Approach grades for bridges and tunnels on RWTs should follow AASHTO guidelines and typically also must meet ADA Accessibility Guidelines. Again, a greater than five percent grade is not recommended.

Trail-Roadway Crossings

At-grade crossings between RWTs and roadways can be complex areas that require the designer to think from the perspective of all types of users who pass through the intersection: trains, motorists, bicyclists, and pedestrians. Trail-roadway intersections are covered in detail by both the AASHTO Bike Guide and the MUTCD. While these manuals do not specifically recommend solutions for RWT crossings, they cover basic safety principles that apply to all trail-roadway crossings.

Variables to consider when designing trail-roadway intersections include right-of-way assignment, traffic control devices, sight distances, access control, pavement markings, turning movements, traffic volume, speed, and number of lanes. Refer to the AASHTO Bike Guide for information regarding these design factors. All traffic control devices should comply with the MUTCD.

At-Grade Trail-Roadway Crossings

At-grade RWT-roadway crossings can be very complex, and typically require the involvement of both the roadway agency and the railroad company. Each must be evaluated on a case-by-case basis through engineering analysis. There are essentially three different methods for handling RWT-roadway crossings:

1. Reroute shared use path users to nearest signalized intersection (see **Figure 5.35**).
2. Provide new signal across roadway (see **Figure 5.36**).
3. Provide unprotected crossing (see **Figure 5.37**).

Another possible scenario (although undesirable) has trail users crossing both the roadway and tracks, as shown in **Figure 5.38**.

The appropriate crossing design should be selected based on the following considerations:

- Motor vehicle traffic must be warned of both types of crossings (railroad and trail). Care should be taken to keep warning devices simple and clear; ambiguous and overly complicated signage and pavement markings can distract both motorists and trail users.
- If a pedestrian-actuated traffic signal is warranted at a mid-block RWT-roadway crossing, the traffic signal should be integrated with the design of active warning devices that alert motorists of an approaching train. This may require redesigning several aspects of the intersection.
- If automatic gates are used, they should be placed in between the trail crossing and the active track(s). Where possible, the stop bar on the highway should be located behind the trail crosswalk. However, if the crossing is located at too great a distance from the automatic gate, the stop bar should be placed in a standard position near the gate, and a DO NOT BLOCK CROSSWALK sign should be used at the trail crossing.

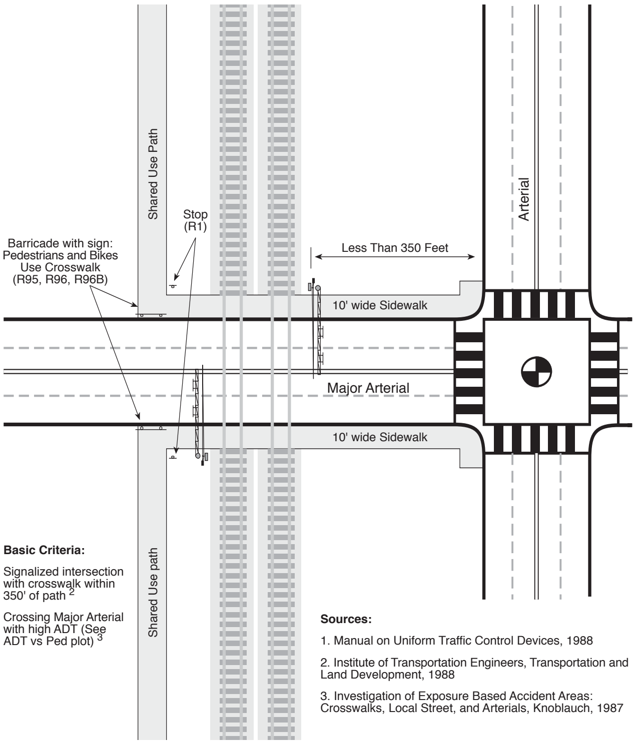

FIGURE 5.35 Roadway crossing type 1 (reroute to nearest intersection)

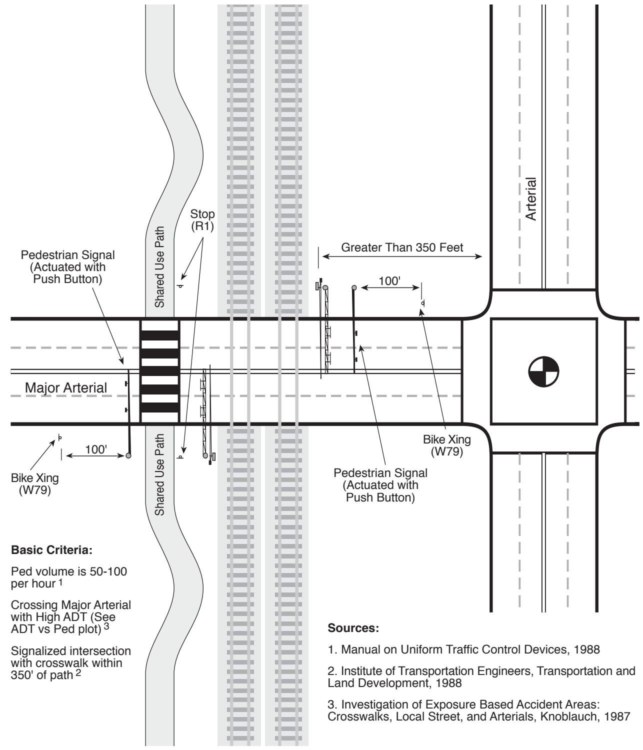

FIGURE 5.36 Roadway crossing type 2 (new signal)

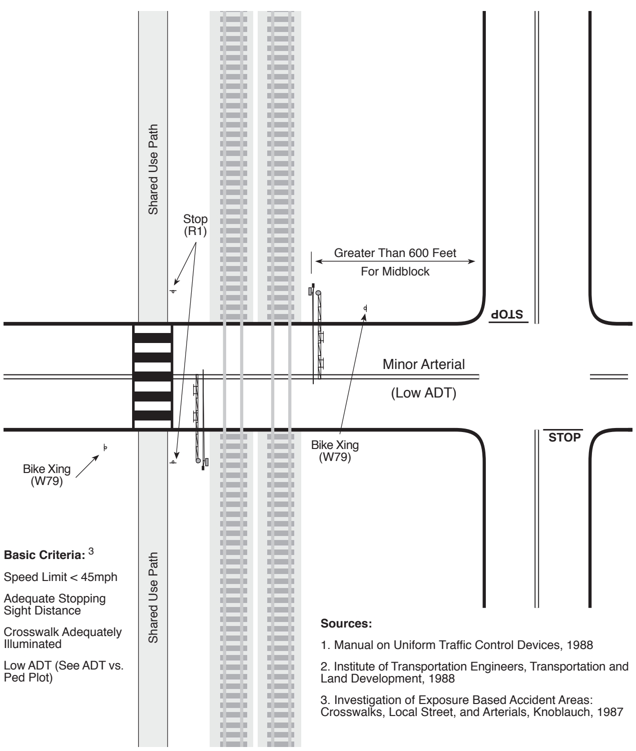

FIGURE 5.37 Roadway crossing type 3 (unprotected crossing)

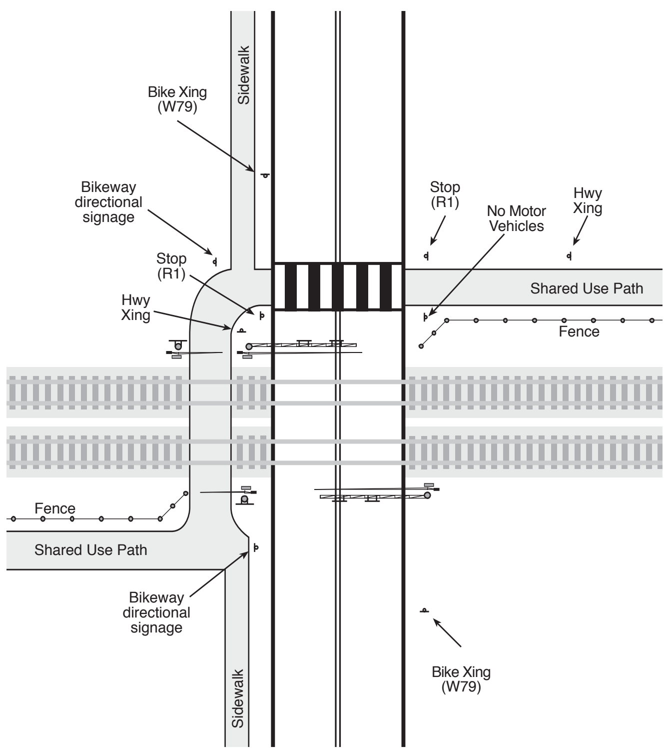

FIGURE 5.38 Roadway and track crossing

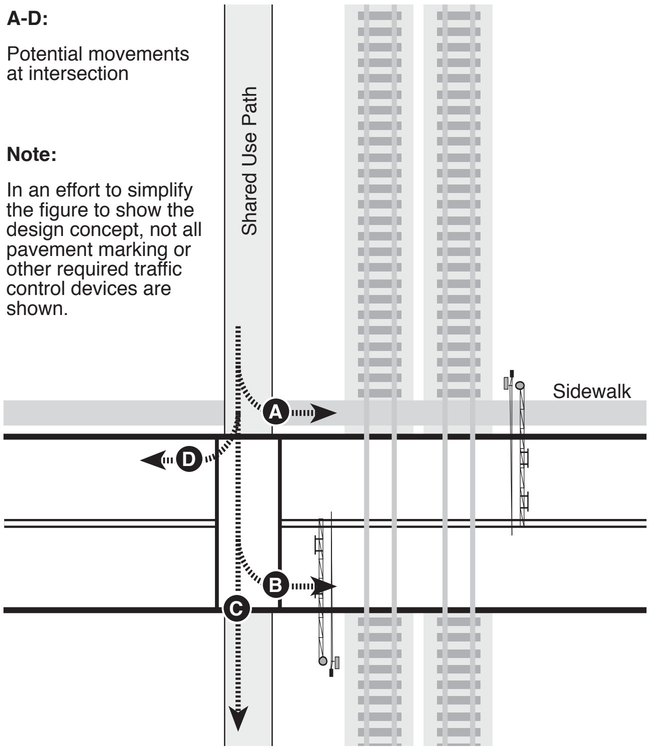

FIGURE 5.39 Summary of potential trail user movements

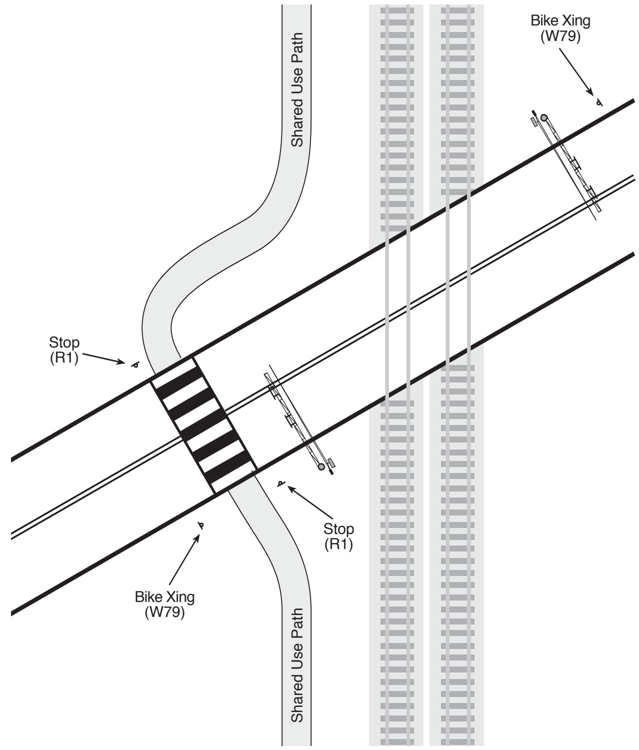

FIGURE 5.40 Angled intersection with roadway

- If active warning devices are used, the trail should be integrated so that trail users are made aware of approaching trains. Trail users may either elect to travel straight across the road, or may exit the trail and continue their journey on the roadway (see **Figure 5.39**). In this scenario, turning movements towards the tracks could be hazardous if the trail user is unable to view active warning devices, or if sight distances are restricted. The angle of approach for these trail users must be considered when placing warning devices. In cases where flashing light signals (post mounted) are used, it is important to locate these devices so that they can be seen by trail users, and to include bells and other audible warning devices to provide additional warning to bicyclists and pedestrians.

RWT-roadway intersections can become further complicated if the railroad crosses the roadway at an angle. Angled trail crossings are not recommended, because they increase the amount of exposure time in the roadway for pedestrians and bicyclists. **Figure 5.40** shows an alternative crossing design that permits trail users to cross perpendicular to the roadway at angled rail-highway crossings.

Grade-Separated Trail-Roadway Crossings

Where a proposed RWT will cross a major roadway or highway carrying heavy traffic volumes (typically more than 20,000 vehicles per day) and/or traffic at speeds greater than 72 km/h (45 mi/h), grade separation should be explored regardless of where the adjacent railroad tracks are located. The design issues related to these undercrossings or overcrossings are the same as on all other shared use paths, and are not covered in this document.

Utilities

Many railroad corridors have utilities that may impact the design, location, or even the feasibility of an RWT. At a minimum, most railroads have their own internal communication systems within their corridors, sometimes located on poles. Any RWT would need to either avoid these poles with a 0.9 m (3 ft) minimum shy distance, or relocate per specification by the railroad. Sometimes a railroad will require that their relocated communication lines be placed underground in new conduit.

Buried fiber optic cable, Washington & Old Dominion Trail. *Fairfax County, VA*

Surface and subsurface utilities often are located within the railroad right-of-way, impacting the location and construction of the RWT. Utilities include active and abandoned railroad communications cable, signal and communication boxes, fiber optic cable, and water, sewer, and telephone lines. Added to this mix, utilities may run parallel to the tracks on one or both sides of the right-of-way, and across, under, or over the tracks.

Trails may need to be closed temporarily to allow utility work. The manager of the Cottonbelt Trail, Texas, notes that one should expect to have interference when utilities companies perform maintenance. The Explorer Pipeline Company required the Cottonbelt Trail to have removable pavement where the trail crossed its pipeline.

Part of the initial feasibility study should identify existing utilities in the corridor, and specifically (a) ownership, (b) location, and (c) easement agreements with the railroad company. While it is not uncommon for a trail to be constructed on top of a subsurface utility, there typically are easement restrictions and requirements that will impact the trail design and location.

RWTs may be constructed with buried conduit under or adjacent to the path to serve existing or future utilities. Inclusion during initial construction saves immense cost and disruption in the future. Conduit and auxiliary equipment (e.g., repeater boxes) should not present slip, trip, or fall opportunities; visual obstacles; or other hazards. The feasibility study staff also must meet with both the railroad and utility representatives to discuss their concerns and requirements.

Accommodating Future Tracks and Sidings

A fundamental part of any feasibility study is to examine the possible addition of tracks and sidings (railroad car storage facilities) that will have a direct impact on RWT design and alignment. The RWT team must seek out information from the railroad operator about their future expansion plans. In many cases, a railroad company may not have specific plans but may want to reserve room to expand in the future if it is needed. In other cases, a railroad operator may have specific plans for additional tracks, either in the short, mid, or long term. In still other cases, a transit agency may have long range plans to use part of or the entire corridor for future transit or commuter rail service. Should a railroad company choose to reserve their land for future rail service, the trail project is not likely to be feasible.

Siding on site of proposed RWT.
Kelowna, BC, Canada

The issue of sidings must be clearly understood by the feasibility study team. A corridor may have existing but unused sidings that either may be removed if the land use has changed significantly or reactivated if a new tenant comes in or economic conditions change. If a rail corridor traverses an industrial or warehouse area, there may be a future need for sidings to serve future land uses, impacting the proposed RWT.

Should additional tracks or sidings seem a possibility even in the long term, they should be included in the RWT design process. In flat terrain, the additional tracks should be located on the opposite side of the proposed RWT, and there should be sufficient room for additional tracks if the RWT is located at the extreme edge of the right-of-way. In terrain with cut and fill, any future tracks would probably require major engineering that would most likely impact the overall feasibility of the RWT project within a typical 30 m (100 ft) wide railroad right-of-way.

An RWT should be located and designed so as to avoid active, potentially active, or potential future sidings. RWTs that cross sidings pose operational and safety problems for the trail manager and rail operator alike. A railroad corridor with numerous sidings or industrial spurs on both sides of the existing tracks would be a poor choice for an RWT project.

One option is to include language in the easement or license agreement to remove or relocate the RWT in the event that there is a future need for additional tracks or sidings. If there are firm plans for future expansion, this is not likely to be attractive to the railroad operator because of the anticipated difficulty in removing or rerouting a popular path in the future.

Trestles and Bridges

As part of the feasibility analysis, the presence of trestles and bridges will loom large as major constraints to the overall feasibility of a project. Virtually all railroad corridors will have at least some minor bridges or culverts either as part of the local drainage system, or the local network of streams and creeks. In some cases, there will be longer trestles and bridges over roadways, highways, rivers, and canyons. In almost all cases, the railroad structures are not designed to accommodate pedestrians at all, let alone bicycles, and represent a real safety hazard (and attraction) to trespassers.

Simple prefabricated bridges over small streams, culverts, and other waterways are not expensive items. However, they may impact a project's feasibility from an environmental perspective. A new bridge over a highway or on a long trestle may have enormous costs, and may, in some cases, represent the single greatest cost on the project.