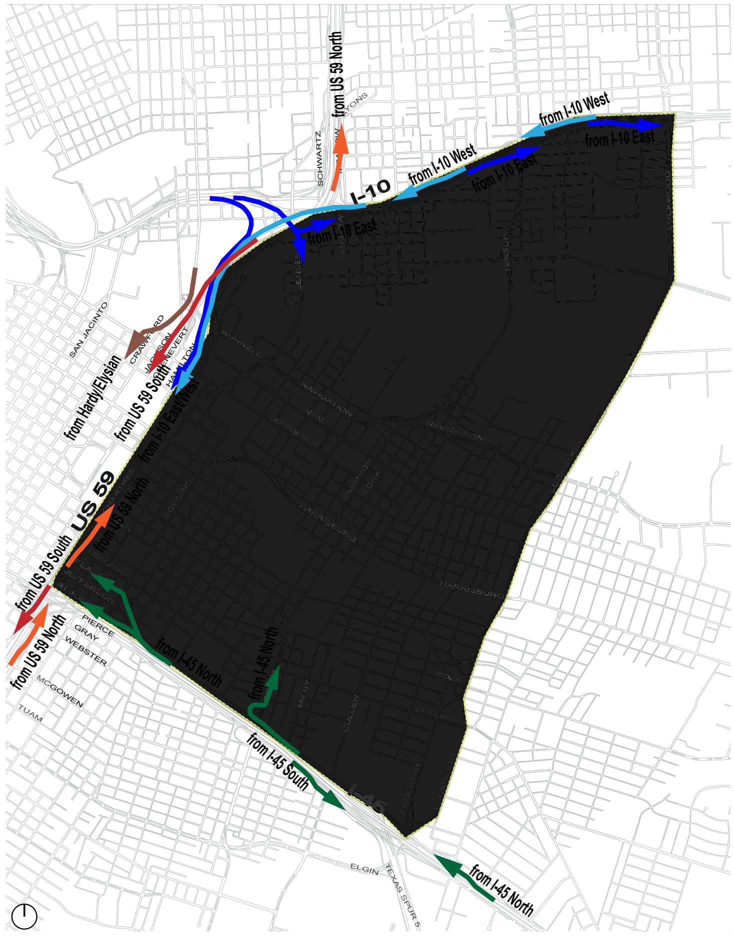


Figure 2.12 Study Area Access Points from the Adjacent Freeways

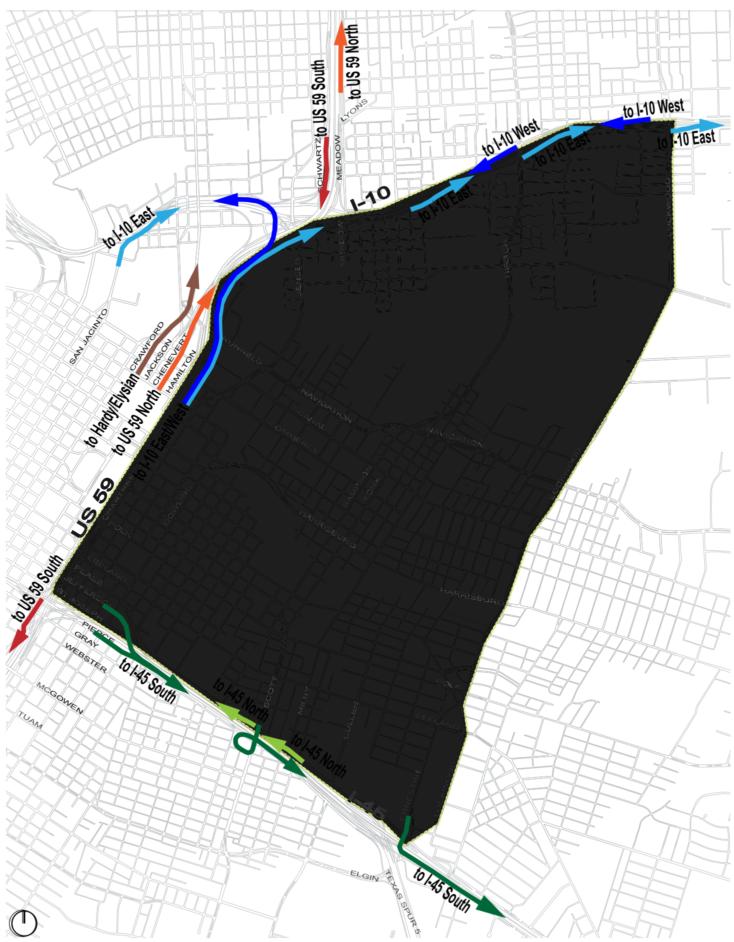


Figure 2.13 Freeway Access Points from the Study Area

Roadway Conditions

The City of Houston assesses roadway conditions for the approximately 16,000 lane miles of roadway on a regular basis (typically every three years). This assessment is used in the prioritization of roadway improvement projects such as roadway maintenance, repairs, and pavement overlays. To support the efficient analysis of the City's extensive roadway system the City uses a Street Surface Assessment Vehicle to automatically collect consistent data. This vehicle measures roadway distress and captures 360-degree video to allow the development of a holistic roadway assessment that is GPS-based.

Figure 2.14 shows the roadway conditions for the East End Study area as of the beginning of 2011. Roadway links labeled Red (bottom 10%) and Orange (next lowest 20% or roadways) represent locations of greatest disrepair and will thus receive higher prioritization. This approach carries increased importance with the passing of the Proposition 1 or Rebuild Houston ordinance that implemented drainage and development fees to support the rebuilding of the drainage and street infrastructure for the City. Roadway condition is one of the major considerations for choosing which roadways will be repaired first.

In the East End there is a broad distribution of roadway quality ratings. With a few exceptions, the roads classified as major thoroughfares (e.g., Polk, Leeland, Navigation, Canal) have roadway quality ratings that are in the upper 30% of roadways in Houston. One thoroughfare that was assessed as having a poor pavement quality was Sampson Street; this street, along with York Street, has since been improved to good quality with a roadway overlay project. Other locations that showed low pavement quality include McKinney Street, locations where rail crossing exist, and many local streets within or just outside the study area.

Street Surface Assessment Vehicle

Map Key

Pavement Condition Rating (PCR)

10%	High (78.6-100)
20%	Medium-High (72.0-78.6)
40%	Medium (64.9-72.0)
20%	Medium-Low (59.0-64.9)
10%	Low (35.0-59.0)

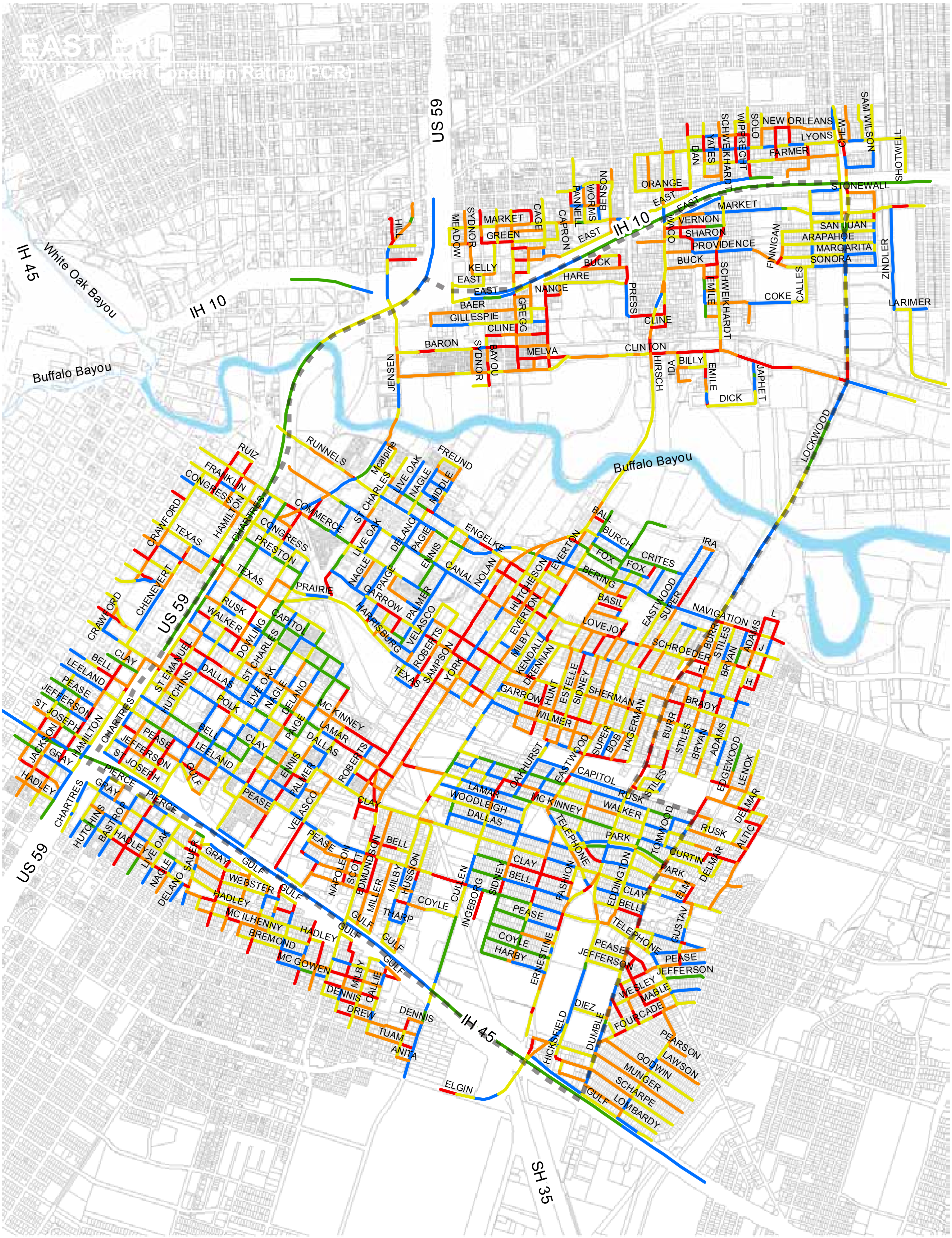


Figure 2.14 Roadway Pavement Conditions

Source: 2011 PCR (Pavement Condition Rating) Assessment
Public Works and Engineering Department, City of Houston

Study Area Connectivity

One of the particular strengths of the study area is the relatively high level of connectivity of the roadway network within the various neighborhoods. A connected neighborhood, often characterized by a grid network of streets, provides multiple routes to numerous destinations. Three metrics for connectivity were used in this analysis. These should be looked at concurrently to get a broader picture of movement in the neighborhood and are shown in Table 2.5.

Intersection Density

Intersection density is measured as the number of intersections per unit of area. Table 2.5 displays intersection density as the number of intersections per square mile in each Super Neighborhood of the study area. A higher ratio indicates higher density and is correlated with higher connectivity. It also indicates that block lengths are short, which supports a pedestrian-friendly environment. Intersections were defined as the junction of two roads at a point with three or more approaches.

Link-Node Ratio

Link-node ratio is an index of connectivity defined as the number of links divided by the number of nodes within an area. Links are defined as roadway segments between two nodes. Nodes are defined as intersections, dead ends, and cul-de-sacs. A higher ratio of links to nodes indicates that the area is more connected and that fewer single link nodes (e.g., cul-de-sacs or dead-ends) exist. Link-node ratios for all Superneighborhoods in the study area are shown in Figure 2.15.

Lane Mile Density

Lane mile density is measured as the number of linear miles of traffic lanes per square mile of land. A higher number indicates more streets and, presumably, higher connectivity.

The connectivity metrics for the neighborhoods and overall study area are shown in Figure 2.15. Each of the neighborhoods within the study area maintains a relatively high level of connectivity, with East Downtown having the highest levels due to limited interruptions to the grid network in the area and the smallest block sizes in the study area. The portions of SN 63 and SN 64 in the study area also have high levels of connectivity (defined as greater that 160 intersections per square mile and greater than 1.6 link-node ratio).

A potential point of comparison to determine whether an area has a high degree of connectivity as measured by intersection density is the criteria for LEED Neighborhood Development (LEED-ND). LEED ND integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design. Pre-requisites for a neighborhood to be considered for LEED ND certification is that it be located in an area with a minimum of 90 intersection per square mile and that it be designed with a minimum of 140 intersections per square mile. To be eligible for additional points, a neighborhood needs to have at least 200 intersections per square mile (similar to EaDo or Downtown Houston).

The Fifth Ward area (north of Buffalo Bayou) exhibits lower connectivity primarily due to the large industrial parcels that take up much of the land near the bayou. As this region redevelops, opportunities should be sought for increasing connectivity with these benchmarks in mind through repairing the roadway network grid.

High Connectivity - Grid
Link-Node Ratio - 2.2

Low Connectivity - Cul-de-Sac
Link-Node Ratio - 1.1

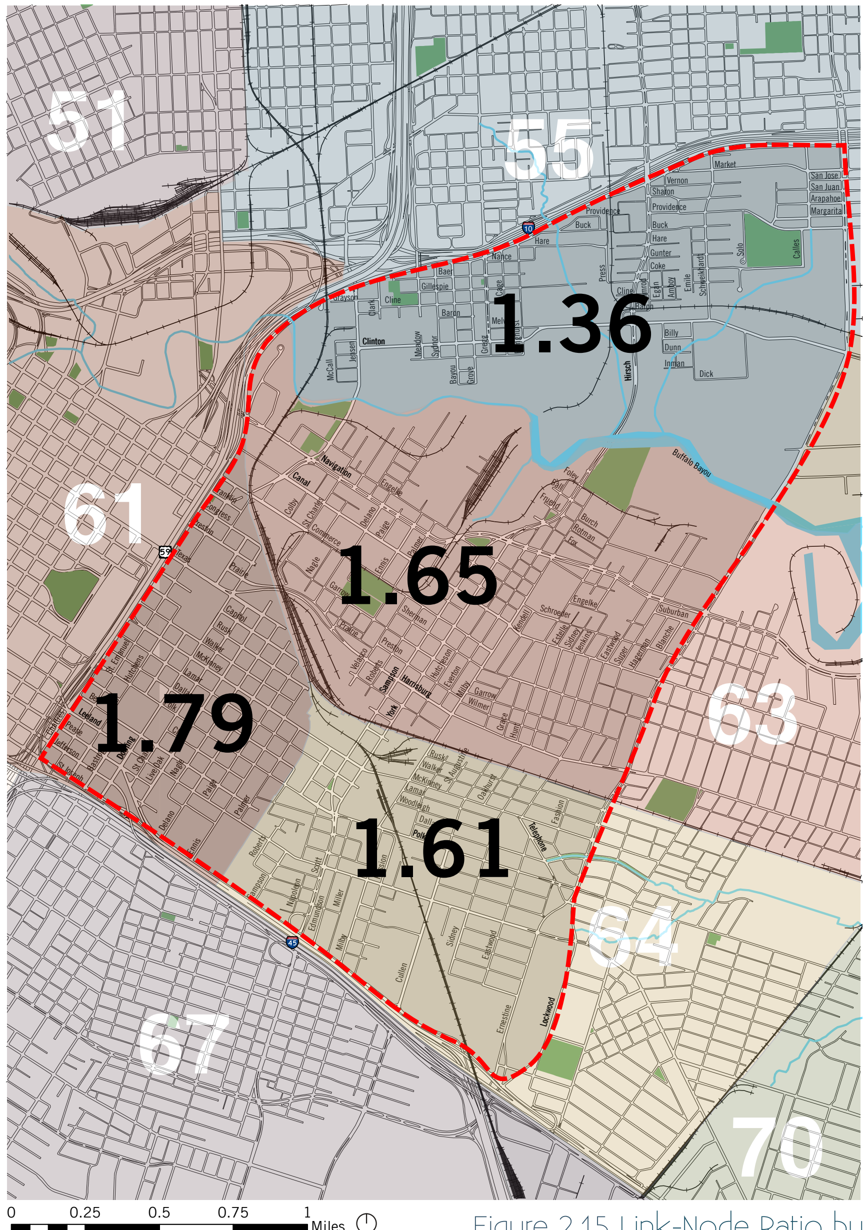


Figure 2.15 Link-Node Ratio by Super Neighborhood

Table 2.5 East End Connectivity Metrics

Region	Intersections	Nodes	Links	Lane Miles	Area (Sq. Mi.)	Intersection Density	Link-Node Ratio	Lane Mile Density
SN 55 - Greater Fifth Ward	146	172	234	69	1.34	109.3	1.36	51.6
SN 61 - Downtown/ EaDo	156	163	292	71	0.71	218.9	1.79	99.6
SN 63 - Second Ward	265	291	481	94	1.64	161.2	1.65	57.2
SN 64 - Greater Eastwood	161	174	280	72	1.00	161.0	1.61	72.0
Total Study Area	728	800	1287	306	4.69	155.2	1.61	65.2

Major Barriers & Traffic Controls

While the connectivity within individual neighborhoods in the study area is relatively high, there are significant barriers that make movement between different neighborhoods and to locations outside the study area difficult. These barriers include both natural and constructed barriers that limit the number of connections for a motorist or pedestrian to make a trip outside their neighborhood.

Major barriers were defined as obstructions to mobility that disrupted the roadway network (Figure 2.16). In a region where there is a well-developed grid like the East End, these barriers transform what could be a fairly direct route to a destination into a circuitous route that increases distance traveled and limits natural wayfinding ability.

Some barriers only impact some modes of travel and not others. These can be physical or psychological barriers. For example, many bridges and grade separations that serve vehicles well have not been designed with adequate pedestrian and bicycle facilities and are thus avoided by people moving by those modes.

Major barriers to connectivity include:

Buffalo Bayou: the bayou completely bisects the study area south of the Fifth Ward neighborhood. Three bridges are provided along the major thoroughfares of Jensen, N. York, and Lockwood, which are spaced one-half to three-quarters of a mile apart in the study area. This spacing of bridges across the bayou -- and the limited availability of sidewalks along the bridges --increases the difficulty of pedestrian crossing.

Freeways: the north (IH-10), west (US 59) and south (IH-45) perimeters of the study area are defined by major freeways with one-way frontage roads. Grade-separated crossings are located at most major thoroughfares but at few other cross streets.

Railroads: railroads have been a key economic driver for the East End; however the West Belt and Galveston Subdivisions bisect the study area and limit the number and location of crossings.

Development: major developments within and adjacent to the study area serve as key economic generators for the region but also can be barriers to mobility where they break up the existing roadway network. These developments include major sports stadiums and the George R. Brown Convention Center along the US 59 corridor which together limit the connections between the study area and the Downtown central business district. The few connections that do exist are largely one-way streets that further limit connectivity to a single direction. Historically, major industrial development in the East End broke up the street network; in places, the development is now gone, but the roadway connections are still missing.

Figure 2.16 also shows the existing traffic control devices installed in the study area. Traffic signals exist at all crossings of roads identified as Thoroughfares and Major Collectors on the Major Thoroughfare Plan (MTFP) within the study area. They are also installed at the intersections of several minor roads with major thoroughfares and even some with other minor roads, particularly in EaDo near Downtown. Most roadways have synchronized traffic signal timing to allow for improved traffic flow along major corridors.

All-way stops (AWSC) are uncommon in the study area. This is likely based on intersection warranting installation based on traffic volumes that may not be currently present. One AWSC intersection was identified on a Major Collector, at the intersection of Leeland Street with St. Emanuel Street. No AWSC intersections were located on principal or major thoroughfares.

Map Key

- Barrier Crossing
- One Way Barrier Crossing
- Trail Crossing
- Major Barrier
- Traffic Signal
- All Way Stop

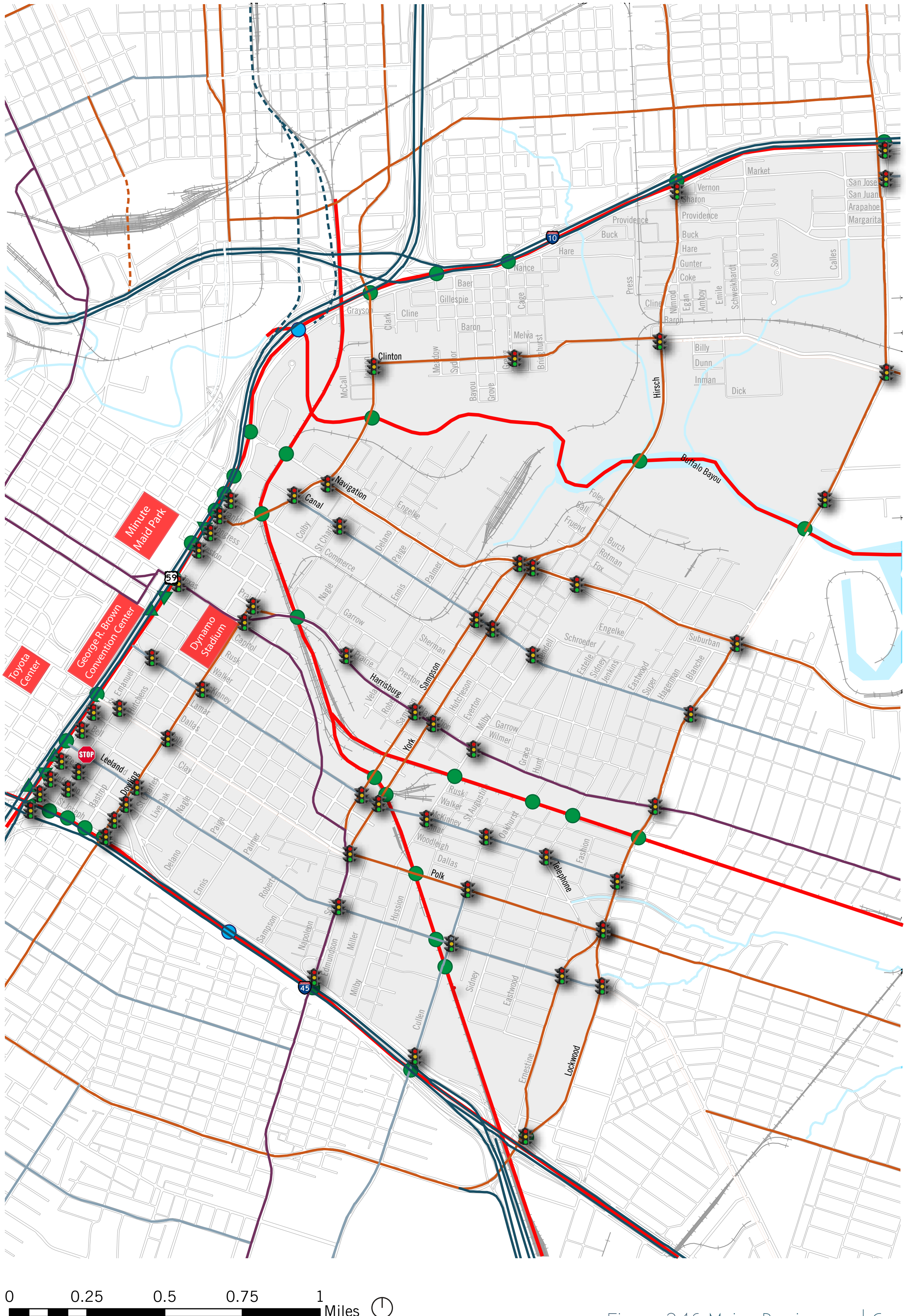


Figure 2.16 Major Barriers and Crossings

Roadway Safety - Incident Maps

Historical crash data were analyzed within the study area to identify safety "hotspots" where particular safety issues may exist. The crash hotspot areas are shown in Figure 2.17 and 2.18 on the adjacent page.

Areas with higher concentrations of vehicle crashes may be perceived as unsafe for motorists and can create an environment that is hostile for pedestrians and cyclists. Between 2006 and 2010, automobile crashes were concentrated mainly along the western boundary of the study area. The hotspots are located near high volume intersections that are primarily entrance and exit corridors into and out of Downtown. The hotspot in the southwest corner of the study area also encompasses the IH-45 and US 59 Downtown freeway ramps.

Pedestrian and bicycle crashes are a small portion of the total crashes. Concentrations of such crashes are found on Dowling Street south of Leeland, Runnels Street at Chartres Street, and on Canal Street near North Drennan Street. Canal Street near North Drennan Street and Runnels Street at Chartres Street likely have higher pedestrian volumes because of the high number of bus riders getting on and off bus routes at these locations.

As shown in Table 2.6, pedestrian and bicycle crashes only make up 2.2% of the total crashes in the study area between 2006 and 2010, they make up 3% of crashes involving an injury, 7% of crashes resulting in an incapacitating injury, and 33.3% of crashes involving a death. These rates support the idea that pedestrians and bicycles are more vulnerable to injury when involved in a crash incident.

Table 2.6 East End Crash Data and Severity ('03-'09)

Crash Data for East End Study Area 2003-2009 CRIS Database		
Total Number of Crashes	2389	100%
Pedestrian Crashes	31	1.3%
Bicycle Crashes	22	0.9%
Ped and Bike Total	53	2.2%

Injury Rate by Mode				
Injury Type	All Crashes	Ped/Bike Crashes	Ped/Bike Share of Injury*	Ped/Bike Injury Index**
Any Injury	1695	51	3.0%	1.4
Incapaci-tation	57	4	7.0%	3.2
Death	6	2	33.3%	15.0

* Ped/Bike Injuries / All Injuries
** Ped Bike Share of Injury / Ped/Bike Share of Crashes (2.2%)

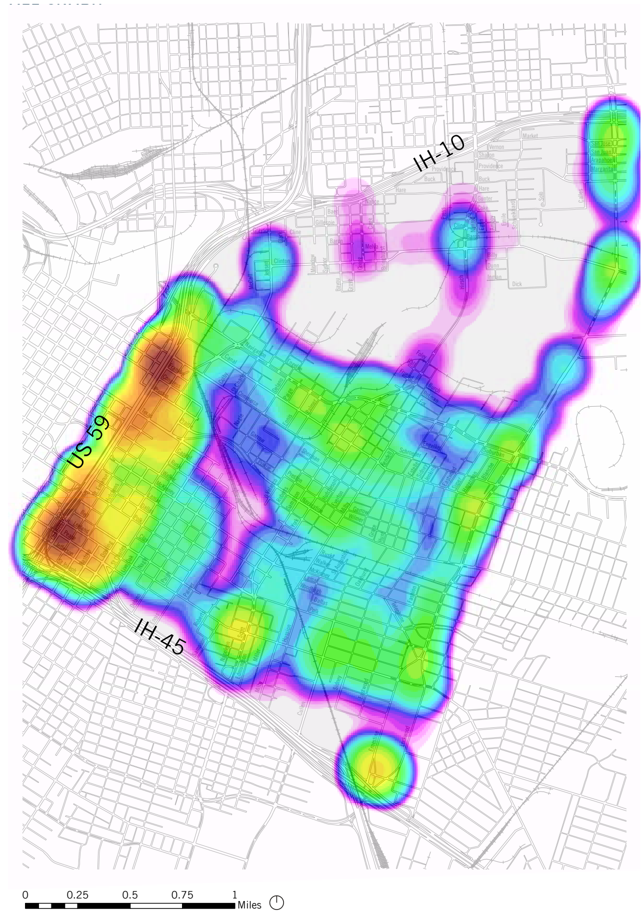


Figure 2.17 Crash Density - All Crashes

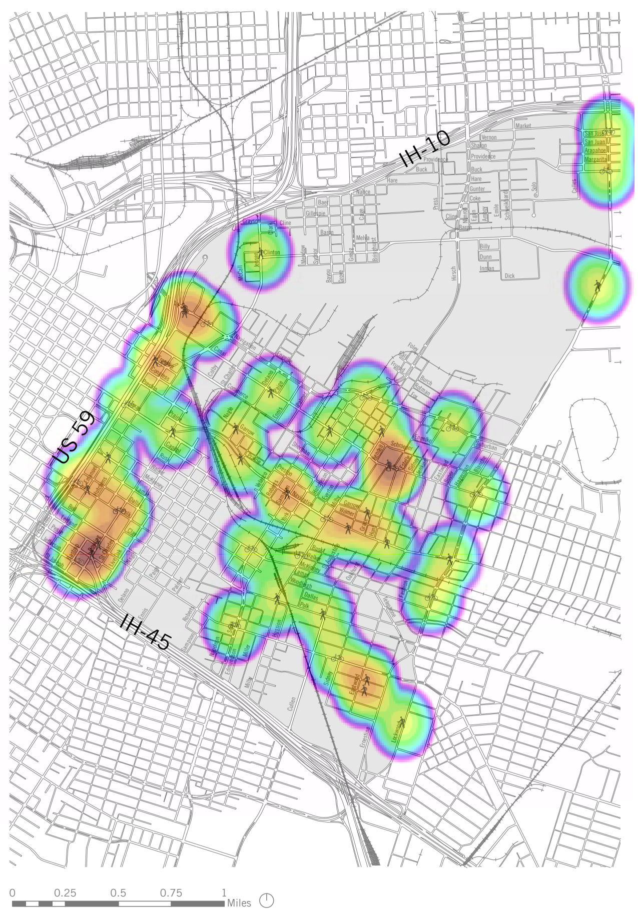


Figure 2.18 Crash Density - Bicycle and Pedestrian

Map Key

More Crashes — Less Crashes

Pedestrian Crash

Bicycle Crash

Parking

The availability of on-street and off-street parking was analyzed as part of the study. The issues involved with parking are far more extensive than the simple goal of finding space to store automobiles. The amount and physical attributes of whatever parking mix is selected has significant impacts on the amount and type of development that is likely to occur, as well as on the feasibility of various travel modes.

Local businesses and employment centers that experience high levels of automobile access require sufficient parking to meet the demand. Additionally, the new, dense multifamily developments that are being built and are planned to be built in the study area will require adequate parking.

However, an area can suffer when excess parking takes the place of land that could otherwise be developed to accommodate additional residents or income-generating businesses. Large collections of surface parking lots can also create hostile areas for pedestrians who typically prefer to walk adjacent to more active or natural land uses such as residential or retail development or public spaces such as parks or plazas. Providing a balanced mix of parking options that accommodate the needs of residences and businesses without discouraging pedestrian activity will be critical to the success of future East End growth.

Currently parking is available in several forms throughout the study area:

- On-Street Parking: parallel parking is allowed on most streets within the study area. Restrictions to on-street parking exist on many of the major thoroughfares for peak hours to maximize capacity during the highest demand travel periods. On-street parking is typically available for free with no meters present to support demand management. Restrictions also exist on roads with existing bicycle lanes such as Polk. There is significant variability in the presence of signage leading to potential confusion for motorists.

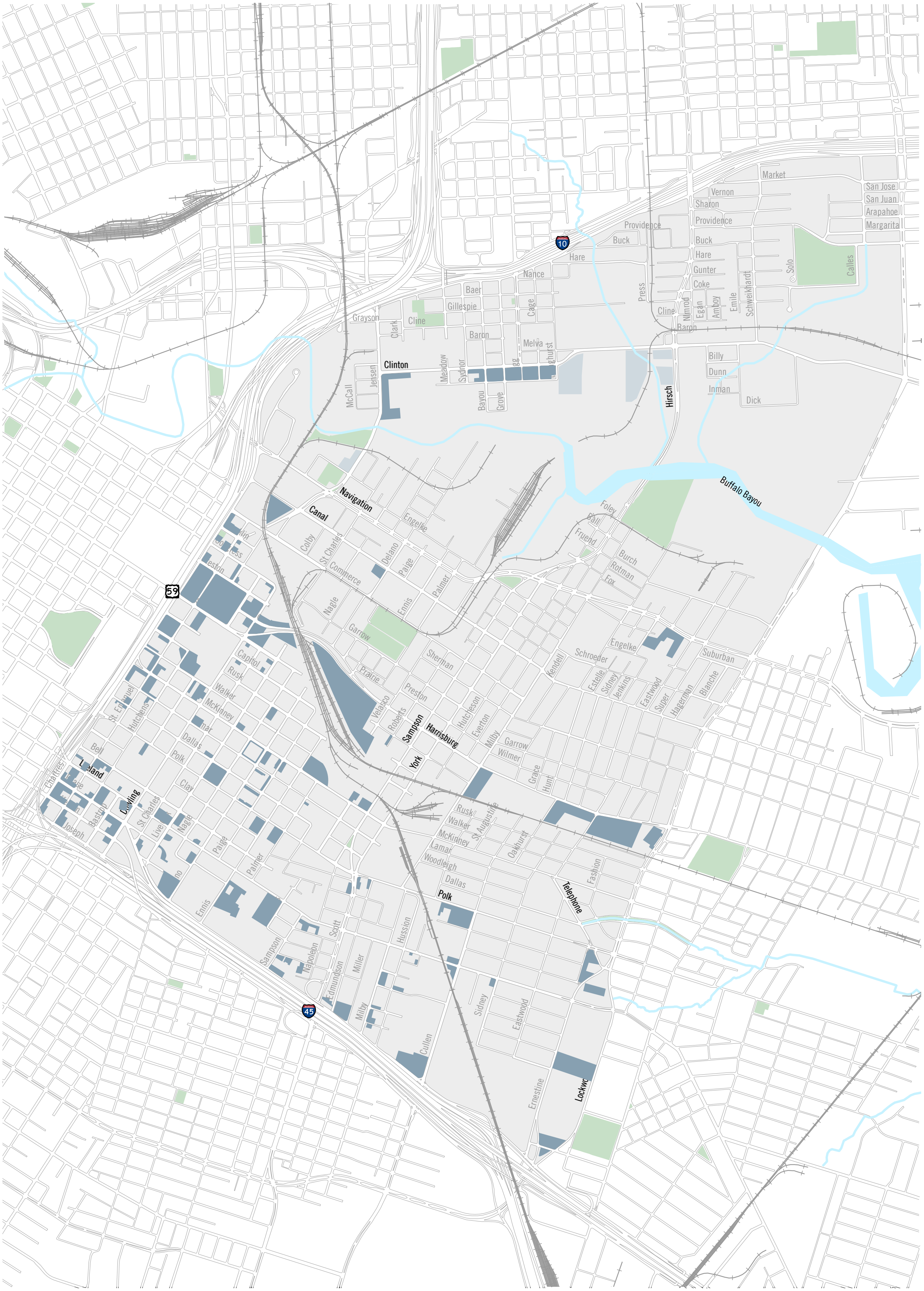
- Off-Street Parking - Surface: Surface parking is largely concentrated on the western portion of the study area with the largest lots serving destinations such as Minute Maid Park and the George R. Brown Convention Center. Other lots are concentrated along Harrisburg Boulevard and the IH-45 Frontage Road. If parking demand increases, there is potential for empty lots to convert to additional parking lots.

- Off-Street Parking - Structured: There are limited structured parking facilities in the study area. This is likely due to the lack of development density and to the presence of available alternatives that would make structured parking economical. The parking garages that do exist are attached to multi-unit apartment buildings near the Minute Maid Park.

Figure 2.19 shows the location and concentration of the major off-street parking facilities in the study area. Most of these are attached to existing developments or exist from previous developments as there is limited demand for active shared parking for existing development.

Surface Parking Lot (Minute Maid Park)

Garage Parking Structure (Canal Place)



0 0.25 0.5 0.75 1 Miles

Figure 2.19 Major Off Street Parking Locations

Off-Street Parking Area

Transit - Bus Service

Although transit ridership in the East End has historically been high, in recent years ridership has shown a decline due to the stagnation of population growth and the evolution of the local job mix. Street car service and interurban rail service in the region were discontinued many years ago and were replaced with the bus service that still operates today. The East End study area is well covered today with a grid of bus routes. Radial (east/west bus service) is provided in the Clinton, Navigation, Canal, Harrisburg, and Polk corridors. Crosstown (north/south) service operates in the Sampson/York/Hirsch and Lockwood corridors. METRO has only one transit center in the study area—the Eastwood Transit Center, which is located at the far southeastern edge of the study area. In the next few years, bus service will be augmented with light rail service, with the first of three lines in the study area opening in 2014.

The study area is currently served by a total of ten METRO bus routes. These routes, along with information on daily ridership, weekday service frequency, and travel times to direct destinations are shown in Figure 2.20. Based on this information, the routes were categorized as major or minor routes. In general, the service provided on major routes is likely to continue with a high level of service or be upgraded to light rail in the planning horizon. Minor routes could be subject to service changes, reductions, or even eliminations to improve METRO's overall efficiency. The majority of METRO bus routes are equipped with bicycle racks. Cyclists using the bus load the bicycle on the rack and then ride the bus like any other passenger.

Based on 2011 boarding and alighting information, the nodes displayed in Figure 2.23 have 50 or more boardings and alightings per day at or near the intersection. This passenger activity is the sum of boardings and alightings at all bus stops for all routes that pass through the intersection. These nodes show areas of high pedestrian activity related to transit and may show where pedestrian amenities such as sidewalks, crosswalks, shelters, and benches may be in highest demand. The nodes in red do not currently have a METRO bus shelter, while those in blue do. Some of the locations with a shelter do not correspond to the higher passenger activity levels. These stops may have had higher activity levels in the past, but METRO does not often remove shelters that have already been installed unless service is completely eliminated in the area. Shelters may also be installed at times due to special requests for reasons such as a high number of elderly patrons.

Major Lines
- 20 - Canal
- 29 - Hirsch
- 36 - Lawndale
- 40 - Telephone
- 42 - Holman
- 50 - Harrisburg

Minor Lines
- 11 - Nance
- 30 - Clinton
- 37 - El Sol
- 48 - Navigation

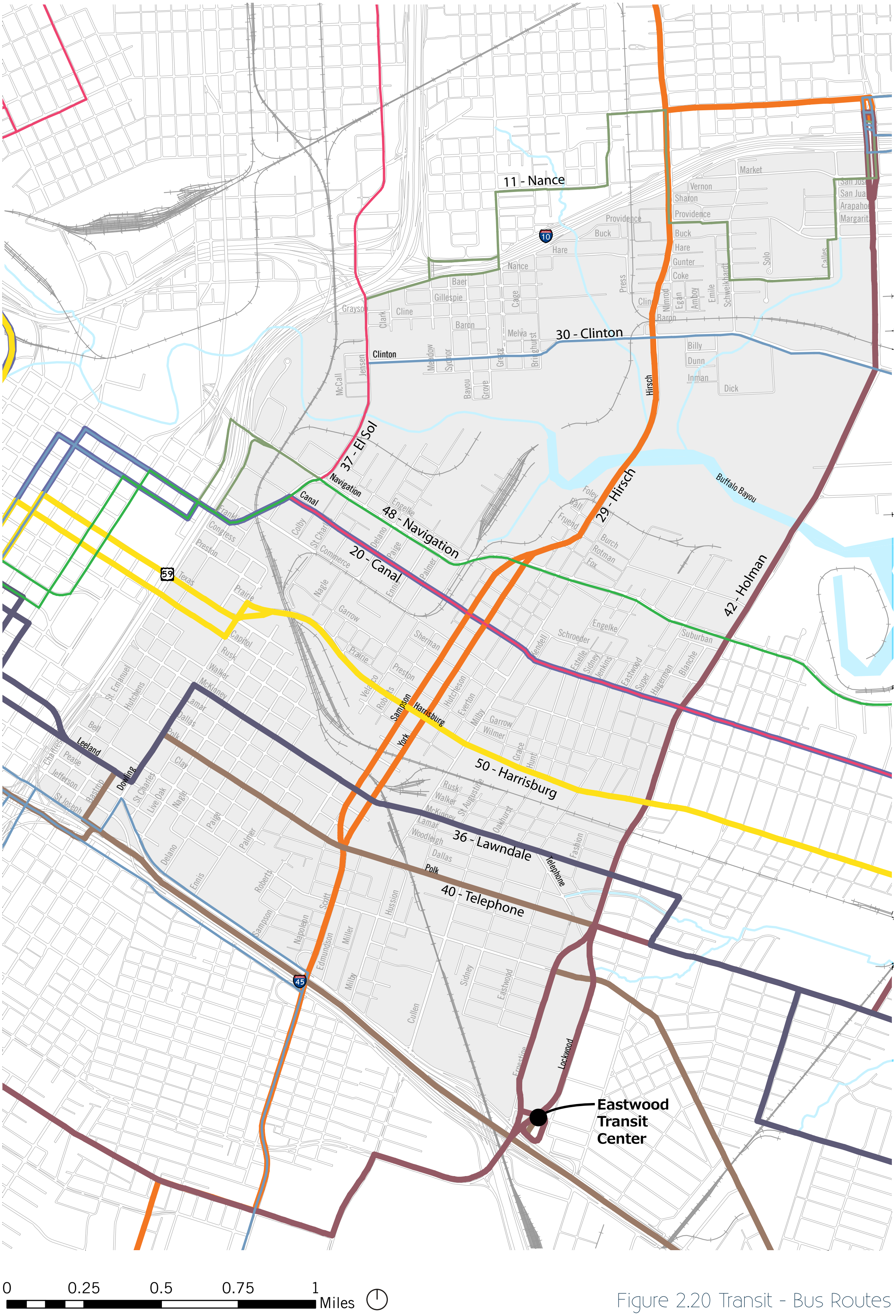


Figure 2.20 Transit - Bus Routes

Major Lines
- 20 - Canal
- 29 - Hirsch
- 36 - Lawndale
- 40 - Telephone
- 42 - Holman
- 50 - Harrisburg

Minor Lines
- 11 - Nance
- 30 - Clinton
- 37 - El Sol
- 48 - Navigation

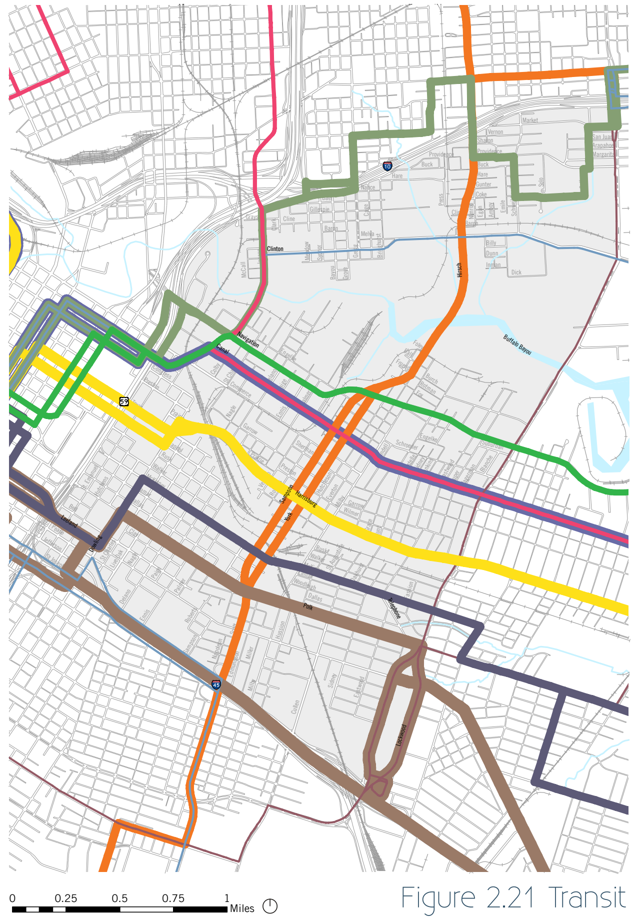


Figure 2.21 Transit Frequency

Table 2.7 Estimated Transit Ridership and Frequency

East End METRO Routes	Avg. Daily Ridership (Oct '10-Aug '11)	Peak Weekday Headways'
50 Harrisburg	3636	20
40 Telephone	3134	15
20 Canal	1728	15
42 Holman Xtown	1651	40
36 Lawndale	1526	25
29 Hirsch / UH / TSU Xtown	1436	23
11 Nance	855	25
48 Navigation	716	30
37 El Sol Xtown	604	35
30 Clinton	562	40

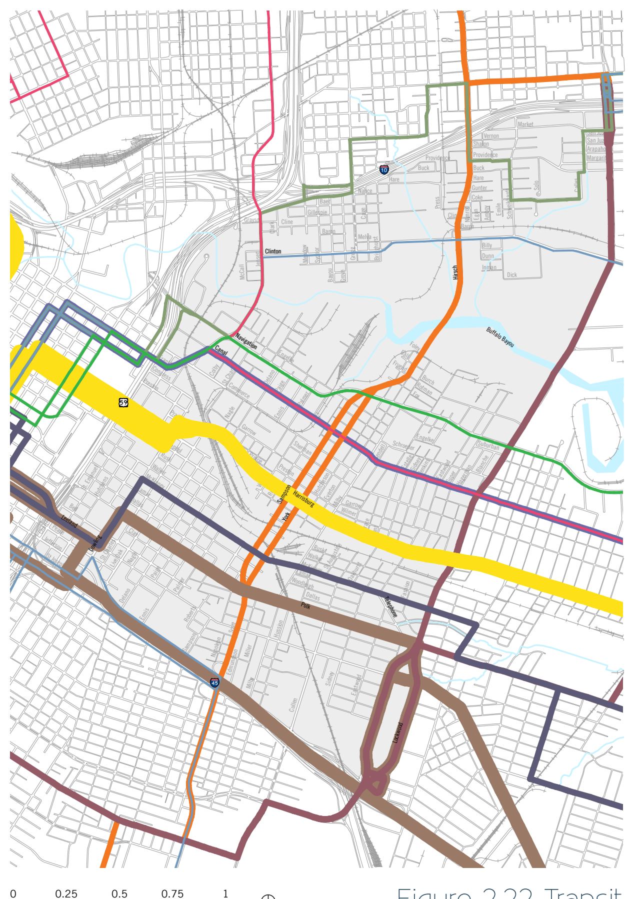


Figure 2.22 Transit Ridership

Table 2.8 Estimated Transit Travel Times to Major Destinations

Direct Service Destinations	Approx. Travel Time	Routes
Downtown	10 Minutes	20, 40, 50, 11, 36
Magnolia TC	15 Minutes	20, 37
Northwest TC	30-60 Minutes	20
Montrose	40 Minutes	42
University of Houston	15 Minutes	42, 29
Kashmere TC	30 Minutes	29
Southeast TC	20 Minutes	29
The Heights	30-35 Minutes	40, 50
Hobby Airport	40 Minutes	50
Near Northside	10 Minutes	37
Washington Avenue	15-25 Minutes	40, 50, 36, 37
Medical Center	30 Minutes	11

Source: METRO Ridership and planning data

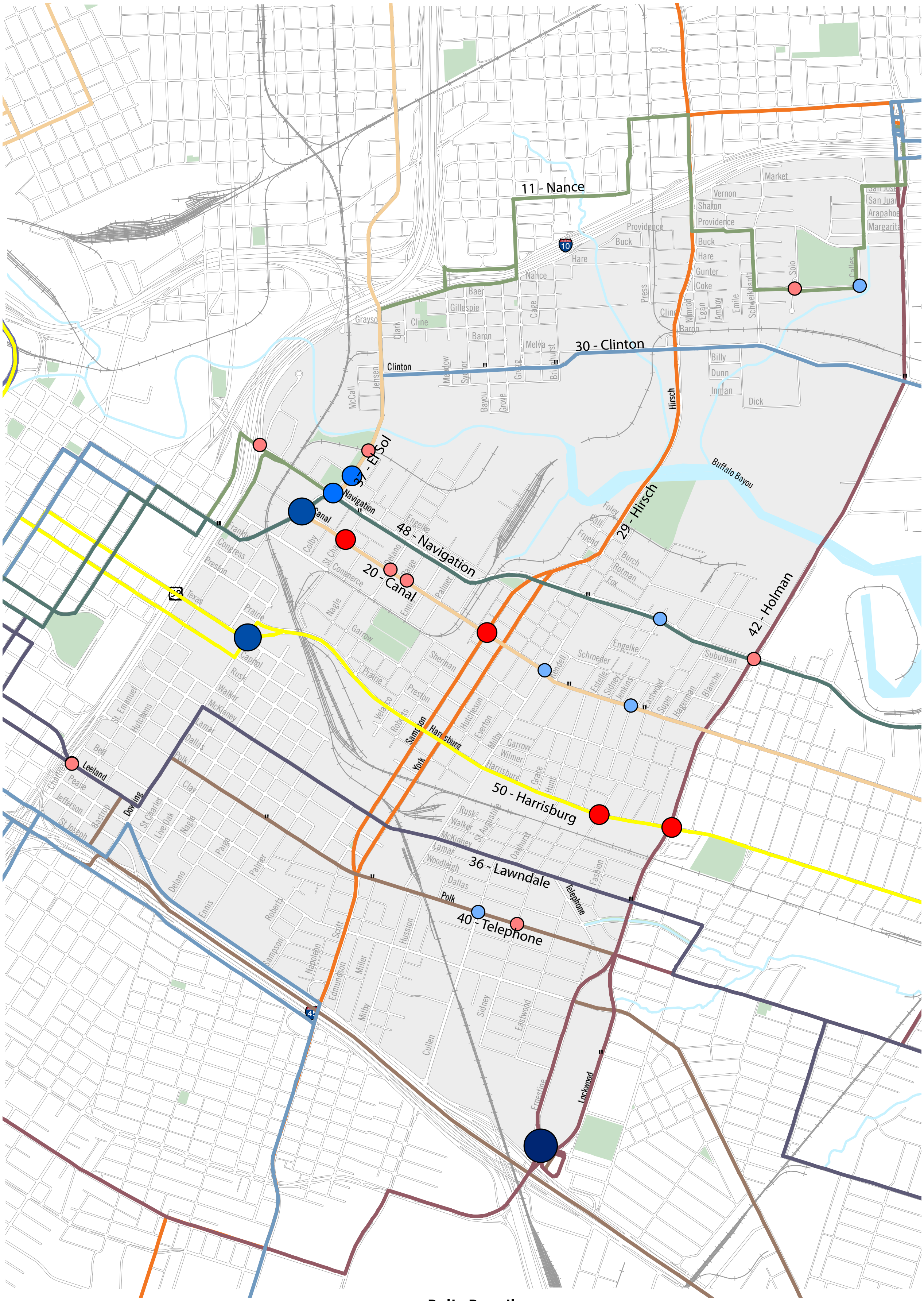


Figure 2.23 Transit Activity Hubs

Transit - Light Rail

Indicative of the potential for transit demand in the area, METRO's long-range transit plan, METRO Solutions, includes plans for three light rail lines that enter the study area. These lines are shown in Figure 2.24. Two of these lines, East End and Southeast, are under construction and are anticipated to open in 2014. The third, the University Line, is still in the planning and design stages.

The East End Line runs east from Downtown between the George R. Brown Convention Center and Minute Maid Park, then enters the study area near the new BBVA Compass Stadium, following Harrisburg Avenue through the study area and terminates at the Magnolia Transit Center. Study area stations and their projected daily boardings (provided by METRO from its long-range travel demand model) include:

- EaDo/Stadium Station – 300 in the opening year and 750 in 2030
- Coffee Plant/Second Ward Station – 600 in the opening year and 1,400 in 2030
- Lockwood/Eastwood Station– 600 opening year and 850 in 2030

The Southeast Line shares its alignment with the East End line from Downtown to the EaDo/Stadium Station. At that station, the line turns south until it reaches Scott Street and the Leeland Station. The line exits the study area along Scott Street as Scott travels under the Gulf Freeway. Study area stations and their projected daily boardings (provided by METRO from its long-range travel demand model) include:

- EaDo/Stadium Station – 400 in the opening year and 1,200 in 2030
- Leeland/Third Ward Station - 500 opening year and 800 in 2030

The University Line terminates at the East End study area at the Eastwood Transit Center. METRO projects opening year boardings of 650 and 2030 boardings of 1,100. Note that for all lines and stations, METRO projects the same number of daily alightings as the listed boardings, doubling the passenger activity expected at each location.

The lines will also serve multi-modal trips including bicycles as METRO allows up to two bicycles per car on its existing light rail line (the Red Line) during off-peak hours. METRO will likely implement the same policy on its new light rail lines.

Map Key

Red Line
North Line
East End Line
Southeast Line
University Line
Existing Station
Proposed Station

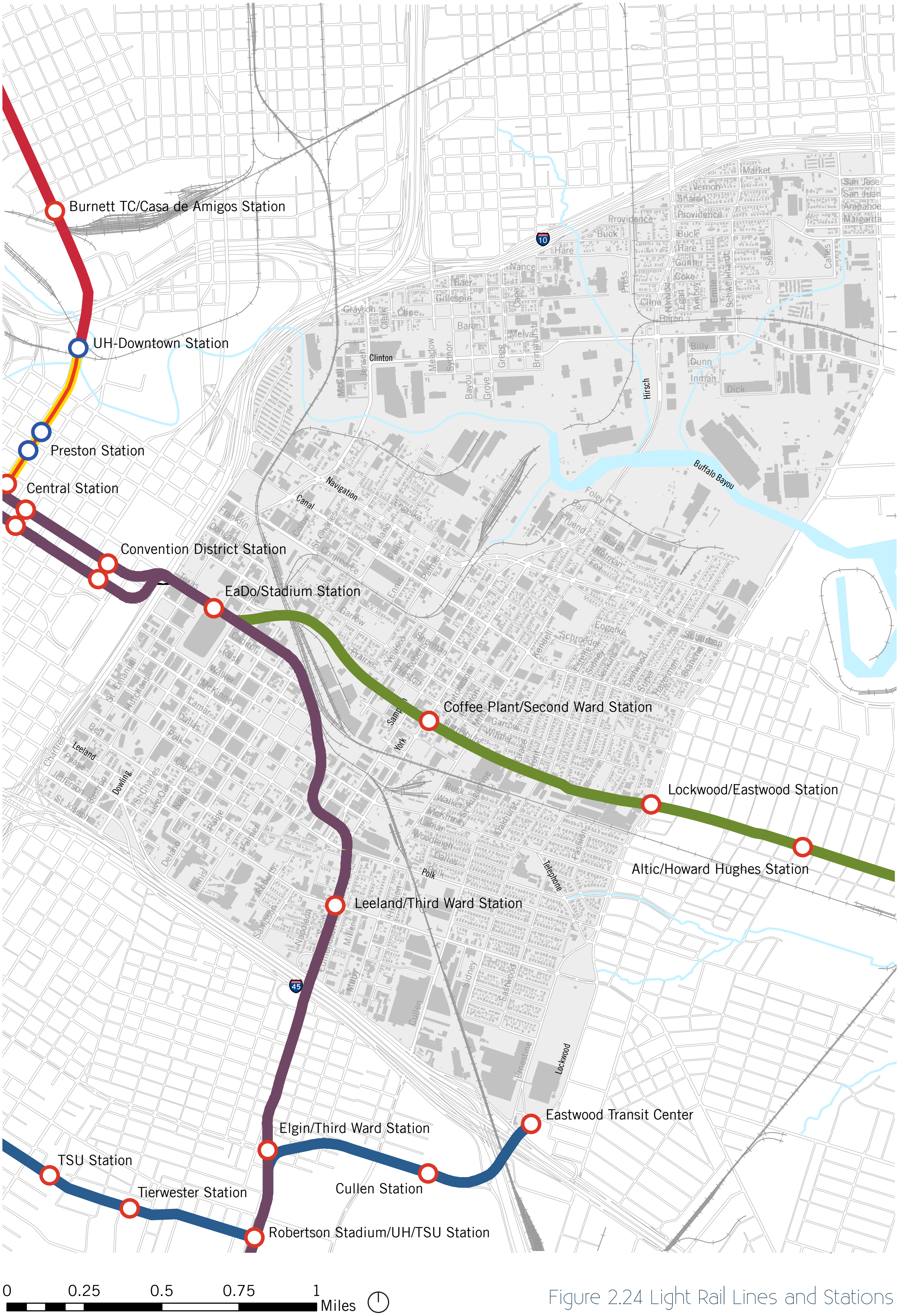


Figure 2.24 Light Rail Lines and Stations

Bicycle Facilities

The East End has several existing bicycle routes throughout the study area as well as two major Rails-to-Trails projects that make the region a potentially attractive area for cyclists. Major corridors include:

Off-Road Paths

- Columbia Tap (Rails-to-Trails)
- Harrisburg (Rails-to-Trails)
- Buffalo Bayou Paths

East-West

Bicycle routes

- Navigation Boulevard
- Sherman/Garrow/Commerce

Bicycle lanes

- Polk Street
- Lyons Avenue

North-South

Bicycle routes

- Sampson & York

Bicycle lanes

- Cullen Boulevard
- Hirsch Street
- Bastrop Street

Figure 2.25 shows existing and proposed bicycle facilities for the study area. The recommendations developed through the Downtown/EaDo Livable Center Study and the Fifth Ward Pedestrian and Bicyclist Special District Study are included on the map to show the full potential of the bicycle network in the area. These recommendations include facilities along St. Emanuel and along the West Belt Rail corridor to connect the Columbia Tap trail to Buffalo Bayou.

In addition to the existing and potential corridors identified through planning projects, many of the local streets have low traffic volumes and speeds, making them suitable for most bicycle riders. The connectivity of the street network also allows for many bicycle trips to be made without necessarily utilizing a major thoroughfare with high speeds and volumes. However, many of the local streets have been identified as having relatively poor pavement quality making riding more difficult.

Shared-Use Path: Columbia Tap Rail-Trail

Shared-Use Path: MKT Trail

Bike Lane

Map Key

Shared-Use Path
Bike Lane
Signed Bike Route
Signed Shared Roadway
Other Trails
Proposed*

* Proposed bicycle facilities identified in the Downtown / EaDo Livable Center Study and the Fifth Ward Bicycle Study have been assessed and incorporated into this study but have not currently been adopted in the City of Houston Master Plan or Management District Implementation Plans

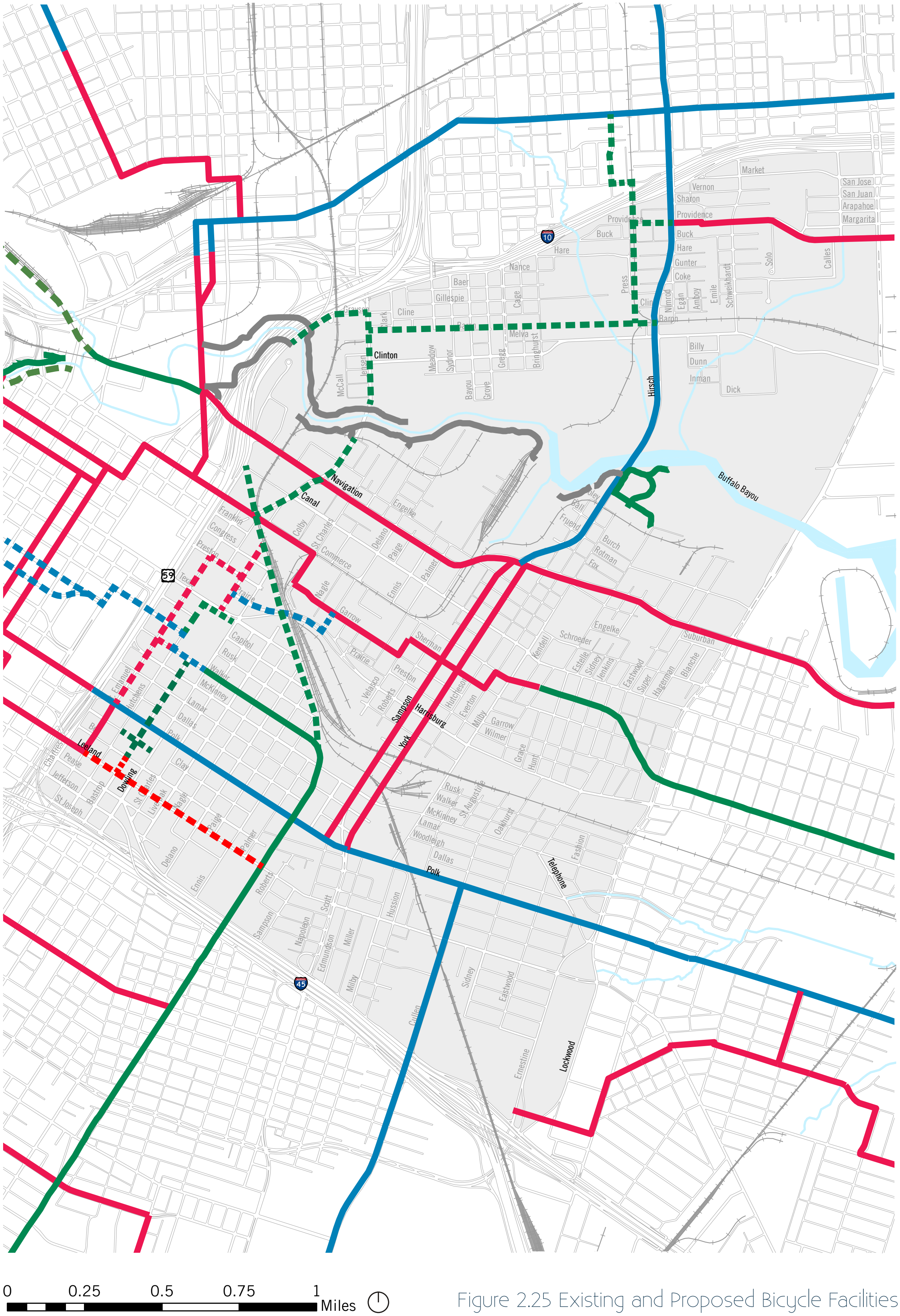


Figure 2.25 Existing and Proposed Bicycle Facilities

Pedestrian Facilities

Sidewalk coverage in the East End is mixed. As shown in Figure 2.27, the arterial roadways in the study area provide sidewalks along one or both sides for most of their lengths. Additionally, many smaller, local roads also provide sidewalks. However, the sidewalks that exist do not form a cohesive mobility network for the entire study area. Sidewalk gaps are plentiful. Additionally, sidewalk quality varies substantially, from new, wide sidewalks along Harrisburg Boulevard to uneven, narrow pavement on other roads.

Most arterial roads in the study area suffer from periodic sidewalk gaps, with the notable exception of Harrisburg Boulevard which is being rebuilt concurrently with the light rail line to provide sidewalks along both sides of the road. Gaps create several problems for pedestrians. If the unpaved section is rough, wet, or covered in vegetation, a pedestrian may be forced to bypass it by entering the road, which increases the likelihood of a crash. Disabled pedestrians in a wheelchair are unlikely to be able to bypass it at all and may have to turn around to find the nearest ramp to enter the street. Cyclists who ride on the sidewalk, such as young children, are challenged if there are unexpected or unseen dangers in the unpaved stretch.

Roads in the study area with extensive gaps in sidewalk pavement include McKinney Street between Dowling Street and Sampson Street, Sampson Street between McKinney Street and Navigation Boulevard, and York Street between McKinney Street and Navigation Boulevard. The numerous gaps along York Street and Sampson Street are particularly detrimental to pedestrian mobility because of the importance of those roads for north-south movement within the study area.

Sidewalks along several roads in the study area dead-end on either side of railroad tracks. This is true for sidewalks along Navigation Boulevard, Lockwood Drive, York Street, Sampson Street, Leeland Street, Commerce Street, and McKinney Street. Pedestrians on these sidewalks must enter the road and negotiate with vehicular traffic in order to cross railroad crossings. Even with full sidewalk accessibility, railroad crossings can be very challenging for pedestrians because of the mixing of train, vehicle, and pedestrian traffic flows and because rail crossings frequently introduce steep grade changes. A gap in sidewalk infrastructure makes the crossing that much more challenging for pedestrians.

Gaps in arterial sidewalks present more of a challenge to pedestrians than those in sidewalks along local streets. Local streets in the study area frequently have substantially lower traffic volumes and speeds and thus present fewer dangerous conflicts for pedestrians with vehicles.

To maximize walkability, focusing on sidewalk infrastructure in clusters has been shown more effective than along long stretches of roadway. Because of the relatively low speed of walking (approximately 3-3.5 MPH for an average adult), walking trips tend to be shorter and are often focused on destinations near trip origins. Consequently, it may be preferable to focus sidewalk improvements on portions of roads in activity centers and where new sidewalks can benefit from networking effects with existing sidewalks.

In addition to gaps in sidewalk pavement, a lack of pedestrian accommodations at intersections can effectively create gaps. These accommodations include wheelchair ramps, countdown pedestrian signals, and painted crosswalks. A lack of these pedestrian accommodations at intersections can be just as obstructive as physical gaps in sidewalk pavement.

Walkscore.com was used to quantify relative walkability in the study area on an everyday basis. Walkscore measures the feasibility of a car-lite lifestyle using a patent-pending system to measure the walkability of an address or region. The Walkscore algorithm awards points based on the distance to likely destinations in several categories. Destinations within 0.25 miles receive maximum points; destinations farther than one mile are awarded no points. Studies have indicated that higher average Walkscore correlate with relatively higher home property values.

As shown in the map below, the Walkscore is relatively low (shown in red or yellow) in most areas of the study area, although there are some areas of the Second Ward with higher scores than the Houston average. This relatively low score is almost entirely due to the lack of destinations in the study area that are within walking distance. However, pedestrian infrastructure in the study area is fairly extensive, and GEEMD sidewalk improvements are making it even better, so as development occurs the area is well-positioned to become one of Houston's premier walkable communities.

Figure 2.26 East End Study Area Walkscore Map

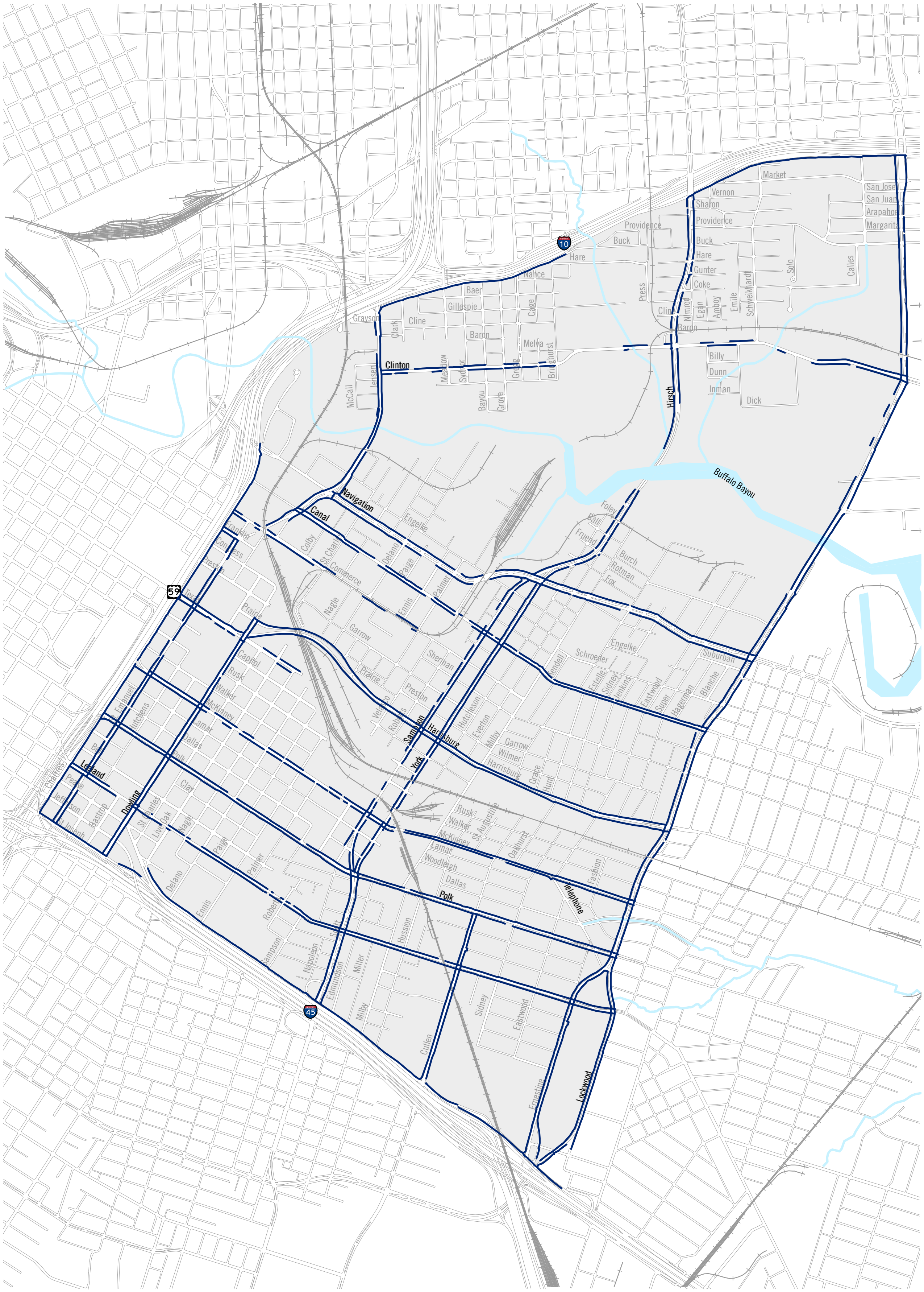


Figure 2.27 Existing Major Thoroughfare Sidewalks

0 0.25 0.5 0.75 1 Miles

Existing Sidewalks on Roadways Classified as Major Thoroughfares or Major Collectors by the City of Houston

Rail Corridors

The East End area has two freight rail corridors within or adjacent to the study area (Figure 2.28). The first is called the West Belt Subdivision, a double track mainline railroad on the travelling from north to southeast through the study area. This subdivision is owned and operated by the Union Pacific (UP) Railroad (acquired as part of the former Houston Belt & Terminal Railway). The BNSF Railway and the Kansas City Southern Railways (KCS), have trackage rights for the corridor and operate trains on this line. This corridor has several roadway crossings within the study boundaries. These crossings are:

- Nance Street
- Runnels Street
- Canal Street
- Navigation Boulevard
- Commerce Street
- Hutchins Street
- Sampson and York Street
- McKinney Street
- Milby Street
- Leeland and Cullen Boulevard

The second corridor is the Galveston, Harrisburg and Houston (GH & H) line. This corridor roughly parallels IH-45 and is located on the southern edge of the study area. The GH & H Subdivision corridor has several roadway crossings within the study boundaries. These crossings are:

- Milby Street
- Oakhurst Street
- Eastwood Street

Usage

The West Belt corridor averages about 65 to 75 trains per day. This rail traffic is bidirectional meaning that trains travel in both north and south directions. This section also has industrial tracks with industries using the rail for receiving and shipping products to market. The GH & H Subdivision averages about 5 to 10 trains per day depending on location. However, numerous industries are served along the corridor which may have more local train deliveries associated with the deliveries of materials and products to these industries.

West Belt Study

The Gulf Coast Rail District recently completed a study for the West Belt. The goal of the study was to determine which grade crossings could be closed and which could be grade-separated to establish a sealed rail corridor. The study assessed the feasibility and costs of creating a rail corridor with no at-grade crossings from IH-45 north to Tower 26 north of the study area.

The following roadways are tentatively shown as closures within the study area:

- Nance Street
- Hutchins Street
- McKinney Street
- Milby Street

The following roadways are proposed to have grade separations constructed. Most of these grade separations are proposed to be underpasses :

- Lyons
- Runnels
- Navigation & Commerce
- Sampson & York
- Leeland & Cullen

This study has identified opportunities to leverage these projects to further improve regional mobility. These opportunities are discussed in Chapter 4 - Improvement Opportunities.

Commuter Rail Alternatives

Galveston-Houston Mobility Corridor Alternatives Analysis (The Goodman Corporation, 2010), a study looking at providing Galveston Commuter Rail, has identified the potential for utilizing the GH & H Subdivision or the West Belt Subdivision to provide service. The line could then continue northwest to connect to Downtown and potentially use the Eureka Subdivision to serve commuters along the US 290 corridor. Current studies are looking at potential station locations to serve the central business district and surrounding areas.

Map Key

Rail Corridor

West Belt Study - Proposed Grade Separation

West Belt Study - Proposed Roadway Closure

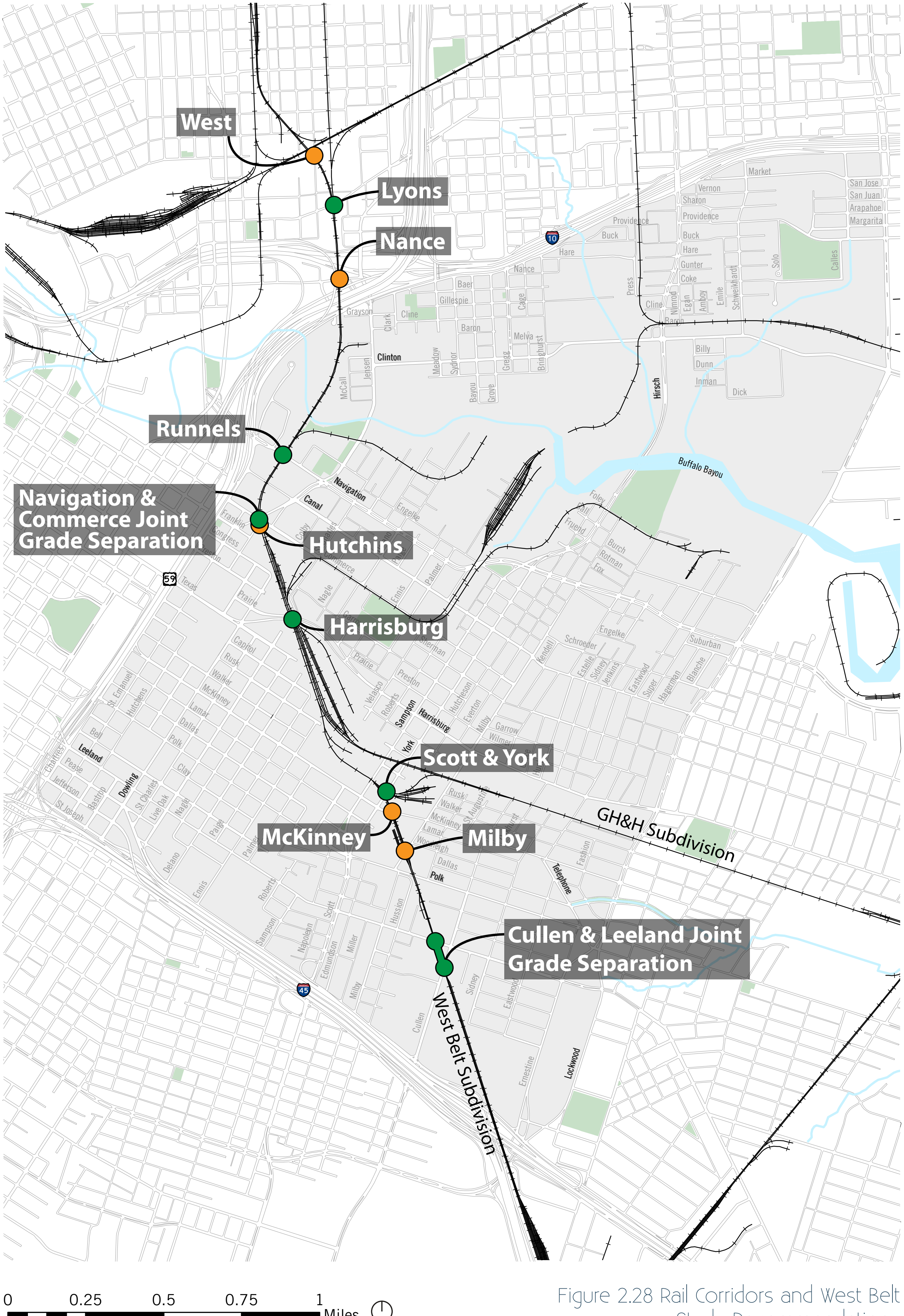


Figure 2.28 Rail Corridors and West Belt Study Recommendations

Chapter 3

Assessment & Analysis

A comprehensive picture of transportation needs for the East End requires an analysis of future land use and development in and around the study area and the impact that development will have on transportation demand. An assessment of transportation demand can help identify potential bottlenecks where additional capacity may be required as well as other areas where right-of-way could potentially be reallocated to better accommodate multi-modal transportation options.

A two-step process was utilized to assess travel demand within and through the study area for several model years including 2011, 2018 (short-medium term), and 2035 (long-term). First, projected land use development was modeled at a parcel level using the H-GAC regional demographic model for two growth scenarios. Second, the estimates of population and employment growth generated for these scenarios were used to develop and refine the travel demand projections for the area. The travel demand model allocates trips to multiple modes of travel (primarily auto and transit) based on the assumed infrastructure in place. Additional analysis on the model projections was performed to assess roadway volume-to-capacity ratios and Level-of-Service (LOS) assessments for study area roadways. This section of the report outlines the findings from these model analyses.

Land Use Scenarios

Two land use scenarios were developed as inputs into the H-GAC regional demographic model based upon three main sources: known development, market trends, and public policy. These sources were split into two future scenarios for year 2035: Base+ and Master Plan/TOD.

Scenario 1: Base+ took into account known development, which was assessed using building permit and replat information from the City of Houston. Using this data, the study team with support from the City of Houston Planning Department extrapolated several types of common developments and used our knowledge of parcel ownership to identify additional sites where redevelopment was likely. For example, we assumed a large underutilized industrial parcel owned by a townhouse developer would be redeveloped in the medium range.

Scenario 2: Master Plan/TOD took the first scenario as a starting point, (with a slightly slower pace of implementation) and added other development identified in existing plans for the neighborhood, especially the Greater East End Livable Center Master Plan (Civic Design, 2011) and the East Downtown Livable Centers Study (Morris Architects, 2011). This scenario is designed to represent a high-end of development potential that could be achieved with support from public policy and catalytic projects developed by the study area's Management Districts. This scenario includes significant transit-oriented development around the light rail stations for the Southeast and East End Lines and increases in park and open space along Buffalo Bayou. In both scenarios, stable single-family neighborhoods were assumed to remain unaltered.

The following Table 3.1 shows the distribution of land use across existing model conditions and the two future scenarios. Figure 3.1 on the opposite page shows the assumed locations for the major developments included in this analysis.

Warehouse conversion (above) and new townhouse development (below) are two of the main trends in land use in the study area.

Table 3.1 Distribution of Land Use Estimates by Scenario - H-GAC Demographic Model

	H-GAC 2010 Existing Conditions		Scenario 1 Base+ (2035)		Scenario 2 Master Plan/TOD (2035)	
Land Use	SF (MM)	%	SF (MM)	%	SF (MM)	%
Residential	24.3	24.0%	27.8	27.5%	31.1	30.5%
Commercial	15.8	15.6%	17.4	17.2%	16.2	15.9%
Industrial	33.5	33.0%	29.7	29.3%	22.2	21.8%
Gov't/Medical/Educ.	6.5	6.4%	5.9	5.8%	5.8	5.7%
Parks/Open	1.7	1.7%	5.6	5.6%	12.8	12.5%
Vacant (Developable)	7.0	6.9%	2.5	2.5%	2.4	2.4%
Undevelopable	11.0	10.9%	11.8	11.7%	10.9	10.7%
Other	1.6	1.5%	.5	0.5%	.5	0.5%
Total	101.4	100%	101.4	100%	101.4	100%

Dark gray represents major increases.

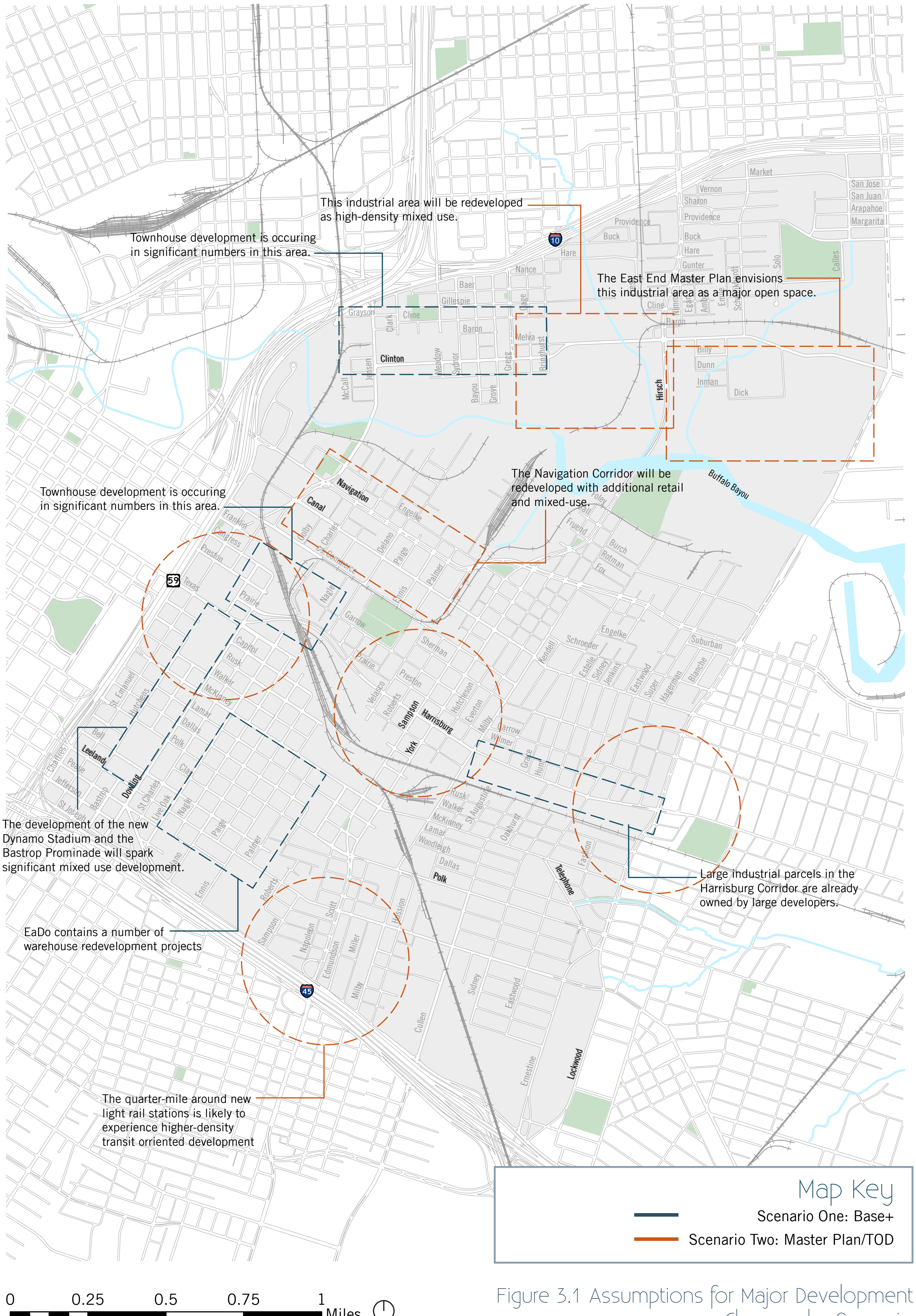


Figure 3.1 Assumptions for Major Development Changes by Scenario

Population and Employment Growth

Using the H-GAC demographics model and assumptions of the two development scenarios, employment and population estimates were made for the future design years of 2018 and 2035. Figures 3.2 and 3.3 show the overall trend for population and employment in the study area relative to the projected trend. The analysis model makes assumptions for changes in land use and employment based on existing land use, which was overlaid with known and projected development input to create the growth scenarios.

Scenario 1 shows faster population growth earlier in the analysis period but levels off after 2018. Scenario 2 shows continued growth for a longer period of time (through 2025), leading it to a higher overall growth over the analysis period (1.78% vs. 0.73% Compound Annual Growth Rate (CAGR) between 2011 and 2035). The majority of this difference is driven by assumed multifamily development occurring between 2018 and 2025, a period where Scenario 2 shows a CAGR of 4.28%. This growth rate is comparable to the growth experienced in fast growing Houston neighborhoods such as Midtown and Washington Heights from 2000-2010.

Figures 3.4-3.7 show the resulting population densities and populations growth rates for each scenario from 2011-2035. Scenario 2 showed higher population densities and growth rates with more development density particularly in the EaDo and Eastwood neighborhoods though all regions show strong growth. Employment growth is relatively flat in both scenarios.

Table 3.2 breaks down where the growth is projected to occur. As shown, the Downtown/EaDo and Eastwood Super Neighborhoods are projected to grow the fastest likely driven by multifamily developments that are planned or projected at least in part around the convention center and the light rail stations.

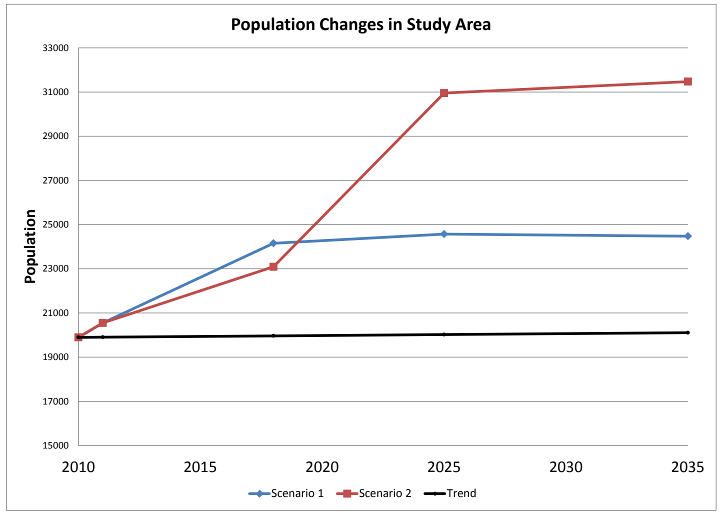


Figure 3.2 Population Trends

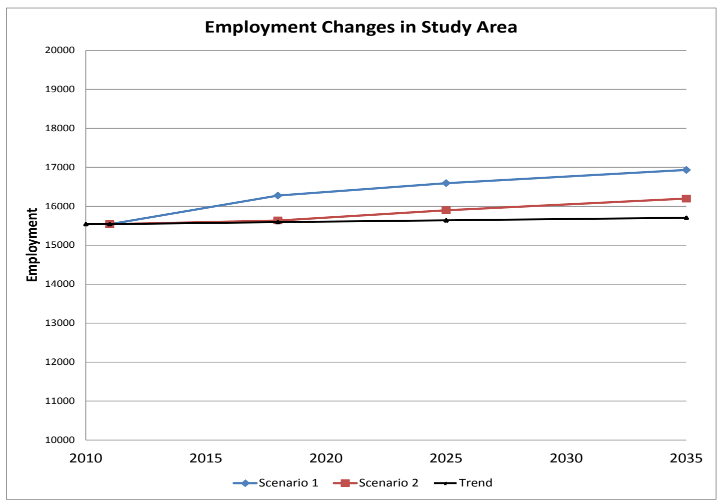


Figure 3.3 Employment Trends

Table 3.2 East End Study Area Population and Growth Rates by Scenario and Neighborhood

	Population							Population: CAGR							
		Scenario 1			Scenario 2			Scenario 1				Scenario 2			
Area	2011	2018	2025	2035	2018	2025	2035	2011-2018	2018-2025	2025-2035	2011-2035	2011-2018	2018-2025	2025-2035	2011-2035
EaDo	2,640	3,363	3,603	3,509	3,136	6,560	6,658	3.52%	0.99%	-0.27%	1.19%	2.49%	11.12%	0.15%	3.93%
Eastwood	4,085	5,002	5,178	5,178	4,928	6,391	6,527	2.94%	0.50%	0.00%	0.99%	2.72%	3.78%	0.21%	1.97%
Fifth Ward	4,295	5,039	5,039	5,039	5,014	6,212	6,497	2.31%	0.00%	0.00%	0.67%	2.24%	3.11%	0.45%	1.74%
Second Ward	9,530	10,750	10,750	10,750	10,011	11,788	11,788	1.74%	0.00%	0.00%	0.50%	0.71%	2.36%	0.00%	0.89%
Study Area	20,550	24,154	24,570	24,476	23,089	30,951	31,470	2.34%	0.24%	-0.04%	0.73%	1.68%	4.28%	0.17%	1.79%

Figure 3.4 2035 Population Density
Scenario 1: Base +

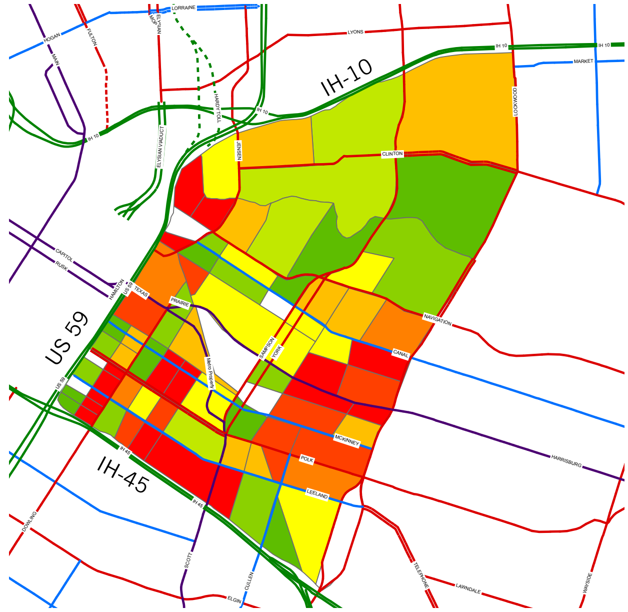


Figure 3.5 2035 Population Density
Scenario 2 Master Plan/TOD

Map Key
Person per Acre

1-2	11-15
3-5	15-17
5-8	17-21
8-11	21+

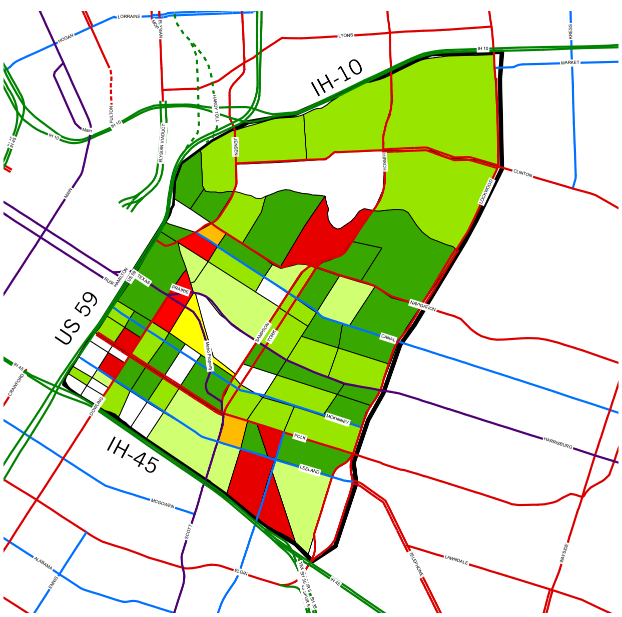


Figure 3.6 2011 - 2035 Population Growth Rate
Scenario 1: Base +

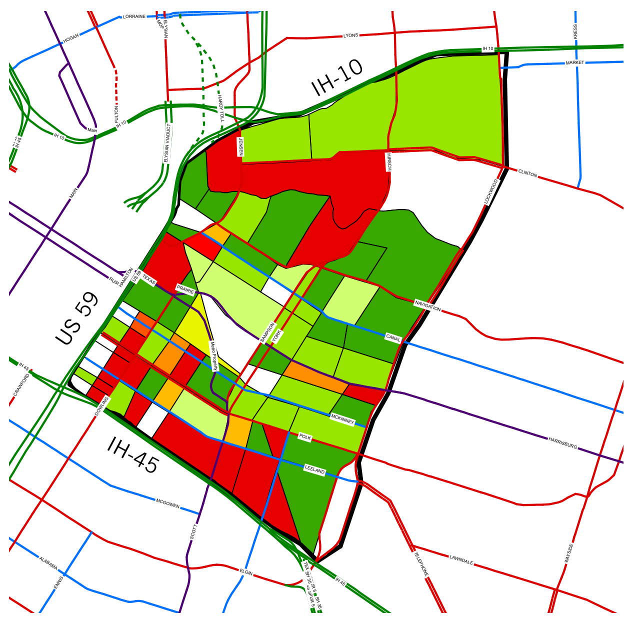


Figure 3.7 2011 - 2035 Population Growth Rate
Scenario 2: Master Plan/TOD

Map Key
Compound Annual Growth Rate %
(2011-2035)

0	2.0-2.5
0.1-0.5	2.5-3.0
0.5-1.0	3.0-3.5
1.0-1.5	3.5-4.0
1.5-2.0	4.0+

Existing Travel Demand Model (2011)

H-GAC maintains a regional travel demand model that projects transportation usage across the region and distributes traffic to the roadway network in order to estimate future traffic operations. This model was refined using the population and land use scenarios described in the previous section. Additionally, the transportation network in the study area was refined to increase the number of traffic analysis zones (TAZs) to more closely model the existing transportation network.

The roadway network was refined to ensure that network links, lane assignments, and trip distributions were consistent with data from field observations. The model uses an optimization algorithm that distributes trips across available roadways and travel modes in such a way that minimizes overall travel time and delay across the regional travel network.

As shown in Tables 3.3 and 3.4 below, screen line samples were used to calibrate the model. Typically, Average Daily Traffic (ADT) projections from the model show higher traffic for the study area than those observed through actual traffic volume counts. The model has been refined to remove some of this bias for the current model output. This bias is particularly true for existing low-volume roadways such as Commerce Street and McKinney Street which account for the majority of the screenline error difference.

Tables 3.3 & 3.4 Screenline Estimates used to Calibrate the TDM Model

Northern East/West Streets Screen Line		Existing ADT	Travel Demand Model ADT	Difference
Canal Street	East of St. Charles	4,200	4,169	-1%
Commerce Street	West of St. Charles	1,800	4,424	146%
Navigation Street	North of Canal St	6,900	7,157	4%
	Total	12,900	15,750	22%

Southern East/West Streets Screen Line		Existing ADT	Travel Demand Model ADT	Difference
McKinney Street	West of Milby	1,100	1,864	69%
Polk Street	East of Dowling	3,600	4,398	22%
Leeland Street	East of Dowling	4,500	4,782	6%
	Total	9,200	11,044	20%

Figure 3.8 shows the 2011 baseline traffic volumes from the travel demand model for major area roadways. The bidirectional roadway link volumes are shown, and the relative line widths are proportional to the volume estimated by the model for the roadway link.

Figure 3.8 Travel Demand Model
Roadway Volume Projections - 2011 ADT

Level of Service Analysis - Automobiles

An important tool to determine the effectiveness of a roadway network is to look at roadway level of service. Level of service is a performance metric that, for automobiles, compares a motorist's ability to travel along a corridor versus what the motorist's ability would be to travel on that corridor in free-flow conditions. This metric is useful for comparing different roadway segments against a common framework.

Roadway level of service is assessed on a range from LOS A through LOS F. This assessment is based on the methodology outline in the *2010 Highway Capacity Manual* which is the generally accepted methodology for calculating Level of Service across all modes of transportation. The LOS categories are described as follows:

- **LOS A** - describes primarily free-flow operations. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Travel speeds exceed 85% of the base free-flow speed.
- **LOS B** - describes reasonable unimpeded operation. Travel speeds are between 67% and 85% of the base free-flow speed.
- **LOS C** - describes stable operations. The ability to maneuver or change lanes at midsegment locations may be more difficult than LOS B. Longer intersection queues at intersections may exist. Travel speeds are between 50% and 67% of the base free-flow speed.
- **LOS D** - less stable condition in which small increases in flow may cause substantial decreases in travel speed. This is frequently the minimum LOS that agencies target for acceptable operations on urban roadways. Travel speeds are between 40% and 50% of the base free-flow speed.
- **LOS E** - characterized by unstable operations and frequent delay. Travel speeds are between 30% and 40% of the base free-flow speed.
- **LOS F** - characterized by flow at extremely low speed. Boundary intersections are likely to have extensive delay and queueing. Travel speeds are less than 30% of the base free-flow speed. This condition also occurs when boundary intersections exceed a volume-to-capacity (v/c) ratio of 1.0.

Level of service is typically assessed during the peak travel hours of the day to understand the potential congestion that may occur in the high traffic volume periods. It is important to note that excellent levels of service (e.g., LOS A) is not always desirable or achievable on a corridor for peak hours and the necessary capacity to achieve that service level may be cost or space prohibitive and come at a trade off with other travel modes and adjacent impacts to land use and access.

For the purpose of a planning-level assessment such as that being performed for the East End, the Highway Capacity Manual has developed general planning tables (HCM Exhibit 16-14) that show the estimated traffic volumes for a roadway corridor for various roadway cross sections and levels of service. This allows the analysis of a large number of roadways, such as in the East End study area, to be performed to identify where potential problems or bottlenecks may occur that should be addressed or improvements may be needed. Table 3.5 shows the roadway information used in this assessment.

Several roadway criteria are required to complete the analysis including:

- Roadway volume (actual counts or from travel demand model)
- Posted travel speed
- Number of travel lanes
- K-Factor: the percent of traffic occurring on a roadway in the peak hour of the day (assumed to be 0.09 for the East End)
- D-Factor: the directional nature of the traffic during the peak hour (assumed to be 0.60 for the East End)

The estimates of traffic volume break points for various levels of service are shown in orange. Calculations for the K- and D-Factors are based on traffic counts completed in the East End study area in 2011. These analyses are shown in Appendix A2 of this report.

Figure 3.9 shows a map of all of the Level of Service estimates based on the 2011 Travel Demand Model volumes. As shown, the roadways within the study area are projected to operate at acceptable or better levels of service with the exception of several links along Chartres and the IH-45 Northbound Frontage Road that experience heavy traffic volumes from US 59 and IH-45 off ramps primarily in the AM peak hour. As a point of comparison, Figure 3.10 shows the v/c ratios for the links within the study area and shows a very strong correlation to the Level of Service assessment methodology.

Alternative report card criteria for Level of Service exist for other travel modes such as transit, pedestrian and bicycle travel and will be addressed in separate sections of this report relating to specific mobility improvement opportunities.

Table 3.5 2010 Highway Capacity Model Level of Service Planning Tool for Urban Street Facilities

East End Study Area (highlighted rows, shown in bold)

			"Generalized Daily Service Volumes for Urban Street Facilities Planning Tool Maximum Volumes to Achieve Level of Service (000s veh/day)"								
			Two Lane Roads			Four Lane Roads			Six Lane Roads		
Posted Speed	K-factor	D-factor	LOS C or Better	LOS D	LOS E	LOS C or Better	LOS D	LOS E	LOS C or Better	LOS D	LOS E
30 MPH	0.09	0.55	5.9	15.4	19.9	11.4	31.4	37.9	16.3	46.4	54.3
		0.60	**5.4**	**14.1**	**18.3**	**10.3**	**28.8**	**34.8**	**15.0**	**42.5**	**49.8**
	0.10	0.55	5.3	13.8	17.9	10.1	28.2	34.1	14.7	41.8	48.9
		0.60	4.8	12.7	16.4	9.3	25.9	31.3	13.5	38.3	44.8
	0.11	0.55	4.8	12.6	16.3	9.2	25.7	31.0	13.4	38.0	44.5
		0.60	4.4	11.5	14.9	8.4	23.5	28.4	12.2	34.8	40.8
35 MPH*	0.09	0.55	7.4	16.5	19.9	14.7	33.3	37.9	21.5	48.9	54.3
		0.60	**6.7**	**15.1**	**18.3**	**13.4**	**30.6**	**34.8**	**19.7**	**44.8**	**49.8**
	0.10	0.55	6.6	14.8	17.9	13.2	30.0	34.1	19.4	44.1	48.9
		0.60	6.0	13.6	16.4	12.1	27.5	31.3	17.8	40.4	44.8
	0.11	0.55	6.0	13.5	16.3	12.0	27.3	31.0	17.6	40.1	44.5
		0.60	5.5	12.3	14.9	11.0	25.0	28.4	16.1	36.7	40.8
40 MPH*	0.09	0.55	8.8	17.5	19.9	18.1	35.3	37.9	26.7	51.5	54.3
		0.60	**8.1**	**16.1**	**18.3**	**16.5**	**32.3**	**34.8**	**24.5**	**47.2**	**49.8**
	0.10	0.55	8.0	15.8	17.9	16.2	31.7	34.1	24.0	46.3	48.9
		0.60	7.3	14.5	16.4	14.9	29.1	31.3	22.0	42.4	44.8
	0.11	0.55	7.2	14.4	16.3	14.7	28.9	31.0	21.9	42.1	44.4
		0.60	6.6	13.2	14.9	13.5	26.4	28.4	20.0	38.6	40.7
45 MPH	0.09	0.55	10.3	18.6	19.9	21.4	37.2	37.9	31.9	54	54.3
		0.60	**9.4**	**17.1**	**18.3**	**19.6**	**34.1**	**34.8**	**29.2**	**49.5**	**49.8**
	0.10	0.55	9.3	16.8	17.9	19.3	33.5	34.1	28.7	48.6	48.9
		0.60	8.5	15.4	16.4	17.7	30.7	31.3	26.3	44.5	44.8
	0.11	0.55	8.4	15.3	16.3	17.5	30.5	31	26.1	44.2	44.4
		0.60	7.7	14.0	14.9	16.1	27.9	28.4	23.9	40.5	40.7

Source: 2010 Highway Capacity Manual - Exhibit 16-14

General Assumptions include: No Roundabouts or all-way stop controlled intersections along the facility; coordinated, semi-actuated traffic signals; arrival type 4; 120-s cycle time; protected left turn phases; 0.45 weighted average g/C ratio; exclusive left turn bays with adequate storage provided at traffic signals; no exclusive right turn lanes provided; no restrictive median; 2-mile facility length; 10% traffic turns left, 10% turns right at each traffic signal; peak hour factor=0.92; and base saturation flow rate - 1900pc/hr/ln

30-mph assumes signal spacing = 1050 ft and 20 access points/mi

45-mph assumes signal spacing = 1500 ft and 10 access points/mi

* Values interpolated from data for 30 mph and 45 mph

Figure 3.9 Travel Demand Model Level of Service Analysis for 2011 TDM Volume Estimates

Figure 3.10 Travel Demand Model
Volume-to-Capacity Ratio
2011 TDM Volume Estimates

Map Key

Volume-to-Capacity Ratio

- 0.00-0.33
- 0.34-0.66
- 0.67-0.99
- 1.00-1.32
- Greater than 1.33

#'s Represent the Number of Lanes

Travel Demand Projections for Scenario 1 & Scenario 2

The regional travel demand model maintained by the Houston-Galveston Area Council (H-GAC) was used to project transportation usage for Scenario 1: Base+ and Scenario 2: Master Plan/TOD land use projection scenarios. Both scenarios were built off the 2011 baseline travel projections from the H-GAC travel demand model. Traffic volume projections were conducted for major roadways within the study area.

The median growth rate and average compound annual growth rate (CAGR) for all links within the area are shown in the Table 3.6. The table shows that, typically, the traffic volume growth associated with the Master Plan/TOD scenario will be higher than the Base+ scenario. Median traffic volumes will grow between 2.1 and 2.2% per year, depending on growth patterns.

Table 3.6 Average Link Growth Rates by Scenario

Statistic		Scenario 1 Base +	Scenario 2 Master Plan/ TOD
2011 – 2035: Total Growth	Median Rate	64%	84%
2011 – 2035: CAGR	Median Rate	2.10%	2.14%

Table 3.8 displays a selection of 24 roadway links within the study area. With the exception of Commerce Street, all roadways shown in the table are part of the City of Houston's Major Thoroughfare Plan. The table summarizes the volume change along each link from the year 2011 to 2035 for both Scenario 1: Base+ and Scenario 2: Master Plan/TOD land use projection scenarios.

Both links along Canal Street show a compound annual growth rate higher than the median for the study area. Dowling Street and Cullen Boulevard also show a higher than the median volume growth. Currently all three of these roads are under capacity, but both models show an increase in traffic by 2035. The increase in volume on these streets also is likely driven by the model's focus on minimizing total travel time by increasing volume on streets that are under capacity.

For all roadway links in Table 3.8, the compound annual growth rate does not vary more than 1% between both scenarios. While there is a difference in traffic growth between both scenarios, on average the difference is not large when analyzed over a long time period. This is at least in part driven by the increased amount of projected transit usage in Scenario 2.

Based on the model output, level of service calculations were completed for each scenario for 2018 and 2035 design years. As a way to assess the overall capacity constraints in the study area, Table 3.7 summarizes the distribution levels of service for roadway links across the two scenarios for each design year. As shown, there are few links that reach a level of service that would not typically be considered to be acceptable for urban areas. The majority of these links are located along the frontage roads on the freeway system that serves as a boundary to the study area.

Table 3.7 Distribution of Links by Level of Service

Share of Links by Level of Service Scenario 1: Base +			
LOS	**2011**	**2018**	**2035**
C or Better	86%	77%	51%
D	12%	20%	40%
E	1%	2%	5%
F	1%	1%	4%

Share of Links by Level of Service Scenario 2: Master Plan/TOD			
LOS	**2011**	**2018**	**2035**
C or Better	86%	73%	50%
D	12%	23%	41%
E	1%	3%	5%
F	1%	1%	4%

The network of roadway traffic volume projects and the resulting level of service estimates, using the approach outlined in this chapter, are shown in the maps on the following pages (Figures 3.10 - 3.18).

Table 3.8 Travel Demand Model Roadway Projections and Compound Annual Growth Rates (2011-2035 CAGR)

East - West Routes			Scenario 1				Scenario 2			
			Volumes		Total Growth (%)	CAGR (%)	Volumes		Total Growth (%)	CAGR (%)
Street	Location	Lanes	2011	2035	2011-2035	2011-2035	2011	2035	2011-2035	2011-2035
Leeland Ave	East of Dowling Street	4	4,782	6,039	26%	1%	4,782	6,158	29%	1%
Leeland Ave	East of Cullen Blvd	4	14,299	18,053	26%	1%	14,299	18,082	26%	1%
Polk Ave	East of Dowling Street	2	4,398	5,219	19%	1%	4,398	5,478	25%	1%
Polk Ave	East of Cullen Blvd	2	8,918	10,610	19%	1%	8,918	10,594	19%	1%
Texas Ave	West of Dowling Street	5	13,833	15,060	9%	0%	13,833	15,076	9%	0%
Harrisburg Blvd	West of Sampson Street	4	11,696	17,139	47%	2%	11,696	17,329	48%	2%
Harrisburg Blvd	East of Estelle Street	4	7,581	12,457	64%	2%	7,581	12,821	69%	2%
Commerce Street	West of St. Charles Street	2	4,424	7,833	77%	2%	4,424	7,827	77%	2%
Canal Street	East of St. Charles Street	4	4,169	10,370	149%	4%	4,169	10,816	159%	4%
Canal Street	West of Milby Street	4	4,182	8,324	99%	3%	4,182	8,411	101%	3%
Navigation Blvd	North of Canal Street	4	7,157	10,124	41%	1%	7,157	10,683	49%	2%
Navigation Blvd	East of York Street	4	9,275	23,232	150%	4%	9,275	23,451	153%	4%
Clinton Drive	East of Jensen Drive	4	4,504	4,467	-1%	0%	4,504	5,631	25%	1%

North - South Routes			Scenario 1				Scenario 2			
			Volumes		Total Growth (%)	CAGR (%)	Volumes		Total Growth (%)	CAGR (%)
Street	Location	Lanes	2011	2035	2011-2035	2011-2035	2011	2035	2011-2035	2011-2035
Chartres Street	South of Leeland Ave	2	22,231	26,416	19%	1%	22,231	26,109	17%	1%
Chartres Street	North of Commerce Street	8	10,458	25,586	145%	4%	10,458	25,703	146%	4%
Dowling Street	North of Leeland Ave	4	6,760	21,080	212%	5%	6,760	21,213	214%	5%
Jensen Drive	North of Navigation Blvd	4	7,352	21,360	191%	5%	7,352	21,939	198%	5%
Scott Street	North of Leeland Ave	4	16,787	27,248	62%	2%	16,787	27,223	62%	2%
Sampson Street	South of Harrisburg Blvd	2	6,530	14,087	116%	3%	6,530	14,225	118%	3%
York Street	South of Harrisburg Blvd	4	4,705	10,673	127%	3%	4,705	10,838	130%	4%
York Street	North of Burch Street	4	6,739	19,885	195%	5%	6,739	19,984	197%	5%
Cullen Blvd	South of Leeland Ave	4	3,099	9,415	204%	5%	3,099	9,354	202%	5%
Lockwood Drive	North of Polk Street	4	13,923	20,157	45%	2%	13,923	20,347	46%	2%
Lockwood Drive	North of Navigation Blvd	4	14,482	23,865	65%	2%	14,482	24,125	67%	2%

Figure 3.11 Travel Demand Model Roadway Volume Projections for 2018 ADT and Scenario 1: Base +

Figure 3.12 Travel Demand Model
Level of Service Analysis
for 2018 Scenario: Base +

Figure 3.13 Travel Demand Model
Roadway Volume Projections for 2018 ADT
Scenario 2: Master Plan/TOD

Figure 3.14 Travel Demand Model Level of Service Analysis for 2018 Scenario 2: Master Plan/TOD

Figure 3.15 Travel Demand Model Roadway Volume Projections for 2035 ADT Scenario 1: Base +

Figure 3.16 Travel Demand Model Level of Service Analysis for 2035 Scenario 1: Base +

Figure 3.17 Travel Demand Model Roadway Volume Projections for 2035 ADT
Scenario 2: Master Plan/TOD

Figure 3.18 Travel Demand Model
Level of Service Analysis for 2035
Scenario 2: Master Plan/TOD

Key Intersection Analysis

In addition to the analysis of roadway corridors, several intersections have been identified for further analysis to determine operational Level of Service for the peak travel hours based on current traffic volumes.

Level of service for an intersection is assessed based on the average vehicle delay in seconds during peak hours. The breakdown of various levels of service criteria for signalized and unsignalized intersections are shown in the Table 3.9.

Table 3.9 Level of Service Criteria

LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10-20 sec	10-15 sec
C	20-35 sec	15-25 sec
D	35-55 sec	25-35 sec
E	55-80 sec	35-50 sec
F	≥80 sec	≥50 sec

Two intersections were identified for further analysis.

- Navigation at Jensen & Runnels
- Navigation at Sampson & York

Traffic volumes (peak hour turning movement counts) used in the analysis were gathered during October 2011. The program Synchro was used to complete the analysis based on the approach outlined in the Highway Capacity Manual. Existing traffic signal timings were obtained from the City of Houston to assess current operational performance.

The existing intersection layouts and LOS delay estimates are shown in Figures 3.17 and 3.18 on the opposite page. As shown, the intersections operate at adequate level of service (LOS D & LOS C respectively) for existing conditions indicating that there may be operational improvements that can be implemented at each intersection.

Navigation at Jensen/Runnels (Figure 3.19)

As shown in the adjacent aerial photograph of the intersection, the obtuse angle between the Jensen and Navigation alignments has resulted in the installation of channelized islands for the northbound, westbound and eastbound right turn movements and the southbound and eastbound left turn movements. Based on observations of the operations at the intersection, the channelized islands can result in driver confusion for drivers unfamiliar with the intersection. Field observations of the intersection also confirmed the signal phasing and timing match the data obtained from the City of Houston for existing conditions. The current signal phasing for the eastbound and westbound approaches operate "split-phased" – or completely separated from each other. This operation has likely been required due to the overlapping left turn paths and unbalanced traffic demand during the peak hours. Another unique observation from the field observations is that the signalized northbound right turn is green concurrent with the westbound left turn phase only.

Navigation at Sampson/York (Figure 3.20)

As shown in the adjacent aerial, immediately north of Navigation, Sampson and York Streets merge to form a two-way roadway but diverge on the southbound approach resulting a wide intersection that operates similar to the frontage roads at a freeway underpass. This also results in Sampson Street operating as a one-way southbound and York Street operating as a one-way northbound roadway south of Navigation. This combination of roadway geometries resulted in a wide median between the Sampson and York Street approaches at Navigation. The intersection of Navigation at Sampson/York operates with three-phase diamond interchange phasing.

Existing Capacity Analysis

Synchro software was used to analyze the AM and PM peak hour operations for the intersections using the existing lane geometry, signal timing and signal phasing, in accordance with the procedures in the Highway Capacity Manual. The intersection of Navigation at Jensen operates at LOS D in the AM peak hour and LOS D in the PM peak hour. The intersection of Navigation and Sampson/York operates at LOS C in the AM peak hour and LOS C in the PM Peak Hour. The delays for the specific approaches is shown in the following table.

Figure 3.19 Navigation at Jensen & Runnels

Navigation at Jensen					
	Delay / LOS				
	Eastbound	Westbound	Northbound	Southbound	Intersection
AM Peak	19.7 / B	83.4 / F	27.4 / C	50.3 / D	51.0 / D
PM Peak	17.5 / B	46.0 / D	37.1 / D	51.4 / D	39.9 / D

Figure 3.20 Navigation at Sampson & York

Navigation at Sampson / York					
	Delay / LOS				
	Eastbound	Westbound	Northbound	Southbound	Intersection
AM Peak	18.1 / B	17.2 / B	29.6 / C	43.4 / D	27.4 / C
PM Peak	15.8 / B	17.4 / B	42.9 / D	42.5 / D	26.7 / C

Goal Development

To develop the goals for the study several inputs were gathered based on previous work and the experience of the study team and stakeholders. First, feedback from the project steering committee was captured during the initial project meetings to understand what outcomes key stakeholders wanted to achieve through the course of the study.

In addition, as many projects have been completed in and around the study area, goals from previous planning efforts were captured to ensure that the East End Mobility Study supported and reinforced the outcomes of those projects. Plans that were reviewed included the Livable Centers and master planning efforts for the East End and EaDo as well as other transportation plans that effect mobility and quality of life in the study area.

The following is a summary of goals identified through the various approaches:

Steering Committee Kickoff

- Identify, understand, and improve transportation and connectivity issues in the East End
- Improve walking, biking, and transit-usage in the study area
- Understand the ties between transportation and land use in the study area including how transportation supports various land-use scenarios and how diverse land-use scenarios impact mode choice
- Coordinate all recommendations from this study with other studies and between various agencies to best leverage funds and achieve shared goals.

East End Master Plan

- Create a vibrant, mixed use multicultural and sustainable model for neighborhood redevelopment
- Leverage existing assets and infill development
- Neighborhood that is active, green, pedestrian oriented and transit friendly with focus around activity nodes and transit facilities (e.g., a new Main Street (Navigation Boulevard)
- Leverage proximity to Downtown and address barriers to mobility
- Create increased development and property value in the East End

Downtown / EaDo Livable Centers Plan

- Realize critical mass of housing options
- Eliminate/address real and perceived barriers (link EaDo and Downtown, transit and Activity Centers)
- Transportation improvements to support current and future adjacent land use
- Development of core/corridors with distinct character
- Additional goals
  - Access to / from study area
  - Connectivity within the study area
  - Integrated network of transportation opportunities
  - District character
  - Major venue amenities
  - Enhanced visitor experience
  - Active street life
  - Mixed uses

West Belt Improvements Study

- Assess the feasibility and costs of creating a continuously enclosed rail corridor with no at-grade crossings from IH-45 north to Tower 26
- Improve safety at existing grade crossings
- Reduce train noise along corridor
- Improve mobility and reduce delay through the study area
- Improve train operations due to elimination of at-grade crossings

Buffalo Bayou Partnership Master Plan

- Greater regional competitiveness
- Enhanced property values
- Reduced future flood impacts
- Increased support for public transit
- Increased tourism and visitation
- Enhanced quality of life for residents and an attractive focus for new jobs and housing

East End Traffic and Roadway Study (2007)

- Identify improvements that increase traffic flow along the major roadway corridors in the East End to support short and long range planning efforts

In reviewing the various goals and the projects themselves, key themes emerge around various outcomes for the study area. The set of goals presented here represent an attempt at synthesizing the various goals into a common framework for this study objectives.

Goals for the East End Mobility Study

1. **Address short and long-term capacity constraints and opportunities** by assessing the traffic impacts of growth and development and developing recommendations

2. **Address barriers to mobility and increase connectivity** between neighborhoods and major activity centers and destinations

3. **Enhance multi-modal trip alternatives** (e.g., walking, biking and transit) by providing improved transportation choices

4. **Prioritize transportation infrastructure investments that support the development objectives** identified through previous neighborhood and regional plans

5. **Reduce safety concerns** within study area for all travel modes

Improvement Opportunities

The goals for the East End Mobility Study outline a set of target outcomes that support improved mobility and access across all travel modes in and around the study area. These goals collectively represent a vision that would leverage the strengths of the existing and potential transportation network, such as the high degree of connectivity within local neighborhoods. Achievement of the vision would require the development of transportation infrastructure and services that support existing and future population, development, and land uses in the area.

A comparison of the study goals with the existing conditions assessed in Chapter 2 and the Land Use and Travel Demand Modeling in Chapter 3 reveals a set of gaps in the transportation network as well as opportunities to build on existing and planned infrastructure and services to improve mobility. To address these gaps and opportunities, a set of potential improvements have been identified through in-depth observations of operations in the study area, land use and travel demand modeling, steering committee and stakeholder recommendations, and a review of existing project plans and proposals for the study area.

These potential improvements:

- Support improved operations for vehicles and address potential network bottlenecks.
- Focus on the relationship of area roadways to the adjacent land uses as well as the through traffic that a roadway carries.
- Support improved mobility for other travel modes including walking, bicycling, and transit use. These modes are critical to the current mobility of residents in the study area and are projected to continue their relative importance given the area's proximity to local employment and activity centers and the demographics of the study area.
- Proactively support or address issues that are projected to arise from future development.

This chapter provides a conceptual overview of the identified mobility improvement opportunities including a description of the improvements and analysis of potential impacts, benefits, and challenges of implementation. Where possible, projects have been developed with both short-term and long-term improvements scenarios to support prioritized implementation planning and flexibility based on available funding opportunities.

Developing the Improvement Opportunities

An assessment of existing conditions and the modelling of land use changes and travel demand growth revealed gaps in the study area for providing quality transportation options both now and in the future. Potential improvement opportunities were developed to address these gaps so that the transportation system in the East End will continue to support existing residents and businesses as well as future development.

The transportation network represents a set of nested networks that serve each of the travel modes. These networks should be integrated to support an optimal system for mobility and access. Sources such as the Journey to Work Data from the U.S. Census and transit ridership data from METRO show that while vehicle trips represent the largest component of trips in the study area, transit, walking, and biking are also important modes. Therefore, potential improvements have been developed that address mobility across multiple modes of travel and have been categorized based on the primary travel mode that would benefit from the improvement.

Although categorizing improvements can help articulate the various improvements in a structured manner, it can also obscure the fact that the improvements can benefit multiple modes of travel if implemented in a coordinated manner through design and implementation. For example, creating new grade separations for major rail crossings may have benefits to both vehicle traffic operations and safety as well as pedestrian movements if appropriate accommodations are provided in the grade crossing design. Conversely, the impact of improving mobility for one mode can have a neutral or adverse impact on other modes that should be considered as part of any potential improvement. Frequently, mobility decisions involve a trade-off in the allocation of available right-of-way, implementation costs, and corresponding level of service for various travel modes.

Analysis of existing and future land uses indicates that there is opportunity for significant redevelopment within the study area. These opportunities include redevelopment of existing parcels that remain unimproved or vacant. Major public investments such as the new Southeast and East End light rail lines could support higher density redevelopment by providing a suitable level of mobility. There are also areas, particularly along Buffalo Bayou, where large parcels may be available for redevelopment. Recognizing this potential for redevelopment, improvements to parking, future roadway connections, and barriers have been identified that emphasize compatibility between land use and infrastructure.

Potential mobility improvements have been classified as follows:

ROADWAY & INTERSECTION

These improvements primarily impact the mobility of passenger vehicles and trucks on the areas roadways. These address capacity bottlenecks due to operations, intersection and roadway geometry, and network connectivity. The improvements also address opportunities to better align the roadway cross sections, operational characteristics, and capacity with the desired land use context and projected traffic volumes while maintaining acceptable roadway Level of Service (typically LOS D or better).

TRANSIT

These improvements support increased transit service levels and ridership within the study area. Potential improvements focus on both enhancing existing service and eliminating barriers to access for potential transit users.

PEDESTRIAN & BICYCLING

These improvements primarily benefit mobility for walking and cycling trips and the development of an enhanced pedestrian and bicycles network, including locations where shared or dedicated facilities would provide improved connections to activity centers or address the crossings of major barriers.

Opportunities have also been identified to provide improved navigation and directions for people travelling in the study area and heading to major destinations. They improve comprehension of the transportation network for all modes of travel.

DEVELOPMENT

These improvements proactively support continued or enhanced mobility and access within the study area as development occurs. These include opportunities such as defining enhancements to the roadway network or potential for future regional issues such as parking that may not be major mobility factors now but will become more important as development increases and trip levels increase.

For each identified improvement opportunity, the following areas have been defined to achieve the mobility benefits of the opportunity:

- **Description of Potential Improvement** – a description of the existing specific mobility challenges including gaps and the opportunities for improvement that would support the project goals.

- **Implementation Projects** – a summary of specific identified projects that, if implemented, would realize the improvement opportunity. In some cases, a series of projects have been grouped in a logical fashion to support coordination, phasing, and funding. Projects are labeled as shown below:

(Improvement Opportunity) - (Project number)

- **Analysis of Mobility Impacts** – detailed assessment of the potential mobility impacts of the improvement including changes in level and quality of service, ridership or usage, and safety across all modes.

- **Benefits** – summary of potential positive impacts to mobility for various travel modes.

- **Challenges** – summary of potential obstacles to implementation and explicit trade-offs that would be made.

- **Mobility Goals Addressed** – because many of these improvements would impact several of the mobility goals outlined in Chapter 3 of this report, primary and supporting goals that would be supported by the identified improvement opportunity have been identified.

- **Important Partners** – identify potential organizations and agencies that would be critical to implement, fund, and approve potential improvements.

Chartres Street

Summary of Improvement Opportunities

The following is a summary of the potential mobility improvements that have been defined for the study area. Figure 4.1 shows the general location of each of the improvement areas. Detailed descriptions of each potential improvement are outlined on the following pages. It is also important to understand how these networks connect and interrelate to each other.

ROADWAY & INTERSECTION

R1: Improve key intersection operations (e.g., Navigation at Sampson/York, Jensen/Runnels, and Canal; Dowling at IH-45/Pease)

R2: Improve connectivity for all modes between the Second Ward / Fifth Ward neighborhoods and EaDo / Downtown

R3: Assess multi-modal mobility impacts of East End Master Plan recommendations on Navigation Boulevard and adjacent roadway network

R4: Assess Sampson/York one-way pair multi-modal operations including potential benefits and challenges of conversion to two-way operations

R5: Improve Chartres Street as both a gateway to the East End and Downtown and as a barrier to mobility

TRANSIT

T1: Develop Enhanced Transit Corridors for both east-west and north-south travel

T2: Identify mobility improvements that would support and integrate with East End Urban Circulator implementation

PEDESTRIAN & BICYCLING

PB1: Pedestrian improvements to support transit, address barriers and encourage more walking trips

PB2: Comprehensive area bicycle improvements that connect the Columbia Tap, MKT, Harrisburg and Buffalo Bayou Trails and Major Destinations

PB3: Implement regional wayfinding system targeting pedestrian-bicyclist connections as well as automobiles

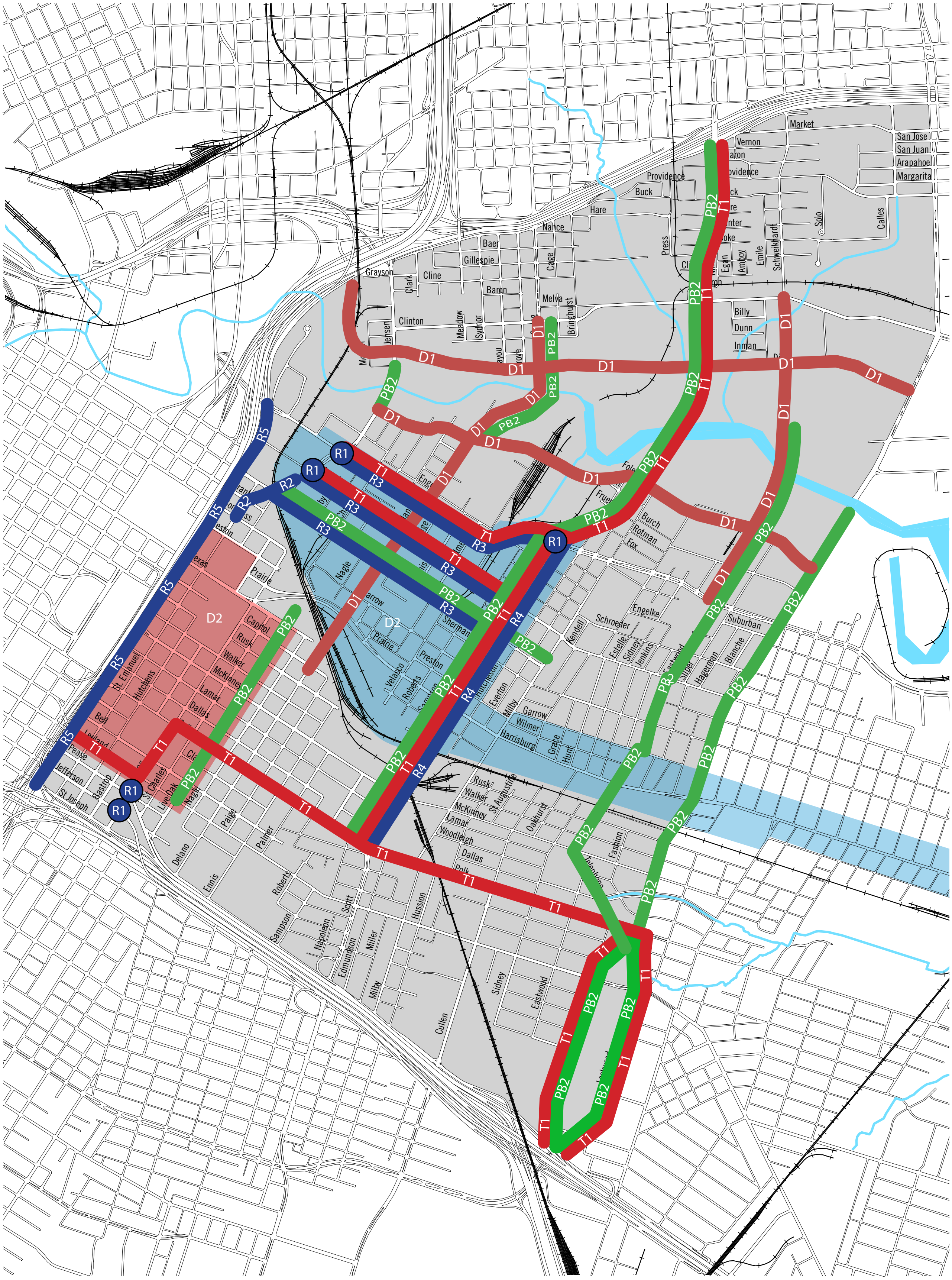
DEVELOPMENT

D1: Support high level of connectivity in future roadway network (e.g., new collectors for thoroughfare plan)

D2: Develop parking management approach for activity centers

NOTE: Improvements T2, PB1, and PB3 do not show up on the map as they are regional in nature. More specific figures addressing these improvements are provided in the following project descriptions.

Figure 4.1 Study Area Improvement Opportunities



0 0.25 0.5 0.75 1 Miles

R1 Corridor Improvement

PB1 Intersection Improvement

R1: Improve key intersection operations (e.g., Navigation at Sampson/York, Jensen/Runnels and Canal, Dowling at IH-45/Pease)

Description of Potential Areas of Improvement

Several intersections in the study area were identified as that create exceptional issues for mobility, safety, difficulty for pedestrians, and vehicular capacity. These intersections are listed below, with a summary of the identified issues:

Navigation Boulevard / Jensen Drive / Runnels Street:

The existing geometry and signal timing do not appear to maximize vehicular capacity. The sweeping right turns on the northbound and westbound approaches create crossing difficulties for pedestrians. The northbound sweeping right turn is signalized, which can be confusing to drivers and also does not appear to be efficiently coordinated with the main signal. The signal pole in the center of the intersection creates a hazard for drivers. The extent of the intersection is intimidating for pedestrians and bicyclists and creates a physical and psychological barrier between activities east of the intersection (e.g. restaurants and Our Lady of Guadalupe Church) and the Guadalupe Plaza park west of the intersection.

Navigation Boulevard at Canal Street:

There may be opportunities to reconfigure this intersection to provide superior mobility for vehicles and crossings for pedestrians. Bastrop Street between Navigation Boulevard and Commerce Street creates conflicts and confusion at the intersection because drivers frequently turn from Bastrop Street onto Navigation Boulevard to access the underpass, and other drivers turn left from Navigation Boulevard onto Bastrop Street. Additionally, pedestrians have to cross a long distance (approximately 100 feet) to cross Navigation Boulevard.

Navigation Boulevard at York Street / Sampson Street:

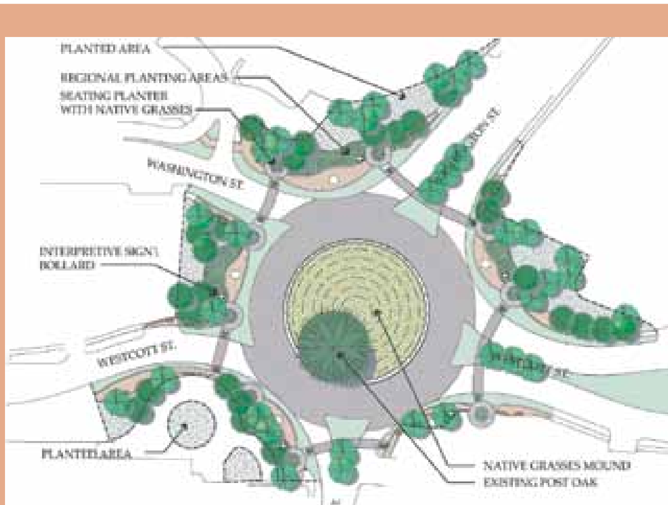
The close spacing of these intersections limits capacity and can be confusing for drivers, particularly those on Navigation Boulevard who see two traffic signals (one for York Street and one for Sampson Street). The split nature of the existing intersection decreases efficiencies for left-turns and increases overall intersection delays. Similarly, pedestrians walking along Navigation Boulevard have higher delays because they must wait at two pedestrian signals in order to cross this intersection.

Pease Street, Jefferson Street, and St. Joseph Parkway at Dowling Street:

Freeway traffic on IH-45 integrates with the local street grid of EaDo and Downtown at these three intersections. The traffic tends to be high speed, which increases the likelihood and potential severity of crashes. These intersection experienced a relatively high number of crashes (35) during the 2006-2010 analysis period though the crash rates are low due to the high traffic volumes. The high speeds also make the corridors hostile to bicyclists and pedestrians, which hampers the viability of a community environment in EaDo. Additionally, the right turn onto Dowling Street from the freeway off-ramp conflicts with the westbound approach of Pease Street at Dowling.

Chartres Street at Runnels Street:

Traffic on Chartres Street passes through the intersection at high speeds to access the IH-10 access ramp north of Runnels Street. These high speeds can make crossing the road difficult for vehicles, pedestrians, and bicyclists trying to access Downtown, Bute Park, or the Heritage East bicycle rail to trail. The northbound left-most lane of Chartres Street is an entrapment lane that forces



More Information: Roundabouts

Roundabouts may be used as a form of neighborhood branding, being incorporated into street design as the gateway to a community with distinct features associated to an area.

The Washington-on-Westcott Roundabout, shown on the left, is a landmark with sculptures and native plants that also serves as a moment for orientation with the use of neighborhood signs directed toward drivers and pedestrians.

Washington on Westcott Roundabout, Houston, TX a left-turn at the intersection, creating confusion for drivers who wish to continue straight onto IH-10.

Implementation Projects

R1-1: Construct a roundabout at the intersection of Navigation Boulevard / Jensen Drive / Runnels Street. As shown in Figure 4.2, a roundabout would increase safety by simplifying the turning movements, slowing down vehicular traffic, and decreasing crossing distance for pedestrians while maintaining equal or better traffic operations. The roundabout design shown in the figure was found to accommodate WB-50 and larger vehicles, including full-size buses.

Alternatively, the geometry of the intersection of Navigation Boulevard / Jensen Drive / Runnels Street could be redesigned using a standard traffic signal to provide improved capacity, pedestrian accessibility, and compatibility with planned changes to Navigation Boulevard over that provided by the existing intersection geometry.

R1-2: Consider the intersection of Navigation Boulevard at Canal Street in the design of the Navigation Boulevard / Commerce Street grade separation at West Belt rail line.

The reconstruction of the underpass will likely impact the intersection and may require the closing of Bastrop Street between Commerce Street and Navigation Boulevard. These construction activities present an opportunity to rebuild the intersection to provide improved accommodations for vehicles as well as bicyclist and pedestrians. In particular, medians on Navigation Boulevard would assist pedestrians crossing the road by providing a refuge to cross each direction of traffic sequentially.

R1-3: Reconstruct the intersection of Navigation Boulevard / York Street / Sampson Street as part of a conversion of York Street and Sampson Street to two-way roads.

Figure 4.3 Conceptual Plan for Navigation Boulevard at York Street Roundabout

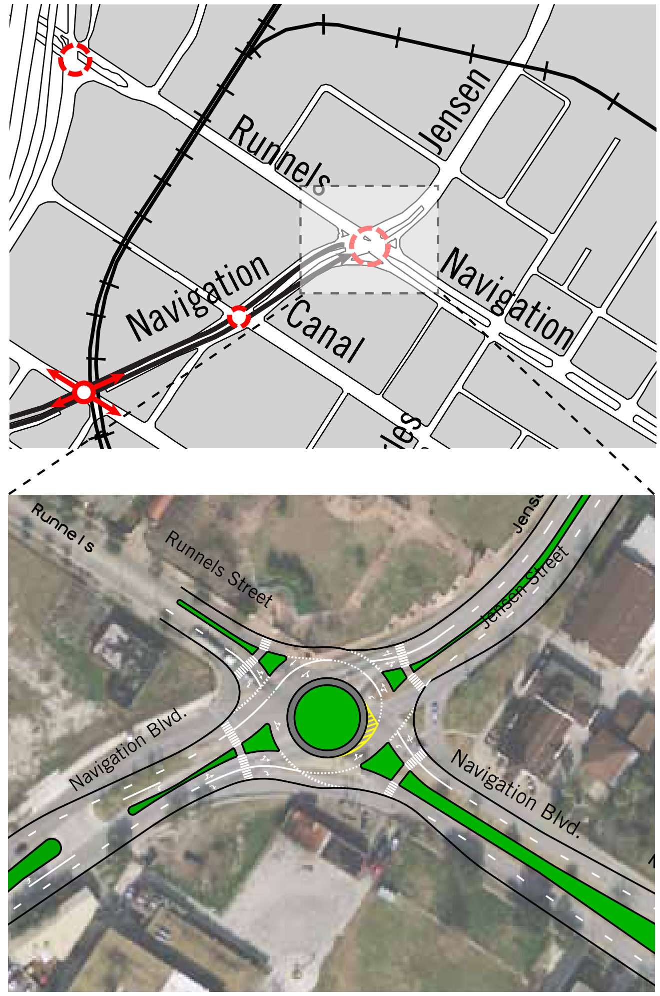


Figure 4.2 Conceptual Plan for Navigation Boulevard at Jensen / Runnels Roundabout

Hirsch Road would naturally align with York Street to form a standard signalized four-leg intersection or a multilane roundabout (see Figure 4.3). Sampson Street could form a T-intersection with Navigation Boulevard with nominal impacts to vehicular mobility.

R1-4: Close westbound Pease Street at Dowling Street (see Figure 4.4.). This movement is unneeded for general mobility and complicates turning movements at the intersection.

Further study will be needed at the Dowling Street intersections to identify a full set of improvements to mobility, accessibility, and safety. Fully achieving all desired goals for these intersections may require extensive roadway construction including modifications to the ramps that tie into IH-45. The proposed design for the IH-45 to US 59 direct connectors do not impact the recommendation.

R1-5: Install a traffic signal or construct a roundabout at the intersection of Chartres Street at Runnels Street. A traffic signal would assist pedestrians and bicyclists in crossing the road, and a roundabout would decrease crossing distances while simultaneously slowing vehicles down to safer speeds. It would also provide an opportunity to eliminate the northbound entrapment lane.

Analysis of Impacts

A planning-level analysis of operations of a roundabout at the intersection of Navigation Boulevard / Jensen Drive / Runnels Street was performed. The analysis considered two roundabout configurations: a single-lane roundabout and a multi-lane roundabout. The operations were analyzed using existing and future (2035 Master Plan/TOD scenario) volumes. An analysis of traffic signal operations assuming geometric and signal modifications at the intersection was also performed. The results of the analysis are summarized in the Table 4.1 below.

Table 4.1 LOS for Various Intersection Operations

Navigation / Jensen / Runnels LOS / Delay (s) per vehicle				
	AM Peak		PM Peak	
	Existing	Future	Existing	Future
Single-lane Roundabout	A / 9	F / 271	A / 9	F / 77
Multi-lane Roundabout	A / 5	C / 22	A / 6	B / 11
Signal with Modifications	C / 20	D / 39	B / 16	C / 29

As shown in the table, all three options would operate with satisfactory levels of service (LOS) with existing volumes. With 2035 Master Plan/TOD scenario volumes, a single lane roundabout would operate at LOS F during the peak hours, a traffic signal with geometric and signal modifications would operate with acceptable delays, and a multi-lane roundabout would operate with the lowest overall delays.

A planning-level analysis of operations of a traffic signal at the intersection of Navigation Boulevard with two-way York Street was performed. The eastbound, westbound, and southbound approaches of the intersection were assumed to provide one left-turn lane, one through lane, and one shared through/right-turn lane. The northbound approach was assumed to provide one left-turn lane and one shared through/right-turn lane; this lane configuration would enable the approach to fit within the existing pavement of York Street. The projected intersection delays and LOS for the 2035 Master Plan/TOD scenario are presented in the Table 4.2.

Table 4.2 LOS for Two-way York Street at Navigation Boulevard

Navigation Boulevard at Two-way York Street LOS / Delay (s) per vehicle		
	AM Peak	PM Peak
Existing (volumes & geometry)	B / 17	B / 16
Future (volumes & proposed geometry)	C / 33	D / 40

As shown in the table, the intersection of Navigation Boulevard at two-way York Street is projected to operate at LOS D or higher for the peak hours of 2035 using 2035 Master Plan/TOD scenario volumes. The capacity of the intersection could be increased further by widening the northbound approach to provide one left-turn lane, one through lane, and one shared through/right-turn lane.

Figure 4.4 Illustration of Project R1-4, Closing of Westbound Pease at Dowling.

R1: Improve key intersection operations (e.g., Navigation at Sampson/York, Jensen/Runnels and Canal, Dowling at IH-45/Pease)

Implementation Projects

- **R1-1:** Roundabout at intersection of Navigation and Jensen
- **R1-2:** Improvements to intersection of Canal and Navigation
- **R1-3:** Intersection improvements or roundabout at intersection or Navigation and York
- **R1-4:** Close westbound Pease at Dowling
- **R1-5:** Traffic signal or roundabout at intersection of Chartres and Runnels

Benefits

- Potential roundabouts at the intersections of Navigation Boulevard and Jensen Drive, Navigation Boulevard and York Street, and Chartres Street at Runnels Street would improve safety, capacity, and pedestrian accessibility
- General improvements to safety and comprehensibility of intersections in study area

Challenges

- A roundabout at the intersection of Navigation Boulevard / Jensen Drive / Runnels Street will require extensive geometric modification of the roadways to accommodate the approach angles and minimize travel speeds
- Multi-lane roundabouts can be difficult to cross for pedestrians and may require a pedestrian beacon. Proposed designs mitigate this challenge by providing single lane exits where possible
- Improvements to the intersections of Pease Street, Jefferson Street, and St. Joseph Parkway at Dowling Street may require extensive roadway reconstruction. In particular, the on- and off-ramps of IH-45 create geometric constrictions and would likely need to be modified to make meaningful changes to the intersections

Mobility Goals Addressed

Primary:

- Goal 5: Reduce safety concerns – Improvements to the identified intersections will likely increase safety for motorists and pedestrians by making the intersections more logical for all users and more accessible for pedestrians

Secondary:

- Goal 1: Address short and long-term capacity constraints and opportunities – Vehicular capacity at the intersection of Navigation Boulevard / Jensen Drive / Runnels Street is projected to increase with installation of a multi-lane roundabout. Vehicular capacity is also projected to increase at the intersection of Navigation Boulevard at York Street with the proposed two-way configuration of York Street

Important Partners

- Greater East End Management District – For coordination with planned Livable Centers investments
- Gulf Coast Rail District – Modifications to the intersection of Navigation Boulevard at Canal Street would need to be coordinated with the reconstruction of the underpass on Navigation Boulevard at the West Belt rail line
- City of Houston Public Works – Will need to review and approve all changes to intersection geometry, traffic signal functioning, signs, and pavement markings
- TxDOT – Improvements to the intersections of Pease Street, Jefferson Street, and St. Joseph Parkway at Dowling Street will require coordination with TxDOT because of potential impacts to freeway on- and off-ramps
- Developers – May be willing to help fund or provide right-of-way dedications for intersection improvements that impact their developments

R2: Identify opportunities to improve connectivity for all modes between the Second Ward / Fifth Ward neighborhoods and EaDo / Downtown

Description of Potential Improvement

The existing underpass on Navigation Boulevard at the West Belt rail line connects Navigation Boulevard to Franklin Street, thereby providing connectivity between the Second Ward and north Downtown. This underpass was first constructed in 1936 as part of the Navigation Boulevard / Franklin Street corridor that was designated as US 90, the major corridor through Houston until the mid-1950s. However, the placement of the underpass complicates the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street. The intersection is oriented to enable eastbound traffic on Franklin Street to access the Second Ward via the underpass and EaDo via St. Emanuel Street. It also enables traffic on St. Emanuel Street to access the Second Ward via the underpass.

However, the configuration of the intersection does not allow traffic from the Second Ward and Fifth Ward areas to access EaDo directly. That route can only be achieved by entering Downtown via Franklin Street, turning left onto Hamilton Street, turning left onto Preston Street or Texas Avenue, and finally turning right on St. Emanuel Street or Dowling Street. Additionally, because of the lack of freeway ramps onto US 59 in the vicinity of the Second Ward, traffic from the Second Ward intending to access IH-45 South, US 59 South, or US 288 must either make that detour to Dowling Street or detour farther into Downtown to La Branch Street, the first southbound street that accesses the southeast side of Downtown.

Improving connectivity between EaDo and the Second Ward would complement the recommended redesign of St. Emanuel Street that was proposed in the Downtown / EaDo Livable Centers Plan.

Implementation Projects

R2-1: Reconfigure the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street so that Navigation Boulevard is aligned with St. Emanuel Street.

A conceptual plan for what this intersection would look like is shown in Figure 4.5. This configuration would create a continuous north-south corridor from IH-10 to IH-45 via Jensen Drive, Navigation Boulevard, and St. Emanuel Street, as shown in Figure 4.6. This is important for regional mobility as there is no other north-south corridor in the East End between US 59 and the Hirsch / Sampson / York / Scott Street corridor, which is approximately 0.75 miles east. Additionally, a traffic signal is recommended for installation at the intersection when it is warranted.

With this reconfiguration, the westbound movement of Franklin Street between Hamilton Street and St. Emanuel Street becomes redundant and could be removed. Access to Downtown would be available via Congress Street, which would become accessible from Navigation Boulevard. As an additional benefit, making Franklin Street one-way eastbound would improve traffic operations at the intersection of Franklin Street and Navigation Boulevard / St. Emanuel Street if a traffic signal were installed because the signal would require fewer phases.

R2-2: Extend Franklin Street east to join with the intersection of Dowling Street and Congress Street.

This proposed extension is shown on Figure 4.5 in red. Dowling Street serves as an important north-south corridor in EaDo and can serve to relieve traffic on St. Emanuel Street, which will be advantageous if project R2-1 is implemented and results in increased traffic on St. Emanuel Street. Additionally, background traffic growth in EaDo related to development and sports events would benefit from good access to an alternative north-south corridor.

Currently, Dowling Street north of Texas Avenue becomes a one-way feeder onto Congress Avenue; this makes the return trip onto southbound Dowling Street from the north parts of Downtown difficult. An extension of Franklin Street would enable it to serve as the eastbound one-way pair to Congress Avenue, and would therefore simplify the conversion from one-way pairs to a two-lane street.

R2-3: Modify West Belt Rail Study proposal for a grade separation at the intersection of Navigation Boulevard and Commerce Street to align Navigation Boulevard with St. Emanuel Street.

Existing conditions at Franklin St, Navigation Boulevard and St Emanuel St

Map Key

Existing Roadway Movements

New Roadway Movements

Potential Movements to Eliminate

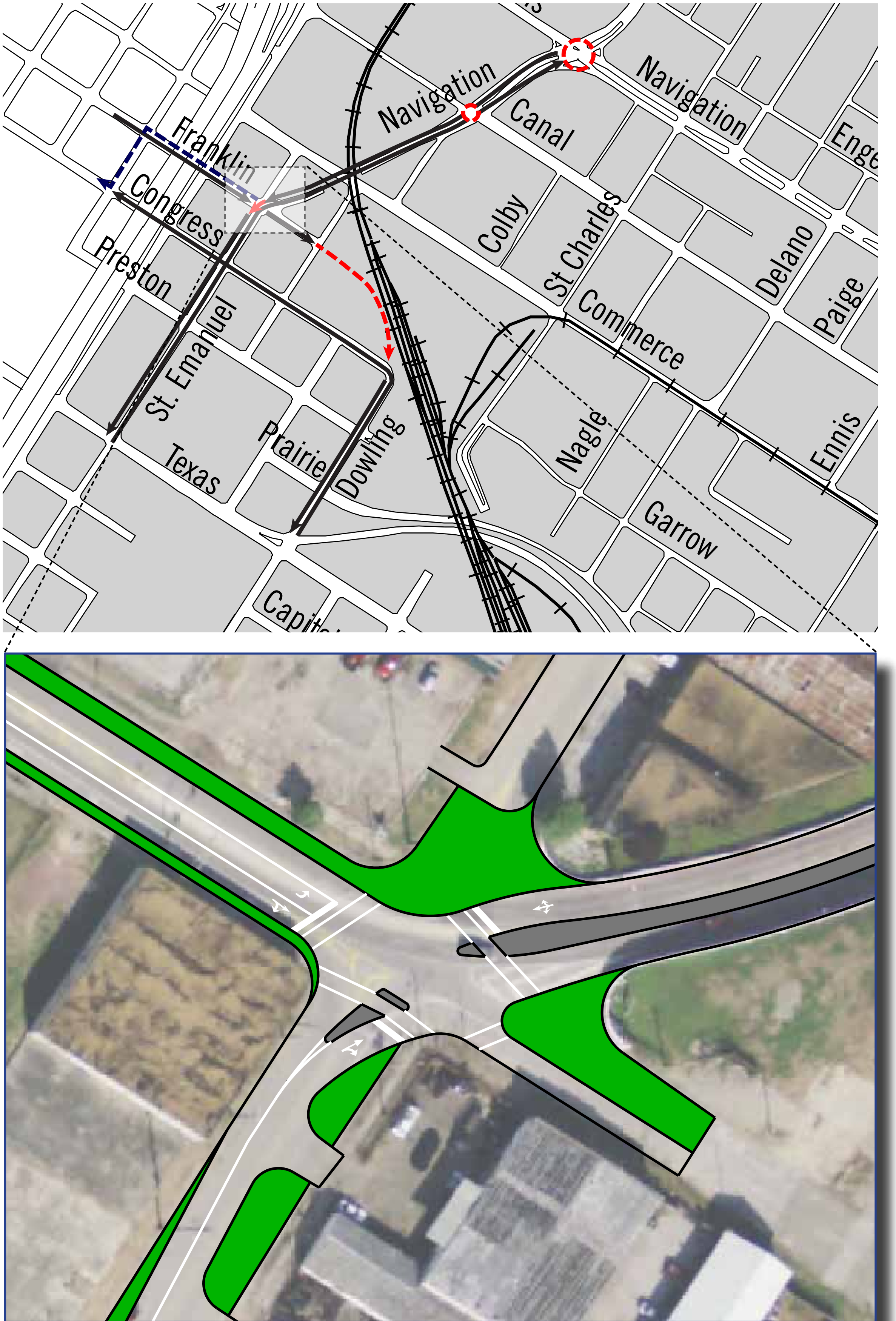


Figure 4.5 Potential Navigation Boulevard at St. Emanuel Intersection Realignment

The Gulf Coast Rail District West Belt Rail Study made recommendations for a new underpass on Navigation Boulevard at the West Belt rail line. This underpass would create a depressed intersection of Navigation Boulevard at Commerce Street beneath the rail line, and as currently proposed would maintain the connection of Navigation Boulevard to Franklin Street.

Under this proposed project, a second alternative for the underpass would be developed that would align Navigation Boulevard directly to St. Emanuel Street. The basic horizontal geometry of the underpass would be similar to the geometry in project R2-1, but the underpass would likely be deeper than the existing underpass, resulting in the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street being depressed below the existing grade.

Analysis of Impacts

A assessment of likely mobility impacts for the major connections is provided below:

- Downtown to Second Ward: Drivers will be able to make a left turn from Franklin Street to St. Emanuel / Navigation Boulevard to utilize the underpass. Because this movement would go from free-flow to signal-controlled, delays are likely to increase. As this is an existing movement, the level of connectivity remains the same.
- Second Ward to Downtown: Drivers will have the new option to continue straight southbound onto St. Emanuel Street and take a right-turn onto Congress Street. This route will likely be preferable because it will require fewer turning movement than using Franklin Street, which requires a left-turn onto Hamilton Street and an additional right-turn onto Congress Street. If Franklin were to remain a two-way street, drivers would still have the option to take a right-turn onto Franklin Street and access Downtown the same way they currently do.
- EaDo to Second Ward: Drivers will be able to continue straight from St. Emanuel Street to Navigation Boulevard. Because this movement will go from stop-controlled to signal-controlled, delays may decrease.
- Second Ward to EaDo: This is the major new point of connectivity from this improvement. Drivers will be able to continue straight from Navigation Boulevard onto St. Emanuel Street and into the heart of the EaDo District. This will be a newly-enabled movement that does not currently exist and will enhance the connectivity between these two neighborhoods.

Based on the proposed change to the intersections of Navigation / Franklin and St. Emanuel Street, overall connectivity will increase with limited impact on vehicular delay. Overall regional delay may actually decline due to the simplification of the roadway network. The roadway network will also operate at an increase level of comprehensibility in that the grid-like nature of the north-south and east-west roads will be improved.

View looking Southwest of St. Emanuel from Navigation Bridge

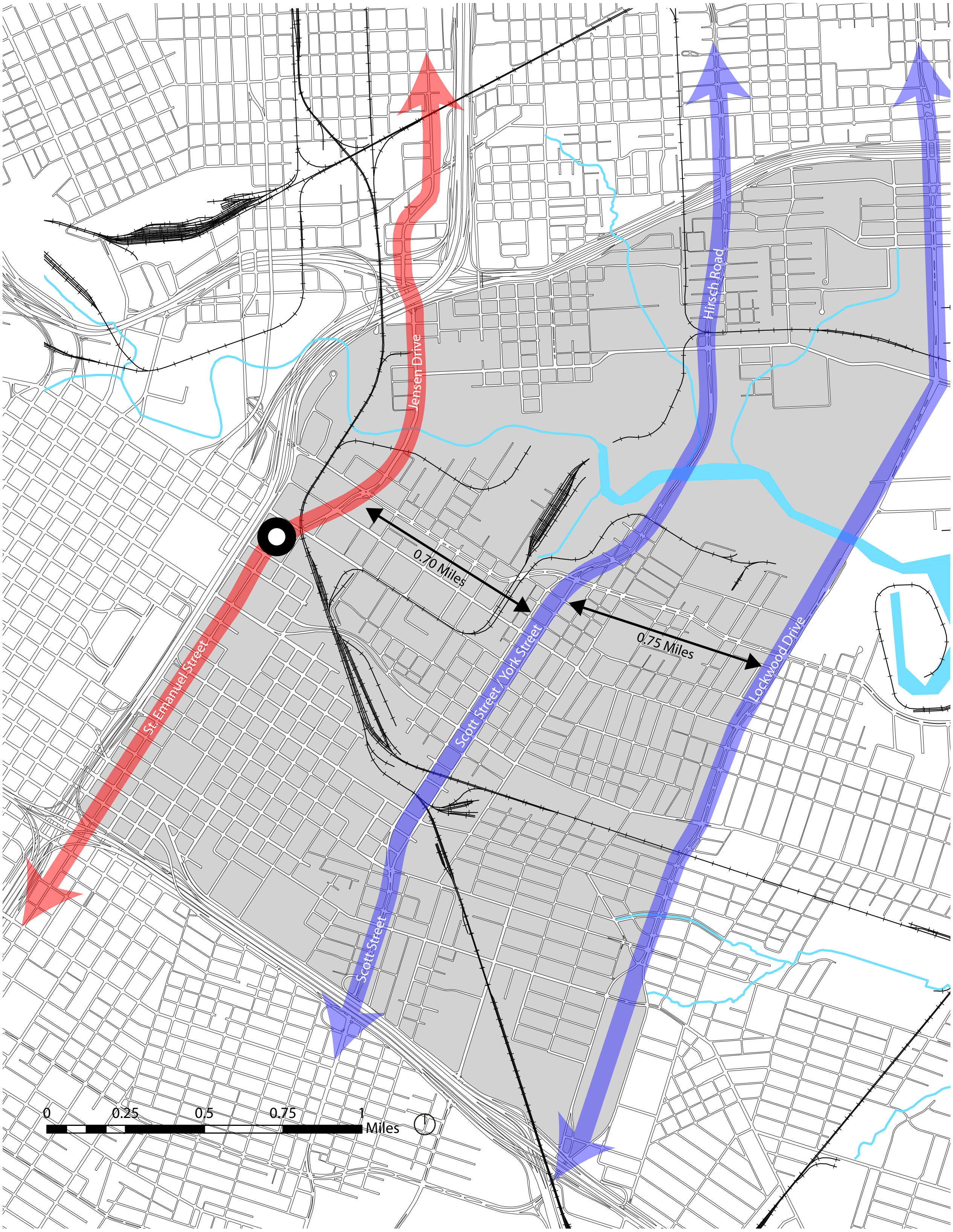


Figure 4.6 St. Emanuel Corridor

Currently, only two corridors provide continuous north-south mobility across Buffalo Bayou and the West Belt / Galveston Subdivision rail lines: Lockwood Drive and Scott / Sampson / York / Hirsch. Providing a southbound movement from Navigation Boulevard to St. Emanuel Street, as shown in Figure 4.5, would create a third continuous corridor and would provide significant mobility benefits to the study area. The corridors would be spaced at approximately ¾ of a mile, which is farther than the MTFP standard of ½ of a mile.

Map Key

- Existing North-South Corridor
- Proposed St. Emanuel/Navigation/Jensen Corridor
- Intersection of St. Emanuel/Navigation/Franklin

Note - Analysis of Proposed St. Emanuel Street One-way Conversion

A further scenario in which St. Emanuel Street is converted to a southbound one-way companion to Chartres Street between Pierce Street and Navigation Boulevard was assessed. This scenario was conceived as a potential method for increasing roadway capacity to accommodate traffic related to sports events at BBVA Compass Stadium and Minute Maid Park, especially because of the potential for on-street parking to reduce capacity on St. Emanuel Street. This arrangement is not proposed for implementation at the time but warrants additional analysis as major development and transportation projects are completed in the area. Short headways of the two future light rail lines crossing St. Emanuel will limit capacity in both directions across Texas Avenue in the area, so maximizing both northbound and southbound traffic wherever possible will be important. Additionally, long-term travel patterns for the area are not known because of the construction related the light rail systems and BBVA Compass Stadium. Finally, one-way operations may have negative impacts on accessibility to the growing number of restaurants, music and entertainment venues, and other destinations in EaDo.

Much of the traffic traveling southbound on St. Emanuel Street after sporting and other events is likely destined for IH-45, US 59, or SH 288 – all of which are accessed on the south side of EaDo. Therefore, improving access to the freeway system should be explored to address traffic issues on St. Emanuel Street. Improving signage and wayfinding that identifies preferred corridors for accessing the freeway system is a low-cost, short-term opportunity for accomplishing this.

Over the long-term, providing an additional access point to southbound US 59 on the north side of Downtown would prevent this traffic from having to travel south through EaDo. It would also reduce the potential for traffic conflicts with the light rail lines, which will be running with short headways throughout the day and especially at peak hours. The exact location for such a ramp would have to balance ease of use and comprehensibility, right-of-way acquisition, impact on adjacent roadways and ramp geometry. There may be an opportunity to further analyze this idea in the upcoming TxDOT comprehensive study of access to Downtown.

More Information: Pavement to Parks

Streets and public right-of-ways make up a large portion of cities' land area. Though these critical components weave the urban fabric together, they often become underutilized, under-maintained spaces. The Pavement to Parks projects in San Francisco, as well as installations in other cities, activate these areas through design interventions. Projects range from the creation of temporary public plazas and pedestrian- and bicycle-safe zones to the introduction of inexpensive landscaping and street furniture. Minimal interventions can create a more inviting public space, while mobilizing communities to take part in the evolution of public realm.

Pavement to Parks project: "Castro Commons", 17th and Castro, San Francisco, CA

R2: Identify opportunities improve connectivity for all modes between the Second Ward and Fifth Ward neighborhoods to EaDo and Downtown

Implementation Projects

- **R2-1:** Reconfigure the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street so that Navigation Boulevard is aligned with St. Emanuel Street
- **R2-2:** Extend Franklin Street east to join with the intersection of Dowling Street and Congress Street
- **R2-3:** Modify West Belt Rail Study proposal for a grade separation at the intersection of Navigation Boulevard and Commerce Street to align Navigation Boulevard with St. Emanuel Street

Benefits

- Creates a continuous north-south corridor providing a clear connection between the developments in the East End, Fifth Ward and those in EaDo, including restaurants, museums, music venues, and the Dynamo Stadium
- Improves comprehensibility of the entire roadway network in the area; whereas today Franklin Street is an east-west street that becomes a north-south street at Navigation Boulevard, which then again becomes and east-west road, under the proposed configuration it would intersect the north-south road as all other east-west Downtown streets do in EaDo. Maintaining consistency of east-west and north-south streets will help drivers understand the roads and more easily navigate throughout the area

Challenges

- Represents change in the roadway network likely requiring community outreach and support. The benefits will need to be clearly explained to ensure people understand the impacts
- Timing of improvements will be important to consider. The West Belt Rail Study recommendation will require complete reconstruction of the intersection of Navigation Boulevard / Franklin Street / St. Emanuel Street. Depending on the timing of this reconstruction, implementing R2-1 may not make financial sense if the West Belt Rail Study recommendations were to be implemented quickly because they would require undoing all of the intersections modifications of R2-1

Mobility Goals Addressed

Primary:

- Goal 2: Address barriers to mobility and increase connectivity

Secondary:

- Goal 4: Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans
- Goal 5: Reduce safety concerns

Important Partners

- City of Houston Public Works – Will need to review and approve all traffic signal and intersection modifications
- Gulf Coast Rail District – Has developed recommendations for the Navigation Underpass as part of the West Belt Study and would be an important partner for coordinating modifications to the underpass and the intersection and also coordinating with the railroad
- Union Pacific Railroad – May need to be included in any discussions for modifying the Navigation Boulevard underpass in any way that could impact rail operations

R3: Assess East End Master Plan recommendations for Navigation Boulevard and adjacent roadway network

Description of Potential Improvement

The East End Master Plan outlines a vision for the roadway network in the Greater East End area that would simultaneously provide sufficient vehicle mobility as well as improved opportunities for alternate travel modes including walking, biking, and transit. The Master Plan also outlines a vision for enhanced public rights-of-way to allow a greater level of activity in the pedestrian realm and potentially in the roadway median along Navigation Boulevard. The objective of this improvement is to assess the mobility impacts of potential modifications to the roadways in this area.

The primary corridors to be assessed include the three roadways that provide east-west connectivity through the East End area between the Sampson Street / York Street one-way pair on the east and Jensen Drive / Navigation Boulevard corridor on the west. These three roadways are (from north to south):

- Navigation Boulevard – currently a four-lane roadway with on-street parking and classified as a Principal Arterial (P-6-120) on the City of Houston Major Thoroughfare and Freeway Plan (MTFP). Estimated traffic on Navigation Boulevard in the analysis area shows a growth from 7,500-8,000 Average Daily Trips (ADT) in 2011 to approximately 14,000-15,000 in 2035 for all growth scenarios.
- Canal Street – currently a four-lane roadway classified as a two-lane Major Collector (C-2-65) on the MTFP. Estimated traffic on Canal Street in the analysis area is approximately 10,000-11,000 ADT in 2035.
- Commerce Street – currently a two-lane roadway with two wide lanes (20' or more) and not classified as a thoroughfare or collector on the city MTFP. Estimated traffic on Canal Street in the analysis area is approximately 7,000-8,000 ADT in 2035.

Altogether these three roadways provide the primary east-west mobility through the Greater East End for all modes of transportation and, combined, are projected to carry a 31,000-34,000 vehicles per day in 2035. All three roadways connect the same regional origins and destinations and provide parallel access between Sampson/York and the Jensen Drive/Navigation Underpass, such that a motorist could choose any of the three for equivalent mobility through the study area.

Determining the design and overall vision for Navigation Boulevard, Canal Street, and Commerce Street is an important component for mobility in the East End and the surrounding region. Potential improvements to these corridors have been assessed for both short and long-term implementation time horizons. In combination with other potential mobility improvements, opportunities that leverage the available capacity within the roadway cross sections have been identified. It is assumed that a minimum of ten feet of pedestrian realm area is available on both sides of each roadway for sidewalks and other items such as shade trees and signage.

Implementation Projects

R3-1: Modify Navigation Boulevard cross section.

The Greater East End Management District (GEEMD) has developed a plan for Navigation Boulevard that would revise the roadway cross section from approximately St. Charles Street to Palmer Street to create a local "Main Street" as shown in Figure 4.7. Realizing this vision would require the roadway pavement to be reduced to either:

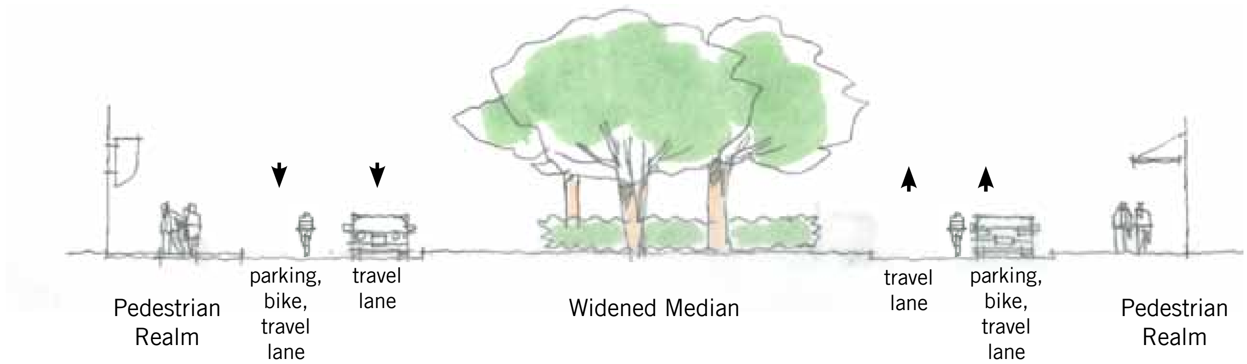
- Two travel lanes in each direction, preferably with off peak parallel parking in the outside lane, or
- One travel lane in each direction with dedicated on-street parking

These modifications would allow for the Master Plan proposals for median enhancements and widening between St. Charles Street and Delano Street and median modifications and on-street angled parking between Delano Street and Palmer Street. Enhanced pedestrian realm accommodations would improve access and activity along the adjacent development tracts.

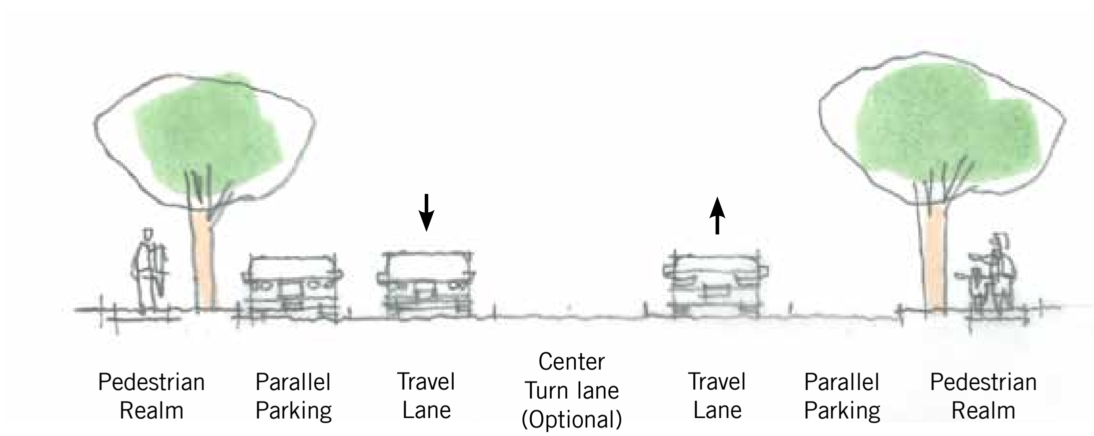
R3-2: Modify cross sections of Canal Street and Commerce Street with pavement markings and minor pavement repair.

- Canal Street: Restripe with a three-lane cross section consisting of one through-lane in each direction and one center turn lane. Use remainder of pavement for parking or bike lanes.
- Commerce Street (west of Palmer Street): Restripe with a two-lane cross section consisting of one through-lane in each direction. Use remainder of pavement for parking or bike lanes. Providing an asphalt overlay on the edges of the roadway may be necessary in some locations.

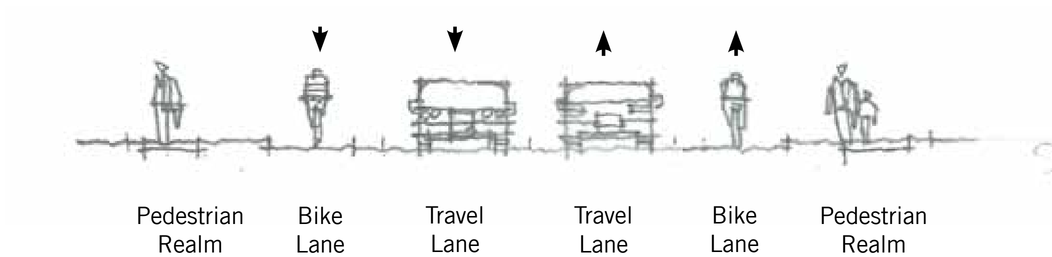
These cross sections would provide adequate capacity for projected traffic volumes and create potential for other dedicated uses within the roadway including on-street parking or bicycle lanes. Three lane cross sections have been shown to maintain access and vehicle capacity while having the potential to improve safety in comparison to a four lane road because of fewer left turn conflicts.



Navigation Boulevard (120' ROW): four-lane boulevard section with median design to allow for both greater activation (St. Charles Street to Delano Street) and angled parking (Delano Street to Palmer Street).



Canal Street (65' ROW): two or three-lane roadway with parallel on-street parking to support increases commercial development expected on the corridor.



Commerce Street (60' ROW): two-lane roadway with bicycle lanes on both sides of the road providing dedicated, direct connection from the Downtown to the Harrisburg shared use trail.

Figure 4.7 Potential Roadway Cross Sections for East End Roadways

R3-3: Reconstruct Canal Street with cross section that emphasizes vehicular mobility and parking.

R3-4: Reconstruct Commerce Street with cross section that emphasizes vehicular and bicycle mobility.

At some point in the future, Canal Street and Commerce Street will likely need to be reconstructed, which will present an opportunity to comprehensively consider the role of each roadway in the larger transportation network. The final cross sections should consider development trends and potential future demand to optimize the corridors to meet those needs. These two proposed implementation projects represent a vision of the role and function that each road could serve in the context of an integrated transportation network. Potential cross-sections for each of these corridors are shown in Figure 4.7 and are summarized below:

- Canal Street (Major Collector with enhanced parking): three-lane roadway with one through lane in each direction, a two-way center left turn lane, and parallel on-street parking on both sides of the road. Increasing the availability of on-street parking will support continued development along the corridor.
- Commerce Street (Minor Collector with bicycle priority): two-lane roadway with one through lane in each direction and bicycle lanes on both sides of the road. The bicycle lanes would provide a dedicated, direct connection from Downtown and the potential northern extension of the Columbia Tap shared-use trail to the Harrisburg shared-use trail.

The implementation of these improvements in coordination with other improvements outlined in this report should support the long-term mobility of the East End for both existing and future development while supporting the Master Plan goals of increased mobility, transportation choice, and economic development.

Analysis of Impacts

Based on existing volumes, each roadway would operate at LOS C or better with a cross section consisting of two through lanes. Based on the projected traffic volumes for 2035, the following number of through lanes are estimated to be needed to maintain LOS D or better:

- Navigation: 4 lanes
- Canal Street: 2 lanes
- Commerce Street: 2 Lanes

However, if the traffic volumes are assumed to balance out equally across these three roadways, each would carry between 10,000 and 12,000 vehicles and would operate at acceptable levels of service as a two lane roadway for future conditions. The likelihood that these roadways achieve balanced traffic volumes will likely be influenced by a number of factors including roadway quality and cross section design, improvements to grade separations for the West Belt Subdivision, adjacent development activity, and the availability (or lack) or quality transit options.

Table 4.3 shows the current and projected traffic volumes on Navigation Boulevard, Canal Street and Commerce Street.

Santana Row, Santa Cruz, CA

Table 4.3 Estimated Roadway Level of Service

Roadway	Year	Estimated Traffic Volumes	Analyzed # of Lanes	Level of Service Estimate
Navigation Boulevard	2011	7,500-8,000	4 (2)	C (C)
	2035	14,000-15,000	4 (2)	D (D/E)[1]
Canal Street	2011	4,000-5,000	4	C
	2035	9,000-11,000	2[2]	D
Commerce Street	2011	3,000-5,000	2	C
	2035	7,000-8,000	2	D

1 - With 2 lanes through lanes, Navigation Boulevard is projected to operate at LOS E if no traffic shift occurs and LOS D if some traffic shifts to parallel routes. Commerce Street and Canal Street are projected to operate at LOS D in 2035 regardless of a traffic shift.

2 - With Two Way Center Turn Lane

Based on this analysis, the roadways are projected to operate at acceptable or better levels of service for all scenarios with either their existing cross sections or with the potential cross sections discussed in this section.

Although Navigation Boulevard is designated as a Principal Thoroughfare with six lanes on the MTFP, it is unlikely to carry sufficient vehicle traffic to require six travel lanes by 2035. Navigation Boulevard will also likely be assessed as a potential route for an Urban Circulator as part of the East End Alternatives Analysis. Design decisions on the corridor should allow implementation of a future circulator line if this corridor is selected as the locally-preferred alternative.

The potential improvements for these east-west corridors would offer additional benefits to other travel modes. The enhancement of sidewalks on each of the corridors would increase the ability to walk to and through the area. Six-foot sidewalks would operate at a projected multi-modal level of service of LOS C or better for future conditions if the sidewalks are maintained in good condition.

The installation of dedicated bicycle lanes along Commerce Street would create a dedicated connection from Downtown to the Harrisburg Trail. Five-foot bike lanes are projected to operate in the range of LOS B to LOS C, primarily depending on pavement quality and vehicle speeds. This also assumes that the existing rail tracks along Commerce are effectively addressed for safe coexistence with bicycle traffic. Commerce Street would serve as a main east-west bicycle corridor and provide a short connection on a low-volume street to many important destinations in the local area.

R3: Assess multi-modal mobility impacts of East End Master Plan recommendations on Navigation Boulevard and adjacent roadway network

Implementation Projects

- **R3-1:** Modify Navigation Boulevard cross section
- **R3-2:** Modify cross sections of Canal Street and Commerce Street with pavement markings and minor pavement repair
- **R3-3:** Reconstruct Canal Street with cross section that emphasizes vehicular mobility and parking
- **R3-4:** Reconstruct Commerce Street with cross section that emphasizes vehicular and bicycle mobility

Benefits

- Improves the context-sensitive nature of the area roadways
- Aligns the vision of the community-supported East End Master Plan including future economic development objectives
- Maintains acceptable or better levels of service for vehicles on area roadways
- Improves level of service for other modes including walking, biking, and transit

Challenges

- May require modification of the City Major Thoroughfare Plan for Navigation Boulevard (reduction in designated lanes or change in classification) and Commerce Street (added as a collector)
- Achievement of full mobility benefit may require improvements to the pavement quality, especially along Commerce Street

Mobility Goals Addressed

Primary:

- Goal 4: Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans.

Secondary:

- Goal 1: Address short and long-term capacity constraints and opportunities
- Goal 3: Enhance multi-modal trip alternatives and transportation choice

Important Partners

- Greater East End Management District
- City of Houston – Public Works
- City of Houston – Planning Department

R4: Assess Sampson/York one way pair multi-modal operations including potential benefits and challenges of conversion to two way operations

Description of Potential Improvements

Sampson Street and York Street are currently configured as a one-way pair between Polk Street and Navigation Boulevard, connecting to Scott Street on the south and Hirsch Road on the north. They are both four-lane, 44-foot wide roadways classified as Major Thoroughfares.

ROW along York Street ranges from 70 to 80 feet, and projected traffic between Polk Street and Navigation Boulevard in 2035 is approximately 8,000-12,000 ADT. ROW along Sampson Street ranges from 75 to 80 feet, and the projected traffic between Polk Street and Navigation Boulevard in 2035 is approximately 8,000-13,000 ADT.

Capacity requirements for future and projected traffic indicate that a total of four to six lanes across these two roadways is sufficient to maintain adequate north-south Level of Service through the corridor.

Implementation Projects

R4-1: Modify cross sections on York Street and Sampson Street with pavement marking modifications.

Given the capacity requirements on Sampson Street and York Street, there is an opportunity to revise the roadway striping to support more multi-modal transportation choices. Based on current and projected volumes, two travel lanes in each direction are projected to be sufficient to meet vehicle capacity needs. This cross section could be accomplished with low-cost modifications to pavement markings. Potential cross sections could be:

- Two 11-foot travel lanes, one 14-foot shared bicycle / travel lane, and one 8-foot parking lane, or
- One 8-foot parking lane, two 11-foot travel lanes, one 6-foot bike lane, and one 8-foot parking lane, or
- Three 10-foot travel lanes, one 6-foot bike lane, and one 8-foot parking lane

R4-2: Convert York Street and Sampson Street to two-way roads.

Sampson Street and York Street could be converted to two-way operations between Navigation Boulevard and Polk Street. This conversion would have multiple mobility benefits: York Street could be aligned as the major through street, and Sampson Street could serve as a local collector street.

As shown in Figure 4.8, the two roads could be configured as:

- York Street: two travel lanes in either direction to function as the main thoroughfare connecting Hirsch Road to Scott Street, both of which provide four travel lanes
- Sampson Street: parallel parking on one side of the street, one bike lane and one travel lane in either direction, and bulb-outs at intersections to encourage slow travel speeds and ease pedestrian crossings

At Navigation Boulevard, Sampson Street could be realigned to run parallel to York Street and intersect Navigation Street as a T-intersection, or it could dead-end at Engelke Street. The southbound approach of York Street at Navigation Boulevard would be reconstructed and realigned with York Street south of Navigation Boulevard, which would make the intersection more of a standard 4-legged intersection and would likely improve operations of the traffic signal. Both legs of York Street at Navigation Boulevard would likely need to be widened to provide left-turn lanes. These intersection modification and alternatives are also discussed in Improvement Opportunity R1 under project R1-3.

The pavement between Polk Street and Lamar Street that currently connects Sampson Street to southbound Scott Street could be removed so that Sampson Street meets Polk Street at a T-intersection. This may reduce conflicts with the METRO Southeast Line which will travel along this pavement section between Polk Street and Dallas Street.

Additionally, two-way operations on Sampson Street and York Street potentially benefits the underpass proposed by the West Belt Freight Rail Study. The study proposed realigning Sampson Street north of the rail line so that it could share the crossing with York Street. This realignment would require the acquisition of several properties that are in close proximity to the East End Coffee Plant/Second Ware light rail stop. If two-way operations were provided along York Street, Sampson Street would not need to be realigned, and the properties that would have otherwise been acquired would be maintained as locations for potential transit oriented development. Sampson Street under this scenario would be discontinuous across the West Belt rail line. Additionally, public street access of all parcels need to be addressed during preliminary engineering of roadway alignment.

The total cost savings to the proposed grade separation at the West Belt rail line because of the conversion to two-way operations has been estimated at approximately $10,000,000.

Map Key

Potential roadway alignment and cross section

Land that would be impacted to accommodate York Street underpass that could be preserved under this scenario.

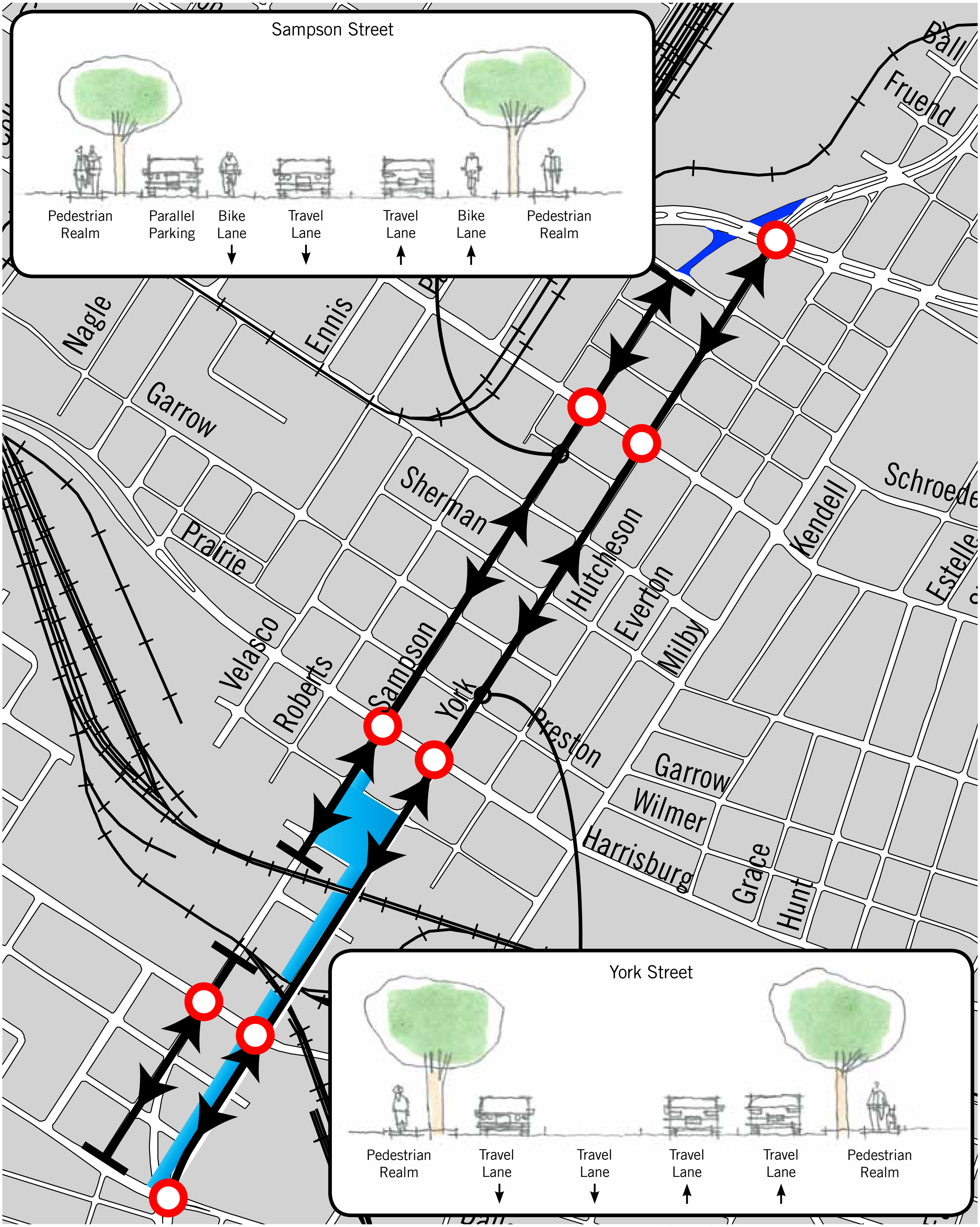


Figure 4.8 Potential Sampson Street and York Street Two-way Operation

Analysis of Impacts

The impacts on vehicular traffic of this reconfiguration were estimated using HCM Planning LOS methodology and traffic projections from 2035 Scenario 2: Master Plan/TOD. The combined bidirectional traffic volume projection for Sampson Street and York Street is approximately 20,462 vehicles per day.

The HCM Planning LOS methodology estimates that roadways with speed limits of 30 MPH and four travel lanes will operate at a peak-hour LOS of D for traffic volumes between 10,300 and 28,800. Consequently, if York Street was configured to provide two-way traffic and if all traffic projected to utilize both York Street and Sampson Street under the existing configuration used York Street under the two-way scenario, York Street would operate at LOS D.

In reality, some of the traffic will likely be distributed to Sampson Street. There are currently businesses and residences along Sampson Street – and in the future there may be more – and trips to and from those destinations would use Sampson Street.

The ability of these two roads to accommodate the projected traffic with fewer-than-existing through lanes seems logical because the two connecting north-south roads on either side of the pair – Hirsch Road on the north and Scott Street on the south – each have four lanes. The eight lanes that are currently provided by the combined pair would therefore seem to provide excess capacity for through-traffic.

R4: Assess Sampson/York one way pair multi-modal operations including potential benefits and challenges of conversion to two way operations

Implementation Projects

- **R4-1:** Modify cross sections on York Street and Sampson Street with pavement marking modifications
- **R4-2:** Convert York Street and Sampson Street to two-way roads

Benefits

- Increases mobility options for all modes along the Sampson / York Corridor
- Provides more direct access to area businesses and other destinations
- Improves signal operations at boundary intersections at Navigation Boulevard and Polk Street
- Maintains acceptable levels of service of area roadways

Challenges

- Intersection operations would need to be revised to allow two-way operations; delays at signalized intersections at Canal street and Harrisburg Street may increase
- Two-way conversion to Sampson and York Streets without grade separation to the Galveston and West Belt Subdivisions would require new rail crossing arms at each crossing for opposite directions
- The existing intersection of Scott, York and Polk with the Southeast Corridor LRT alignment would have to be redesigned for proposed two-way York Street

Mobility Goals Addressed

Primary:

- Goal 1: Address short and long-term capacity constraints and opportunities by assessing the traffic impacts of growth and development and developing recommendations

Secondary:

- Goal 3: Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

Important Partners

- City of Houston
- METRO - Coordination with light rail and bus line operations
- Gulf Coast Rail District
- UP Railroad

R5: Improve Chartres Street as both a gateway to the East End and Downtown, and as a barrier to mobility

Description of Potential Improvements

Chartres Street represents the first local roadway that many motorists experience as they access Downtown Houston or the East End. The roadway functions similarly to a one-way, northbound frontage road for US 59. Two freeway exits from US 59 serve the study area at Gray Avenue/Pierce Avenue and at Polk Street. As does the elevated freeway beside it, Chartres Street serves as a physical and psychological barrier for trips between Downtown and the East End. In some ways, Chartres Street presents even more of a barrier than the freeway because it is at-grade. Elements of the road that create this barrier include:

- Width: Chartres Street is typically a four or five-lane roadway, though frequently these lanes become left-turn lanes at intersections to provide capacity to access Downtown. The resulting width of the road can make crossings difficult.
- Geometry, which is complicated by the freeway off-ramps and combination of one-way and two-way cross streets
- Speeds: The speed limit on Chartres Street is posted at 30 MPH; however, vehicles were frequently observed to travel in excess of the posted speed.

These barriers impact not only motorists, but pedestrians and cyclists as well. This is likely to become an increasing issue as activity increases with the construction of BBVA Compass Stadium, new light rail stations, potential expansion of the convention center, and other potential developments east of US 59.

One of the challenges for motorists on Chartres Street is that this corridor is the primary location where the Downtown grid of predominantly one way streets meets the predominantly two-way streets of the East End. As shown in Figure 4.9, navigating through this corridor is made even more challenging by the location of major event venues including Toyota Center, the George R. Brown Convention Center, Minute Made Park, and BBVA Compass (Dynamo) Stadium which creates disruptions in the roadway network for many of the east-west roadways. As a result, motorists can find it difficult to determine which direction they can travel on cross streets and which roadways will ultimately lead to their destinations. Although many of the motorists on Chartres Street are likely to be frequent users who are traveling to jobs or other major destinations and are familiar with the roadway network, many others are visiting for events or occasional trips to the study area and Downtown and would benefit from improved signage and wayfinding as well as an improved design of Chartres Street to enhance mobility.

Many of these barrier and mobility issues could be addressed with improved signage, traffic control and wayfinding on Chartres Street in the short-term and redesigning the roadway to improve operations a legibility for users in the long term.

Several short-term and long-term projects could greatly improve operations, access, and aesthetics along Chartres Street. Instead of serving as a barrier, Chartres Street could ultimately be an attractive corridor that operates well and is comprehensible to unfamiliar users. It could simultaneously support improved east-west connectivity between the East End and Downtown as well as serve as a distinctive gateway into the area.

Implementation Projects

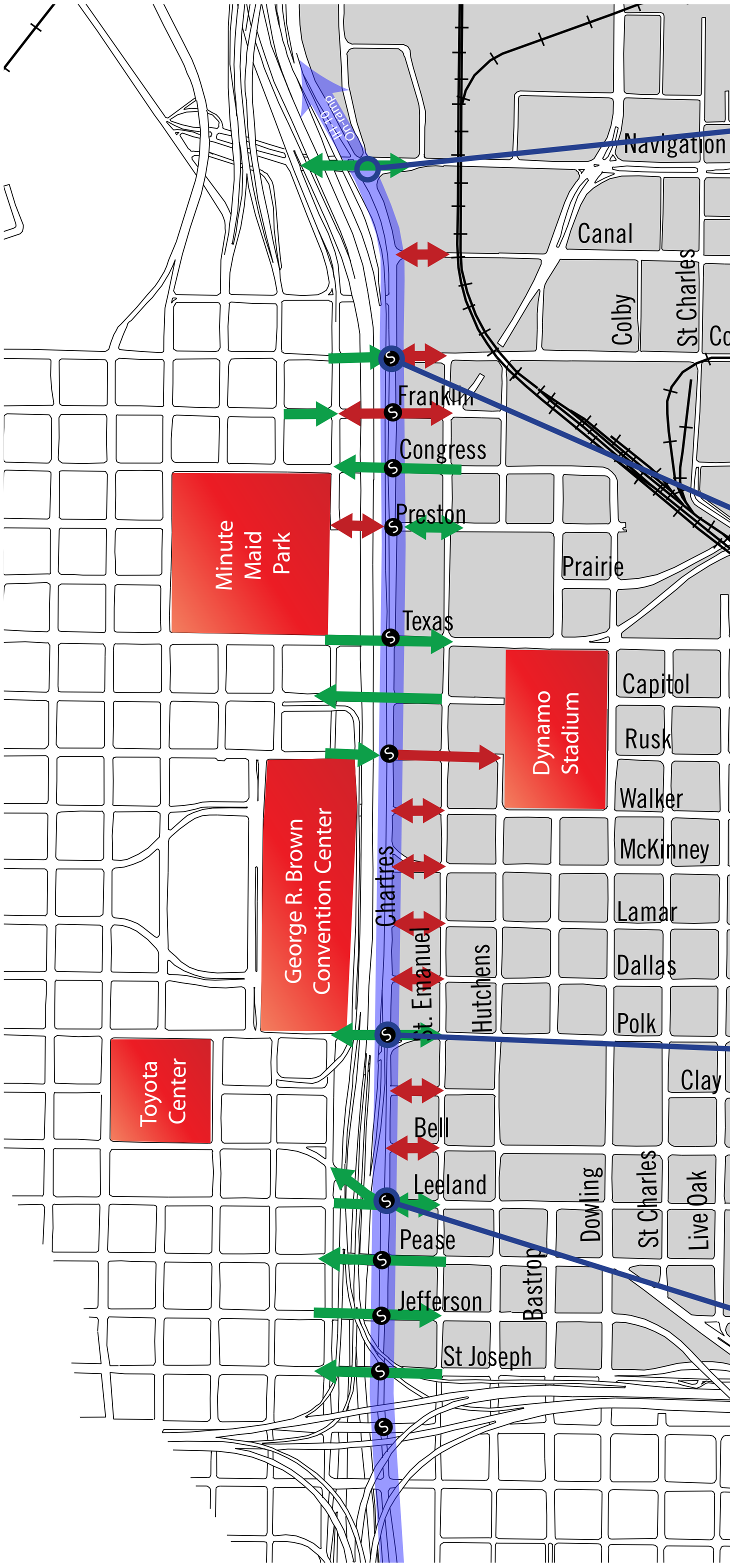
R5-1: Improvements to signage, wayfinding, and pavement markings along Chartres Street.

Potential improvements that have been identified include:

- Wayfinding signage to provide advanced warning of upcoming roadway names, directions of travel, and potential destinations. This is particularly important where Chartres transitions from alternating one way cross street roadways to two way and back. This may include larger signs that are more legible at the speeds that motorists are travelling on Chartres Street.
- Improved pedestrian crosswalks and signal heads at priority locations should also be considered.
- Higher-level traffic control at the intersection of Chartres Street and Runnels Street could address high travel speeds, crash rates, and pedestrian crossings. This improvement is detailed is section R1 as an intersection improvement.

R5-2: Enhance and potentially redesign Chartres Street to make it a safe and attractive gateway into Downtown and the East End.

Such a redesign could maintain adequate vehicle capacity while also improving comprehensibility for motorists, encouraging travel at the posted speed limit of 30 MPH through geometric design considerations, adjusting locations where through lanes are currently forced into turn lanes, and making the roadway safer and easier to cross for pedestrians.




Chartres at Runnels

Chartres at Congress


Chartres at Polk


Chartres at Leeland/Bell

Map Key

- Signal
- Crossing Roadway
- Intersecting Only Roadway

Figure 4.9 Chartres Street Roadway Operations and Barriers

Analysis of Impacts

Figure 4.9 shows the potential turning directions for a vehicle traveling northbound on Chartres Street. As shown, the direction of available turning movements is highly inconsistent. South of the George R. Brown Convention Center, cross streets largely offer alternating one-way travel. At the Convention Center, cross streets are mostly two-way but are blocked by the Convention Center. North of the Convention Center, roads inconsistently provide one-way and two-way travel. A coordinated wayfinding and signage system would improve the comprehensibility and navigability of the corridor.

As shown in Table 4.4 and Figure 4.10, the assessment of crash locations also indicated that nine intersections along Chartres Street were among the top twelve by crash volumes in the study area. It is important to note that the City of Houston has made improvements including new or upgraded traffic signals, pedestrian push buttons, and signage at many of the intersections, so the historical crash data does not necessarily reflect existing conditions. Additionally, because the traffic volumes on Chartres Street are relatively high, the crash rates are not especially high. However, because the traffic volumes are high and because the corridor is a key gateway to Downtown and the East End, crashes on Chartres Street can have an outsized impact on mobility in the study area. Signage and design changes including wayfinding and the elimination of entrapment lanes that force left turn movements are expected to improve crash frequency on the corridor.

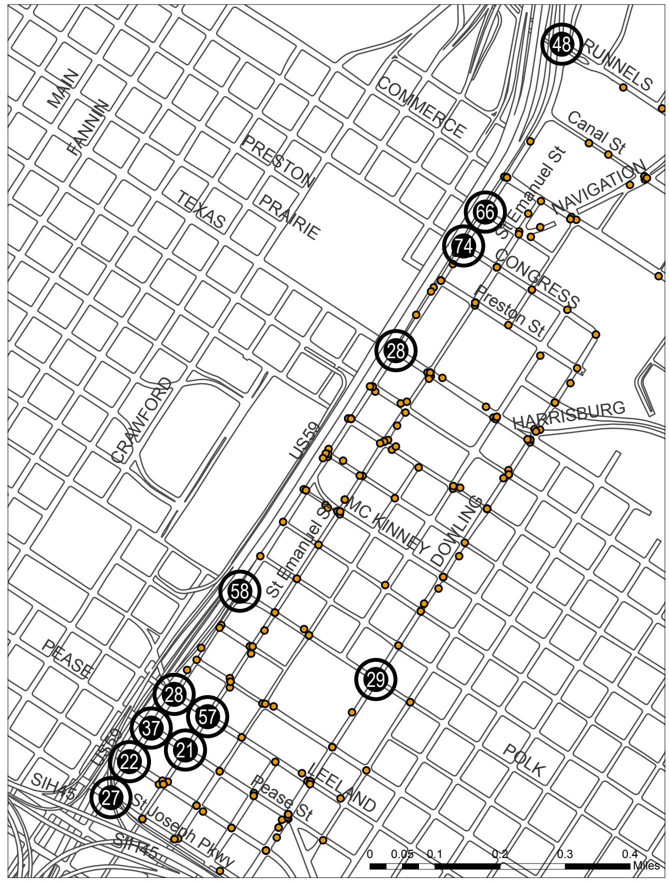


Figure 4.10 Intersections with Greater than 20 Crashes 2006-2010

Table 4.4 Study Area Intersection with More than 20 Crashes During the 2006-2010 Analysis Period

Intersection	Total Crashes	2006	2007	2008	2009	2010	Top Contributing Factor (with % of total)
Chartres St & Congress St	74	9	10	15	14	26	DISREGARD TURN MARKS AT INTERSECTION (57%)
Chartres St & Franklin St	66	10	9	15	18	14	DISREGARD STOP SIGN OR LIGHT (39%)
Chartres St & Polk St	58	10	9	9	16	14	TURNED IMPROPERLY - WRONG LANE (53%)
St. Emanuel St & Leeland St	57	6	17	14	13	7	FAILED TO YIELD ROW - STOP SIGN (72%)
Chartres St & Runnels St	48	10	3	10	16	9	FAILED TO YIELD ROW - STOP SIGN (56%)
Chartres St & Pease St	37	15	9	4	2	7	DISREGARD STOP AND GO SIGNAL (24%)
Dowling St & Polk St	29	4	4	7	4	10	DISREGARD STOP AND GO SIGNAL (38%)
Chartres St. & Texas Ave	28	3	4	7	7	7	TURNED IMPROPERLY - WRONG LANE (31%)
Chartres St & Leeland St	28	5	9	7	5	2	DISREGARD STOP AND GO SIGNAL (36%)
Chartres St & St. Joseph Parkway	27	10	4	6	3	4	DISREGARD STOP AND GO SIGNAL (41%)
Chartres St & Jefferson St	22	4	5	6	3	4	DISREGARD STOP SIGN OR LIGHT (36%)
St. Emanuel St & Pease St	21	4	4	4	2	7	DISREGARD STOP SIGN OR LIGHT (38%)

Source: TxDOT CRIS database for reported crashes with over $1000 in damages; 2006-2010

Redesigning the roadway to support lower travel speeds should also improve safety for motorists and pedestrians and make Chartres Street easier to cross. Pedestrian improvements at key intersections such as Polk Street, Rusk Street, Texas Avenue, Franklin Street, and Runnels Street would greatly improve connectivity between Downtown and the East End.

Improved traffic controls at the intersection of Chartres Street and Runnels Street would mitigate the barrier effects of Chartres Street on the north side of the study area. Motorists, pedestrians, and bicyclists would have an easier time accessing Downtown, Bute Park, and the Heritage East bike trail. Pedestrian and bicycle connectivity at the intersection is particularly important because of the close proximity of Clayton Homes and concomitant presence of children and because any future extension of the Heritage East bike trail would likely cross Chartres Street at this intersection. Please see further discussion in proposed improvement R1.

R5: Improve Chartres Street as both a gateway to the study area and Downtown, and as a barrier to mobility

Implementation Projects

- **R5-1:** Improvements to signage, wayfinding, and pavement markings along Chartres Street
- **R5-2:** Enhance and potentially redesign Chartres Street to make it a safer and more attractive gateway into Downtown and the East End

Benefits

- Create a true gateway corridor along the entire border of Downtown and EaDo
- Improved wayfinding makes local destination more attractive to motorist who may be unfamiliar with the roadway network
- Reduced travel speeds to more appropriate levels in line with the posted speed
- Enhances safety and potentially crashes impacting mobility
- Improved pedestrian crossings enhances connectivity between Downtown and East End destination

Challenges

- Adjacent US 59 presents significant challenges to the aesthetics and operations of the Chartres corridor
- Adjacent developments including sports and event venues limit the cross street access along Chartres
- Limited development with frontage on Chartres Street and location as border of Downtown and East Downtown limits focus on the corridor

Mobility Goals Addressed

Primary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

Secondary:

- Goal 5: Reduce safety concerns within study area for all travel modes

Important Partners

- City of Houston
- Downtown Management District
- East Downtown Management District

T1: Develop Enhanced Transit Corridors for both east-west and north-south travel

Description of Potential Improvement

The current transit system in the East End is essentially a grid network, which is generally METRO's transit design approach for areas inside Loop 610 and other mature areas where the street network allows for regularly spaced bus routes. Within the study area, bus routes that travel on major east/west thoroughfares are considered radial routes (destined to Downtown on one end), while routes that travel on major north/south streets are crosstown routes. Crosstown routes are generally anchored at one or both ends by transit centers outside of Downtown.

While the radial routes are fairly straight through the study area, most of these routes transition to a collector function east of the study area and include loops and turns along collector streets in the outlying neighborhoods. The performance of the radial routes within the study area is fairly strong, but the long and less productive sections of some of these routes in the low density areas east of the study area hurt overall route productivity.

The spacing of the transit routes in the study area is appropriate, allowing most residents and employees access to transit with a quarter-mile or shorter walk. Frequency of service is a function of productivity—if the routes can be made more attractive and productive, improved frequency will follow. At the same time sufficient frequency and a highly understandable systems are keys to productive lines. Overall, current transit headways on the major routes are acceptable. The potential improvements identified by this study are aimed less at changing the current transit network and more at improving access and use of the services that are already in place.

In general, the transit service in the study area is good in terms of frequency and spacing, given the current population and employment of the area. The challenge for the future is to integrate transit and area redevelopment so that they support each other. Very high levels of transit service and infrastructure—including the current bus service and the light rail lines under construction—are unique assets to the East End that can encourage sustainable redevelopment in the area.

The light rail lines under construction in the Study Area will provide the first and most capital-intensive layer of transit infrastructure in the study area. These light rail lines will provide frequent service, with headways generally more frequent than 15 minutes all day. While these lines will provide a great transit foundation for the area, many potential transit users will live or work too far from the light rail stations for regular use. The remaining bus routes in the area will still carry the bulk of the transit trips and should be improved as well.

A series of improvements have been identified that would improve the level-of-service provided by bus routes in the study area, likely boost transit ridership, and support the developing light rail network:

- High-frequency transit service with headways of 15 minutes or better.
- Coordinated "look" across street, sidewalks, and amenities that identify the corridor as a transit priority corridor.

  This distinctive look may include unique pavement designs on the streets, a unique sidewalk design, signage, or other features that create a cohesive and identifiable look for the corridor, signalling to potential transit riders that a certain level of transit service can be expected along the corridor. This effect would work much the same way that the tracks, wires, and other features of light rail immediately identify the corridor as a high-quality transit corridor. This look can be built from the existing GEEMD sidewalk enhancements on Sampson Street, York Street, and Harrisburg Boulevard
- Continuous sidewalks and other features to make walking attractive; see Improvement PB 1.
- Distinctive shelters and other patron amenities; however, shelters should remain easily-identifiable as METRO facilities to minimize confusion for users.
- Priority transit treatment for buses at intersections, where possible, as either modifications to existing traffic signals or as geometric modifications that can be implemented when roadways are rebuilt.

Specific priority corridors, shown in Figure 4.11, have been identified for implementation of these transit improvements. These are discussed in the implementation projects below.

Map Key

- Proposed Priority Bus Line
- 1/4 Mile Catchment Area
- East End Light Rail Line
- Southeast Light Rail Line
- Light Rail Station

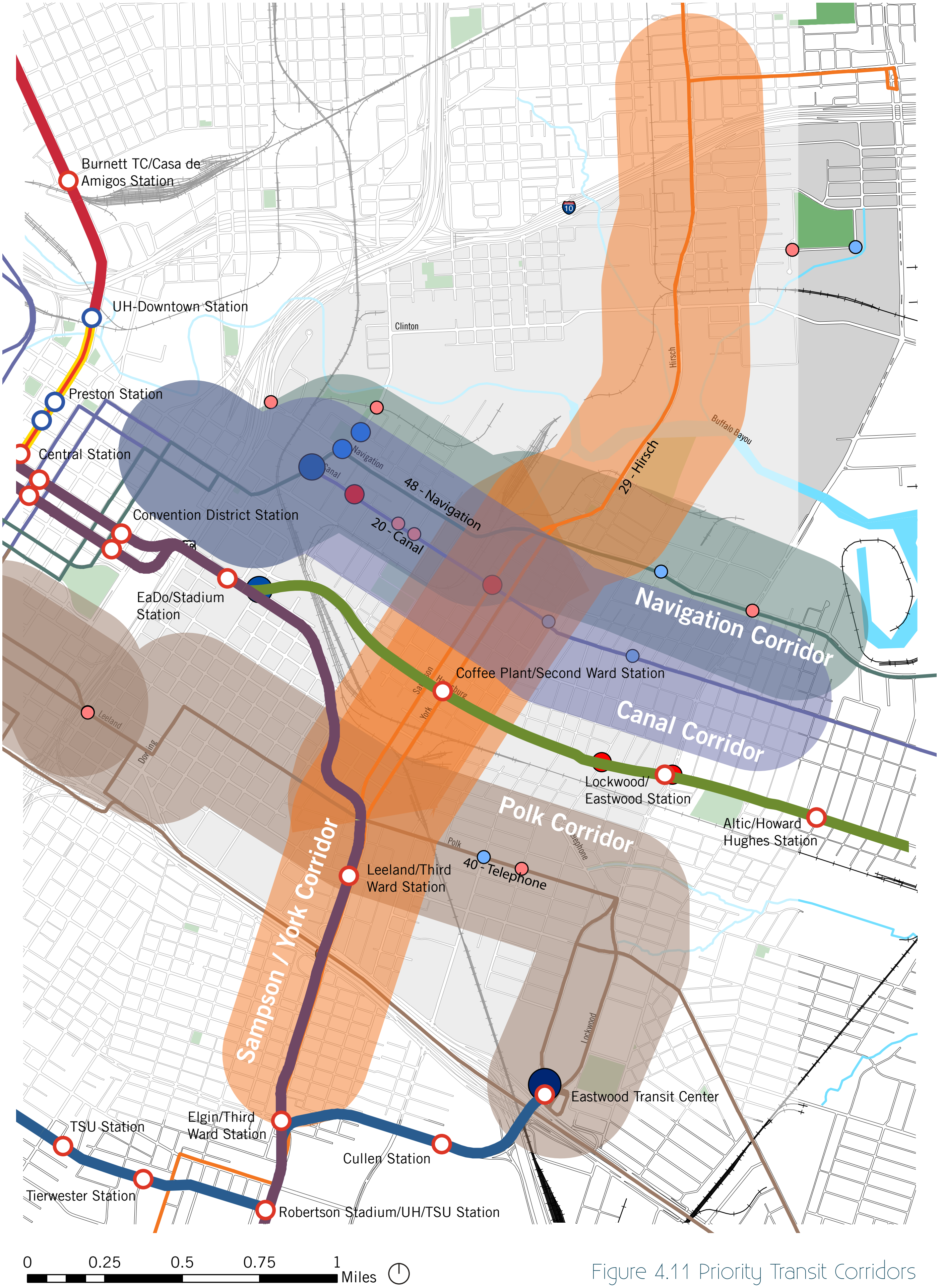


Figure 4.11 Priority Transit Corridors

The improvements proposed for creating priority corridors will introduce some ongoing maintenance and operations costs. In corridors where additional service is needed to achieve 15-minute headways, operations costs can be substantial. Maintenance costs include weekly shelter and trash can cleanings as well as annual power washings.

Midtown Bus Shelter

Greater East End Sidewalk Design

Implementation Projects

T1-1: Develop Canal Street, Polk Street, and Sampson Street / York Street as priority transit corridors.

These three corridors have been grouped because they can likely be implemented in a coordinated fashion under a similar time frame.

Canal Street and Navigation Boulevard offer parallel radial transit service on the northern side of the study area, but Canal Street will likely be suitable for priority transit service sooner. Two bus routes operate on Canal Street in the study area—one crosstown (37 El Sol Crosstown) and one radial (20 Canal)—and one route operates on Navigation (48 Navigation). The 20 Canal is currently a stronger performer than the radial route on Navigation, with double the service and more than double the ridership. The lower performance of the 48 Navigation is at least partially caused by the truncation of its catchment area by Buffalo Bayou. Additionally, there is currently more development along Canal Street. For these reasons, Canal Street has been identified as the preferred corridor for improved bus transit service for the northern part of the study area.

The bus route on Polk Street (40 Telephone) has relatively high frequency and ridership, and Polk Street is approximately equidistant from the Harrisburg light rail line and the study area boundary at the Gulf Freeway. For these reasons, Polk Street has been identified as the optimal opportunity for a priority transit corridor for the southern part of the study area.

Sampson Street / York Street has been identified as the optimal corridor for crosstown transit priority in the study area. The other crosstown corridor in the study area, the 42 - Holman Crosstown, on the eastern boundary of the study area, is another strong candidate for improvements; however the Sampson Street / York Street corridor benefits from its central location in the study area and its future connections to two light rail lines.

T1-2: Develop Navigation Boulevard as a priority transit corridor.

As the East End Master Plan recommendations are implemented to turn Navigation Boulevard into a "Main Street," and as other redevelopment follows, ridership along Navigation Boulevard may increase to a point that will warrant priority transit improvements. Transit service along Navigation Boulevard would likely serve more local trips, while transit service along Canal Street would likely serve both local trips and regional trips.

Analysis of Mobility Impacts

Transit ridership tends to increase when the pedestrian environment is improved and when transit speeds and frequencies are increased. Transit ridership is even more dependent, however, on the population and employment levels of the catchment area. The improvements identified in this section and others throughout the report are designed to support positive land use redevelopment of the area that will support transit ridership.

Most transit improvements are unlikely to have negative consequences to other modes of transportation. Some transit priority improvements may have some impacts: traffic signal priority, bus priority lanes, and signal queue-jumping lanes can all reduce intersection and roadway capacity for vehicles but may improve overall people-moving capacity.

Care must be taken when locating bicycle facilities adjacent to bus traffic or when creating shared bus/bicycle lanes. Bicyclists and buses frequently move at approximately the same speed, resulting in a leap-frog situation where buses bypass the cyclists between stops and bicyclists bypass the buses at stops. Shared or adjacent facilities should be wide enough to allow for comfortable and safe maneuvering for both bicyclists and buses.

T1: Enhance Transit Services including Priority Corridors for both east-west and north-south travel

Implementation Projects

- **T1-1:** Develop Canal Street, Polk Street, and Sampson Street / York Street as priority transit corridors
- **T1-2:** Develop Navigation Boulevard as a priority transit corridor

Benefits

- Reinforces existing transit network of radial and crosstown service through the study area, with investments in highest volume locations
- Develops bus service that complements light rail construction and potentially supports future circulator implementation
- Supports increase transit-oriented development patterns in the study area

Challenges

- Need to balance increased frequency to match increased development; several routes in study area have been threatened because of low ridership
- Complicated route structures for existing routes outside of study area limits effectiveness
- Need to identify ongoing resources to support operations and maintenance

Mobility Goals Addressed

Primary:

- Goal 3: Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

Secondary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

Important Partners

- METRO
- East End Management District
- East Downtown Management District

T2: Identify mobility improvements that would support and integrate with East End Urban Circulator implementation

Description of Potential Improvements

The Greater East End Management District, in coordination with METRO, is beginning the process of developing an Alternatives Analysis for an Urban Circulator that would connect the GEEMD area to EaDo and potentially Downtown Houston and the Fifth Ward. The circulator would provide a dedicated, fixed transit route that would enhance mobility and walkability and support an increased level of economic development as well as GEEMD's vision of creating a vibrant, mixed-use, multicultural, and sustainable model for the district. It would likely provide a dedicated route to cross the West Belt Subdivision Rail Line and better link the Greater East End and East Downtown. While it is not in the scope of this study to determine the feasibility of a circulator such as a streetcar, mobility improvements that may benefit the operations and ridership have been identified. Additionally, coordination with other projects will be critical to ensure that design decisions that would limit the potential for a circulator to operate successfully are avoided.

Implementation Projects

T2-1: Support East End urban circulator implementation.

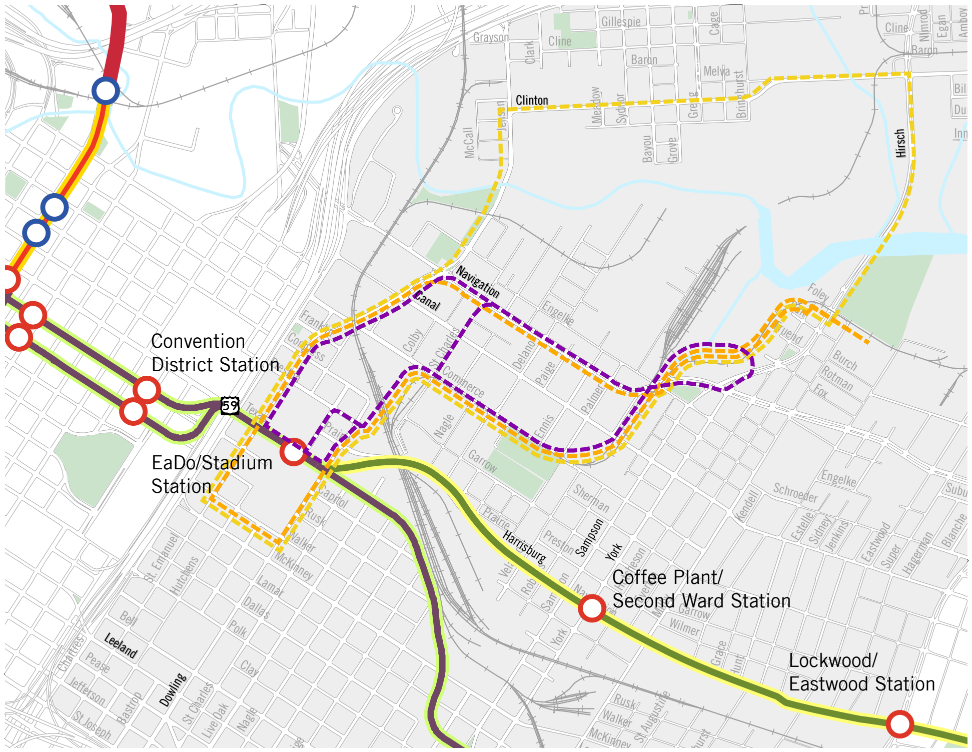
Specific improvements and project coordination opportunities that have been identified as part of this study include:

- Incorporate circulator operations in the potential redevelopment of Navigation Boulevard as a local Main Street corridor from Jensen Street to Sampson Street. Ensure the ultimate roadway cross section and any intersection improvements provide adequate and appropriate vehicle mobility, pedestrian realm and intersection improvements while also maintaining opportunities for a circulator.
- Improve access between the East End and EaDo by redesigning the intersection of Navigation/Franklin and St. Emanuel and installing a traffic signal that could serve as key circulator corridor (see improvement R2).
- Improve the priority transit corridors along Navigation Boulevard and/or Canal Street that could also be supported by, or converted to, streetcar service for appropriate segments (see improvement T1).
- Adapt local bus service to coordinate with and feed a streetcar line while decreasing the number of local stops which would allow improved bus travel time through the service area.
- Identify suitable points for a streetcar to cross the West Belt Subdivision Rail Line and coordinate with the Gulf Coast Rail District on the potential West Belt grade separations, including potential locations at the Navigation Boulevard underpass and the Preston Street underpass.
- Support improvements to St. Emanuel Street and Bastrop Streets identified in the Downtown/EaDo Livable Centers Study to create an enhanced pedestrian and bicycle corridor that would connect to the circulator line and provide a potential route for future streetcar service.
- Enhance sidewalks within the study area to provide improved access to transit and support a culture of safe pedestrian access to major destinations in the analysis area.

New Orleans Canal Street Streetcar

Analysis of Impacts

The East End Alternatives Analysis for an Urban Circulator will determine the feasibility, vehicle options, and potential routing for an Urban Circulator in the East End. The potential improvements identified in this study will have positive mobility benefits for the study area and if implemented in a coordinated fashion could also benefit the success of the potential circulator. Importantly, the implementation of certain projects, such as the design of potential improvements to grade crossings for the West Belt, may have significant impacts on the potential for a circulator. It will be important for the City of Houston, the GEEMD, the East Downtown Management District, METRO, and other community groups and leaders to work together on these improvements to ensure the maximum benefit to the community.



Potential Alignments Identified in the East End Master Plan and East End Development Potential Report

T2: Identify mobility improvements that would support and integrate with East End Urban Circulator implementation

Implementation Projects

- **T2-1:** Support East End urban circulator implementation

Benefits

- Coordination of potential improvements will reinforce the success and positive impact each improvement can have and reduce the likelihood that one project will negatively impact or hinder others in the area

- Each of the identified improvement opportunities has mobility benefits irrespective of the implementation of a circulator and should be supported on their own merits. A circulator has the potential to increase the mobility and economic benefits of each improvement

Challenges

- Optimized circulator implementation may be dependent on other projects or policies (e.g., West Belt grade separations; rail referendums)

- Additional development density likely required to support ridership levels for a circulator and create value to support implementation funding

Mobility Goals Addressed

Primary:

- Goal 3: Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

Secondary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

- Goal 4: Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans

Important Partners

- City of Houston

- METRO

- Greater East End Management District

- East Downtown Management District

PB1: Pedestrian Improvements

Description of Potential Improvement:

Pedestrian infrastructure is the backbone of the transportation system for non-vehicular users. As such, the provision of a quality pedestrian realm is an important linchpin for the success of other projects that emphasize other modes such as bicycles and transit. Additionally, the proximity of transit and of East End residents to their jobs (see Figure 2.7, pg 17) shows a significant potential for growth for pedestrian trips. At the same time, pedestrians currently face a number of challenges in the East End, including:

- Gaps in the sidewalk system, a lack of ADA compliance, and sidewalks that are in poor repair, not constructed to current standards, overgrown or broken up by utility poles.
- Physical barriers to walking, such as railway lines or Buffalo Bayou.
- Mental barriers to walking, including large blocks that break up the street grid and unpleasant areas such as highway underpasses.
- Areas with unsafe (real or perceived) crossings due to proximity to high-speed thoroughfares, a lack of crosswalks and a lack of pedestrian-oriented signal timing.
- A lack of urban design features that promote walking by creating interest and/or mitigating high summer temperatures.

Investments by the Greater East End Management District have begun to improve the pedestrian realm in several areas of the study area, including Harrisburg Boulevard, Sampson Street, and York Street. Additional improvements to complement and supplement these existing projects can be grouped into several categories:

1. Street Standards

- Ensure all streets meet the current City of Houston standards for minimum sidewalk widths (typical minimum of 5 feet and 6 feet on transit streets).
- Encourage developers to opt into the voluntary standards established by the Transit Corridors ordinance once the East End and Southeast light rail lines are completed.
- Encourage best practices in creating an active public realm, including active storefronts and ground floor retail.

2. Signal improvements and crossings

- Ensure all traffic lights have pedestrian countdown signals.
- Add Pedestrian Leading Intervals (PLIs) at traffic signals to allow pedestrians to enter the intersection before cars begin their turning movements.
- Ensure that all users, including mobility-constrained pedestrians, are provided sufficient time to cross streets at traffic signals.
- Ensure that crosswalks are provided in all directions at all bus stops and traffic signals.

3. Comprehensibility and Safety

- Improve pedestrian-scale lighting of sidewalks and other pedestrian areas, including underneath US 59 and IH-45 as proposed by the Downtown/EaDo Livable Centers Study (2011).
- Implement wayfinding and signage to assist navigation by foot (see proposed improvement PB3 for more information).

4. Major Barrier Crossings

- Consider the development of a pedestrian and bicyclist bridge over Buffalo Bayou, connecting the trails on the north and south sides of the Bayou (see improvement opportunity PB2 for more information)
- Investigate feasibility of reopening the underpass at the West Belt rail line between St. Charles Street and Preston Street as a pedestrian and bicyclist connection underneath the freight rail lines. Ensure that the connection is well-signed and well-lit.

Upgrading the pedestrian realm for the entire study area will a costly endeavor. Priority corridors have been identified and grouped into implementation projects so that improvements will be complementary to each other and will be able to leverage other infrastructure and development projects that are planned and underway.

Implementation Projects

PB1-1: Implement pedestrian realm improvements on Navigation Boulevard, Sampson Street, and York Street.

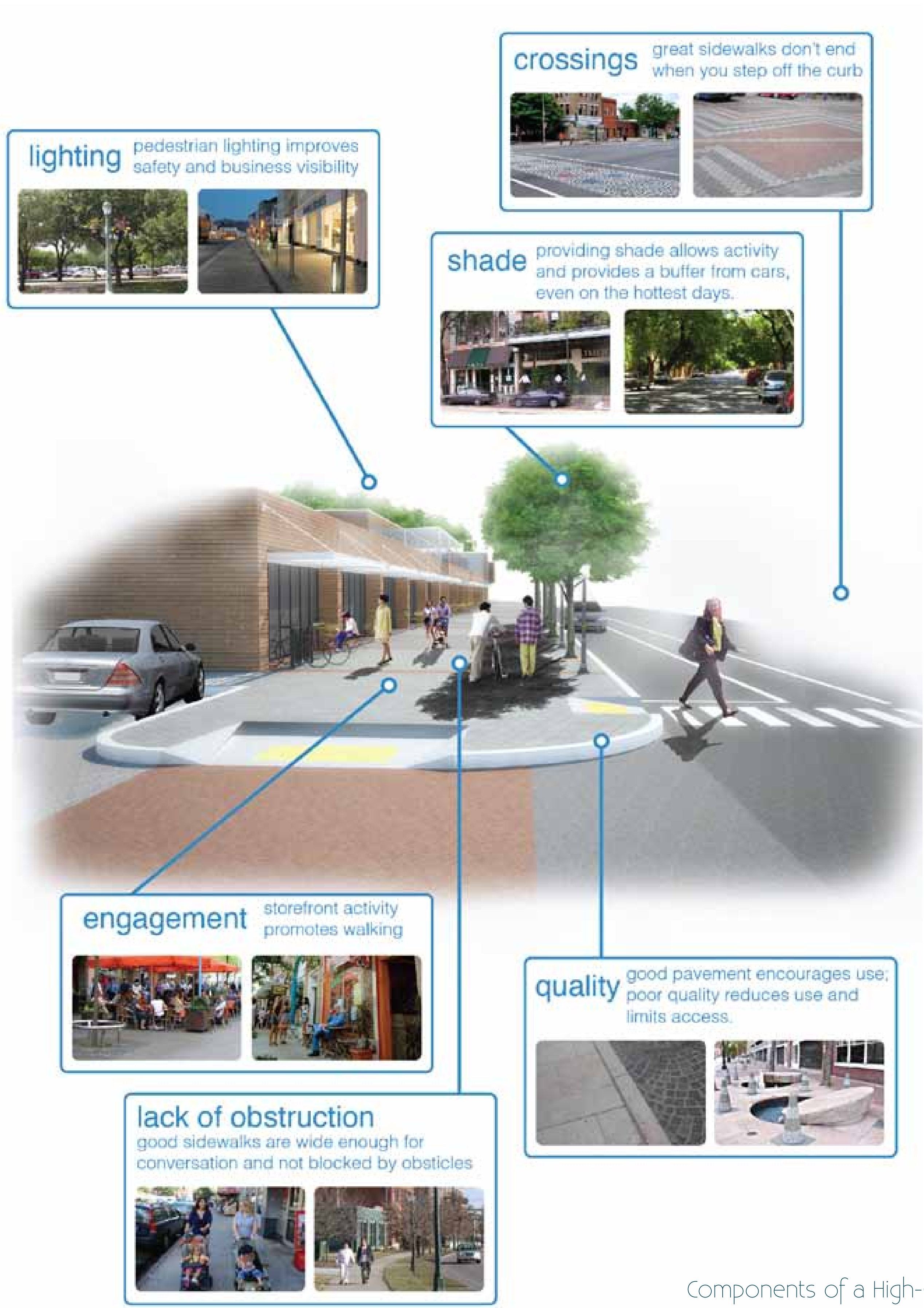
These corridors are shown on Figure 4.12. Many pedestrian improvements on these corridors have already been implemented or are near implementation. Additional improvements should complement those already underway.

PB1-2: Implement pedestrian realm improvements on the other Primary Corridors.

These improvements are proposed for those Primary Corridors on Figure 4.11 that are not Navigation Boulevard, Sampson Street, and York Street (those included in PB1-1). These corridors have been identified largely as those that serve transit routes or are in commercial districts and thus have the most potential for promoting economic development.

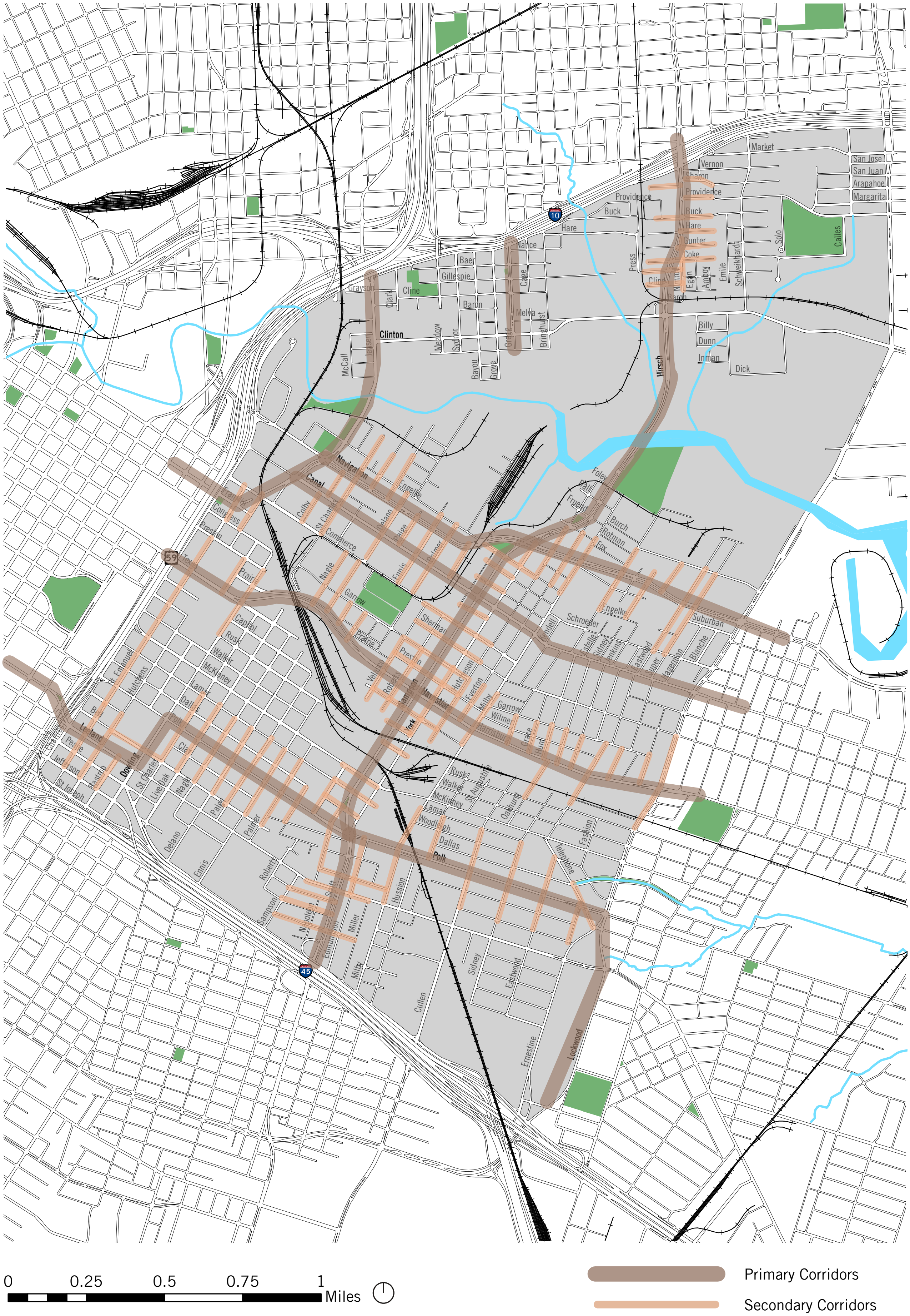
PB1-3: Implement pedestrian realm improvements on the Secondary Corridors.

Secondary Corridors are identified in Figure 4.11. These



Components of a High-Quality Pedestrian Realm

Figure 4.12 Priority Pedestrian Corridors



roads feed into Primary Corridors and thus provide crucial connections between neighborhoods and activity centers.

Analysis of Mobility Impacts:

Walking infrastructure will have a positive impact on other modes. Transit, especially, is dependant on quality walking infrastructure to promote usage. The high ridership already found in the East End will likely be improved with the addition of additional safe routes to transit and the addition of the East End and Southeast Light Rail lines in the study area.

Where pedestrian sidewalks are installed with a minimum 5-foot width and maintained in good condition, they should all operate at an acceptable levels of service.

Modifications to traffic signals to increase pedestrian crossing times and to implement PLIs have the potential to decrease vehicular capacity at intersections. However, the majority of intersections in the study area are not projected to face capacity constraints that would make these signal modifications unfeasible.

PB1: Pedestrian Improvements

Implementation Projects

- **PB1-1:** Implement pedestrian realm improvements on Navigation Boulevard, Sampson Street, and York Street
- **PB1-2:** Implement pedestrian realm improvements on the other Primary Corridors
- **PB1-3:** Implement pedestrian realm improvements on the Secondary Corridors

Benefits

- The promotion of walking infrastructure has a positive impact on all forms of non-vehicular travel. Most, if not all, non-vehicle trips begin or end with a pedestrian trip
- Pedestrian infrastructure has been shown to improve the competitiveness of neighborhood business districts, especially for locally-owned, neighborhood-scaled retailers

Challenges

- Cost is the primary challenge of implementing pedestrian infrastructure; therefore, improvements are proposed for strategically-phased implementation

Mobility Goals Addressed

Primary:

- Goal 3: Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

Secondary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

Important Partners

- City of Houston
- Greater East End Management District
- METRO
- EaDo Management District

PB2: Enhanced Bicycle Network Connecting the Columbia Tap, MKT, Harrisburg and Buffalo Bayou Trails and Major Destinations

Description of Potential Improvements

The existing bikeway network within the study area provides a mix of off-street trails, on-street bike lanes, and signed bike routes. These facilities provide a good level of mobility to bikes traveling east/west across the study area. However, no existing facility provides a complete north/south bicycle corridor across the study area. The bicycle facilities recommended by previous studies, particularly those in EaDo, would improve bicycle mobility and circulation within the study area. Additionally, a series of new bicycle facilities, shown with corresponding project numbers on Figure 4.13, are proposed to expand and complement this existing bicycle network in the area.

Implementation Projects

PB2-1: On-street bicycle facility improvements.

1. Eastwood Street bicycle route: A signed bike route on low-volume streets from Lockwood Drive to north of Navigation Boulevard. A short trail section can connect the signed route to the existing trail along Buffalo Bayou. Eastwood Street crosses the Galveston Subdivision rail line and will have a traffic signal at Harrisburg Boulevard to cross the Harrisburg light rail line.

2. Lockwood Drive/Ernestine Road facilities: A bicycle facility between Polk Street and IH-45, potentially consisting of a shared-use path, on-street bike lanes (right or left side), shared lanes, cycle tracks, or some combination.

3. Live Oak Street: Bicycle lanes between IH-45 and West Belt rail line.

PB2-2: Include bicycle facilities along Lockwood Drive when the road is reconstructed.

4. Bike lanes along Lockwood Drive between Polk Street and Buffalo Bayou to connect the existing bike lanes on Polk Street and proposed bike facilities on Lockwood/Ernestine south of Polk Street to the existing bike trail along Buffalo Bayou. The cross section would need to be developed to fit within the existing 100' right-of-way.

PB2-3: Complete Buffalo Bayou trail network.

5. Fill in trail gaps and build new trails on both sides of Buffalo Bayou between US 59 and Lockwood Drive.

PB2-4: Pedestrian and bicyclist bridges over Buffalo Bayou.

6. Bicycle/Pedestrian Bridge east of Hirsch Drive: An additional bridge would connect bicycle facilities on the south side of the bayou to future development and bicycle facilities on the north side. It could serve as the northern extension of the proposed Eastwood Street signed bike route to provide a continuous bicycle facility from IH-45 to the north side of Buffalo Bayou.

7. Bicycle/Pedestrian Bridge at Gregg Street with connection (possibly a shared-use path) to Gregg Street. An additional bridge would connect bicycle facilities on the south side of the bayou to future development and bicycle facilities on the north side. This would provide a much more feasible connection across the bayou than either Hirsch Road or Jensen Drive, which are nearly one mile apart. Furthermore, the Jensen Drive bridge does not provide dedicated bicycle facilities.

8. Construct a bridge for bicyclists and pedestrians adjacent to the existing Jensen Drive bridge.

PB2-5: Develop underpass designs at West Belt rail line to accommodate all levels of bicycle experience.

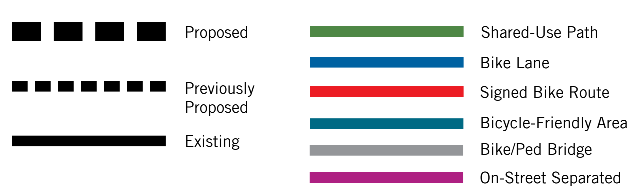
9. York Street grade separation: Although the proposed grade separation at the West Belt rail line would include sidewalks on either side, the inclusion of additional facilities such as bike lanes or a wide side path would make the grade crossing safer and more appealing to bicyclists. An additional bicycle facility along York Street between the grade separation and Polk Street would provide a connection to bike lanes on Polk Street.

10. Leeland Street/Cullen Street grade separation: The conceptual design for this grade separation at the West Belt rail line would have 9‘ shared use paths on both sides of Cullen Road. These would make the grade crossing safer and more appealing to bicyclists and maintain the Cullen Road as an existing corridor in the City of Houston Bikeway Plan.

11. Navigation Boulevard/Commerce Street grade separation: If the grade separation at the West Belt rail line is constructed, it will serve as a critical connection between EaDo, Downtown, and the East End for bicyclists. Although the proposed grade separation at the West Belt rail line is currently planned to include sidewalks on either side, the inclusion of additional facilities such as bike lanes or a wide side path would make the grade crossing safer and more appealing to bicyclists.

12. Preston Street Underpass: An additional crossing under the West Belt is possible at the now closed Preston Street underpass that has been previously back filled. This connection would be a pedestrian and bicycle only crossing connecting sign bike routes on Garrow Street and destinations in EaDo.

PB2-6: On-street bicycle improvements from Downtown/EaDo Livable Centers study and Fifth Ward Special



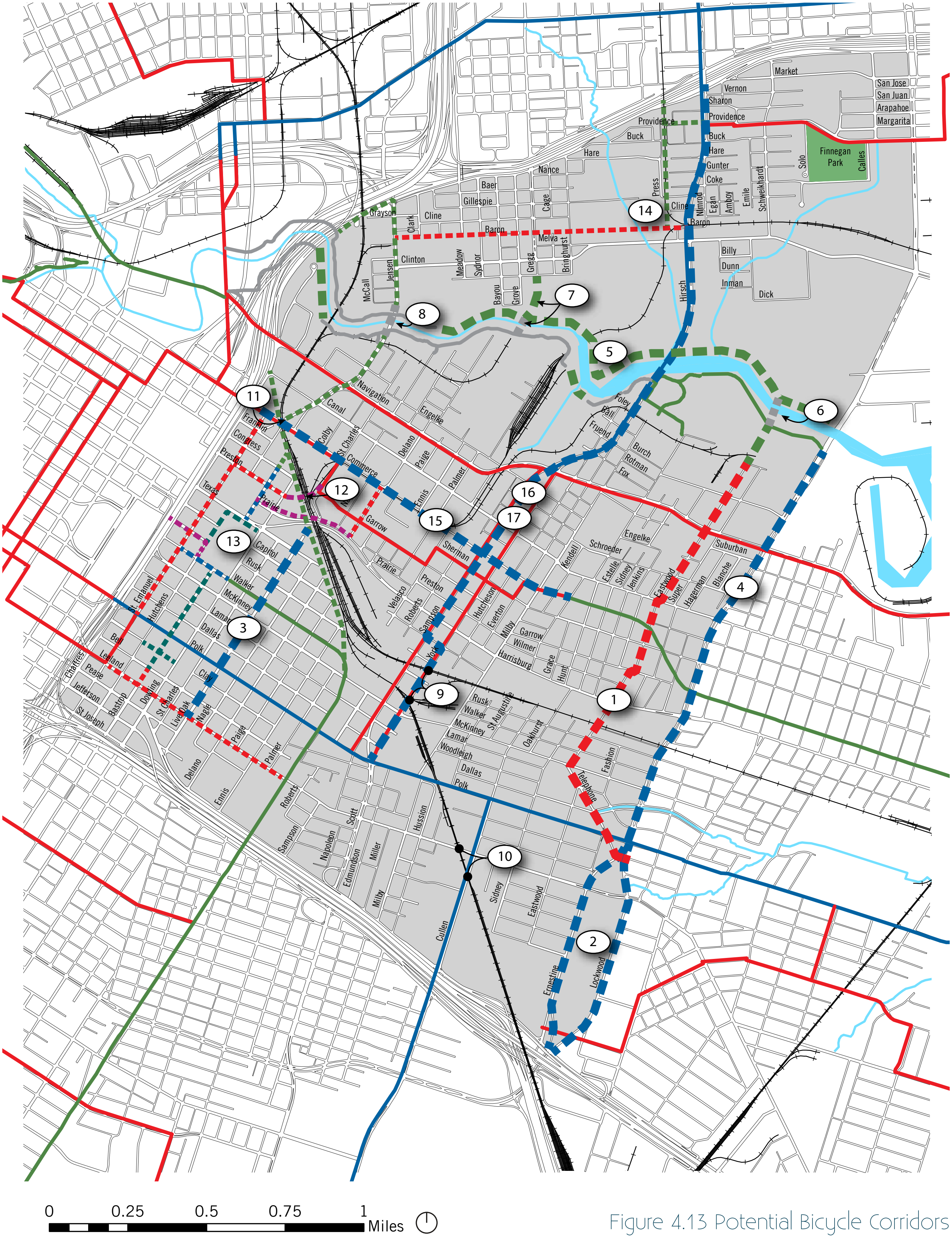


Figure 4.13 Potential Bicycle Corridors

Districts study.

Projects from the Downtown/EaDo Livable Centers study are shown as item 13 on Figure 4.13 and include:

- Signed bike route on St. Emanuel Street between Polk Street and Franklin Street; on Leeland Street between St. Emanuel Street and the Columbia Tap shared use path; on Preston Street between St. Emanuel Street and Dowling Street; and on Delano Street between Harrisburg Street and Commerce Street.
- Bike lanes on Walker Street between Dowling Street and St. Emanuel Street to serve bicycle traffic on the Columbia Tap Rail to Trail and on Bastrop Street between Texas Avenue and Congress Street.
- Separated on-street bicycle facility on Hutchins Street and Rusk Street between Walker Street and US 59 and on Harrisburg Street between Bastrop Street and Delano Street.

Projects from the Fifth Ward Special Districts study are shown as item 14 on Figure 4.13 and include:

- Bicycle boulevard on Baron Street.

PB2-7: Off-street bicycle improvements identified in Downtown/EaDo Livable Centers study.

Projects from the Downtown/EaDo Livable Centers study are shown as item 13 on Figure 4.13 and include:

- Shared-use paths identified in the Livable Centers study as "bicycle-friendly areas" along the Bastrop Street esplanade and around the BBVA Compass Stadium.
- Shared-use path along West Belt rail line between the Columbia Tap Rail to Trail to Chartres Street and on Jensen Drive between West Belt rail line and Buffalo Bayou.

PB2-8: Off-street bicycle improvements identified in Fifth Ward Special Districts study.

Projects from the Fifth Ward Special Districts study are shown as item 14 on Figure 4.13 and include:

- Shared use path along Jensen Drive between Buffalo Bayou and IH-10; along Baron Street and UPRR Spur; along US 59 between Buffalo Bayou and Jensen Drive; and connecting to Finnegan Park.

Additional bicycle facilities shown on Figure 4.13 have been proposed in conjunction with other improvement opportunities in this report. These include:

15. Commerce Street: Bicycle lanes between US 59 and the Harrisburg Hike/Bike Trail. Described in project R3-4.

16. York Street/Sampson Street: A bicycle facility between Navigation Boulevard and Polk Street, potentially consisting of on-street bike lanes, shared lanes, or cycle tracks. York Street and Sampson Street are wide, cross the Galveston Subdivision rail line, and will have traffic signals at Harrisburg Boulevard to cross the Harrisburg light rail line. Described in project R4-1.

17. Sampson Street: If the proposed two-way configuration of York Street and Sampson Street (detailed in Mobility Improvement R4) is implemented, Sampson Street would likely serve low-speed, low-volume, local traffic and would therefore be an ideal bicycle route. Bicycle facilities along York Street would not be necessary because York Street and Sampson Street serve the same route and destinations. The facility on Sampson Street could potentially be implemented with bike lanes and bulb-outs to encourage slower speeds. Described in project R4-2.

Analysis of Impacts

When looking at impacts of various bicycle facilities on overall mobility for all modes, the type of facility plays an important role in determining the type, location, and extent of impact.

The impact of trails and paths on other modes of travel occur primarily at intersections of the facility with roadways. Treatment of those intersections can be a trade-off in mobility for bicyclists and motorists. At other points along a path or trail, impacts to other modes are negligible because bicyclists and pedestrians travel along a grade-separated facility.

The impacts of signed bike routes on other modes of transportation are typically minimal because volumes tend to be lower and different modes can share the same travel way. If bicycle use becomes substantial, vehicular level of service may decline because of the reduction in capacity along lanes used by bicyclists.

Facilities proposed for the York Street, Navigation Boulevard, and Leeland Street grade separations along the West Belt rail line would be constructed in conjunction with the grade separations and should therefore have limited impacts on vehicular mobility while improving mobility for pedestrians and bicyclists.

Proposed bikes lanes could potentially impact vehicular mobility if travel lanes are reduced to accommodate the bike lanes. The available capacity and projected vehicular demands along roadways where bike lanes are proposed were analyzed to estimate this impact. Table 4.5 summarizes available pavement and the number of lanes required to operate at LOS D or better in 2035 for roads where bike lanes could potentially be installed within the existing cross section. For reference, 6 feet is the preferred width for a bike lane; therefore, two bike lanes would require approximately 12 feet of pavement, which is equivalent to one lane of traffic.

Table 4.5 Capacity Assessment for On-Street Bicycle Facilities

Road	2035 TOD Volume	# Existing Lanes	# Lanes for LOS D or better	Extra Capacity
Lockwood / Ernestine	30,000	6	4	2 lanes
Live Oak	5,000	2 (50' pavement)	2 (24' pavement)	(26' pavement)
Commerce	10,000	2 (48' pavement)	2 (24' pavement)	(24' pavement)
Sampson / York	40,000	8	4	4 lanes

As shown in the table, Lockwood/Ernestine, Live Oak, Commerce, and Sampson/York could be narrowed by two to four lanes and still operate at LOS D or better in 2035. This is sufficient for two 6-foot bike lanes.

Bicycle facilities on these roads could also be implemented during future roadway reconstructions to avoid taking existing pavement. This is the proposed course for implementation of bike lanes on Lockwood Drive north of Polk Street. Waiting for reconstruction to install bike lanes would minimize the impact on vehicular mobility because the number of travel lanes would not be reduced to accommodate bike lanes.

PB2: Enhance the Bicycle Network and Connect the Columbia Tap, MKT, Harrisburg and Buffalo Bayou Trails and Major Destinations

Implementation Projects

- **PB2-1:** On-street bicycle facility improvements
- **PB2-2:** Include bicycle facilities along Lockwood Drive when the road is reconstructed
- **PB2-3:** Complete Buffalo Bayou trail network
- **PB2-4:** Pedestrian and bicyclist bridges over Buffalo Bayou
- **PB2-5:** Develop underpass designs at West Belt rail line to accommodate all levels of bicycle experience
- **PB2-6:** On-street bicycle improvements from Downtown/EaDo Livable Centers study and Fifth Ward Special Districts study
- **PB2-7:** Off-street bicycle improvements identified in Downtown/EaDo Livable Centers study
- **PB2-8:** Off-street bicycle improvements identified in Fifth Ward Special Districts study

Benefits

- Provides bicycle connections to destinations including the Second Ward, EaDo, Downtown, the University of Houston, Dynamo Stadium, and Tony Marron Park
- Enables multimodal connectivity by providing bicycle connections to light rail lines
- Provides connections to existing facilities including the Polk Street bike lane, Harrisburg Hike and Bike Trail, Navigation Boulevard signed bike route, Buffalo Bayou trails, Columbia-Tap Rails-to-Trail and to facilities proposed by the City of Houston, the EaDo Livable Center study, and the Fifth Ward Special Districts study

Challenges

- Bicycle facilities on Lockwood Drive/Ernestine Road and Sampson Street/York Street may conflict with MTFP

Mobility Goals Addressed

Primary:

- Goal 3: Enhance multi-modal trip alternatives

Secondary:

- Goal 2: Address barriers to mobility and increase connectivity

Important Partners

- City of Houston Public Works – Will need to review and approve all signage and pavement marking modifications
- City of Houston Planning Department - Coordination with MTFP
- Gulf Coast Rail District – Modifications to proposed grade separations would need to coordinate with the existing plans of the West Belt rail study
- METRO – Opportunities to coordinate bicycle facilities such as bike racks at light rail stations and transit centers
- Buffalo Bayou Partnership – An organization promoting and building bicycle facilities along Buffalo Bayou; bicycle plans that interact with Buffalo Bayou should be coordinated

PB3: Pedestrian & Bicycle Wayfinding

Description of Potential Improvement

The vast majority of street signs provide information primarily for motorists. For pedestrians and bicyclists, signs are often located in inconvenient places that make them hard see, are of improper scale, or do not provide pertinent information. A wayfinding system for bicyclists and pedestrians, designed to standards that would allow both regional implementation and the possibility of district branding, would encourage residents and visitors to use non-vehicular modes by connecting them with destinations and defining safe and comfortable routes. Figure 4.14 shows potential locations for priority implementation of pedestrian and bicyclist wayfinding.

Pedestrian signage in Houston has historic precedents within the study area. Tile street names at the curb level, as shown in Figure 4.15, are difficult for motorists to read but relate well to the pedestrian scale and identify the historic nature of the area. Likewise, historic areas of Houston also often contain obelisks with street names, such as the one shown in Figure 4.16.

Bikeway signage is governed by the Federal Highway Administration's Manual on Uniform Traffic Control Devices (Chapter 9). The MUTCD signs can be used to identify bike routes, alerting both bicyclist and motorists to the existence of bike routes (Figure 4.16) and to alert bicyclists to destinations, distances and directions, or "DDD" signs (Figure 4.18). DDD signs should be placed where bike routes intersect or where important destinations lie just off of the bike routes. Non-standard signage (such as management district-branded signage) is allowable pending approval of the FHA.

Maps (Figure 4.20) form the final component of a wayfinding system for bicyclists and pedestrians. Maps should be provided near transit stops and in commercial districts. Retailers may be a potential funding partner under an "adopt a map" program.

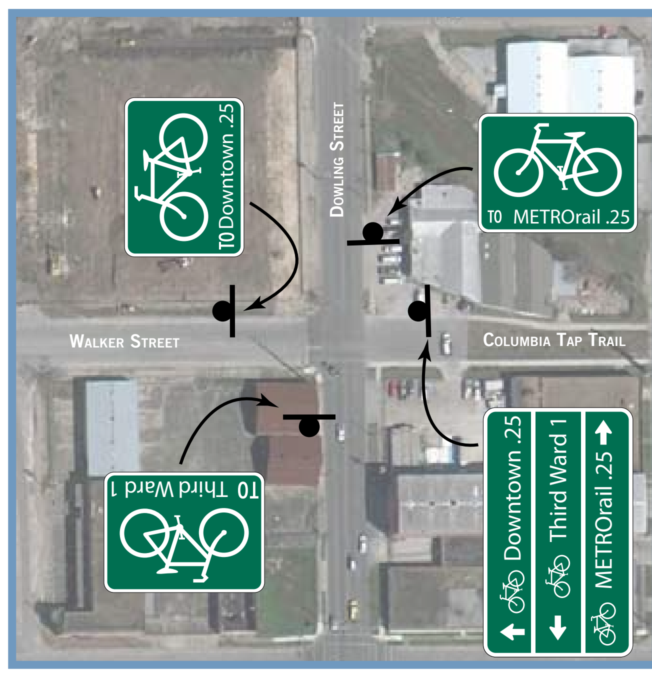
Implementation Projects

PB3-1: Implement a signage and wayfinding program for the area using standard signage from the MUTCD.

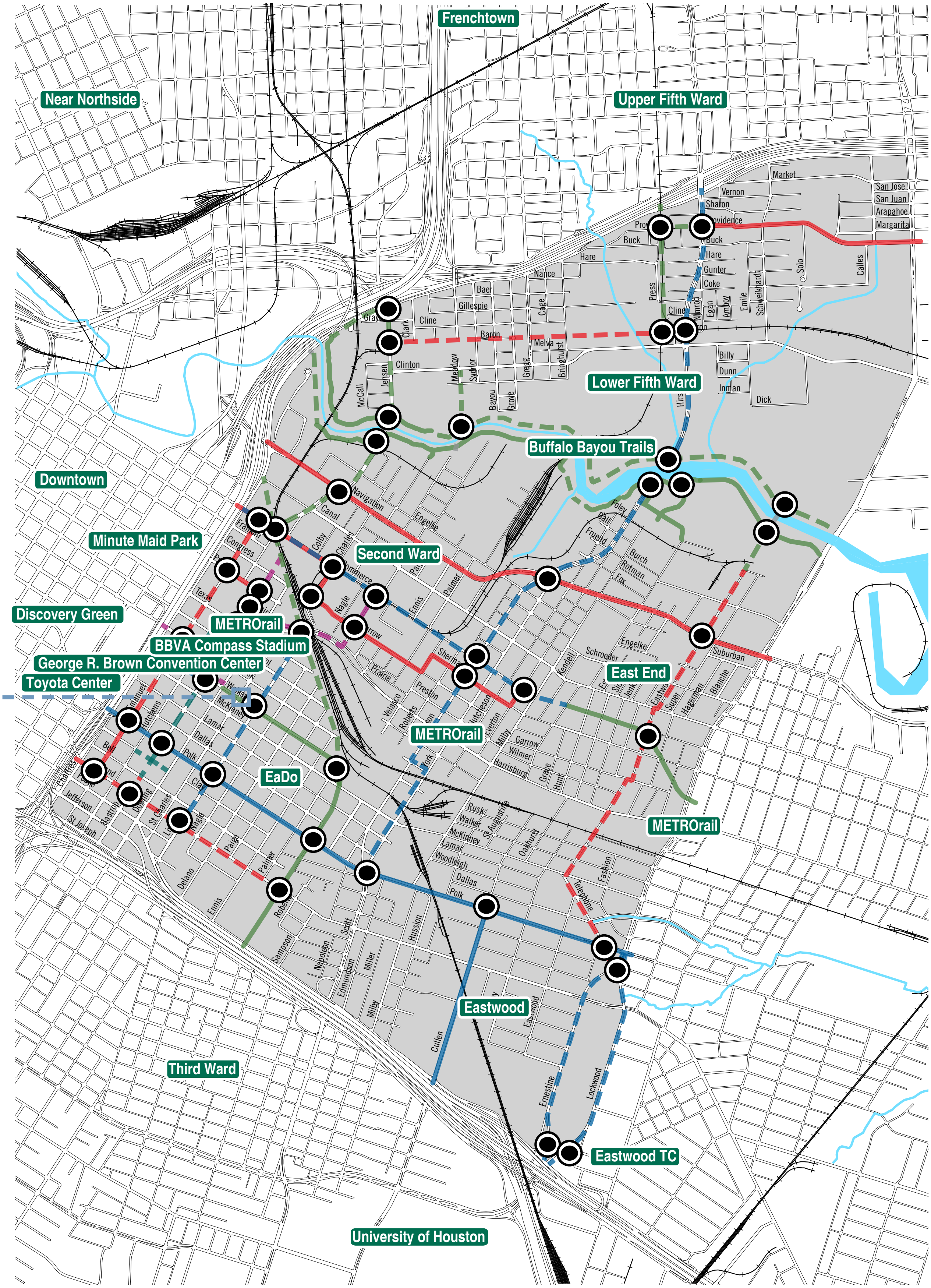
Example of MUTCD signage are shown in Figures 4.16, 4.17, and 4.18. Figure 4.13 shows proposed priority locations for bicyclist and wayfinding signage in the study area.

PB3-2: Implement a district-branding signage and wayfinding program.

This program should complement the standard signage of PB3-1. This signage may take cues from the historical tile and obelisk wayfinding that exists throughout the study area, or it may use an entirely new design, perhaps one that imitates aesthetics implemented in the pedestrian realm improvements along Harrisburg Boulevard.



Example of typical sign placement at an intersection using standard MUTCD signage



● Priority Wayfinding Location

Figure 4.14 Priority Wayfinding Locations

Figure 4.15 This historic tilework has survived the change of the street name. While this form of pedestrian signage is often removed or damaged during the addition of ADA compliant ramps, saving or replacing the tile work can provide an interesting historic brand for the area that also improves pedestrian experience.

Figure 4.16 Obelisks, like this one in the Sixth Ward, are a distinctly Houstonian form of street signage that predates the introduction of the automobile.

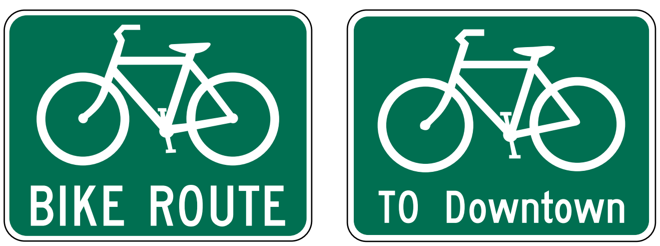


Figure 4.17 MUTCD-approved Bike Route Signs

Figure 4.18 MUTCD Destination, Distance and Direction Signs.

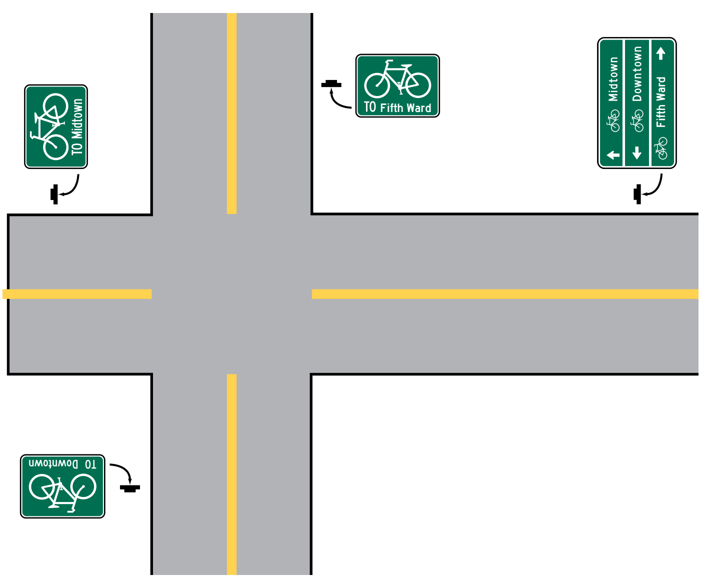


Figure 4.19 Typical sign placement at an intersection.

Figure 4.20 Pedestrian wayfinding map from Philadelphia. Note that the map orientation changes depending on the direction the pedestrian is facing.

Analysis of Mobility Impacts:

Implementation of a bicyclist and pedestrian wayfinding system would dramatically improve the comprehensibility of the pedestrian and bicyclist systems in the study area.

Like all bicyclist and pedestrian improvements, wayfinding and signage can improve the usability of transit because every transit trip has a bicycle or pedestrian trip on at least one end. Wayfinding can assist transit users find a bus stop or find a destination once they have left the bus.

Wayfinding does not impact roadway capacity and is not expected to have capacity impacts on vehicular modes of travel.

PB3: Pedestrian & Bicycle Wayfinding

Implementation Projects

- **PB3-1:** Implement a signage and wayfinding program for the area using standard signage from the MUTCD
- **PB3-2:** Implement a district-branding signage and wayfinding program

Benefits

- Improved ease of mobility through the area for bicyclists and pedestrians, who will benefit from the delineation of safe and convenient routes. This may result in increased shares for the transportation modes
- Branding opportunities in the design of wayfinding markers
- Regional cohesion because of better-defined ties between neighborhoods

Challenges

- Funding is the greatest obstacle to implementation of improved wayfinding

Mobility Goals Addressed

Primary:

- Goal 3: Enhance multi-modal trips. Walking and biking in the area will be encouraged by clearly defining safe and convenient routes for bicyclists and pedestrians

Secondary:

- Goal 2: Address barriers to mobility and increase connectivity. Wayfinding will identify routes around barriers such as rail lines, stadiums, and Buffalo Bayou

Important Partners

- Greater East End Management District
- East Downtown Management District
- City of Houston Public Works
- Retailers and business owners (possibility of sign-adoption programs)

D1: Support high level of connectivity in future roadway network

Description of Potential Improvement

As shown in Table 4.6, the East End Study area is composed of four Superneighborhoods that each have relatively high levels of connectivity as measured by metrics such as intersection density and link-node ratio. This high level of connectivity provides good overall mobility in the study area because traffic volumes can distribute across multiple roadways.

Table 4.6 Study Area Connectivity Summary

Superneighborhood	Intersection Density	Link Node Ratio
Greater Fifth Ward	110	1.36
Second Ward	161	1.65
EaDo (Downtown)	218	1.79
Greater Eastwood	161	1.61

The Fifth Ward and the areas in the Greater Second Ward/ East End along Buffalo Bayou represent the locations within the study area where connectivity is lowest because of the presence of barriers including the bayou and historical rail corridors, as well as large industrial development parcels that interrupt the extension of the grid street network that is well-developed elsewhere in the study area. These large parcels represent some of the larger contiguous development opportunities within close proximity to Downtown and therefore may be major redevelopment opportunities for both more open/park space along the bayou and increased residential and commercial development.

Increasing the connectivity in the area around Buffalo Bayou will provide a suitable level of mobility to support future development.

Implementation Projects

D1-1: Add corridors to MTFP to support a high level of connectivity.

Because the level of connectivity is lower in the area around Buffalo Bayou, there is an opportunity for future connectivity to be increased by defining the desired future thoroughfare network as shown in Figure 4.21. Designating these corridors on the City's Major Thoroughfare and Freeway Plan (MTFP) would mean that as these areas are redeveloped, new roadway connections would be established, most likely as collector streets. These connections would support improved access to the freeway network and also provide a coordinated approach for alternate routes for traffic related to new development along Clinton Drive and Navigation Boulevard, thereby increasing overall mobility in the study area.

Potential north-south corridors to designate as future collector corridors include:

1. Between Jensen Drive and Hirsch Road, connecting Gregg Street north of Buffalo Bayou to Middle Street, continuing south along Delano Street and crossing Harrisburg Boulevard and Congress Yard with a new grade separation. This grade separation could potentially be built as an overpass without excessive impacts to the neighborhood because the south side of Harrisburg Boulevard at that point is depressed below the north side.

   This connection would create a new north-south corridor through the study area from Jewel Street in the Fifth Ward to IH-45 in the East End with a length of approximately 3.75 miles.

2. Between Hirsch Road and Lockwood Drive , aligned west of Eastwood Street south of the bayou and along Schweikhart Street north of the bayou, from Navigation Boulevard to Clinton Drive. The proposed alignment of Schweiskhart Street to Eastwood is recommended for a bike route. Schweikhart Street links north to the IH-10 Frontage Road, where a pedestrian overpass crosses the freeway.

   Alternatively, the new collector could be aligned along Eastwood Street south of the bayou. The available ROW along Eastwood Street is narrower, but Eastwood Street provides good north/south connectivity across the study area.

There are also opportunities to provide east-west roadway connectivity parallel to Buffalo Bayou between Navigation Boulevard and Clinton Drive:

3. North of Buffalo Bayou, from Jensen Drive on the west to Lockwood Drive on the east.
4. North of Buffalo Bayou and west of Jensen Drive, connecting Rothwell Street to proposed collector #3. This connection was proposed in the West Belt Freight Rail Study as a realignment for Nance Street, which is proposed to be closed at the West Belt rail line.
5. South of Buffalo Bayou, from Jensen Drive to Lockwood Drive. This proposed collector and proposed collector #3 will be 0.4 miles apart at Jensen Drive and 1 mile apart at Lockwood Drive. Providing these two roadways would enhance the roadway network and create more development opportunities in the study area.

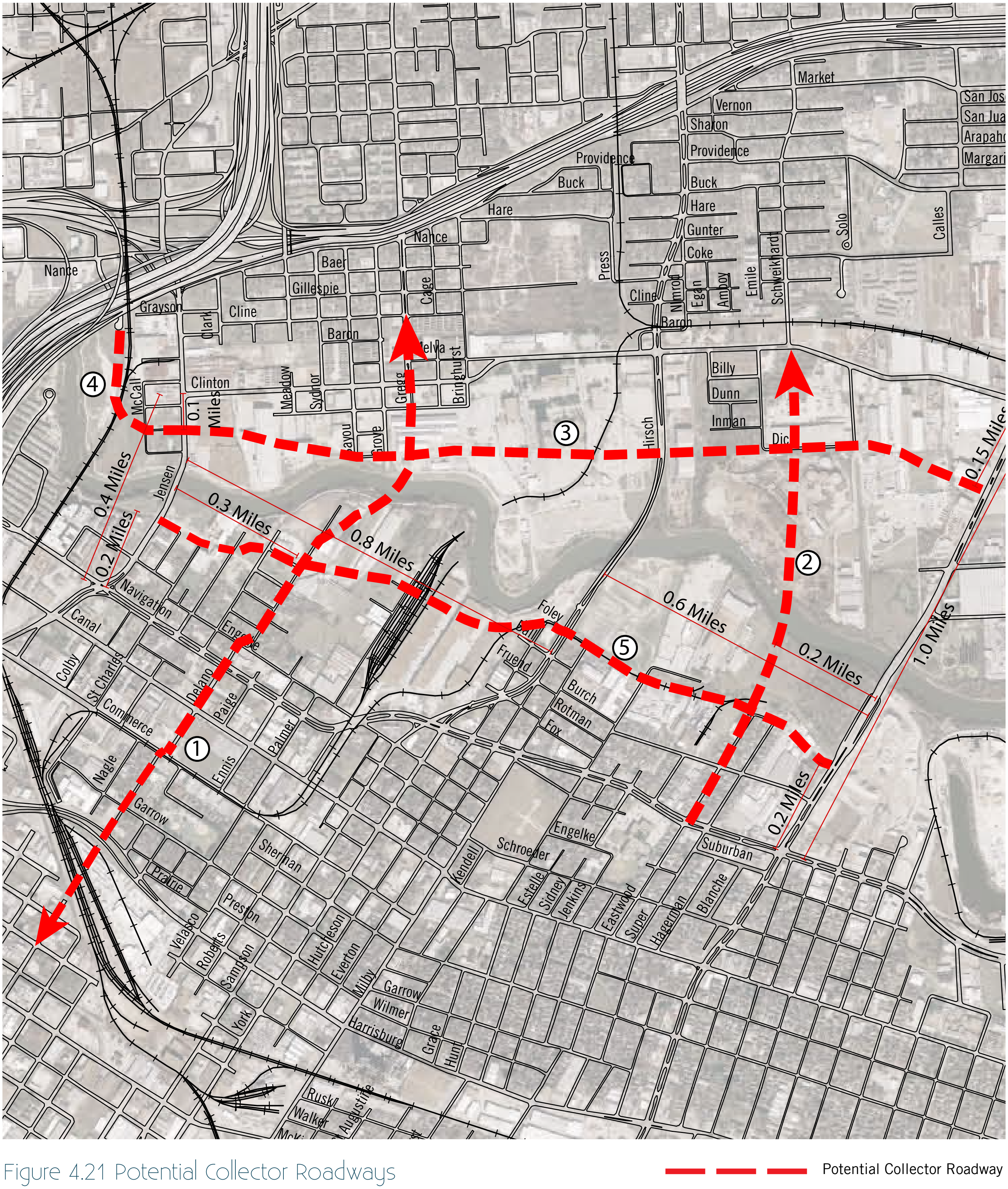


Figure 4.21 Potential Collector Roadways

Analysis of Impacts

East of US 59, there are limited north-south corridors that connect the various Superneighborhoods. Only Lockwood Drive and the Hirsch / Sampson / York / Scott Street corridors provide continuous across the study area. Improvement R2 would create an additional north-south corridor by connecting Jensen Street and Navigation Boulevard to St. Emanuel Street. Even with the three corridors, the spacing between Jensen / Navigation and Lockwood Drive is approximately 1.5 miles. Additional north-south roadways would improve mobility by enhancing the existing grid network and by creating an additional crossing over Buffalo Bayou.

The biggest positive impact may be for pedestrian and bicycle connections. The long spacing between existing crossings is a strong deterrent for these active transportation modes because finding an appropriate connection may add half a mile or more to a trip.

D1: Support high level of connectivity in future roadway network

Implementation Projects

- **D1-1:** Add corridors to MTFP to support a high level of connectivity

Benefits

- Enhances network connectivity and connections between the Fifth Ward and the Second Ward
- Supports coordinated future development in the study area, potentially creating value across property owners

Challenges

- Requires coordination with existing property owners

Mobility Goals Addressed

Primary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

Secondary:

- Goal 3: Enhance multi-modal trip alternatives

Important Partners

- City of Houston
- Gulf Coast Rail District
- Local developers and property owners

Jensen Street Bridge over Buffalo Bayou

D2: Parking Management Strategies

Description of Potential Improvement:

Parking management represents a significant challenge to mobility systems. The availability of parking is a major factor for people when deciding what modes to use. Insufficient parking can make destination inaccessible for motorists, or can force on-street parking on neighborhood streets. Excessive parking can create areas devoid of destinations, street activity, and visual interest, which can be a strong deterrent to walking, biking, or transit usage.

The availability of parking can also be an important factor for investors when choosing properties in which to invest. Although parking requirements can often be limited in areas that are well served by transit, investors and lending institutions frequently desire easily-accessible parking directly in front of their stores, businesses, and other real estate investments. It is therefore important to find a proper balance in parking, not providing so much that modes other than driving are disincentivized, but not so little that investment is endangered.

Parking best-practices can be broken down into three major categories: on-street, off-street, and statutory.

On-street parking provides a number of benefits in addition to the stated goal of storing vehicles. Cars parked on-street provide a physical, protective barrier between pedestrians on the sidewalk and vehicular traffic, thereby improving the pedestrian experience. On-street parking also has the potential to slow down traffic on streets where low traffic volumes promote faster-than-posted speeds, improving safety for all road users including bicyclists and pedestrians. The link between on-street parking and the quality of the pedestrian realm has even been included in the 2010 Highway Capacity Manual (HCM) which factors on-street parking into its new methodology for computing pedestrian level of service.

On-street parking also provides the potential to reduce parking requirements for off-street parking on streets which are currently operating at acceptable levels-of-service and whose cross section could be modified to encourage on-street parking. Potential roadways for this treatment include Canal Street, Sampson Street, and York Street. Where only peak hour numbers sustain the current lane configurations, parking may be restricted during those hours but encouraged the rest of the day.

Off-street parking also has a major impact on pedestrian accessibility. Large parking lots adjacent to sidewalks not only fail to offer destinations for pedestrians but also increase walking distance to actual destinations. They also typically do not provide an appealing walking environment, eschewing trees and buffer plantings for extra parking spaces. Locating off-street parking behind commercial buildings can mitigate many of these negative impacts on the pedestrian realm because doing so allows buildings to be built closer to the property line, putting the front door nearer the sidewalk and resulting in an overall improvement in the pedestrian realm (see sidebar - More Information: Impacts of Parking Orientation).

Even when large parking lots are not present, the existence of many driveways and curb cuts can be equally detrimental to the pedestrian realm. In many areas of Houston which have experienced high residential growth, the lack of regulation for curb cuts, especially in areas with a number of townhouses, has led to an ill-defined pedestrian realm with numerous conflict points with vehicles. Shared driveways for this type of development would provide a pedestrian realm that feels safe with fewer conflicts.

Finally, changes to the City of Houston's Off-Street Parking Ordinance will likely provide some statutory authority to regulate parking. The changes currently under consideration would give the Management Districts the authority to create a Parking Management District to accommodate the parking needs within identified major activity centers where the parking demand can be met by establishing ratios lesser than what is normally required for reasons including transit ridership and level of mixed-use development. Additionally, Parking Benefit Districts can be created along corridors, and tolls collected at parking meters in the corridors are reinvested along the corridors.

Map Key

- Potential EaDo Parking Management District
- Potential East End Parking Management District
- Potential Parking Benefits District (EaDo)
- Potential Parking Benefits District (East End)

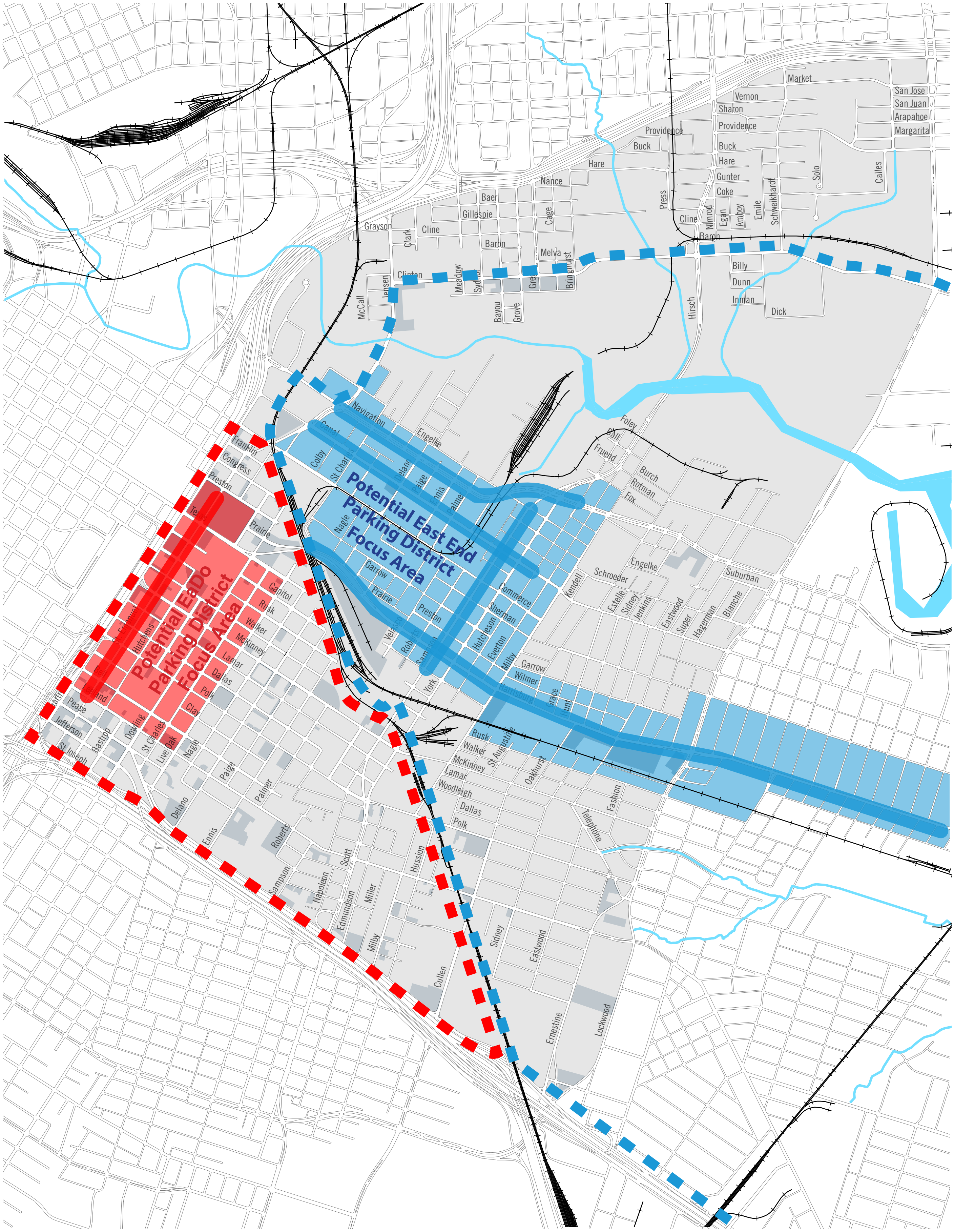
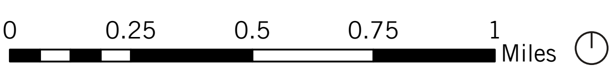


Figure 4.22 Potential Parking Districts



Implementation Projects

The following proposed improvements, illustrated on Figure 4.22, are made to address parking concerns in the study area:

D2-1: Create Parking Benefits Districts along St. Emanuel Street and Harrisburg Boulevard.

Increasing levels of activity in EaDo related to restaurants, bars, music venues, and the BBVA Compass Stadium will result in increasing demand for parking. Event parking in particular related to soccer games would likely make a Parking Benefits District successful. A Parking Benefits District would need to be coordinated with other improvements on St. Emanuel Street, detailed in Improvement Opportunity R2.

The proposed cross-section along Harrisburg Boulevard will create a large capacity for on-street parking. Potential future development that may accompany the light rail line will likely create high demand for parking.

D2-2: Create Parking Benefits Districts along Navigation Boulevard, Canal Street, and Sampson Street as development warrants them.

Although existing development along Navigation Boulevard is light and demand for parking is relatively low, proposed investments by the GEEMD may serve to spur future development. At that time, demand for parking may warrant implementation of a Parking Benefits District.

As discussed in potential improvement R4, Sampson Street is envisioned in the long-term to be converted into a two-way street that serves local traffic and offers on-street parking, while York Street will serve through traffic. At that time, demand for parking on Sampson Street may warrant a Parking Benefits District.

D2-3: Create a Parking Management District in the East End/Third Ward and EaDo once development and parking demand warrants them.

Parking in the East End/Third Ward is currently sufficient to meet demand, but as redevelopment occurs and density increases, additionally statutory guidance from a Parking Management District can help shape development so that parking does not become a hindrance to the pedestrian environment. A Parking Management District will be most useful if implemented prior to an influx of development so that parking can be implemented in a coordinated fashion.

More Information: Impacts of Parking Orientation

Placing parking lots behind structures and reducing setbacks allows the street front to take on a more pleasant pedestrian environment, rather than the conventional automobile-focused approach. This is essential in creating walkable destinations.

PREFERRED: Rear-building parking / active street front

DISCOURAGED: Front-structure parking

Analysis of Mobility Impacts:

The East End represents the location of significant potential development over the next twenty years. A proactive approach to develop a coordinated parking strategy can have significant mobility benefits if implemented prior to the development. Parking management strategies have a major impact on mode split and on pedestrian experience.

For example, the sidebar on Page 128, "Impacts of Parking Orientation," illustrates two different options for locating parking for a development. The "recommended" arrangement places parking on the backside of the development so that the building itself is set up next to the pedestrian realm of the street. When windows, entryways, and outdoor dining amenities are provided, this arrangement can create a much more pedestrian-friendly environment than the standard arrangement of placing parking adjacent to the street. Parking Management Districts may have the ability to incentivize desirable parking formats.

D2: Parking Management Strategies

Implementation Projects

- **D2-1:** Create Parking Benefits Districts along St. Emanuel Street and Harrisburg Boulevard
- **D2-2:** Create Parking Benefits Districts along Navigation Boulevard, Canal Street, and Sampson Street as development warrants them
- **D2-3:** Create a Parking Management District in the East End/Third Ward and EaDo once development and parking demand warrants them

Benefits

- Coordinated approach creates potential economic benefits to development with more utilizable space for development and limited parking costs
- Supports improved pedestrian experience and attractiveness of alternate modes of travel
- Public realm that is more attractive and that provides environmental benefits such as decreased stormwater runoff and decreased heat island effect

Challenges

- Reduction in available parking can have negative effects on commercial investment in the study area. Changes to parking requirements should be incremental, and steps should be taken to collect data on the number of users in commercial areas who are using different modes in order to promote the success of the area's parking strategies

Mobility Goals Addressed

Primary:

- Goal 2: Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

Secondary:

- Goal 3: Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

Important Partners

- City of Houston
- Greater East End Management District
- East Downtown (EaDo) Management District
- Local developers and property owners


CASE

Implementation Plan

The mobility improvement opportunities presented in Chapter 4 were identified based on their ability to satisfy the goals of this mobility study, summarized below:

1. Address short and long term capacity constraints and opportunities by assessing the traffic impacts of growth and development and developing recommendations

2. Address barriers to mobility and increase connectivity between neighborhoods and major activity centers and destinations

3. Enhance multi-modal trip alternatives (e.g., walking, biking and transit) by providing improved transportation choices

4. Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans

5. Reduce safety concerns within study area for all travel modes.

All of the identified improvement opportunities support one or more of these goals and, if implemented, would promote improved mobility within and around the study area and accommodate and support future development. However, scarcity of funding resources makes it impossible to implement all projects simultaneously. Additionally, some identified improvements require coordination with other planned projects, such as the proposed grade separation along the West Belt rail line, and thus cannot be implemented immediately.

With these considerations in mind, an implementation strategy was developed. Projects were ranked by priority, which was determined by the ability of the project to satisfy project goals, project cost, community input and support, and availability of funding mechanisms, This chapter details the adopted approach to project prioritization and summarizes the implementation strategy.

The implementation strategy detailed in this chapter also includes a discussion of the approach taken to estimate project costs and an overview of changes proposed to area roadways that could require modifications to the City of Houston Major Thoroughfare Plan.

Project Prioritization

Thirty-five implementation projects were identified in Chapter 4 to achieve the full scope of the Improvement Opportunities and the project goals. These projects are summarized on Tables 5.1, 5.2, and 5.3. The summaries include the following information about each project:

Project description – A brief description of the major elements of each project. A more thorough description can be found in the relevant section of Chapter 5.

Cost – Estimated cost of the identified improvement opportunity. Cost estimates for each project were developed based on planning-level conceptual designs and used TxDOT low-bid cost estimates for trailing 12 months as of April 1, 2012.

Ease of implementation – A qualitative assessment of the overall ease of implementation for a project. This assessment includes consideration of cost, community support, right-of-way requirements, regulatory hurdles, coordination with other projects such as freight rail grade separations, and overall project scope.

A project with high ease of implementation could theoretically be implemented quickly and inexpensively once a sponsor is identified. Ease of implementation is represented as:

Ease of Implementation	
LOW	Harder
MEDIUM-LOW	
MEDIUM-HIGH	
HIGH	Easier

Goals Supported – Identifies the primary goals addressed by each project.

Benefits – Summarizes the mobility benefits associated with each implementation project and corresponding improvement opportunity.

Proposed Implementation Schedule for Improvement Opportunities

Every proposed improvement opportunity identified in Chapter 5 was selected because of its strong potential to improve mobility in the East End by addressing the mobility goals. As such, they are all considered high-priority projects. However, the availability of funding resources and the contingency of some projects on others necessitate a further prioritization so that projects can be scheduled in a logical manner to take advantage of funding as it becomes available. A prioritization schedule was developed based on each project's cost, ease of implementation, and impact on mobility goals. Additionally, community feedback from the third public meeting was considered.

Three priorities have been utilized:

Short-term (Table 5.1) – Project with low-costs or previously identified funding that do not require extensive right-of-way or coordination with other projects and that can be implemented in **one to two years**. These are typically "shovel-ready" projects.

Medium-term (Table 5.2) – Medium-cost projects or higher-cost projects with particular importance to meeting the East End mobility goals that can be implemented in **two to five years**.

Long-term (Table 5.3) – Typically higher-cost projects that will involve coordination with other projects and with several stakeholders and regulatory agencies. These projects are recommended for implementation in **five or more years**.

The priorities identified for each project are tentative and are based on existing conditions. Projects may be accelerated or decelerated based on availability of funding, local priorities, or the scheduling of contingent projects. For example, the implementation of grade separations along the West Belt Subdivision may accelerate projects identified for St. Emanuel Street (Improvement Opportunity R2) and York Street (Improvement Opportunity R4).

Table 5.1 Short-term Implementation Schedule

Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-4	Close Westbound Pease at Dowling	$10,000	●	5 - Reduce Safety Concerns	Improve safety of intersection by removing unneeded movement from Pease Street at Dowling Street
R2	R2-1	Reconfigure the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street so that Navigation Boulevard is aligned with St. Emanuel Street.	$485,000	◑	2 - Address Barriers 5 - Reduce Safety Concerns 4 - Support Development	Create a continuous north-south connection between EaDo and the East End; improve comprehensibility of roadway network
R3	R3-1	Modify Navigation Boulevard cross section	$1,500,000	◑	4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; aligns with visions set out in East End Master Plan; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-2	Modify cross sections of Canal Street and Commerce Street with pavement markings and minor pavement repair.	$155,000	◑	4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R4	R4-1	Modify cross sections on York Street and Sampson Street with pavement marking modifications	$42,900	◕	1 - Capacity Constraints/ Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; maintains acceptable LOS for vehicular traffic
T1	T1-1	Develop Canal Street, Polk Street, and Sampson Street / York Street as priority transit corridors	$379,000	◕	2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
T2*	T2-1	Support East End urban circulator implementation	$0	◕	2 - Address Barriers 4 - Support Development	Coordinates across projects for leverage and to minimize obstacles and disruption
PB1	PB1-1	Implement pedestrian realm improvements on Navigation Boulevard, Sampson Street, and York Street	$249,000	◕	2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports East End Master Plan recommendations; supports transit facilities
PB2	PB2-1	On-street bicycle facility improvements	$116,000	◕	2 - Address Barriers 3 - Multimodal Trips	Connects the Eastwood Transit Center, Harrisburg Light Rail Line, Harrisburg Rails-to-Trail, Columbia-Tap Bike Rails-to-Trail, and Buffalo Bayou bike trails; improves access to UH
PB2	PB2-6	On-street bicycle improvements from Downtown/EaDo Livable Centers study and 5th Ward Special Districts study	$344,000	◕	2 - Address Barriers 3 - Multimodal Trips	Bicycle proposals from other projects tie into the existing bicycle network and facilities proposed in this report
PB3	PB3-1	Implement a signage and wayfinding program for the area using standard signage from the MUTCD	$96,000	◕	2 - Address Barriers 3 - Multimodal Trips	Low-cost option for improving bicycle access in the area; can encourage regional cohesion because of better ties between neighborhoods
D1	D1-1	Add corridors to MTFP to support high level of connectivity	$0	◑	2 - Address Barriers 3 - Multimodal Trips	Enhances network connectivity and connection between East End and 5th Ward; supports coordination across future development, potentially creating value for impacted property owners
D2	D1-2	Create Parking Benefits Districts along St. Emanuel Street and Harrisburg Boulevard	$0	◕	2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area

* T2 is a short-term, medium-term and long-term priority.

Table 5.2 Medium-term Implementation Schedule

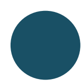
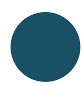
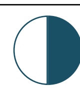
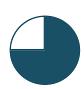
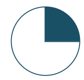
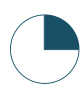
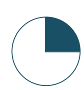
Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-1	Roundabout at intersection of Navigation and Jensen	$1,120,000		5 - Reduce Safety Concerns 1 - Capacity Constraints/ Opportunities	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R1	R1-5	Traffic signal or roundabout at intersection of Chartres and Runnels	$421,000		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R3	R3-3	Reconstruct Canal Street with cross section that emphasizes vehicular mobility and parking (Navigation to York)	$2,000,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-4	Reconstruct Commerce Street with cross section that emphasizes vehicular and bicycle mobility (US 59 to Harrisburg Rail to Trail)	$3,700,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R5	R5-1	Improvements to signage, wayfinding, and pavement markings along Chartres Street	$97,000		2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
T1	T1-2	Develop Navigation Boulevard as a priority transit corridor	$99,000		2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
PB1	PB1-2	Implement pedestrian realm improvements on the other Primary Corridors	$217,000		2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports transit facilities
PB2	PB2-7	Off-street bicycle improvements identified in Downtown/EaDo Livable Centers study	$760,000		2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities near Dynamo Stadium and other destinations
PB3	PB3-2	Implement a district-branding signage and wayfinding program	$246,000		2 - Address Barriers 4 - Support Development	Can simultaneously offer direction to important destinations while also helping create an identifiable brand for the area
D2	D2-2	Create Parking Benefits Districts along Navigation Boulevard, Canal Street, and Sampson Street as development warrants them	$0		2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area
D2	D2-3	Create a Parking Management District in the East End/ Third Ward and EaDo once development and parking demand warrants them	$0		2 - Address Barriers 3 - Multimodal Trips	Coordinated approach to parking that can satisfy parking needs with minimal parking infrastructure

Table 5.3 Long-term Implementation Schedule

Improvement Opportunity	Project #	Project Description	Cost	Ease of Implementation	Goals Supported	Benefits
R1	R1-2	Improvements to intersection of Canal and Navigation	$146,300		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities; decrease safety concerns related to vehicles accessing Hutchins Street
R1	R1-3	Intersection improvements or roundabout at intersection or Navigation and York	Costs are included in project R4-2		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R2	R2-2	Extend Franklin Street east to join with the intersection of Dowling Street and Congress Street.	$3,000,000		2 - Address Barriers 4 - Support Development	Improve connectivity between Downtown, EaDo, and the East End; simplifies entering/exiting Downtown
R2	R2-3	Modify West Belt Rail Study proposal for a grade separation at the intersection of Navigation Boulevard and Commerce Street to align Navigation Boulevard with St. Emanuel Street.	$22,480,000 (cost is for original underpass design; proposed modifications may have marginal additional costs)		2 - Address Barriers	With modification, will provide continuous north-south link along Jensen, Navigation, and St. Emanuel; will provide bicycle connections along Navigation and Commerce; will improve access between Downtown, EaDo, and the East End
R4	R4-2	Convert York Street and Sampson Street to two-way roads	$1,260,000 (signal at Navigation and York) $1,900,000 (roundabout at Navigation and York)		1 - Capacity Constraints / Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; improves access to businesses and other destinations; maintains acceptable LOS for vehicular traffic
R5	R5-2	Enhance and potentially redesign Chartres Street to make it a safer and more attractive gateway into Downtown and the East End	$5,700,000		2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
PB1	PB1-3	Implement pedestrian realm improvements on the Secondary Corridors	$1,900,000		2 - Address Barriers 3 - Multimodal Trips	Improves local access between neighborhoods and primary corridors, including business-intense corridors and transit corridors
PB2	PB2-2	Include bicycle facilities along Lockwood Drive when the road is reconstructed	$500,000		2 - Address Barriers 3 - Multimodal Trips	Provides logical connection between Eastwood Transit Center, Harrisburg Light Rail, Harrisburg Rails-to-Trail, and Buffalo Bayou bike trails; if implemented during roadway reconstruction, costs would be minimized
PB2	PB2-3	Complete Buffalo Bayou trail network	$580,000		2 - Address Barriers 3 - Multimodal Trips	Completing the trail system along Buffalo Bayou will provide a dedicated "bicycle highway" that is comfortable for all users between the East End, Downtown, and the Heights.
PB2	PB2-4	Pedestrian and bicyclist bridges over Buffalo Bayou	$1,890,000		2 - Address Barriers 3 - Multimodal Trips	Will improve connectivity between the East End and the Fifth Ward; will support pedestrian- and bicycle-friendly development along Buffalo Bayou
PB2	PB2-5	Develop underpass designs at West Belt rail line to accommodate all levels of bicycle experience	$2,440,000		2 - Address Barriers 3 - Multimodal Trips	Consideration of bicycle facilities on grade separations that are already proposed can leverage construction money to provide quality bicycle improvements
PB2	PB2-8	Off-street bicycle improvements identified in Fifth Ward Special Districts study	$1,033,800		2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities to neighborhoods and schools north of Buffalo Bayou

Proposed Changes to MTFP

The City of Houston maintains a Major Thoroughfare and Freeway Plan (MTFP) that tracks and characterizes major existing and proposed travel corridors in the City and its extraterritorial jurisdiction. Corridors on the MTFP are classified as Principal Arterial, Major Arterial, Major Collector, Transit Street, or Freeway. The MTFP provides details for each corridor including right-of-way, lane designations, and pavement-widening needs. In turn, City ordinances place further standards and requirements on the roadways and adjacent development, including building setbacks and minimum sidewalk widths, based on roadway classification.

Modifying an existing cross section on a roadway can require modifying the MTFP itself. The City of Houston Planning Department manages the development and refinement of the MTFP. Proposed revisions to the MTFP are researched by the department, and comments are sought from impacted land owners. Any proposed changes to the MTFP that remain must be adopted by the Planning Commission and City Council. This process is repeated annually.

Several of the improvement opportunities identified in this report propose changes to roadways that could impact the MTFP. The changes range from a modification of number of travel lanes to the addition of entirely new thoroughfares. Tables 5.4, 5.5 and 5.6 summarize the existing and proposed conditions for roadways on the MTFP in the East End study area. Proposed changes to the MTFP are highlighted in bold.

Table 5.4 Proposed Changes: Major Thoroughfare (Classification)

		EXISTING							FUTURE (IF CHANGED)						
Street Name	Extent	Classification	Lanes (MTFP)	Lanes (Field)	ROW	Bicycle Facilities	Transit	ADT	Improvement Opportunity	Classification	Lanes (MTFP)	ROW	Bicycle Facilities	Transit	2035 Projections
Sampson	Navigation to Commerce	Major Thoroughfare	4	4	80	Signed bicycle route	29	2800	R4	Collector (C - 2)	2		Bicycle lanes	Move bus to York	5500
Sampson	Commerce to McKinney		4	4	80	Signed bicycle route	29	2900	R4	Collector (C - 2)	2		Bicycle lanes	Move bus to York	14600
Sampson	McKinney to Scott		4	4	80	Signed bicycle route	29	3400	R4	Collector (C - 2)	2		Bicycle lanes	Move bus to York	13300
Polk	Chartres to Scott		4	2	80	Bicycle lane	40	3600							6800
Polk	Scott to Lockwood		4	2	80	Bicycle lane	40	6000							13900
Dowling	Harrisburg to Leeland		4		80	None	36	9000							22200
Dowling	Leeland to Elgin		4		80	None	--	4900							23700
Waco	Gunter to Eastex Freeway		4		100	Bicycle lane	29	11600							17500
Hirsch	Buffalo Bayou to Gunter		4		100	Bicycle lane	29	6200							20000
York	Navigation to Buffalo Bayou		4	4	100	Bicycle lane	29	4700							20000
York	Commerce to Navigation		4	4	100	Signed bicycle route	29	2700	R4				Remove bicycle route		8500
York	McKinney to Commerce		4	4	100	Signed bicycle route	29	2900	R4				Remove bicycle route		13400
York	Polk to McKinney		4		100	Signed bicycle route	29	3000	R4				Remove bicycle route		10000

☐ Potential roadway modification

Table 5.5 Proposed Changes: Principal Thoroughfare (Classification)

		EXISTING							FUTURE (IF CHANGED)						
Street Name	Extent	Classification	Lanes (MTFP)	Lanes (Field)	ROW	Bicycle Facilities	Transit	ADT	Improvement Opportunity	Classification	Lanes (MTFP)	ROW	Bicycle Facilities	Transit	2035 Projections
Navigation	Lockwood to Sampson / York	Principal Thoroughfare	6	4	120	Signed bicycle route	48	9600	R3		4		Shared lane		15200
Navigation	Sampson / York to Jensen		6	4	120	Signed bicycle route	48	7800	R3		4		Shared lane		28700
Lockwood (One-Way NB)	IH-45 to Polk		3	3	66	None	40, 42	8000	PB2		2		Bicycle lanes		16300 Lockwood & Ernestine Combined
Ernestine (One-Way SB)	IH-45 to Polk		3	3	70	None	40,42	7700	PB2		2		Bike Lanes		
Lockwood	Polk to Harrisburg		6	6	100	None	42	13500	PB2				Bicycle lanes		25200
Lockwood	Harrisburg to Canal		6	6	100	None	42	13800	PB2				Bicycle lanes		16900
Lockwood	Canal to Navigation		6	6	100	None	42	11500	PB2				Bicycle lanes		17700
Lockwood	Navigation to Clinton		6	6	100	None	42	16300	PB2				Bicycle lanes (to Buffalo Bayou)		24500

☐ Potential roadway modification

Table 5.6 Proposed Changes: Other (Classification)

		EXISTING							FUTURE (IF CHANGED)							
Street Name	Extent	Classification	Lanes (MTFP)	Lanes (Field)	ROW	Bicycle Facilities	Transit	ADT	Improvement Opportunity	Classification	Lanes (MTFP)	ROW	Bicycle Facilities	Transit	2035 Projections
Commerce	Sampson / York to US 59	Other (N/A)	N/A	2	N/A	Signed bicycle route	--	1800	R3	Collector (C - 2)	2	60	Bicycle lanes		8700
Proposed Road 1	N-S between Jensen and Hirsch		N/A	N/A	N/A	N/A	N/A	N/A	D1	Collector (C - 2)	2	60	Bicycle lanes		N/A
Proposed Road 2	N-S between Hirsch and Lockwood		N/A	N/A	N/A	N/A	N/A	N/A	D1	Collector (C - 2)	2	60	Bicycle lanes		N/A
Proposed Road 3	E-W north of Buffalo Bayou		N/A	N/A	N/A	N/A	N/A	N/A	D1	Collector (C - 2)	2	60	Bicycle lanes		N/A
Proposed Road 4	E-W connection to Nance Street		N/A	N/A	N/A	N/A	N/A	N/A	D1	Collector (C - 2)	2	60	Bicycle lanes		N/A
Proposed Road 5	E-W south of Buffalo Bayou		N/A	N/A	N/A	N/A	N/A	N/A	D1	Collector (C - 2)	2	60	Bicycle lanes		N/A

☐ Potential roadway modification

Evaluation Criteria and Performance Metrics

This study has defined mobility goals and projects to deliver them for the East End study area. These projects have been identified as the best candidates for improving mobility under existing conditions. Long term delivery of mobility in the East End study area under uncertain future conditions can be accomplished by:

Defining success through performance metrics. Performance metrics are tools to assess performance and success, and they enable improved ongoing performance management, decision making, and project prioritization. Successful metrics should be based on a common understanding of success, be linked to a mobility goal, and be measurable with reasonable resources and effort. Metrics have been developed to support the assessment of opportunity projects identified in this study to address the mobility goals.

Assessing performance. It is important to build into the ongoing planning cycle an assessment of performance against goals using defined metrics. This routine activity can ensure that resources such as capital funding and staff time are aligned with current priorities.

Refining approach through a feedback cycle. The mobility projects identified in this study have been selected to deliver the study goals within the context of existing conditions. As environmental, political, and social conditions change over time, the goals and tools available to address them may also change. Building a feedback cycle into the long-term planning process allows continuous adjustments to best capture opportunities.

The potential Evaluation Criteria Metrics for each goal are described below and summarized in Table 5.7. They have been developed to allow continued assessment of performance in attaining the goals for the study.

Goal 1: Address short and long-term capacity constraints and opportunities

Share of roadways operating at LOS D or better is a measure of the quality of mobility for motor vehicles and of the delays they experience. It should be computed using actual traffic counts, either at intersections or along roadways. Count locations should be chosen to be representative of the entire roadway network. A higher number is desirable.

Travel Time Runs measures the amount of time for a typical vehicle to travel from an origin to destination along a corridor. They can be helpful for analyzing the entire trip experience of roadway users. Roadways selected for travel time runs should be chosen for their tendency to move through-traffic and should not vary between measurement periods. The runs should occur at similar times of day, days of week, and seasons of year to minimize natural variations in traffic patterns. A lower number is desirable.

Goal 2: Address barriers to mobility and increase connectivity

Intersection Density measures the number of intersections for a given analysis area. A higher intersection density indicates that road users have more direct routes and more options for avoiding undesirable traffic conditions such as high speeds or congestion. This metric is unlikely to change substantially unless roadways are added or removed. A higher number is desirable.

Link Node Ratio measures the number of intersections compared to the number of roadways connecting them. Similar to intersection density, a higher link node ratio indicates that road users have more opportunities for mobility. A higher number is desirable.

Barrier Crossing Density measures the number of crossings of barriers including railroads, freeways, and bayous per mile of a specified barrier. A higher number is desirable.

Goal 3: Enhance multi-modal trip alternatives

Pedestrian LOS, measured by the ratio of linear feet of sidewalk to the linear feet of curb. A true pedestrian LOS would utilize the 2010 Highway Capacity Manual Multimodal LOS tool; however, the tool is very data-intensive and is also very reliant on the presence of sidewalks. Until the sidewalk network is built out, a simplified metric is proposed.

Bicycle LOS, measured by the total linear feet of dedicated bicycle facilities. A true bicycle LOS would utilize the 2010 Highway Capacity Manual Multimodal LOS tool, and this tool is recommended for long-term implementation.

Mode Share is the percentage of the population commuting by each transportation mode. Efforts to increases walking, bicycling, and transit usage would find higher shares for those modes and a lower share for single-occupancy vehicles desirable.

Transit Ridership is the number of people boarding and alighting from transit vehicles in the analysis area. This measure provides insight into transit utilization, although it does not necessarily indicate a higher transit mode share. Counts are available from METRO. A higher number is desirable.

Ped/Bike Counts is a physical count of all pedestrians and bicyclists passing a point on a road, trail, or other facility for a specified time period. The location and time period should be constant to compare sequential counts. A higher number is desirable.

Coverage is the percentage of population in an analysis area living with 1/4-mile of a transit stop. This is the population that is considered to have access to transit. A higher number is desirable.

Goal 4: Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans

Property Values are a measure of the economic vitality of an area and of the economic impact of major public investments. For an analysis area, both the total property value and the rate of change in property value are useful. A higher number for each is desirable.

Sales Tax Revenues are a measure of the economic vitality of an area. For an analysis area, both the total sales tax revenue for a designated time period and the rate of change in total sales tax revenue are useful. A higher number for each is desirable.

Population Growth measures the total population and the rate of increase in population over a set time period for an analysis area. A higher number is desirable.

Employment Growth measures the total employment and the rate of increase in employment over a set time period for an analysis area. A higher number is desirable.

Goal 5: Reduce safety concerns

Crash Frequency is the total number of crashes at a location for each mode of travel compared to the total number of vehicles passing the location over a set time period. A lower number is desirable.

Crash Severity is the percentage of total crashes at a location over a set time period that involved an injury or death. A lower number is desirable.

Community Feedback can help gauge the public's perception of safety. For modes such as walking or biking, a perceived lack of safety can suppress rates of walking and biking, which in turn can make other safety metrics difficult to use. This feedback can be gathered in the form of physical and/or online surveys to assess the percentage of respondents that feel safe using various modes of transportation in the study area. A higher number would be desirable.

Table 5.7 Evaluation Criteria for East End Study Area Goals

Goal	Evaluation Criteria Metrics	Units
1. Address short and long-term capacity constraints and opportunities	Share of roadways operating at LOS D or better	Percent
	Travel Time Runs	Seconds
2. Address barriers to mobility and increase connectivity	Intersection Density	Intersections per sq. mile
	Link Node Ratio	Calculated Ratio
	Barrier Crossing Density	Crossings per mile
3. Enhance multi-modal trip alternatives	Pedestrian Level of Service	Ratio of linear feet of sidewalks to linear feet of curb
	Bicycle Level of Service	Linear feet of dedicated bicycle facilities
	Mode Share	Percent by mode
	Transit Ridership	Count
	Ped/Bike Counts	Count
	Coverage	% Population withing 1/4 mile of transit or trail
4. Prioritize transportation infrastructure investments that support the development objectives identified through previous neighborhood and regional plans	Property Values	Total $ and rate of change
	Sales Tax Revenues	Total $ and rate of change
	Population Growth	Total and rate of change
	Employment Growth	Total and rate of change
5. Reduce safety concerns	Crash Frequency	Count (by Mode)
	Crash Severity	Count (by Mode)
	Community Feedback	Survey response - % that felt safe driving/walking/biking

Potential Funding Sources

This section presents an overview of potential funding sources for projects identified in this study. Federal funds have been categorized by the types of projects they are eligible to support. These categories approximately match the Improvement Opportunities identified in this report; however, many specific implementation projects are cross-cutting and could be funded through a variety of sources. For example, although a roundabout is technically a roadway improvement, it could also be considered an improvement to the pedestrian realm and may be eligible for funds typically reserved for pedestrian enhancements.

Local Funds

Many federal funds require local matches, either at an 80-20 level (20% local funds) or 50-50 level (50% local funds). The local funds identified here are potential sources for either direct implementation or as match for federal funds.

Management District General Funds - The management districts in the area (Greater East End Management District and East Downtown Management District) assess taxes on commercial businesses and multifamily developments within its boundaries. Some of these funds may be used as a local match for federal funds.

City of Houston Capital Improvement Program (CIP) Funds - With the passage of Rebuild Houston in 2010, the City of Houston CIP process works to prioritize projects based on need. However, opportunities exist to identify solutions for high priority locations. There may be some ability to influence prioritization to include impacts on economic development and alignment with other projects – especially if some outside funding partnerships can be identified.

METRO - The Metropolitan Transit Agency of Harris County assesses a one cent sales tax on sales in its service area. These funds can be used for transit-related projects including transit operation expenses, transit capital expenses, and other projects that support transit such as pedestrian and bicycle facilities and wayfinding. Partnership on programs such as Job Access Reverse Commute (JARC) and New Freedom grants can help obtain grants such as the one to support the planned sidewalk improvements along Canal Street.

Harris County - The County funds a wide variety of transportation projects, including roadway, transit, pedestrian, and bicycle improvements. For example, the County will be a funding partner in planned bicycle and sidewalk improvements in the Greater East End Management District.

Tax Incremental Reinvestment Zone (TIRZ) - A TIRZ is a state-created entity that retains a portion of property taxes once property values exceed a predetermined level. TIRZs have bonding power to leverage projected increases in taxable property value that result from planned infrastructure development. Funds must be spent within the boundaries of the TIRZ. A new TIRZ has recently been created along the Harrisburg Boulevard corridor. Some of the funds generated by this TIRZ could conceivably be used to support projects identified in this report.

Private Sector Sources - Developers and land owners could be partners in developing infrastructure projects that impact their interests. Land owners could provide land dedications or direct capital support for projects such as expansions of the pedestrian realm or intersection improvements. They can also provide pedestrian wayfinding, easements and amenities on their land, such as improved bus stops, that can simultaneously promote public mobility as well as serve as marketable branding for their own developments.

Federal Funds: Multiple Modes

The federal funding opportunities discussed below are provided under the SAFETEA-LU transportation bill, which guided transportation funding through 2012. In July 2012 a new Federal Surface Transportation bill (MAP-21) was signed into law which will change some funding programs and funding levels. It will be important to monitor these changes in programs to understand new or different funding opportunities as the programs are developed.

Transportation Improvement Program (TIP) - The Texas Transportation Commission and Texas Department of Transportation (TxDOT) develop the Unified Transportation Plan (UTP), which organizes transportation spending into several categories. These categories match SAFETEA-LU requirements for allocation of federal funds for transportation projects. There are 12 categories of funding in the UTP, though H-GAC down not program funds for all categories. Long-range planning for funding is developed through the Regional Transportation Plan (RTP) and short term projects are then prioritized and funded through the TIP utilizing the categories in the UTP, which is adopted by the H-GAC's Transportation Policy Council. Federal funds available through the TIP for capital projects are typically funded 80% by federal funds with a 20% local match required. Advanced planning and an understanding of what prioritization factors exist is critical to developing projects to be funded through this process. Funding categories in the UTP and reflected in the TIP for specific modes are discussed in the funding opportunities for each mode.

Federal Funds: Roadway and Traffic

TIP - A description of some of the major current funding categories for roadways in the TIP include:

- Category 2 - Metropolitan and Urban Corridor Projects - Mobility and added capacity projects along a corridor that improve transportation facilities in order to decrease travel time and level or duration of traffic congestion, and to increase the safe and efficient movement of people and freight in metropolitan and urbanized areas.

- Category 3 - Non-Traditionally Funded Transportation Projects - Transportation related projects that qualify for funding from sources not traditionally part of the state highway fund including state bond financing under programs such as proposition 12 (General Obligation Bonds), pass-through toll financing, unique federal funding, regional toll revenue, and local participation funding.

- Category 5 – Congestion Mitigation and Air Quality (CMAQ) Improvements - Addresses attainment of national ambient air quality standards in the non-attainment areas (including Houston). Funds cannot be used to add capacity for single occupancy vehicles.
- Category 7 – Metropolitan Mobility/Rehabilitation - Transportation needs within the Transportation Management Areas (TMAs).
- Category 8 - Safety Programs - projects which address safety issues on roadways, railroad crossings and pedestrian issues such as Safe Routes To School improvements
- Category 9 Transportation Enhancements - Discussed under Pedestrian and Bicycling Section
- Category 12 - Strategic Projects - projects which generally promote economic opportunity, increase efficiency on military deployment routes or to retain military assets in response to the federal military base realignment and closure report, or maintain the ability to respond to both man-made and natural emergencies.

The State of Texas UTP has more details about each of these funding categories. Many of these programs will change under MAP-21 including the consolidation of programs including Transportation Enhancement and Safe Routes to School under one funding group called Transportation Alternatives while programs such as CMAQ are projected to remain largely in their current form.

State and Federal Funds: Transit

Federal Transit Administration - The primary potential source of transit capital and planning funding will be through the Section 5307 Urbanized Formula Funds from the Federal Transit Administration (FTA). As Houston is in a large transit service area (METRO) it will be ineligible to use these funds for operating expenses.

The 5307 funds are allocated to an entire urbanized area based on a formula that includes urban population, miles of service provided, and passenger miles carried. The regional Metropolitan Planning Organization (in the Houston area's case, H-GAC) is responsible for then allocating those funds to all transit providers in the region.

Federal funds are also available to help pay for bus acquisition and other capital needs. If wheelchair lift-equipped buses are purchased the local share of the cost of buses is 17 percent. FTA funds will cover about 80 percent of the cost of shelters, benches, bus stop poles, and other passenger amenities.

The Fixed Guideway Capital Investment grants, commonly referred to as New Starts is the primary federal program providing funding for major new transit projects and would be a potential source for future street car or urban circulator development.

The State of Texas administers various special Federal grant programs, such as Job Access and Reverse Commute (JARC) and New Freedom. While New Freedom grants are focused on improving mobility for the disabled, the funds can be used to provide service for the general public as well on a space-available basis.

Transit services, both operating and capital, are also eligible for support under the Federal CMAQ program. CMAQ programs typically are most helpful in launching new services, but local sources must still be developed to continue service operations.

Federal Funds: Pedestrian, Bicycle, and Wayfinding

- TIP Category 9 - Transportation Enhancements (TE) – Transportation Enhancement activities offer funding opportunities to help expand transportation choices and enhance the transportation experience through 12 eligible TE activities related to surface transportation, including pedestrian and bicycle infrastructure and safety programs, scenic and historic highway programs, landscaping and scenic beautification, historic preservation, and environmental mitigation. TE projects must relate to surface transportation and must qualify under one or more of the 12 eligible categories.
- Safe Routes to School – Safe Routes to School programs create practical projects to make school routes safer for children to walk and bicycle, such as sidewalks, crosswalks and bicycle facilities. Community leaders, parents and schools also use education programs to help children travel safely to and from school. TxDOT typically issues a call for projects approximately every two years.

As noted, these programs will be combined under Transportation Alternatives in MAP-21.

Pedestrian and bicycle projects are also eligible for funding under the CMAQ program in non-attainment areas to reduce emissions. Pedestrian and bicycle programs that can be funded under this program can include trails or paths as well as education and marketing efforts designed to encourage bike riding and walking as forms of transportation.

- FHWA Recreational Trails Program - The Recreational Trails Program (RTP) provides funds to the States to develop and maintain recreational trails and trail-related facilities for both non-motorized and motorized recreational trail uses. The RTP is an assistance program of the Department of Transportation's Federal Highway Administration (FHWA) and is overseen by the Texas Parks and Wildlife Department. Federal transportation funds can be tapped to benefit a variety of recreational activities. Grants are typically subject to an 80-20 funding match. Individual trail grants can range from $4,000 ($5,000 total project cost) to $200,000 ($250,000 total project cost).
- TIGER Grants - Transportation Investment Generating Economic Recovery (TIGER) is a competitive project funding program started in 2009 to promote surface transportation projects. There have been three round of grants so far, funding $1.5 billion in 2009, $600 million in 2010, and $527 million in 2011. The program has been heavily oversubscribed with applicant projects in recent years. The City of Houston was successfully awarded a $15 million dollar TIGER grant in 2012 that will support improved pedestrian and bicycle mobility by filling in major gaps in the existing trail network including some locations in the East End. These grant are also awards for other project categories such as roadway, transit, and freight rail that are viewed as having significant potential benefits to their community or region. The future of TIGER Grants or comparable competitive funding grant program are uncertain under MAP-21.

Implementation Plan Summery

The projects outlined in the implementation plan in this chapter have been identified to efficiently meet the mobility goals of the study. Considerations of cost, coordination with other projects, ease of implementation, and public feedback will help ensure delivery of implementable projects in a timely and logical fashion. A superior level of mobility can be promoted through a combination of the identified mobility projects with the inherent strengths of the East End that include:

- Proximity to Downtown, University of Houston, and other important regional employment centers
- Major transit investments in the East End and Southeast light rail lines
- A relatively extensive network of on-street and off-street bicycle facilities
- A roadway network that was built for substantially higher population levels than exist today
- A large collection of contiguous vacant parcels that have the potential for redevelopment

The superior level of mobility provided by these inherent strengths combined with the proposed mobility improvements identified in this report will support existing neighborhoods and businesses as well as future development and growth in the East End.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Appendix

Appendix A1. Roadway Fact Base

Canal - Navigation to Sampson/York

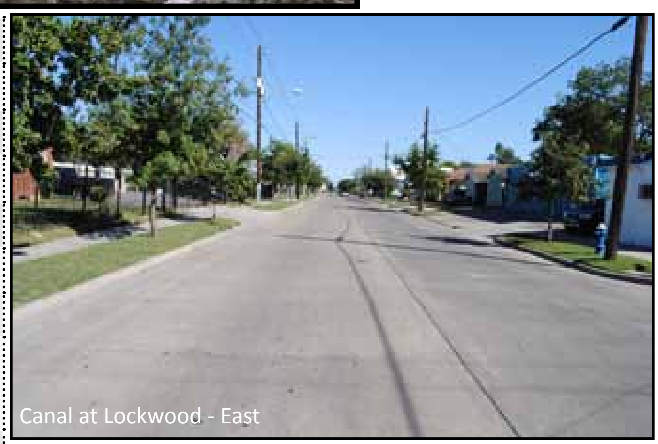
Classification	Major Collector
ROW	65’
Travel Lanes	2
Posted Speed Limit	30 MPH
Roadway Width	52’
Transit	METRO Line 37
Traffic Counts	Navigation to Sampson 3,730 (2009)
TDM Projections	4,200 (2011) 10,400 (2035 Sc1) 10,800 (2035 Sc2)
Sidewalks	Yes, sidewalks on both side of street, intermittent, poor condition
Bicycle Facilities	None


Canal - East


Canal - West

Canal - Sampson/York to Lockwood

Classification	Major Collector
ROW	65’
Travel Lanes	2
Posted Speed Limit	30 MPH
Roadway Width	35’
Transit	METRO Line 37
Traffic Counts	Sampson to Lockwood 6,190 (2009)
TDM Projections	4,900 (2011) 10,000 (2035 Sc1) 10,000 (2035 Sc2)
Sidewalks	Yes, sidewalks on both side of street, nearly continuous, poor condition
Bicycle Facilities	None


Canal at Lockwood - East


Canal at Lockwood - West

Clinton - Jensen to Lockwood

Classification	Major Thoroughfare
ROW	Varies (60' - 80')
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	52' - 53'
Transit	METRO Line 30
Traffic Counts	Jensen to Gregg 3,172 (2009) Gregg to Hirsch 2,532 (2009) Hirsch to Lockwood 4,746 (2009)
TDM Projections	4,600 (2011) 7,900 (2035 Sc1) 8,200 (2035 Sc2)
Sidewalks	Noncontinuous on both sides, poor condition
Bicycle Facilities	None


Clinton at Lockwood - East


Clinton at Lockwood - West

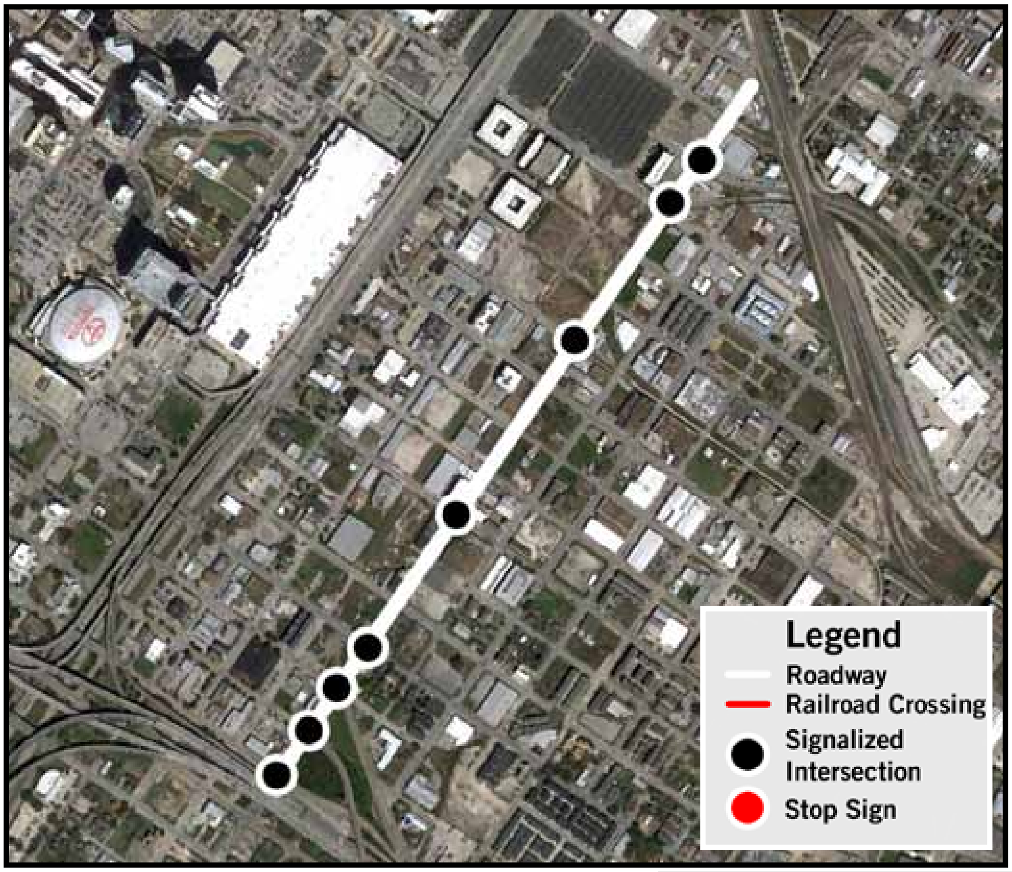
Commerce - US 59 to Sampson/York

Classification	N/A
ROW	N/A
Travel Lanes	2
Posted Speed Limit	30 MPH
Roadway Width	29' from Milby to tracks, 50' with tracks
Transit	None
Traffic Counts	None Available
TDM Projections	4,600 (2011) 8,700 (2035 Sc1) 8,700 (2035 Sc2)
Sidewalks	Extremely intermittent, poor condition
Bicycle Facilities	Signed bicycle route


Commerce at Milby - East


Commerce at Milby - West

Dowling - Congress to IH-45

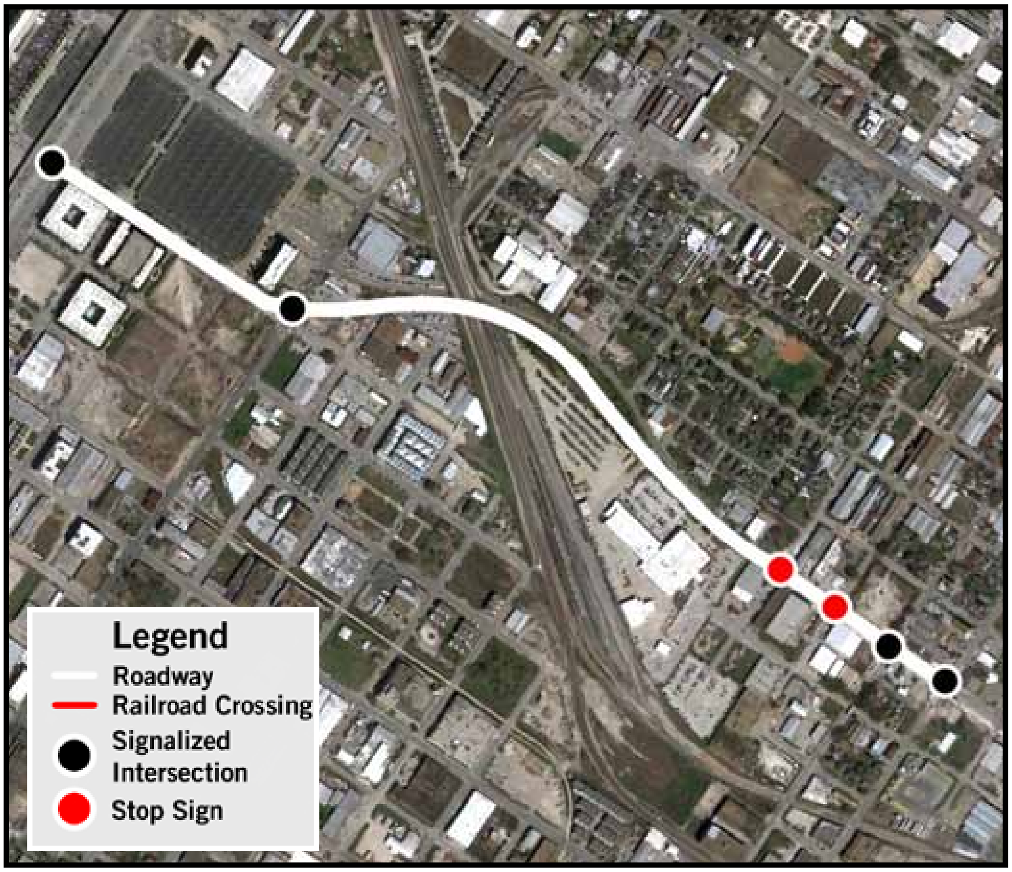


Classification	Major Thoroughfare
ROW	80'
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	42'
Transit	METRO Line 36 (south of McKinney), 50 (north of McKinney)
Traffic Counts	Harrisburg to Leeland 9,011 (2009) Leeland to Elgin 4,900 (2009)
TDM Projections	7,600 (2011) 23,600 (2035 Sc1) 23,700 (2035 Sc2)
Sidewalks	Intermittent, varying condition
Bicycle Facilities	None


Dowling at McKinney - North


Dowling at McKinney - South

Harrisburg - Dowling to Sampson/York



Classification	Major Thoroughfare
ROW	80’
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	N/A due to light rail construction
Transit	METRO Line 50 Note: Future Light Rail Line
Traffic Counts	Dowling to Sampson 8,321 (2009)
TDM Projections	11,900 (2011) 17,100 (2035 Sc1) 17,300 (2035 Sc2)
Sidewalks	Yes, continuous, good condition
Bicycle Facilities	None


Harrisburg - East


Harrisburg - West

Harrisburg - Sampson/York to Lockwood

Classification	Major Thoroughfare
ROW	70’
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	N/A due to light rail construction
Transit	METRO Line 50 Note: Future Light Rail Line
Traffic Counts	York to Lockwood 6,377 (2009)
TDM Projections	8,000 (2011) 12,500 (2035 Sc1) 12,800 (2035 Sc2)
Sidewalks	Yes, continuous, good condition
Bicycle Facilities	None


Harrisburg - East


Harrisburg - West

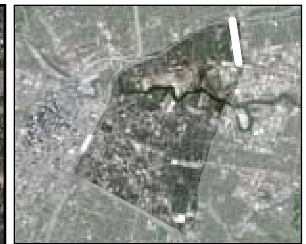
Leeland - US 59 to Lockwood

Classification	Major Collector
ROW	Varies (70' - 80')
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	28'/24' west of Dowling 39' east of Dowling 45' east of Scott
Transit	METRO Lines 36, 40 West of Dowling
Traffic Counts	US 59 to Dowling 5,026 (2009) Dowling to Scott 4,525 (2009) Scott to Cullen 3,863 (2009) Cullen to Lockwood 5,660 (2009)
TDM Projections	14,300 (2011) 18,000 (2035 Sc1) 18,000 (2035 Sc2)
Sidewalks	Intermittent west of Cullen, poor condition Continuous east of Cullen, good condition
Bicycle Facilities	None


Leeland at Tracks - West

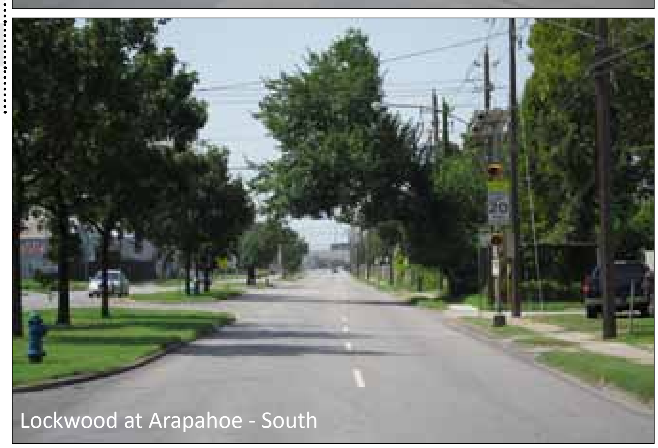

Leeland at Tracks - East

Lockwood - IH-10 to Clinton

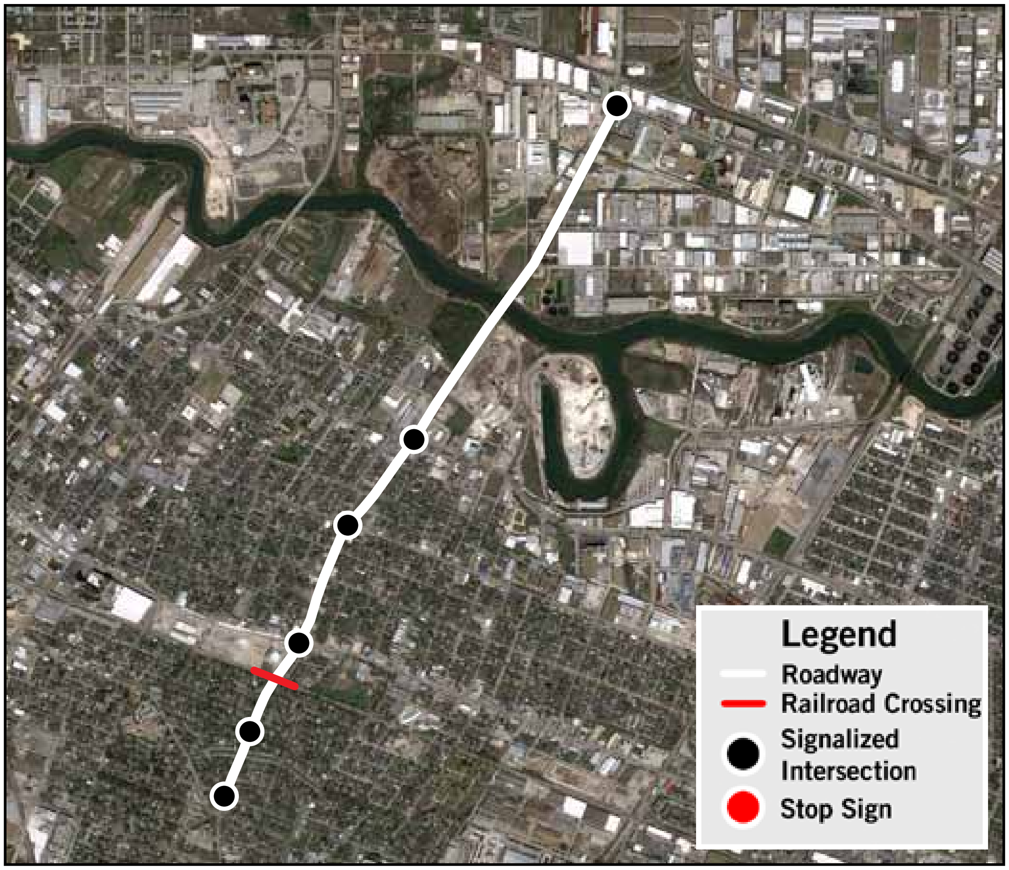


Classification	Principle Thoroughfare
ROW	80' (MTFP) 110-180' (GIMS)
Travel Lanes	6 4 lanes north of Arapahoe
Posted Speed Limit	35 MPH
Roadway Width	78'
Transit	METRO route 42
Traffic Counts	19,374 (2009)
TDM Projections	27,800 (2011) 30,000 (2035 Sc1) 30,300 (2035 Sc2)
Sidewalks	Yes, on both sides, varying conditions
Bicycle Facilities	None


Lockwood at Sonora - North


Lockwood at Arapahoe - South

Lockwood - Clinton to Polk

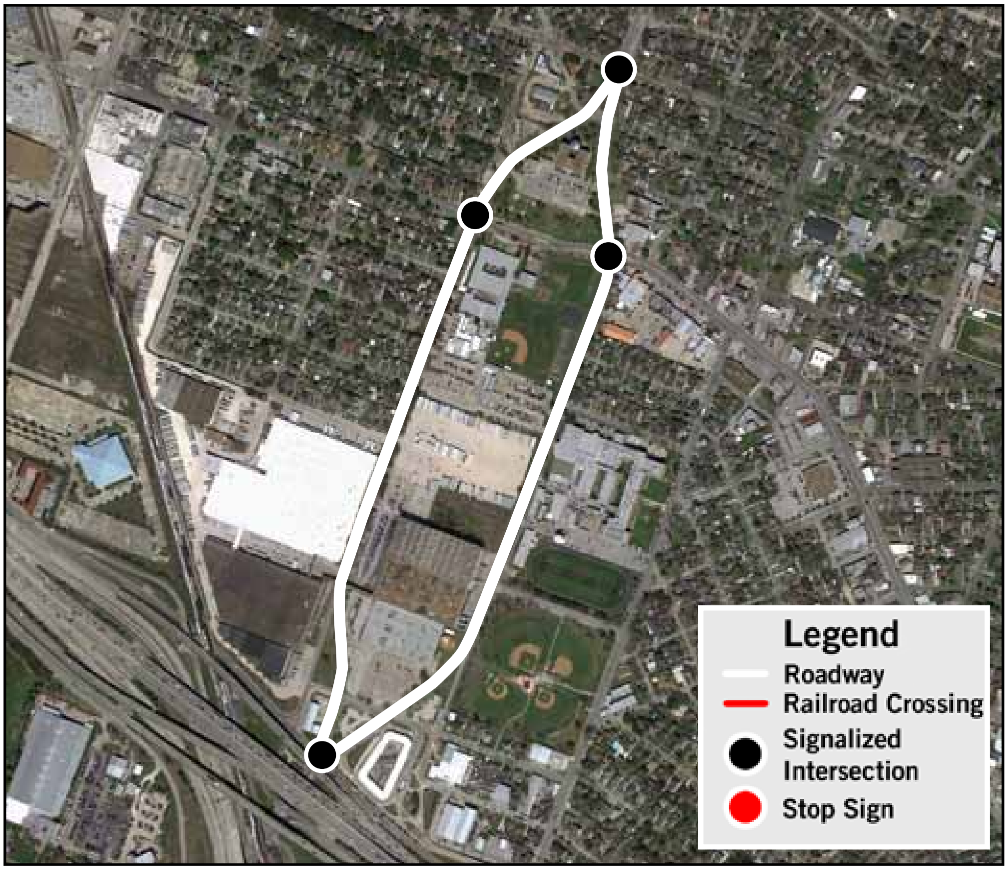


Classification	Principle Thoroughfare
ROW	100'
Travel Lanes	4 6 lanes on bridge over Buffalo Bayou)
Posted Speed Limit	35 MPH
Roadway Width	77' - 80' with raised median south of Buffalo Bayou 73' on bridge over Buffalo Bayou 60' north of Buffalo Bayou
Transit	METRO route 42
Traffic Counts	Clinton to Navigation 16,276 (2009) Navigation to Canal 11,463 (2009) Canal to Harrisburg 13,793 (2009) Harrisburg to Polk 13,481 (2009)
TDM Projections	16,700 (2011) 25,100 (2035 Sc1) 25,280 (2035 Sc2)
Sidewalks	Yes, on both sides, a few gaps, varying conditions
Bicycle Facilities	None


Lockwood at Walker - North


Lockwood at Walker - South

Lockwood/Ernestine - Polk to IH-45

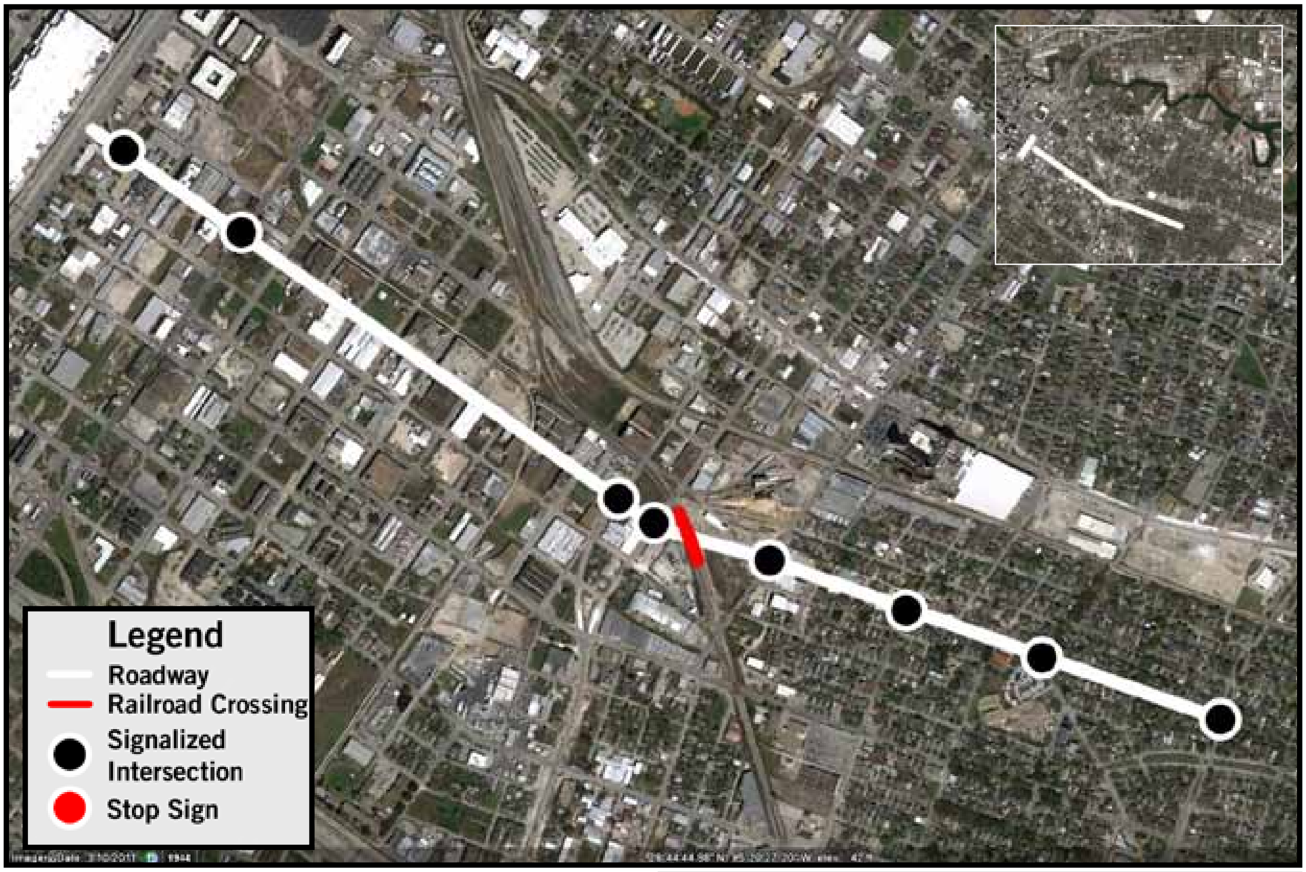


Classification	Principle Thoroughfare
ROW	Lockwood NB - 66' Ernestine SB - 70'
Travel Lanes	Lockwood NB - 3 lanes (2 lanes south of Hicksfield) Ernestine SB - 3 lanes (2 lanes south of Maplewood)
Posted Speed Limit	35 MPH
Roadway Width	Lockwood NB - 35' north of Hicksfield, 24' south of Hicksfield Ernestine SB - 35' north of Maplewood, 25' south of Maplewood
Transit	METRO routes 40 and 42 Eastwood Transit Center is located at the northeast corner of the intersection of Lockwood at IH-45. METRO Routes 40, 42, 68, 77, 88, 244, 246, 247, 249 service the Eastwood TC.
Traffic Counts	Ernestine SB 7,663 (2009) Lockwood NB 8,073 (2009)
TDM Projections	SB 6000 NB 6800 (2011) SB 11,000 NB 4800 (2035 Sc1) SB 11,400 NB 4900 (2035 Sc2)
Sidewalks	Yes, on both sides when 3 lanes and on one side when 2 lanes, good condition
Bicycle Facilities	None


Lockwood - North


Ernestine - South

McKinney - US 59 to Lockwood

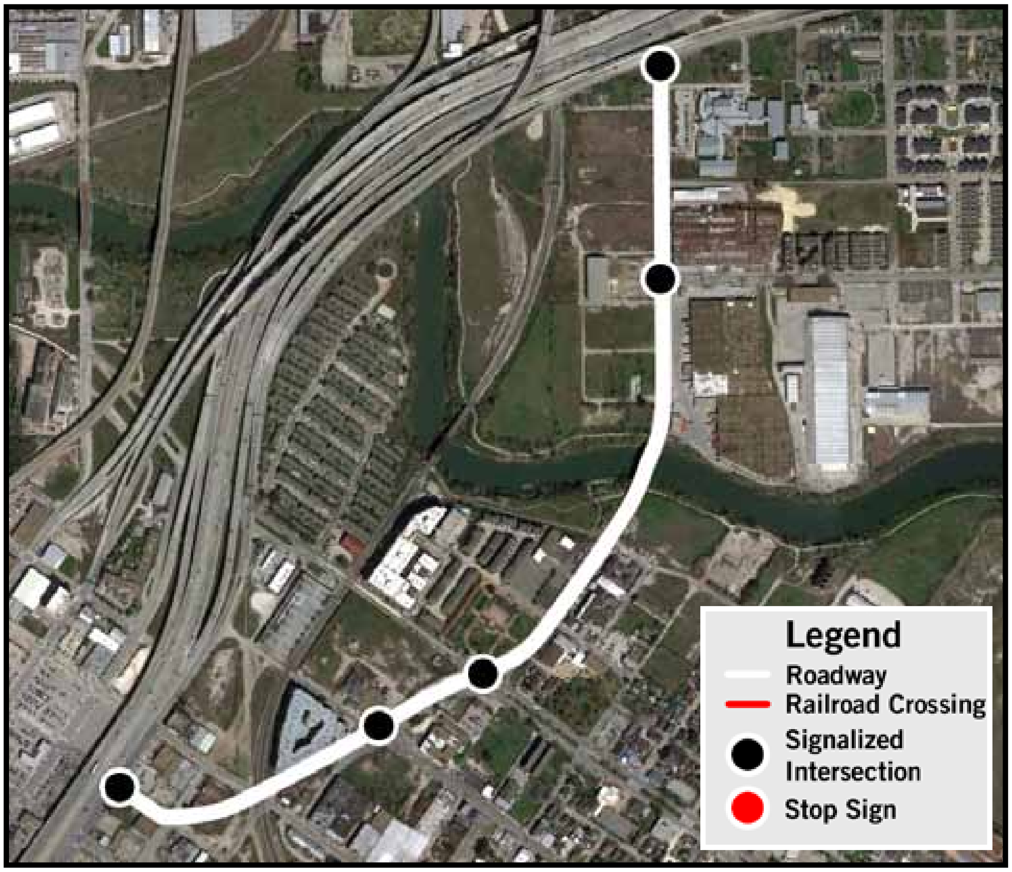


Classification	Major Collector
ROW	80’
Travel Lanes	4
Posted Speed Limit	30 MPH
Roadway Width	52’ west of tracks, 35’ near Lockwood
Transit	METRO Line 36
Traffic Counts	Chartres to Dowling 1,063 (2010) Dowling to York 1,310 (2010 York to Cullen 1,139 (2009) Cullen to Telephone 1,848 (2009) Telephone to Lockwood 1,223 (2009)
TDM Projections	2,300 (2011) 7,560 (2035 Sc1) 7,550 (2035 Sc2)
Sidewalks	Intermittent on both sides, varying condition
Bicycle Facilities	None


McKinney at Telephone - West


McKinney at Telephone - East

Navigation/Jensen

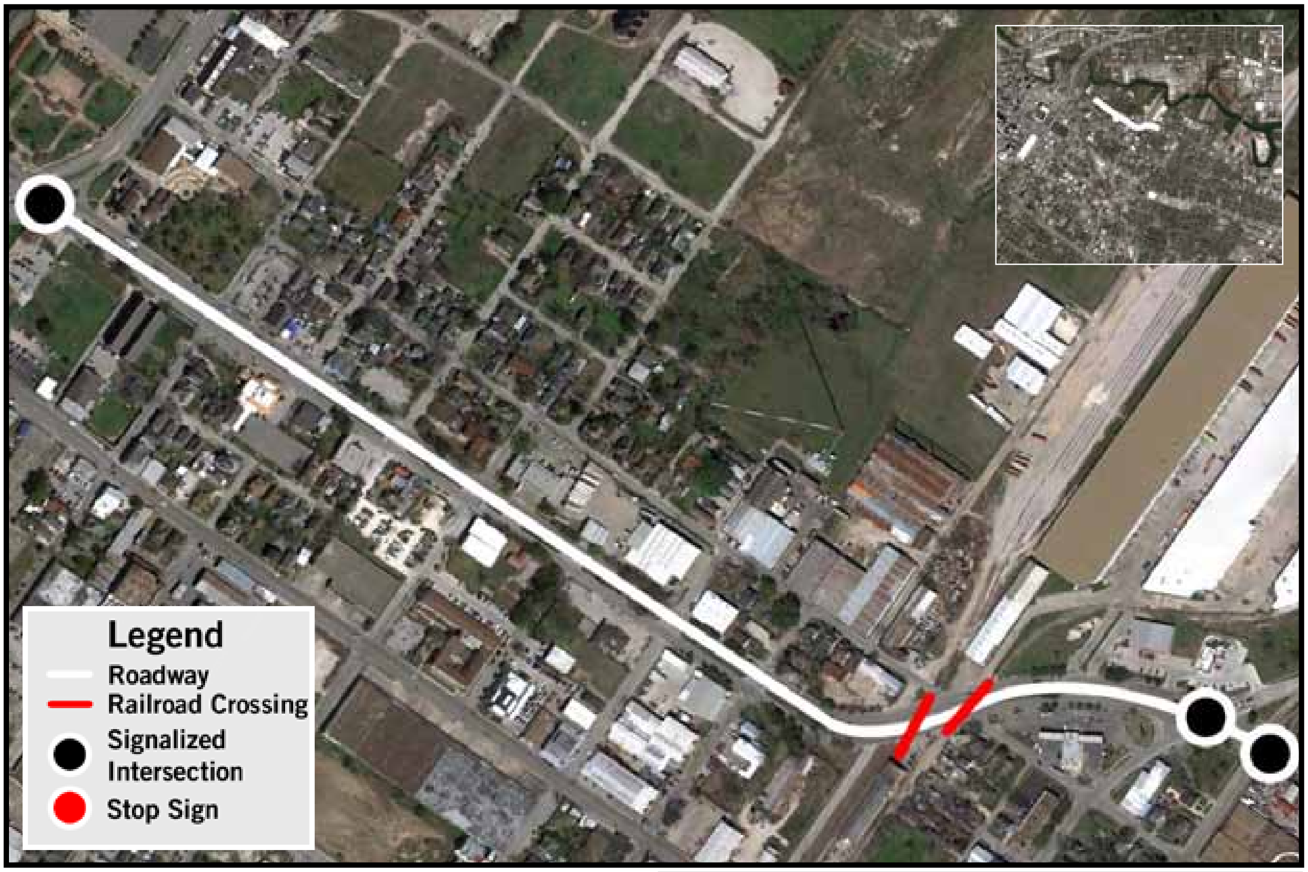


Classification	Major Thoroughfare
ROW	80’
Travel Lanes	4
Posted Speed Limit	35 MPH
Roadway Width	60’
Transit	None
Traffic Counts	IH-10 to Clinton 7,701 (2010) Clinton to Buffalo Bayou 6,432 (2009) Navigation to Buffalo Bayou 6,212 (2009)
TDM Projections	9,200 (2011) 21,600 (2035 Sc1) 22,200 (2035 Sc2)
Sidewalks	None between US 59 and Canal After Canal, sidewalks are continuous, mostly good condition
Bicycle Facilities	None


Jensen - North


Jensen - South

Navigation - Jensen to Sampson/York



Classification	Principal Thoroughfare
ROW	120’
Travel Lanes	6
Posted Speed Limit	35 MPH
Roadway Width	30’ both directions with a 30’ median
Transit	METRO Line 48
Traffic Counts	S. Jensen to N. York 7,316 (2009)
TDM Projections	12,200 (2011) 28,500 (2035 Sc1) 28,700 (2035 Sc2)
Sidewalks	Yes, sidewalks on both side of street, continuous, varying conditions
Bicycle Facilities	None

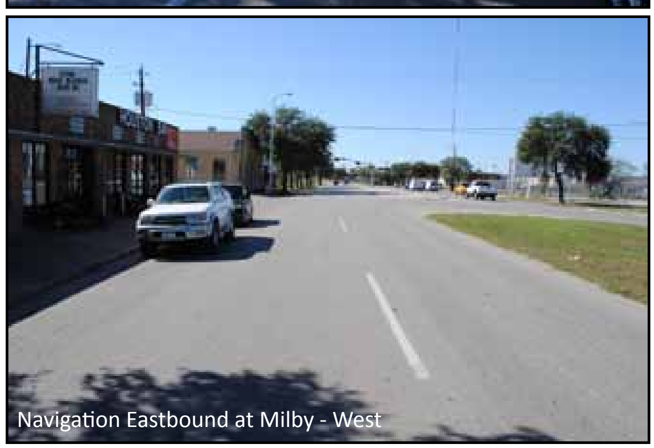

Navigation - Ninfa’s


Navigation - West

Navigation - Sampson/York to Lockwood

Classification	Principal Thoroughfare
ROW	120’
Travel Lanes	6
Posted Speed Limit	35 MPH
Roadway Width	30’ both directions with a 30’ median
Transit	METRO Line 48
Traffic Counts	N. York to Lockwood 9,941 (2009)
TDM Projections	9,300 (2011) 23,500 (2035 Sc1) 23,600 (2035 Sc2)
Sidewalks	Yes, sidewalks on both side of street, continuous, varying conditions
Bicycle Facilities	None


Navigation Eastbound at Milby - East


Navigation Eastbound at Milby - West

Polk - US 59 to Lockwood

Classification	Major Thoroughfare
ROW	80’
Travel Lanes	2
Posted Speed Limit	30 MPH
Roadway Width	34’
Transit	METRO Line 40
Traffic Counts	Chartres to Scott 3,575 (2009) Scott to Lockwood 6,082 (2009)
TDM Projections	12,500 (2011) 13,900 (2035 Sc1) 13,800 (2035 Sc2)
Sidewalks	Mostly continuous on both sides
Bicycle Facilities	Bicycle lane


Polk at Eastwood - East


Polk at Eastwood - West

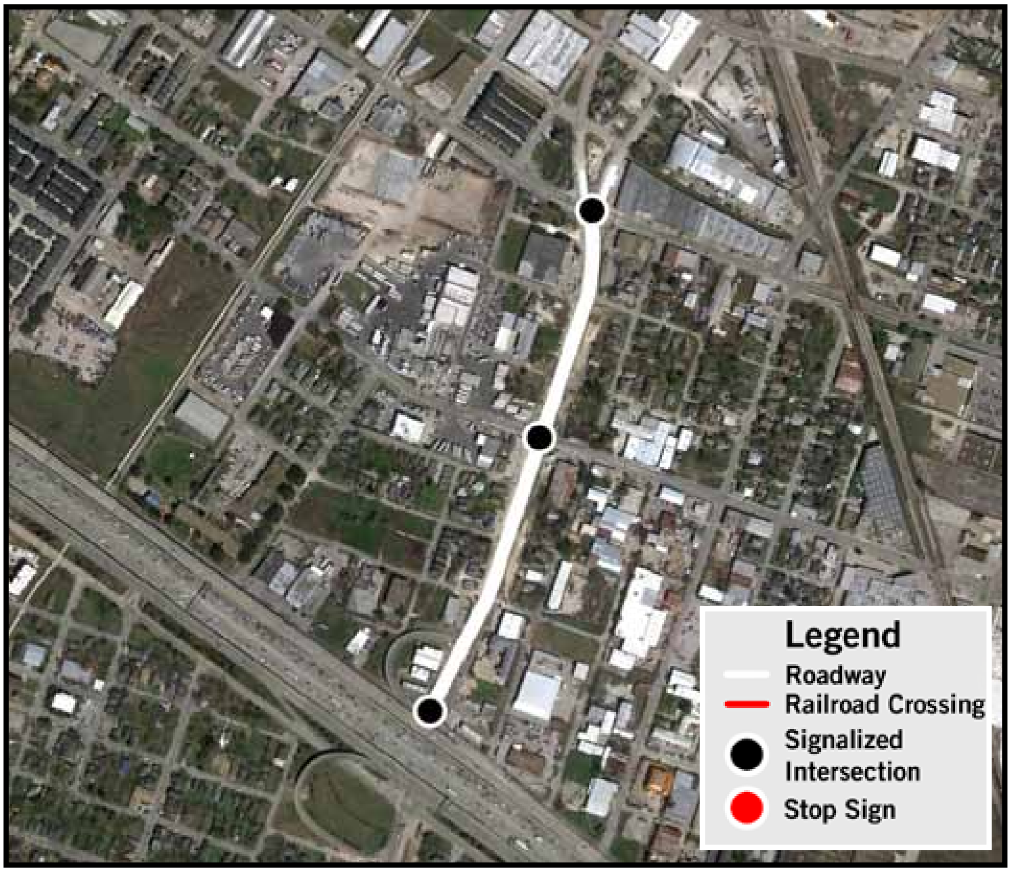
Sampson - Navigation to Polk

Classification	Major Thoroughfare
ROW	80’
Travel Lanes	4
Posted Speed Limit	35 MPH
Roadway Width	40’
Transit	METRO Line 29
Traffic Counts	Navigation to Commerce 2,804 (2009) Commerce to McKinney 2,955 (2009) McKinney to Scott 3,361 (2010)
TDM Projections	7,100 (2011) 14,500 (2035 Sc1) 14,600 (2035 Sc2)
Sidewalks	Intermittent on east side of street
Bicycle Facilities	Signed bicycle route


Sampson near Navigation


Sampson near McKinney - North

Scott - Polk to IH-45



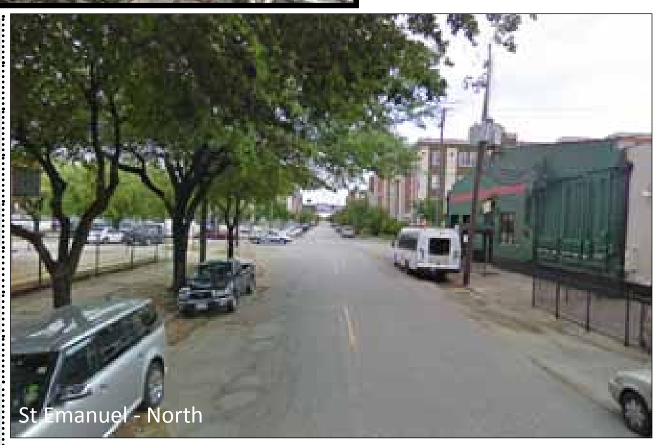
Classification	Major Thoroughfare
ROW	96’
Travel Lanes	4
Posted Speed Limit	35 MPH
Roadway Width	N/A due to light rail construction
Transit	Note: Future Light Rail Line
Traffic Counts	Polk to IH-45 13,636 (2009)
TDM Projections	21,000 (2011) 29,000 (2035 Sc1) 30,000 (2035 Sc2)
Sidewalks	Yes, mostly continuous, varying condition
Bicycle Facilities	None

Scott - North


Scott - South

St. Emanuel - IH-45 to Franklin

Classification	N/A
ROW	N/A
Travel Lanes	2
Posted Speed Limit	30 MPH
Roadway Width	34'
Transit	None
Traffic Counts	N/A
TDM Projections	TBD
Sidewalks	Yes, mostly continuous, varying condition
Bicycle Facilities	Signed bicycle route


St Emanuel - North


St Emanuel - South

York/Hirsch/Waco - IH-10 to Navigation

Classification	Major Thoroughfare
ROW	100’
Travel Lanes	4
Posted Speed Limit	35 MPH
Roadway Width	South of bayou - 26’ both ways with a 28’ median North of bayou - 61’
Transit	METRO Line 29
Traffic Counts	IH-10 to Gunter 11,604 (2009) Gunter to Buffalo Bayou 6,202 (2011) Buffalo Bayou to Navigation 6,734 (2009)
TDM Projections	9,700 (2011) 20,000 (2035 Sc1) 20,000 (2035 Sc2)
Sidewalks	South of bayou - on both sides up to bridge North of bayou - continuous on west side of street, intermittent on east side
Bicycle Facilities	Bicycle lane


Hirsch - North


Hirsch - South

York - Navigation to Polk

Classification	Major Thoroughfare
ROW	100’
Travel Lanes	4
Posted Speed Limit	35 MPH
Roadway Width	44’
Transit	METRO Line 29
Traffic Counts	Navigation to Commerce 2,723 (2009) Commerce to McKinney 2,903 (2009) McKinney to Polk 2,996 (2009)
TDM Projections	6,600 (2011) 13,300 (2035 Sc1) 13,400 (2035 Sc2)
Sidewalks	Yes, continuous, good condition
Bicycle Facilities	Signed bicycle route


York - North


York - North

Appendix A2. Study Area K & D Factor Analyses

K and D Factors are key inputs into planning level analysis for roadway level of service. These were estimated based on 24-hour traffic volume counts that were completed in October 2011. These were roadway classification counts that also determined the distribution of heavy trucks in the study area. Combined counts from three parallel roadways, Navigation Boulevard, Canal Street and Commerce Street, that provide access within the study area and to/from Downtown were used.

K-Factor: the share of daily traffic that occurs in the peak hour
The peak travel hour for the study area was determined to be 7 AM with 9.2% of daily trips occurring fur the peak hour. For LOS analysis 0.09 was used to estimate roadway performance.

D-Factor: the directional traffic distribution in the peak hour
D-factor looks at the share of traffic in the peak hour that is travelling in one direction. A perfectly balanced road would have a D-factor of .5 meaning 50% of traffic was travelling in the each direction of travel. The roadways in the study area showed a stronger directional bias, as in both the AM and PM peak hours 58% of traffic was travelling in the primary travel direction (inbound in the AM peak, outbound in the PM peak). For LOS analysis 0.60 was used to estimate roadway performance.

 Appendix A2. K & D Factor Analyses 170

Time Period Begins	Commerce			Navigation			Canal			Outbound Traffic	Inbound Traffic	
	Eastbound	Westbound	Total	Northbound	Southbound	Total	Eastbound	Westbound	Total	EB + NB	WB + SB	Total
0:00	3	9	12	13	20	33	22	20	42	38	49	87
1:00	3	2	5	16	8	24	10	6	16	29	16	45
2:00	4	5	9	8	9	17	8	7	15	20	21	41
3:00	7	7	14	12	8	20	7	9	16	26	24	50
4:00	3	3	6	30	12	42	20	16	36	53	31	84
5:00	11	15	26	104	82	186	29	58	87	144	155	299
6:00	35	46	81	148	113	261	102	71	173	285	230	515
7:00	65	95	160	236	439	675	187	159	346	488	693	1181
8:00	59	88	147	204	335	539	152	127	279	415	550	965
9:00	40	59	99	203	206	409	122	96	218	365	361	726
10:00	39	46	85	192	169	361	150	84	234	381	299	680
11:00	47	66	113	198	163	361	141	92	233	386	321	707
12:00	44	49	93	214	193	407	118	125	243	376	367	743
13:00	48	69	117	194	172	366	112	121	233	354	362	716
14:00	41	51	92	201	182	383	132	96	228	374	329	703
15:00	53	73	126	210	186	396	186	116	302	449	375	824
16:00	62	128	190	264	188	452	185	136	321	511	452	963
17:00	46	71	117	306	242	548	234	104	338	586	417	1003
18:00	53	61	114	248	160	408	145	91	236	446	312	758
19:00	24	29	53	149	161	310	103	73	176	276	263	539
20:00	36	20	56	120	107	227	86	60	146	242	187	429
21:00	10	22	32	114	113	227	63	51	114	187	186	373
22:00	12	22	34	96	60	156	61	49	110	169	131	300
23:00	10	13	23	62	22	84	36	18	54	108	53	161
Total	755	1049	1804	3542	3350	6892	2411	1785	4196	6708	6184	12892

Calculated Rates Based on Traffic Counts		
k-factor:	0.092	7:00 AM
d-factor (am)	0.587	7:00 AM
d-factor (pm)	0.584	5:00 PM

Assumed Analysis Variables for Level of Service	
K-factor	0.09
D-factor	0.6

Appendix A3. Capacity Analysis

Data for Table 3.19 (Navigation at Jensen - AM Peak) Page 1

Lanes, Volumes, Timings
1: Navigation & Jensen

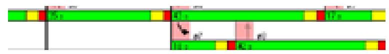
Existing Conditions
Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	0	3336	0	1681	1713	0	1770	3539	2787	1770	3539	1583
Flt Permitted		0.989		0.602	0.987		0.950			0.950		
Satd. Flow (perm)	0	3336	0	1065	1694	0	1770	3539	2787	1770	3539	1583
Satd. Flow (RTOR)		52			10				175			100
Volume (vph)	40	88	58	149	177	47	34	84	135	140	261	77
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	52	114	75	194	230	61	44	109	175	182	339	100
Lane Group Flow (vph)	0	241	0	184	301	0	44	109	175	182	339	100
Turn Type	Split			custom			Prot		custom	Prot		custom
Protected Phases	2	2					3		6	7		
Permitted Phases				6	6			8			4	4
Total Split (s)	25.0	25.0	0.0	35.0	35.0	0.0	17.0	42.0	35.0	18.0	43.0	43.0
Act Effct Green (s)		48.7		26.7	26.7		9.9	12.7	26.7	15.9	20.6	20.6
Actuated g/C Ratio		0.41		0.22	0.22		0.08	0.11	0.22	0.13	0.17	0.17
v/c Ratio		0.17		0.78	0.78		0.30	0.29	0.23	0.78	0.56	0.28
Control Delay		19.7		88.6	80.2		56.9	50.1	5.8	73.2	49.8	10.3
Queue Delay		0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		19.7		88.6	80.2		56.9	50.1	5.8	73.2	49.8	10.3
LOS		B		F	F		E	D	A	E	D	B
Approach Delay		19.7			83.4			27.4			50.3	
Approach LOS		B			F			C			D	
Queue Length 50th (ft)		47		157	252		33	42	0	137	132	0
Queue Length 95th (ft)		71		203	295		60	55	17	#211	145	30
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)												
Base Capacity (vph)		1385		275	445		192	1121	850	234	1150	582
Starvation Cap Reductn		0		0	0		0	0	0	0	0	0
Spillback Cap Reductn		0		0	0		0	0	0	0	0	0
Storage Cap Reductn		0		0	0		0	0	0	0	0	0
Reduced v/c Ratio		0.17		0.67	0.68		0.23	0.10	0.21	0.78	0.29	0.17

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 5.1 (4%), Referenced to phase 2:EBTL, Start of FDW or yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 51.0 Intersection LOS: D
Intersection Capacity Utilization 40.1% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Navigation at Jensen
Traffic Engineers, Inc.
Synchro 6 Report
6/7/2012

Data for Table 3.19 (Navigation at Jensen - AM Peak) Page 2



Data for Table 3.19 (Navigation at Jensen - PM Peak) Page 1

Lanes, Volumes, Timings
1: Navigation & Jensen

Existing Conditions
Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	0	3370	0	1681	1662	0	1770	3539	2787	1770	3539	1583
Flt Permitted		0.992		0.640			0.950			0.950		
Satd. Flow (perm)	0	3370	0	1133	1662	0	1770	3539	2787	1770	3539	1583
Satd. Flow (RTOR)		38			26				142			39
Volume (vph)	26	88	42	82	126	85	37	194	125	113	87	34
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	30	100	48	93	143	97	42	220	142	128	99	39
Lane Group Flow (vph)	0	178	0	93	240	0	42	220	142	128	99	39
Turn Type	Split			custom			Prot		custom	Prot		custom
Protected Phases	2	2					3		6	7		
Permitted Phases				6	6			8			4	4
Total Split (s)	25.0	25.0	0.0	30.0	30.0	0.0	20.0	46.0	30.0	19.0	45.0	45.0
Act Effct Green (s)		52.5		23.6	23.6		13.4	14.1	23.6	13.8	18.5	18.5
Actuated g/C Ratio		0.44		0.20	0.20		0.11	0.12	0.20	0.12	0.15	0.15
v/c Ratio		0.12		0.42	0.69		0.21	0.53	0.21	0.63	0.18	0.14
Control Delay		17.5		43.0	47.1		48.0	54.4	7.0	64.5	48.1	16.4
Queue Delay		0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		17.5		43.0	47.1		48.0	54.4	7.0	64.5	48.1	16.4
LOS		B		D	D		D	D	A	E	D	B
Approach Delay		17.5			46.0			37.1			51.4	
Approach LOS		B			D			D			D	
Queue Length 50th (ft)		34		47	105		29	85	0	95	37	0
Queue Length 95th (ft)		59		90	192		61	121	27	157	64	33
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)												
Base Capacity (vph)		1496		245	380		256	1239	715	221	1209	567
Starvation Cap Reductn		0		0	0		0	0	0	0	0	0
Spillback Cap Reductn		0		0	0		0	0	0	0	0	0
Storage Cap Reductn		0		0	0		0	0	0	0	0	0
Reduced v/c Ratio		0.12		0.38	0.63		0.16	0.18	0.20	0.58	0.08	0.07

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 5.1 (4%), Referenced to phase 2:EBTL, Start of FDW or yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 39.9 Intersection LOS: D
Intersection Capacity Utilization 40.6% ICU Level of Service A
Analysis Period (min) 15

York at Navigation
Traffic Engineers, Inc.
Synchro 6 Report
6/7/2012

Data for Table 3.19 (Navigation at Jensen - PM Peak) Page 2

Lanes, Volumes, Timings
1: Navigation & Jensen

Existing Conditions
Timing Plan: PM Peak

Splits and Phases: 1: Navigation & Jensen

York at Navigation
Traffic Engineers, Inc.
Synchro 6 Report
6/7/2012

Data for Table 3.20 and 4.2 (York and Sampson at Navigation - AM Peak - Existing Volumes) Page 1

Lanes, Volumes, Timings
7: Navigation & Sampson

Existing Conditions
Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	0	5085	0	1770	3539	0	0	0	0	0	5080	1583
Flt Permitted				0.950							0.999	
Satd. Flow (perm)	0	5085	0	1770	3539	0	0	0	0	0	5080	1583
Satd. Flow (RTOR)												101
Volume (vph)	0	275	0	32	381	0	0	0	0	3	220	85
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	0	327	0	38	454	0	0	0	0	4	262	101
Lane Group Flow (vph)	0	327	0	38	454	0	0	0	0	0	266	101
Turn Type				Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases										4		4
Total Split (s)	0.0	56.0	0.0	30.0	65.0	0.0	0.0	0.0	0.0	34.0	34.0	34.0
Act Effct Green (s)		79.0		18.4	76.0						15.0	15.0
Actuated g/C Ratio		0.66		0.15	0.63						0.12	0.12
v/c Ratio		0.10		0.14	0.20						0.42	0.35
Control Delay		8.3		46.2	3.0						49.8	12.0
Queue Delay		0.0		9.9	0.5						0.0	0.0
Total Delay		8.3		56.1	3.5						49.8	12.0
LOS		A		E	A						D	B
Approach Delay		8.3			7.6						39.4	
Approach LOS		A			A						D	
Queue Length 50th (ft)		34		28	20						71	0
Queue Length 95th (ft)		42		60	25						87	40
Internal Link Dist (ft)		127			65			142			483	
Turn Bay Length (ft)												
Base Capacity (vph)		3349		384	2243						1270	472
Starvation Cap Reductn		0		317	1298						0	0
Spillback Cap Reductn		76		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.10		0.57	0.48						0.21	0.21

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 31 (26%), Referenced to phase 2:EBT and 5:, Start of FDW or yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 17.6 Intersection LOS: B
Intersection Capacity Utilization 29.2% ICU Level of Service A
Analysis Period (min) 15

Data for Table 3.20 and 4.2 (York and Sampson at Navigation - AM Peak - Existing Volumes) Page 2

Lanes, Volumes, Timings
10: Navigation & York

Existing Conditions
Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3539	0	0	5045	0	1770	3539	1583	1770	0	0
Flt Permitted	0.950						0.950			0.711		
Satd. Flow (perm)	1770	3539	0	0	5045	0	1770	3539	1583	1324	0	0
Satd. Flow (RTOR)					10				90			
Volume (vph)	32	295	0	0	362	20	20	56	76	74	0	0
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	38	351	0	0	431	24	24	67	90	88	0	0
Lane Group Flow (vph)	38	351	0	0	455	0	24	67	90	88	0	0
Turn Type	Prot						Perm		Perm	custom		
Protected Phases	5	2			6			8				
Permitted Phases							8		8	4		
Total Split (s)	21.0	56.0	0.0	0.0	65.0	0.0	34.0	34.0	34.0	34.0	0.0	0.0
Act Effct Green (s)	17.0	79.0			76.0		15.0	15.0	15.0	15.0		
Actuated g/C Ratio	0.14	0.66			0.63		0.12	0.12	0.12	0.12		
v/c Ratio	0.15	0.15			0.14		0.11	0.15	0.33	0.53		
Control Delay	49.9	2.3			9.2		45.5	46.0	12.2	60.1		
Queue Delay	12.5	0.2			0.0		0.0	0.0	0.0	0.0		
Total Delay	62.4	2.4			9.2		45.5	46.0	12.2	60.1		
LOS	E	A			A		D	D	B	E		
Approach Delay		8.3			9.2			29.1				
Approach LOS		A			A			C				
Queue Length 50th (ft)	31	12			46		17	24	0	65		
Queue Length 95th (ft)	65	16			67		38	41	38	105		
Internal Link Dist (ft)		65			692			304			497	
Turn Bay Length (ft)												
Base Capacity (vph)	251	2331			3201		443	885	463	331		
Starvation Cap Reductn	189	1224			0		0	0	0	0		
Spillback Cap Reductn	0	0			123		0	0	0	0		
Storage Cap Reductn	0	0			0		0	0	0	0		
Reduced v/c Ratio	0.61	0.32			0.15		0.05	0.08	0.19	0.27		

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 31 (26%), Referenced to phase 2:EBT and 5:, Start of FDW or yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 16.2 Intersection LOS: B
Intersection Capacity Utilization 33.3% ICU Level of Service A
Analysis Period (min) 15

Data for Table 3.20 and 4.2 (York and Sampson at Navigation - AM Peak - Existing Volumes) Page 3

Lanes, Volumes, Timings
7: Navigation & Sampson

Existing Conditions
Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	0	5085	0	1770	3539	0	0	0	0	0	5065	1583
Flt Permitted				0.950							0.996	
Satd. Flow (perm)	0	5085	0	1770	3539	0	0	0	0	0	5065	1583
Satd. Flow (RTOR)												47
Volume (vph)	0	309	1	38	282	0	0	0	0	7	70	40
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	0	359	1	44	328	0	0	0	0	8	81	47
Lane Group Flow (vph)	0	360	0	44	328	0	0	0	0	0	89	47
Turn Type				Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases										4		4
Total Split (s)	0.0	57.0	0.0	24.0	53.0	0.0	0.0	0.0	0.0	39.0	39.0	39.0
Act Effct Green (s)		88.4		9.4	85.2						12.3	12.3
Actuated g/C Ratio		0.74		0.08	0.71						0.10	0.10
v/c Ratio		0.10		0.32	0.13						0.17	0.23
Control Delay		5.6		66.4	2.6						49.3	16.3
Queue Delay		0.0		0.4	0.4						0.0	0.0
Total Delay		5.6		66.8	3.0						49.3	16.3
LOS		A		E	A						D	B
Approach Delay		5.6			10.6						37.9	
Approach LOS		A			B						D	
Queue Length 50th (ft)		30		35	16						23	0
Queue Length 95th (ft)		38		73	23						38	33
Internal Link Dist (ft)		127			65			142			483	
Turn Bay Length (ft)												
Base Capacity (vph)		3745		295	2512						1477	495
Starvation Cap Reductn		0		93	1707						0	0
Spillback Cap Reductn		242		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.10		0.22	0.41						0.06	0.09

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 111 (93%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.47
Intersection Signal Delay: 12.8 Intersection LOS: B
Intersection Capacity Utilization 29.2% ICU Level of Service A
Analysis Period (min) 15

Data for Table 3.20 and 4.2 (York and Sampson at Navigation - AM Peak - Existing Volumes) Page 4

Lanes, Volumes, Timings
10: Navigation & York

Existing Conditions
Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3539	0	0	5004	0	1770	3539	1583	1770	0	0
Flt Permitted	0.950						0.950			0.636		
Satd. Flow (perm)	1770	3539	0	0	5004	0	1770	3539	1583	1185	0	0
Satd. Flow (RTOR)					20				77			
Volume (vph)	52	261	0	0	264	31	16	146	66	36	0	0
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	60	303	0	0	307	36	19	170	77	42	0	0
Lane Group Flow (vph)	60	303	0	0	343	0	19	170	77	42	0	0
Turn Type	Prot						Perm		Perm	custom		
Protected Phases	5	2			6			8				
Permitted Phases							8		8	4		
Total Split (s)	28.0	57.0	0.0	0.0	53.0	0.0	39.0	39.0	39.0	39.0	0.0	0.0
Act Effct Green (s)	12.7	88.4			85.2		12.3	12.3	12.3	12.3		
Actuated g/C Ratio	0.11	0.74			0.71		0.10	0.10	0.10	0.10		
v/c Ratio	0.32	0.12			0.10		0.10	0.47	0.33	0.35		
Control Delay	54.2	0.8			6.1		49.1	54.8	14.7	57.5		
Queue Delay	0.8	0.4			0.0		0.0	0.0	0.0	0.0		
Total Delay	55.0	1.1			6.1		49.1	54.8	14.7	57.5		
LOS	D	A			A		D	D	B	E		
Approach Delay		10.0			6.1			42.7				
Approach LOS		B			A			D				
Queue Length 50th (ft)	49	4			27		14	66	0	31		
Queue Length 95th (ft)	93	4			43		35	95	41	64		
Internal Link Dist (ft)		65			692			304			497	
Turn Bay Length (ft)												
Base Capacity (vph)	354	2606			3558		516	1032	516	346		
Starvation Cap Reductn	152	1799			0		0	0	0	0		
Spillback Cap Reductn	0	0			184		0	0	0	0		
Storage Cap Reductn	0	0			0		0	0	0	0		
Reduced v/c Ratio	0.30	0.38			0.10		0.04	0.16	0.15	0.12		

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 111 (93%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.47
Intersection Signal Delay: 19.3 Intersection LOS: B
Intersection Capacity Utilization 35.8% ICU Level of Service A
Analysis Period (min) 15

Data for Table 4.1 (Single Lane Roundabout - AM Peak - Existing Volumes)

```
                              HCS 2010 Roundabouts 6.2
Phone:                                          Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:               IH
Agency/Co.:            TEI
Date Performed:        2/22/2012
Analysis Time Period: AM Peak
Intersection:          Navigation at Jensen
Jurisdiction:          Houston
Units: U. S. Customary
Analysis Year:         2011
Project ID:
East/West Street:      Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
           | L    T    R    | L    T    R    | L    T    R    | L    T    R    |
           |________________|________________|________________|________________|
Volume     |40   88   58    |149  177  47    |34   84   135   |0    261  0     |
U-Turn Vol |0               |0               |0               |0               |
% Thrus Left Lane           |                |                |                |
              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Lane Assn.   LTR              LTR              LTR              LTR
RT Bypass              0                0                0                0
PHF          0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92
%HV          3    3    3      3    3    3      3    3    3      3    3    3
NumPeds      0                0                0                0
U-Turn PHF   1.00             1.00             1.00             1.00
U-Turn %HV   3                3                3                3
Flow Rate    45   99   65     167  198  53     38   94   151    0    292  0
No. Lanes    0    1    0      0    1    0      0    1    0      0    1    0
Cnfl. Lanes 1                 1                1                1
Duration, T   0.25  hrs.
___________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound        Westbound        Northbound       Southbound
Crit. Hdwy   5.1929    5.1929     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy   3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
                                  Flow Computations
              Eastbound        Westbound        Northbound       Southbound
Circ. Flow    459              177              144              403
Exit. Flow    250              236              192              524
_____________________ Capacity and Level of Service____________________________

              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Entry Flow        209              418              283              292
Entry Cap.        714              947              978              755
Volume (vph)      203              406              275              283
Cap. (vph)        693              919              950              733
v/c Ratio         0.29             0.44             0.29             0.39
Critical Lane       *                *                *                *
Lane Delay        8.8              9.2              6.8              9.9
Lane LOS            A                 A               A                A
95 % Queue        1.2              2.3              1.2              1.8
Approach:
   Delay          8.80             9.19             6.77             9.91
   LOS              A                A                A                A
Intersection Delay  8.72              Intersection LOS  A
______________________________________________________________________________
```

Data for Table 4.1 (Single Lane Roundabout - AM Peak - Future Volumes)

```
                              HCS 2010 Roundabouts 6.2
Phone:                                          Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:               IH
Agency/Co.:            TEI
Date Performed:        2/22/2012
Analysis Time Period: AM Peak
Intersection:          Navigation at Jensen
Jurisdiction:          Houston
Units: U. S. Customary
Analysis Year:         2035
Project ID:  Single Lane
East/West Street:      Navigation
North/South Street:    Jensen
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
           | L    T    R    | L    T    R    | L    T    R    | L    T    R    |
           |________________|________________|________________|________________|
Volume     |82   180  118   |304  361  96    |69   171  276   |286  533  157   |
U-Turn Vol |0               |0               |0               |0               |
% Thrus Left Lane           |                |                |                |
              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Lane Assn.   LTR              LTR              LTR              LTR
RT Bypass              0                0                0                0
PHF          0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92
%HV          3    3    3      3    3    3      3    3    3      3    3    3
NumPeds      0                0                0                0
U-Turn PHF   1.00             1.00             1.00             1.00
U-Turn %HV   3                3                3                3
Flow Rate    92   202  132    340  404  107    77   191  309    320  597  176
No. Lanes    0    1    0      0    1    0      0    1    0      0    1    0
Cnfl. Lanes 1                 1                1                1
Duration, T   0.25  hrs.
___________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound        Westbound        Northbound       Southbound
Crit. Hdwy   5.1929    5.1929     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy   3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
____________________________Flow Computations_________________________________
              Eastbound        Westbound        Northbound       Southbound
Circ. Flow    1257             360              614              821
Exit. Flow    831              657              390              1069
_____________________ Capacity and Level of Service____________________________

              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Entry Flow        426              851              577              1093
Entry Cap.        321              788              612              497
Volume (vph)      414              826              560              1061
Cap. (vph)        312              765              594              483
v/c Ratio         1.33             1.08             0.94             2.20
Critical Lane       *                *                *                *
Lane Delay        200.5            78.8             50.3             564.5
Lane LOS            F                 F               F                F
95 % Queue        20.3             21.8             12.5             77.4
Approach:
   Delay          200.48           78.81            50.28            564.47
   LOS             F                F                F                F
Intersection Delay  270.94            Intersection LOS  F
______________________________________________________________________________
```

Data for Table 4.1 (Single Lane Roundabout - PM Peak - Existing Volumes)

```
                              HCS 2010 Roundabouts 6.2
Phone:                                          Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:               IH
Agency/Co.:            TEI
Date Performed:        2/22/2012
Analysis Time Period: PM Peak
Intersection:          Navigation at Jensen
Jurisdiction:          Houston
Units: U. S. Customary
Analysis Year:         2011
Project ID:  Single Lane
East/West Street:      Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
           | L    T    R    | L    T    R    | L    T    R    | L    T    R    |
           |________________|________________|________________|________________|
Volume     |26   88   42    |82   126  85    |37   194  125   |113  87   34    |
U-Turn Vol |0               |0               |0               |0               |
% Thrus Left Lane           |                |                |                |
              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Lane Assn.   LTR              LTR              LTR              LTR
RT Bypass              0                0                0                0
PHF          0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92
%HV          3    3    3      3    3    3      3    3    3      3    3    3
NumPeds      0                0                0                0
U-Turn PHF   1.00             1.00             1.00             1.00
U-Turn %HV   3                3                3                3
Flow Rate    29   99   47     92   141  95     41   217  140    127  97   38
No. Lanes    0    1    0      0    1    0      0    1    0      0    1    0
Cnfl. Lanes 1                 1                1                1
Duration, T   0.25  hrs.
___________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound        Westbound        Northbound       Southbound
Crit. Hdwy   5.1929    5.1929     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy   3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
                                  Flow Computations
              Eastbound        Westbound        Northbound       Southbound
Circ. Flow    316              287              255              274
Exit. Flow    366              220              341              236
_____________________ Capacity and Level of Service____________________________

              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Entry Flow        175              328              398              262
Entry Cap.        824              848              876              859
Volume (vph)      170              318              386              254
Cap. (vph)        800              823              850              834
```

Data for Table 4.1 (Single Lane Roundabout - PM Peak - Future Volumes)

```
                              HCS 2010 Roundabouts 6.2
Phone:                                          Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:               IH
Agency/Co.:            TEI
Date Performed:        2/22/2012
Analysis Time Period: PM Peak
Intersection:          Navigation at Jensen
Jurisdiction:          Houston
Units: U. S. Customary
Analysis Year:         2035
Project ID:  1.5 Lanes
East/West Street:      Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
           | L    T    R    | L    T    R    | L    T    R    | L    T    R    |
           |________________|________________|________________|________________|
Volume     |53   180  86    |167  257  174   |76   396  255   |231  178  69    |
U-Turn Vol |0               |0               |0               |0               |
% Thrus Left Lane           |                |                |          47    |
              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Lane Assn.   LT   R           L    T           LT   R           LT   LTR
RT Bypass              0                0                0                0
PHF          0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92   0.92 0.92 0.92
%HV          3    3    3      3    3    3      3    3    3      3    3    3
NumPeds      0                0                0                0
U-Turn PHF   1.00             1.00             1.00             1.00
U-Turn %HV   3                3                3                3
Flow Rate    59   202  96     187  288  195    85   443  285    259  199  77
No. Lanes    0    1    1      1    1    0      0    1    1      0    2    0
Cnfl. Lanes 2                 1                1                2
Duration, T   0.25  hrs.
___________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound        Westbound        Northbound       Southbound
Crit. Hdwy   4.2929    4.1129     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy   3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
____________________________Flow Computations_________________________________
              Eastbound        Westbound        Northbound       Southbound
Circ. Flow    645              587              520              560
Exit. Flow    746              450              697              482
_____________________ Capacity and Level of Service____________________________

              Eastbound        Westbound        Northbound       Southbound
             Left Right BP    Left Right BP    Left Right BP    Left Right BP
Entry Flow   261  96          382  475         528  285         251  284
Entry Cap.   697  719         628  628         672  672         742  764
Volume (vph) 253  93          371  461         513  277         244  276
Cap. (vph)   677  698         610  610         652  652         720  742
v/c Ratio    0.37 0.13        0.61 0.76        0.79 0.42        0.34 0.37
Critical Lane       *           *    *           *    *              *
Lane Delay   10.3 6.6         17.7 25.6        26.7 11.7        9.2  9.6
Lane LOS      B     A          C      D         D     B          A     A
95 % Queue   1.7  0.5         4.1  6.8         7.7  2.1         1.5  1.7
Approach:
   Delay          9.34             22.09            21.41            9.40
   LOS             A                C                C                A
Intersection Delay  17.45             Intersection LOS  C
______________________________________________________________________________
```

Data for Table 4.1 (Multi Lane Roundabout - AM Peak - Existing Volumes)

```
                                  HCS 2010 Roundabouts 6.2
Phone:                                         Fax:
E-Mail:
____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:              IH
Agency/Co.:           TEI
Date Performed:       2/22/2012
Analysis Time Period: AM Peak
Intersection:         Navigation at Jensen
Jurisdiction:         Houston
Units: U. S. Customary
Analysis Year:        2011
Project ID:  1.5 Lanes
East/West Street:     Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
           | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
           |_______________|_______________|_______________|_______________|
Volume     |40   88   58   |149  177  47   |34   84   135  |0    261  0    |
U-Turn Vol |0              |0              |0              |0              |
% Thrus Left Lane          |               |               |          47   |
              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Lane Assn.   LT   R          L    T          LT   R          LT   LTR
RT Bypass               0               0               0               0
PHF         0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92
%HV         3    3    3     3    3    3     3    3    3     3    3    3
NumPeds     0               0               0               0
U-Turn PHF  1.00            1.00            1.00            1.00
U-Turn %HV  3               3               3               3
Flow Rate   45   99   65    167  198  53    38   94   151   0    292  0
No. Lanes   0    1    1     1    1    0     0    1    1     0    2    0
Cnfl. Lanes 2               1               1               2
Duration, T   0.25  hrs.
__________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound       Westbound       Northbound      Southbound
Crit. Hdwy  4.2929    4.1129     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy  3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
___________________________Flow Computations_________________________________
              Eastbound       Westbound       Northbound      Southbound
Circ. Flow    459             177             144             403
Exit. Flow    250             236             192             524
____________________ Capacity and Level of Service____________________________

              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Entry Flow   144  65         220  365        132  151        137  155
Entry Cap.   801  819        947  947        978  978        835  852
Volume (vph) 140  63         214  354        128  147        133  150
Cap. (vph)   778  795        919  919        950  950        811  827
v/c Ratio    0.18 0.08       0.23 0.39       0.13 0.15       0.16 0.18
Critical Lane       *          *    *               *               *
Lane Delay   6.5  5.3        6.3  8.3        5.1  5.3        6.1  6.2
Lane LOS      A     A         A      A        A     A         A     A
95 % Queue   0.7  0.3        0.9  1.8        0.5  0.5        0.6  0.7
Approach:
   Delay          6.16            7.52            5.16            6.18
   LOS             A               A               A               A
Intersection Delay  6.54             Intersection LOS  A
_____________________________________________________________________________
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Data for Table 4.1 (Multi Lane Roundabout - AM Peak - Future Volumes)

```
                                  HCS 2010 Roundabouts 6.2
Phone:                                         Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:              IH
Agency/Co.:           TEI
Date Performed:       2/22/2012
Analysis Time Period: AM Peak
Intersection:         Navigation at Jensen
Jurisdiction:         Houston
Units: U. S. Customary
Analysis Year:        2035
Project ID:  1.5 Lane Roundabout
East/West Street:     Navigation
North/South Street:   Jensen
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
           | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
           |_______________|_______________|_______________|_______________|
Volume     |82   180  118  |304  361  96   |69   171  276  |286  533  157  |
U-Turn Vol |0              |0              |0              |0              |
% Thrus Left Lane          |               |               |          47   |
              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Lane Assn.   LT   R          L    T          LT   R          LT   LTR
RT Bypass               0               0               0               0
PHF         0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92
%HV         3    3    3     3    3    3     3    3    3     3    3    3
NumPeds     0               0               0               0
U-Turn PHF  1.00            1.00            1.00            1.00
U-Turn %HV  3               3               3               3
Flow Rate   92   202  132   340  404  107   77   191  309   320  597  176
No. Lanes   0    1    1     1    1    0     0    1    1     0    2    0
Cnfl. Lanes 2               1               1               2
Duration, T   0.25  hrs.
__________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound       Westbound       Northbound      Southbound
Crit. Hdwy  4.2929    4.1129     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy  3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
___________________________Flow Computations_________________________________
              Eastbound       Westbound       Northbound      Southbound
Circ. Flow    1257            360             614             821
Exit. Flow    831             657             390             1069
____________________ Capacity and Level of Service____________________________

              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Entry Flow   294  132        447  744        268  309        514  579
Entry Cap.   440  469        788  788        612  612        610  636
Volume (vph) 285  128        434  722        260  300        499  562
Cap. (vph)   427  455        765  765        594  594        592  617
v/c Ratio    0.67 0.28       0.57 0.94       0.44 0.51       0.84 0.91
Critical Lane       *               *               *          *    *
Lane Delay   27.2 12.4       13.5 43.3       12.9 14.6       34.6 43.2
Lane LOS      D     B         B      E        B     B         D     E
95 % Queue   4.8  1.1        3.6  14.0       2.2  2.8        9.1  11.5
Approach:
   Delay          22.60           32.14           13.81           39.16
   LOS             C               D               B               E
Intersection Delay  30.02            Intersection LOS  D
_____________________________________________________________________________
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Data for Table 4.1 (Multi Lane Roundabout - PM Peak - Existing Volumes)

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                                  HCS 2010 Roundabouts 6.2
Phone:                                         Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:              IH
Agency/Co.:           TEI
Date Performed:       2/22/2012
Analysis Time Period: PM Peak
Intersection:         Navigation at Jensen
Jurisdiction:         Houston
Units: U. S. Customary
Analysis Year:        2011
Project ID:  1.5 Lanes
East/West Street:     Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
           | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
           |_______________|_______________|_______________|_______________|
Volume     |26   88   42   |82   126  85   |37   194  125  |113  87   34   |
U-Turn Vol |0              |0              |0              |0              |
% Thrus Left Lane          |               |               |          47   |
              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Lane Assn.   LT   R          L    T          LT   R          LT   LTR
RT Bypass               0               0               0               0
PHF         0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92
%HV         3    3    3     3    3    3     3    3    3     3    3    3
NumPeds     0               0               0               0
U-Turn PHF  1.00            1.00            1.00            1.00
U-Turn %HV  3               3               3               3
Flow Rate   29   99   47    92   141  95    41   217  140   127  97   38
No. Lanes   0    1    1     1    1    0     0    1    1     0    2    0
Cnfl. Lanes 2               1               1               2
Duration, T   0.25  hrs.
__________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound       Westbound       Northbound      Southbound
Crit. Hdwy  4.2929    4.1129     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy  3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
___________________________Flow Computations_________________________________
              Eastbound       Westbound       Northbound      Southbound
Circ. Flow    316             287             255             274
Exit. Flow    366             220             341             236
____________________ Capacity and Level of Service____________________________

              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Entry Flow   128  47         187  233        258  140        123  139
Entry Cap.   892  906        848  848        876  876        920  933
Volume (vph) 124  46         182  226        250  136        119  135
Cap. (vph)   866  880        823  823        850  850        893  906
v/c Ratio    0.14 0.05       0.22 0.27       0.29 0.16       0.13 0.15
Critical Lane       *               *          *    *               *
Lane Delay   5.6  4.6        6.7  7.4        7.5  5.8        5.3  5.4
Lane LOS      A     A         A      A        A     A         A     A
95 % Queue   0.5  0.2        0.8  1.1        1.2  0.6        0.5  0.5
Approach:
   Delay          5.30            7.09            6.89            5.37
   LOS             A               A               A               A
Intersection Delay  6.42             Intersection LOS  A
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Data for Table 4.1 (Multi Lane Roundabout - PM Peak - Future Volumes)

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                                  HCS 2010 Roundabouts 6.2
Phone:                                         Fax:
E-Mail:

____________________________ROUNDABOUT ANALYSIS_______________________________

Analyst:              IH
Agency/Co.:           TEI
Date Performed:       2/22/2012
Analysis Time Period: PM Peak
Intersection:         Navigation at Jensen
Jurisdiction:         Houston
Units: U. S. Customary
Analysis Year:        2035
Project ID:  1.5 Lanes
East/West Street:     Navigation
North/South Street:
_______________________Volume Adjustments and Site Characteristics____________

           |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
           | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
           |_______________|_______________|_______________|_______________|
Volume     |53   180  86   |167  257  174  |76   396  255  |231  178  69   |
U-Turn Vol |0              |0              |0              |0              |
% Thrus Left Lane          |               |               |          47   |
              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Lane Assn.   LT   R          L    T          LT   R          LT   LTR
RT Bypass               0               0               0               0
PHF         0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92  0.92 0.92 0.92
%HV         3    3    3     3    3    3     3    3    3     3    3    3
NumPeds     0               0               0               0
U-Turn PHF  1.00            1.00            1.00            1.00
U-Turn %HV  3               3               3               3
Flow Rate   59   202  96    187  288  195   85   443  285   259  199  77
No. Lanes   0    1    1     1    1    0     0    1    1     0    2    0
Cnfl. Lanes 2               1               1               2
Duration, T   0.25  hrs.
__________________Critical and Follow-Up Headway Adjustment__________________
              Eastbound       Westbound       Northbound      Southbound
Crit. Hdwy  4.2929    4.1129     5.1929     5.1929    5.1929     5.1929
Flup. Hdwy  3.1858    3.1858     3.1858     3.1858    3.1858     3.1858
___________________________Flow Computations_________________________________
              Eastbound       Westbound       Northbound      Southbound
Circ. Flow    645             587             520             560
Exit. Flow    746             450             697             482
____________________ Capacity and Level of Service____________________________

              Eastbound       Westbound       Northbound      Southbound
             Left Right BP   Left Right BP   Left Right BP   Left Right BP
Entry Flow   261  96         382  475        528  285        251  284
Entry Cap.   697  719        628  628        672  672        742  764
Volume (vph) 253  93         371  461        513  277        244  276
Cap. (vph)   677  698        610  610        652  652        720  742
v/c Ratio    0.37 0.13       0.61 0.76       0.79 0.42       0.34 0.37
Critical Lane       *          *    *          *    *               *
Lane Delay   10.3 6.6        17.7 25.6       26.7 11.7       9.2  9.6
Lane LOS      B     A         C      D        D     B         A     A
95 % Queue   1.7  0.5        4.1  6.8        7.7  2.1        1.5  1.7
Approach:
   Delay          9.34            22.09           21.41           9.40
   LOS             A               C               C               A
Intersection Delay  17.45            Intersection LOS  C
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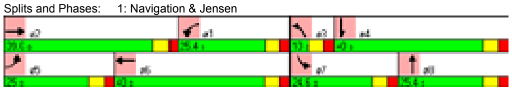
Data for Table 4.1 (Signals with Modifications - AM Peak - Existing Volumes)

Lanes, Volumes, Timings — Existing with Modifications
1: Navigation & Jensen — Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3327	0	1770	3429	0	1770	3214	0	1770	3419	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3327	0	1770	3429	0	1770	3214	0	1770	3419	0
Satd. Flow (RTOR)		75			30			175			35	
Volume (vph)	40	88	58	149	177	47	34	84	135	140	261	77
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	52	114	75	194	230	61	44	109	175	182	339	100
Lane Group Flow (vph)	52	189	0	194	291	0	44	284	0	182	439	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	25.0	39.6	0.0	25.4	40.0	0.0	10.0	25.4	0.0	24.6	40.0	0.0
Act Effct Green (s)	9.9	11.0		13.9	17.5		6.6	11.5		13.5	19.9	
Actuated g/C Ratio	0.15	0.19		0.23	0.30		0.10	0.19		0.22	0.34	
v/c Ratio	0.19	0.28		0.49	0.28		0.24	0.37		0.47	0.37	
Control Delay	30.3	18.7		28.1	19.0		36.1	13.2		28.3	17.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.3	18.7		28.1	19.0		36.1	13.2		28.3	17.2	
LOS	C	B		C	B		D	B		C	B	
Approach Delay		21.2			22.7			16.3			20.5	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	18	20		64	43		16	19		60	65	
Queue Length 95th (ft)	49	47		125	77		48	45		119	102	
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)	150			350			150			350		
Base Capacity (vph)	517	1523		569	1674		185	1194		552	1716	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.10	0.12		0.34	0.17		0.24	0.24		0.33	0.26	

Intersection Summary
Cycle Length: 115
Actuated Cycle Length: 59.3
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 20.4 — Intersection LOS: C
Intersection Capacity Utilization 40.3% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: Navigation & Jensen



Data for Table 4.1 (Signals with Modifications - AM Peak - Future Volumes)

Lanes, Volumes, Timings — Future 2035 TOD
1: Navigation & Jensen — Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3330	0	1770	3426	0	1770	3210	0	1770	3419	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3330	0	1770	3426	0	1770	3210	0	1770	3419	0
Satd. Flow (RTOR)		107			27			282			33	
Volume (vph)	82	180	118	304	361	96	69	171	276	286	533	157
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	106	234	153	395	469	125	90	222	358	371	692	204
Lane Group Flow (vph)	106	387	0	395	594	0	90	580	0	371	896	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	25.0	28.0	0.0	37.0	40.0	0.0	13.0	25.0	0.0	35.0	47.0	0.0
Act Effct Green (s)	13.5	16.2		27.8	34.2		9.0	16.5		26.3	37.4	
Actuated g/C Ratio	0.13	0.16		0.27	0.33		0.08	0.16		0.25	0.36	
v/c Ratio	0.47	0.63		0.83	0.52		0.60	0.78		0.83	0.71	
Control Delay	53.5	36.2		54.4	32.0		69.8	30.4		55.5	33.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	53.5	36.2		54.4	32.0		69.8	30.4		55.5	33.4	
LOS	D	D		D	C		E	C		E	C	
Approach Delay		39.9			40.9			35.7			39.9	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	75	104		272	185		67	113		258	295	
Queue Length 95th (ft)	114	126		346	216		#116	136		330	318	
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)	150			350			150			350		
Base Capacity (vph)	333	823		549	1223		154	869		520	1392	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.32	0.47		0.72	0.49		0.58	0.67		0.71	0.64	

Intersection Summary
Cycle Length: 125
Actuated Cycle Length: 103.8
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 39.4 — Intersection LOS: D
Intersection Capacity Utilization 68.4% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

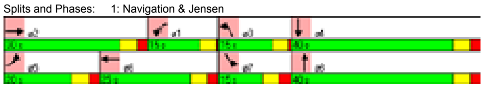
Data for Table 4.1 (Signals with Modifications - PM Peak - Existing Volumes)

Lanes, Volumes, Timings — Existing with Modifications
1: Navigation & Jensen — Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3366	0	1770	3323	0	1770	3330	0	1770	3391	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3366	0	1770	3323	0	1770	3330	0	1770	3391	0
Satd. Flow (RTOR)		48			97			142			39	
Volume (vph)	26	88	42	82	126	85	37	194	125	113	87	34
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	30	100	48	93	143	97	42	220	142	128	99	39
Lane Group Flow (vph)	30	148	0	93	240	0	42	362	0	128	138	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	20.0	30.0	0.0	15.0	25.0	0.0	15.0	40.0	0.0	15.0	40.0	0.0
Act Effct Green (s)	8.7	9.7		8.3	12.3		7.0	13.8		10.1	20.5	
Actuated g/C Ratio	0.15	0.19		0.15	0.25		0.12	0.28		0.19	0.41	
v/c Ratio	0.11	0.21		0.34	0.27		0.19	0.35		0.37	0.10	
Control Delay	24.8	16.5		26.1	12.6		27.0	12.7		25.1	11.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.8	16.5		26.1	12.6		27.0	12.7		25.1	11.4	
LOS	C	B		C	B		C	B		C	B	
Approach Delay		17.9			16.4			14.2			18.0	
Approach LOS		B			B			B			B	
Queue Length 50th (ft)	9	15		29	15		13	32		38	8	
Queue Length 95th (ft)	30	40		69	52		39	69		91	34	
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)	150			350			150			350		
Base Capacity (vph)	451	1395		356	1301		336	1768		376	1930	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.07	0.11		0.26	0.18		0.13	0.20		0.34	0.07	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.37
Intersection Signal Delay: 16.2 — Intersection LOS: B
Intersection Capacity Utilization 39.3% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: Navigation & Jensen



Data for Table 4.1 (Signals with Modifications - PM Peak - Future Volumes)

Lanes, Volumes, Timings — Future 2035 TOD
1: Navigation & Jensen — Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3366	0	1770	3323	0	1770	3330	0	1770	3391	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3366	0	1770	3323	0	1770	3330	0	1770	3391	0
Satd. Flow (RTOR)		71			150			165			64	
Volume (vph)	55	180	86	167	257	174	76	396	255	231	178	69
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	62	205	98	190	292	198	86	450	290	262	202	78
Lane Group Flow (vph)	62	303	0	190	490	0	86	740	0	262	280	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	20.0	23.0	0.0	22.0	25.0	0.0	15.0	40.0	0.0	15.0	40.0	0.0
Act Effct Green (s)	10.1	12.7		12.4	18.0		8.6	21.3		11.8	27.5	
Actuated g/C Ratio	0.13	0.18		0.17	0.25		0.12	0.30		0.16	0.38	
v/c Ratio	0.26	0.46		0.64	0.52		0.42	0.67		0.90	0.21	
Control Delay	36.3	25.2		41.5	20.0		40.8	21.3		70.8	15.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	36.3	25.2		41.5	20.0		40.8	21.3		70.8	15.7	
LOS	D	C		D	C		D	C		E	B	
Approach Delay		27.1			26.0			23.4			42.3	
Approach LOS		C			C			C			D	
Queue Length 50th (ft)	26	50		80	71		37	120		120	37	
Queue Length 95th (ft)	70	102		169	140		93	201		#342	76	
Internal Link Dist (ft)		369			402			72			1019	
Turn Bay Length (ft)	150			350			150			350		
Base Capacity (vph)	350	902		408	1101		262	1507		291	1597	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.18	0.34		0.47	0.45		0.33	0.49		0.90	0.18	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 72
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 28.9 — Intersection LOS: C
Intersection Capacity Utilization 62.2% — ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Data for Table 4.2 (Navigation at 2-Way York Street - AM Peak - Future Volumes)

Lanes, Volumes, Timings — Two Way York - Future
6: Navigation Blvd & York Street — Timing Plan: AM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3539	0	1770	3511	0	1770	1703	0	1770	3391	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	0	1770	3511	0	1770	1703	0	1770	3391	0
Satd. Flow (RTOR)					8			79			73	
Volume (vph)	78	772	0	78	856	49	49	137	186	188	538	208
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	93	919	0	93	1019	58	58	163	221	224	640	248
Lane Group Flow (vph)	93	919	0	93	1077	0	58	384	0	224	888	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	10.0	31.1	0.0	10.9	32.0	0.0	9.5	22.0	0.0	16.0	28.5	0.0
Act Effct Green (s)	6.0	25.6		7.0	26.2		5.6	16.8		11.9	27.5	
Actuated g/C Ratio	0.08	0.34		0.09	0.35		0.07	0.22		0.16	0.37	
v/c Ratio	0.66	0.76		0.58	0.87		0.46	0.86		0.80	0.69	
Control Delay	61.0	27.5		51.5	32.5		48.8	44.5		55.3	24.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	61.0	27.5		51.5	32.5		48.8	44.5		55.3	24.1	
LOS	E	C		D	C		D	D		E	C	
Approach Delay		30.6			34.0			45.1			30.4	
Approach LOS		C			C			D			C	
Queue Length 50th (ft)	46	212		46	259		29	149		110	197	
Queue Length 95th (ft)	#106	257		#96	307		61	#265		#205	243	
Internal Link Dist (ft)		375			590			739			461	
Turn Bay Length (ft)	150			150			150			150		
Base Capacity (vph)	140	1271		160	1303		126	469		290	1293	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.66	0.72		0.58	0.83		0.46	0.82		0.77	0.69	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 74.7
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 33.3 — Intersection LOS: C
Intersection Capacity Utilization 71.9% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Navigation Blvd & York Street

East End Mobility Study — Synchro 6 Report
Traffic Engineers, Inc. — 2/23/2012

Data for Table 4.2 (Navigation at 2-Way York Street - PM Peak - Future Volumes)

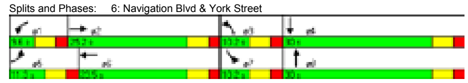
Lanes, Volumes, Timings — Two Way York - Future
6: Navigation Blvd & York Street — Timing Plan: PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	3539	0	1770	3479	0	1770	1775	0	1770	3345	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	0	1770	3479	0	1770	1775	0	1770	3345	0
Satd. Flow (RTOR)					18			33			114	
Volume (vph)	127	646	2	93	592	76	39	357	161	105	171	98
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	148	751	2	108	688	88	45	415	187	122	199	114
Lane Group Flow (vph)	148	753	0	108	776	0	45	602	0	122	313	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Total Split (s)	11.3	25.2	0.0	9.6	23.5	0.0	10.2	30.0	0.0	10.2	30.0	0.0
Act Effct Green (s)	7.3	20.9		5.6	19.2		6.2	25.8		6.2	30.0	
Actuated g/C Ratio	0.10	0.28		0.08	0.26		0.08	0.35		0.08	0.40	
v/c Ratio	0.86	0.76		0.81	0.85		0.32	0.95		0.83	0.22	
Control Delay	75.5	30.4		77.9	36.8		39.4	49.2		77.2	10.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	75.5	30.4		77.9	36.8		39.4	49.2		77.2	10.7	
LOS	E	C		E	D		D	D		E	B	
Approach Delay		37.8			41.8			48.5			29.3	
Approach LOS		D			D			D			C	
Queue Length 50th (ft)	69	167		51	175		20	255		57	33	
Queue Length 95th (ft)	#159	216		#126	#236		48	#427		#138	57	
Internal Link Dist (ft)		375			590			739			461	
Turn Bay Length (ft)	150			150			150			150		
Base Capacity (vph)	173	1002		133	920		140	640		147	1413	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.86	0.75		0.81	0.84		0.32	0.94		0.83	0.22	

Intersection Summary

Cycle Length: 75
Actuated Cycle Length: 74.5
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 40.2 — Intersection LOS: D
Intersection Capacity Utilization 73.6% — ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Navigation Blvd & York Street



East End Mobility Study — Synchro 6 Report
Traffic Engineers, Inc. — 2/23/2012

Appendix A4. Cost Estimates

Cost Estimates and Implementation

Improvement T1 – Transit Priority Corridors

As discussed earlier, Priority Corridors would feature consistent, high levels of transit service and regularly spaced amenities designed to identify the corridors as priority corridors within the East End area. The shelters need to be clearly for METRO riders, but the design would convey a sense of place within the East End. Examples of other areas in Houston with unique shelter designs include the Uptown/Galleria and Energy Corridor districts. These management districts paid for and installed the shelters, in some cases with the assistance of grant funds. METRO has also used shelters different from their standard bus shelter along its Quickline route on Bellaire Boulevard and in the Midtown Houston area.

Where additional service would be needed to reach the target headways of 15 minutes, additional service is priced at $118.80 per revenue hour. This cost is based on METRO's budgeted cost for the delivery of local service operated by METRO in FY 2012.

While the cost of specialty shelters is a function of size and the design, the cost per installed shelter (which includes a bench and trash can) for this study is estimated at $15,000. This estimate is based on the actual cost of the shelters purchased by the Energy Corridor Management District (ECMD) and METRO for Midtown. Benches and trash cans also can vary significantly in price, but a cost of $750.00 a piece installed is used here based on recent bids provided to the ECMD.

Generally, when management districts or other groups install specialty bus shelters, they are required to maintain the shelters, including the cost of emptying trash cans. As a general cost guideline, the ECMD pays its contractor $15 per week per shelter or trash can to empty the trash and clean up the general area. It pays the contractors $125 per shelter for an annual power washing.

The Energy Corridor Management District has paid for new service in its area and related amenities with a Job Access Reverse Commute (JARC) grant. Fort Bend County has also used JARC grants for new local bus service. Other agencies, including Fort Bend and Harris Counties, have used Congestion Mitigation Air Quality (CMAQ) grants to pay for transit improvements. Winning grants through either of these funding sources would be more challenging in the East End, because, with well-established and well-patronized existing transit service, it may be hard to demonstrate the additional ridership needed show benefits under these two programs. Private funding partners, such as adjacent property owners, can also be tapped to help pay for either amenities or their maintenance.

T1-1 – Canal, Sampson/York, Polk Corridors

Canal Corridor

Peak period service in this corridor is provided every 15 minutes. Therefore, no additional service is needed. METRO currently has six shelters in the corridor, which is about 1.5 miles long. With service on both sides of the street, current shelter spacing is about every ½ mile. This spacing seems appropriate for a priority corridor. The six current shelters would be replaced with the special shelters.

In addition to shelters, the priority corridor could include benches and trash cans for some stops that either do not warrant a shelter based on passenger volumes or where there is simply not room for a shelter. Based on the length of the corridor, the cost estimate will include six benches and six trash cans.
Total Incremental Operating Cost

Cost for shelter and trash can maintenance – approximately $10,000 annually
No additional bus service needed.

Total Capital Cost - $99,000
New Bus Shelters – 6
New Benches – 6
New Trash Cans – 6

Polk Corridor

Peak period service in this corridor is provided every 15 minutes. Therefore, no additional service is needed. Metro currently has five shelters in this corridor, which is about 1.8 miles long. With service on both sides of the street, current shelter spacing is about every ¾ mil. For cost purposes, the project assumes that shelters would be placed every ½ mil as is currently in place on Canal Street. Therefore, seven replacement and new shelters would be needed. As with the Canal Corridor, benches and trash cans may be appropriate at some locations as well. The cost estimate will include seven benches and seven trash cans.
Total Incremental Operating Cost

Cost for shelter and trash can maintenance – approximately $11,800 annually
No additional bus service needed.

Total Capital Cost - $115,500
New Bus Shelters – 7
New Benches – 7
New Trash Cans –7

Sampson/York/Hirsch Corridor

Peak period service in this corridor is provided every 23 minutes. Therefore, additional service will be required at some point to elevate the service in this corridor to Priority Corridor levels. If METRO deploys additional service in response to proven demand, it would pay for the additional service. If the East End Management District (GEEMD) wants to stimulate demand with additional service, METRO would likely require a subsidy for the added service, either directly from the GEEMD or through some type of grant. Once the added service reaches METRO's required productivity levels, it would likely assume the cost of the incremental revenue hours.

There are currently no shelters along this 2.5 mile corridor, because current ridership levels do not warrant shelters under current METRO service standards. If enough shelters were added to bring this corridor to the same standard as the other priority corridors, ten shelters would be required. While the costs for all 10 shelters are included here, these shelters could be phased in as ridership grows. At a minimum, benches and trash cans could be used in this corridor to start. As shelters are installed, these benches and trash cans could be moved to others bus stops. For cost purposes, 10 benches and 10 trash cans are also included.
Total Incremental Operating Cost

Cost for shelter and trash can maintenance – approximately $17,000 annually
Approximately 34% additional service on weekdays - approximately $2.5 million annually

Total Capital Cost - $165,500
New Bus Shelters – 10
New Benches – 10
New Trash Cans –10

T1-2 - Navigation Corridor

As redevelopment along Navigation Street progresses, Navigation should also evolve into a priority transit corridor. Service is provided on the 48 Navigation every 30 minutes in the peak period. The 37 El Sol Crosstown also operates along Navigation through the study area every 35 minutes in the peak period. Therefore, if the schedules are staggered, the effective headways along Navigation nearly achieve the service levels desirable for a priority corridor. Given the fact that the demand on the Navigation Corridor will still have 2 to 5 years to mature, operating cost for additional service is not included here.

METRO currently has six shelters in the corridor, which is about 1.5 miles long. With service on both sides of the street, current shelter spacing is about every ½ mile. This spacing seems appropriate for a priority corridor. The six current shelters would be replaced with the special shelters.

In addition to shelters, the priority corridor could include benches and trash cans for some stops that either do not warrant a shelter based on passenger volumes or where there is simply not room for a shelter. Based on the length of the corridor, the cost estimate will include six benches and six trash cans.

Total Incremental Operating Cost
Cost for shelter and trash can maintenance – approximately $10,000 annually
No additional bus service needed.

Total Capital Cost - $99,000
New Bus Shelters – 6
New Benches – 6
New Trash Cans – 6

R1-1 & R1-3 Multilane Roundabouts					
Construct Multilane Roundabout					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$3.86	6481	$25,000.00
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$2.15	45384	$97,575.76
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$145.53	670	$97,575.76
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$36.14	6750	$243,939.39
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	13316	$40,000.00
531 2015	CONC SIDEWALKS (4")	SY	$36.06	1109	$40,000.00
	INLET ADJUSTMENTS	EA	$25,000.00	1	$25,000.00
	OTHER UTILITIES	EA	$90,000.00	1	$90,000.00
	PAVEMENT MARKINGS	EA	$25,000.00	1	$25,000.00
	TRAFFIC CONTROL	EA	$25,000.00	1	$25,000.00
	CONSTRUCTION SUBTOTAL 1				$709,090.91
	LANDSCAPING (10%)				$70,909.09
	CONSTRUCTION SUBTOTAL 2				$780,000.00
	CONTINGENCY (15%)				$117,000.00
	MOBILIZATION (4.5%)				$35,100.00
	CONSTRUCTION SUBTOTAL 3				$932,100.00
	ENGINEERING AND MANAGEMENT (20%)				$186,420.00
	Total				**$1,118,520.00**

Note: Cost is generic for a multilane roundabout assuming substantial curb modifications; actual construction cost for a specific roundabout will vary.

R1-5 Single Lane Roundabouts					
Construct Single Lane Roundabout					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$3.86	3889	$15,000.00
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$2.15	13953	$30,000.00
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$145.53	206	$30,000.00
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$36.14	1937	$70,000.00
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	3329	$10,000.00
531 2015	CONC SIDEWALKS (4")	SY	$36.06	832	$30,000.00
	INLET ADJUSTMENTS	EA	$25,000.00	1	$20,000.00
	OTHER UTILITIES	EA	$90,000.00	0	$40,000.00
	PAVEMENT MARKINGS	EA	$25,000.00	0	$10,000.00
	TRAFFIC CONTROL	EA	$25,000.00	1	$15,000.00
	CONSTRUCTION SUBTOTAL 1				$270,000.00
	LANDSCAPING (10%)				$27,000.00
	CONSTRUCTION SUBTOTAL 2				$297,000.00
	CONTINGENCY (15%)				$40,500.00
	MOBILIZATION (4.5%)				$13,365.00
	CONSTRUCTION SUBTOTAL 3				$350,865.00
	ENGINEERING AND MANAGEMENT (20%)				$70,173.00
	Total				**$421,038.00**

Note: Cost is generic for a single lane roundabout; actual construction cost for a specific roundabout will vary.

R1-2 Improve Navigation at Canal					
Add median refuges for pedestrians; narrow intersection where possible; close Hutchins at Canal					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	CURB AND PAVEMENT MODIFICATIONS	EA	$92,400.00	1	$92,400.00
	CURB RAMPS	EA	$1,200.00	8	$9,600.00
	CONSTRUCTION SUBTOTAL 1				$102,000.00
	CONTINGENCY (15%)				$15,300.00
	MOBILIZATION (4.5%)				$4,590.00
	CONSTRUCTION SUBTOTAL 2				$121,890.00
	ENGINEERING AND MANAGEMENT (20%)				$24,378.00
	Total				$146,268.00

Note: This project is proposed to accompany the proposed redesign of the Navigation underpass; the connectivity provided by the grade-separated intersection will enable the closure of Hutchins Street.

R1-4 Close Westbound Pease at Dowling					
Remove existing pavement and install median, curb, and sidewalk					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
105 2014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY	$2.79	210	$585.33
104 2021	REMOVING CONC (CURB)	LF	$2.85	20	$56.92
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	215	$645.84
132 2006	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY	$3.78	25	$94.54
531 2003	CONC SIDEWALKS (5') (6")	LF	$46.16	130	$6,001.00
162 2002	BLOCK SODDING	SY	$2.37	150	$355.34
	CONSTRUCTION SUBTOTAL				$7,738.97
	CONTINGENCIES (30%)				$2,321.69
	TOTAL				$10,060.66

R2 - 1 Navigation at St Emanuel					
Reconfigure intersection of Navigation at St. Emanuel to enable southbound movement from Navigation to St. Emanuel. Adjust medians and curbs to guide vehicles.					
Bid Code	Description	Unit	$/Unit	Qty	Total
	Remove Existing				
105 2014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY	$2.79	1850.00	$5,156.49
	REMOVING CONC (RIPRAP)	SY	$6.92	400.00	$2,766.52
	REMOVING CONC (CURB)	LF	$2.85	600.00	$1,707.68
	Install New Concrete				
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	1900.00	$5,707.39
132 2006	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY	$3.78	320.00	$1,210.10
531 2004	CONC SIDEWALKS (6")	SY	$46.16	80.46	$3,713.96
162 2002	BLOCK SODDING	SY	$2.37	2000.00	$4,737.86
	Miscellaneous				
	INSTALL STORM SEWER INLET	LS	$3,000.00	6.00	$18,000.00
	PAVEMENT MARKINGS	EA	$20,000.00	1.00	$20,000.00
	INSTALL TRAFFIC SIGNAL	EA	$275,000.00	1.00	$275,000.00
	CONSTRUCTION SUBTOTAL 1				$338,000.00
	CONTINGENCY (15%)				$50,700.00
	MOBILIZATION (4.5%)				$15,210.00
	CONSTRUCTION SUBTOTAL 2				$403,910.00
	ENGINEERING AND MANAGEMENT (20%)				$80,782.00
	TOTAL				$484,692.00

Note: Assumes pavement is only removed where new curb and medians are constructed. All other pavement is assumed to remain.

R2-2 Franklin-Dowling Connection					
Construct new two-lane road from the intersection of Navigation Boulevard / Franklin Street / St. Emanuel Street to Dowling Street					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$3.86	2888.8889	$11,142.85
100 2002	PREPARING ROW	STA	$500.00	10.500	$5,250.00
110 2001	EXCAVATION (ROADWAY)	CY	$3.86	2028.000	$7,827.69
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$2.15	4203	$9,035.90
260 2012	LIME (HYD, COM OR QK) (SLRY) OR QK (DRY)	TON	$145.53	52	$7,637.71
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$36.14	4203	$151,880.68
529 2004	CONC CURB & GUTTER (TY II)	LF	$13.23	2750	$36,375.24
531 2004	CONC SIDEWALKS (6")	SY	$46.16	1527.7778	$70,524.54
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$3,825.32	5	$19,126.61
462 2011	CONC BOX CULV (6 FT X 4 FT)	LF	$216.51	700	$151,554.99
465 2001	INLET (COMPL)(TY C)	EA	$2,940.94	7	$21,566.91
	UTILITIES - WATER, ELECTRICAL	EA	$100,000.00	1	$100,000.00
	PAVEMENT MARKINGS	EA	$5,000.00	1	$5,000.00
	DEMOLISH BUILDING	EA	$5,000.00	3	$15,000.00
	CONSTRUCTION SUBTOTAL 1				**$591,923.12**
	CONTINGENCY (30%)				$177,576.94
	MOBILIZATION (4.5%)				$34,627.50
	CONSTRUCTION SUBTOTAL 2				**$804,127.57**
	ENGINEERING AND MANAGEMENT (20%)				**$160,825.51**
	RIGHT OF WAY AND BUILDINGS				$2,129,312.00
	TOTAL				**$3,094,265.08**

Note: Property values as per 2012 HCAD estimates

R3-1 Navigation Reconstruction					
Reconstruct pavement between Jensen and Palmer to provide 4 travel lanes install new sidewalks and make drainage adjustments					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	13889	$53,571.39
104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$ 4.52	10000	$45,210.60
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	14444	$31,055.56
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	179	$26,013.61
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	13889	$501,922.92
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$ 3,825.32	8	$31,877.68
529 2006	CONC CURB (MONO) (TY II)	LF	$ 3.00	10000	$30,038.90
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	2240	$8,639.99
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	2240	$80,950.13
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	2240	$4,816.00
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	28	$4,034.11
104 2015	REMOVING CONC (SIDEWALKS)	SY	$ 7.71	2222	$17,135.53
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	926	$3,573.90
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	5556	$200,344.22
	INLET ADJUSTMENTS	EA	$ 5,000.00	13	$62,500.00
	OTHER UTILITIES	LF	$ 33.33	2500	$83,333.33
	PAVEMENT MARKINGS	EA	$ 2,000.00	1	$2,000.00
	CONSTRUCTION SUBTOTAL				$1,187,017.87
	CONTINGENCIES (30%)				$356,105.36
	TOTAL				$1,543,123.23

Assumes: existing pavement between Jensen and Palmer is removed and new pavement cross-section is constructed.

Commerce Street/Navigation Boulevard

Roadway Underpass

Item	Quantity	Units	Price		Probable Cost	
Clearing/Grubbing	4	AC	$	2,000	$	8,000
Excavation (Roadway)	44,447	CY	$	5	$	222,000
Embankment (Roadway)	1,944	CY	$	5	$	10,000
Concrete Pavement (10")	14,421	SY	$	50	$	721,000
Cement Stabilized Base (6")	14,421	SY	$	3	$	43,000
Lime Treated Subgrade (12")	14,599	SY	$	3	$	44,000
Lime (6% weight)	390	TON	$	150	$	59,000
Sidewalk	17,624	SF	$	4	$	70,000
Traffic Rail	3,846	LF	$	40	$	154,000
Handrail (Sidewalk)	3,470	LF	$	25	$	87,000
Curb and Gutter (Concrete)	0	LF	$	14	$	-
Removal (Pavement)	17,260	SY	$	6	$	104,000
Removal (Retaining Wall)	14,200	SF	$	8	$	114,000
Removal (Bridge)	8,710	SF	$	10	$	87,000
Retaining Wall (MSE)	0	SF	$	35	$	-
Retaining Wall (Drilled Shaft)	40,762	SF	$	75	$	3,057,000
Bridge (Roadway) - Concrete I-Beam	0	SF	$	40	$	-
Bridge (Rail)	12,420	SF	$	200	$	2,484,000
Pump Station	1	EA	$	3,000,000	$	3,000,000
Drainage	0.41	MI	$	750,000	$	308,000
Lighting	0.41	MI	$	150,000	$	62,000
Signing and Pavement Markings	0.41	MI	$	50,000	$	21,000
SW3P	0.41	MI	$	50,000	$	21,000
Subtotal I					**$**	**10,668,000**
Mobilization				4% of Subtotal I	$	430,000
Traffic Control				2% of Subtotal I	$	210,000
Landscaping				1% of Subtotal I	$	110,000
Subtotal II					**$**	**11,418,000**
Utility Adjustments				10% of Subtotal II	$	1,140,000
Construction Contingency				30% of Subtotal II	$	3,430,000
Subtotal III (Construction)					**$**	**15,988,000**
Environmental					$	800,000
Engineering PER					$	420,000
Engineering (Final Design)					$	595,000
Engineering (Construction Administration)					$	180,000
Total of Construction & Design					**$**	**17,983,000**
Right-of-Way Acquisition					$	4,500,000
GRAND TOTAL					**$**	**22,480,000**

The costs shown in this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Cost Estimate for R2-3 Navigation/Commerce Underpass
Source: West Belt Freight Rail Study,

R3-2 Commerce and Canal Cross Sections					
Commerce - Asphalt overlay for 6' on either side; restripe to provide bike lanes. Canal - Restripe to provide 2 travel lanes, 1 CTL, and 2 parking lanes					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	Commerce Street Cross Section with Resurfacing for Bike Lanes				
310 2001	PRIME COAT (MC-30)	GAL	$4.14	1600	$6,616.35
354 2051	PLANE ASPH CONC PAV (0" TO 1 1/2")	SY	$1.29	8000	$10,306.16
251 2026	REWORK BS MTL (TY B) (8") (ORD COMP)	SY	$1.60	8000	$12,800.00
341 2119	D-GR HMA(QCQA) TY-D SAC-A PG70-22	TON	$68.59	684	$46,914.96
	ADJUST PAVEMENT MARKINGS	EA	$25,000.00	1	$25,000.00
	SUBTOTAL COMMERCE				$101,637.48
	Canal Street Cross Section				
	ADJUST PAVEMENT MARKINGS	EA	$18,000.00	1	$18,000.00
	SUBTOTAL CANAL				$18,000.00
	SUBTOTAL - COMMERCE AND CANAL				$119,637.48
	CONTINGENCIES (30%)				$35,891.24
	TOTAL				**$155,528.72**

Note: Commerce Street assumes no special treatment for the freight rail line that runs down the street

R3-3 Canal Reconstruction					
Reconstruct pavement to provide 2 parking lanes, 2 travel lanes, and a center turn lane; install new sidewalks and make drainage adjustments					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	22222.222	$ 85,714.22
104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$ 4.52	8000.000	$ 36,168.48
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	22222	$ 803,076.67
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	23111	$ 49,688.89
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	286	$ 41,621.78
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$ 3,825.32	13	$ 51,004.29
529 2006	CONC CURB (MONO) (TY II)	LF	$ 3.00	8000	$ 24,031.12
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	560	$ 2,160.00
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	560	$ 20,237.53
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	560	$ 1,204.00
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	6.93	$ 1,008.53
104 2015	REMOVING CONC (SIDEWALKS)	SY	$ 7.71	3555.5556	$ 27,416.85
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	889	$ 3,430.94
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	5333.3333	$ 192,330.45
	INLET ADJUSTMENTS	EA	$ 5,000.00	20	$ 100,000.00
	OTHER UTILITIES	LF	$ 33.33	4000	$ 133,333.33
	PAVEMENT MARKINGS	EA	$ 8,000.00	1	$ 8,000.00
	CONSTRUCTION SUBTOTAL				$ 1,580,427.08
	CONTINGENCIES (30%)				$ 474,128.12
	TOTAL				$ 2,054,555.21

R3-4 Commerce Reconstruction					
Reconstruct pavement to provide 2 bike lanes and 2 travel lanes; install new sidewalks and make drainage adjustments					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	43750	$ 168,749.88
104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$ 4.52	12600.000	$ 56,965.36
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	1400	$ 5,403.73
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	45150	$ 97,072.50
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	559	$ 81,312.54
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	43750	$ 1,581,057.19
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$ 3,825.32	21	$ 80,331.75
529 2006	CONC CURB (MONO) (TY II)	LF	$ 3.00	12600	$ 37,849.01
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	560	$ 2,160.00
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	560	$ 20,237.53
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	560	$ 1,204.00
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	6.93	$ 1,008.53
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	8400	$ 302,920.46
	INLET ADJUSTMENTS	EA	$ 5,000.00	32	$ 157,500.00
	OTHER UTILITIES	LF	$ 33.33	6300	$ 210,000.00
	PAVEMENT MARKINGS	EA	$ 25,000.00	1	$ 25,000.00
	CONSTRUCTION SUBTOTAL				$ 2,828,772.48
	CONTINGENCIES (30%)				$ 848,631.74
	TOTAL				$ 3,677,404.23

Note: Cost of accommodating or removing existing rail line not included in estimate.

R4-1 Restripe York and Sampson					
Restripe York and Sampson to provide bike lanes and parking					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	ADJUST PAVEMENT MARKINGS	EA	$25,000	1	$25,000.00
	SIGNAGE	FT	$4,000	1	$4,000.00
	BIKE LANE MARKINGS	EA	$4,000	1	$4,000.00
	CONSTRUCTION SUBTOTAL				$33,000.00
	CONTINGENCIES (30%)				$9,900.00
	TOTAL				$42,900.00

R4-2 Convert York and Sampson to Two-way Operations					
Pavement marking modifications for two-way operation					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	ADJUST PAVEMENT MARKINGS	EA	$25,000.00	1	$25,000.00
	SIGNAGE	FT	$4,000.00	1	$4,000.00
	BIKE LANE MARKINGS	EA	$4,000.00	1	$4,000.00
	Subtotal for pavement markings				**$33,000.00**
Widening of York at Cross Streets for left-turn lanes					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
100-2001	PREP ROW	AC	$7,786.68	0.126	$983.17
104-2001	REMOVING CONC (PAV)	SY	$3.60	167	$600.00
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$2.15	778	$1,672.22
260 2012	LIME (HYD, COM OR QK) (SLRY) OR QK (DRY)	TON	$145.53	10	$1,413.47
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$36.14	667	$24,092.30
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$3,825.32	1	$3,825.32
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	1000	$3,003.89
	RELOCATE STORM SEWER INLET	LS	$2,000.00	4	$8,000.00
	Subtotal for intersections of York with Canal and Harrisburg				**$43,590.37**
OPTION 1: TRAFFIC SIGNAL AT YORK AT NAVIGATION					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
100-2001	PREP ROW	AC	$7,786.68	0.108	$840.96
104-2001	REMOVING CONC (PAV)	SY	$3.60	2667	$9,600.00
162 2002	BLOCK SODDING	SY	$2.37	2667	$6,317.15
160 2004	FURNISHING AND PLACING TOPSOIL (6")	SY	$1.10	262	$288.71
110 2001	EXCAVATION (ROADWAY)	CY	$3.86	115	$443.19
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$2.15	549	$1,180.35
260 2012	LIME (HYD, COM OR QK) (SLRY) OR QK (DRY)	TON	$145.53	7	$1,018.71
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$36.14	521	$18,828.13
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$3,825.32	2	$7,650.64
529 2006	CONC CURB (MONO) (TY II)	LF	$3.00	767	$2,303.98
	INSTALL NEW TRAFFIC SIGNAL AT INTERSECTION OF NAVIGATION AT YORK	EA	$257,000.00	1	$257,000.00
	RELOCATE STORM SEWER INLET	LS	$3,000.00	2	$6,000.00
	Subtotal for Option 1				**$311,471.83**
OPTION 2: ROUNDABOUT AT YORK AT NAVIGATION					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	CONSTRUCT MULTI LANE ROUNDABOUT (SEE ESTIMATE FOR R1-1)	EA	$780,000.00	1.000	$780,000.00
	Subtotal for Option 1				**$780,000.00**
TRAFFIC SIGNAL MODIFICATIONS					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	MODIFY SIGNAL AT INTERSECTION OF CANAL AT SAMPSON	EA	$137,500.00	1	$137,500.00
	MODIFY SIGNAL AT INTERSECTION OF CANAL AT YORK	EA	$137,500.00	1	$137,500.00
	MODIFY SIGNAL AT INTERSECTION OF HARRISBURG AT SAMPSON	EA	$137,500.00	1	$137,500.00
	MODIFY SIGNAL AT INTERSECTION OF HARRISBURG AT YORK	EA	$137,500.00	1	$137,500.00
	Subtotal for Traffic Signal Modifications				**$550,000.00**
	Option 1: Subtotal for all items				**$938,062.20**
	30% Contigencies				$281,418.66
	4.5% Mobilization				$42,212.80
	Grand Total for Conversion (Option 1)				**$1,261,693.66**
	Option 2: Subtotal for all items				**$1,406,590.37**
	30% Contigencies				$421,977.11
	4.5% Mobilization				$63,296.57
	Grand Total for Conversion (Option 2)				**$1,891,864.04**

R4 - Calculation of Savings to York Street Crossing of West Belt Line With Conversion to Two-Way York and Sampson		
Savings Item / Assumptions	**Units**	**Quantity**
Pavement related to narrowing & Sampson		
Total length of unneeded pavement	FT	1750
Total extra width	FT	45
Area of extra pavement	SF	78750
Area (yards)	SY	8750
Extra Lime-treated subgrade	TONS	131.12
Savings due to extra pavement		$ 437,500.00
Savings due to extra cement-stabilized base		$ 26,250.00
Savings due to extra lime-treated subgrade		$ 26,250.00
Savings due to extra lime		$ 19,667.81
Unneeded Curb related to Sampson		
Length of section not needed	FT	400
Curb not needed	FT	800
Savings related to curb		$ 11,200.00
Rail bridge related to narrowing		
Cost of original bridge		$ 3,423,000.00
Length of original bridge	SF	21396
Assumed size of bridge as percentage of original design		50%
Savings due to extra bridge length		$ 1,711,500.00
Excavation related to narrowing		
Assume: 100% of ROW is used for grade separation		
Assume: excavation only related to underpass (not other pavement)		
Original cost of excavation		$709,000
Original Full ROW Width	FT	160
Cost of excavation/ROW Width		$ 4,431.25
Extra ROW not needed	FT	60
Savings due to extra excavation		$ 265,875.00
Resized pump station		
Original pump cost		$3,000,000
Assumed cost of new pump as % of old		75%
Pump savings		$750,000.00
Retaining wall due to Sampson grade change		
Sampson no longer must be grade-separated		
Assume: no Sampson retaining wall between stations 121 and 127	FT	600
Max depth	FT	23
Extra retaining wall (no underground penetration of wall assumed)	SF	13800
Retaining wall cost (per SF)		$75
Retaining wall savings		$1,035,000
Subtotal 1 savings		**$4,283,242.81**
Mobilization savings (4%)		$171,329.71
Traffic control savings (2%)		$85,664.86
Landscaping savings (1%)		$42,832.43
Subtotal 2 savings		**$4,583,069.81**
Utility savings (10%)		$458,306.98
Contingency savings (30%)		$1,374,920.94
Subtotal 3 (construction) savings		**$6,416,297.73**
ROW savings		$ 3,750,000.00
Total savings		**$10,166,297.73**

R5-1 Signing and Striping on Chartres					
Provide new pavement markings and signage to improve navigability of Chartres					
ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
	Bastrop Bike Lanes				
	REMOVE EXISTING MARKINGS	FT	$ 1.06	8000	$8,507.58
	PAVEMENT MARKINGS	FT	$ 3.00	8000	$24,000.00
636 2001	ALUMINUM SIGNS (TY A)	SF	$ 18.95	1080	$20,461.84
644 2001	IN SM RD SN SUP&AM TY10BWG(1)SA(P)	EA	$ 359.98	60	$21,599.03
	CONSTRUCTION SUBTOTAL				$74,568.45
	CONTINGENCIES (30%)				$22,370.54
	TOTAL				**$96,938.99**

Assume: 6 new signs (36"x36") and 3 new sign posts per intersection

R5-2 Chartres Enhancements					
Reconstruct pavement, add new sidewalks, rebuild driveways, make adjustments to inlets and utilities between Pierce Street and Runnels Street					
ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	55555.6	$214,285.56
104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$ 4.52	16000.0	$72,336.96
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	55555.6	$2,007,691.67
529 2006	CONC CURB (MONO) (TY II)	LF	$ 3.00	16000.0	$48,062.24
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	57333.3	$123,266.67
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	709.5	$103,254.02
104 2001	REMOVING CONC (PAV)	SY	$ 3.86	7093.3	$27,359.98
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	7093.3	$256,342.07
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	7093.3	$15,250.67
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	87.8	$12,774.68
502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$ 3,825.32	26.7	$102,008.57
104 2015	REMOVING CONC (SIDEWALKS)	SY	$ 7.71	7111.1	$54,833.71
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	2963.0	$11,436.47
132 2006	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY	$ 3.78	987.7	$3,734.88
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	17777.8	$641,101.51
	DRAINAGE	EA	$ 5,000.00	40.0	$200,000.00
	UTILITIES	EA	$ 33.33	8000.0	$266,666.67
	PAVEMENT MARKINGS	EA	$ 25,000.00	1.0	$25,000.00
	SIGNAGE	EA	$ 45,000.00	1.0	$45,000.00
	CONSTRUCTION SUBTOTAL				$4,230,406.33
	CONTINGENCIES (30%)				$1,269,121.90
	MOBILIZATION (4.5%)				$190,368.28
	TOTAL				$5,689,896.51

PB1-1 Primary Corridor Sidewalks (Navigation, Sampson/York)					
Construct 5' sidewalks where none currently exist; install wheelchair ramps on all intersection corners; provide landscaping					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	563	$ 2,171.14
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	3375	$ 121,709.12
531 2008	CURB RAMPS (TY 4)	EA	$ 1,294.10	52	$ 67,292.97
	CONSTRUCTION SUBTOTAL				$ 191,173.23
	CONTINGENCIES (15%)				$ 28,675.98
	LANDSCAPING (15%)				$ 28,675.98
	TOTAL				**$ 248,525.20**

PB1-2 Primary Corridor Sidewalks (other primary corridors)					
Construct 5' sidewalks where none currently exist; install wheelchair ramps on all intersection corners; provide landscaping					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	451	$ 1,740.49
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	2706	$ 97,567.64
531 2008	CURB RAMPS (TY 4)	EA	$ 1,294.10	52	$ 67,292.97
	CONSTRUCTION SUBTOTAL				$ 166,601.09
	CONTINGENCIES (15%)				$ 24,990.16
	LANDSCAPING (15%)				$ 24,990.16
	TOTAL				**$ 216,581.42**

PB1-3 Secondary Corridor Sidewalks					
Construct 5' sidewalks where none currently exist; install wheelchair ramps on all intersection corners					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	7278	$ 28,090.84
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	43667	$ 1,574,705.59
531 2008	CURB RAMPS (TY 4)	EA	$ 1,294.10	52	$ 67,292.97
	CONSTRUCTION SUBTOTAL				$ 1,670,089.40
	CONTINGENCIES (15%)				$ 250,513.41
	TOTAL				**$ 1,920,602.81**

PB2-1 On-Street Bicycle Facilities					
Provide bike lanes, signage, and bicycle-related pavement markings where appropriate					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	Lockwood/Ernestine Bike Lane and Sharrows				
	ADJUST PAVEMENT MARKINGS	EA	$ 4,000	1	$ 4,000.00
	SIGNAGE	FT	$ 7,000	1	$ 7,000.00
	BIKE LANE MARKINGS	EA	$ 24,000	1	$ 24,000.00
	SUBTOTAL FOR LOCKWOOD/ERNESTINE SOUTH OF POLK				**$ 35,000.00**
	Eastwood Signed Bike Route				
	SIGNAGE	FT	$ 5,000	1	$ 5,000.00
	CONCRETE TRAIL CONNECTION TO BAYOU TRAIL	FT	$ 43	750	$ 31,927.50
	SUBTOTAL FOR EASTWOOD				**$ 36,927.50**
	Live Oak Bike Lanes				
	ADJUST PAVEMENT MARKINGS	EA	$ 15,000	1	$ 2,000.00
	SIGNAGE	FT	$ 3,000	1	$ 3,000.00
	BIKE LANE MARKINGS	EA	$ 14,000	1	$ 12,000.00
	SUBTOTAL FOR LIVE OAK				**$ 17,000.00**
	CONSTRUCTION SUBTOTAL				**$ 88,927.50**
	CONTINGENCIES (30%)				$ 26,678.25
	TOTAL				**$ 115,605.75**

PB2-2 Lockwood bike lanes					
Add 6' pavement on either side of road for bike lanes between Polk St and Buffalo Bayou (7500 ft)					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
360 2003	CONC PVMT (CONT REINF-CRCP)(10")	SY	$ 36.14	10000.0	$ 361,384.50
260 2014	LIME TRT (SUBGR)(DC)(6")	SY	$ 2.15	11666.7	$ 25,083.33
260 2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$ 145.53	144.4	$ 21,010.99
	BIKE LANE-RELATED PAVEMENT MARKINGS	EA	$ 20,000.00	1	$ 20,000.00
	BIKE LANE-RELATED SIGNAGE	EA	$ 5,000.00	1	$ 5,000.00
	CONSTRUCTION SUBTOTAL				$ 432,478.83
	CONTINGENCIES (30%)				$ 64,871.82
	TOTAL				**$ 497,350.65**

Note: Entire roadway reconstruction is assumed to happen simultaneously; costs related to utilities, curb modifications, and driveway modifications are assumed to be factored into reconstruction cost

PB2-3 Buffalo Bayou Trails					
Construct 10'-wide trail at 4 gaps in Buffalo Bayou trail network (total 10,500 ft)					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	1944.4	$7,505.19
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	11666.7	$420,722.87
100 2001	PREPARING ROW	AC	$ 7,786.68	2.41	$18,769.55
	CONSTRUCTION SUBTOTAL				$446,997.60
	CONTINGENCIES (30%)				$134,099.28
	TOTAL				**$581,096.88**

PB2-4 Pedestrian Bridges Over Buffalo Bayou					
Install prefabricated truss bridge; construct 100' of 10'-wide trail to bridge on either side					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
4007 2028	PEDESTRIAN TRUSS BRIDGE SPAN (443 FT)	EA	$ 475,000.00	1.0	$ 475,000.00
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	37.0	$ 142.96
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	222.2	$ 8,013.77
100 2001	PREPARING ROW	AC	$ 7,786.68	0.05	$ 357.52
	SUBTOTAL				$ 483,514.24
	CONTINGENCIES (30%)				$ 145,054.27
	TOTAL				**$ 628,568.51**

PB2-5 Modify Planned Underpasses to Include Shared-Use Trail					
Add 5' to planned 5' sidewalk to create 10' trail on one side of underpass (For York underpass and Navigation approach of Navigation/Commerce underpass)					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	EXCAVATION (ROADWAY)	CY	$ 5.00	4431.3	$ 22,156.25
	CONCRETE PAVEMENT (10")	SY	$ 50.00	972.2	$ 48,611.11
	CEMENT STABILIZED BASE (6")	SY	$ 3.00	972.2	$ 2,916.67
	LIME TREATED SUBGRADE (12")	AC	$ 3.00	972.2	$ 2,916.67
	LIME (6% WEIGHT)	TON	$ 150.00	14.6	$ 2,185.31
	SUBTOTAL 1				$ 78,786.01
	MOBILIZATION				$ 3,151.44
	TRAFFIC CONTROL				$ 1,575.72
	LANDSCAPING				$ 787.86
	SUBTOTAL 2				$ 84,301.03
	UTILITY ADJUSTMENTS				$ 8,430.10
	CONSTRUCTION CONTINGENCY				$ 25,290.31
	SUBTOTAL PER UNDERPASS				$ 118,021.44
	TOTAL FOR TWO UNDERPASS				**$ 236,042.88**
Note: Quantitites and unit costs are based on the estimates included in the West Belt Freight Rail Study					
Rehabilitate Preston Street underpass with large culverts, trails, and lighting.					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	JACK OR TUNNEL LARGE BOX CULVERTS	FT	$4,000.00	360.0	$ 1,440,000.00
	SHARED USE PATH ON APPROACH	FT	$51.37	550.0	$ 28,251.67
	LIGHTING	EA	$2,000.00	12.0	$ 24,000.00
	SHADE TREES	EA	$500.00	20.0	$ 10,000.00
	LANDSCAPING	EA	$30,000.00	1.0	$ 30,000.00
	SUBTOTAL 1				$ 1,532,251.67
	MOBILIZATION				$ 229,837.75
	TRAFFIC CONTROL				$ 68,951.33
	LANDSCAPING				$ 1,831,040.74
	SUBTOTAL 2				$ 183,104.07
	UTILITY ADJUSTMENTS				$ 73,241.63
	CONSTRUCTION CONTINGENCY				$ 109,862.44
	TOTAL				**$ 2,197,248.89**

PB2-6 On-Street Bicycle Facilities from Other Studies (EaDo Livable Center)				
Provide bike lanes, signage, and concrete buffers where appropriate				
DESCRIPTION	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
Bastrop Bike Lanes				
REMOVE EXISTING MARKINGS	FT	$ 1.06	1200	$1,276.14
PAVEMENT MARKINGS	FT	$ 4.74	1200	$5,684.32
SIGNAGE	FT	$ 0.63	1200	$757.73
SUBTOTAL BASTROP				**$7,718.18**
St. Emanuel Signed Bike Route				
SIGNAGE	FT	$ 0.63	5000	$3,157.20
SUBTOTAL ST. EMANUEL				**$3,157.20**
Walker Bike Lanes				
REMOVE EXISTING MARKINGS	FT	$ 1.06	1000	$1,063.45
PAVEMENT MARKINGS	FT	$ 4.74	1000	$4,736.93
SIGNAGE	FT	$ 0.63	1000	$631.44
SUBTOTAL WALKER				**$6,431.82**
Leeland Signed Bike Route				
SIGNAGE	FT	$ 0.63	4000	$2,525.76
SUBTOTAL LEELAND				**$2,525.76**
Preston Signed Bike Route				
SIGNAGE	FT	$ 0.63	1000	$631.44
SUBTOTAL PRESTON				**$631.44**
Hutchins/Rusk Separated On-street Facility (Cycle Track)				
REMOVE EXISTING MARKINGS	FT	$ 1.06	1700	$1,807.86
PAVEMENT MARKINGS	FT	$ 4.74	1700	$8,052.78
SIGNAGE	FT	$ 0.63	1700	$1,073.45
CONCRETE MEDIAN BUFFER	CY	$ 300.00	189	$56,666.67
SUBTOTAL HUTCHINS/RUSK				**$67,600.76**
Harrisburg Separated On-street Facility (Cycle Track)				
PAVEMENT MARKINGS	FT	$ 1.50	1500	$2,250.00
SIGNAGE	FT	$ 0.63	1500	$947.16
CONCRETE MEDIAN BUFFER	CY	$ 300.00	167	$50,000.00
SUBTOTAL HARRISBURG				**$53,197.16**
SUBTOTAL - ALL ITEMS				**$141,262.31**
CONTINGENCIES (30%)				$42,378.69
TOTAL				**$183,641.00**

PB2-7 Off-street facilities from EaDo Livable Center					
Construct 10'-wide trail ("Bicycle Friendly Areas")					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	629.6	$ 2,430.25
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	3777.8	$ 136,234.07
100 2001	PREPARING ROW	AC	$ 7,786.68	0.78	$ 6,077.76
	SUBTOTAL				$ 144,742.08
Construct bridge over Harrisburg; construct 10' trail along West Belt rail line from Velasco Street to Runnels Street					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
4007 2027	PEDESTRIAN TRUSS BRIDGE SPAN (200 FT)	EA	$ 225,000.00	1.0	$ 225,000.00
110 2001	EXCAVATION (ROADWAY)	CY	$ 3.86	925.9	$ 3,573.90
531 2015	CONC SIDEWALKS (4")	SY	$ 36.06	5555.6	$ 200,344.22
100 2001	PREPARING ROW	AC	$ 7,786.68	1.15	$ 8,937.88
	SUBTOTAL				$ 437,856.00
	SUBTOTAL ALL ITEMS				**$ 582,598.08**
	CONTINGENCIES (30%)				$ 174,779.42
	TOTAL				**$ 757,377.51**

Cost Estimates

The total, shown below, is for all priced projects. If federal funds are used to implement the Pedestrian and Bicycle Districts improvements, the sponsoring agency (in this case the Fifth Ward Tax Increment Reinvestment Zone) must contribute 20% of the cost of improvements. It is also acceptable for the sponsoring agency to secure financial commitment from other government agencies (such as the City of Houston, TxDOT, Harris County, or other management districts or TIRZs). In-kind services are not countable towards this total; contributions must be in actual dollars.

Fifth Ward Special District Pedestrian/Bicyclist Plan
Overall Cost Estimates

Code #	Description	Estimate
1	Lyons Avenue Bicycle Lane Coloration	$ 412,300
2	Gregg Street - Sidewalk and Parking Improvements	$ 268,200
3	Market Street - Sidewalk and Street Improvements (Option 2)	$ 354,800
4	North - South Bike Trail along Benson and Rail Track	$ 558,200
5	Finnegan Park Bike Trail Connector	$ 57,200
6	East-West Baron Street "Bike Boulevard"	$ 160,200
7	Jensen and Buffalo Bayou Bike Connector (New Sidewalks from Baron to Lyons)	$ 178,700
8	Rail Bridge under US 59 (By Others) and New Bike Trail from bridge to Jensen	$ 79,500
9	McKee and Hardy Street Bike Improvements	$ 12,800
10	New Sidewalk Under US 59 from Commerce to Runnels	$ 25,300
11	Waco Street (IH 10 overpass) Sidewalk Widening	$ 52,800
12	Runnels Street Crosswalk (near US 59) with Median Extension	$ 35,300
13	Bruce Elementary School New Sidewalks	$ 81,900
14	Crawford Elementary School New Sidewalks	$ 98,400
15	South Jensen Drive New Sidewalks - not priced (implemented by others)	$ -
16	Multi-Service Center & YES Prep. School New Sidewalks	$ 148,000
17	Pedestrian (Hawk) Signal at Lyons Avenue and Pannell Street	$ 112,000
18	New Sidewalks along Meadow Street/US 59 Feeder Road	$ 29,600
19	Hare Street and IH 10 EB Feeder New Sidewalks	$ 89,400
20	Additional Wayfinding Signage - not priced	$ -
GRAND TOTAL		**$ 2,754,600**
FEDERAL SHARE (80%)		$ 2,204,000
LOCAL MATCH (20%)		**$ 551,000**

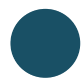
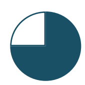
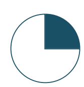
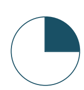
These cost estimates are intended for planning purposes only. If H-GAC or the TIRZ moves forward on the implementation of these improvements, construction drawings and engineering plans would be required. Further detail on the cost estimates for each improvement is provided on the following pages. The funding of the potential improvements identified in this report, is up to the TIRZ board, with the potential involvement of other public entities such as the City of Houston.

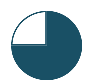
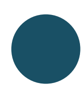
Cost Estimate for PB2-8 Off-Street Bicycle Recommendations
from Special Districts Ward Study
Source: Fifth Ward Special Districts Study

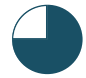
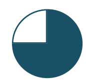
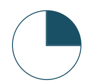
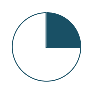
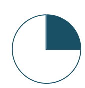
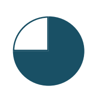
PB3-1 Standard Wayfinding				
Install bike signage as per MUTCD at 41 identified intersections				
DESCRIPTION	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
SIGN POLES	EA	$ 359.98	164	$ 59,037.36
BIKE WAYFINDING SIGNAGE	SF	$ 18.95	717.5	$ 13,593.86
BIKE ROUTE SIGNAGE	SF	$ 18.95	369	$ 6,991.13
CONSTRUCTION SUBTOTAL				$ 79,622.35
CONTINGENCIES (20%)				$ 15,924.47
TOTAL				**$ 95,546.82**

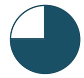
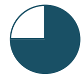
PB3-2 District Branding Wayfinding					
Install district-branding signage/wayfinding and maps					
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**
	BRANDING WAYFINDING AND MAPS	EA	$ 2,500.00	82	$205,000.00
	SUBTOTAL				$205,000.00
	CONTINGENCIES (20%)				$41,000.00
	TOTAL				**$246,000.00**

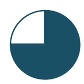
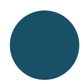
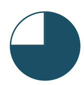
Note: Assume that 2 signs will be installed at 41 identified intersections

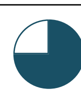
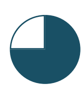
ROADWAY & INTERSECTION IMPLEMENTATION STRATEGY							
Improvement Opportunity	**Project #**	**Project Description**	**Priority**	**Cost**	**Ease of Implementation**	**Goals Supported**	**Benefits**
R1	R1-1	Roundabout at intersection of Navigation and Jensen	Medium-term	$1,120,000		5 - Reduce Safety Concerns 1 - Capacity Constraints/ Opportunities	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R1	R1-2	Improvements to intersection of Canal and Navigation	Long-term	$146,300		5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
R1	R1-3	Intersection improvements or roundabout at intersection or Navigation and York	Long-term	Costs are included in project R4-2		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R1	R1-4	Close Westbound Pease at Dowling	Short-term	$10,000		5 - Reduce Safety Concerns	Improve safety of intersection by removing unneeded movement from Pease Street at Dowling Street
R1	R1-5	Traffic signal or roundabout at intersection of Chartres and Runnels	Medium-term	$421,000		5 - Reduce Safety Concerns	Improve safety of intersection; ease crossing of road by pedestrians; improved landscaping opportunities
R2	R2-1	Reconfigure the intersection of Navigation Boulevard / St. Emanuel Street / Franklin Street so that Navigation Boulevard is aligned with St. Emanuel Street.	Short-term	$485,000		2 - Address Barriers 5 - Reduce Safety Concerns 4 - Support Development	Create a continuous north-south connection between EaDo and the East End; improve comprehensibility of roadway network
R2	R2-2	Extend Franklin Street east to join with the intersection of Dowling Street and Congress Street.	Long-term	$3,000,000		2 - Address Barriers 4 - Support Development	With modification, will provide continuous north-south link along Jensen, Navigation, and St. Emanuel; will provide bicycle connections along Navigation and Commerce; will improve access between Downtown, EaDo, and the East End
R2	R2-3	Modify West Belt Rail Study proposal for a grade separation at the intersection of Navigation Boulevard and Commerce Street to align Navigation Boulevard with St. Emanuel Street.	Long-term	$22,480,000 (cost is for original underpass design; proposed modifications may have marginal additional costs)		2 - Address Barriers	Improves mobility options in corridor for all modes; improves access to businesses and other destinations; maintains acceptable LOS for vehicular traffic

Improvement Opportunity	Project #	Project Description	Priority	Cost	Ease of Implementation	Goals Supported	Benefits
R3	R3-1	Modify Navigation Boulevard cross section	Short-term	$1,500,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; aligns with visions set out in East End Master Plan; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-2	Modify cross sections of Canal Street and Commerce Street with pavement markings and minor pavement repair.	Short-term	$155,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-3	Reconstruct Canal Street with cross section that emphasizes vehicular mobility and parking (Navigation to York)	Medium-term	$2,000,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R3	R3-4	Reconstruct Commerce Street with cross section that emphasizes vehicular and bicycle mobility (US 59 to Harrisburg Rail to Trail)	Medium-term	$3,700,000		4 - Support Development 3 - Multimodal Trips 1 - Capacity Constraints/ Opportunities	Improve context-sensitivity of roadway; maintains acceptable vehicular LOS; improves LOS of walking, biking, and transit
R4	R4-1	Modify cross sections on York Street and Sampson Street with pavement marking modifications	Short-term	$42,900		1 - Capacity Constraints/ Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; maintains acceptable LOS for vehicular traffic
R4	R4-2	Convert York Street and Sampson Street to two-way roads	Long-term	$1,260,000 (signal at Navigation and York) $1,900,000 (roundabout at Navigation and York)		1 - Capacity Constraints / Opportunities 3 - Multimodal Trips	Improves mobility options in corridor for all modes; improves access to businesses and other destinations; maintains acceptable LOS for vehicular traffic
R5	R5-1	Improvements to signage, wayfinding, and pavement markings along Chartres Street	Medium-term	$97,000		2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings
R5	R5-2	Enhance and potentially redesign Chartres Street to make it a safer and more attractive gateway into Downtown and the East End	Long-term	$5,700,000		2 - Address Barriers 5 - Reduce Safety Concerns	Creates a gateway into Downtown, EaDo, and the East End; improves attractiveness of local destinations; reduces traffic speeds; improves safety; improves pedestrian crossings

PEDESTRIAN & BICYCLING IMPLEMENTATION STRATEGY							
Improvement Opportunity	Project #	Project Description	Priority	Cost	Ease of Implementation	Goals Supported	Benefits
PB1	PB1-1	Implement pedestrian realm improvements on Navigation Boulevard, Sampson Street, and York Street	Short-term	$249,000		2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports East End Master Plan recommendations; supports transit facilities
PB1	PB1-2	Implement pedestrian realm improvements on the other Primary Corridors	Medium-term	$217,000		2 - Address Barriers 3 - Multimodal Trips	Improves mobility for pedestrians with consequential benefits to other modes; supports transit facilities
PB1	PB1-3	Implement pedestrian realm improvements on the Secondary Corridors	Long-term	$1,900,000		2 - Address Barriers 3 - Multimodal Trips	Improves local access between neighborhoods and primary corridors, including business-intense corridors and transit corridors
PB2	PB2-1	On-street bicycle facility improvements	Short-term	$116,000		2 - Address Barriers 3 - Multimodal Trips	Connects the Eastwood Transit Center, Harrisburg Light Rail Line, Harrisburg Rails-to-Trail, Columbia-Tap Bike Rails-to-Trail, and Buffalo Bayou bike trails; improves access to UH
PB2	PB2-2	Include bicycle facilities along Lockwood Drive when the road is reconstructed	Long-term	$500,000		2 - Address Barriers 3 - Multimodal Trips	Provides logical connection between Eastwood Transit Center, Harrisburg Light Rail, Harrisburg Rails-to-Trail, and Buffalo Bayou bike trails; if implemented during roadway reconstruction, costs would be minimized
PB2	PB2-3	Complete Buffalo Bayou trail network	Long-term	$580,000		2 - Address Barriers 3 - Multimodal Trips	Completing the trail system along Buffalo Bayou will provide a dedicated "bicycle highway" that is comfortable for all users between the East End, Downtown, and the Heights.
PB2	PB2-4	Pedestrian and bicyclist bridges over Buffalo Bayou	Long-term	$1,890,000		2 - Address Barriers 3 - Multimodal Trips	Will improve connectivity between the East End and the Fifth Ward; will support pedestrian- and bicycle-friendly development along Buffalo Bayou
PB2	PB2-5	Develop underpass designs at West Belt rail line to accommodate all levels of bicycle experience	Long-term	$2,440,000		2 - Address Barriers 3 - Multimodal Trips	Consideration of bicycle facilities on grade separations that are already proposed can leverage construction money to provide quality bicycle improvements
PB2	PB2-6	On-street bicycle improvements from Downtown/EaDo Livable Centers study and 5th Ward Special Districts study	Short-term	$344,000		2 - Address Barriers 3 - Multimodal Trips	Bicycle proposals from other projects tie into the existing bicycle network and facilities proposed in this report
PB2	PB2-7	Off-street bicycle improvements identified in Downtown/EaDo Livable Centers study	Medium-term	$760,000		2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities near Dynamo Stadium and other destinations
PB2	PB2-8	Off-street bicycle improvements identified in Fifth Ward Special Districts study	Long-term	$1,033,800		2 - Address Barriers 3 - Multimodal Trips	Provides family-friendly bike facilities to neighborhoods and schools north of Buffalo Bayou

Improvement Opportunity	Project #	Project Description	Priority	Cost	Ease of Implementation	Goals Supported	Benefits
PB3	PB3-1	Implement a signage and wayfinding program for the area using standard signage from the MUTCD	Short-term	$96,000		2 - Address Barriers 3 - Multimodal Trips	Low-cost option for improving bicycle access in the area; can encourage regional cohesion because of better ties between neighborhoods
PB3	PB3-2	Implement a district-branding signage and wayfinding program	Medium-term	$246,000		2 - Address Barriers 4 - Support Development	Can simultaneously offer direction to important destinations while also helping create an identifiable brand for the area

TRANSIT IMPLEMENTATION STRATEGY							
Improvement Opportunity	**Project #**	**Project Description**	**Priority**	**Cost**	**Ease of Implementation**	**Goals Supported**	**Benefits**
T1	T1-1	Develop Canal Street, Polk Street, and Sampson Street / York Street as priority transit corridors	Short-term	$379,000		2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
T1	T1-2	Develop Navigation Boulevard as a priority transit corridor	Medium-term	$99,000		2 - Address Barriers 3 - Multimodal Trips	Reinforces existing transit network; complements light rail construction; supports transit-oriented development
T2	T2-1	Support East End urban circulator implementation	Short-Medium-& Long-term	$0		2 - Address Barriers 4 - Support Develop-ment	Coordinates across projects for leverage and to minimize obstacles and disruption

DEVELOPMENT IMPLEMENTATION STRATEGY							
Improvement Opportunity	**Project #**	**Project Description**	**Priority**	**Cost**	**Ease of Implementation**	**Goals Supported**	**Benefits**
D1	D1-1	Add corridors to MTFP to support high level of connectivity	Short-term	$0		2 - Address Barriers 3 - Multimodal Trips	Enhances network connectivity and connection between East End and 5th Ward; supports coordination across future development, potentially creating value for impacted property owners
D1	D1-2	Create Parking Benefits Districts along St. Emanuel Street and Harrisburg Boulevard	Short-term	$0		2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area
D2	D2-2	Create Parking Benefits Districts along Navigation Boulevard, Canal Street, and Sampson Street as development warrants them	Medium-term	$0		2 - Address Barriers 3 - Multimodal Trips	Can capture value of public parking for reinvestment in the area
D2	D2-3	Create a Parking Management District in the East End/Third Ward and EaDo once development and parking demand warrants them	Medium-term	$0		2 - Address Barriers 3 - Multimodal Trips	Coordinated approach to parking that can satisfy parking needs with minimal parking infrastructure

Appendix A6. Public Engagement

To better understand the needs of the community, the study team developed and executed a stakeholder engagement approach that targeted input on plan goals, projects, implementation strategy and phasing. This was done in parallel with the other activities of the plan development and provided critical feedback on various phases of the plan. Our stakeholder engagement strategy was guided in consultation with our steering committee, which consisted of 15 members. Along with our steering committee, more than 50 local stakeholders were identified from among the business community, local elected officials, community non-profits and city departments.

Meetings took place on the following dates. All meetings took place at the Greater East End Management District Offices on Harrisburg Avenue in the study area.

October 31, 2011: Steering Committee Meeting

- Key Activities
  - Project Launch
  - Steering Committee and Team Introductions
  - Discussion of Project Goals

January 23, 2012: Steering Committee Meeting

- Key Activities
  - Review of Existing Conditions and Analysis Report
  - Refinement of Goals
  - Small Group Breakout Exercise to Brainstorm Potential Projects

March 26, 2012: Steering Committee Meeting and Stakeholder Open House

- Key Activities
  - Review of Conceptual Plan and Proposed Projects

June 25, 2012: Steering Committee Meeting and Stakeholder Open House

- Key Activities
  - Review of Implementation Plan, Project Costs and Priorities and Plan Refinement

Steering Committee (Primary Member is listed first followed by Alternates):

Greater East End Management District: Patrick Ezzell and Diane Schenke
City of Houston Public Works: Jeff Weatherford
City of Houston Planning Department: Michael Kramer, Marlene Gafrick, Amar Mohite and Sungmin Lee
Gulf Coast Rail District: Maureen Crocker
METRO: Larry Badon
TxDOT: Travis Milner and Joey Welch
H-GAC: Roland Strobel, Hans-Michael Ruthe, Chris VanSlyke, Heng Wang, and Dmitry Messen