





# CHAPTER 4:

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# DESIGNING OUR TRAILS SYSTEM

**One size does not fit all!** Waco’s existing network of metropolitan and recreational trails includes segments of widely-varying design – built for different interests, to fit into the surrounding built or natural environments, and to make the best use of available funding. The construction of a city-wide trails network will require site-specific design applications which reflect these and other variables.

Trail development will require that best practices in design and construction are calibrated to function properly within local conditions. **Chapter 4, Designing Our Trails System**, highlights key trail design factors that should be considered when extending or improving the City’s trails network. This design guidance is intended to be instructive only and should augment – not substitute – local professional judgment. Furthermore, the recommended trail design features and treatments contained in this chapter are intended to align with and be an extension of the standards and guidelines of applicable federal and state agencies and professional organizations.

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# TRAIL DESIGN PRINCIPLES AND RESOURCES

## REFERENCE GUIDE

The design recommendations contained in this Plan are derived from national best practices and should not be used exclusive of other federal, state and professional resources. Landscape architects and engineers developing a trail should consider at least the following standards and guidelines.

### BICYCLE AND PEDESTRIAN FACILITY DESIGN RESOURCES<sup>1</sup>

Resource	Organization <sup>2</sup>	Year <sup>3</sup>
Guide for the Development of Bicycle Facilities	AASHTO	2012
Guide for the Planning, Design and Operation of Pedestrian Facilities	AASHTO	2021
Bikeway Selection Guide	FHWA	2016
Manual on Uniform Traffic Control Devices	FHWA	2020
Shared-use Path Level of Service Calculator	FHWA	2006
Small Town and Rural Multi-modal Networks	FHWA	2019
Urban Bikeway Design Guide	NACTO	No
Public Rights-of-way Accessibility Guidelines	US Access Board	Varies
ADA Standards for Accessible Design	US Access Board	No

1. Principal resources only. Not all-inclusive. Excludes associated federal and state policy briefs and statements.
2. See “List of Abbreviations” on page ix.
3. Most recent edition.

## DESIGN FOCUS - GREENWAY AND ROADSIDE TRAILS

The proposed Metropolitan trail system is comprised of both roadside and green-way trails. While recreational trails will be present in every community, these special use trails will require specialized design consideration tailored to user interest which will be highly variable from site to site.



## TRAILS CONTEXT

When developing Waco’s greenway and roadside trail network, designers must consider not only the built conditions of today, but also the potential for surrounding land uses to change in ways that affect long-term trail function. Basic design variables that must be considered in the design of all trail segments are listed on the following pages. (See pages 66 through 80 for further recommendations on how many of these factors should be incorporated into trail design and construction in Waco.) Ultimately, alternative design solutions will be necessary in many instances to account for site-specific conditions.



The popularity of the Katy Trail in Dallas, Texas, resulted in the construction of an additional parallel pathway to accommodate user volumes.

## TRAIL DESIGN BASICS

### TRAIL WIDTH

Although national guidance suggests a standard (two-way) multi-use trail width of 10 feet, this width can prove insufficient to accommodate bicycle and pedestrian traffic for popular trail segments. The FHWA’s Shared-use Path Level of Service Calculator (SUPLOS) may be used during design to determine if expected user volumes may necessitate trail widths of greater than 10 feet.

### TRAIL SURFACE

For maximum accessibility, most greenway and roadside trails should employ a hard surface such as asphalt or concrete – the latter being a more durable surface treatment. The use of either material will be influenced by cost, setting, and environmental factors, as will the selective use of other surface materials such as pervious pavement, pavers, crushed granite, boardwalk, etc.

### TRAIL CLEARANCE

Well-designed and maintained trails are kept clear of obstructions. Horizontal clearance - the distance from the pavement edge to the nearest adjacent encroachment - will vary from a minimum of 2 feet or more depending on whether accessory amenities such as signage or seating amenities are present. Vertical clearance is the distance from the trail surface to overhanging obstructions. Although establishing this as a 10 foot minimum would be beneficial to future users of this plan.

“DURING THE DESIGN OF EVERY SHARED-USE PATH, SOMEONE EVENTUALLY ASKS, “HOW WIDE SHOULD THIS PATHWAY BE?” THAT QUESTION NEARLY ALWAYS RAISES EVEN MORE QUESTIONS: “WHAT TYPES OF USERS CAN WE REASONABLY EXPECT? WHEN WILL WE NEED TO WIDEN THE PATH? DO WE NEED TO SEPARATE DIFFERENT TYPES OF USERS FROM EACH OTHER?”

- FHWA, SHARED-USE PATH LEVEL OF SERVICE CALCULATOR

## TRAIL DESIGN BASICS (CONT.)

### ACCESSIBILITY

National guides establish clear recommendations on maximum cross-slopes, running grades, compliant curb ramps and more to ensure trail accessibility to a wide cross-section of users. The US Access Board's Public Rights-of-Way Accessibility Guidelines (PROWAG) should be consulted to ensure compliance with the Americans with Disabilities Act (ADA).

### DESIGN SPEED

There is no common design speed recommended for multi-use trails. Design speed will vary depending on the type of users (and mode split) anticipated, terrain and preferred surface. All these factors will further influence trail alignments and sight distances. Design speed should consider the fastest possible user which most multi-use trails accommodate (i.e. bicyclists) and how the user's speed may be moderated in a way that respects the comfort and safety of slower trail users.

### MODE SPLIT

In areas where high volumes of trails users or high percentages of pedestrian users are expected, consideration should be given to splitting users onto two parallel facilities. While the parallel facilities within a greenway corridor may still visually represent a “shared-use” facility, splitting the trail in targeted areas along the roadside may require the construction of distinct bicycle facilities (i.e. bicycle lanes) and sidewalks.

### CONNECTIVITY

Trail safety, comfort and utilization – and its utility as a viable transportation facility – will depend on the frequency of access points to and from adjacent properties. Local development codes should require unobstructed pathways between adjacent development and all metropolitan trail corridors where feasible and should define an expected frequency of access points from adjacent development to greenway trail corridors.

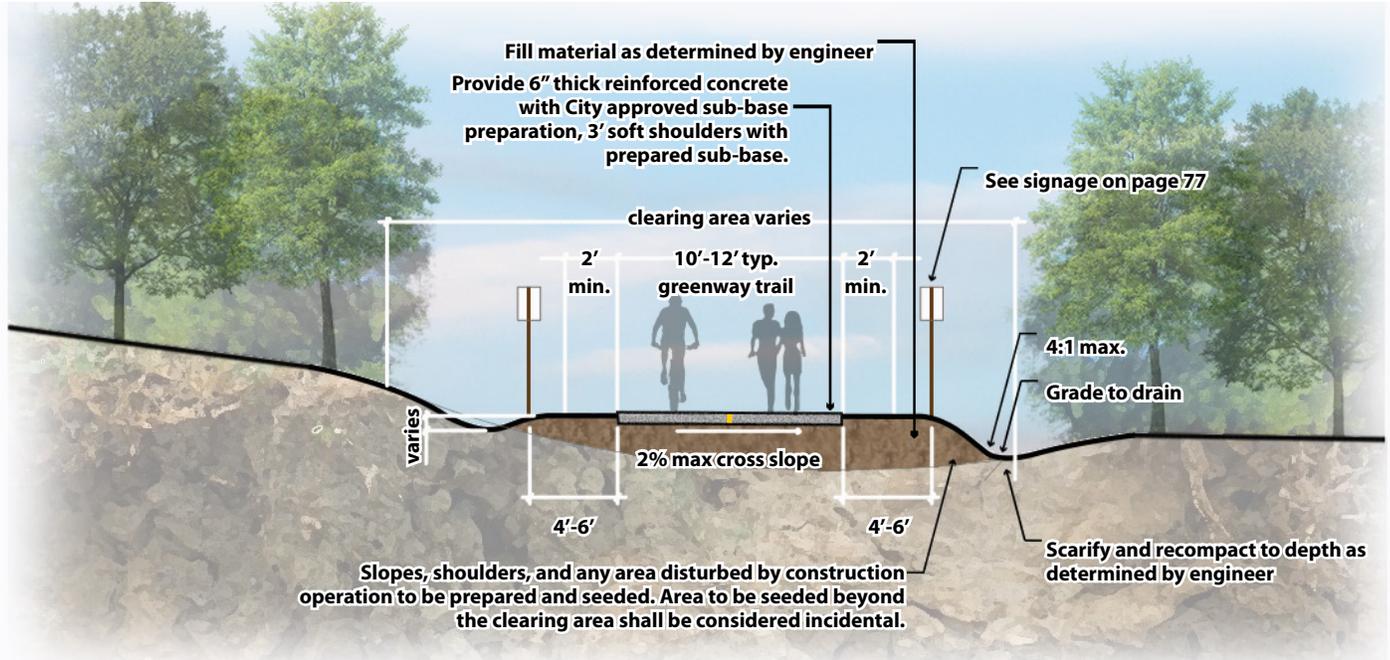
### INTERSECTIONS

Facility treatments where trail users will interact with motor vehicle traffic will vary greatly depending on whether the interaction occurs at a controlled or uncontrolled intersection. The application of pavement markings, signage, signalization and traffic calming features will be influenced by traffic volumes, roadway widths, mid-block versus intersecting street locations, and even whether the trail is crossing a street or a driveway.

# METROPOLITAN TRAILS SYSTEM DESIGN

## TRAIL DESIGN FEATURES

### GREENWAY TRAIL DESIGN FEATURES

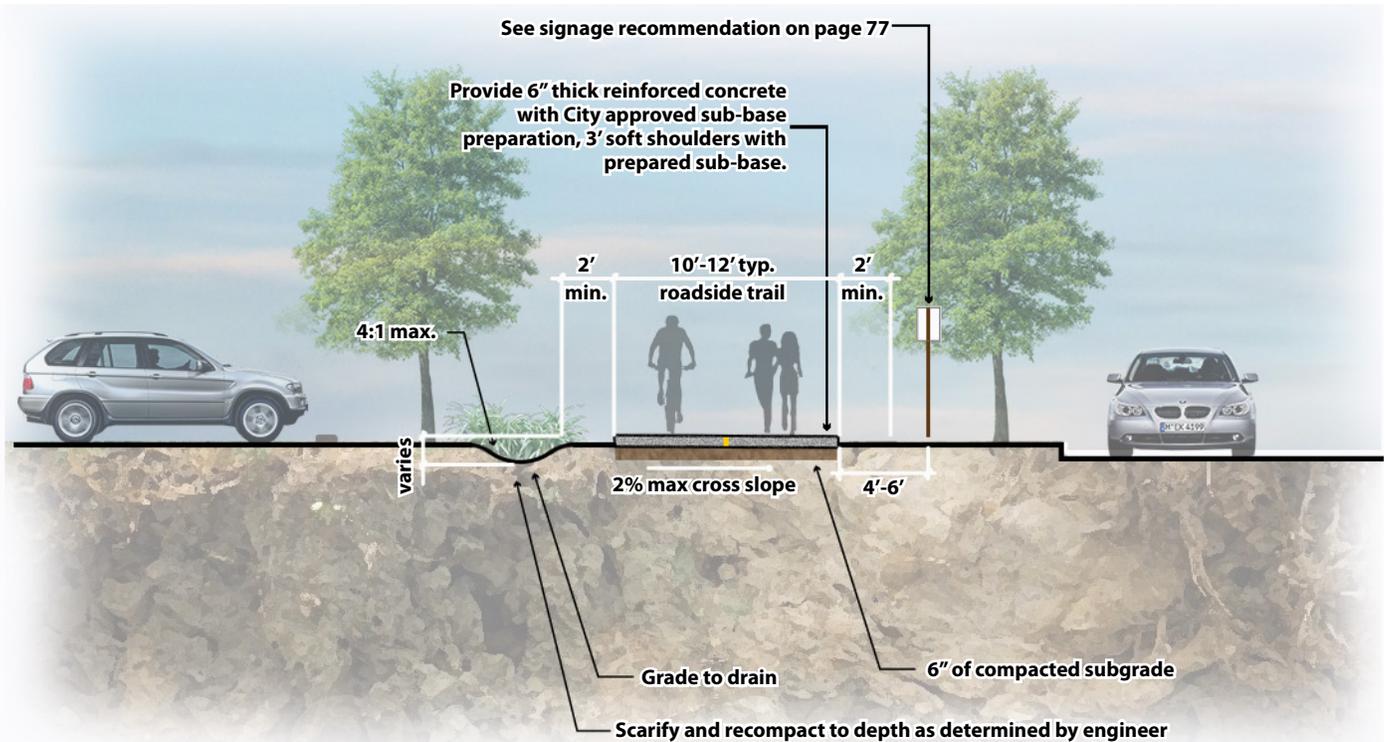


**Greenway Trail Design Features** illustrates the recommended design of a “typical” greenway trail segment when applying the ‘Trail Design Basics’ referenced on pages 64 and 65. It assumes the application of a paved trail surface for a low-to-moderate volume of bicyclists, pedestrians, wheelchair users and others. (It is acknowledged that Waco may selectively utilize a pervious surface material for future greenway trails on a case-by-case basis.)

Final trail design will vary by segment. **Utilize the bicycle and pedestrian design resources listed on page 63.** Other design considerations include:

- **Pervious Surfaces.** Some trail segments may employ a pervious surface such as decomposed granite or other crushed stone that contains about 4 percent fines by weight, and compacts with use. Where possible, concrete ribbon curbing may be used to maintain the trail surface edge.
- **Parallel Paths.** In anticipated areas of high future usage, acquire wide right-of-way or easements, and grade additional shoulder widths to provide for trail widening or the addition of future parallel paths.
- **Striping.** A dashed yellow centerline stripe should be provided for two-way traffic while a solid yellow line should be applied on tight/blind corners, on bridges, in tunnels and at approaches to roadway crossings.
- **Signage.** Traffic control signage adhering to MUTCD standards should be provided on the trail (for trail users) and adjacent roadways (for motorists) to promote safe behavior when using or crossing the trail.
- **Lighting.** Targeted lighting installation should occur at every point where the trail intersects with a street (regardless of the presence of a crossing) and on the approaches to and within tunnels and underpasses. Additional lighting should occur on those stretches of trail that may serve as key transportation corridors and are intended for 24-hour use.

ROADSIDE TRAIL DESIGN FEATURES



**Roadside Trail Design Features** illustrates the recommended design of a “typical” roadside trail segment when applying the ‘Trail Design Basics’ referenced on pages 64 and 65. As illustrated above, the trail (or “sidepath”) is designed to accommodate a low-to-moderate volume of bicyclists, pedestrians, wheelchair users and others.

Roadside trails should always be designed primarily as a transportation facility due to the direct proximity and relationship of the trail with adjacent transit and motor vehicle facilities. **Utilize the bicycle and pedestrian design resources listed on page 63.** Other design considerations include:

- **Property Access.** Defined pedestrian access paths between the roadside trail and adjacent buildings/ structures should be provided independent of motor vehicle access.
- **Parkways.** User comfort will be increased by the physical separation of the trail from adjacent traffic. Parkway separation from motor vehicle travel lanes should be at least six feet on local streets with buffers increasing with higher posted speed limits and additional travel lanes.
- **Shade.** The incorporation of roadside trails into a street corridor should be accompanied by additional streetscaping features including trees. The targeted and deliberate placement of street trees in the parkway provides shade and a physical barrier between trail users and motorists.
- **Striping.** A dashed yellow centerline stripe should be provided for two-way traffic while a solid yellow line should be applied on tight/blind corners, on bridges, in tunnels and at approaches to roadway crossings.
- **Signage.** Traffic control signage adhering to MUTCD standards should be provided on the trail (for trail users) and adjacent roadways (for motorists) to promote safe behavior when using or crossing the trail.

## METROPOLITAN TRAIL FEATURES (REPRESENTATIVE IMAGES)



A



C



B



D

*Ribbon curb along the edge of soft surface trails can reduce erosion due to runoff during rain events (A). Targeted plantings between trails and roadways can make roadside trails more comfortable for users (B). Defined and protected pedestrian pathways should extend between trails and buildings on adjacent development sites (C). Trail signage and striping intended for "traffic" control on multi-use trails should adhere to MUTCD guidance (D) although other signage features may employ unique and distinguishing branding elements.*

## INTERSECTION AND CROSSING TREATMENTS

Multi-use trail intersections with roadways and driveways are among the complex challenges for trail users to navigate due to the variability of roadway design, traffic volumes and speeds, and the unpredictability of motorist behaviors. Correspondingly, the treatment of trail crossing facilities at signalized intersections, mid-block locations and driveway approaches will differ in response to these design variables.

### TRAFFIC CONTROLLED INTERSECTIONS

Basic design considerations where trails approach or cross a roadway at a signed or signalized intersection are depicted in **Traffic Controlled Intersections** (facing page, top). Specific design solutions will vary but the basic building blocks of trail/roadway intersection design are listed below.

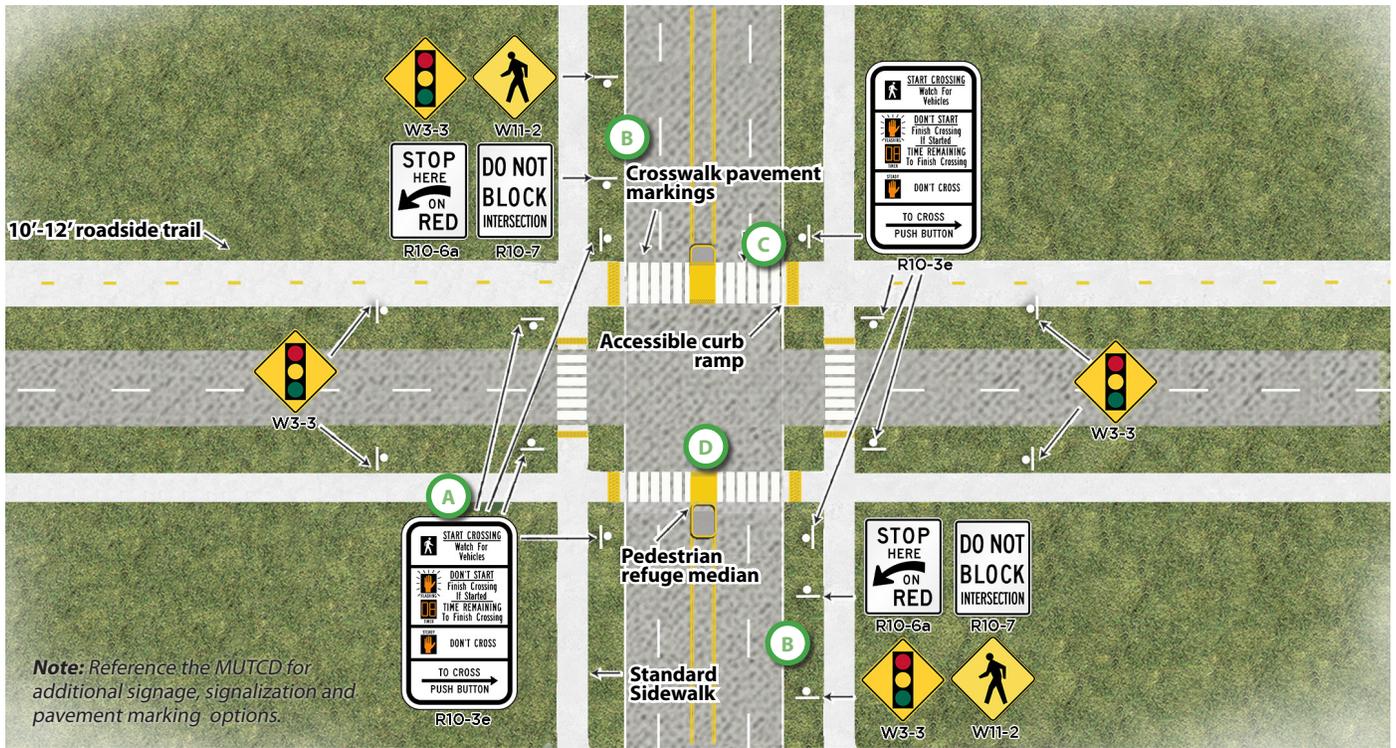
- A Trail Approach.** Protected intersections for trail users outside of the roadway curb radius are preferred. As necessary, roadside trail approaches to intersections should bend in to increase the visibility of motorists and trail users to each other (not depicted).
- B Stop/Yield Control.** Combine MUTCD signage with pavement markings to establish the right of trail users to cross the roadway and increase the predictability of trail user and motorist behaviors. Establish designated crossing intervals for pedestrians and bicyclists.
- C Crosswalks.** Install detectable warnings at sidewalk and street intersections. Apply high visibility pavement markings through the length of the crosswalk to slow motorists and prioritize the bicyclist/pedestrian space.
- D Median Refuge.** Median refuge islands may be constructed where trail users must cross multiple lanes of traffic. Additional hand actuated signal buttons may be installed in the median island in the off chance they are unable to cross the full roadway during designated pedestrian interval.
- + Miscellaneous.** Trail users may be provided with a designated crossing interval at high-volume intersections requiring even right-hand turning motorists to remain stationary on red to allow for bicyclists and pedestrians to cross unobstructed.

### MID-BLOCK CROSSINGS

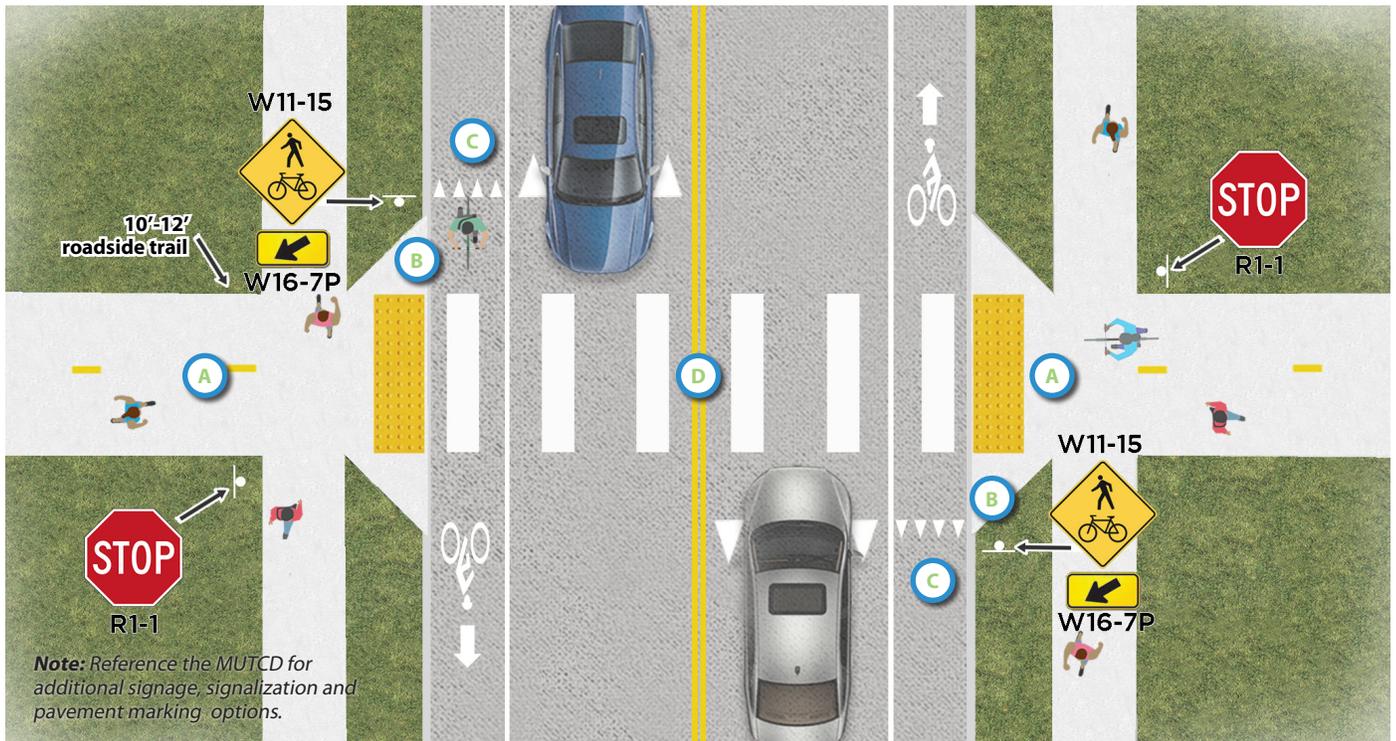
A typical trail crossing of a roadway at an un-signed/ non-signalized location is depicted in **Mid-block Crossings** (facing page, bottom). Mid-block trail crossings eliminate the need for lengthy detours to signalized roadway locations, but the feasibility of their application at candidate locations will be dependent on roadway geometry and traffic operations.

- A Trail Approach.** Install detectable warnings at sidewalk and street intersections. Consider indirect approaches or slight inclines to encourage slower speeds of trail users as they approach the street right-of-way. Other design features such as dismount gates and additional trailside provide space for temporary congregation may be considered depending on topography and user volumes.
  - **Trail Access.** Provide flared access on curb ramps to ease access to the trail from pedestrians or bicyclists accessing from the street.
  - **Stop/Yield Control.** Combine MUTCD signage with pavement markings to establish the right of trail users to cross the roadway and increase the predictability of trail user and motorist behaviors. Hand-actuated signals requiring motorists to stop, or in-pavement flashers increasing visibility, may be installed at the discretion of the City to provide trail users with greater comfort.
  - **Crosswalk Features.** Standard MUTCD pavement markings may be augmented by the construction of a raised crossing to compel slower motorist speeds. Median refuge islands may be constructed where trail users must cross multiple lanes of traffic.
  - **Miscellaneous.** Ensure clear sight lines for both motorists and bicyclists so that - as the fastest trail users - they have sufficient time to stop or yield to other users.

### TRAFFIC CONTROLLED INTERSECTIONS



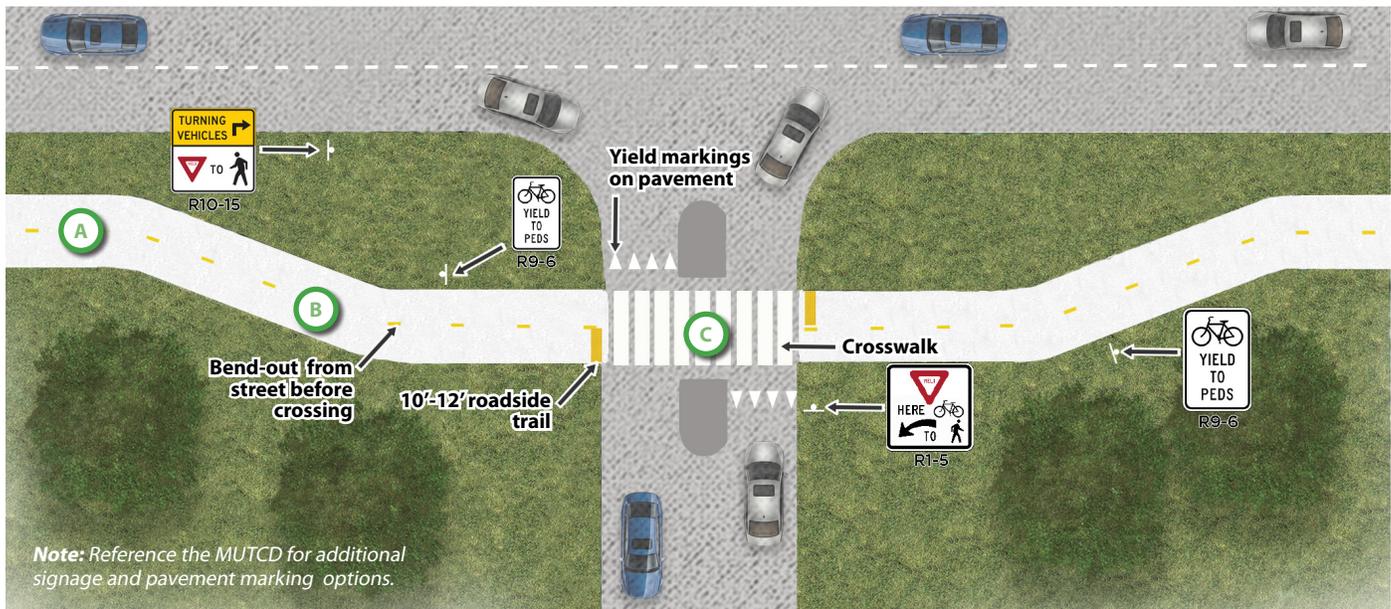
### MID-BLOCK CROSSINGS



## DRIVEWAY CROSSINGS

Driveway crossings are a special condition and warrant traffic control features that are different from a typical street intersection. The figure below depicts recommended design treatments for roadside trails that intersect driveways. As depicted, the treatment requires motorists entering or exiting the driveway to yield to bicycle and pedestrian through traffic. Yield signage posted on the roadway warns motorists entering the driveway to be aware of bicycle and pedestrian traffic, while a 'bend-out' adjustment to the trail alignment allows at least one motor vehicle to stack while exiting the roadway (should a bicyclist or pedestrian be present).

### DRIVEWAY CROSSINGS



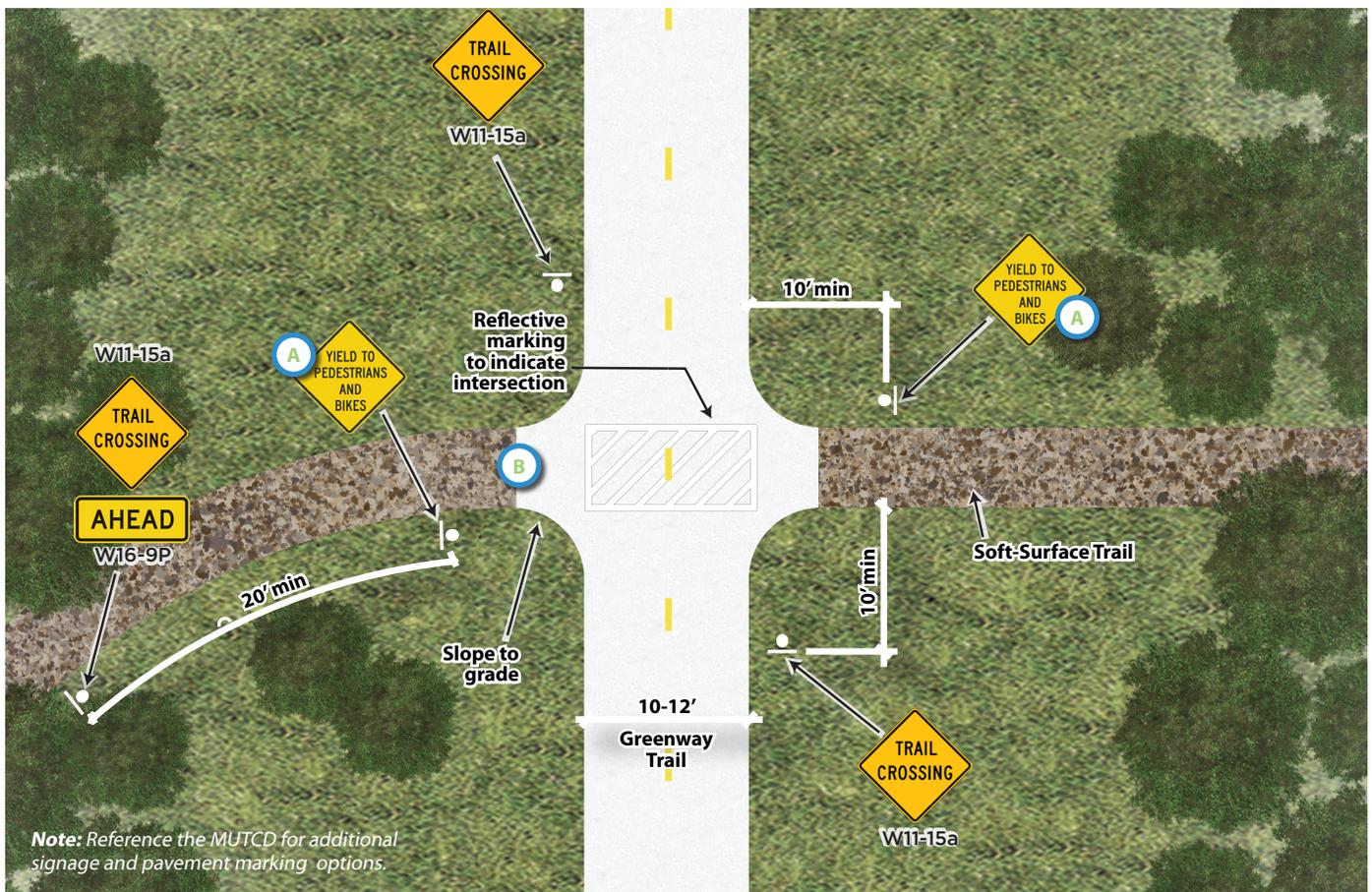
- A Pavement Markings.** Roadside trails should be designed in the same manner as other transportation facilities in the street right-of-way. The application of pavement markings emphasizes that the trail provides for two-way traffic and also provides cues to adjacent and intersecting motorists that the trail is a transportation facility (not just a recreational amenity) and that through-traffic on the trail has priority over intersecting traffic.
- B Bend Out.** Bending the trail out (i.e. away from the roadway) at driveways provides trail users with a higher degree of comfort when entering areas shared with motorists that are not signaled. When using this technique, sight lines must be kept clear between the adjacent roadway and the trail.

- C Crosswalks.** Where possible (particularly in areas of high traffic volume), raised crosswalks may be installed or augmented by pedestrian refuge medians. Detectable warnings on the trail surface at approaches will alert visibility-impaired users of the presence of a mixing zone.
- + Miscellaneous.** The bend-out orientation of a roadside trail may be reversed in favor of a “bend-in” (i.e. toward the adjacent roadway) where the trail intersects an unsignaled side street. The bend-in orientation at intersecting streets takes into account that the side street will have ‘stop’ signage and that approaching motorists will need to stop closer to the adjacent street to help with sight distance as they access the principal street.

## INTERSECTING TRAILS

Careful design of trail-to-trail intersections is necessary to minimize potential conflicts between bicyclists and pedestrians of different ages and abilities that are sharing popular but constrained spaces. Well designed trail intersections not only alert users to the potential presence of others who may be crossing their path of travel but also serve as hubs of information to orient users regarding routes to surrounding destinations. **Trail Hubs** depicts a typical intersection of a soft surface “special use” trail to a paved greenway trail. Similar design considerations must be given to the intersection of two hard surface trails but the application of materials will differ slightly. Either type of trail surface can be addressed with the following configuration.

### TRAIL HUBS



**A Trail Priority.** Signage should typically require that users of intersecting soft-surface trails yield to traffic on the principal greenway trail. In most instances, user volumes on the greenway will exceed those found on intersecting special use trails. In addition, some special use trails will serve users with advanced abilities (i.e. mountain biking) who should moderate their speeds in anticipation of interacting with trail users of varying ages and abilities.

**B Curb Aprons.** The paved apron of the principal greenway trail should extend into the approach of the intersecting soft surface trail to minimize the amount of debris that might accumulate on the paved trail surface.

**+ Miscellaneous.** Intersections can be key “hubs” of information and serve as perfect locations for wayfinding features. Extensive mountain biking networks can be disorienting and benefit from regularly spaced markers.

## MARY AVENUE COMPLETE STREET CORRIDOR

Building a trail connection from the Brazos River to the existing Cotton Belt Trail (and beyond to McGregor) has been identified by this Plan as a community priority. This critical trail linkage would not only be a recreational amenity, but also as a regional tourist 'destination,' and an important active transportation linkage providing direct bicycle and pedestrian access to multiple community destinations.

The highest-priority segment of this corridor extends for roughly 2.5 miles between Waco's downtown riverfront and the redeveloping Hart-Patterson Track site. Over 50 percent of the proposed trail would extend along existing Mary Avenue street right-of-way. Of this 16 block roadside section, over 7 blocks would not be multi-use trail to accommodate existing developments – but is proposed as parallel sidewalks and bicycle lanes. Whether incorporating metropolitan trails, bicycle lanes or sidewalks, the **Mary Avenue Complete Street Corridor** (below) should be designed to prioritize the comfortable and efficient movement of bicyclists, pedestrian and wheelchair users from the Brazos River, through downtown Waco and to destinations beyond.



*Mary Avenue looking northeast to downtown Waco. The current roadway section and right-of-way provides sufficient space for a parallel multi-use trail and other complimentary streetscape enhancements.*

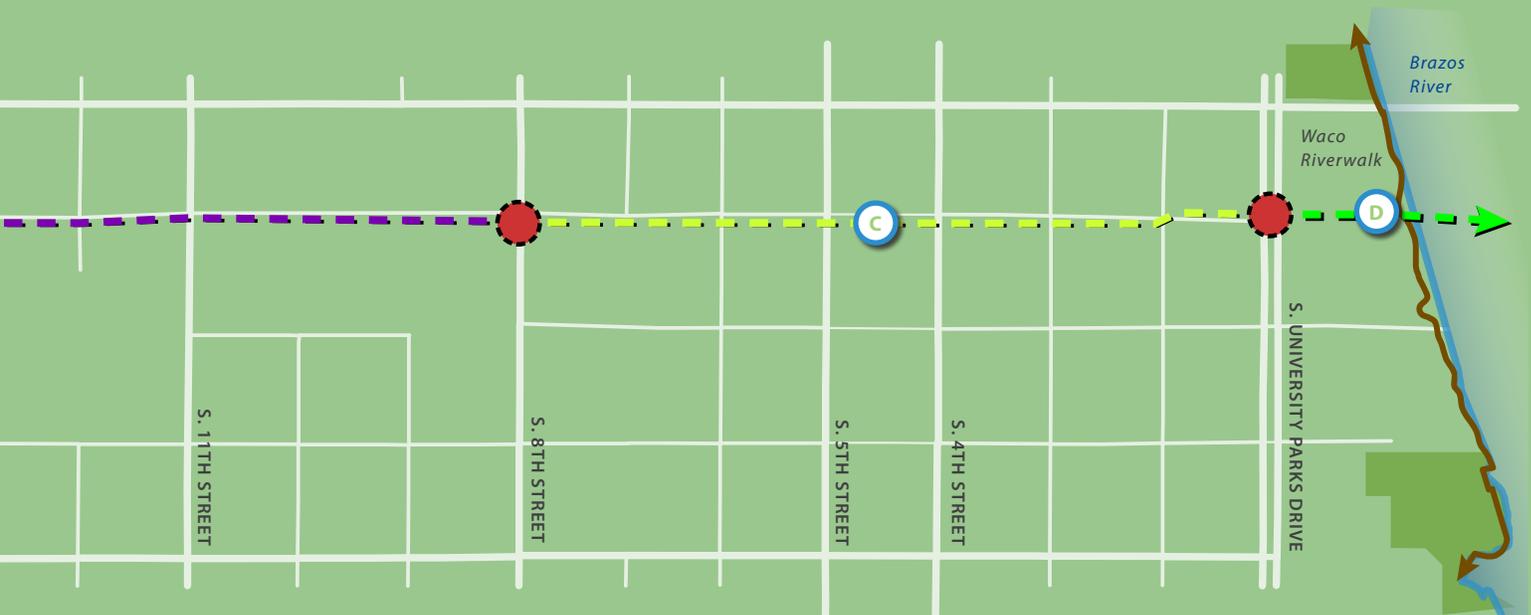
## MARY AVENUE COMPLETE STREET CORRIDOR



### MARY AVENUE TRAIL SEGMENTS<sup>1</sup>

- A Segment A: Waco Creek (S. 26th Street - S. 17th Street).** Greenway trail extending to the northeast from the Hart-Patterson Track site along railroad right-of-way to Bells Hill Park. At Bells Hill Park, the trail bridges the railroad right-of-way and follows Waco Creek forming a greenway corridor underneath the 18th Street and 17th Street bridges to Mary Avenue.
- B Segment B: Mary Avenue (S. 17th Street - S. 8th Street).** Roadside Trail adjacent to Mary Avenue creating a parkway setting and linking the Floyd-Casey and Hart Patterson sites to redevelopment sites in downtown Waco. Existing corridor includes wide rights-of-way with minimal obstructions. Low traffic volumes makes Mary Avenue an ideal “people” corridor adjacent to the more heavily trafficked Franklin Avenue.
- C Segment C: Mary Avenue (S. 8th Street - S. University Parks Drive).** From 8th Street toward the Brazos River, the multi-use roadside trail converts to a wide sidewalk with parallel protected bicycle lanes. Wide sidewalks provide furnishing, through-way and frontage zones of varying width that allow for pedestrian travel and the creation of public gathering spaces. The two-way protected bicycle lanes are positioned to maximize the inclusion of on-street parking where possible. Separated facilities for bicyclists and pedestrians in this area are recommended due to ongoing redevelopment and the anticipated increases in pedestrian activity that accompanies urban spaces.
- D Segment D: Mary Avenue (S. University Parks Drive - Brazos River ).** Northeast from S. University Parks Drive, the corridor transitions back into a greenway trail as it proceeds to the Mary Avenue railroad trestle. With conversion of the railroad trestle to a bicycle/pedestrian bridge the trail will connect to the City’s existing and planned north side trails system.

1. Additional details on the conceptual design and alignment of the Mary Avenue Trail segments can be found in Appendix A.



## TRAILHEADS

Trailhead design and facility selection is dependent on the number of anticipated users, the type of trail, and the surrounding land use context. Examples of the function and design distinctions between two trailhead classifications is illustrated in **Major Trailheads** and **Minor Trailheads** (facing page). Common trailhead features that serve surrounding residents and/or the traveling public are listed in **Typical Trailhead Features** below.

### TYPICAL TRAILHEAD FEATURES<sup>1</sup>

Feature	Major Trailhead	Minor Trailhead
Parking Area	X	
Drinking Fountains	X	X
Benches	X	X
Bicycle Racks	X	X
Trash Cans	X	X
Way-finding	X	X
Informational Signage	X	
Restrooms	X	
Shelter	X	
Fitness Amenities	X	
Bicycle Repair Stations	X	

1. See page 8-11 for a full description of all metropolitan and recreational trails by type.

## WAYSIDES

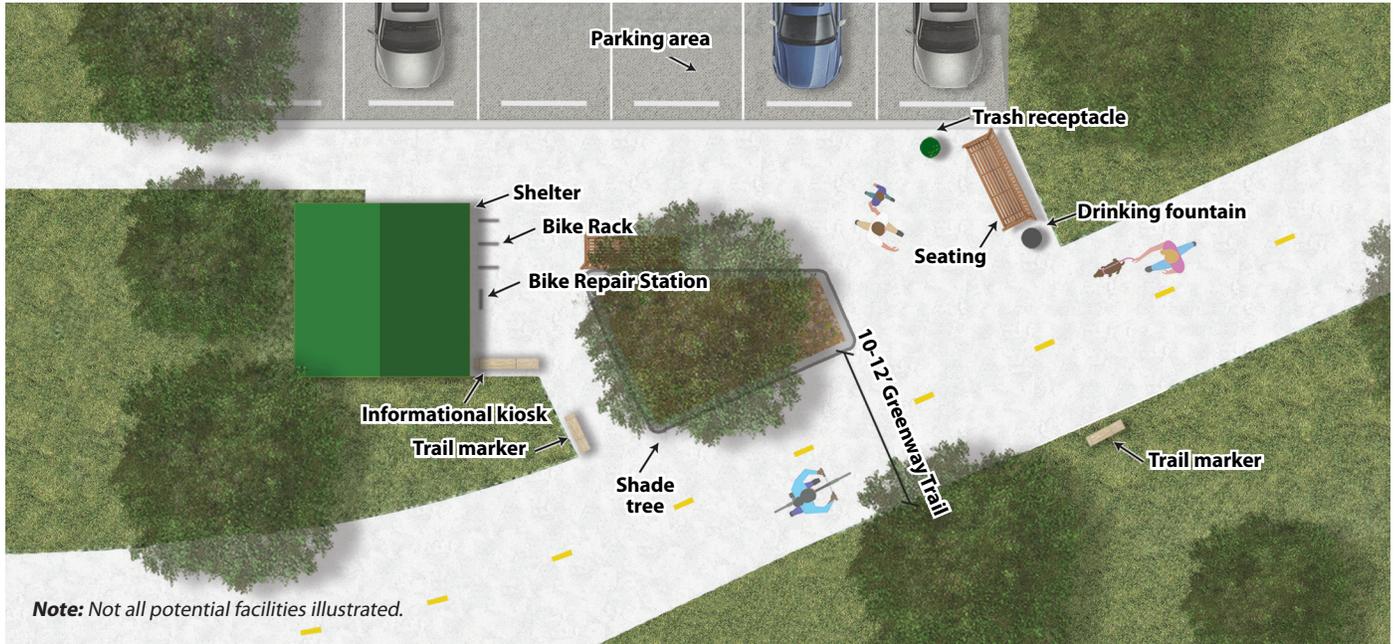
Waysides can enhance the trail user experience by providing intermittent places along a trail to rest, gather, or observe key views or trailside features. Although not typically located at an access point (such as a trailhead), waysides may be located at intervals along a trail segment or at intersecting points and may provide some (or many) of the same amenities that may be found at a trailhead.

*Small comforts offered by simple and inexpensive wayside features can greatly enhance the trail user*



### MAJOR TRAILHEADS

Major trailheads should serve the needs of local residents while also enticing visitors from outside of the community. Facility selection should support extended visits to the city's trails network.



### MINOR TRAILHEADS

Minor trailheads provide access to trails for individuals who reside or work in close proximity to the network. Facility selection should focus on meeting basic trail user needs including access and orientation.



## SUPPORT FEATURES AND AMENITIES

The safety and comfort of the persons that utilize the **Waco Metropolitan Trails System** requires considerations beyond the railway alignment, grades, surface treatments and access points. The cumulative impact of other accessory features will greatly improve the user experience and is often essential in ensuring usability.

### WAYFINDING

Trails system wayfinding features are designed to promote the safe use of the trail, to orient users and to present additional educational/interpretive information. These features can be divided into two categories that describe their primary function: safety and support.

#### SAFETY (WAYFINDING) FEATURES

Designed to address trail user safety – including among trail users; and, where trail user and motor vehicle interaction may occur. Most wayfinding safety features must be consistent with MUTCD guidance.

- **Traffic Control Signage.** Includes “stop,” “yield,” and other traffic control features, plus warning signs and hazard markings.
- **Pavement Markings.** Includes dashed and solid striping for two-way travel and miscellaneous markings that can be coupled with traffic control signage to advise the user about trail conditions.

#### SUPPORT (WAYFINDING) FEATURES

Designed to improve the trail user experience and make the system more accessible, enjoyable and utilitarian for recreation and transportation purposes.

- **System Signage.** System maps including routes, amenities and destinations. Content may also include trail user rules, etiquette, accessibility and level of difficulty.
- **Directional Signage.** Identifies distance and direction to trailheads, amenities, intersecting trails and destinations.
- **Educational or Interpretive Signage.** Providing general information about the history, cultural value or natural features associated with the trail. May be themed and may also include information about contributors to the trail-building effort.



*Multi-use trail safety features are designed for trail users and motorists. Traffic control signage should adhere to MUTCD guidance - particularly at locations where both parties will interact.*

Although this plan recommends that many safety-oriented wayfinding features adhere to MUTCD guidance, the overall trail user experience can be greatly enhanced by creating a consistent and recognizable “brand” among all wayfinding elements.

A wayfinding plan is recommended as a design component for all new trail segments. Waco should also consider aligning its wayfinding efforts with a new trails system branding initiative to ensure consistency across the community as the existing trails system grows and interconnectivity between existing segments increases.



Trails system brand created as part of a wayfinding plan. Includes various gateway, directional, and interpretive signage, and corresponding trail markings within and adjacent to the trail surface. Branding elements are applied to each new trail segment according to placement plans that are incorporated into design and construction drawings. **Elements from above (A) and (B), being installed below.**



## SAFETY AND SECURITY

A usable trails system incorporates essential design features that promote the safe utilization of the trailway, and additional features that provide an inviting and secure environment for visitors.



Hand rails must be a minimum of 42-inches above the surface for pedestrian-only facilities, but at least 48-inches above the surface for multi-purpose facilities that also serve bicyclists (A). Vertical clearance at underpasses must exceed 8-feet, but greater clearance is preferred (B).

### BRIDGES

Bridges should be as wide as the trail (at a minimum); but preferably one to two feet wider on each side. This is to account for bicyclists to “squeeze” into a space that is perceived as more constrained due to handlebar width and so that users can stop and view the adjacent scenery without obstructing the trail. Bridge material and design will vary greatly, but pre-fabricated spans are typically being used for spans of between 50 feet and 200 feet in length. Trail bridge design should adhere to AASHTO’s Bridge Design Specifications.

### RAILINGS AND FENCING

Railing and fences are essential features on bridges but may also be utilized on some boardwalks, in areas where there may be incompatible adjacent land uses (such as active rail lines) or adjacent to natural drop-offs in terrain. Minimum pedestrian and bicyclist railing heights will differ, but AASHTO’s Bridge Design Specifications and applicable building codes should always be referenced to determine appropriate railing height and construction.

### UNDERPASSES

Underpasses should be well lit and attractive and project a sense of security. Where adequate clearance is available, 10 feet is allowed as a minimum, but 10 feet or more is preferred. Underpass trail segments should be designed to occasionally withstand drainage flow.

### LOW-WATER CROSSINGS

Low-water crossings should not exceed 4 feet from the path surface to the waterway flowline unless approved by a professional engineer. Any crossing exceeding 4-foot vertical separation will require a bridge to ensure the trail is compliant with ADAAG standards. For creek crossings that require a short span, box culverts can be used with handrails.

### LIGHTING

Lighting should be provided for all parking areas, trailheads and street crossings. Policies for lighting along trailways should consider whether the trail is a component of a high-volume public amenity (i.e. the Brazos Riverwalk) or whether the specific trail segment is intended to serve as a significant active transportation corridor requiring 24-hour illumination. Regardless, trailway lighting beyond access and crossing points should align with policies on hours of use.

## COMFORT AND CONVENIENCE

Many of the miscellaneous features that increase the comfort and convenience of trail users such as seating, restrooms, bicycle racks and more are associated with trailhead and wayside locations (pages 75 and 76).



*Simple trail conveniences can be grouped at trailhead locations, or placed at targeted waysides and other locations along the trailway.*



## PUBLIC ART

Trails systems can be great locations to showcase public art – often serving as the spine for a series of themed exhibits. Much of the Brazos Riverwalk Trail is home to a collection of sculptures that relate to the animal exhibits in the Cameron Park Zoo.

During the design of future trail segments, the City should clearly and pro-actively identify those locations where public art may be permitted (or encouraged) at a future date

so that placement does not occur arbitrarily. Decisions about the placement of public art should align with a City-adopted public art strategic plan and associated policies on the acceptance, maintenance, rotation and removal of public art pieces.



Site-amenity trails that provide access to facilities within a fixed park site may incorporate many of the same design features as multi-use trails.

## RECREATIONAL TRAIL DESIGN FEATURES

The specific focus of many types of recreational trails means that they must often incorporate specialized design features meant to serve the unique needs of focused user groups. While many of the bicycle and pedestrian design resources listed on page 63 may be applicable for site amenity trails within specific parks or other destinations, recreational trails serving targeted user groups such as avid mountain bikers, paddlers or equestrians must include customized design components.

### MOUNTAIN BIKING TRAILS

Customized mountain biking trails (including cross-country, flow, and downhill sub-types) are designed to utilize natural terrain to provide users with riding challenges extending across a range of difficulty. Although many mountain biking trails also support some hiking or jogging activity, well-designed systems are increasingly limiting access solely to mountain-biking enthusiasts due to design features that combine speed, jumps and drops.

Key mountain biking trail features include trailheads with parking, wayfinding and bike maintenance features, hub markers for orientation and trail signage that provides a thorough description of the features of each trail segment and trail safety/etiquette. The International Mountain Biking Association (IMBA) produces authoritative resources on mountain bike trail design:

- **Guidelines for a Quality Trail Experience (2018, with the US Dept. of Interior, Bureau of Land Management)**
- **Trail Solutions, IMBA's Guide to Building Sweet Singletrack (2004)**



Mountain biking trail signage must clearly communicate difficulty, direction of flow and acceptable type of use.

## HIKING TRAILS

Hiking trails provide able-bodied hikers and walkers with the opportunity to enjoy an “up-close” experience with the surrounding natural environment and are often located in areas with challenging topography that may be inaccessible to some users. Hiking trail design is meant to promote passive enjoyment of nature and low-impact design is meant to limit disturbances to the area.

Essential United States Forest Service resources on trail design include the following:

- **Standard Trail Plans and Specifications (2014)**
- **TRACS, Trail Assessment and Condition Surveys (2011)**
- **Forest Service Trail Accessibility Guidelines (2013)**

## PADDLING TRAILS

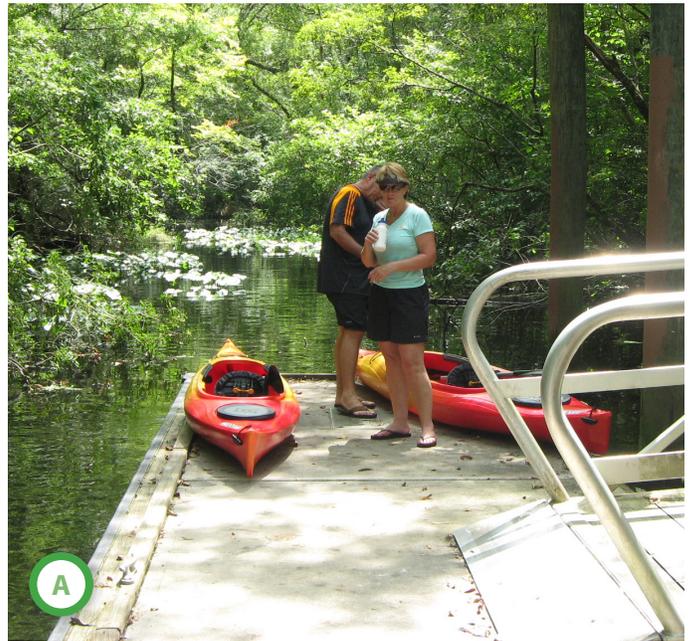
Paddling trail design must consider unique amenities that will ensure a comfortable and enjoyable user experience. Paddling trail designers must consider boat launch facilities, parking-to-launch access, channel markers and navigational signage.

While multiple paddling or water trail design recommendations can be found online, one of the most comprehensive design resources is **Developing Water Trails in Iowa (2010)** developed by the Iowa Department of Natural Resources.

## EQUESTRIAN TRAILS

As with other user groups, trail design to serve equestrians – including the riders and their stock – requires specialized design considerations. Trailhead and parking needs will differ from most other trail types due to the size of vehicles and need to corral animals. Trailway surfaces, clearances and grades, and bridge structures will also require alternative applications to meet the needs of users. Perhaps the greatest issues arise with the manner in which a community may choose to provide shared versus parallel or separated trail access to equestrians, bicyclists and pedestrians.

The **Equestrian Design Guidebook** produced by the United States Forest Service provides detailed and comprehensive guidance on equestrian trail design.



Comfortable, low-stress paddling trail launch facilities (A) - separated from ramps for motorized boats - is a critical component of creating an engaging paddling trail experience. Shared-use of trail facilities with equestrians requires significant design adjustments - particularly in terms of surface selection and maintenance. Most jurisdictions opt to create equestrian-specific trails systems where use by hikers, runners or bicyclists may be incidental (B).

