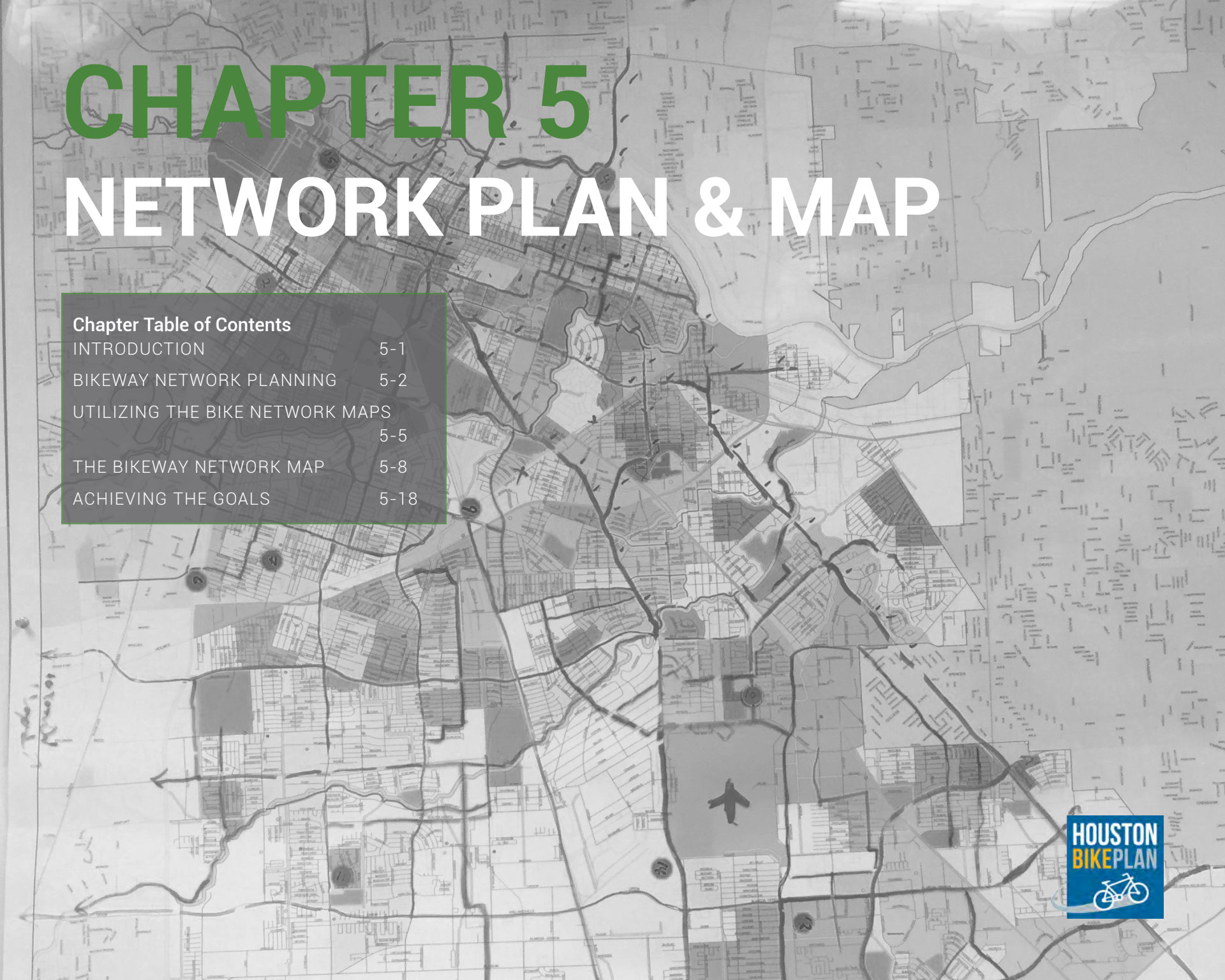
CHAPTER 5
NETWORK PLAN & MAP

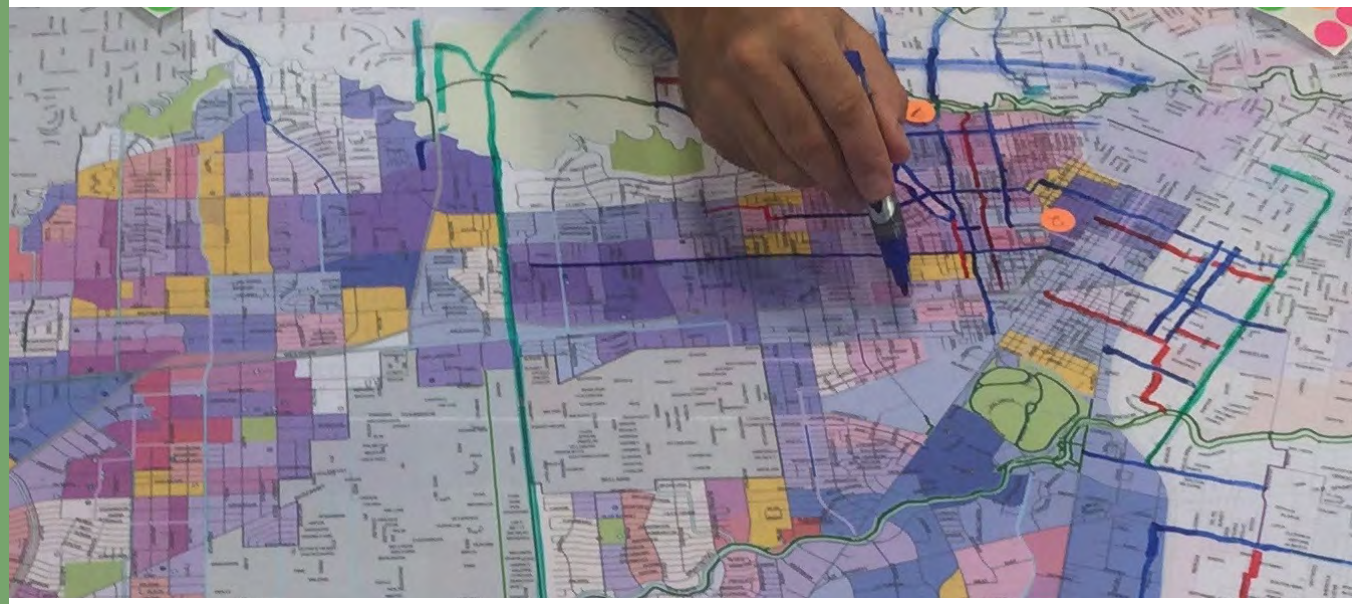
Chapter Table of Contents

INTRODUCTION	5-1
BIKEWAY NETWORK PLANNING	5-2
UTILIZING THE BIKE NETWORK MAPS	5-5
THE BIKEWAY NETWORK MAP	5-8
ACHIEVING THE GOALS	5-18



05

NETWORK PLAN & MAP



The bikeway design elements, policies, and programs outlined in **Chapter 4: Bicycle Toolbox** set the approach for helping Houston realize the goal of becoming a more bike-friendly city as described in **Chapter 3: Vision & Goals**. Significant public feedback and input from stakeholders indicated that a low-stress, well-connected bikeway network is the most critical need that must be addressed in order to move Houston toward its goals. Over 70% of respondents to the bike plan survey identified this as one of the top two priorities to improve biking in the city and many people cited gaps in the existing bikeway network as the biggest impediment to more people biking.

To develop the Bike Plan's bikeway network, the study team gathered for a week-long workshop to begin the process of mapping the future bicycle network in the City of Houston. Existing infrastructure, assessment of comfort levels, and planned projects identified in **Chapter 2: Existing Conditions & Opportunities** served as a baseline and starting point for the network. Ideas for new facilities were based on public input, along with travel demands, demographic data, and the team's knowledge and experience of bicycling in Houston. This plan was refined through input from stakeholders, further research of specific field conditions, and coordination with other implementation entities including Management Districts, Tax Increment Reinvestment Zones (TIRZs), Harris County, and adjacent cities that have been working on bikeway improvement projects.

The draft network developed by the Houston Bike Plan team was refined through input from the funding partners, Bicycle Advisory Committee (BAC), and through feedback gathered from the

public at meetings throughout February, March, and April 2016 (detailed in **Chapter 6: Implementation Strategies**). Every comment was considered and specific suggestions were evaluated against the goals of the Bike Plan to determine if a change was needed.

The resulting network, presented in this chapter, is a long-term vision, to be implemented over multiple time horizons. The network plan identifies programmed components that are funded and scheduled to be implemented as well as projects that have the potential to be implemented in a shorter, five year time frame if funding were available. Additionally, key projects are identified that would yield the greatest benefits in terms of city-wide network connectivity.

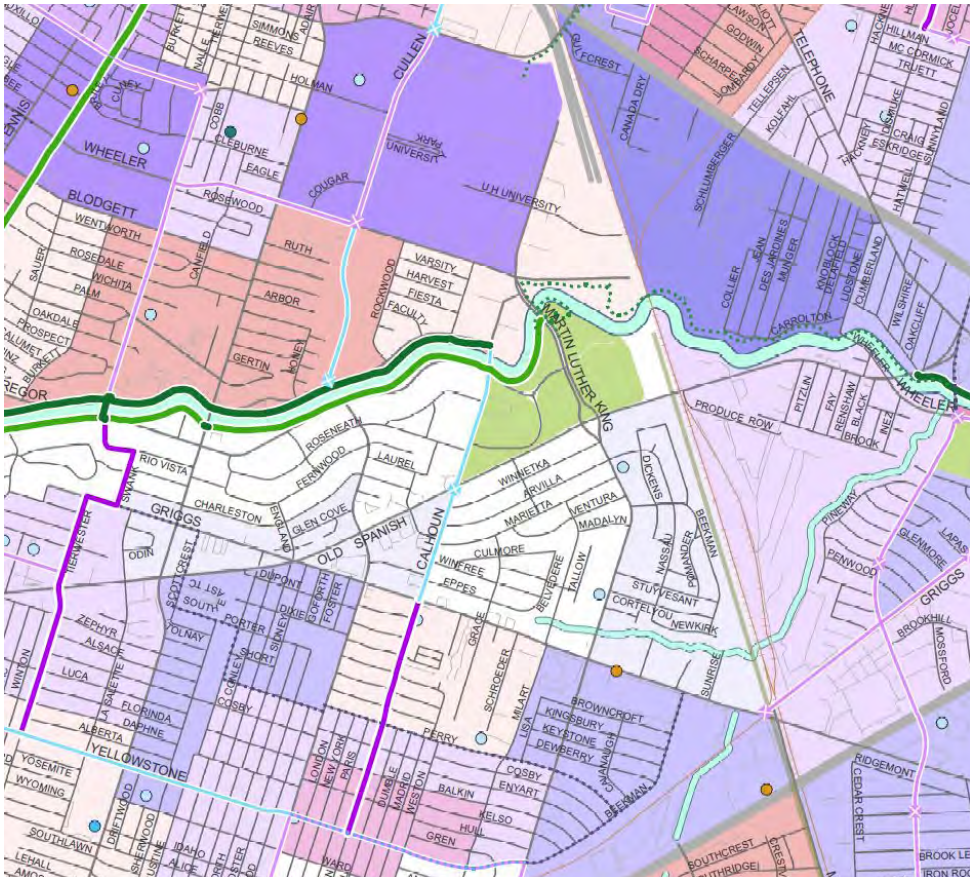
BIKEWAY NETWORK PLANNING

The network planning workshop was a collaborative effort involving City of Houston staff representing three departments (Planning & Development, Public Works & Engineering, and Parks & Recreation) and the consulting team. Members of the Bicycle Advisory Committee were also invited to participate in one portion of the workshop to observe the approach and process, and to provide feedback on the draft plan.

The team devoted a full week to the network planning workshop. Maps posted around the room showed population density, job density, poverty density, major destinations, management districts, TIRZ boundaries, existing bikeways, and bicycle facilities recommended in previous planning studies. Other resources at the team's disposal included the City of Houston Major Thoroughfare and Freeway Plan, traffic counts, right-of-way information, and Google Earth aerial imagery. The specific comments collected during the first public outreach phase were sorted by geographic area and reviewed periodically to ensure they were addressed as part of the planning process.

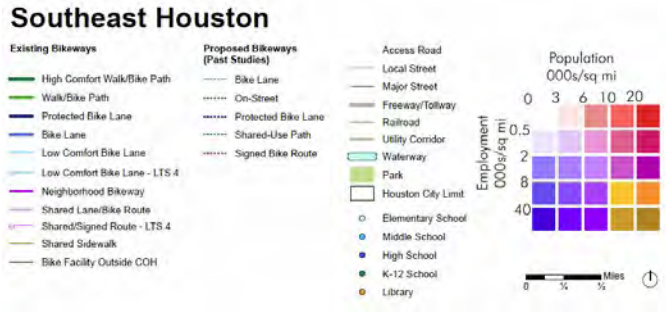


The Houston Bike Plan Team works on bikeway recommendations for northwest Houston during the network planning workshop.



A closer view of the table map showing job and population density, existing bikeways, and recommendations from past studies (above).

The legend for the network planning workshop table maps (right).



Drawing the Lines

To develop the plan, the city was broken into eight sections and each was the focus of a detailed design exercise. Working as a group, the team developed recommendations on a table map zoomed into one portion of the city at a time. The map for each section depicted roads, parks, bayous and drainage channels, population and job density, and the location of schools and libraries, along with existing bikeways and proposed bicycle facilities from previous planning efforts.

Proposed facilities for the Bike Plan were drawn and classified as 'Off-Street' (green), 'Dedicated in Street Right-of-Way' (blue) or 'Shared On-Street' (purple). Blue lines were drawn on streets where dedicated space such as a bike lane or side path will likely be required to meet the goal of providing a high-comfort bikeway. Purple lines were used on lower speed, low volume streets where high-comfort shared lanes are realistic.

More detailed facility specifications - for instance, whether a bike lane should be buffered or not - will be determined in the engineering and design phase of specific projects in consultation with **Chapter 4: Bicycle Toolbox**. The facility type (green, blue, or purple), may also be reconsidered in the design phase based on the and community engagement, the desired level of comfort, roadway design, and available right-of-way.

In developing the map, careful attention was given to ensure continuity of bikeways in adjacent areas of the city. The focus

was on developing a cohesive citywide network, linking areas of housing, jobs, major destinations and activity centers, providing connections across longer distances, and connecting to major off-street bikeways such as bayous, parks, and other trails.

The density of proposed bikeways in a particular section of the city was typically aligned with the density of activity, the connectivity of the roadway network, and availability of off-street corridors. Neighborhood routes that deliver connectivity benefits or had been prioritized through other plans were included while those that simply run within a neighborhood were typically not.

Existing conditions information was referenced to assess the feasibility of each recommendation in light of available information about existing right-of-way, roadway configuration, and traffic demands. Ideas and concepts requiring additional research or coordination were noted. The team continuously compared the progress of the draft network to public feedback from the corresponding area to confirm that all ideas were taken into consideration.

Toward the end of the network planning workshop week, members of the Bicycle Advisory Committee were invited to provide additional input on the progress.

At the end of the workshop, the working maps were photographed and the proposed lines were transferred to GIS software to aid in review, analysis, and mapping.

The Bike Plan is a master plan similar to other City master plans that outline the City's long range vision, goals and recommendation for policies, programs and projects. It is also a component plan required by the City's Complete Streets Executive Order. Master plans are adopted by City Council Motion and not ordinance.

The facilities shown on the maps are recommendations for future facilities, representing corridors along which bicycle facilities should be considered along the corridor. Having a recommended facility in the Plan on a street does not mean the facility must be built on that street; nor does the Plan prohibit a facility from being built if the facility is not shown on a map in the Plan.

Although the Plan does not require agencies to construct in accordance in the Plan, it does compel agencies who are improving streets to consider the Plan as they develop plans and design for any improvement along the corridor. Final decisions on the design and location of bicycle facilities will only happen after additional analysis and public engagement. In some cases, detailed planning, design and community feedback may determine a more appropriate route to serve the same connection. If so, the proposed bikeway may be relocated elsewhere within the same general corridor.

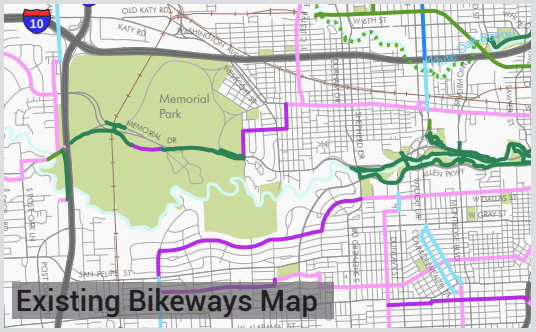
Important Note on Bike Plan Maps:

The lines on the maps represent transportation corridors that are recommended for bicycle facilities. Public engagement beginning no later than the preliminary engineering phase will be conducted prior to the determination of the specific location and design for all new bike facilities.

Blue lines shown on short-term and long term-maps as future projects represent dedicated bicycle facilities within the street right-of-way. A side path within the right-of-way could be implemented where appropriate, based on context, design considerations, and community input.

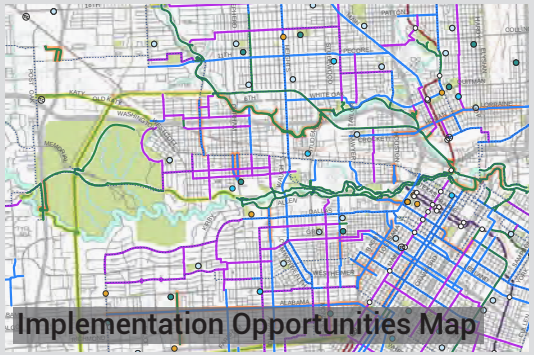
HOW TO UTILIZE THE BIKEWAY NETWORK MAPS

The bikeway network maps developed in this chapter are provided in greater detail online in both static and interactive versions on the Houston Bike Plan and Houston Bikeways Program websites. It is recommended that the city maintain the following bikeway maps to communicate and manage the development of the bikeway network.

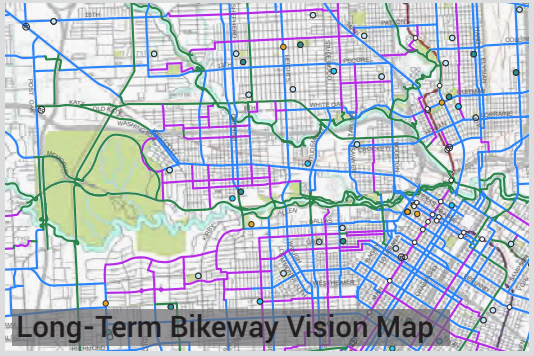


Existing Bikeways Map

The **Existing Bikeways Map** should be available and primarily utilized to communicate the existing network to people for ***trip planning***. This map should include facility type and level of comfort details so that all bicyclists can select routes aligned with their skill and comfort level. This map should be updated as new bikeway segments are implemented or, where no dedicated bikeways exist, new bikeway segments are assessed for level of comfort. A version of this map should be made readily available in an easy-to-carry, easy-to-read, pocket-sized format as well as an online tool.


Implementation Opportunities Map

The **Short-Term Implementation Opportunities Map** serves as a tool to ***identify, track, and manage near-term implementation*** projects. This includes funded projects as well as potential implementation projects that are feasible and possible with limited resources. This map serves as a coordination platform for city projects and opportunities, partner implementation coordination, and development coordination. New projects should be added to this map as they are identified for potential implementation by the City and regional partners. The map should be developed to help support future grant applications, calls for projects, and project prioritization.


Long-Term Bikeway Vision Map

The **Long-Term Bikeway Vision Map** outlines the corridors where bikeways are desired to support the city's goals of providing citywide access to safe, comfortable bikeways that connect many people to many jobs, activity centers, and destinations. This map should link with the city's overall plan for complete streets implementation and serve as the framework for the development of new facilities. It should be a key input as new roadway corridors are constructed or roads are redone through the CIP program, or constructed by other entities.

On the maps, blue lines represent dedicated bikeways within the street right-of-way. A side path within the right-of-way could be implemented where appropriate, based on context, design considerations, and community input. For example, some corridors may be shown on the map in blue indicating a plan for a dedicated on-street facility with the public street right-of way along the corridor, but through detailed planning and engineering a side path within the public right-of-way may be determined as a more appropriate design for the bike facility. This is why side paths are shown in both the Off-Street column (Green) and the Dedicated On-Street column (Blue) of facilities in the Bicycle Toolbox in Chapter 4. . If constructed as a side path, the bikeway will be shown in green on updated maps of existing bikeways.

The Bike Plan map recommends bike facilities along a broad range of on and off-street corridors. In general, the study team attempted to use local and collector streets where feasible as they often provide the most comfortable and safe route for a bicyclist. However, local and collectors streets do not always provide direct, convenient connections between neighborhoods or provide access to important destinations. In some areas of the City, there is not a well-connected roadway network other than the major thoroughfares. Recognizing these challenges, the League of American Bicyclists recognizes the value of thoroughfares in a bicycle network, and includes percentage of arterial streets with bike lanes as one of its benchmarks in achieving a silver or gold bike-friendly community rating. In order to create a well-connected network some major thoroughfares are also included as part of the overall bikeway network.

ThinkBike

The unique context of Downtown Houston and an opportunity to engage international experts supported an additional workshop to build more detailed consensus around

ThinkBike Workshop - Downtown Houston

Source: Rice Design Alliance



recommendations for Downtown bicycle infrastructure. To this end, the City of Houston and the Downtown Management District sponsored a workshop in mid-October called ThinkBike. Consultants from the Dutch Cycling Embassy were brought in to provide expertise on worldwide best practices, and the public was invited to hear from them and provide input. A diverse group of engineers, planners, architects, property owners, developers, city staff, advocates, and students were invited to take part in the two-day working session which culminated in a public presentation of bikeway recommendations for Downtown Houston. Those recommendations were incorporated into the draft network plan presented here.

Updates to the Bike Plan Maps:

Based on additional community input after this document was developed, the several additional changes will be made to the online versions of the final draft Bike Plan maps (Note: These changes will not be made to the maps included within this document, only to large format and online maps.)

- Center Street between Houston Avenue and Detering Street and Detering Street between Center Street and Washington Avenue have been added as shared on-street facilities to the short-term implementation opportunities map following additional public comment, outreach, and analysis.
- Ranchester Road between Town Park Drive and Bellaire Boulevard has been added as a dedicated in street ROW bikeway to the short-term implementation opportunities map as a result of a pre-engineering study for need area N-2016T-0010.
- W. Airport Blvd. between Hiram Clarke and Rosehaven Drive, change from green (off-street) to blue (dedicated on-street). This reflects a programmed TxDOT project.
- Elmside and Woodchase in Westchase as green (off street) on the long- term visions map. Westchase District is actively designing a side path along these streets from Westheimer to the Centerpoint trail south of Westpark Drive. This project has been discussed with PWE including a new traffic signal to cross Richmond.
- Walnut Bend Lane from Olympia to Cedar Creek, Cedar Creek from Walnut Bend to Blue Willow, Blue Willow from Cedar Creek to Riverview, and Riverview from Blue Willow to Harbor Oaks as shared on-street; Harbor Oaks from Riverview to Beltway 8 frontage as dedicated (Blue). These are part of as connection north to Terry Hershey Park.
- Chimney Rock south of Orem has been changed from long-term to short term.
- Bikeways on Lamar Street between Bagby Street and Buffalo Bayou and Holman between Smith and Louisiana have been added to the existing facilities map
- Boheme from BW8 to Memorial Drive (shared on-street) and Woodway between Bering Ditch and Winrock Blvd. (off-street) added to long-term map.
- Briargreen Drive between Richmond Ave. and Piping Rock Lane added as shared on-street bikeway to long-term map to provide additional connectivity.

BUILDING THE BIKEWAY NETWORK MAP

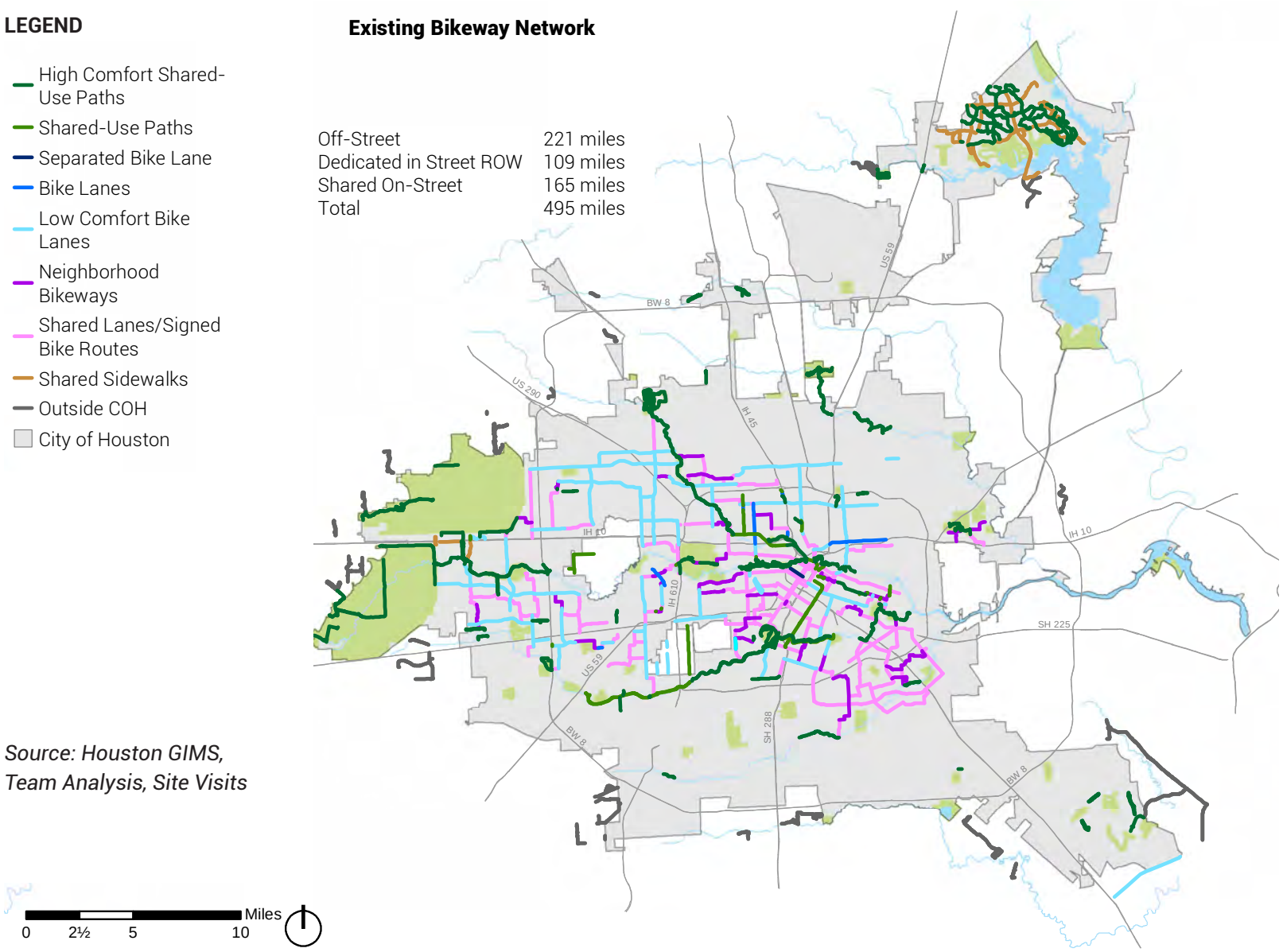
A starting point for building out the Houston Bicycle Network Map is the system of bikeways already in existence. Figure 5.1 shows the existing Houston Bikeway Network using the bikeway types presented in **Chapter 2: Existing Conditions & Opportunities**.

Two of those bikeway types, however, were defined as low-comfort facilities with a level of comfort 3 or 4. Given the Bike Plan's goal to create a "citywide network of comfortable bike facilities," it was determined that Low Comfort Bike Lanes and Shared Lanes/Bike Routes on high-volume streets should not be part of the toolbox going forward. While these bikeway facilities will remain on streets and on the map of existing bikeways for the time being, the long-term goal will be to phase them out, either by upgrading or replacing them with parallel, high-comfort bikeways.

Of the approximately 500 miles of bikeways in the current network, only about 260 miles meet the definition of high-comfort facilities. Figure 5.2 shows the remaining network when the low-comfort bikeways are excluded. With the exception of the major bayou and rails-to-trail corridors, limited connectivity currently exists among high-comfort bikeways, which are primarily off-street paths and neighborhood routes.

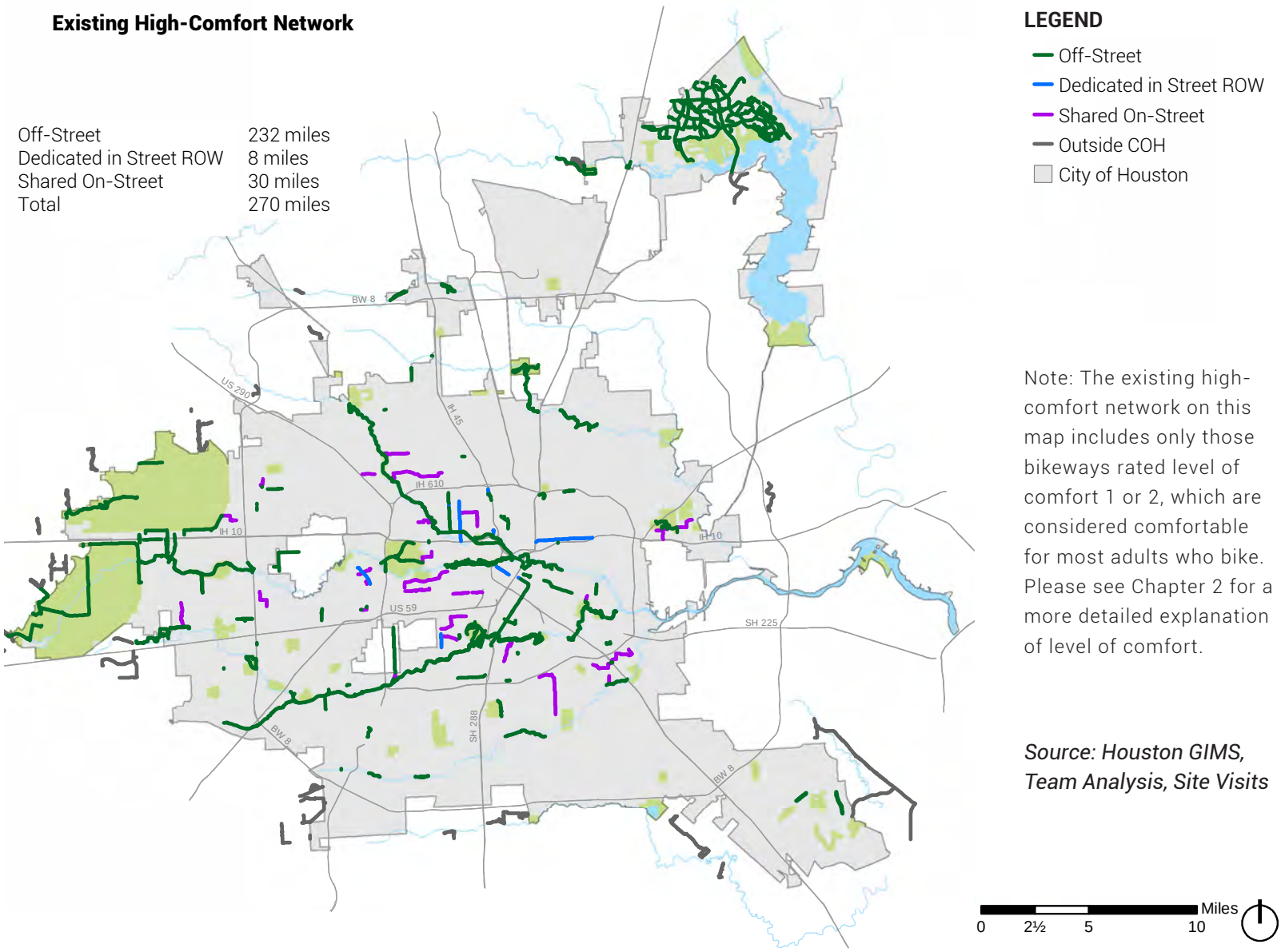


New White Oak Bayou Trail connection to the Leonel Castillo Community Center under construction but already getting use. Project funded by a TIGER Grant award to the City of Houston and the Houston Parks Board



Source: Houston GIMS, Team Analysis, Site Visits

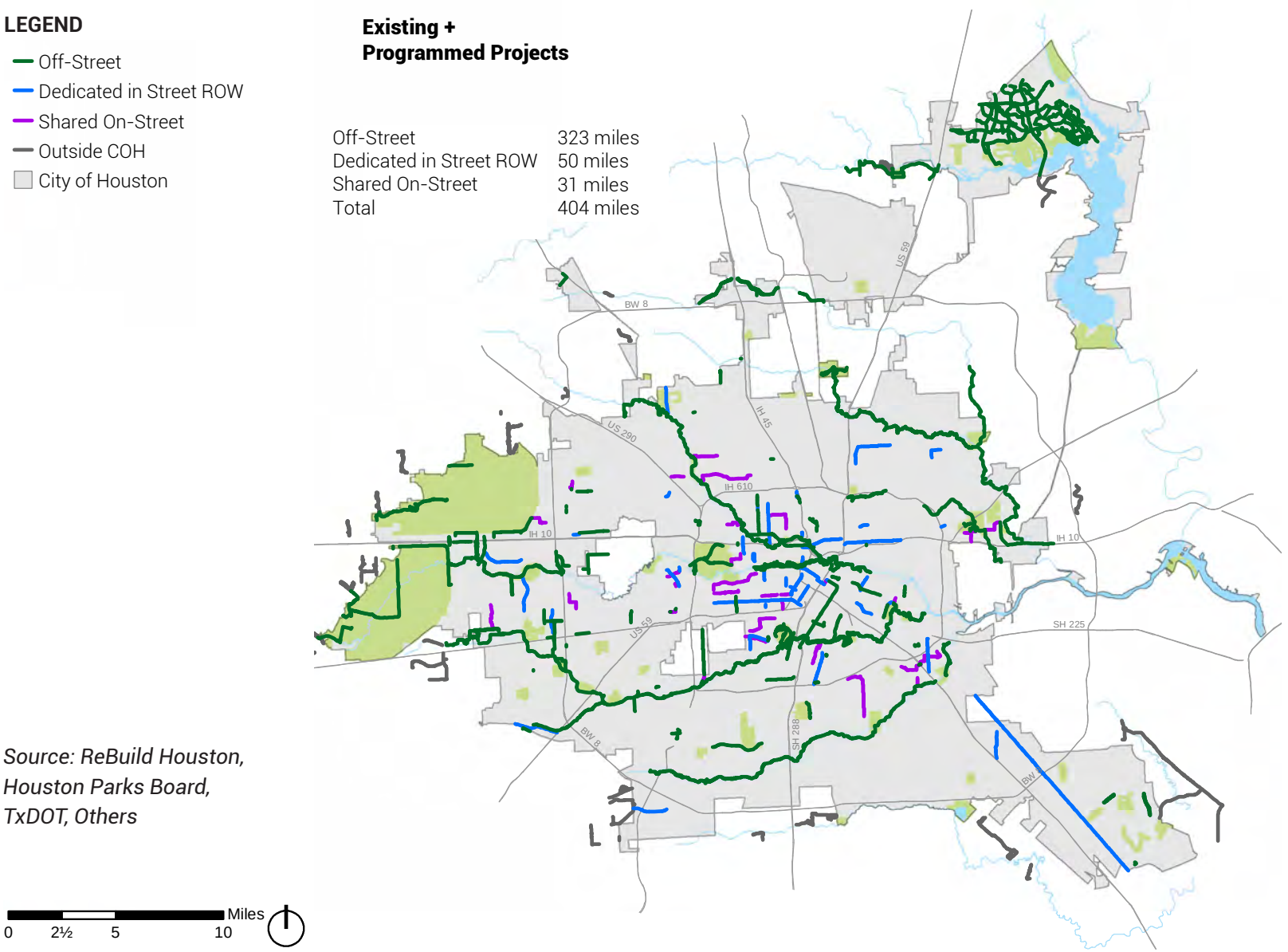
Figure 5.1: Existing Bikeway Network



Note: The existing high-comfort network on this map includes only those bikeways rated level of comfort 1 or 2, which are considered comfortable for most adults who bike. Please see Chapter 2 for a more detailed explanation of level of comfort.

Source: Houston GIMS, Team Analysis, Site Visits

Figure 5.2: Existing High-Comfort Bikeways



Source: ReBuild Houston, Houston Parks Board, TxDOT, Others

Figure 5.3: Existing High-Comfort Bikeways and Programmed Projects

Where We Can Be in 5 Years

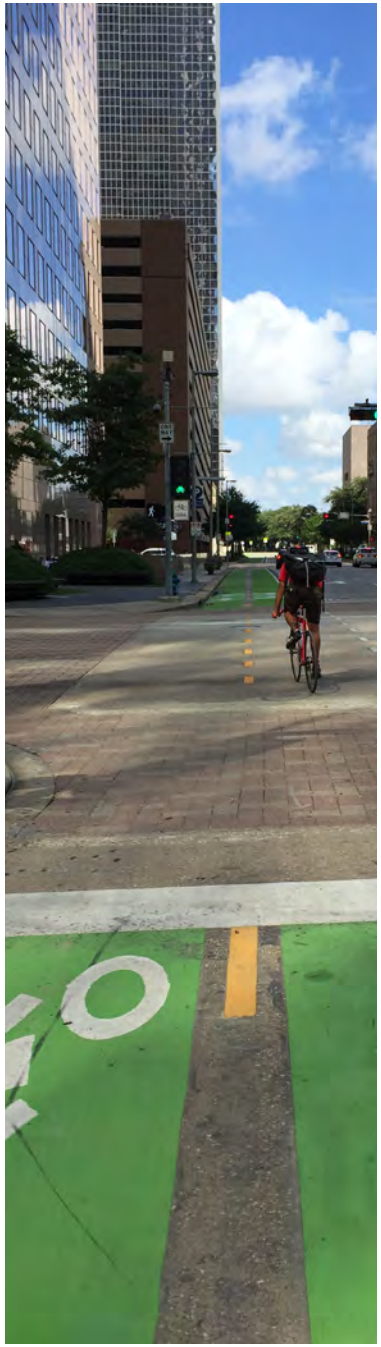
A number of projects throughout the region currently in development include or are anticipated to include bikeway facilities. These include projects funded through Bayou Greenways 2020, the Houston-Galveston Area Council's Transportation Improvement Program (TIP), Management Districts and TIRZs, and the City of Houston Capital Improvement Program (CIP).

Figure 5.3 shows the high-comfort bikeway network with the addition of these programmed projects. Some 91 miles of off-street paths (shown in green) and 42 miles of dedicated in street R.O.W. bikeways (shown in blue) are expected to be added in the next five years or so, generally completing the major bayou corridors within the city and adding a handful of on-street connections. The bulk of the on-street mileage consists of the TxDOT project along State Highway 3 (Old Galveston Road), City of Houston CIP projects along West Alabama Street and Hogan/Lorraine Street, and Midtown Redevelopment Authority projects along Brazos and Caroline Streets. The roughly 130 miles of programmed projects will increase Houston's high-comfort bike network to about 400 miles, a significant addition but only a small step toward a citywide network.

Beyond the projects that are already funded, progress toward a citywide network can be made most quickly by identifying opportunities for lower-cost improvements that won't require major capital construction. These often take the form of "signs and striping" projects, either designating and enhancing bike routes along comfortable, low-volume streets or retrofitting bike lanes onto streets with pavement space that can be reallocated.

Recommendations from the network planning workshop that fit these categories from a technical perspective are shown in Figure 5.4. Implementing these facilities, particularly the bike lanes, will often require trade-offs with other potential uses of space. The streets suggested for optimization of space to allow on-street bikeways (by either reallocation of vehicle lanes or on-street parking) typically have excess capacity at existing traffic volumes, so in many cases the trade-off would be against capacity for potential future traffic increases. Many cities capture these implementation opportunities through regular street striping maintenance or pavement overlay programs.

The benefits in connectivity and providing more people access to the bikeway network borne by these short-term implementation opportunities are tremendous, and a citywide network starts to emerge. The total mileage of high comfort facilities increases by 381 miles to about 780 miles. The Plan recommends that significant progress be made in building out the short term implementation opportunities map within five years, in addition to completion of the programmed projects However, critical gaps persist and some segments remain isolated.

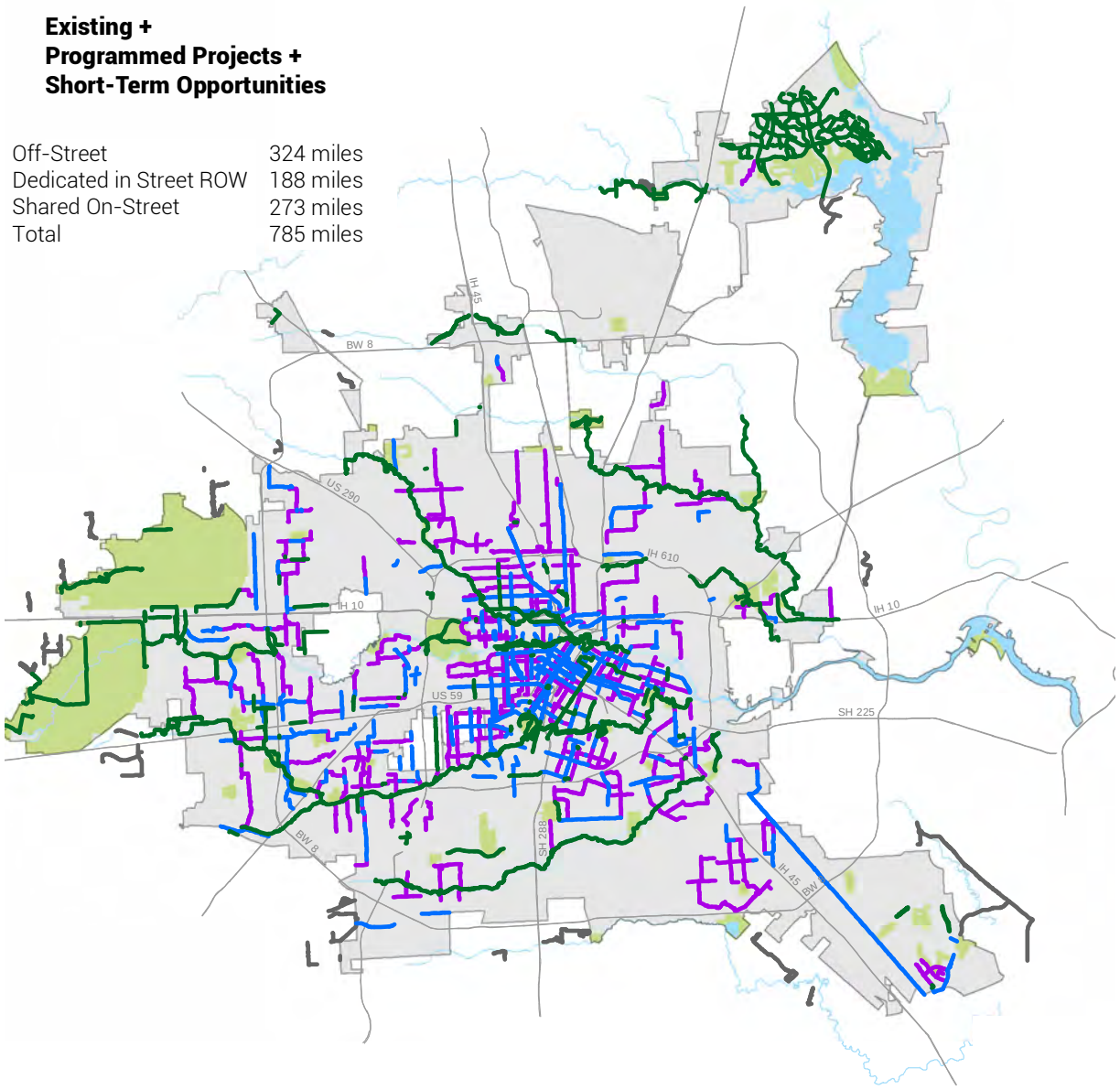


LEGEND

- Off-Street
- Dedicated in Street ROW
- Shared On-Street
- Outside COH
- City of Houston

Existing + Programmed Projects + Short-Term Opportunities

Off-Street	324 miles
Dedicated in Street ROW	188 miles
Shared On-Street	273 miles
Total	785 miles



0 2½ 5 10 Miles

Source: Team Analysis

Note: The lines on the maps represent transportation corridors that are recommended for bicycle facilities. Public engagement beginning no later than the preliminary engineering phase will be conducted prior to the determination of the specific location and design for all new bike facilities.

Figure 5.4: Existing High-Comfort Bikeways, Programmed Projects, and Short-Term Implementation Opportunities

Connecting the Pieces

In some cases there may be opportunities for off-street connections or key on-street bikeway segments to tie together the isolated segments of the citywide network.

Figure 5.5 (with projects highlighted) and Figure 5.6 show how 32 projects encompassing approximately 75 miles of key off-street paths and 12 miles of key street corridor bikeways could tie together many of the disconnected pieces of the existing and potential short-term networks. The Plan has identified these short-term implementation opportunities and the key connections as potential projects that may be implemented over the next 10 years as funding allows, and additional feasibility analysis and public engagement supports.

The short term and key connections would enable Houstonians to bicycle from Clear Lake to George Bush Park, or Tidwell Park in the northeast to Keegan's Bayou in the southwest on high-comfort bikeways. Indeed, all of the Bayou Greenways corridors would be tied into a continuous, high-comfort bikeway network.

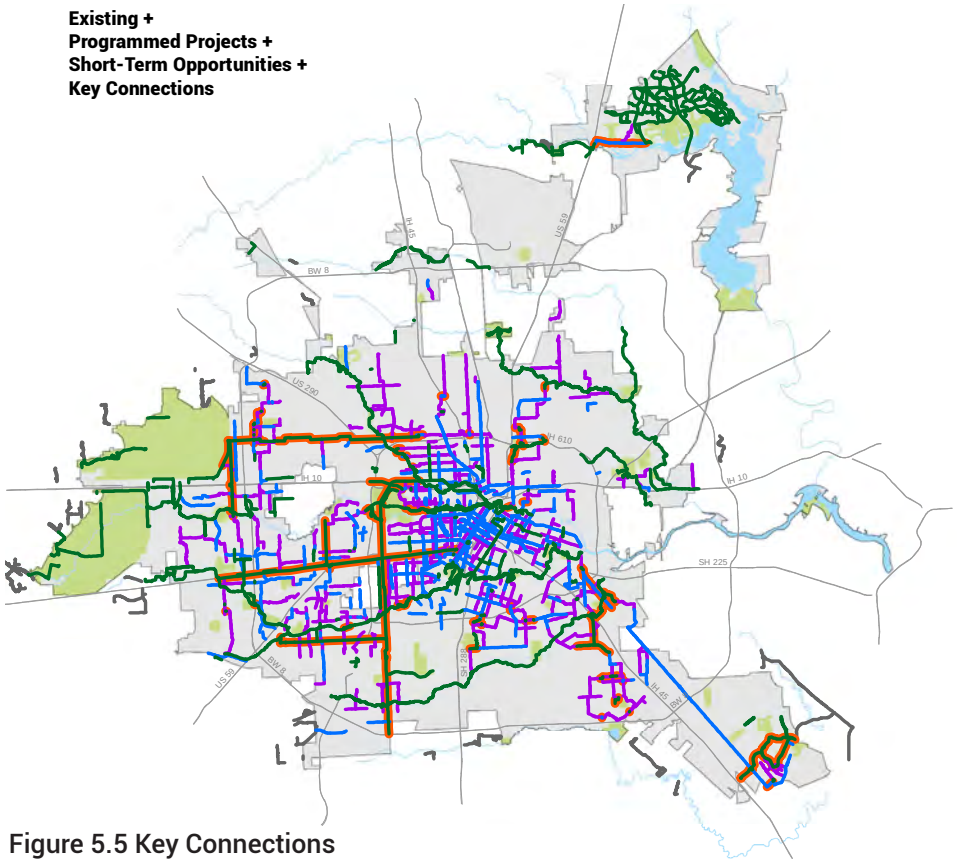
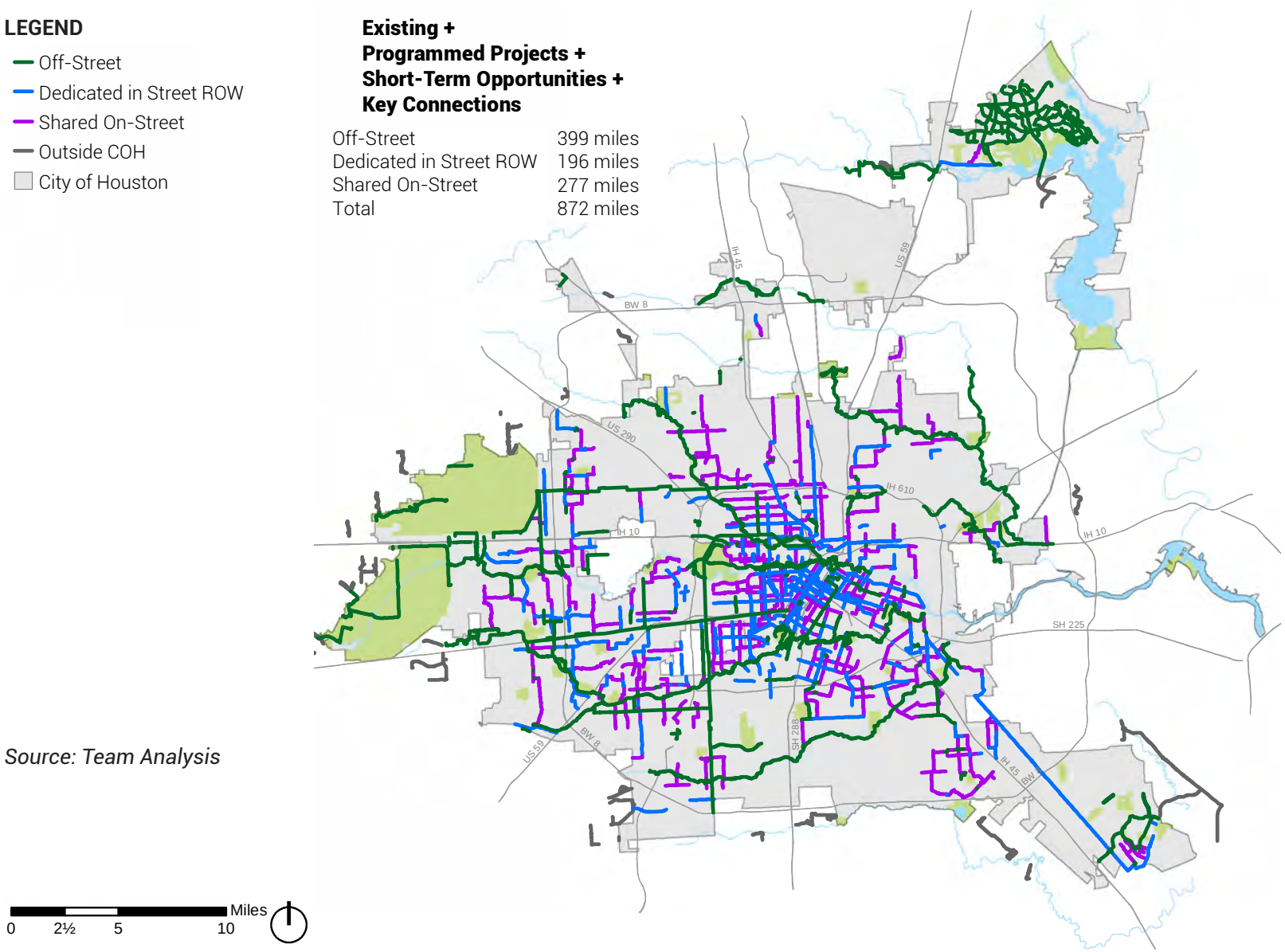


Figure 5.5 Key Connections

Note: The lines on the maps represent transportation corridors that are recommended for bicycle facilities. Public engagement beginning no later than the preliminary engineering phase will be conducted prior to the determination of the specific location and design for all new bike facilities.



Source: Team Analysis

Note: The lines on the maps represent transportation corridors that are recommended for bicycle facilities. Public engagement beginning no later than the preliminary engineering phase will be conducted prior to the determination of the specific location and design for all new bike facilities.

Figure 5.6: Existing High-Comfort Bikeways, Programmed Projects, Potential Short Term Projects, and Key Connections

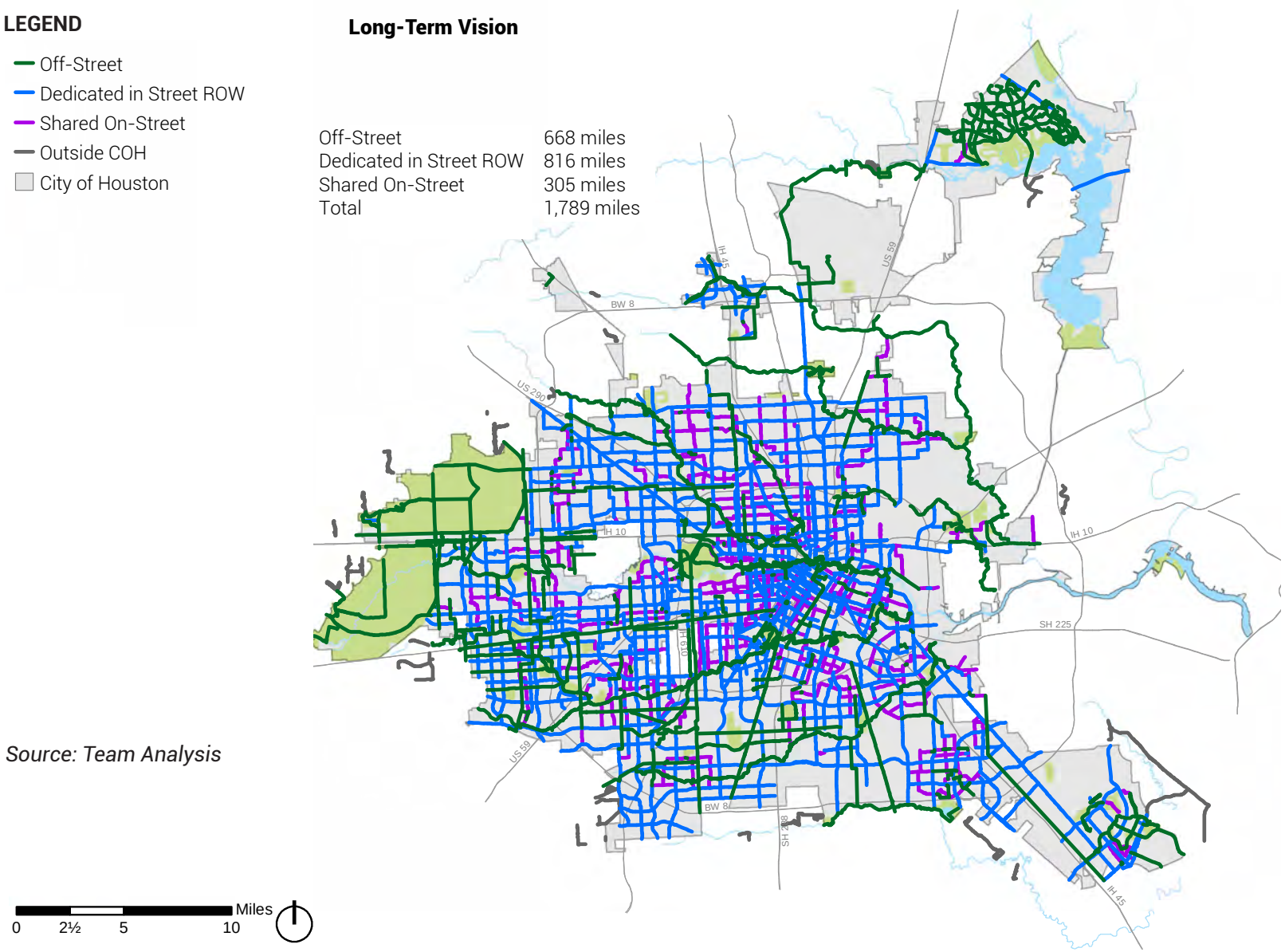
Vision for the Future

While the development of the network described in the previous section would serve most neighborhoods in the city, some parts of Houston lack a connected network of secondary streets that could accommodate comfortable bike routes or retrofitted bike lanes. Often the only option to provide a connected bicycle network in such areas is to use the major thoroughfare corridors.

Adding high-comfort bikeways to thoroughfares can be a major undertaking, requiring reconstruction of the street and potentially acquisition of additional right-of-way to meet all the needs on a corridor. Since the City of Houston CIP is fully subscribed for at least the next five years, additional thoroughfare bikeway projects will necessarily be longer-term efforts or would require a different funding source.

Figure 5.7 shows the long-term vision for the City of Houston Bikeway Network, including an expanded trail and off-street path system and many bikeways that will require street reconstruction to implement. These add 620 miles of potential in street R.O.W. bikeways, 269 miles of off-street bikeways, and 28 miles of bike routes for a full network of 1,789 miles. As noted, the implementation of many of the street corridor bikeways would occur as the streets are reconstruction. Off-street paths would typically require separate implementation projects, and some would involve coordination with neighboring jurisdictions and implementation partners.

For more discussion of how the plan could be funded and implemented, see **Chapter 6: Implementation Strategies**.



Source: Team Analysis

Note: The lines on the maps represent transportation corridors that are recommended for bicycle facilities. Public engagement beginning no later than the preliminary engineering phase will be conducted prior to the determination of the specific location and design for all new bike facilities.

Figure 5.7: Long-Term Vision for the Bicycle Master Plan

ACHIEVING THE GOALS

The ultimate objective of the Houston Bike Plan is to connect people to the places they want to go so that bicycling can be a safe and attractive option for most Houstonians. To ensure the plan delivers on the goal of increased access, it is important to assess how the proposed network would serve people, jobs, and other destinations.

Figure 5.8 shows how each phase of the proposed implementation provides access for people, including some specific populations of interest, and employment. Fewer than 40% of Houston residents currently live within one half mile of a high-comfort bike facility. This improves to about 50% when currently programmed projects are included, and about 80% with the potential short-term projects. This shows the significant opportunity from capturing these near term potential projects in making the bikeway network accessible to many more people.

However, the existence of a comfortable bikeway nearby isn't as useful to someone unless it connects to the places he or she wants to go. Once again, several dozen key projects will be necessary to join the isolated segments into the citywide network. These key implementation projects would create a functional high-comfort network and extend the reach of the bikeways further.

The long-term vision for the full network would touch over 95% of Houstonians. Those not near a bikeway are typically located in low density or relatively undeveloped areas that would be very difficult to serve in a cost-effective manner. Similar coverage numbers for population of color and individuals in poverty indicate that the bikeway network will serve Houstonians equitably and improve low-cost transportation options for the households who may benefit most.

High-comfort bikeway access to jobs within the city is poised to improve from 46% to 65% through completion of programmed projects. This could potentially reach about 85% in the short term and over 95% when the full network is realized. Note that access to jobs is not just important in its own right but also as a proxy for shopping, dining, entertainment, and other business destinations.

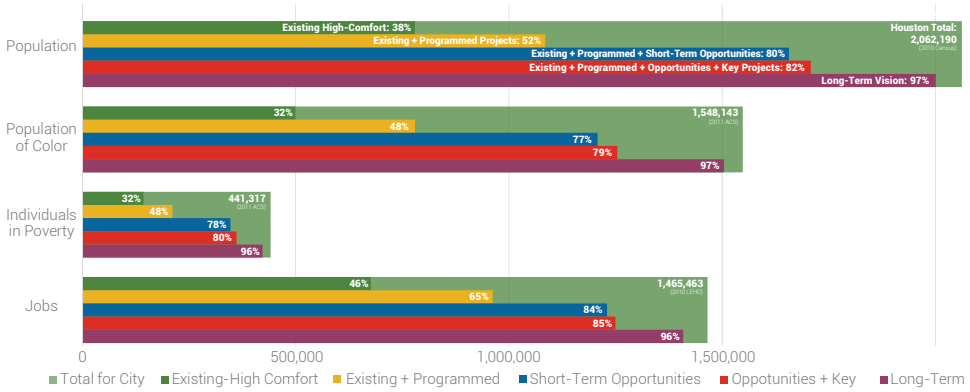
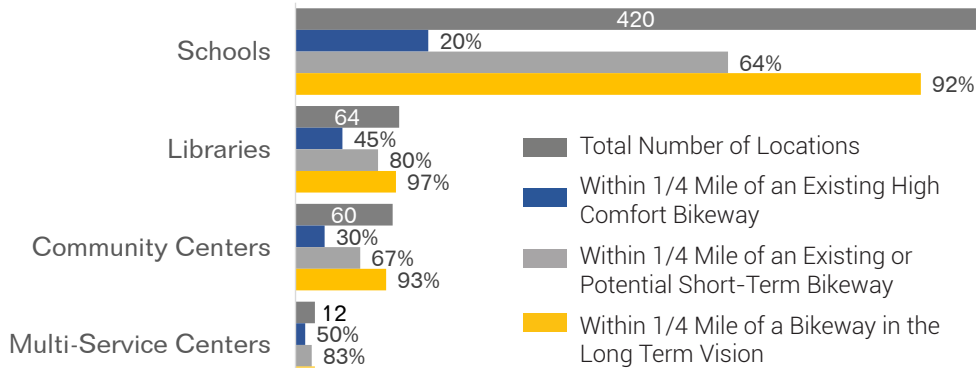


Figure 5.8: Population and Employment Coverage of the Houston Bike Plan Draft Network

Figure 5.9: Quarter Mile Access to Civic Destinations



Connections to the civic destinations previously examined in Chapter 2 are shown in Figure 5.9. Short-term and key projects could serve about 65% of schools and community centers (276 out of 420 and 40 out of 60, respectively) and about 80% of libraries and multi-service centers within one quarter mile. Full implementation will serve over 90% of the current locations of these destinations, with care needed to ensure that the "last mile" connection (or quarter mile, in this case) from the bikeway network to the civic destinations are well designed. Thoughtful planning should ensure that future civic facilities are located on the high-comfort bikeway network.

High-comfort connections to transit will be enhanced, as well. Of the 83 METRO transit centers, park & ride lots, and rail stations within or adjacent to Houston city limits, 31 are currently located within one quarter mile of a high-comfort bikeway. This will improve to 44 with programmed projects and could reach 66 with the addition of the potential short-term and key projects. The master plan will serve 81 of the 83 transit nodes, missing only two park & rides on the very edges of the city. Access to parks, which can be measured in different ways, mirrors the trends seen in the other civic destinations.

The plan described in this chapter would establish a city-wide network of high-comfort bikeways as recommended in the Houston Bike Plan's goals. By matching the bikeway network to the places Houstonians live, work, play, and learn, the network plan also delivers on the goal of access and, if implemented, will be a key component in achieving the Bike Plan's ridership objectives.