

METRO Rapid University Corridor

**EVALUATION OF  
ALTERNATIVES TO  
LOCKWOOD ALIGNMENT**

April 5, 2023





## REVISION HISTORY

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1/23/23	0.0	All	Draft
2/28/23	1.0	All	Response to METRO comments
3/24/23	1.1	5, 10	Clarified descriptions of railroad facilities and ridership modeling
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## LIST OF ACRONYMS

ACRONYM	DEFINITION
ADA	Americans with Disabilities Act
BBP	Buffalo Bayou Partnership
BEB	Battery-Electric Bus
BRT	Bus Rapid Transit
CIP	Capital Improvement Program
CRC	Community Redevelopment Council
EJ	Environmental Justice
EPA	Environmental Protection Agency
FTA	Federal Transit Administration
GTFS	Google Transit Feed Specification
H-GAC	Houston-Galveston Area Council
IHWCA	Industrial and Hazardous Waste Corrective Action
LOS	Level of Service



<b>ACRONYM</b>	<b>DEFINITION</b>
LPST	Leaking Petroleum Storage Tanks
LRT	Gross Floor Area
METRO	Metropolitan Transit Authority of Harris County
MTFP	Major Thoroughfare and Freeway Plan
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
PST	Petroleum Storage Tanks
STOPS	Simplified Trips-On-Project Software
TIRZ	Tax Increment Reinvestment Zone
TOD	Transit-Oriented Development
TSP	Transit Signal Priority
TVM	Ticket Vending Machine
TxDOT	Texas Department of Transportation
UPRR	Union Pacific Railroad
VOMS	Vehicles Operated in Maximum Service
VRH	Vehicle Revenue-Hours
VRM	Vehicles Revenue-Miles

Prepared by





# 1 INTRODUCTION

The METRORapid University Corridor is a proposed METRORapid Bus Rapid Transit (BRT) line from Westchase Park & Ride to Tidwell Transit Center planned by the Metropolitan Transit Authority of Harris County (METRO). With dedicated bus lanes, over 40 stations, and connections to METRO's existing light rail (LRT) and BRT lines, the project will further the development of a high-frequency, high-capacity transit network across Houston.

Segments 4 and 5 of the project encompass the area between Eastwood Transit Center and Tidwell Transit Center. The conceptual alignment for the project, developed during planning for the *METRONext Moving Forward Plan* in the late 2010s, would run north from Eastwood Transit Center via Lockwood Drive to Tidwell Road, then turn west on Tidwell, north on Jensen Drive, and east on Turner Drive to reach Tidwell Transit Center. This alignment would intersect the METRORail Green Line and serve destinations including Fifth Ward/Denver Harbor Transit Center, Lyndon B. Johnson Hospital, Tidwell Transit Center, several high schools, and one Houston Community College campus. METRO used this alignment, shown in Figure 1 and Figure 2, to develop conceptual designs for the project that the agency presented to the public in December 2021 at a virtual open house and again in July 2022 at public meetings.

Although communities in Segments 4 and 5 were supportive of the project overall, some residents questioned Lockwood as the best road for the BRT guideway and recommended neighboring thoroughfares. METRO therefore evaluated several alternatives to reassess the best path for the project through Segments 4 and 5. This report presents the results of the analysis.

Following completion of the original analysis, METRO evaluated one further alternative at the request of Eastwood Civic Association. The results of this additional analysis are included here as Section 13.



Figure 1: Conceptual Alignment, Segment 4

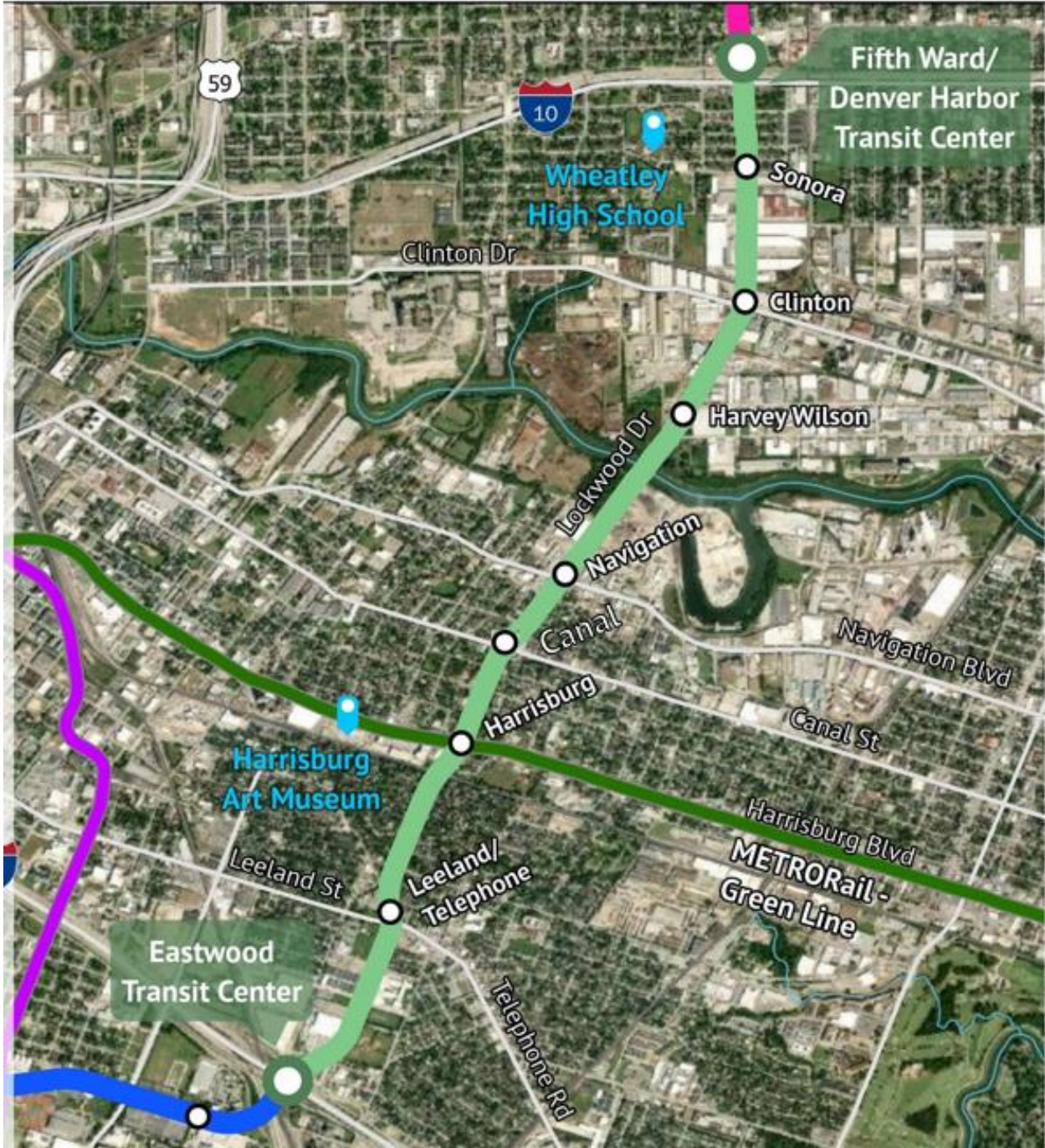
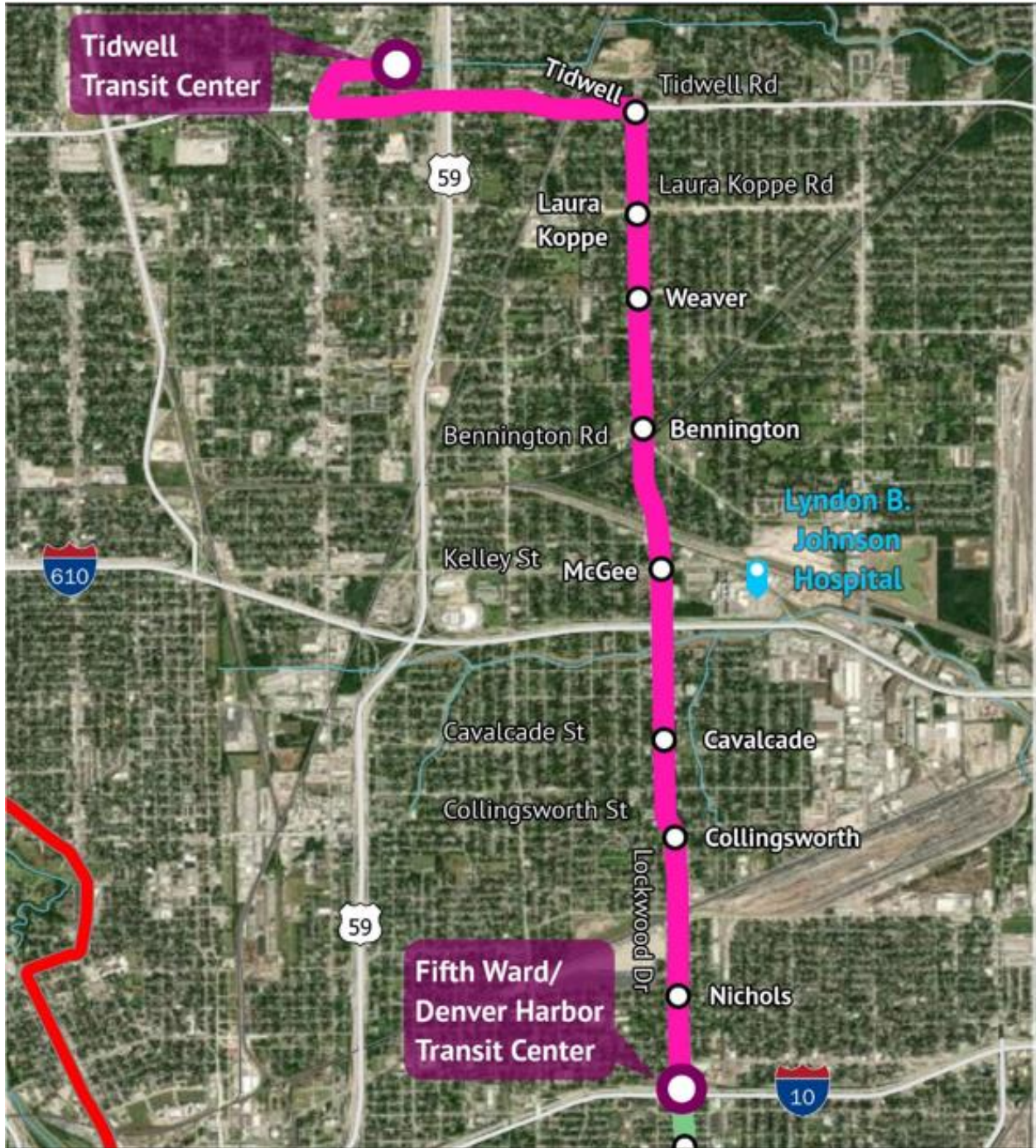


Figure 2: Conceptual Alignment, Segment 5



## 2 BACKGROUND

### 2.1 METRONext

#### 2.1.1 Public Engagement

METRO developed the Lockwood alignment based on an analysis of existing conditions and robust public engagement during the planning process for METRONext. From 2017 to 2019, METRO hosted dozens of public meetings about METRONext, of which five, listed in Table 1, were in communities along Lockwood.

*Table 1: METRONext Public Meetings near Lockwood Drive*

DATE	AUDIENCE	LOCATION
July 15, 2017	General Public	Kashmere Multiservice Center, 4802 Lockwood Dr, 77026
July 29, 2017	General Public	Magnolia Multiservice Center, 7037 Capitol St, 77011
August 10, 2017	General Public	Judson Robinson Senior Community Center, 1422 Ledwicke St, 77029
January 26, 2019	General Public	Fifth Ward Multiservice Center, 4014 Market St, 77020
February 2, 2019	General Public	Magnolia Multiservice Center, 7037 Capitol St, 77011

#### 2.1.2 Alternatives Analysis

##### 2.1.2.1 Alternatives Considered

During planning for METRONext, METRO identified three potential corridors for the University Corridor project:

- 1) Lockwood Drive (Lockwood Corridor)
- 2) Scott Street, Sampson/York Street, Hirsch Street (Hirsch Corridor)
- 3) Wayside Drive/ Sgt Macario Garcia Drive (Wayside Corridor)

##### 2.1.2.2 Roadway Network

These three options were considered because they were the only three corridors with contiguous routes from I-45 to the area north of I-10, crossing the major freeways (I-45, I-10, and I-610), Buffalo Bayou, and the major freight rail lines. All three corridors are thoroughfares per the City of Houston Major Thoroughfare & Freeway Plan (MTFP). Lockwood and Wayside are principal thoroughfares, all three have bridges over Buffalo Bayou, though the bridge at Hirsch is narrower than those to the east. The Wayside Corridor, also designated as US 90A, is a facility of the Texas Department of Transportation (TxDOT) and part of the Texas Highway Freight Network. Given the narrow width of the Hirsch bridge and Wayside's status as a freight corridor (which was not considered conducive to transit use), the existing roadway network pointed toward Lockwood as the preferred alignment.

### *2.1.2.3 Transit Connections*

One of METRO's goals was for the University Corridor to connect to Eastwood Transit Center after serving the University of Houston's main campus, facilitating connections to several local routes (including the 50 Harrisburg, 40 Telephone, and 80 MLK/Lockwood) and to regional express service along the Gulf Freeway between Downtown and Clear Lake. Eastwood Transit Center sits adjacent to Lockwood Drive, which becomes Elgin Street south of I-45. Using the Hirsch or Wayside Corridor would require a deviation to reach Eastwood Transit Center.

A similar condition exists where the three corridors cross I-10. Fifth Ward/Denver Harbor Transit Center is adjacent to Lockwood Drive and offers local bus service (including the 11 Almeda/Lyons, 28 OST Wayside, 48 Market) and express bus service (137 Northshore Express). Using the Hirsch or Wayside Corridor would require a 0.5- to 1.5-mile deviation to reach Fifth Ward/Denver Harbor Center.

Deviations to connect to the two transit centers would make the route longer and less direct while increasing the cost and complexity of providing transit connections along the BRT alignment. Because convenient connections between services are essential to providing a strong, useful transit network, connectivity considerations pointed toward Lockwood as the preferred alignment.

### *2.1.2.4 Existing Service*

All three corridors considered had (and have, discussed further below) existing local bus service—the 29 Cullen/Hirsch on the Hirsch Corridor, the 80 MLK/Lockwood on the Lockwood Corridor, and the 28 OST/Wayside and 78 Wayside on the Wayside Corridor. During planning for METRONext and prior to covid-19-related services changes, the 80 MLK/Lockwood was part of METRO's frequent network, operating at least every 15 minutes for most of the day, seven days per week. This higher frequency of service was based on the route's higher ridership, direct network connections to other routes, and major trip generators, which together could justify investments in improved services such as BRT.

The Hirsch Corridor and the Wayside Corridor, then and now, have lower local bus ridership than the Lockwood Corridor, with existing routes running every 30 minutes or 60 minutes. Because improving service where it would benefit more existing riders and support more future riders would be most the most cost-effective use of funds, service considerations pointed toward Lockwood as the preferred alignment.

### *2.1.2.5 Land Use/Destinations*

METRO considered the land uses and key destinations that would be served along each corridor. Lockwood would provide the most direct connection to LBJ Hospital, which is an important, high-ridership destination for Northeast Houston. While all three corridors would provide connections to planned development along Buffalo Bayou, most of that redevelopment is planned near Lockwood and Hirsch.

Hirsch would connect to Kashmere Transit Center, which serves several local routes. North of the transit center, however, Hirsch runs parallel to a freight rail corridor, which would limit connectivity and development potential. Wayside would provide useful connections to destinations such as Wal-Mart and Gus Wortham Park nearer to I-45. Similar to Hirsch, however, the northern stretch of Wayside is bordered by heavy industrial uses and rail yards, limiting demand, access to stations, and future development opportunities.



METRO determined all three corridors would benefit from improved transit service, which could better link destinations and catalyze development. Important connections, such as LBJ Hospital, and the lack of parallel freight rail lines or service yards were factors supporting the selection Lockwood as the preferred corridor.

### 2.1.3 Recommendation

Based on the above criteria, METRO selected the Lockwood Corridor as the preferred alignment for the University Corridor from I-45 to Tidwell Transit Center. The Lockwood alignment was included in the METRONext plan approved by a supermajority of voters in November 2019

## 2.2 Conceptual Development

In 2021, as METRO began conceptual development for the University Corridor, the agency introduced the project, with the Lockwood alignment to stakeholders such as the East End Management District and the Fifth Ward Community Redevelopment Corporation. METRO then produced conceptual design plans to 10-percent completion in November 2021 and to 15-percent completion in June 2022. In July 2022, METRO presented the 15-percent designs to the public and continued to engage stakeholders throughout the fall. Table 2 lists the meetings METRO held with stakeholders and the public in Segments 4 and 5 of the project between June 2021 and September 2022.

*Table 2: University Corridor Stakeholder and Public Meetings, Segments 4 and 5, 2021-2022*

DATE	AUDIENCE	LOCATION
June 2, 2021	East Aldine District	Zoom
June 8, 2021	East End Management District	Zoom
June 14, 2021	Fifth Ward Community Redevelopment Corporation	Zoom
November 30, 2021	Northeast Houston Community Leaders	Zoom
December 2021	General Public (Virtual Open House)	METRO Website
February 1, 2022	Greater Northside Management District CIP Committee	Zoom
February 7, 2022	Lyndon B. Johnson Hospital	Zoom
April 4, 2022	Eastwood Civic Association	Zoom
June 14, 2022	Kashmere Gardens Super Neighborhood	Zoom
June 28, 2022	Trinity/Houston Gardens Super Neighborhood	Zoom
July 13, 2022	General Public, Segment 4	BakerRipley Ripley House, 4410 Navigation Blvd, 77011
July 14, 2022	General Public, Segment 4	HCC - Felix Fraga Campus 301 N Drennan Street, 77003
July 16, 2022	General Public, Segment 5	Hester House, 2020 Solo, 77020

DATE	AUDIENCE	LOCATION
July 21, 2022	General Public, Segment 5	Northeast Multi-Service Center 9720 Spaulding Street, 77016
July 25, 2022	General Public	METRO Website
August 1, 2022	Second Ward Super Neighborhood	BakerRipley Ripley House 4410 Navigation, 77011
August 10, 2022	Eastwood Civic Association	METRO, 1900 Main St, 77002
August 15, 2022	Oaklawn/Fullerton Civic Club	La Voz del Salvador Church 214 Adams St, 77011
September 26, 2022	Harrisburg TIRZ	East End Management District 3211 Harrisburg Blvd, 77003

The 2022 public meetings revealed some public skepticism of the proposed alignment and generated suggestions for alternatives to Lockwood. Homestead, Wayside, and Jensen were all proposed as options. In response, METRO reexamined the Lockwood alignment, evaluating four additional alignments based on public feedback and existing bus service.

### 3 ALTERNATIVES STUDIED

#### 3.1 Assumptions

In assessing alternatives to Lockwood, METRO assumed several constants: 1) as elsewhere in the project, BRT vehicles would have exclusive guideway, 2) service levels would be equivalent to other areas of the project, and 3) alternatives would connect Eastwood Transit Center to Tidwell Transit Center. METRO did not study alternative termini to Tidwell Transit Center because Tidwell was seen as the best option to meet the goals of the project and METRONext. The site offers the potential for future connections to regional express service via a director connector to the US-59/I-69 high-occupancy vehicle lane, as well as sufficient space for transit-oriented development (TOD). METRO recently issued a request for information to developers to gauge interest in TOD at the site, and METRO received a nearly \$500,000 grant from the Federal Transit Administration in 2022 to conduct a planning study for TOD at Tidwell Transit Center. The study will begin in 2023.

#### 3.2 Physical Constraints

Buffalo Bayou, numerous freight rail lines, and an inconsistent street grid mean there are few continuous north-south roadways between Eastwood Transit Center and Tidwell Transit Center. Between Downtown and the East Loop (I-610), only four roadways cross Buffalo Bayou: Jensen Drive, Hirsch Road, Lockwood Drive, and Wayside Drive/S. Sgt. Macario Garcia Drive (US 90A). The same four roadways also cross several east-west rail lines, while other north-south roadways such as Lathrop Street and Homestead Road do not.

#### 3.3 Five Alternatives

Given the limited choices for getting from Eastwood to Tidwell, then, METRO assessed four alternatives to Lockwood: Jensen, Hirsch, Homestead via Lockwood and Kelley Street, and Wayside.

These alternatives, as well as the conceptual alignment on Lockwood, are shown in Figure 3 and Figure 4 and described below. Alternatives are presented from west to east throughout this report.

Figure 3: Alternatives Studied, Segment 4

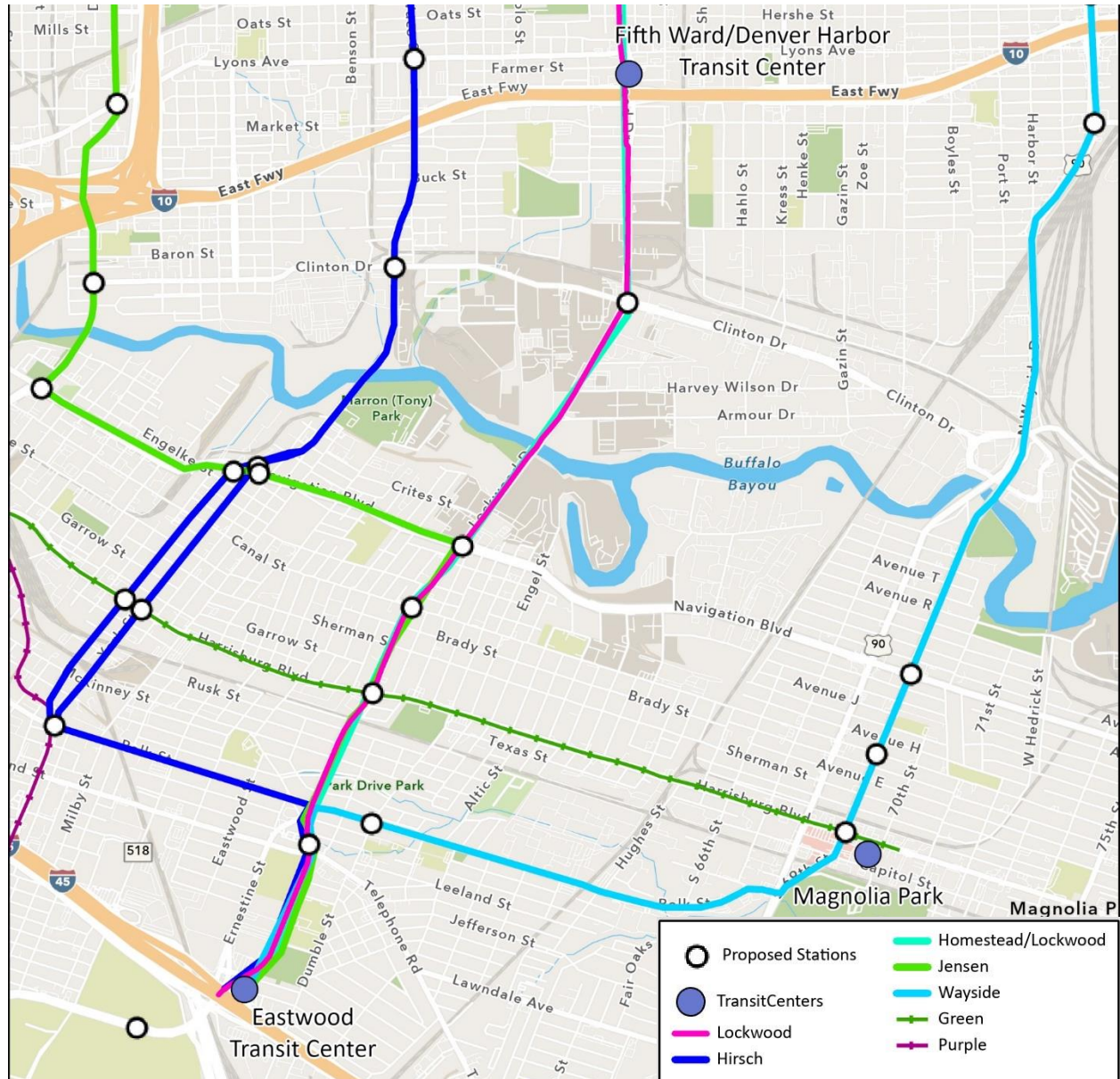
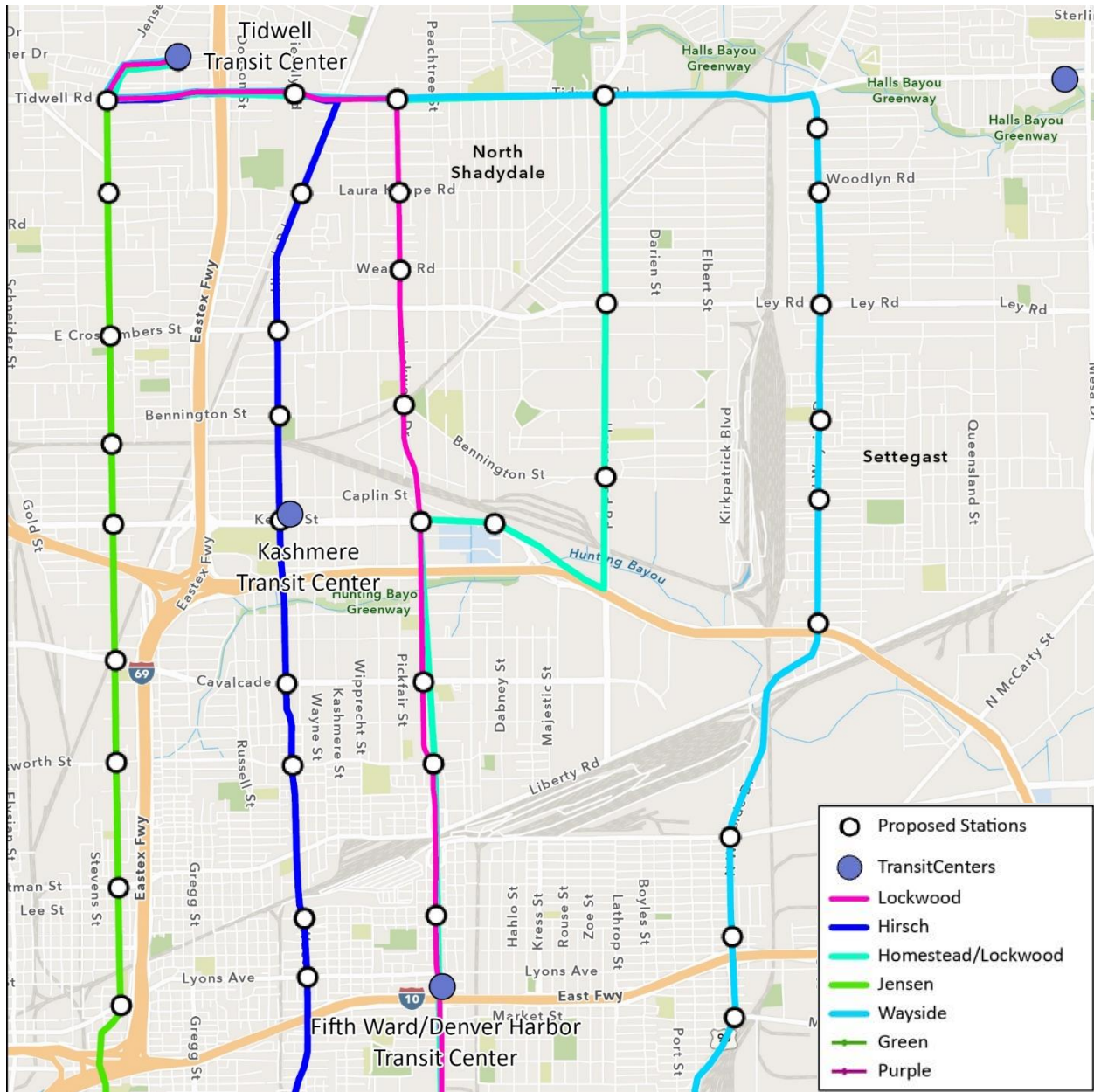


Figure 4: Alternatives Studied, Segment 5



### 3.3.1 Jensen

The Jensen alignment would run north on Lockwood Drive, west on Navigation Boulevard, north on Jensen Drive, and east on Turner Drive, for a total of approximately 10.1 miles. Table 3 lists the stations assumed for this analysis:



*Table 3: Jensen Alignment Proposed Stations*

<b>STREET</b>	<b>CROSS STREET</b>
Eastwood Transit Center	N/A
Lockwood	Leeland/Telephone
Lockwood	Harrisburg
Lockwood	Canal
Lockwood	Navigation
Navigation	York
Navigation	Jensen
Jensen	Clinton
Jensen	Lyons
Jensen	Quitman
Jensen	Collingsworth
Jensen	Cavalcade
Jensen	Kelley
Jensen	Bennington
Jensen	Crosstimbers
Jensen	Laura Koppe
Jensen	Tidwell
Tidwell Transit Center	N/A

### 3.3.2 Hirsch

The Hirsch alignment would run north on Lockwood Drive, west on Polk Street, and north on York Street, which becomes Hirsch Road at Buffalo Bayou. The alignment would continue north to Tidwell Road, where it would turn west on Tidwell, north on Jensen, and east on Turner, for a total of approximately 11.3 miles. Note that while Hirsch Road is named Waco Street and Broyles Street in certain areas, the road is continuous. Along the York/Sampson couplet, this analysis assumes that northbound vehicles would run on York Street and southbound vehicles would run on Sampson Street, but this decision would be finalized in a later phase of planning. Table 4 lists the stations assumed for this analysis:

*Table 4: Hirsch Alignment Proposed Stations*

<b>STREET</b>	<b>CROSS STREET</b>
Eastwood Transit Center	N/A
Lockwood	Leeland/Telephone
Polk	York
Sampson/York	Harrisburg
Sampson/York	Navigation
Hirsch	Clinton
Waco (Hirsch)	Lyons
Waco (Hirsch)	Nichols

<b>STREET</b>	<b>CROSS STREET</b>
Broyles (Hirsch)	Collingsworth
Hirsch	Cavalcade
Hirsch	Kelley (Kashmere Transit Center)
Hirsch	Bennington
Hirsch	Crosstimbers
Hirsch	Laura Koppe
Tidwell	Friendly
Tidwell Transit Center	N/A

### 3.3.3 Lockwood

The Lockwood alignment is the conceptual alignment presented to the public in July 2022. It would run north on Lockwood Drive, west on Tidwell Road, north on Jensen Drive, and east on Turner Drive, for a total of approximately 10.8 miles. Table 5 lists the stations assumed for this analysis:

*Table 5: Lockwood Stations*

<b>STREET</b>	<b>CROSS STREET</b>
Eastwood Transit Center	N/A
Lockwood	Leeland/Telephone
Lockwood	Harrisburg
Lockwood	Canal
Lockwood	Crites (Marron Park)
Lockwood	Harvey Wilson
Lockwood	Clinton
Lockwood	Sonora
Lockwood	Lyons (Denver Harbor Transit Center)
Lockwood	Nichols
Lockwood	Collingsworth
Lockwood	Cavalcade
Lockwood	Kelley (LBJ Hospital)
Lockwood	Bennington
Lockwood	Weaver
Lockwood	Laura Koppe
Lockwood	Tidwell
Tidwell Transit Center	N/A

### 3.3.4 Homestead

The Homestead alignment would follow the Lockwood alignment until Kelley Street, where it would turn east. It would then run north on Homestead Road, west on Tidwell Road, north on Jensen Drive, and east on Turner Drive, for a total of approximately 13.8 miles. To connect from Kelley to

Homestead, this analysis assumes that the BRT lanes would be constructed in right-of-way parallel to I-610, but this is a decision that would be finalized in a later phase of planning. Table 6 lists the stations assumed for this analysis:

*Table 6: Homestead Stations*

<b>STREET</b>	<b>CROSS STREET</b>
Eastwood Transit Center	N/A
Lockwood	Leeland/Telephone
Lockwood	Harrisburg
Lockwood	Canal
Lockwood	Navigation
Lockwood	Harvey Wilson
Lockwood	Clinton
Lockwood	Sonora
Lockwood	Lyons (Denver Harbor Transit Center)
Lockwood	Nichols
Lockwood	Collingsworth
Lockwood	Cavalcade
Kelley	LBJ Hospital
Homestead	Bennington
Homestead	Crosstimbers
Tidwell	Homestead
Tidwell	Lockwood
Tidwell Transit Center	N/A

### 3.3.5 Wayside

The Wayside alignment would run north on Lockwood Drive, east on Polk Street, north on S. Sgt. Macario Garcia Drive (US 90A), north on Wayside Drive, west on Tidwell Road, north on Jensen Drive, and east on Turner Drive, for a total of approximately 14.8 miles. Along the S. Sgt. Macario Garcia Drive/Wayside couplet, this analysis assumes that both directions of BRT lanes would run on S. Sgt. Macario Garcia Drive and that southbound Wayside Drive would be converted to a two-way roadway. This approach is the same as METRO is currently proposing for the Lockwood/Ernestine couplet near Eastwood Transit Center. However, this is a decision that would be made in a later phase of planning following traffic analysis. Table 7 lists the stations assumed for this analysis:

*Table 7: Wayside Alignment Proposed Stations*

<b>STREET</b>	<b>CROSS STREET</b>
Eastwood Transit Center	N/A
Polk	Dumble
Wayside	Harrisburg
Wayside	Canal
Wayside	Navigation

STREET	CROSS STREET
Wayside	Market
Wayside	Wallisville
Wayside	Waxahatchie
Wayside	Rand
Wayside	Kenton
Wayside	Sunbury
Wayside	Ley
Wayside	Laura Koppe
Wayside	Snowden
Tidwell	Homestead
Tidwell	Lockwood
Tidwell Transit Center	N/A

### 3.4 Assessment

This report is a planning-level assessment of the five alternatives identified. The following areas were studied. Methodology and results are described below.

- Existing plans
- Existing transportation infrastructure
- Land use
- Population and employment
- Environmental constraints
- Right-of-way
- Operations
- Ridership forecasts
- Operating and maintenance costs
- Capital costs

## 4 EXISTING PLANS

This section describes previous studies and plans conducted in Segments 4 and 5 of the project and presents a selection of development projects underway in the area. This list is not comprehensive but is intended to convey the focus of current planning and development efforts in neighborhoods that would be served by the five alternatives.

### 4.1 Community Planning Efforts

#### 4.1.1 Complete Communities

Complete Communities is an equitable development initiative launched by Mayor Sylvester Turner in 2017. The City of Houston has designated ten neighborhoods as Complete Communities, which will be prioritized for capital improvements. The Jensen, Hirsch, Lockwood, and Homestead alternatives would each serve two Complete Communities—Second Ward and Kashmere Gardens—albeit different areas of each. The University Corridor would be compatible with plans for both

communities. In terms of mobility, the Second Ward Action Plan prioritizes roadway improvements and safety at railroad crossings;<sup>1</sup> the Kashmere Gardens Action Plan prioritizes street and sidewalk repairs to improve mobility and drainage improvements to mitigate chronic flooding.<sup>2</sup> The Wayside alternative would serve one Complete Community, Magnolia Park-Manchester. That community's Action Plan prioritizes pedestrian improvements and more comprehensive METRO bus service.<sup>3</sup> Any of the five alternatives therefore has the potential to help meet the City of Houston's goals for these areas.

#### 4.1.2 Live/Viva Greater Eastwood: A Livable Centers Study

Published in 2021, *Live/Viva Greater Eastwood* was developed with the Lockwood alignment for the University Corridor in mind.<sup>4</sup> The plan presents an assessment of areas with TOD potential and a potential site plan for TOD around Eastwood Transit Center. All five alternatives would serve the study area.

#### 4.1.3 Fifth Ward/Buffalo Bayou/East End Livable Centers Study

The *Fifth Ward/Buffalo Bayou/East End Livable Centers Study*, published in 2014, covers the area bounded approximately by Lyons Avenue on the north, Lockwood Drive on the east, Harrisburg Boulevard on the south, and Sampson/York/Hirsch Street on the west.<sup>5</sup> The plan includes recommendations for spurring redevelopment of former industrial properties, improving the inconsistent street grid in the area, and installing bike lanes on Lockwood Drive, Clinton Drive, Schweikhardt Street, Dick Street, Foley Street, Milby Street, and Sampson/York/Hirsch Street. The Hirsch, Lockwood, and Homestead alternatives would serve the study area.

#### 4.1.4 East End Bike Plan

In August 2021, Harris County Precinct 2 adopted the *East End Bike Plan*, which lays out a three-phase strategy for creating a bike network across the area.<sup>6</sup> Phase 1 will create bike lanes on major arteries, including Lockwood Drive, Leeland Street, and Navigation Boulevard. Also identified are

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<sup>1</sup> Second Ward Complete Communities Action Plan (2018), [https://www.houstoncc.org/our\\_communities/second\\_ward/index.php](https://www.houstoncc.org/our_communities/second_ward/index.php), accessed 1/18/2023.

<sup>2</sup> City of Houston, *Kashmere Gardens Complete Communities Action Plan* (2020), [https://www.houstoncc.org/our\\_communities/kashmere\\_gardens/index.php](https://www.houstoncc.org/our_communities/kashmere_gardens/index.php), accessed 1/18/2023.

<sup>3</sup> Magnolia-Park Manchester Complete Communities Action Plan (2020) [https://cms7files.revize.com/ldrhoustoncctx/Our%20Communities/Magnolia%20Park%20CC-MPMH\\_ActionPlan.pdf](https://cms7files.revize.com/ldrhoustoncctx/Our%20Communities/Magnolia%20Park%20CC-MPMH_ActionPlan.pdf), accessed 1/18/2023.

<sup>4</sup> East End District and Houston-Galveston Area Council (H-GAC), *Greater Eastwood Livable Centers Study* (2021), <https://www.h-gac.com/getmedia/b1670d2c-1651-4cb0-b89a-43377c59e702/6-2-2021-Live-Viva-Greater-Eastwood-LCS-Reduced>, accessed 1/18/2023.

<sup>5</sup> H-GAC, *Fifth Ward/Buffalo Bayou/East End Livable Centers Study* (2014), <https://www.h-gac.com/livable-centers/planning-studies/fifth-ward-buffalo-bayou-east-end>, accessed 1/19/2023.

<sup>6</sup> Harris County Precinct 2, *East End Bike Plan* (2021), <https://hcp2.com/Portals/53/Documents/East-End-Bike-Plan.pdf?ver=r5pu7xOxwiNABOo07xsk00%3d%3d>, accessed 1/19/2023.

locations for new bike-share stations, which the plan says will "set the stage for future investments like the METRORail Green Line extension and the University Line Bus Rapid Transit [Line] along Lockwood Drive." In addition, the plan recommends the City of Houston designate at least three major corridors as Walkable Places. Lockwood Drive, Lawndale Street, Telephone Road, and Navigation Boulevard are prioritized for this treatment. All five alternatives would serve the study area.

#### 4.1.5 Kashmere Gardens Livable Centers Study

The *Kashmere Gardens Livable Centers Study*, published in 2015, recognizes that Kashmere Gardens' major roadways are designed to move much more automobile traffic than currently exists, or is likely to exist in the short-to-medium term. The plan recommends transforming thoroughfares such as Lockwood Drive, Cavalcade Street, Hirsch/Broyles/Altoona/Waco Streets, Collingsworth Street, Gregg Street, and Jensen Drive into Complete Streets by reallocating excess roadway space from exclusive use for automobiles to use by cyclists, pedestrians, and transit riders. The study also identifies railroads as a major barrier to mobility and recommends new and improved grade separations for cars and pedestrians. The Jensen, Hirsch, Lockwood, and Homestead alternatives would serve the study area.<sup>7</sup>

## 4.2 Site Planning

### 4.2.1 LBJ Hospital Master Plan

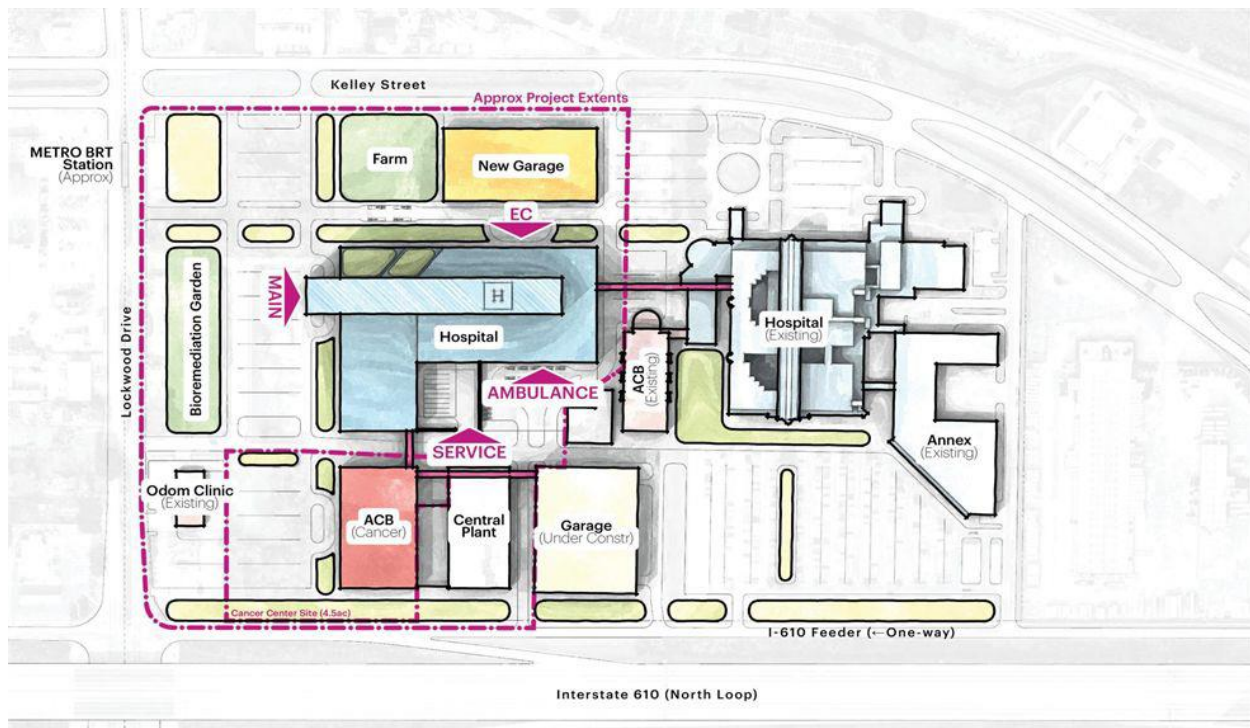
Harris Health System, which manages Harris County's public hospitals, has developed a master plan for the expansion of Lyndon B Johnson (LBJ) Hospital by 2028.<sup>8</sup> Today, the hospital sits south of Kelley Street approximately a quarter mile east of Lockwood Drive. The 1.2 million square-foot expansion would extend the hospital campus westward to Lockwood, adding a new hospital building, a central plant, a new parking structure, two bridge connectors, and an ambulatory care building (see Figure 5). The master plan includes a University Corridor station near Lockwood and Kelley, as Lockwood was the assumed alignment when the plan was developed. The Lockwood and Homestead alternatives are compatible with the incorporation of a BRT station into the campus master plan.

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<sup>7</sup> H-GAC, *Kashmere Gardens Livable Centers Study* (2015), <https://www.h-gac.com/getmedia/4fe5999f-707a-4b1e-88a4-f9a8f8161bef/Kashmere-Gardens-LC-Final.pdf>, accessed July 22, 2022.

<sup>8</sup> Harris Health System, Meeting of the Board of Trustees, October 27, 2022, [https://www.harrishealth.org/about-us-hh/board/Documents/2022/Board%20Documents/Packet/10.27.22\\_non\\_confidential\\_board\\_packet.pdf](https://www.harrishealth.org/about-us-hh/board/Documents/2022/Board%20Documents/Packet/10.27.22_non_confidential_board_packet.pdf), accessed January 19, 2023.

Figure 5: LBJ Hospital Master Plan 2028



Harris Health System

#### 4.2.2 Buffalo Bayou East Master Plan

Buffalo Bayou Partnership (BBP) is a nonprofit organization focused on the redevelopment and stewardship of Houston's central waterway. The recently adopted *Buffalo Bayou East Master Plan* calls for mobility improvements and new development along the bayou from Downtown eastward to the Turning Basin.<sup>9</sup> As of 2023, work has begun on an affordable housing development called Lockwood South on BBP-owned land at Lockwood and Buffalo Bayou (see Figure 6). This project includes a new street, Marron Park Way, connecting North York Street to Lockwood Drive. The 10-year plan for the bayou also includes new trails across the entire length of the bayou, meaning that all the alternatives studied in this report would benefit from planned improvements to walking and biking infrastructure in the area. In addition, BBP is working with the City of Houston to convert existing lanes on Navigation Boulevard into an on-street greenway wide enough to be a transportation path and a linear park.

<sup>9</sup> Buffalo Bayou Partnership, *Buffalo Bayou East Master Plan*, <https://buffalobayou.org/our-vision/buffalo-bayou-east/>, accessed July 9, 2022.

Figure 6: Lockwood South Concept



Buffalo Bayou Partnership

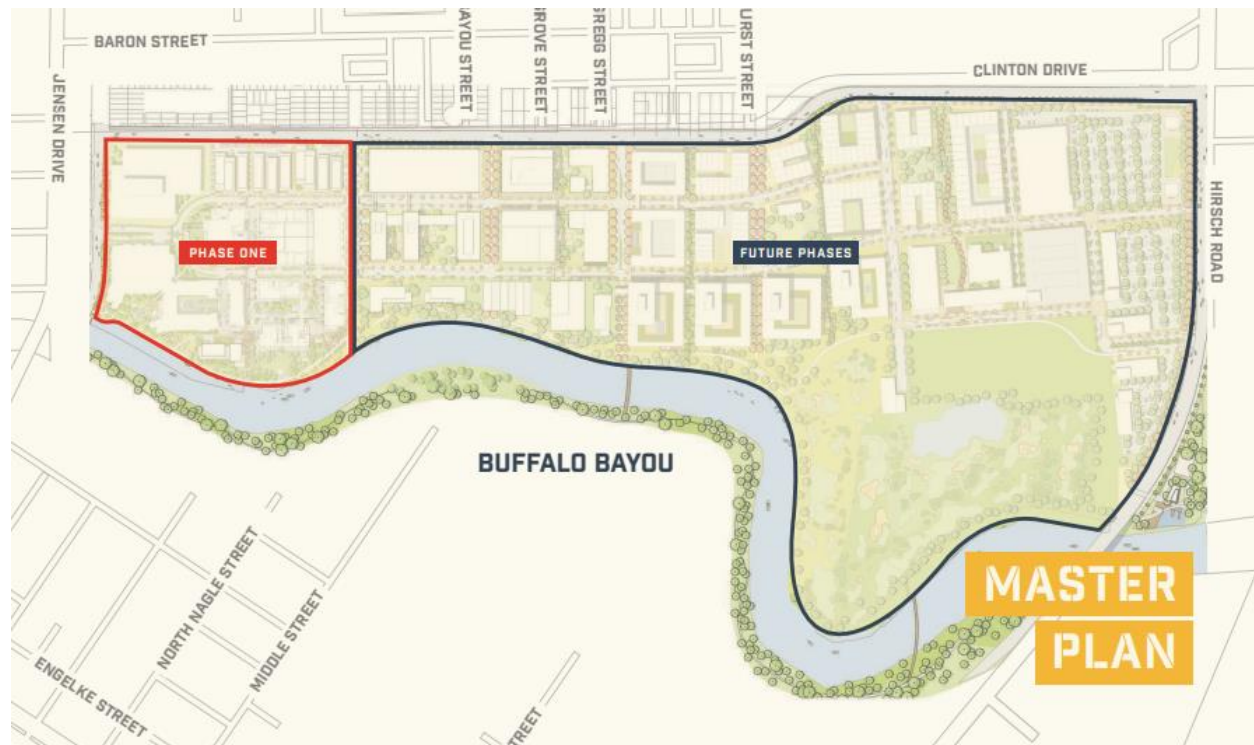
## 4.3 Upcoming Affordable Housing Developments

### 4.3.1 East River

East River is a new multiuse development that will redevelop a 150-acre former industrial site into mixed-income apartments, office space, retail, green space, and a new home for the Houston Maritime Museum. The development will ultimately span the area bounded by Jensen, Clinton, Hirsch, and Buffalo Bayou (see Figure 7). The site would best be served by the Jensen and Hirsch alternatives.



Figure 7: East River Master Plan



Midway

#### 4.3.2 800 Middle Street

Houston Housing Authority is developing up to 900 units of mostly affordable housing at 800 Middle Street, a 26-site in the East End (see Figure 8), funded in part by low-income housing tax credits and Section 8 project-based vouchers.<sup>10</sup> The site would best be served by the Jensen and Hirsch alternatives.

<sup>10</sup> Houston Housing Authority, *Master Plan for 800 Middle Street*, <https://www.houstontx.gov/council/h/affordable-housing/EADO-800-Middle-Additional.pdf>; accessed January 19, 2023; Jasper Scherer, *Houston Chronicle*, April 14, 2021, <https://www.houstonchronicle.com/news/houston-texas/housing/article/Houston-council-approves-East-End-affordable-16100730.php>, accessed January 19, 2023.

Figure 8: 800 Middle Street Master Plan



City of Houston

### 4.3.3 Scott Street Lofts

Scott Street Lofts, shown in Figure 9, is a 123-unit, mixed-income community for seniors currently under construction.<sup>11</sup> Already strategically placed near the METRORail Purple Line, the development would also be served by the Hirsch alternative.

<sup>11</sup> City of Houston Housing and Community Development Department, Harvey Multifamily Program, <https://recovery.houstontx.gov/multifamily/>, accessed January 19, 2023.

Figure 9: Scott Street Lofts



*FDI Management Group*

#### 4.3.4 Saint Elizabeth Place

Saint Elizabeth Place, located on Lyons Avenue between Hirsch and Lockwood, is a former hospital currently being converted to mixed-income apartments (see Figure 10).<sup>12</sup> The project is the result of a collaboration between Fifth Ward Community Redevelopment Corporation (CRC), the City of Houston, and the US Department of Housing and Urban Development. The Hirsch and Lockwood alternatives would best serve this site.

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<sup>12</sup> City of Houston Housing and Community Development Department, “St. Elizabeth Place Breathes New Life Into Historic Fifth Ward Hospital,” September 24, 2021 <https://recovery.houstontx.gov/st-elizabeth-place-breathes-new-life-into-historic-fifth-ward-hospital/>, accessed January 19, 2023.

*Figure 10: Saint Elizabeth Place Concept*



*Fifth Ward Community Redevelopment Corporation*

#### **4.3.5 W. Leo Daniels Tower**

W. Leo Daniels Tower, an existing affordable housing development, is being renovated into a 100-unit, entirely affordable community for seniors in the Eastex/Jensen Area (see Figure 11).<sup>13</sup> The renovation will modernize the facility and ensure it remains affordable for several decades. The Jensen alternative would best serve this redevelopment.

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<sup>13</sup> City of Houston Housing and Community Development Department, “W. Leo Daniels Tower to Bring Refreshed Apartments to Northside Neighborhood,” October 6, 2021, <https://www.houstontx.gov/citizensnet/2021/DanielsTower20211014.html>, accessed January 19, 2023.

Figure 11: W. Leo Daniels Tower



Google

## 5 EXISTING TRANSPORTATION INFRASTRUCTURE

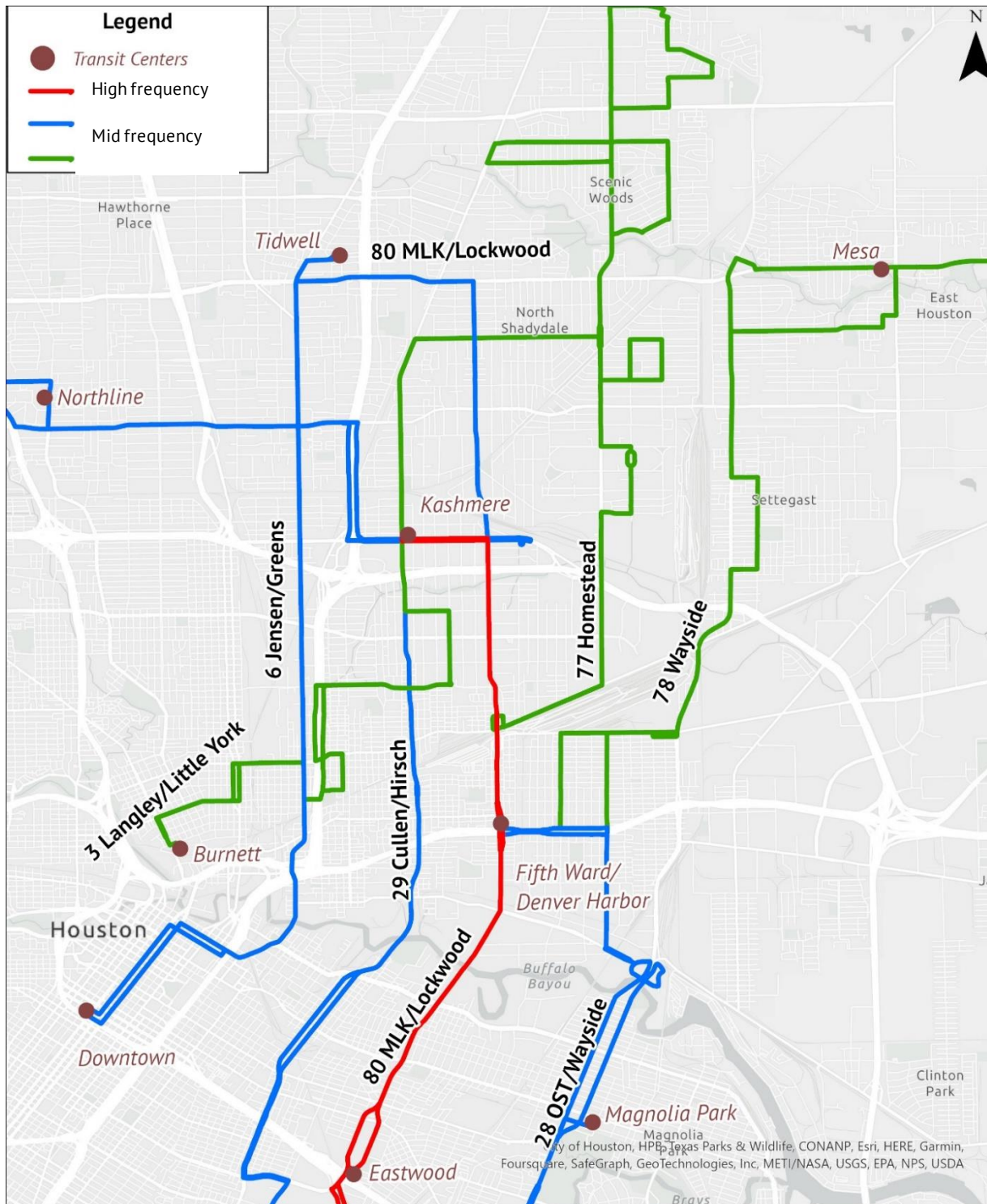
This section describes existing transit, roadway, and railroad facilities in the areas served by the five alternatives. In addition, numerous bikeways are proposed across the proposed alignments, but bike and pedestrian infrastructure were not considered independently, as there is little to distinguish one alternative from another by these features.

### 5.1 Transit Service

METRO currently operates several bus routes on Jensen, Hirsch, Lockwood, Homestead, and Wayside, as shown in Figure 12. The 80 MLK/Lockwood operates on nearly the same route as the proposed Lockwood alternative for the University Corridor, though with jags to Kashmere Transit Center and LBJ Hospital. Before the covid-19 pandemic, the 80 MLK/Lockwood was part of METRO's frequent network, with headways of 15 minutes or less all day. METRO has decreased service slightly in the past several years. Other major north-south routes are the 6 Jensen/Greens, 28 OST/Wayside, and 29 Cullen/Hirsch, which have 20- to 30-minute headways. The 3 Langley/Little York runs every 45 minutes, and the 77 Homestead and 78 Wayside run hourly. In addition to these routes, METRO

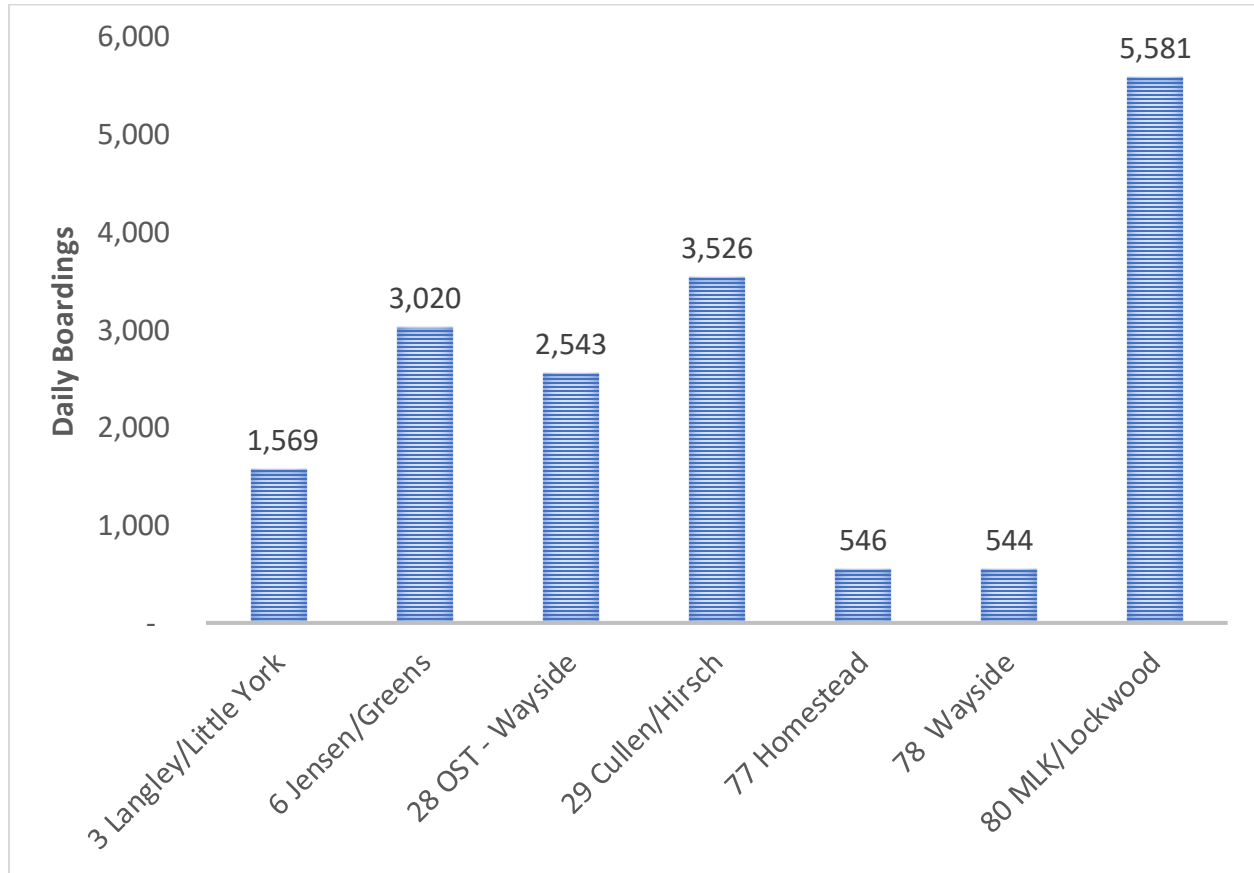
operates the Kashmere Late-Night curb2curb service between 8:00 PM and 12:00 AM to transport passengers within a certain zone to and from Kashmere Transit Center.

Figure 12: Existing Transit Service, Select North-South Routes



Of the seven routes shown here, the 80 MLK/Lockwood has the highest ridership, with about 5,600 daily boardings in October 2019, followed by the 29 Cullen/Hirsch, 6 Jensen/Greens, and 28 OST-Wayside.<sup>14</sup> As shown in Figure 13, the three less frequent routes have significantly lower ridership.

Figure 13: October 2019 Ridership, Select Routes



METRO

In addition to these key north-south routes, over 20 other bus routes cross the area bounded approximately by the Gulf Freeway (I-45) to the south, Jensen to the west, Tidwell to the north, and Wayside to the east. Of the five alternatives studied in this report, the Lockwood alignment would intersect the most existing routes, 22, followed by the Homestead alignment, as shown in Table 8.

Table 8: Intersecting Bus Routes

ROUTE	NAME	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
3	Langley-Little York	^	^	^	^	^
6	Jensen/Greens	^	^	^	^	^
11	Gulfton/Holman	^	^	^	^	^

<sup>14</sup> 2019 ridership numbers are cited because 2019 data were used to prepare the ridership forecasts discussed later in this report. This approach is consistent with federal guidance for ridership forecasting for major capital projects.

ROUTE	NAME	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
20	Canal/Memorial	^	^	^	^	^
25	Richmond	^	^	^	^	^
26	Long Point/Cavalcade	^				
28	OST-Wayside			^	^	^
29	Cullen/Hirsch		^			
30	Clinton/Ella	^	^	^	^	^
36	Kempwood	^	^			
38	Manchester-Lawndale					^
40	Telephone/Heights	^	^	^	^	^
41	Kirby/Polk	^	^	^	^	^
45	Tidwell	^	^	^	^	^
48	Market	^	^	^	^	^
50	Broadway	^	^	^	^	^
51	Hardy-Kelley	^	^	^		
52	Hardy-Ley	^	^	^	^	^
66	Quitman	^	^	^	^	
76	Evergreen					^
77	Homestead			^	^	^
78	Wayside			^	^	^
80	MLK/Lockwood		^	^	^	
83	Lee Road-JFK	^	^	^	^	^
97	Settegast		^	^	^	^
137	Northshore Express			^	^	
244	Monroe/El Dorado P&R	^	^	^	^	^
	<b>TOTAL</b>	<b>18</b>	<b>20</b>	<b>22</b>	<b>21</b>	<b>20</b>

METRO

## 5.2 Roadways

The City of Houston’s MTFP categorizes streets into one of five categories: principal thoroughfare, thoroughfare, major collector, minor collector, and local street, in order of greatest traffic volume to least. Of the north-south streets considered in this analysis, all are classified as thoroughfares. Lockwood is considered a principal thoroughfare between the Gulf Freeway (I-45) and the North Loop (I-610), and Wayside is considered a principal thoroughfare between the Gulf Freeway and Market Street. See the MTFP for more information on how streets are classified.<sup>15</sup>

<sup>15</sup> <https://www.houstontx.gov/planning/transportation/MTFP.html>, accessed January 19, 2023.



### 5.3 Railroads

Numerous freight rail lines, all owned by Union Pacific Railroad (UPRR), crisscross the area covered by the five alternatives, as shown in Figure 14. Of the five alternatives studied, Jensen has the fewest railroad crossings and Wayside the most. Lockwood has the lowest proportion of existing grade separations to total railroad crossings (see Table 9).

Figure 14: Alternatives, Freight Rail Lines, and Active Crossings

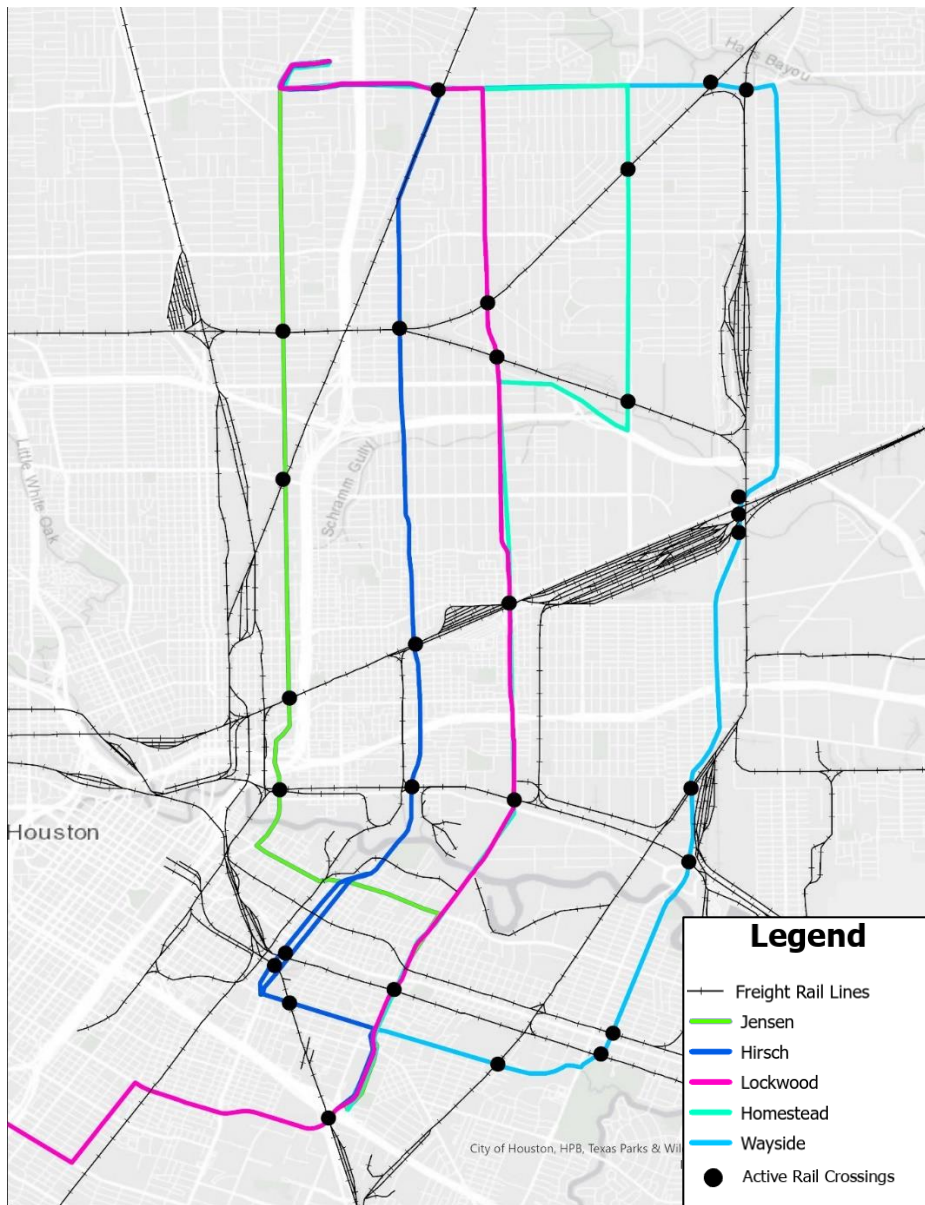


Table 9: Summary of Railroad Crossings

ALTERNATIVE	TOTAL GRADE CROSSINGS	EXISTING GRADE SEPARATIONS	POTENTIAL NEW GRADE SEPARATIONS
Jensen	4	2	2
Hirsch	7	3	4
Lockwood	6	2	4
Homestead	6	3	3
Wayside	11	8	3

The Jensen alignment would cross four freight rail lines, listed in Table 10. Two of the four are currently grade-separated.

Table 10: Jensen Alignment Railroad Crossings

STREET	CROSS STREETS	STATUS
Lockwood	Rusk and Harrisburg	New
Jensen	Brooks and Mills	Existing Underpass
Jensen	Vintage	New
Jensen	Creston and Lynnfield	Existing Underpass

The Hirsch alignment would cross seven freight rail lines, listed in Table 11. Three of the seven are currently grade-separated.

Table 11: Hirsch Alignment Railroad Crossings

STREET	CROSS STREETS	STATUS
Polk	East of Milby	Existing Underpass
Sampson/York	Between McKinney and Rusk	New
Sampson/York	Between Rusk and Capitol	New
Hirsch	North of Baron	New
Waco (Hirsch)	Between Lee and Quitman	Existing Overpass
Hirsch	Between King and Lumber	Existing Overpass
Tidwell	Between Hirsch and Lundy	New

The Lockwood alignment would cross six freight rail lines, listed in Table 12. Two of the six are currently grade-separated.

Table 12: Lockwood Railroad Crossings

STREET	CROSS STREETS	STATUS
Lockwood	Between Rusk and Capitol	New
Lockwood	North of Clinton	New
Lockwood	North of Wallisville (Englewood Yard)	Existing Overpass
Lockwood	Between Caplin and Baton Rouge	Existing Overpass

STREET	CROSS STREETS	STATUS
Lockwood	At Bennington	New
Tidwell	Between Hirsch and Lundy	New

The Homestead alignment would cross six freight rail lines, listed in Table 13. Three of the six are currently grade-separated.

*Table 13: Homestead Railroad Crossings*

STREET	CROSS STREETS	STATUS
Lockwood	Between Rusk and Capitol	New
Lockwood	North of Clinton	New
Lockwood	North of Wallisville (Englewood Yard)	Existing Overpass
Lockwood	North of Hunting Bayou	Existing Overpass
Homestead	Between Shreveport and Westcott	Existing Overpass
Tidwell	Between Hirsch and Lundy	New

The Wayside alignment would cross 11 freight rail lines, listed in Table 14. Eight of the 11 are currently grade-separated.

*Table 14: Wayside Railroad Crossings*

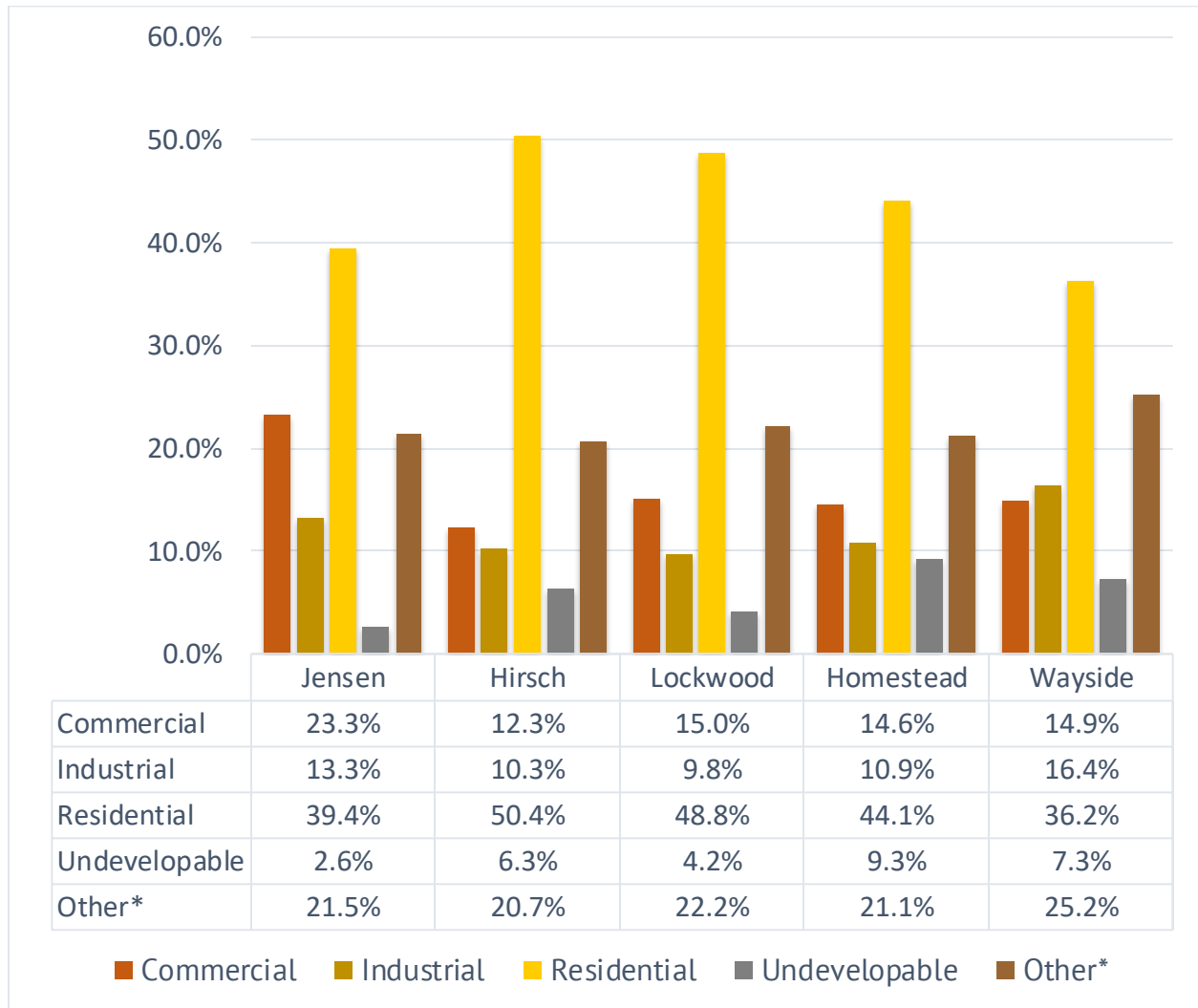
STREET	CROSS STREETS	STATUS
Polk	Between Lansing and Hughes	New
69 <sup>th</sup> Street	South of Capitol	Existing Underpass
69 <sup>th</sup> Street	Between Avenue B and Avenue C	New
Wayside	North of Clinton	Existing Overpass
Wayside	South of Palestine	Existing Overpass
Wayside	South of Liberty	Existing Underpass
Wayside	South of Liberty	Existing Overpass
Wayside	North of Liberty	Existing Overpass
Tidwell	West of Parkhurst	Existing Overpass
Tidwell	East of Sherbourne	Existing Overpass
Tidwell	Between Hirsch and Lundy	New

## 6 LAND USE

To determine the propensity of each alternative for transit use and economic development, the share of different land uses within a quarter of a mile of each alignment were calculated. The most pertinent statistic was considered to be the share of industrial properties, which, relative to other uses, are generally not conducive to transit ridership. Because one of the goals of the University Corridor project is to support economic growth, the share of land considered undevelopable was also examined. Uses such as government facilities and parks were considered less germane to this analysis and were therefore grouped together with several minor uses as *Other*.

The analysis showed the Lockwood alternative to be the least industrial and the Wayside alternative the most, with 9.8- and 16.4-percent industrial shares, respectively (see Figure 15). The Wayside alternative also has a significant share, 7.3 percent of undevelopable land, topped only by the Homestead alternative, with 9.3 percent. The Jensen alternative stands out for its high share of commercial use, but it also has the second highest share of industrial use. Overall, the Lockwood alternative has a good balance between residential and commercial uses while having relatively little industrial and undevelopable land.

Figure 15: Land Use Comparison



H-GAC Regional Growth Forecast

\* Other includes government/medical/educational, multiple, parks, unknown, and vacant

## 7 POPULATION AND EMPLOYMENT

As with the land use analysis, the five alternatives were evaluated for the density of population and jobs within a quarter of a mile of the proposed alignments for conditions in 2020 and forecast conditions in 2040. The Jensen alternative was found to have the highest density of residents and

jobs of the five alternatives, with about 4,100 people per square mile and 2,200 jobs per square mile. The equivalent figures for all five alternatives fell within 1,000 people and jobs of one another. The Houston-Galveston Area Council (H-GAC) expects the Jensen and Hirsch alternatives to have faster employment growth over twenty years than those alternatives farther east, likely because they run nearer to Downtown. Population and employment are expected to grow near every alternative except Wayside, where adjacent areas may lose some population. Table 15 and Figure 16 show the current statistics and expected trends for each alternative.

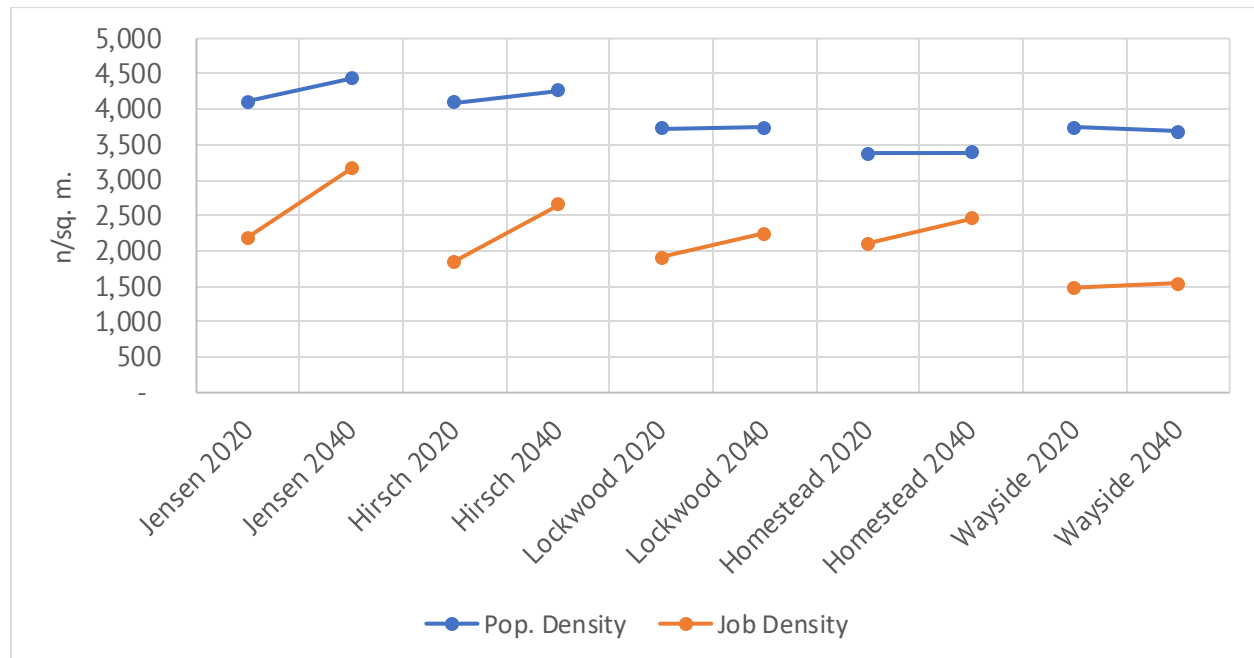
Table 15: Population and Employment Forecasts

	JENSEN		HIRSCH		LOCKWOOD	
	2020	2040	2020	2040	2020	2040
Population	20,103	21,691	22,291	23,209	19,445	19,504
Population Density	4,110	4,434	4,093	4,262	3,726	3,738
Jobs	10,749	15,462	10,061	14,437	9,954	11,739
Job Density	2,197	3,161	1,848	2,651	1,908	2,250

	HOMESTEAD		WAYSIDE	
	2020	2040	2020	2040
Population	21,814	21,827	26,815	26,457
Population Density	3,383	3,385	3,744	3,694
Jobs	13,623	15,813	10,621	11,072
Job Density	2,113	2,453	1,483	1,546

H-GAC Regional Growth Forecast

Figure 16: Population and Employment Forecasts



H-GAC Regional Growth Forecast

## 8 ENVIRONMENTAL CONSIDERATIONS

For this part of the analysis, select environmental features addressed by the National Environmental Policy Act (NEPA) lying within 500 feet of the five alignments were identified. The scope of this report did not extend to confirming environmental impacts. Rather, these data were intended to test whether any one environmental factor strongly distinguished one alternative from another.

### 8.1 Right-of-way

The effects of the property acquisition required for a federal project is an important component of NEPA. Because METRO has only completed conceptual designs for the Lockwood alternative, not the other four, estimating the number of acquisitions and displacements that each alternative would require was outside the scope of this analysis. Therefore, average public right-of-way width was used as a proxy for property acquisitions, with the assumption that a wider existing right-of-way would mean fewer acquisitions.

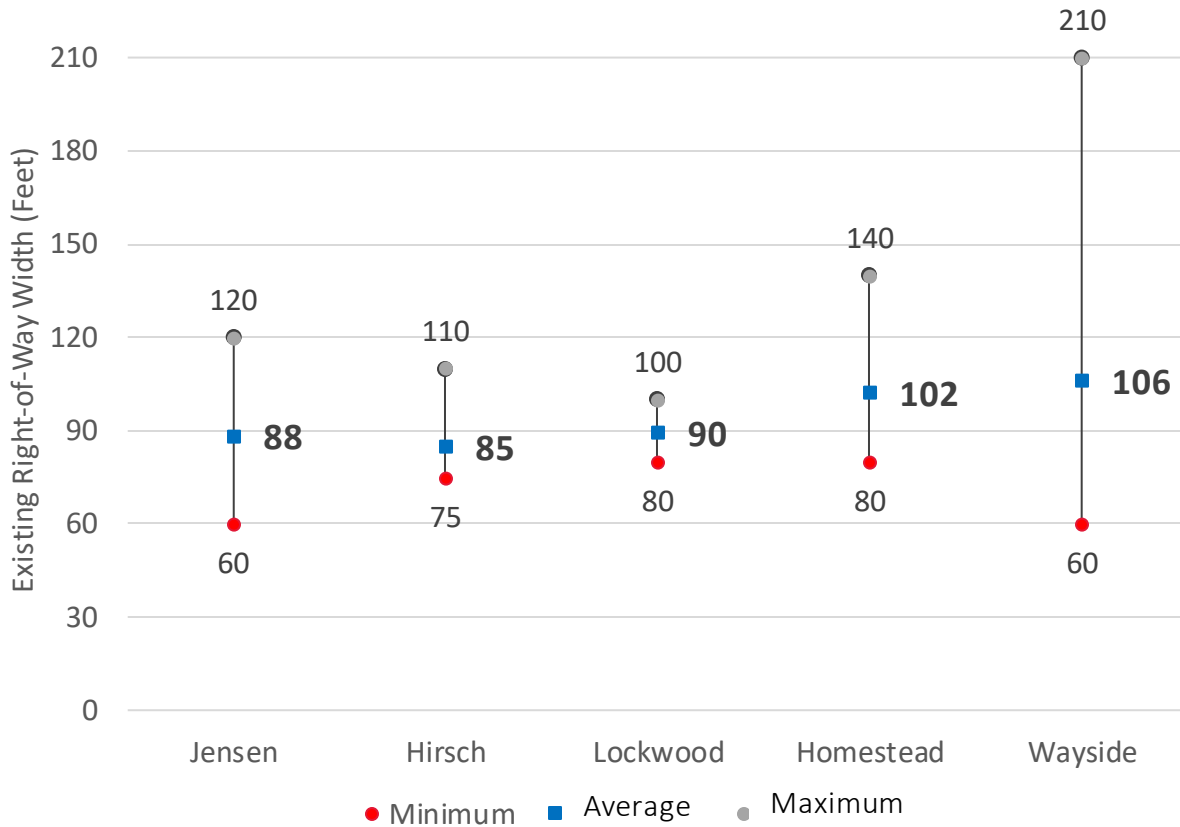
Right-of-way data for the five alternatives were drawn from the 2022 MTFP for the area between the intersection of Lockwood and Polk and the intersection of Tidwell and Jensen.<sup>16</sup> (All five alternatives share the same alignment outside those boundaries.) The results, shown in Figure 17, reveal that right-of-way width varies widely across the alternatives, from 60 feet on some parts of Jensen and Polk (east of Lockwood) to over 200 feet on a small stretch of Wayside. The Lockwood alternative has the narrowest range of widths, between 80 and 100 feet, and is wider on average than the alternatives to the west. The Homestead and Wayside alternatives, which run through slightly less dense areas, average over 100 feet wide.

For reference, the typical proposed right-of-way width in Segments 4 and 5 in METRO's conceptual designs for the project ranges from approximately 80 feet to 120 feet. At the low end, the proposed cross section at Lockwood and Marcus Street is 78 feet wide. This design, which is common in the middle of blocks and away from major thoroughfares and stations, accommodates one BRT lane, one general-purpose lane, and one sidewalk per direction. At the other end of the spectrum, the proposed cross section on Lockwood at Lyons Avenue is 122 feet wide. This design, which has a center platform at an intersection with a major thoroughfare, accommodates one BRT lane, two general-purpose lanes, and a sidewalk in the southbound direction, and one BRT lane, three general-purpose lanes, and a sidewalk in the northbound direction. In the middle is a case like the proposed cross section on Tidwell between Friendly Road and Dodson Street, which at 92 feet wide accommodates one BRT lane, two general-purpose lanes, and a sidewalk in each direction.

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<sup>16</sup> Although more detailed right-of-way data are available for Lockwood, this analysis used the MTFP for all five alternatives to ensure they were compared fairly.

Figure 17: Right-of-way Comparison



City of Houston MTFP

## 8.2 Historic Properties

This study identified six historic structures within 500 feet of the five proposed alignments: three near the Jensen alignment, one each near the Lockwood, Homestead, and Wayside alignments, and none near the Hirsch alignment. (See Table 16). One property—the South Jensen Drive Bridge across Buffalo Bayou, on the Jensen alignment—is listed on the National Register of Historic Places (NRHP). If the Jensen alignment were to use this bridge, METRO would have to complete a Section 106 review to determine whether the project would cause adverse impacts to the historic features of the structure. Independent of the Section 106 process, the bridge’s age, 85 years old, could complicate the construction of BRT lanes.

Two additional properties are currently considered NRHP-eligible and could likewise require Section 106 review. The US 90A bridge over Buffalo Bayou, on the Wayside alignment, is NRHP-eligible and is designated a historic bridge by the Texas Department of Transportation. The bridge has two spans, both built in 1956. The substructure of the western span is currently rated *structurally deficient* by the Federal Highway Administration.<sup>17</sup> Although the concept for the Wayside alignment presented in

<sup>17</sup> Federal Highway Administration, National Bridge Report 2022, <https://infobridge.fhwa.dot.gov/Data/BridgeDetail/23147288>, accessed January 19, 2023.

this analysis would have the BRT lanes constructed on the eastern span, more general-purpose traffic would have to be rerouted to the substandard western span. If traffic analysis found having BRT lanes on both spans to be preferable to accommodate traffic volumes, then METRO could potentially have to rehabilitate the western span. The other NRHP-eligible property identified, the Mickey Leland College Preparatory Academy for Young Men, sits adjacent to the Jensen alignment. Further right-of-way analysis would be required to determine potential impacts.

Three properties designated landmarks by the City of Houston were identified near the alternative alignments. These properties are regulated by the City’s Historic Preservation Ordinance.<sup>18</sup> Alteration or demolition of landmark structures requires a Certificate of Appropriateness issued by the Houston Archaeological and Historical Commission. Further right-of-way analysis would be required to determine potential impacts to these structures, but the Joseph Merkel House, at a minimum, is extremely unlikely to be affected, as it sits several parcels north of Navigation

*Table 16: Adjacent Historic Resources*

<b>NAME</b>	<b>CATEGORY</b>	<b>LOCATION</b>	<b>ALTERNATIVE</b>	<b>NOTES</b>
South Jensen Drive Bridge	NRHP-listed	Buffalo Bayou	Jensen	One span. Built 1938. Alterations to structure possible.
US 90A Bridge	NRHP-eligible	Buffalo Bayou	Wayside	Two spans. Built 1956. Alterations to structure possible. Western span structurally deficient.
Mickey Leland College Preparatory Academy for Young Men	NRHP-eligible	1510 Jensen Street	Jensen	Built 1964. Currently houses Secondary Disciplinary Alternative Education Program.
Tom and Ingeborg Tellepsen House	City of Houston Landmark	4518 Park Street	Jensen, Lockwood, Homestead	Built 1916. No impacts identified in preliminary historical work for Lockwood alignment.
Joseph Merkel House	City of Houston Landmark	416 N Hutcheson St	Jensen	Built 1860. Currently single-family residence. Several parcels north of Navigation.
Fire Station #2	City of Houston Landmark	317 Sampson Street	Hirsch	Built 1910. Currently a single-family residence.

<sup>18</sup> City of Houston Municipal Code, Chapter 33, Article VII, “Historic Preservation,” [https://library.municode.com/tx/houston/codes/code\\_of\\_ordinances?nodoid=COOR\\_CH33PLDE\\_ARTVIIHIPR](https://library.municode.com/tx/houston/codes/code_of_ordinances?nodoid=COOR_CH33PLDE_ARTVIIHIPR), accessed January 21, 2023.



### 8.3 Parks

Five parks were identified along the five alignments—four adjacent to Hirsch and one each adjacent to Jensen, Lockwood, and Homestead (see Table 17). Because the BRT guideway would be constructed primarily within existing right-of-way, few significant impacts to these parks are anticipated. In some cases, improved sidewalks could create better pedestrian access to parks. Further study would be required to determine potential impacts.

*Table 17: Adjacent Parks*

<b>NAME</b>	<b>LOCATION</b>	<b>ALTERNATIVE</b>	<b>NOTE</b>
Guadalupe Plaza Park	West of Jensen between Runnels and Ann	Jensen	Minor acquisition for sidewalk improvements possible
Busby Park	East of Hirsch between UPRR and Bennington	Hirsch	BRT would use existing bridge next to park
Atwell Henry Triangle	North of Crane between Broyles and Hirsch	Hirsch	Minor acquisition for sidewalk improvements possible
Marron Park	East of Hirsch and south of Buffalo Bayou	Hirsch	Minor acquisition for sidewalk improvements possible
Hunting Bayou Greenway	Hunting Bayou between Lockwood and Hirsch	Hirsch, Lockwood, Homestead	Minor impacts possible during construction

### 8.4 Cemeteries

Table 18 lists the three cemeteries adjacent to the proposed alignments. One challenge of the Lockwood and Homestead alternatives is the location of the historic Evergreen Negro Cemetery on either side of Lockwood Drive between Market Street and the East Freeway (I-10). The cemetery originally stretched across what is today Lockwood Drive. Graves were relocated when Lockwood was built, but preliminary archaeological investigations suggest there may be scattered remains under the pavement.

The Jensen alternative, meanwhile, would run very near St. Vincent De Paul Cemetery, a historic Catholic cemetery in the East End, and the Hirsch alternative would skirt Oak Park/Golden Gate Cemetery in Trinity Gardens. Because the Lockwood alignment has been studied in much greater detail to date than the other alternatives evaluated here, it is unknown whether these cemeteries would pose similar problems to Evergreen Negro Cemetery. Further study would be required to determine potential impacts

Table 18: Adjacent Cemeteries

Name	Location	Alternative	Notes
St. Vincent De Paul Cemetery	North of Navigation between N St Charles St and S Jensen Dr	Jensen	Established 1853. Oldest Catholic cemetery in Houston
Oak Park/Golden Gate Cemetery	West of Hirsch between June St and Laura Koppe Dr	Hirsch	
Evergreen Negro Cemetery	East and west of Lockwood between Market and I-10	Lockwood, Homestead	Established 1894; third-oldest African-American cemetery in Houston

## 8.5 Community Resources

Community resources were identified in the following categories:

- Schools
- Childcare facilities
- Churches
- Libraries
- Government Buildings
- Police Storefronts
- Fire Stations
- Healthcare Facilities

These data, presented in Table 19, are intended to provide a snapshot of conditions on the ground along each alignment. A higher number of community resources is not necessarily a point in favor of an alignment or a strike against it. The impacts of the project to these sites would be determined later in the planning process. Nevertheless, the data suggest that Lockwood and Homestead would serve more community resources than the other alternatives, which could bring higher ridership along with more required mitigations.

Table 19: Adjacent Community Resources

CATEGORY	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
Schools and Childcare	11	7	7	11	10
Churches	11	21	23	28	17
Libraries	0	1	1	1	1
Government Buildings	2	1	3	3	3
Police and Fire Stations	2	1	2	1	3
Healthcare Facilities	0	0	3	3	0
<b>TOTAL</b>	<b>26</b>	<b>31</b>	<b>39</b>	<b>47</b>	<b>34</b>

## 8.6 Hazardous Materials

Sites with hazardous materials were identified for four categories:

- Industrial and Hazardous Waste Corrective Program (IHWCA) sites
- Leaking Petroleum Storage Tanks (LPST)
- Petroleum Storage Tanks (PST)
- Superfund sites

These data, presented in Table 20, are intended to provide a snapshot of conditions on the ground along each alignment. A higher number of hazardous materials sites is not necessarily a strike against an alignment. The impacts of the project to these sites would be determined later in the planning process once METRO identified right-of-way needs and conducted environmental site assessments. The data suggest that the Homestead alternative could have the highest probability of encountering hazardous materials and the Hirsch alternative the lowest.

*Table 20: Adjacent Hazardous Materials Sites*

	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
IHWCA Sites	7	2	5	5	10
LPSTs	35	19	33	41	34
PSTs	15	10	22	32	21
Superfund	2	0	0	0	0
<b>TOTAL</b>	<b>59</b>	<b>31</b>	<b>60</b>	<b>78</b>	<b>65</b>

## 8.7 Environmental Justice

All five alternatives would serve predominantly low-income and minority communities, which are protected by Environmental Justice (EJ) regulations from adverse effects relative to other populations affected by the project. Data from Environmental Protection Agency’s (EPA’s) EJ Screen tool<sup>19</sup> show that all the census tracts served by the five alignments are in at least the fiftieth percentile of the EJ Demographic Index, an EPA measure that blends data on income and race. Therefore, environmental justice issues, though important to consider for the project as a whole, are not an important distinguisher between the five alternatives.

<sup>19</sup> <https://www.epa.gov/ejscreen>, accessed January 19, 2023.

## 9 OPERATIONS

Running times and annual operating statistics were estimated for the five alternatives using the methodology described below. Although METRO has conducted more analysis on the Lockwood alternative to date, the same methodology was applied across alternative to allow for direct comparisons.

### 9.1 Running Times

Peak and off-peak running times were developed for each alternative based on a spreadsheet-based model that produces station-to-station running times by direction for each alternative. Industry best practices and planning-level assumptions were applied to each alternative to ensure direct comparisons and fill data gaps, as detailed engineering plans and traffic models were produced as part of the alternatives analysis. The running time model's inputs include industry-standard acceleration and deceleration factors, variations and adjustments for roadway and operational treatments (e.g., transit signal priority, dedicated right-of-way, etc.), roadway and intersection level of service (LOS), and delay and dwell assumptions. The following sections provide additional details for the inputs and summarize each alternative's running times.

#### 9.1.1 Travel Times

The running time model calculates travel times between signalized intersections and/or stations using speed limits (for maximum speeds), distances, and acceleration/deceleration factors. Speed limits were assigned to each roadway segment based on current posted limits (generally 35 to 40 mph) and a conservative bus acceleration and deceleration rate of 2 mph per second was used to estimate travel times. The model calculates an allowable speed to use (in 2.5 mph increments) for each roadway segment based on the posted speed limit, segment LOS, availability of dedicated lanes, distance, and acceleration/deceleration rates. This calculation is made for each roadway segment, and the results are summarized to develop overall travel times for each alternative. Lacking traffic data, this analysis utilized consistent roadway segment LOS for each alternative but distinguished between peak and off-peak periods. Elements of lane dedication were also assumed for most of the segments in each alternative. Intersection delay and dwell times are not included in this calculation and are determined separately.

#### 9.1.2 Intersection Delay and Transit Signal Priority (TSP) Assumptions

Intersection delay was estimated at each signalized intersection based on planning-level estimates of intersection classes (with classes 1 to 3 accounting for 60-120 second signal cycle times), intersection LOS, the availability of TSP, and industry best practices. The Transit Cooperative Research Program's Bus Rapid Transit Practitioner's Guide<sup>20</sup> developed potential intersection delay metrics based on several BRT case studies across the country. These inputs were used to determine delay at each intersection and account for average savings from TSP. TSP was assumed at every signalized intersection for each alternative. Like roadway segment LOS, intersection LOS was estimated and kept consistent for each alternative but was varied between peak and off-peak

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<sup>20</sup> TCRP Report 118 – Bus Rapid Transit Practitioner's Guide (2007), [https://nacto.org/docs/usdg/tcrp118brt\\_practitioners\\_kittleson.pdf](https://nacto.org/docs/usdg/tcrp118brt_practitioners_kittleson.pdf), accessed January 19, 2023.

periods. Intersections with stop signs were assigned 5 seconds of delay. Unsignalized intersections with stations (mid-block) were not considered to incur intersection delay.

### 9.1.3 Dwell Time

Dwell times at stations were estimated based on the following assumptions:

- Each alternative will stop at all proposed stations
- Off-board fare collection (included in dwell assumptions below)
  - Average dwell time per station per trip is applied for two conditions:
  - Transit centers and/or high ridership locations = 30 second dwell time
  - Moderate ridership and/or remaining stations = 15 second dwell time

### 9.1.4 Running Time Summary

Table 21 displays the peak and off-peak running times, distances, and average speeds for each alternative for segments 4 and 5.

*Table 21: Segment 4 & 5 Running Time Summary*

	<b>JENSEN</b>	<b>HIRSCH</b>	<b>LOCKWOOD</b>	<b>HOMESTEAD</b>	<b>WAYSIDE</b>
Distance (miles)	10.1	11.3	10.1	13.8	14.8
Peak travel time (mm:ss)	36:36	38:12	36:30	42:48	41:30
Off-peak travel time (mm:ss)	33:30	34:54	33:06	38:42	37:54

## 9.2 Operating Statistics

### 9.2.1 Methodology

Annual operating statistics for each alternative<sup>21</sup> were developed using the service frequency and span assumptions shown in

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<sup>21</sup> Operating statistics for each alternative cover the entire project, not just segments 4 and 5. Consistent running times for segments 1, 2, and 3 were applied to each alternative.



Table 22 and the assumption of using battery-electric buses (BEB). Standard annualization factors of 255 weekdays, 52 Saturdays, and 58 Sunday and holidays were applied to daily metrics to estimate annual totals. Estimated peak vehicle requirements were determined by calculating cycle times for peak periods and dividing by the applicable frequency/headway. A minimum of 20 percent layover time was assumed for each cycle time calculation; however, additional layover time was required to accommodate BEB charging needs after each trip.

Table 22: METRO University Corridor BRT Proposed Span and Frequency

	<b>EARLY MORNING</b>	<b>AM PEAK</b>	<b>MIDDAY</b>	<b>PM PEAK</b>	<b>EVENING &amp; NIGHT</b>
Time	4:00 am* – 6:30 am	6:30 am – 9:00 am	9:00 am – 3:00 pm	3:00 pm – 7:00 pm	7:00 pm – 12:30 am
Weekday Headways	12 min	6 min	6 min	6 min	12 min
Weekend Headways	12 min	12 min	12 min	12 min	12 min

\*Weekend service is anticipated to begin at 5:00 am

## 9.2.2 Annual Operating Statistics Summary

Table 23 shows estimated peak vehicles, total vehicles, annual revenue hours, and annual revenue miles for each alternative. The statistics account for the entire project, not just Segments 4 and 5. The Jensen, Hirsch, and Lockwood alternatives all require 39 peak vehicles, while the Wayside and Homestead alternatives require slightly more due to their due to longer running times and impacts to service cycle times. The annual operating statistics for each alternative were utilized to develop annual O&M costs shown in Section 11.1.

Table 23: Annual Operating Statistics by Alternative

	<b>JENSEN</b>	<b>HIRSCH</b>	<b>LOCKWOOD</b>	<b>HOMESTEAD</b>	<b>WAYSIDE</b>
Peak vehicles (BEB)	39	39	39	42	41
Total vehicles (BEB, 20% spare)	47	47	47	51	50
Annual vehicle hours	200,768	202,298	200,768	212,985	211,328
Annual vehicle miles	2,624,160	2,750,880	2,698,080	3,014,880	3,120,480

# 10 RIDERSHIP

## 10.1 Forecast Methodology

Ridership estimates were developed for each alternative using the Simplified Trips-on Project Software (STOPS) model developed as part of the METRORapid University Corridor FTA New Starts submittal in August 2022. Note that STOPS is a tool developed by FTA specifically for forecasting ridership on projects seeking capital grants from FTA. STOPS uses national data and is designed to facilitate comparisons between projects nationally. The disadvantage is that the inability to adjust the model for local conditions often results in forecasts that are less robust, particularly for future years. METRO used STOPS for this analysis because it is FTA’s preferred tool, but readers should understand that the results may not be as precise as could be produced by a Houston-specific model.

For this analysis, then, the five alternatives were incorporated into the STOPS model through Google Transit Feed Specification (GTFS) files that include station-to-station running times displayed in Table 21 and span and frequencies detailed in

Table 22. For detailed model methodology related to inputs, calibration, and scenario development, please refer to the August 2022 *Travel Demand Report Technical Memorandum* for the project, under separate cover.

Ridership estimates were developed for the *Build* network for current year (2019, per FTA guidance) and horizon years (2040 and 2045). Inputs for the current-year estimates include October 2019 data on METRO service, service plans and stations for each University Corridor alternative, and an assumed baseline of existing local route service. Horizon-year *Build* scenarios use the same inputs, but with the addition of demographic forecasts from the Houston-Galveston Area Council and travel time skims for 2040 and 2045.

## 10.2 Forecast Results

Forecast results for each alternative are displayed in Table 24. Generally, the STOPS model develops ridership forecasts based on stop-level and adjacent area inputs, including variations in transit service (e.g., travel times, connections (transfers), access types, etc.), changing demographics, and zone-to-zone markets across a transit system (including mode choice and estimates based on optimal travel times between zones). The model version used for this analysis was developed for the METRORapid University Corridor FTA New Starts submittal in August 2022, and the zone districts utilized were not recalibrated for each alternative. This methodology may have led to minor differences between the results for three more western alternatives and the results for the Homestead and Wayside alternatives, as existing zone districts along the northeast portions of those two alternatives tend to be larger. This difference may marginally impact forecasts in those areas but are deemed appropriate for comparison purposes.

In the 2045 horizon year, the Lockwood and Homestead alternatives are expected to produce the highest ridership, between 20,000 and 21,000 daily boardings. The Hirsch and Jensen alternatives are expected to produce around 19,000 daily boardings and the Wayside alternative significantly fewer at 16,400 daily boardings. The ridership differences between the top three alternatives (Homestead, Lockwood, and Hirsch) are considered minimal from a forecasting perspective; the differences can be attributed to variances in travel time and impacts from changing demographics and zone markets.

To further parse the differences between alternatives, newly generated transit trips for 2045 were also estimated. This metric helps identify the ridership impact each alternative has on the METRO system—whether ridership would simply shift from existing transit services to the University Corridor or whether the University Corridor would generate new transit trips on the system. The Lockwood and Homestead alternatives are estimated to generate approximately 4,400 new transit trips across the system, outperforming the other alternatives by 800 to 1,200 trips.



Table 24: Build Alternative Ridership Forecast Results

	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
Current Year (2019)	14,500	14,500	15,600	15,500	13,100
Horizon Year (2040)	18,400	18,800	19,800	20,000	16,100
Horizon Year (2045)	18,700	19,300	20,100	20,800	16,400
New Systemwide Transit Trips (2045)	3,400	3,600	4,400	4,400	3,200

## 11 COST ESTIMATES

### 11.1 Operating and Maintenance Cost Estimates

#### 11.1.1 Methodology

Operating and maintenance (O&M) cost estimates were developed for each alternative using the incremental O&M cost model developed as part of the METRORapid University Corridor FTA New Starts submittal in August 2022. For detailed model methodology related to inputs, assumptions, and data sources, refer to the August 2022 *Operations and Maintenance Cost Model Methodology Technical Memorandum* for the project, under separate cover.

O&M costs for each alternative incorporate various unit and cost drivers for local bus service and BRT-specific elements for both diesel and BEB operations<sup>22</sup>. Although this analysis assumes BEB operations for the University Corridor, some cost drivers are based on diesel operations and adjusted for BEB. A summary of the various unit and cost drivers are shown in Table 25, Table 26, and Table 27.

Table 25: METRO Local Bus Unit O&M Costs

UNIT	UNIT COST (2022\$)
Cost per hour	\$73.26
Cost per mile	\$3.29
Cost per peak vehicle	\$183,383

Table 26: Unit O&M Costs for BRT-Specific Elements

BRT-SPECIFIC ELEMENTS	COST (2022\$)	COST DRIVER
Guideway		
Guideway Lane Maintenance	\$2,789	/ Route-Mile
Guideway Lighting	\$2,000	/ Route-Mile

<sup>22</sup> Additional changes to the cost model are required if BEBs are used. The base local bus unit costs include the cost of diesel fuel, so this must first be deducted and replaced with the cost of electricity. Additionally, research has shown that BEBs have lower per-mile maintenance costs than diesel buses, but there is also additional charging infrastructure that must be maintained. BEBs also can impact service plans depending on the availability of charging locations and requiring additional layover time to accommodate adequate charging times.

BRT-SPECIFIC ELEMENTS	COST (2022\$)	COST DRIVER
TSP Intersection	\$4,300	/ Intersection
Bridge Inspection	\$600	/ Bridge
BRT Vehicle O&M		
60' Bus Fuel Upcharge	\$0.16	/ VRM
60' Bus Maintenance Upcharge	\$0.90	/ VRM
Vehicle Wi-Fi	\$960	/ VOMS
Proof of Payment Inspection	\$11.65	/ VRH
No Farebox: Maintenance Savings	\$(2,581)	/ VOMS
Station Costs		
Platform Maintenance	\$4,000	/ Station Platform
Continuous Daily Cleaning Service	\$12,700	/ Station Platform
Pressure Washing Deep Cleaning Services	\$3,800	/ Station Platform
Electricity / Lighting	\$500	/ Station Platform
Station Wi-Fi	\$800	/ Station Platform
Emergency Phone	\$190	/ Station Platform
Real Time Signage	\$3,486	/ Station Platform
Ticket Vending Machine (TVM) Maintenance	\$11,836	/ Station Platform

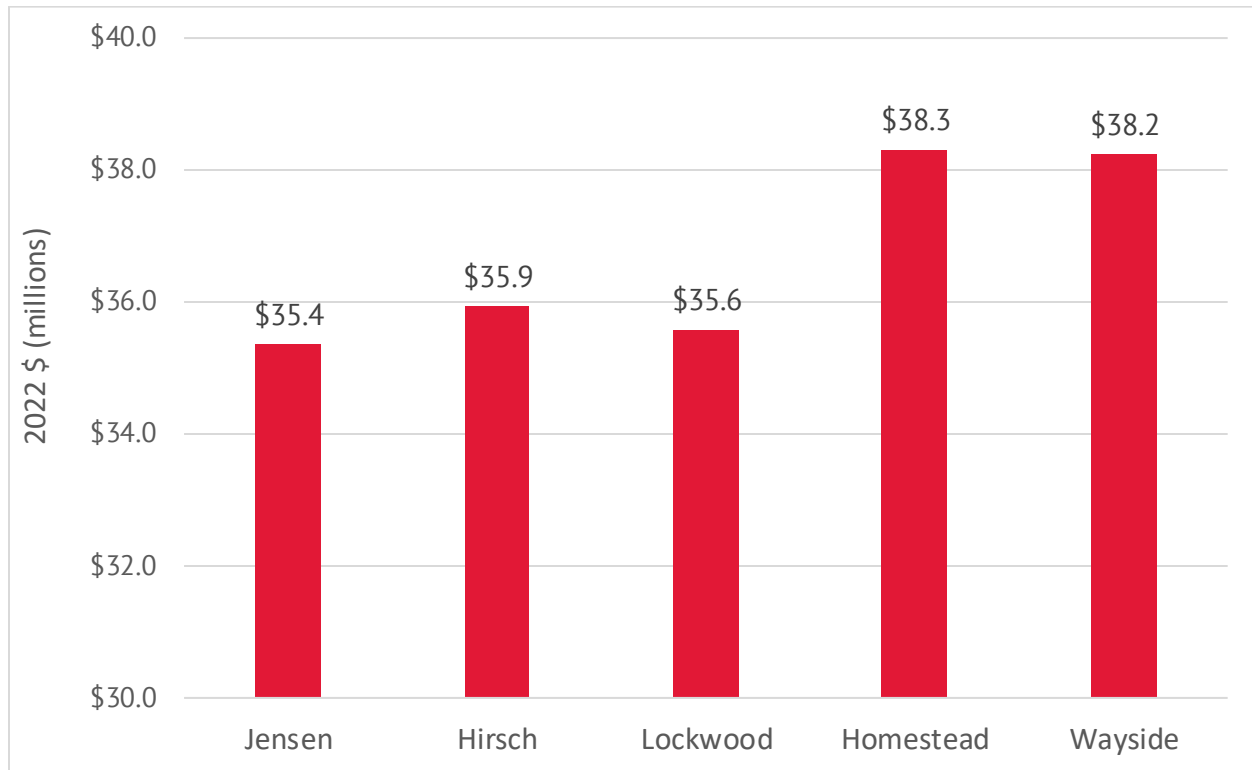
Table 27: Unit O&M Costs for BEB-Specific Elements

BEB-SPECIFIC ELEMENTS	COST (2022\$)	COST DRIVER
BRT Vehicle O&M		
Diesel Fuel Saved	\$(0.66)	/ VRM
Maintenance Down-charge	\$(0.26)	/ VRM
Energy Costs	\$0.14	/ VRM
Station Costs		
Charger Maintenance	\$0.05	/ VRM

### 11.1.2 Results

Figure 18 summarizes the annual O&M costs for each alternative for BEB operations. Costs account for operations on the entire project, not just Segments 4 and 5. The cost differences between alternatives are largely driven by revenue hours, revenue miles, and peak vehicle requirements; however, various infrastructure components related to route length, intersections, bridges, and station platforms impact maintenance costs and vary slightly for each alternative. The Jensen, Hirsch, and Lockwood alternatives are estimated to have comparable annual BEB O&M costs of between approximately \$35.5 and \$36 million. The Homestead and Wayside alternatives are estimated to carry slightly higher annual BEB O&M costs of approximately \$38.2 to \$38.3 million due to longer running times and impacts to service cycle times. Total annual costs, including operating reductions from changes to local bus service, are also shown for reference.

Figure 18: Estimated Annual BEB O&M Costs



## 11.2 Capital Cost Estimates

### 11.2.1 Methodology

The capital cost of each alternative was estimated based the number of new grade separations at railroad crossings required and the length of BRT guideway, using the 15-percent cost estimate developed for the August 2022 New Starts submittal as a reference. First, to estimate an average cost per structure, the total cost of new structures in Segments 4 and 5 was divided by the number of new structures required; the total construction cost for the project in Segments 4 and 5,<sup>23</sup> minus the cost of structures, was divided by total length of new guideway to estimate an average cost per mile. Then, for each alternative, the number of new structures and length of new guideway were multiplied by the appropriate cost factor and summed to estimate the total cost of construction. Capital cost estimates are given in 2022 dollars and do not include contingency.

### 11.2.2 Results

Table 28 and Figure 19 show the estimated capital cost for each alternative. The Jensen alternative has the lowest estimated capital cost, \$249 million, owing to its shorter length and existing grade crossings. The Lockwood and Hirsch alternatives fall between \$285 and \$300 million, and the Homestead and Wayside options are significantly more expensive due to their longer guideways.

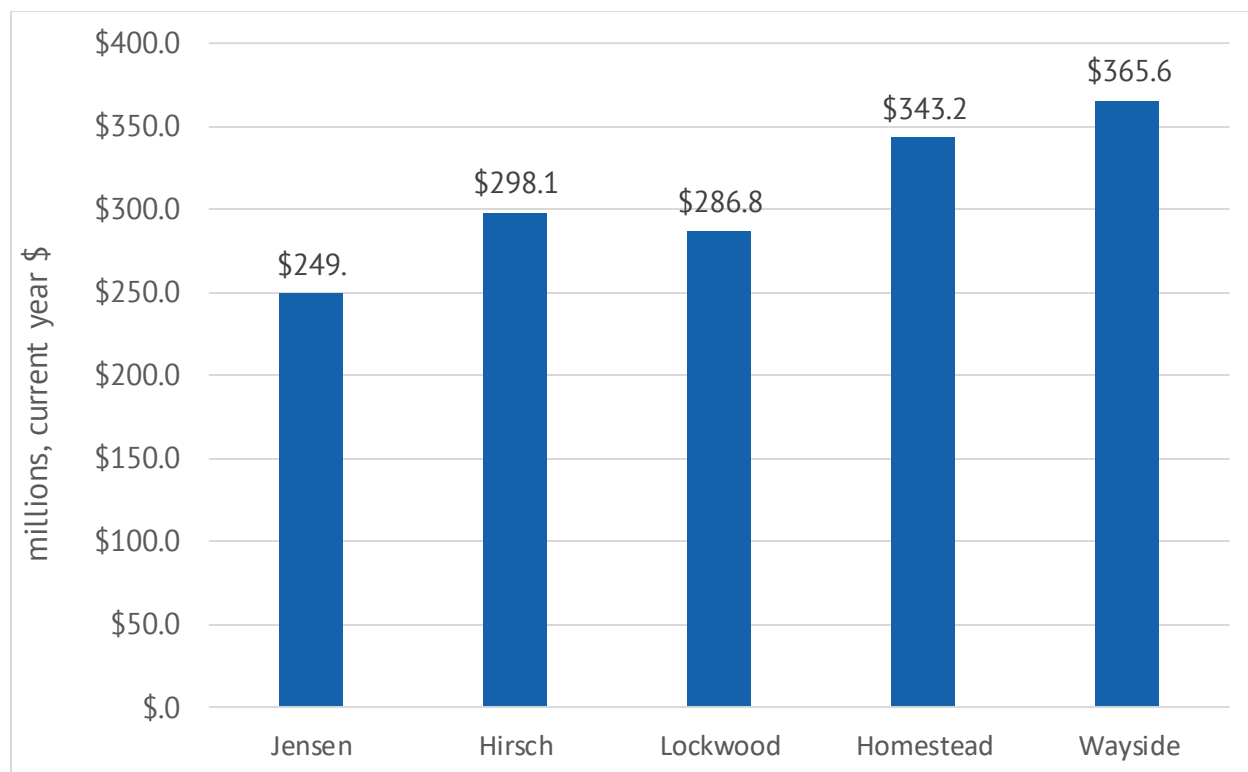
<sup>23</sup> Includes costs of guideway, stations, support facilities, sitework, and systems; does not include costs of right-of-way, vehicles, professional services, contingency, or finance charges.

Note that this analysis did not account for any new structures that could be required if the current grade separations cannot accommodate BRT lanes. Jensen, for example, has several narrow underpasses under railroads that could be challenging to modify. Also, as discussed above, both the Jensen and Wayside bridges over Buffalo Bayou are aging and may not be suitable for the major refits the project would require.

Table 28: Estimated Capital Costs\*

	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
New grade separations	2	4	4	3	3
Cost of structures (millions)	\$22.1	\$44.3	\$44.3	\$33.2	\$33.2
Guideway length (miles)	10.1	11.3	10.8	13.8	14.8
Cost of guideway minus structures (millions)	\$226.9	\$253.8	\$242.6	\$309.0	\$332.4
<b>TOTAL CAPITAL COST (MILLIONS)</b>	<b>\$249.0</b>	<b>\$298.1</b>	<b>\$286.8</b>	<b>\$343.2</b>	<b>\$365.6</b>

Figure 19: Estimated Capital Costs\*



\*Based on 15-percent cost estimate for University Corridor; includes costs of guideway, stations, support facilities, sitework, and systems; does not include costs of right-of-way, vehicles, professional services, contingency, or finance charges.

## 12 RECOMMENDATIONS

### 12.1 University Corridor

Based on the factors analyzed above, this report recommends that METRO proceed with the Lockwood alternative for the University Corridor because, of the five alternatives, it best balances cost, ridership, and the built environment. Start with cost. With the shortest running time of the five alternatives, the Lockwood alternative would cost the least to operate. Though the Jensen and Hirsch alternatives would perform similarly, the Homestead and Wayside choices would carry significantly higher operating costs and require several more vehicles. In terms of capital cost, the Lockwood alternative is lower than all its competitors but Jensen. Again, the Hirsch alternative is similar, but the Homestead and Wayside alternatives, being several miles longer, would cost more to build.

Ridership data point in favor of using Lockwood as well. In 2019, the existing 80 MLK/Lockwood route had several thousand more daily boardings than similar routes along Jensen and Hirsch, and nearly ten times as many as routes on Homestead and Wayside. Ridership forecasts indicate that, under existing conditions, the Lockwood alternative would generate the most ridership, and in 2045, the second-most ridership. Although the Homestead alternative is forecast to generate slightly higher ridership than Lockwood in 2045, its much higher estimated capital and operating costs make it far less cost-effective than the Lockwood alternative for carrying approximately the same number of riders.

If cost-ineffectiveness hurts the Homestead and Wayside alternatives, the Jensen and Hirsch alternatives are less favorable because their narrower right-of-way and higher shares of industrial land use (relative to Lockwood) are not offset by any significant difference in cost or ridership. Existing right-of-way on Jensen is as narrow as 60 feet in some places, while Hirsch has the narrowest right-of-way on average of the five alternatives. And while the Jensen and Hirsch alignments would serve several new developments near Downtown, the areas along Lockwood have more varied land use, which contributes to that alternative's higher forecast ridership.

As Figure 20 suggests, Lockwood is the best option by several measures and the worst by none. (See [Appendix A](#) for a numerical rendering of the same information as in Figure 20.) To the west of Lockwood, the relatively low costs and high population densities of the Jensen and Hirsch alternatives are counterbalanced by their narrow right-of-way and middling ridership forecasts. To the east, the wide rights-of-way and relatively few environmental constraints of the Homestead and Wayside alternatives do not compensate for their longer running times and higher costs. Lockwood, then, is the most rational choice in an area with limited options for connecting Eastwood Transit Center and Tidwell Transit Center.

Figure 20: Alternatives Summary

	JENSEN	HIRSCH	LOCKWOOD	HOMESTEAD	WAYSIDE
Land use (best = lowest % industrial)	Light Green	Medium Green	Dark Green	Light Green	Light Brown
Population density (best = highest)	Dark Green	Medium Green	Light Brown	Light Brown	Light Green
Employment density (best = highest)	Dark Green	Light Brown	Light Green	Medium Green	Light Brown
Historic sites, parks, and cemeteries (best = fewest)	Light Brown	Light Brown	Light Green	Medium Green	Dark Green
Right-of-way (best = highest average)	Light Brown	Light Brown	Light Green	Medium Green	Dark Green
Running time (best = shortest)	Medium Green	Light Green	Dark Green	Light Brown	Light Brown
Ridership (best = highest)	Light Brown	Light Green	Dark Green	Dark Green	Light Brown
Annual capital cost (best = lowest)	Dark Green	Light Green	Medium Green	Light Brown	Light Brown
Annual operating cost (best = lowest)	Dark Green	Light Green	Medium Green	Light Brown	Light Brown

## 12.2 Opportunities for Additional Service Improvements

Although this report recommends keeping the University Corridor on Lockwood, METRO may wish to consider ways to improve local bus service on some of the other corridors studied. The Jensen alternative, for example, is not ideal for BRT because of its narrow right-of-way in some areas, but it could support enhanced local bus service given its relatively high population and employment densities. The 3.3-mile segment of Jensen between Kelley Street and Parker Road is also one focus of the *Northside on the Move* planning study currently being completed by Harris County Precinct 2 and Greater Northside Management District (GNMD). A draft version of the plan, provided by GNMD, recommends improving this corridor at a cost of \$95 million “to provide safer multimodal access to transit and commercial destinations.” Currently, the pavement on Jensen is in poor condition and sidewalks are discontinuous or missing altogether. Businesses frequently contact GNMD to request better bus shelters and more frequent service on the 6 Jensen/Greens. Given the potential for capital

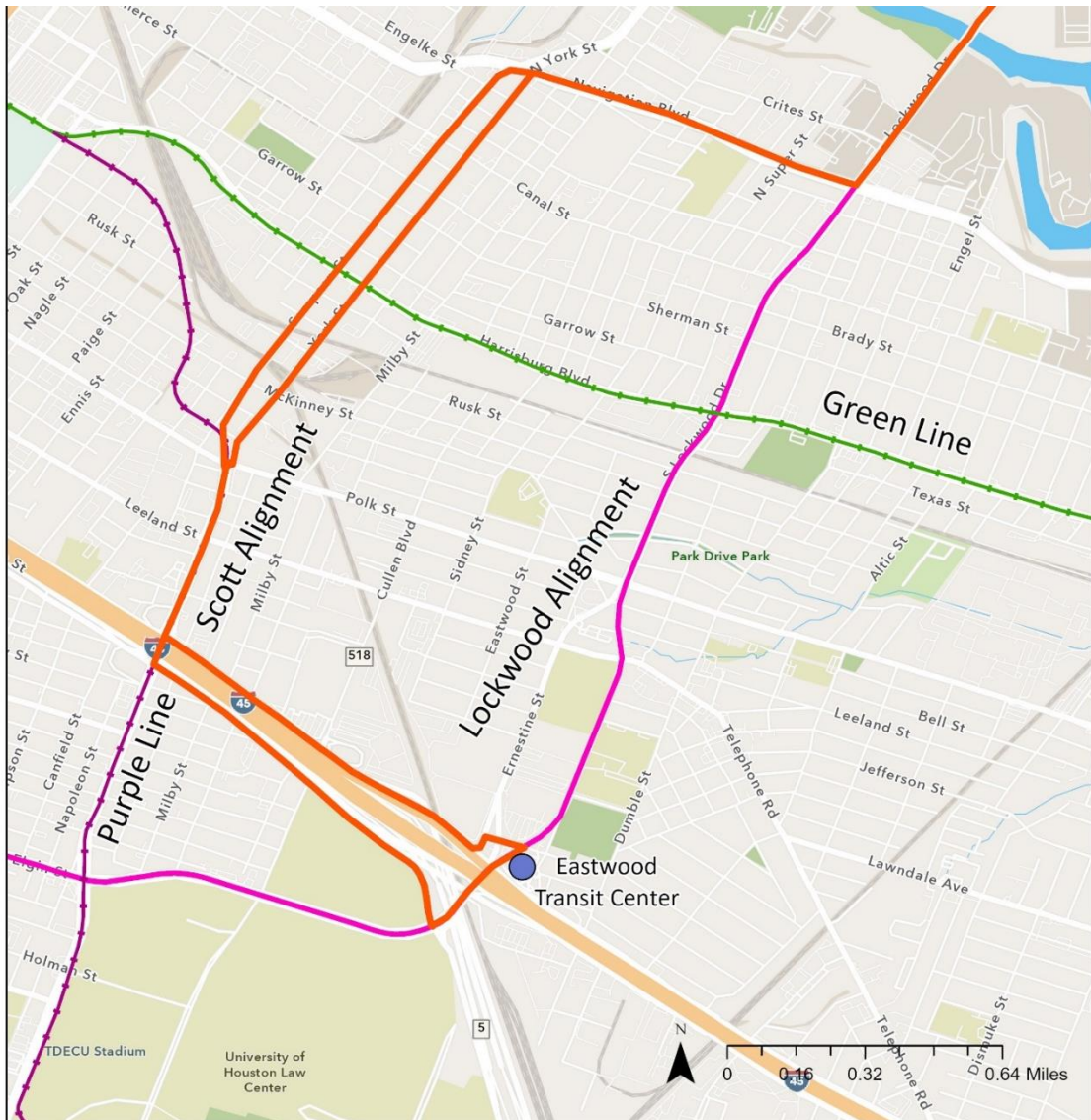


investments in Jensen over the next several years, this report recommends that METRO study the Jensen corridor further to see how best to meet the transit needs of the community.

## 13 SCOTT ALIGNMENT

Following completion of the analysis described above, METRO studied one additional alignment at the request of the Eastwood Civic Association. Called here the Scott alignment (see Figure 21), this alignment would run northwest from Eastwood Transit Center on the I-45 northbound frontage road and turn north on Scott Street. On Scott, the alignment would share guideway with the METRORail Purple Line from Scott to Polk, continue north on York, turn east on Navigation, and turn north on Lockwood, where it would return to the path of the currently proposed Lockwood alignment. Southbound, the alignment would turn west from Lockwood onto Navigation, run south on Sampson, continue south on Scott, and turn southeast on the I-45 southbound frontage road. At Elgin Street the alignment would turn back under I-45 to access Eastwood Transit Center, then turn around and proceed westward into Segment 3.

Figure 21: Lockwood and Scott Alignments, Segment 4



The intent of this alignment was to review a route recommended by the Eastwood neighborhood based on perceived potential impacts of the project to the neighborhood. The route would avoid Eastwood by redirecting the alignment to the east and could potentially take advantage of a proposed underpass on York Street that the City of Houston may pursue.<sup>24</sup> For this analysis, the following stations were assumed:

<sup>24</sup> See Gulf Coast Rail District for more information: <https://www.gcrd.net/post/west-belt-improvements-conceptual-design-and-environmental-documentation>, accessed March 29, 2023.



Table 29: Scott Alignment Proposed Stations

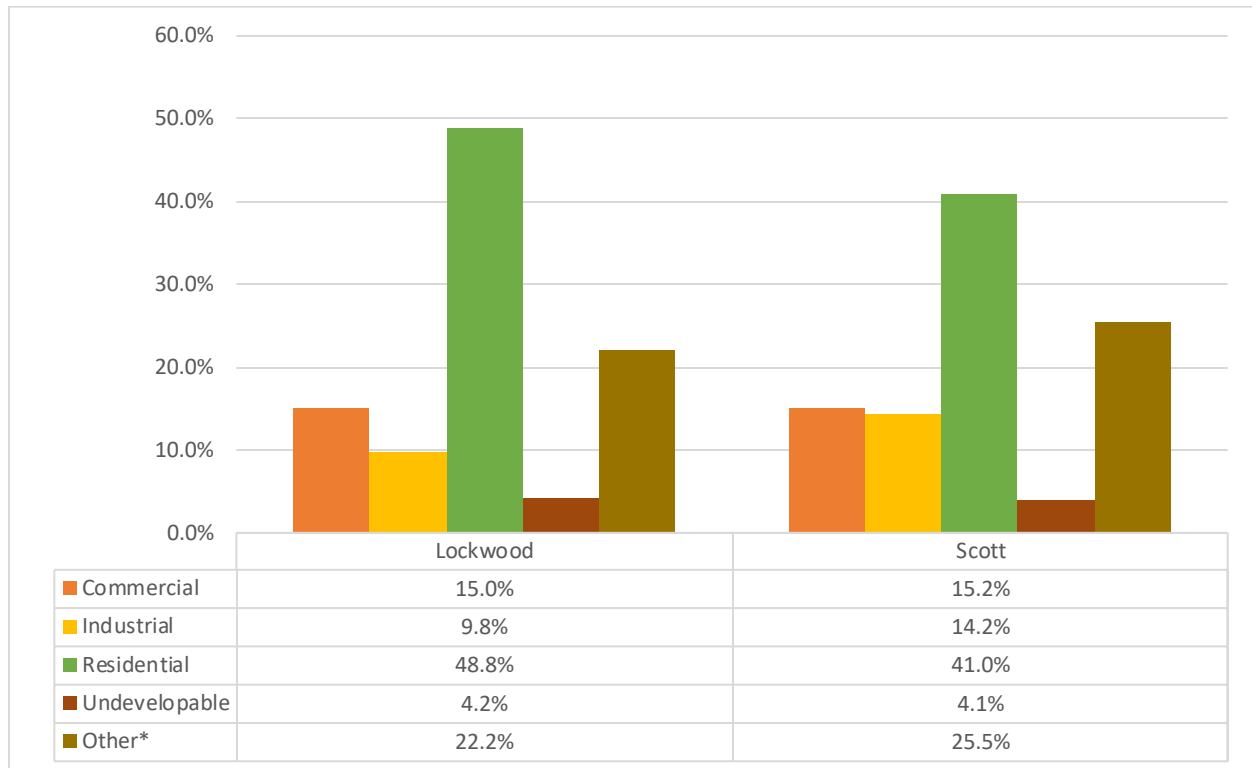
Street	Cross Street
Eastwood Transit Center	N/A
Scott	Leeland
Sampson/York	Harrisburg
Navigation	Sampson/York/Hirsch
Lockwood	Crites (Marron Park)
Lockwood	Harvey Wilson
Lockwood	Clinton
Lockwood	Sonora
Lockwood	Lyons (Denver Harbor Transit Center)
Lockwood	Nichols
Lockwood	Collingsworth
Lockwood	Cavalcade
Lockwood	Kelley (LBJ Hospital)
Lockwood	Bennington
Lockwood	Weaver
Lockwood	Laura Koppe
Lockwood	Tidwell
Tidwell Transit Center	N/A

The remainder of this section compares the Scott alignment to the Lockwood alignment using the same criteria and methodology as were used in Sections 6 through 11 above.

### 13.1 Land Use and Demographics

Land use within a quarter mile of the Scott alignment is somewhat more industrial and less residential than near the Lockwood alignment, primarily owing to the portion of the Scott alignment along the Gulf Freeway (see Figure 22). Figure 22: Population density is very similar between the two. Job density is expected to grow at a faster rate near the Scott alignment, likely because it runs nearer Downtown (see Table 30).

Figure 22: Lockwood and Scott Land Use



\* Other includes government/medical/educational, multiple, parks, unknown, and vacant

Table 30: Lockwood and Scott, Population and Jobs

	LOCKWOOD		SCOTT	
	2020	2040	2020	2040
Population	19,445	19,504	23,161	24,378
Population Density	3,726	3,738	3,526	3,712
Jobs	9,954	11,739	13,463	18,649
Job Density	1,908	2,250	2,050	2,839

## 13.2 Environmental Considerations

No significant differences were identified in terms of impacts to previously identified environmental and community resources. Note that this study was completed before the studies currently being conducted on the Lockwood alternative to meet NEPA requirements. Note as well that this report evaluates the path of each alignment but is neutral with respect to design, meaning the relative impacts of elevated or depressed grade crossings are not considered.

### 13.3 Operations

Because the Scott alignment is 2.2 miles longer than the Lockwood alignment, it would have a longer running time and require more vehicles. Annual vehicles hours and vehicles miles would also be slightly higher, as shown in Table 31.

*Table 31: Lockwood and Scott, Operating Statistics*

	<b>LOCKWOOD</b>	<b>SCOTT</b>
Distance (miles)	10.1	12.3
Peak travel time (mm:ss)	36:30	40:06
Off-peak travel time (mm:ss)	33:06	37:24
Peak vehicles (BEB)	39	41
Total Vehicles (BEB, 20% spare)	47	50
Annual vehicle hours	200,768	211,328
Annual vehicle miles	2,698,080	2,856,480

The Scott alignment presents several operational challenges that would require further study. First, METRO would need to study scheduling and signaling where the alignment would share guideway with the Purple Line on Scott to be sure the facility could accommodate two high-frequency services without detriment to either. METRO does plan to operate the Inner Katy BRT in shared guideway with the Green and Purple Lines downtown, but the streetcar-like characteristics of the LRT in that area limit the comparison. In addition, implementing dedicated BRT lanes on the I-45 frontage roads would be extremely difficult operationally, because of the need to maintain access to businesses and facilitate U-turns, and politically, because there is not precedent for TxDOT allowing that kind of use for their facilities. The likely compromise would be to operate the BRT in mixed traffic, which would reduce service reliability and operating speeds.

### 13.4 Ridership

Ridership was forecast using the same methodology described in Section 10 for 2019 and 2040 conditions. The results, shown in Table 32, show that the Scott alignment would yield slightly lower ridership, primarily because its longer running time would discourage a small number of trips.

*Table 32: Lockwood and Scott, Build Alternative Ridership Forecast Results*

	<b>LOCKWOOD</b>	<b>SCOTT</b>
Current Year (2019)	15,600	14,600
Horizon Year (2040)	19,800	19,000
New Systemwide Transit Trips (2040)	4,100	3,900

## 13.5 Estimated Costs

The estimated annual operating cost of the Scott alignment is about \$2 million higher than the Lockwood alignment and the estimated capital cost is about \$12 million higher (see Table 33). The extra length of the Scott alignment is the main cost driver in both cases. This capital cost estimate assumes that the proposed York underpass would be completed, and that METRO would not contribute any funds. This assumption is made here for comparative purposes only and does not reflect any discussion between METRO and the City of Houston.

*Table 33: Estimated Operating and Capital Costs\**

	<b>LOCKWOOD</b>	<b>SCOTT</b>
<b>ANNUAL OPERATING COST (MILLIONS)</b>	<b>\$35.6</b>	<b>\$37.6</b>
New grade separations	4	2
Cost of structures (millions)	\$44.3	\$22.1
Guideway length (miles)	10.8	12.3
Cost of guideway minus structures (millions)	\$242.6	\$276.2
<b>TOTAL CAPITAL COST (MILLIONS)</b>	<b>\$286.8</b>	<b>\$298.4</b>

\*Based on 15-percent cost estimate for University Corridor; includes costs of guideway, stations, support facilities, sitework, and systems; does not include costs of right-of-way, vehicles, professional services, contingency, or finance charges.

## 13.6 Summary

METRO’s analysis suggests that the Scott alignment would have slightly higher capital and operating costs and slightly lower ridership than the Lockwood alignment. These findings are primarily a function of the alignment’s longer route. Even assuming that an underpass is constructed on York, the estimated capital cost for the Scott alignment is higher because it requires several more miles of guideway. The deviation to Scott, meanwhile, lengthens the running time, driving up operating costs and discouraging ridership. Key points that favor Lockwood over Scott include:

- Scott is estimated to have 4 percent higher capital costs (assuming no contribution from METRO to the proposed York underpass) and 6 percent higher operating costs
- Serving Eastwood Transit Center in both directions requires southbound vehicles to double back under I-45, lengthening running time
- Scott has a higher percentage of industrial land use and a lower percentage of residential land use, making it less conducive to ridership, as well as to use of the Project’s associated bicycle and pedestrian improvements
- Scott is forecast to produce slightly lower ridership, which when coupled with slightly higher costs makes the alignment a less cost-effective option

This report therefore recommends that METRO keep the University Corridor on Lockwood and pursue design solutions to community concerns. See Appendix A for a description of how Lockwood and Scott perform against all the other alignments, presented in a quantitative form.



## 14 CURRENT UNIVERSITY CORRIDOR PROJECT EFFORTS

METRO is currently completing preliminary engineering for the Lockwood alternative. The agency is simultaneously collaborating with the Eastwood Civic Association and other community stakeholders to seek a design for the Project that is acceptable to residents while still meeting the purpose and need of the project. METRO will continue to solicit public feedback as it advances the project toward final design and construction.

## APPENDIX A: NUMERICAL RANKINGS

The table below summarizes how the six alignments rank relative to one another. A score of 1 was assigned to the alignment that performed best on each criterion and a score of 6 to the alignment that performed worst. Scores for right-of-way, ridership, and total capital cost were doubled to reflect the importance of these factors to FTA when rating projects. Using this methodology, the alignment with the lowest score would be considered best and the alignment with the highest score the worst. Lockwood thus outperformed the other alignments with a low score of 29, compared to Jensen with 34; Scott and Homestead with 45; Hirsch with 46; and Wayside with 50.

ALTERNATIVE	JENSEN	HIRSCH	SCOTT	LOCKWOOD	HOMESTEAD	WAYSIDE
Land use (best = lowest % industrial)	4	2	5	1	3	6
Population density (best = highest)	1	2	5	4	6	3
Employment density (best = highest)	1	5	3	4	2	6
Historic sites, parks, and cemeteries (best = fewest)	5	5	4	3	2	1
Right-of-way (best = highest average)*	10	12	6	8	4	2
Running time (best = shortest)	2	3	4	1	6	5
Ridership (best = highest) *	8	8	6	2	4	12
Total capital cost (best = lowest)*	2	6	8	4	12	10
Annual operating cost (best = lowest)	1	3	4	2	6	5
<b>Total Score</b>	<b>34</b>	<b>46</b>	<b>45</b>	<b>29</b>	<b>45</b>	<b>50</b>

\* Weighted double