V. Changing Mobility Considerations

5.1 Addressing the Shift in How Transportation is Viewed

During Phase One of the City Mobility Planning initiative, the City of Houston contemplated the concept of providing multi-modal transportation options within a corridor planning exercise. That conversation led to the development of the alternative design standards that are located within Appendix 2 of Chapter 10 of the Infrastructure Design Manual. These alternative cross-sections provide for a myriad of design configurations, providing options within the transportation network other than an automobile.

As the City of Houston continues to grow in population, the Northwest Study Area is only expected to grow in popularity. However, as highlighted within the existing conditions chapter of this Report, there are still opportunities within the network to explore new options of how to best move people in a safe and effective manner. Incorporating alternative modes of transportation into the system design before network failure can potentially decrease the likelihood of failure. By providing users with more modal options, the burden on automobiles and streets can be lessened.

The City recognizes that automobile travel will continue to be a vital component of transportation within the region. This is especially true in areas with large clusters of jobs and population. The Northwest is projected to see an increase in automobile traffic throughout various corridors, especially as more people try to access the regional highway network that surrounds the Study Area. However, there is a need to shift the current approach of designing a roadway for the maximum capacity of *vehicles* to the maximum movement of *people* before a corridor before it reaches maximum capacity; this can be achieved by evaluating a corridor for all modes of transport. As a result, the following represent the change in mobility considerations that are taking place across the United States, and as seen in recent years, in the City of Houston. Although exact policies within the City have not been developed for all considerations discussed, these concepts should be continuously considered when evaluating complete system mobility. The most recent change in Houston includes the concept of Complete Streets which is discussed in more detail here.

PHOTO PROVIDED COURTESY CITY OF HOUSTON

5.2 Complete Streets and Houston

What is a Complete Street?

The push for designing Complete Streets is felt by many major cities for different reasons. In some communities, traffic has become an unmanageable challenge and right-of-way is limited. In other areas, a health-conscious community has learned that using other modes of transportation benefits their social and physical health. Regardless of the motivating factor, creating corridors for more than just the automobile is a policy shift that is gaining momentum in the United States.

Tying into the Existing Culture of Houston

Houston is known for its innovation and willingness to let the community grow and develop by allowing the market to influence development. With this notion, Mayor Annise Parker issued Executive Order 1-15 regarding Houston Complete Streets and Transportation Plan. This initiative promotes the use of Complete Streets throughout the City of Houston. In her press release on October 10, 2013, Mayor Parker stated, “Houston is a city that embraces its diversity. This Complete Streets policy applies the same approach to our mobility system by meeting the diverse needs of all Houstonians while also creating more accessible and attractive connections to residential areas, parks, businesses, restaurants, schools and employment centers.” Houston’s attitude towards moving with the changing times and needs of its communities is well suited for moving into a new era with Complete Streets.

However, moving to implement a Complete Streets policy will be a new way of thinking for many officials and residents within Houston. When it comes to streets, Houston has relied on increasing the roadway capacity for vehicles to manage the growing population. The Complete Streets policy is focused on the movement of people along corridors, not just vehicles. Transitioning to this approach will require education and training on Complete Streets for it to be embraced, even for a community that is willing to adapt to new trends in many areas of development.

Elements of Design

Complete Streets have many design characteristics and plans for the travelway, streetside and context. Within the travelway, a Complete Street will provide for the modal uses deemed appropriate for the corridor. This includes the designs and widths of travel lanes, special transit facilities, on-street bicycle facilities, on-street parking, medians, and pedestrian crossings. Design elements for the streetside include off-street bicycle facilities, pedestrian travelway, landscaping (such as buffers or tree wells), and frontage zones.

The interaction of different modes (automobiles, transit vehicles, bicycles, pedestrians, and light-rail) can be a complex challenge. Some modes are compatible with one another within the right-of-way, while others need specific guidelines to create a safe and harmonious corridor for the different users.

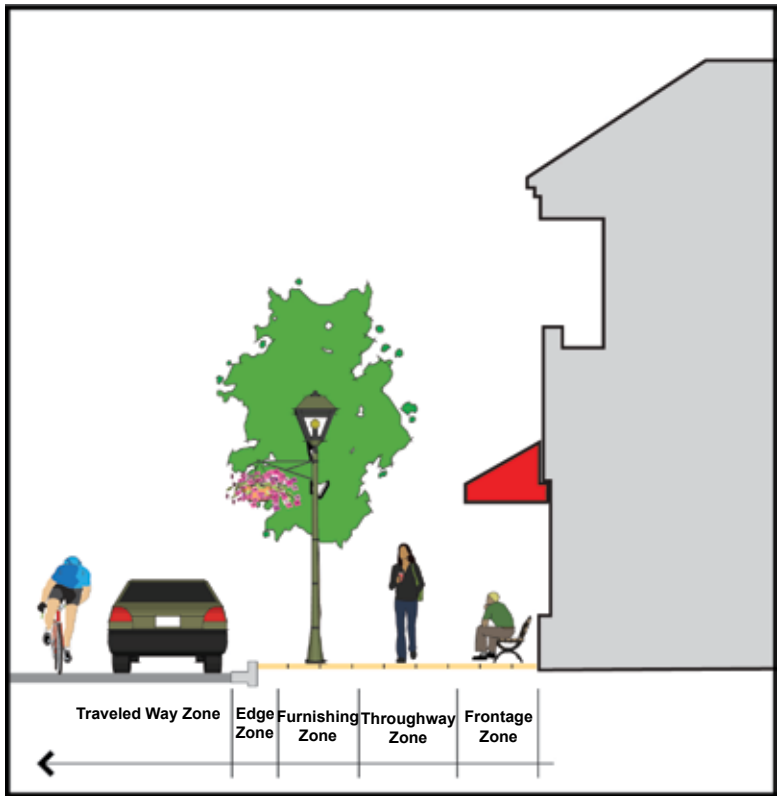


FIGURE 5.1 SOURCE: DALLAS COMPLETE STREETS MANUAL

Purpose of Complete Streets

The Purpose of Complete Streets Design

Complete Streets intend to provide a safe and accessible street for users of all ages and abilities. In major cities and metropolitan areas, Complete Street policies are being designed to guide the future development and redevelopment of major corridors. An Executive Order initiated by Houston's Mayor in October of 2013, states within the definition of Complete Streets, "The Complete Street concept takes the following variables into account when providing services [corridor attributes]:

- People being served at their residence or property by other right-of-way users;
- People of all ages and abilities, including children, older adults, and persons with disabilities;
- The function of the road (e.g. local collector and thoroughfare) and the level of vehicular, pedestrian, and bicycle traffic;
- Multi-Modal Classification Street Types; and
- Providing other options of transportation for different incomes."

Enhanced Efficiency of All Modes

The street network of a community/city/region defines its structure and has the largest impact on the types of traffic challenges they face. A well-connected network can provide for many routes, reducing congestion levels on a single thoroughfare. Connectivity is an important factor in creating an efficient transportation network. A well-connected network provides several inlets/outlets for users to travel to their destination. This helps to reduce heavy loading on a particular corridor and does not apply singularly to automobile networks. Transit networks need to be well-connected to other lines, stations, and destination centers. This also relates to bike networks, but they have the advantage of using on- and off-street facilities to create their network.

Implementing Complete Streets

Many techniques are being employed in Houston. For instance, Chapter 10 Appendix 2 of the Infrastructure Design Manual maintains current MMC design considerations. Also, the many sub-regional plans each promote Complete Street policies. However, all planning needs to be combined with a change in policy matched with changes in the Engineering Design Manual.

The City is also embracing on its first ever Complete Street Transportation Plan. Although the development of the Plan is still in its infancy stages, it is anticipated to provide a framework or blueprint for the City's adoption of such policies as the concept continues to mature within the City of Houston.

PHOTO PROVIDED COURTESY CITY OF HOUSTON

5.3 Health in the Community

The Houston Mobility Plan and related sub-studies focus on encouraging multi-modal corridor design throughout the Houston area. By doing so, each study area has the potential to grow and redevelop into an environment that is friendly for both auto and non-automobile users. This process can be split into near and long-term redevelopment strategies; from sidewalk repair (near-term), to multi-modal street reconstruction (long-term). Developing livable environments also produces an additional outcome not traditionally stated as a goal at the onset of mobility plans: A healthier community.

Health and Transportation

Can the way we travel to and from destinations impact our health? This is a question that is being raised across the nation, as communities seek ways to increase health and decrease alarming statistics related to obesity, asthma, and other chronic diseases associated with unhealthy food choices and inactivity. Findings from an international survey show that the United States has some of the highest rates of car usage and the lowest rates of walking, biking, and public transportation compared to other industrialized countries. These factors were also found to directly correlate with obesity rates and related lack of physical activity.[1] Overall population health reflects these trends, where over two-thirds of Houston adults and almost one-third of children are overweight or obese, thus at increased risk for a range of health conditions such as heart disease and diabetes.[2]

Houston & Harris County Statistics [2]

Inefficient Physical Activity

- *Adults 53%*
- *Children 77%*

Obese of Overweight

- *Adults 63 %*
- *Children 34%*

According to the US Surgeon General report on physical activity and health, "30 minutes of moderate physical activity, 5 day a week, even when performed in short sessions of activity, is enough to provide health benefits such as reduction in obesity levels, coronary heart disease and hypertension."[3] Therefore, a simple shift away from driving and toward a more active commute – such as walking, walking to transit or bike riding – could provide an opportunity for physical activity and decrease the risk of chronic disease for otherwise sedentary individuals.[4]

In a study published in the American Journal of Preventative Medicine, key indicators found to increase physical activity include building and enhancing sidewalks, providing efficient bicycle lanes, and promoting more efficient transit service.[5] Similar evidence also indicates that individuals living in areas with a more complete, walkable network are more likely to walk to nearby amenities and transit stations. These individuals walk an average of 35-45 additional minutes per day than individuals living in less walkable environments.[6]

The desire for increased opportunities for physical activity through walkability and bikability is also evident within public comments received for the purposes of this Report within the Northwest study area. Whether these desires are for recreational, commute, or utilitarian purposes, one underlying concept remains the same: these forms of travel are active.

Improvements to the built environment and integration of complete streets at the neighborhood level can improve access to healthy food in addition to physical activity. In a study that highlighted the need for better access to healthy choices called the Harris County Food System report (October 2013), the location of food stores and their accessibility via public transportation was found to greatly impact a family's access to healthy food and healthy choices. For families or individuals without a car, public transportation – including safe sidewalks and bike routes - is necessary for accessing food, services, and recreation. Study findings indicate that over half (54%) of residents in one Harris County community traveled over 6 miles to a grocery store, while two-thirds of residents in a second community traveled over 1 mile to a grocery store, with an additional

20% traveling over 6 miles. The report identified issues that impact community health and can lead to childhood obesity, and also provided policy recommendations that would make healthy choices easier for community residents, including improvements to the built environment.

This paradigm shift in transportation as it relates to health is fitting for the purposes of the Northwest Mobility Study, as well as similar sub-regional studies especially in regard to the implementation of the new Complete Streets policy. A well-functioning transportation network not only moves people, but also provides healthy and safe

transportation options that benefit all users of the network.

PHOTO PROVIDED COURTESY KHA

Example Initiative Include:

- Community Transformation Initiative (CTI): Aimed at enhancing community livability through enhancing connectivity, walkability, increasing access, etc. for all area residents.
- Healthy Living Matters (HLM): mission is to mobilize policy action to curb childhood obesity in Harris County which includes measures such as active living. Report: http://www.healthylivingmatters.net/wp-content/uploads/2012/07/HLM-Assessment-Report-Final.pdf

[1] Pucher, J. and C. Lefevre. 1996. The Urban Transport Crisis in Europe and North America. London: Macmillan Press Ltd.

[2] Institute for Health Policy at The University of Texas School of Public Health, Houston Health Survey, 2010

[3] US Department of Health and Human Services. Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Promotion; 1996, Available at http://www.cdc.gov/nccdphp/sgr/sgr.htm, accessed 14 August 2008.

[4] Transit and Health: Mode of Transport, Employer-Sponsored Public Transit Pass Programs, and Physical Activity. Journal of Public Health Policy (2009) 30, S73-S94.

[5] Brennan-Ramirez, Laura K. et al. (2006). "Indicators of Activity-Friendly Communities: An Evidence-Based Consensus Process." American Journal of Preventive Medicine, Volume 31, Issue 6

5.4 Street Connectivity Consideration

Traffic congestion within suburbs is a well-known concern across the United States, and Houston is no different. As suburbs continue to emerge as not only bedroom communities, but a place for commerce, employment, and residential recreational activities, the blending of regional peak hour traffic with local commuter trips is inevitable. As such, concerns expressed by the general public and stakeholders regarding congestion within the Northwest study area is not a surprise as residents seek ways to keep those aspects of the suburban network for which they love, but increase the system's usability to provide a more workable network for the local experience.

Connectivity and the way it is perceived in the suburban context is a conversation taking place across the United States, and it is one evident within the Northwest Study Area. As expressed during the first public meeting and subsequent stakeholder meetings, the suburbs are a direct result of market demands, and as such should not be developed to mimic the urban context. However, the following aspects concerning enhanced connectivity within this network have been expressed.[1]

Expressed Benefits to Keep:

- Refuge from urban living
- Less cut-through traffic
- Less hard scape/more natural features
- Larger lot sizes
- Exclusivity
- Security

Expressed Connectivity to Enhance:

- Alternative modes of transportation (i.e. via walking, bike and transit)
- Use of natural features, trails, and bayous
- Connections to schools, libraries, and other neighborhood amenities
- Access to shopping and local entertainment
- Key transit/bus stops

Market Trends

These expressed desires for enhanced connectivity via alternative modes are not new. In fact, they relay many of the design considerations of more historic suburbs that were more inclined to mimic the natural environment.[2] As cars became more predominate, the pedestrian network was ultimately preserved by a system of off-street trails that linked communities together with a series of parks or open space, commonly referred to as the Radburn Model. [3]

FIGURE 5.2 SOURCE: MARTIN, M.D. RETURNING TO RADBURN

Newer suburban subdivisions, however do not emphasize the need for a strong alternative network often citing the ever-increasing land values, construction costs, and the perception of decreased security as noted concerns.

The result of these development practices has ultimately led to the "Loop and Lollipop" pattern most prevalent with today's suburban development. Within the Northwest

1. For full set of public comments, see Appendix XX

2. Grammenos, F., Pogharian, S. and Tasker-Brown (2001). Residential Street Pattern Design Working Paper #389. Research funded by Canada Mortgage and Housing Corporation.

3. Birch, Eugenie L., Radburn and the American Planning movement. University of Pennsylvania. Department of City and Regional Planning.

Study Area development trends align with historic national trends where older suburbs, characteristics of elongated street grids, are located closer to the 610 Loop (i.e. Fragmented and Wrapped Parallel). However, more recent "Loop and Lollipop" suburban communities are more commonly positioned closer to Beltway 8 (i.e. Loops and Lollipops), where virgin land is more abundant.

Making it Work

Street Patterns

Gridiron	*Fragmented parallel*	*Wrapped parallel*	*Loops and lollipops*	*Lollipops on a stick*
(c. 1900)	*(c. 1950)*	*(c. 1960)*	*(c. 1970)*	*(c. 1980)*

FIGURE 5.3 SOURCE: GRAMMENOS, F. (2002). RESIDENTIAL STREET PATTERN DESIGN

The general public is aware of the premises of the suburbs and, as stated earlier, desires to maintain those traits because they make the suburbs a desirable place to live. Similarly, the City of Houston recognizes that the design trends identified above occurred over an extended period of time. This resulted in varying degrees of existing networks of streets, sidewalks, parks, and other infrastructure that make up a system of neighborhoods that cannot be moved or drastically changed overnight for the sake of increased connectivity.

So what is the solution? To put it simply, many communities are working with what they have. In other words, communities are seeking ways to improve the suburban networks that already exist. The tools explored below are unique to the City of Houston and are intended to explore ways to enhance alternative networks which not only link communities and related neighborhood amenities to each other, but also to the greater area network. General considerations include:

Connect Pedestrian Attractors/Neighborhood Amenities

Pedestrian attractors/neighborhood amenities are best defined within the provided context as destinations that generate foot traffic from nearby residential communities to areas of activity whether for recreational or utilitarian purposes. The City of Houston does not currently maintain a standard methodology for measuring such attractors, but examples of typical residential attractors within residential neighborhoods include parks, libraries, schools and health related facilities.

Look Past the Street

Although multi-modal street treatments are an essential part of this study, it is important to note that the intended purpose is not to design streets, but rather move people. In areas like the county where pedestrian movement along primary corridors is restricted due to safety concerns, neighborhood connectivity is best achieved off the beaten path. The City of Houston has several natural resources (the bayous) which can be used to develop this off-street path. The Houston trail system is gaining popularity as it continues to mature.

The Northwest Study Area is comprised of three primary Bayous: White Oak, Little White Oak, and Halls Bayous. As part of the City's and County's storm water management plan, these naturally occurring corridors have been largely preserved throughout the City of Houston and the greater ETJ. As organizations, such as Houston Parks Board – Parks by You and the City develop these bayous for trail use, communities should identify key transition points from existing neighborhoods onto these newly constructed amenities.

Fill in the Gaps

Gaps within the local street network are expected given the suburban nature of this area. However, understanding why gaps might exist will help communities and the City alike to better understand what changes, if any, might result in a more usable network. Potential gap connectors include:

Local Street Extensions/Stubs: Within the City of Houston, developers are required to provide internal block lengths of at least 1,400 feet for local subdivision streets. If a local street terminates without means of a turnaround (i.e. a street stub) future developers are required to extend this connection to preserve internal connectivity within the local street network. Depending on the circumstances, variances are granted [4] eliminating local connectivity for car traffic. With a simple reconfiguration the local network can be maintained for pedestrian and bike traffic only. The result is a street network which works to eliminate unwanted vehicular through traffic without inhibiting the movement of people. Potential examples of connections include local area connections to grocery stores, boutiques or other commercial establishments.

Excess Development Reserve: Where parcels of land are too small and an additional house is not feasible, a reserve may be established within a provided subdivision. These parcels can be located at the edge of provided development, offering great connectors from one development to the next, or alternative access to bayous, parks or other neighborhood amenities. [5]

Utility Easements: Easements provide access to various piping, electrical wiring, etc. throughout the City and County alike. These easements (like provided bayous) typically transcend multiple neighborhoods providing a strong network of essential utility lines of various types. Where appropriate, these easements may be utilized as an alternative transportation network not appropriately suited for the automobile.

Source: Pending. Image provide from study conducted in Germany.

Source: Standard Highway Sign Designs (SHSD) for Texas, 2012 Edition. Texas Department of Transportation (TxDOT).

Publicly Owned Property: Provided properties in and around the City of Houston and Harris County alike maintain access to properties that may have limited use due to regional concerns such as flooding. In circumstances where appropriate, potential opportunities arise where alternative transportation access may be more suitable then the automobile. Within the Northwest Study Area, it is appropriate to construct paths over man-made footpaths that have been created over the years, connecting popular points of interest.

Figure 5.4 Source: Image acquired via Google Maps. Representative of Example B within "Exploring the Possibility" section of this Chapter.

Future Developments: 23% of the Northwest Study Area is comprised of undeveloped land, and an additional 6% is owned or used by a public entity (See Appendix A). As these connections are considered throughout existing developments, new developments should warrant easy retrofits to existing networks as previously defined. Put simply, the market has shown evidence of demand where, as reported in the 2002 survey conducted by the National Association of Realtors and the National Association of Home Builders, "Trails ranked the second most important amenity..." within residential communities.

Figure 5.5 Source: Image acquired via Google Maps. Representative of Example B within "Exploring the Possibility" section of this Chapter.

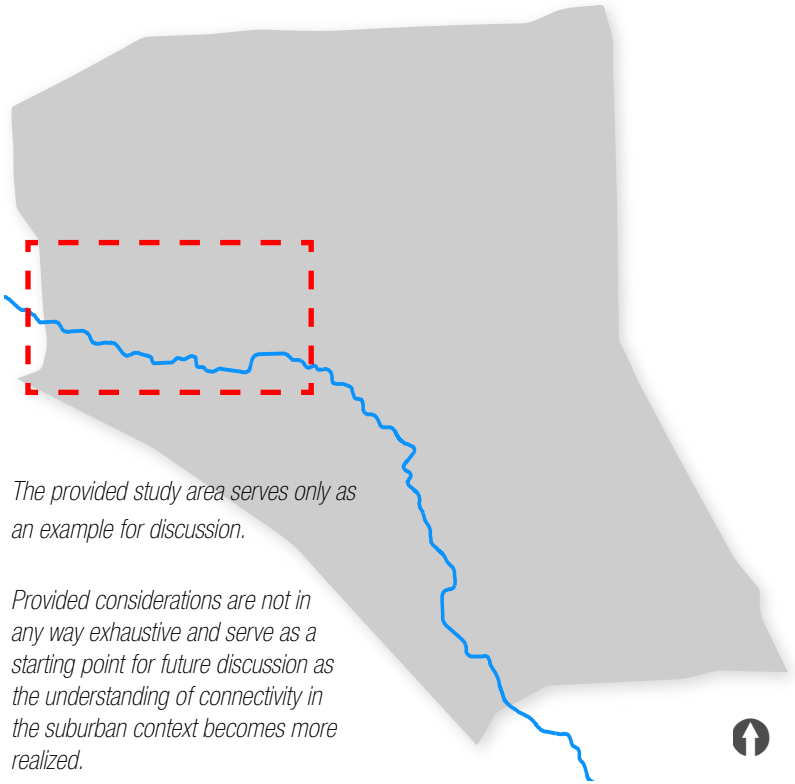
4. For more information regarding street extensions, visit the City Code of Ordinances, Chapter 42, Sec. 42-135.
5. For more information regarding Reserves, visit the City Code of Ordinances, Chapter 42, Sec. 42-190 - Sec. 42-193.

Exploring the Possibility

The Northwest Study Area is comprised of a variety of community types with an array of connectivity considerations. As such, further study is warranted to fully understand the best method for increasing local connectivity between communities and to the greater transportation network. Based on general understandings as previously defined, the provided example explores possible connectivity options along White Oak Bayou. The White Oak Bayou transcends the back side of residential, industrial, and some commercial properties just east of the North Houston Rosslyn corridor to local school facilities west of Beltway 8. Midblock crossings should be avoided and direct paths to intersections or overpasses should be explored where appropriate.

The concepts previously presented are not identified for implementation by a single entity, community, or developer. Instead, these provided concepts only serve as examples and a starting point of discussion as the City of Houston and County continue to mature and attract more and more residents within their respective boundaries.

The example below represents properties both within the City of Houston and Harris County. A consideration of amenities within a half and quarter mile of the White Oak Bayou are highlighted on the next page for consideration.



The provided study area serves only as an example for discussion.

Provided considerations are not in any way exhaustive and serve as a starting point for future discussion as the understanding of connectivity in the suburban context becomes more realized.

FIGURE 5.6

FIGURE 5.7

FIGURE 5.8

Connectivity Opportunities:

A: Enhance Connections to Existing Trail Networks

- Key Amenities:
  - » Existing pedestrian bridge
  - » Existing Jersey Village Trails
- Benefit:
  - » Link school locations to neighborhoods east of Beltway 8 and use connection to existing trail system
- Obstacle:
  - » Overpass at Beltway 8

B: Utilize Publicly Owned Property

- Key Amenities:
  - » Existing east-west local corridor
  - » Note: Provided configuration upholds evidence of pedestrian footpaths from this provided corridor
- Benefit:
  - » Key access point for neighborhood pedestrian or bikeway users. Provides alternative network opportunity to parks, associated library, adjacent neighborhoods and health facilities
- Obstacle:
  - » Understanding of future use
  - » Agency coordination

C: Excess Development Reserve:

- Key Amenities:
  - » White Oak Bayou
  - » Neighborhood schools
- Benefit:
  - » Key access point for neighborhood pedestrian or bikeway users. Provides alternative network opportunity to parks, associated library, adjacent neighborhoods and health facilities
- Obstacle:
  - » Understanding of future use

D: Reestablish the Street Grid for Alternative Modes (Street Stubs):

- See next page (example F)

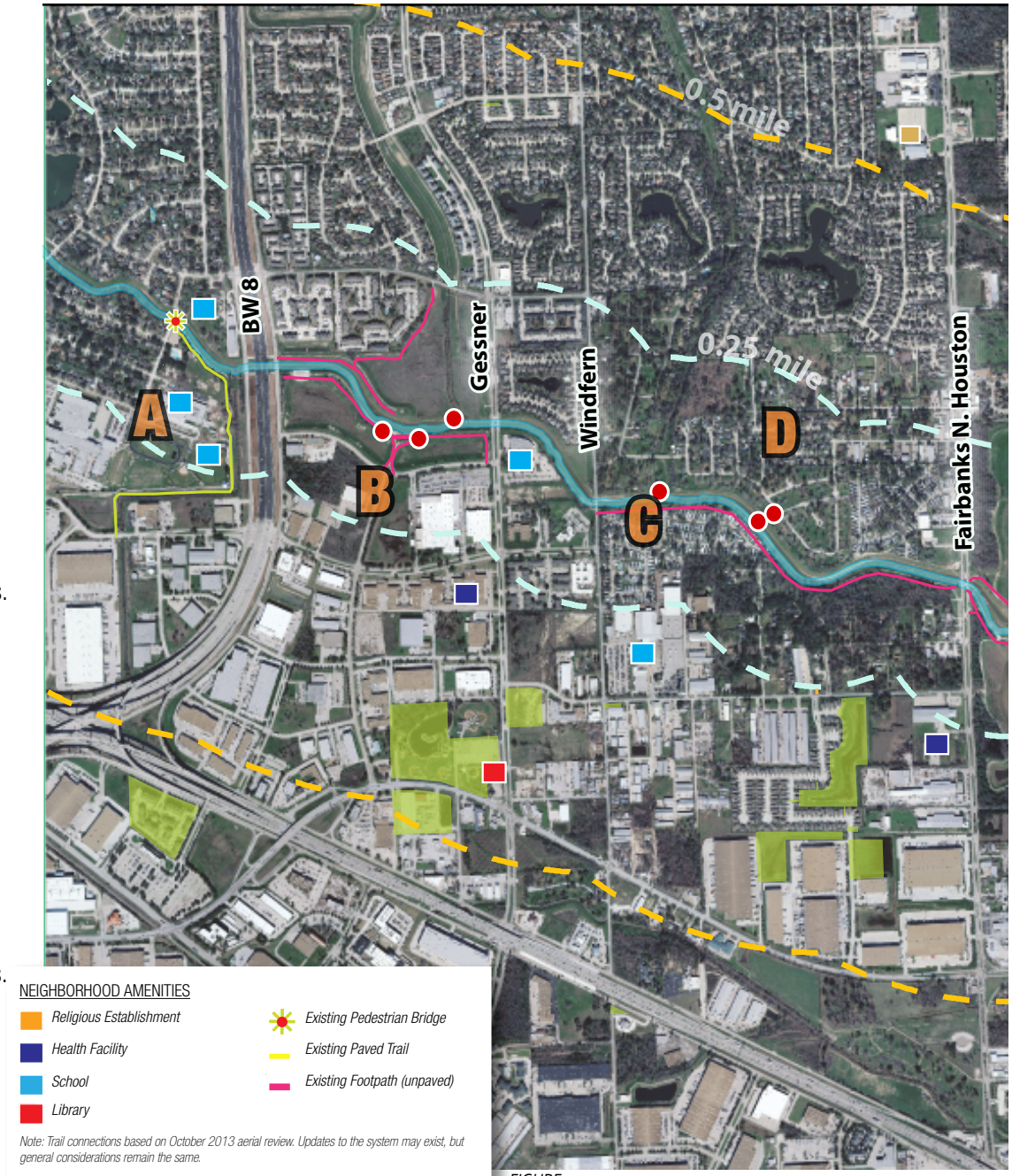


FIGURE 5.9

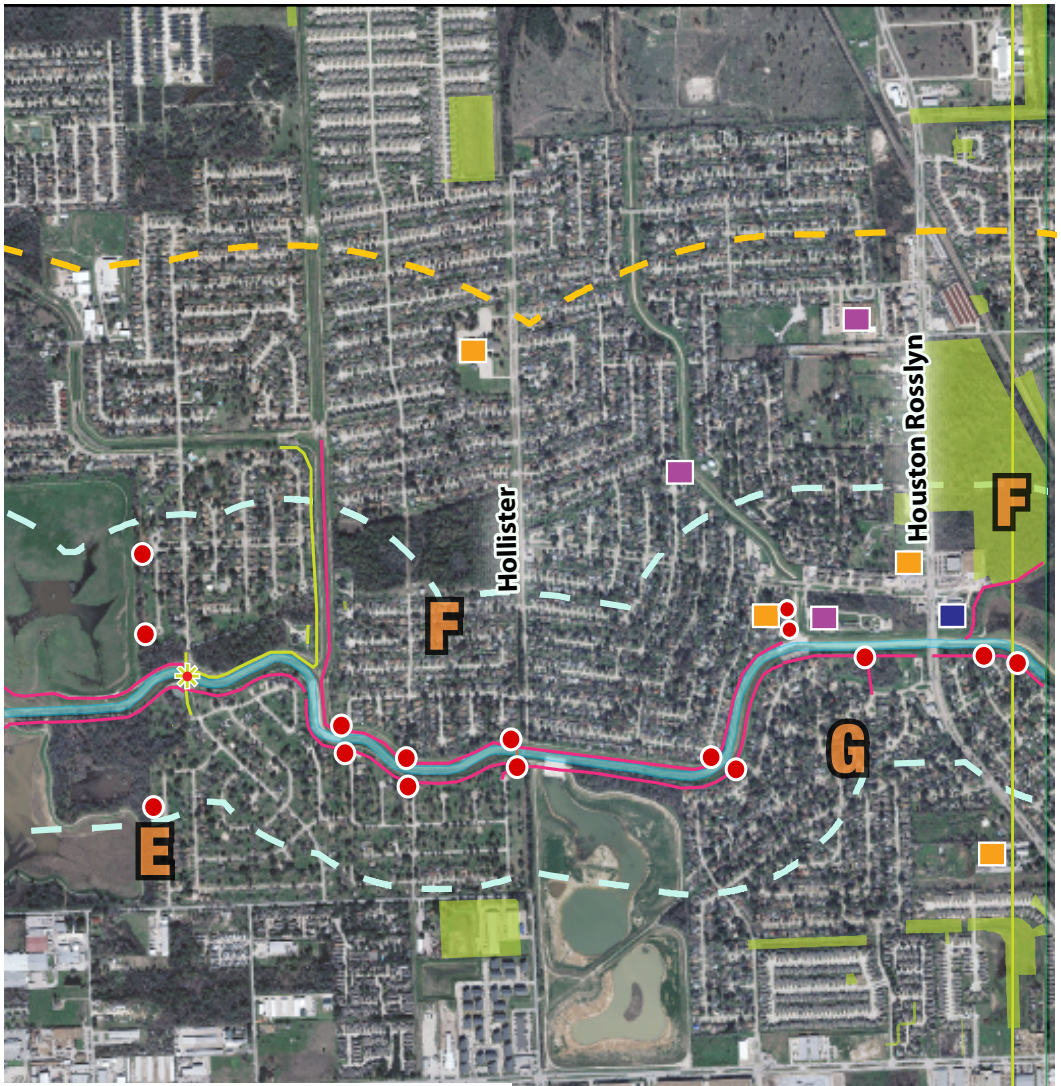


FIGURE 5.10

Connectivity Opportunities:

E: Promote Local Neighborhood Connections

- Key Amenities:
  - » Existing pedestrian bridge
  - » Existing trail development
- Benefit:
  - » Key access point for neighborhood pedestrian or bikeway users. Provides alternative network opportunity to parks, associated library, adjacent neighborhoods and heath facilities
- Obstacle:
  - » Adjacent subdivision coordination

F: Reestablish the Street Grid for Alternative Modes (Street Stubs)

- Key Amenities:
  - » Existing access to residential neighborhood preserved
  - » Existing street stub
- Benefit:
  - » Used street stubs are potential extension of alternative modes of transportation not specific to the motor vehicle
- Obstacle:
  - » Community buy in

G: Promote use of undeveloped or vacant parcels

- Key Amenities:
  - » Access to neighboring church and health care facilities
- Benefit:
  - » Potential increase in future development for enhanced community interaction
- Obstacle:
  - » Coordination

5.5 Bicycle User and Facility

Houston is seeing a shift in how we view the bicycle user as part of our overall transportation system. Just as street design considerations do not take a "one-size fits all" approach to vehicular movement, bicycle movement varies as well. For example, what type of facility is most appropriate for a child traveling to school on a bike versus a working professional traveling to work? How might this consideration vary if the user is enjoying a leisurely bike ride (i.e. recreational user) versus someone who might be on a daily commute where speed and time are a prevalent choice in route consideration?

User Types

Like other topics explored, the recognition of bicycle user types and variations in bicycle facility considerations is taking place across the United States. In accordance with the American Association of State Highway and Transportation Officials (AASHTO)[1] , bicycle users are best defined by level of biking experience and comfort on a specified roadway categorized as:

AASHTO Bicycle User Types

Type	**Type A** Advanced/Experienced	**Type B** Basic Adult	**Type C** Children
			
Values	• Convenience • Speed direct access to destination	• Comfortable experience • Low stress	• Lower complexity decision environment
Comfortable Riding on...	• Comfort riding on all street types • High Traffic • High Speeds	• Designated facilities	• Residential streets • Busier streets with well-defined bike travel areas • Off-street bike paths
Confident "claiming" a narrow lane?	Probably	No	No
Knowledge of traffic principals	Yes	Yes	No

FIGURE 5.11

Facility Types

The City of Houston currently does not maintain a formal process to evaluate what corridors are most appropriate for the user type as defined on the previous page. The City instead evaluates facility type on a case-by-case basis as appropriate for the City and community alike. As such, the City recognizes that bike facility types most appropriate for a given corridor vary and maintain the following classifications as adopted by the City of Houston Master Bike Plan:

Bike Lanes

- A bike lane is the portion of the roadway adjacent to the travel lane that is designed by striping, signing, and pavement marking for the preferential or exclusive use of the cyclist.
- There is no parking allowed in this lane unless otherwise indicated.

Signed-Shared Roadway

- A signed-shared roadway is designated for bicycle or motor vehicle use. The shared lane is not for simultaneous use of both vehicles. Motor vehicles traveling at a greater speed than cyclist can pass cyclist as any other slow moving vehicle using the adjacent lane.
- There are special pavement markings and signs along this lane to remind both cyclist and motorist to share the road.
- These roadways typically have lower travel speeds and traffic volumes, and also provide convenient routes to destinations.
- Shared-use lanes should not be used on roadways with speed limits below 40 mph.

Signed Bike Routes

- A signed bike route is a roadway that has been designated by signing a corridor as a preferred route for bicycle use.
- Parking may be allowed on this route and cyclist will ride to the left and around parked cars.
- Ideally these routes would still have favorable conditions for bicycling, such as low vehicle volumes, low travel speeds, or wide shoulders.
- Route signs should be placed at locations where the bike route turns at an intersection and where bike routes cross one another.
- With proper wayfinding, bike routes assist with guiding cyclist to more dominate roadways with safer pedestrian and bike crossings.

Trails/Shared-Use Paths

- A bikeway that is physically separated from motorized vehicular traffic by an open space or barrier, and can be located:
  - Within a highway right-of-way
  - Within an independent right-of-way, such as a retired railroad corridor
  - Along bayous and drainage easements
- Also known as “Hike and Bike Trails”
- Off-street shared-use paths attract a mix of users with a wider range of skill levels and riding speeds.
- The use of a centerline stripe is recommended on pathways with high use to designate two directions of travel.
- Shared-use paths, or sidepaths, may be located adjacent to roadways when sufficient right-of-way is present to provide additional separation from motorists. These sidepaths should follow the same design criteria as shared-use paths in independent rights-of-way.

Other definitions may prove relevant to the City as it continues to grow and mature its understanding of the bikeway user. Additional facility types for consideration include:

Bicycle Boulevard

- Bicycle Boulevards are designed to give priority to bicycle traffic.
- Local roads with low volumes and speeds offering an alternative for, but running parallel to, major roads.
- Offer convenient access to land use destinations.
- Signs and pavement markings are used as way finding for bicyclists.

Cycle Track

- Bicycle highways intended for commuting traffic.
- Protected cycle tracks are recommended on major arterials with high travel speeds, high traffic volumes and multiple lanes. Conventional bike lanes without protection on these types of roadways can be stressful for less confident riders.
- Two-way cycle tracks may be considered when there is not enough room for one-way cycle tracks on both sides of the street or when extra right-of-way is available only on one side. Two-way cycle tracks may be considered to optimize the ROW (such as when you remove on-street parking).
- Advance timing of signalization is recommended for cycle track facilities at signalized intersections and is a recommended best practice to reduce potential conflicts with turning vehicles.

Buffered Bike Lanes

- Buffered bike lanes are beneficial on streets with higher travel speeds, higher travel volumes, or high truck traffic.
- These facilities may be accomplished as retrofits or the reconfiguration of existing roadways with more travel lanes than needed. Buffers should be delineated by two solid white lines at least 2 feet apart; if wider than 3 feet, diagonal hatching should also be marked.

Other treatments for consideration pertain to increasing awareness of the user and motor vehicle alike and are not focused necessarily on one bicycle facility type. Instead, the provided recommendations, where appropriate, are for universal consideration.

Highlighted Conflict Points – Bike Facility Caution

- Colored pavement for bicycle use, typically green in color, may be used to increase the visibility of facilities in potential areas of conflict with motor vehicles. Colored pavement is commonly applied at intersections or driveways, in areas where motor vehicles are likely to cross over a bike lane into an adjacent turn lane or property.

Yield to Bike Signage

- “Yield to Bikes” signage should be used to reinforce that bicycles have the right-of-way at colored bike lane areas.

Bike Facility Design/Considerations

The appropriate design for a corridor considers certain factors such as daily traffic volume, travel speed, and related context as it pertains to area attractors and neighborhood context. However, regardless of what is desired, a corridor only maintains a certain number of feet in which it must accommodate vehicular, bike and pedestrian traffic as discussed in previous section of this Report. As such, there has been a shift in the way streets are evaluated in terms based on the time a bike facility is recommended where the following are considered:

- Is the Roadway a new construction?
- Is the Roadway being repurposed?
- Is the Roadway being reconstructed?

In short, a simple set of variables to select the most appropriate bicycle facility does not always encapsulate the complexity of Houston's streets as they pertain to facility feasibility.

1. New Construction

New roadway construction projects can typically follow the City's standard cross-sections as found in the COH Mobility Plan Street Paving Design Requirements, which include options for bicycle facilities based on the multi-modal classification of the corridor.

2. Repurpose

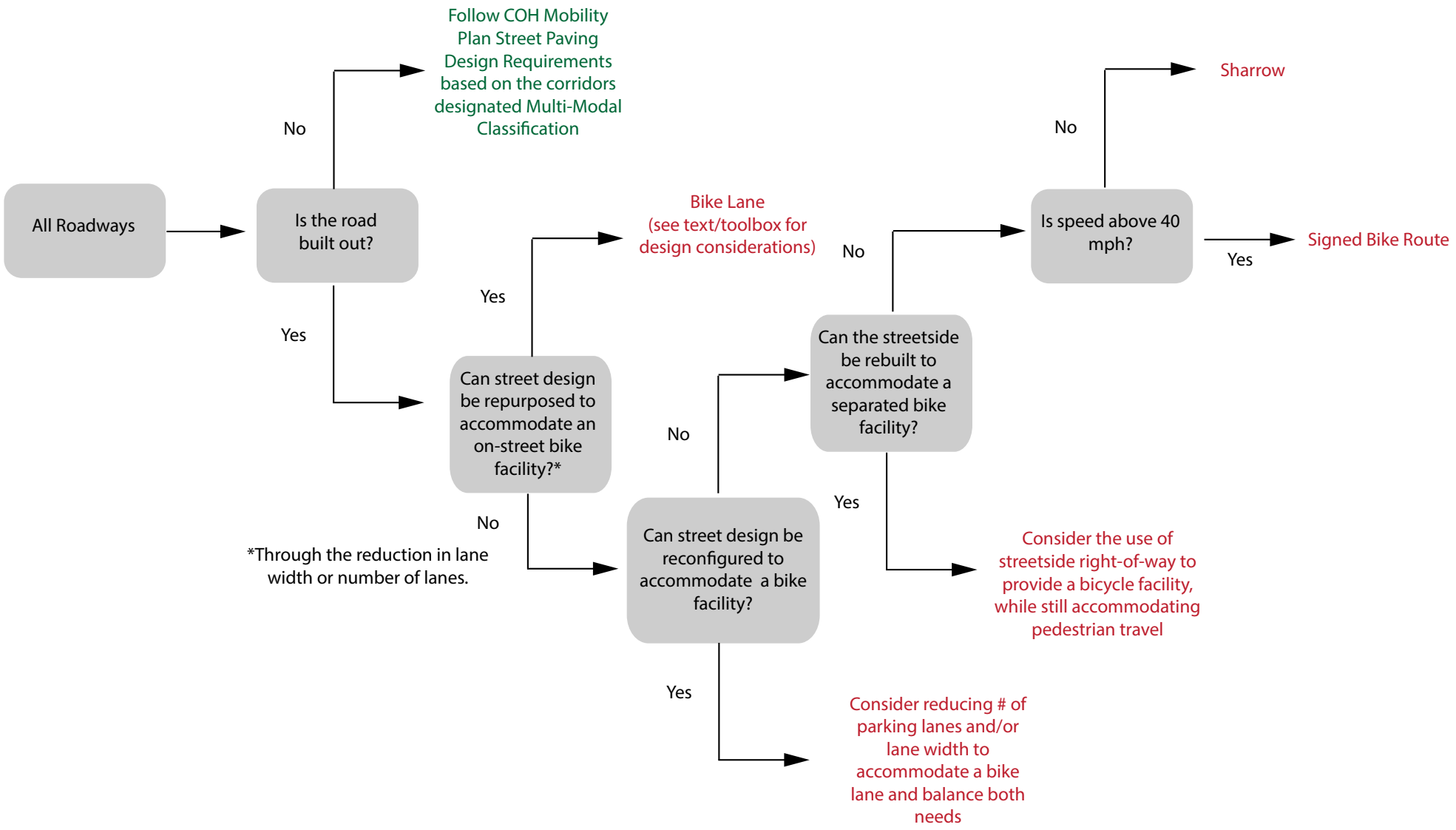
Repurpose projects typically require modifications to existing standard design cross-sections, as currently endorsed by the City, in order to meet the various transportation needs within limited right-of-way. Most repurpose projects to accommodate bicycle facilities on existing streets will be difficult to implement without special design and context considerations for each individual corridor. However, the ideal facility type may not always be able to be implemented due to various constraints.

3. Reconfiguration

When the width of the travel way cannot be widened along a corridor, the City should evaluate whether a roadway's existing lanes can be reconfigured to provide the necessary space for a bicycle facility. Reconfiguration of a travel way may include reducing the total number of lanes when traffic volumes demonstrate an excess of roadway capacity. Another scenario would be to reduce median width to maintain vehicle travel lanes and also introduce a bike facility within the existing roadway width. On-street parking may be a high priority on some corridors and should be evaluated during roadway reconfiguration. It may be necessary to balance both parking and bicycle travel needs using an atypical cross-section. Occasionally, a wide existing streetside zone (the portion of the right-of-way dedicated to pedestrian facilities and amenities) may be repurposed to include both bicycle and pedestrian facilities separated from the roadway. These facilities would include physically buffered bike lanes or raised cycle tracks.

The following flow chart is intended to guide the facility selection process and ensure that a preferred facility is an appropriate choice for a specific corridor. This tool will not automatically provide the best solution for a roadway, but is intended to demonstrate why certain desired bike facilities might not always make sense on the ground. Given the complexities of many roadways, the City should use planning and engineering judgment in order to develop a cross-section that addresses all road users.

FIGURE 5.12 FACILITY SELECTION PROCESS



Houston Bike Related Policies

The paradigm shift in the way Houston views bikes can also be seen in the recent policies embraced by the City which include:

Complete Streets Policy

The Complete Street Executive Order directs the City efforts to achieve complete streets. A complete street is defined as a "public roadway that takes into account all users" including people on bikes. Of the objectives listed within the order, the establishment of a complete street types based upon multi-modal Classifications is defined – of which, bikes are considered within the modal choice for consideration. Finally, the Complete Streets Executive Order directs the development of a "Houston Complete Streets and Transportation Plan" of which one of the Plan Components must, at a minimum, include the Bikeway/Pedestrian Plan as currently maintained by the City of Houston.

Safe Passing Ordinance

Chapter 45 Article 2 of the City Codes of Ordinances was adopted by the City in April of 2013. The Ordinance requires drivers to pass or trail a cyclist, pedestrians and other non-vehicular or "vulnerable road users" at a safe distance. Although safe distance is a termed defined to take into consideration "road, traffic and weather conditions at the time, in any event, not less than 3' laterally while passing a vulnerable road user in a passenger car or light truck and not less than 6' laterally if the operator's vehicle is a truck (other than a light truck) or a commercial vehicle as defined by the Transportation Code." The code further requires motorists to be mindful of vulnerable users during turning movements as well as diminishes the use of harassment or intimidation of vulnerable users at any time.

Houston Bike Education

As the City of Houston continues to mature adoption of bikes into its everyday culture, the need to educate not only automobile users, but bicyclists themselves becomes increasingly important. The City, and other bike advocate organizations, continuously work to educate all roadway users of the importance of proper roadway etiquette. That is to say, both cars and bikes are considered "traffic" while utilizing public roadways. As such, all roadway users must abide by laws that dictate what is legal for each user type. How to function on the roadway can vary slightly between a motorized and non-motorized vehicle, so there is a need to educate all users about not only their responsibilities, but the responsibilities of additional users (i.e. What are automobiles supposed to do when they see a bike, and visa-versa?)

PHOTO PROVIDED COURTESY CITY OF HOUSTON

5.6 Sidewalk Design Considerations

Returning to Pedestrians as a Priority

Returning focus to pedestrian amenities is a trend around the nation as the many benefits of active transportation are being publicly endorsed by health and other officials. Such benefits include:

- Improve physical and social health
- Reduce personal transportation costs
- Reduce carbon footprint

Existing Policy

Within the City of Houston any new or reconstructed sidewalk must be built to a 5 foot wide minimum standard. A 6 foot minimum standard is required for any sidewalks located along a transit corridor. Sidewalk improvements above the minimum standard are recommended based on a variety of factors. These factors include land use and context, traffic volumes, and transit availability along a corridor.

Design Considerations

When designing a sidewalk, the pedestrian zone should be taken into consideration. This will vary based on the context of the corridor. The pedestrian zone is the streetside area between the edge of the curb and the property line of the bordering parcel. Pedestrian amenities can encourage growth in a walkable environment within the appropriate context type. The pedestrian zone can be broken into 4 subcategories: 1) edge zone, 2) furnishing zone, 3) throughway, and 4) frontage zone.

Edge Zone

The edge zone comprises the area between the curb and the furnishing zone. This zone creates a space between the recognized sidewalk area and automobiles. On corridors where on-street parking is permitted, this zone allows for door swing space. It also provides an area for pedestrians to transition between the walkway and their automobile without creating issues for other users.

PHOTO PROVIDED COURTESY KHA

Furnishing Zone

The furnishing zone provides an area for functional and artistic features within the pedestrian zone. It is also used for public services, landscaping, utilities, and as a buffer between pedestrians and the corridor. The functional features within this zone include public services, bicycle racks, utilities, fire hydrants, utility poles, sign poles, traffic signal cabinets and utility cabinets. Additional features that are functional, but also enhance the appeal of this zone are trees, shrubs and planters, landscaping, vendors, street furniture, and decorative artwork.

The furnishing zone provides many benefits. It increases the tangible and the perceived safety of pedestrians by identifying the division between the street and pedestrian realm. When properly implemented and maintained, a furnishing zone can increase the lure, walkability and safety to pedestrians along a corridor.

Throughway Zone

The throughway is the basic function of the pedestrian zone. It is located between the furnishing and the frontage zone. The throughway is the section of the sidewalk where

pedestrians travel. It is critical to keep this zone clear of obstructions (including the condition of the pavement) to allow for pedestrians' safe movements. This design element should also account for the handicapped and disabled. Movement of wheelchairs within the throughway zone is a critical design element.

Frontage Zone

The frontage zone is dependent on the context of uses or location of buildings along the corridor. It can serve as a buffer between the building front (if there is not a setback) and the walkable area. It can also serve as an advertisement area for storefronts. Stationary items can be placed within this area with proper licensing agreements.

PHOTO PROVIDED COURTESY KHA

PHOTO PROVIDED COURTESY KHA

5.7 Transit Corridor Considerations

Public Transit for the Public

Public transportation within the United States became increasingly polarized to a specific demographic over the past few decades. Only recently has a shift away from this stereotypical user base occurred. Bus and light-rail are no longer seen as options designed specifically for low-income communities. The benefits of using public transportation as opposed to a personal automobile are enticing a new demographic of users, not defined by their income. Younger generations are turning to public transportation for many reasons including:

- Reduce expenses associated with personal automobile
- Reduce time spent in traffic
- Spend commuting time working via personal devices
- Environmentally friendly
- Benefits to personal health

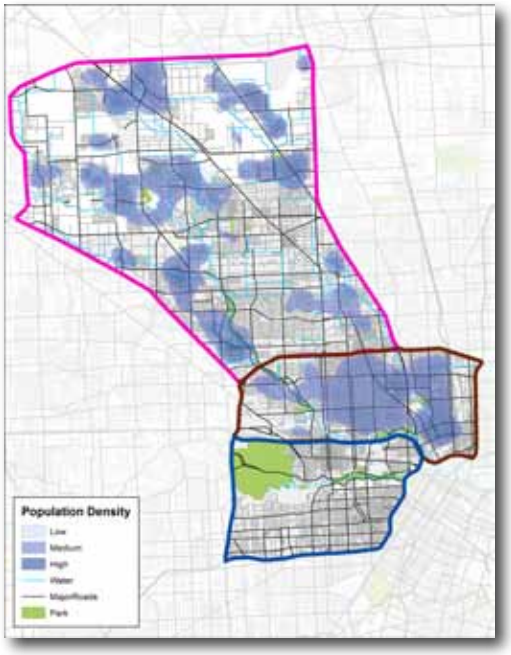
Another user base is found in persons, now residing in Houston, who immigrated from countries where public transportation is socially acceptable and widely used. As more people understand the benefits associated with public transportation, utilization will increase.

Increasing the Availability

Congestion will continually increase, making transportation funding an urgent concern within the country and region. Therefore more efficient transportation alternatives are increasingly more attractive. Improving transportation capacity has evolved from simply moving vehicles to moving people. This shift in focus has given transportation planners more flexibility in identifying new technologies to increase the capacity of a corridor or a transportation network. Transit service is an efficient method of moving people, but it does not work in every situation and along every corridor. To identify the specific corridors and areas of Houston that transit can be the most successful in capturing riders, the following factors were analyzed and ranked in the Northwest:

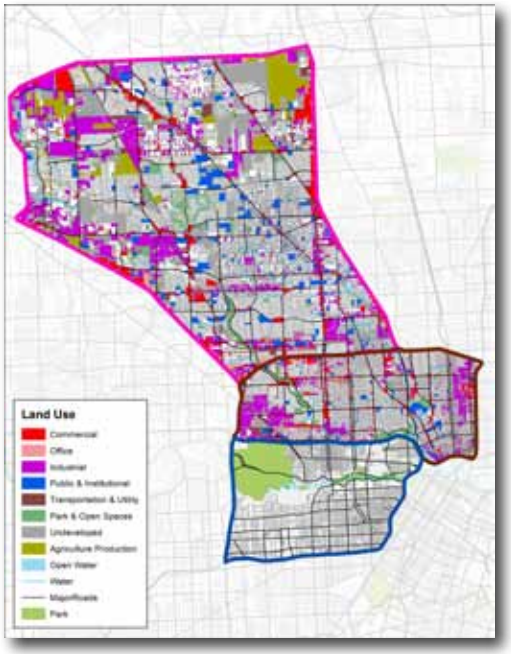
- Residential Density
- Lane Use
- Network Density
- Existing Transit Ridership
- Projected Transit Ridership

Each factor detailed below helps to determine which corridors in the study area can best accommodate transit service, primarily from a ridership perspective. Larger scales of the maps are provided in Appendix C.



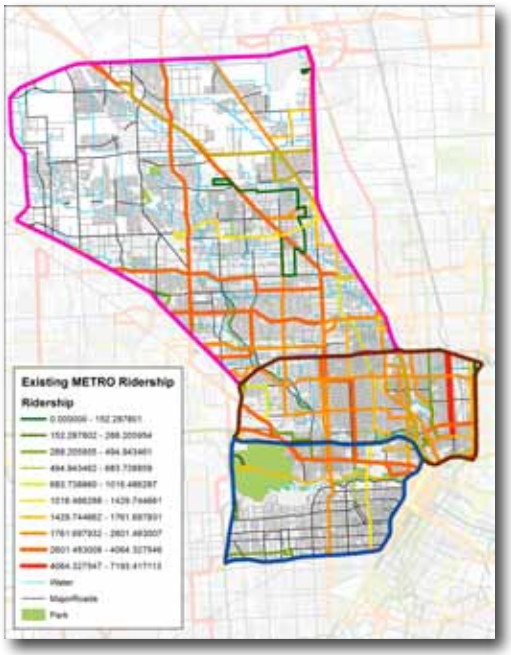
Residential Density:

Residential density is an important factor for determining transit potential. The higher density an area is the more likely people will use transit. The corridors that are within or in proximity to the medium and high density locations were considered for transit locations.



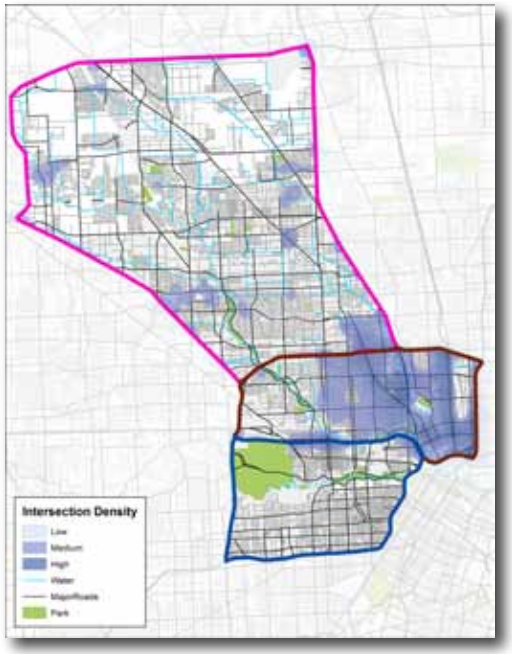
Land Use:

Identifying corridors that contain a higher amount of commercial, retail and employment activity is important for transit selection. Destinations for transit riders are shopping centers, grocery stores and employment centers.



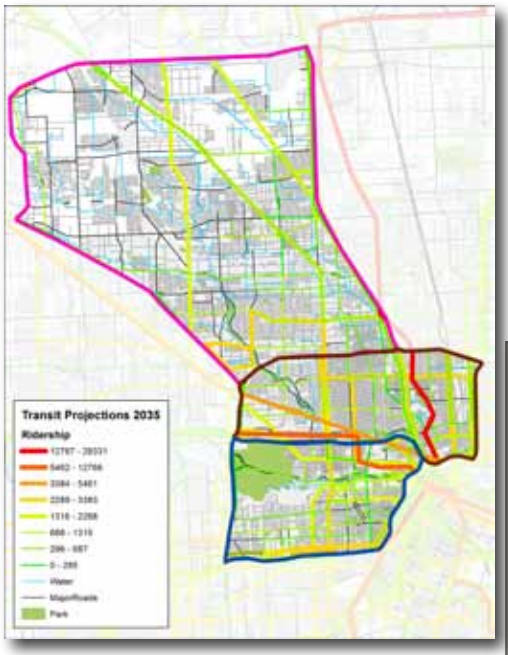
Existing Transit Ridership:

Examining existing transit patterns is an effective tool to determine potential transit corridors. Some of these routes may already be functioning as a significant transit corridors but can be enhanced with improved infrastructure, shorter headways or enhanced buses to increase ridership.



Network Density:

The density of the street network affects the ability for people to walk or bike to their destination. The less dense an area is in regards to network, the more automobile oriented it may be. As expected, the Northwest has relatively low Network Density.



Projected Transit Ridership:

H-GAC currently incorporates transit routes in its 2035 travel demand model. This data is helpful to see where the transit demand is based on future demographic and traffic patterns/congestion.

Complete Streets is not about moving vehicles only. As you can see from these maps, other forms of transportation have a large impact on the road network. Focusing on moving people (whether it be via automobile, transit vehicle, bicycle, or pedestrian) is important.

5.8 Intersection Design Considerations

Changing Priorities

A strong component of a multi-modal plan is designing corridors for safe passage of automobile and non-automobile users. Creating safe realms for these users extends to all parts of the corridor, with increased importance at intersections and other types of crossings. All mode types should feel safe, comfortable, and experience a minimal amount of delay when passing through an intersection. However, enhancing conditions for one mode may negatively impact others. Previous intersection design focused on the quick and efficient movement of automobiles, but as other modes gain popularity (transit/bicycles) this attitude can potentially hinder the efficient flow of the overall network.

Modes for consideration within the scope of intersection design include automobile, pedestrian, bus transit, and bicycle traffic. Although other alternative modes of transportation may exist, the provided represent the most commonly understood forms of traffic within the City of Houston and hence serve as a baseline for discussion for alternative design options for intersections.

Multi-Modal Intersection Design

The following section discusses the fundamentals of multi-modal intersection design and describes the concepts of how automobiles, bicycles, pedestrians and transit vehicles can be accommodated in the design of an intersection. Example innovative intersection improvements and specific location applications are provided to give the designers a potential framework for creating multi-modal intersections. All modes of transportation are found on the corridors within the City of Houston, including: automobile, transit, light-rail, bicycles, and pedestrians. Accommodating multiple modal types on a corridor requires an understanding of how these modes interact.

At all intersections, multi-directional movement is occurring. Planning for these movements to transpire safely requires specific design effort. For instance, the turning movements of automobiles in relation to pedestrians (or transit vehicles next to bicyclist) are a critical design feature in creating a safe environment. Intersections create many points where collisions can occur. (See Figure 5.13.)

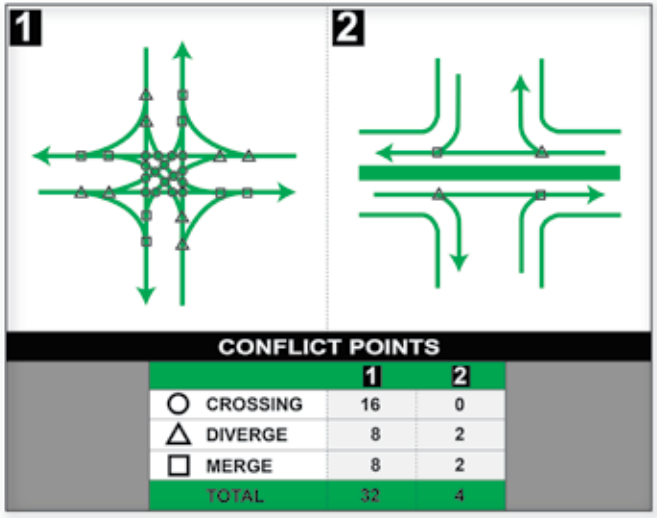


FIGURE 5.13

Basic design attributes include a variety of planning concepts. The following acknowledge only a few of the design elements listed within Figure 5.16.

- Additional signage
- Designated crosswalks
- Pedestrian signals
- Continued markings for bicycles at intersections
- Proper bus stop placement
- Advanced stop lines
- Intersection median barriers
- Right-turn-on-red restrictions

Prioritization of these types of attributes at a particular intersection must be completed with an in-depth look at the activity occurring there. Modes with higher priority will typically take precedence in the design features of the corridor, but should not reduce the actual safety of other modes. If this should occur, priority of the modal needs on the corridor should be reevaluated.

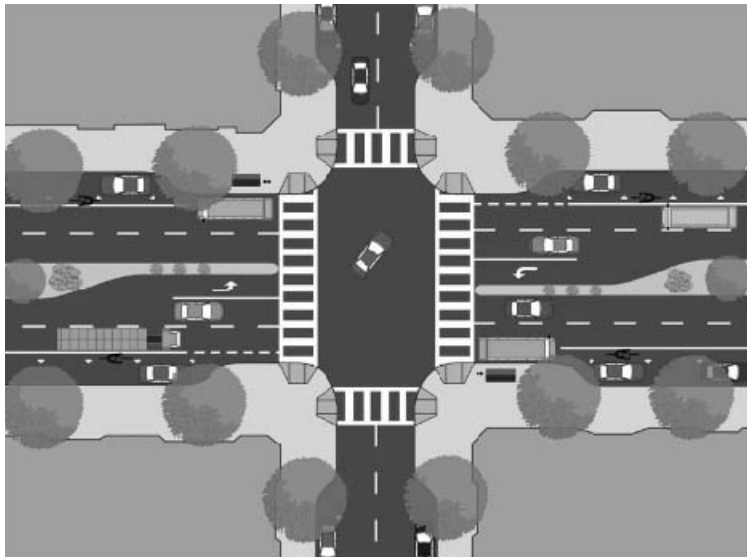


FIGURE 5.14 SOURCE: DIGITAL MEDIA PRODUCTIONS

Pedestrians

Pedestrian traffic represents the most basic form of transportation that is free of cost for the user. Intersections, or crossings in general, pose a particular challenge to pedestrian safety. Crosswalks serve two main purposes: 1) guiding pedestrians to locations where they will be visible when crossing the street, and 2) alerting drivers of pedestrian movements. At intersections, several elements affect pedestrians:

- Visibility at curbs
- ADA accessibility
- Crosswalks
- Pedestrian signals
- Pedestrian crossing refuges
- Traffic control types

Several different tools can be used as visual indicators of pedestrian movements, including items such as:.

PHOTO COURTESY OF KHA

- Pavers can be a different color of brick or material on the ground to indicate the path the pedestrian will be following.
- Raised crossings are also a physical technique of showing the defined pedestrian realm at an intersection or crossing.
- In-street YIELD TO PEDESTRIAN signs is a way of alerting drivers of possible activity before arriving at the intersection.

PHOTO COURTESY OF KHA

- Pedestrian signalization includes several types of indicative tools or measures. For instance, at signalized intersections, there can be a gap time before cars are allowed to move that allows pedestrians the right-of-way. A signal phase singularly defined for pedestrian movement can be used at intersections with high pedestrian activity.

Transit

Design for transit function at intersections also requires additional study. Transit vehicles need to maintain an efficient schedule and move safely through an area. Transit vehicles require additional planning due to their size and frequent stops. This also requires planning for the safety of the passengers waiting, as well as boarding or alighting from the transit vehicle. Focus on transit design at intersections is influenced by its interaction with other modes of transportation.

Proper **bus stop placement** is an important element in the design of intersections (See Figure 5.15).**Mid-block stops** are the least desirable because they require the most amount of curb side space. Locating bus stops at the near- or far-side of intersections is recommended. Far-side placement is recommended for signalized intersections. There are several advantages to this placement, for instance, buses are allowed to take advantage of gaps in traffic flow. This eliminates the need for buses to be at the front of the queue line at an intersection for a near-side stop. It also minimizes the conflicts between buses and right turning vehicles.

Other important factors to consider include the trade-offs between transit vehicles and other modes of transportation. Automobiles, bicyclists and pedestrians can potentially converge at the same intersection, and the interaction of these users is defined by the intersection design. Transit vehicles are usually large and their movements can dominate the area. Planning for the turning radius of the vehicle can assist in making their movements safe and efficient.

Where it is possible, **transit-only lanes** at intersections provide transit vehicles a dedicated space to bypass traffic, and can typically be shared with bicyclist.

PHOTO COURTESY OF KHA

Transit priority treatments provide an early green signal, or hold a green signal, for transit vehicles to cross an intersection with minimal delay. Use of this method should be evaluated based on how it will affect the overall network system.

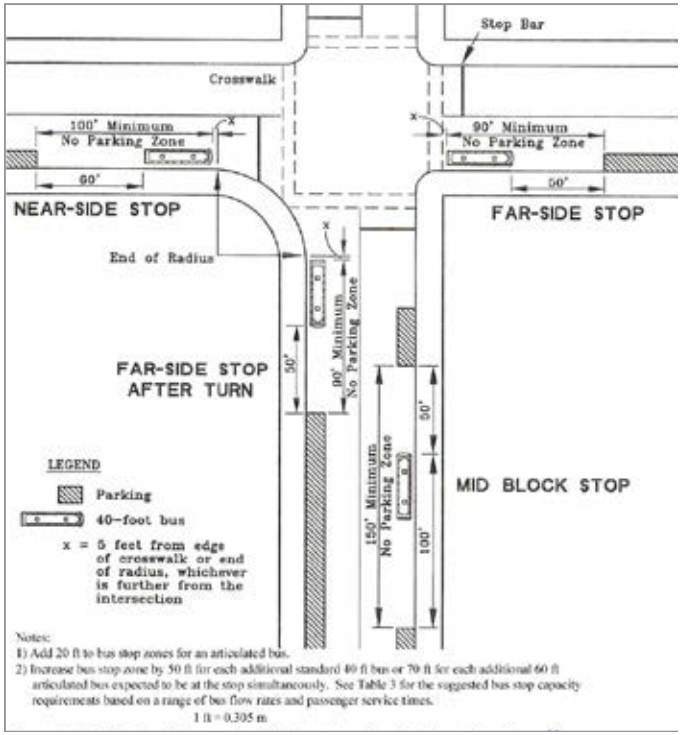


FIGURE 5.15 SOURCE: ITE MANUAL

Bike

Creating a safe environment is important for bicyclist since they typically range in their skill level and confidence. When designing bicycle facilities at an intersection or other crossing, recognizing the different skill levels assists in the creation of a path that is easy to follow.

A direct and safe path through intersections is affected by factors like the number of driveways, ramps, and other mode users.

Design features for bicycle crossings include designated crossings, signage, designated holding patterns, stop bars, right-turn protection, and signalization.

Bike crossing markings through an intersection reinforce that priority is given to bicyclist over turning vehicles. They also facilitate in providing a safe path for bicyclist to make left-turns.

PHOTO COURTESY OF KHA

Chart

Figure 5.16 is a chart that identifies pedestrian and bicycle features at signalized intersections that can be used to create safe and functional intersections.

Shorter and more visible crosswalks	• Crosswalks on all approaches; • Longitudinal markings (possible use of colored and/or textured paving); • Reduced overall street widths by reducing the number of travel and turn lanes, or narrowing travel lanes; • Curb extensions with pedestrian push buttons on extensions; and • Median refuges on wide streets (greater than 60 feet) with median push buttons.

Priority for pedestrians, bicyclist, and accessibility	• Shorter cycle lengths, meeting minimum pedestrian clearances (also improves transit travel times);
	• Longer pedestrian clearance times (based on 3.5 feet/sec. to set flashing (clearance) time and 3.0 feet/sec for total crossing time);
	• Reduced conflicts between pedestrians and turning vehicles achieved with:
	  ○ Pedestrian lead phases;
	  ○ Scramble phases in very high pedestrian volume locations;
	  ○ Restricted right turns on red when pedestrians are present during specified hours; and
	  ○ Allowing right turns during cross-street left turn phases reduces the number of right turn conflicts during pedestrian crossing phase.

Low speed channelized right turn lanes	• Adequate sized islands for pedestrian refuge; • Raised pedestrian crossing/speed table within channelized right turn lane; and • Signal control of channelized right turn in high pedestrian volumes locations.
Improved pedestrian information	• Pedestrian countdown timers; and • “Look Before Crossing” markings or signs.
Bicycle features	• Bicycle lanes striped up to crosswalk (using “skip lines” if vehicular right turns are allowed); • Bicycle detectors on high volumes routes, or bicyclist-accessible push buttons; • Adequate clearance interval for bicyclist; • Colored paving in bicycle/vehicle lanes in high-conflict areas; and • “Bike Boxes” (painted rectangle along right hand curb or behind crosswalk) to indicate potential high-conflict area between bicycles continuing through an intersection and right turning vehicles, and to allow bicyclist to proceed through intersection or turn in advance of vehicles.
High-priority transit thoroughfare elements	• Adaptive Transit Signal Priority (TSP) when transit detected; • Extended green phase on bus route (rapid transit signal priority); • Truncated green phase for cross street; • Re-order phasing to provide transit priority (transit priority not to be given in two successive cycles to avoid severe traffic impacts); • Other bus priority signal phasing (sequencing) • Queue jump lanes and associated signal phasing; and • Curb extension bus stops, bus bulbs.

Accessibility and space for pedestrians	• Properly placed pedestrian actuation buttons, with audible locator tones;
	• Detectable warnings;
	• Two curb ramps per corner depending on radius of curb return and presence of curb extensions;
	• Clear pedestrian paths (and shoulder clearances) ensuring utilities and appurtenances are located outside pedestrian paths;
	• Vertical and overhang clearance of street furnishings for the visually impaired;
	• Properly placed signal poles and cabinets:
	  ○ Behind sidewalks (in landscaping or in building niches);
	  ○ In planting strips (furnishing zone); and
	  ○ In sidewalk, at least three feet from curb ramps.

Traffic operations for safe speeds and pedestrian convenience	• Target speeds between 25-35 mph; • Signal progression at target speeds; and • Fewer very long/very short cycle lengths.
Higher priority on aesthetics	• Textured and colored material within the streetside; • Colored material within crosswalks, but avoid coarse textures which provide rough surfaces for the disabled; • Attractive decorative signal hardware, or specialized hardware; and • Attention to landscaping and integration with green street stormwater management techniques.

FIGURE 5.16

5.9 Integration of Modal Types

The following examples are generalized conceptual illustrations of different intersection configurations, along with an existing aerial photo.

FIGURE 5.18: 43RD AT ELLA EXISTING AERIAL PHOTO

FIGURE 5.19: TIDWELL/W MONTGOMERY/SHEPHERD EXISTING AERIAL PHOTO

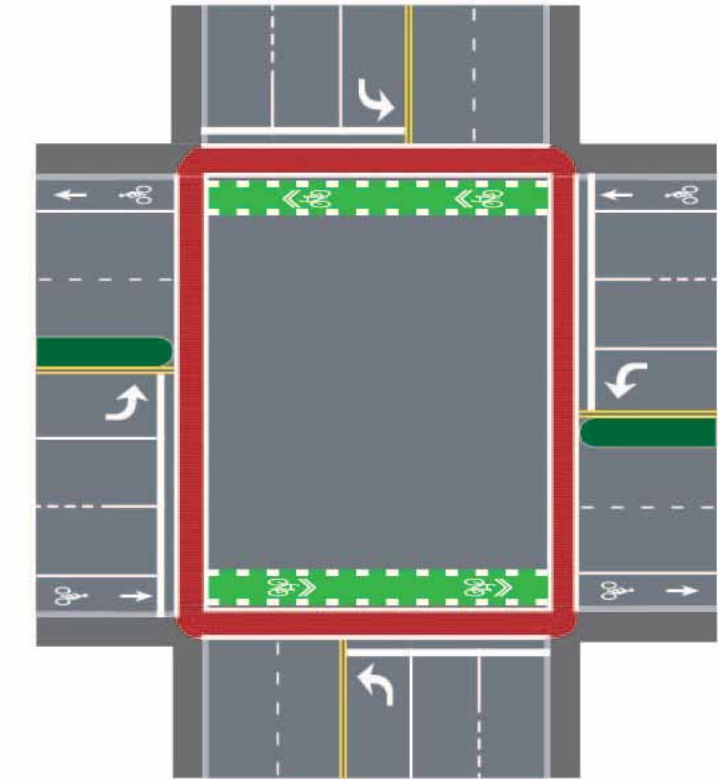


FIGURE 5.17: INTERSECTION REDESIGN CONCEPT

FIGURE 5.18: FAIRBANKS N HOUSTON AT BREEN EXISTING AERIAL PHOTO

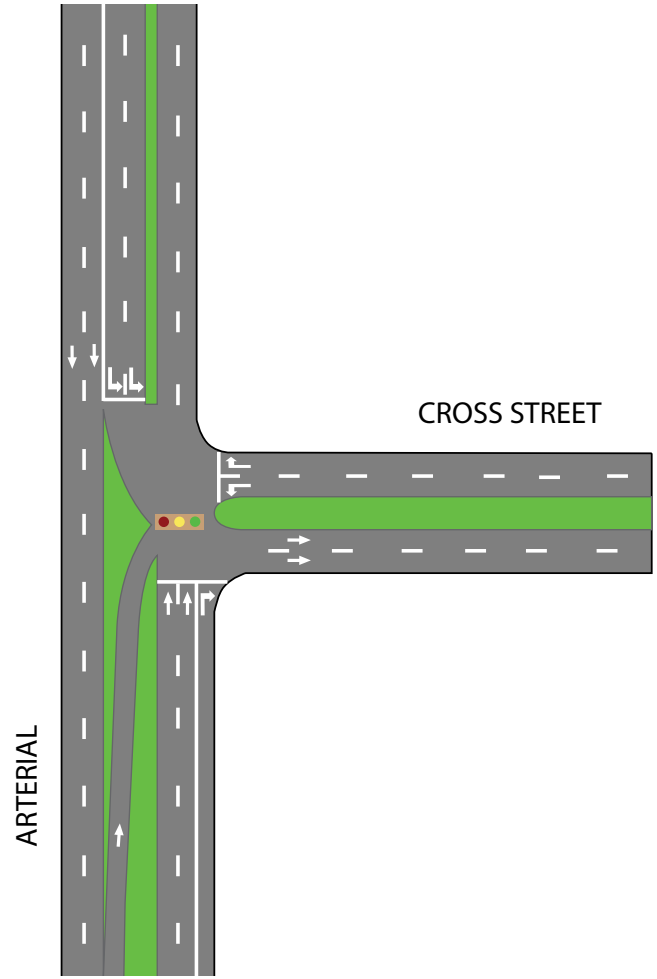


FIGURE 5.19: MODIFIED FLORIDA T INTERSECTION CONCEPT

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