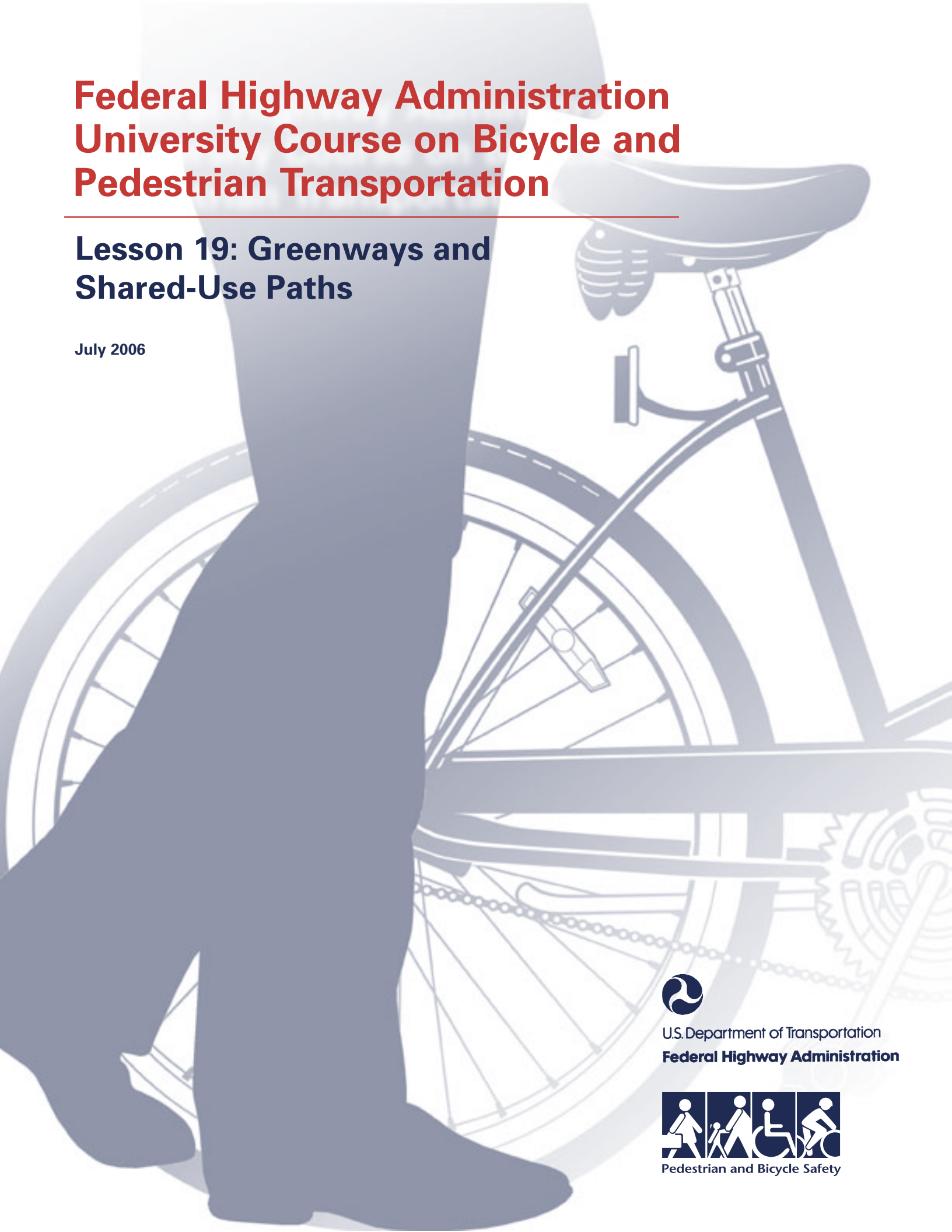
Federal Highway Administration University Course on Bicycle and Pedestrian Transportation

Lesson 19: Greenways and Shared-Use Paths

July 2006



U.S. Department of Transportation
Federal Highway Administration

Pedestrian and Bicycle Safety

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LESSON 19:

GREENWAYS AND SHARED-USE PATHS

19.1 Introduction

Shared-use paths provide low-stress environments for bicycling and walking that are separate from motor vehicle traffic. They can be great places for novice and child bicyclists to try out their bicycling skills prior to taking trips on urban streets. Shared-use paths are frequently in high demand among bicyclists, joggers, in-line skaters, people walking dogs, people with disabilities, and a variety of other users. Systems of shared-use paths in urban and suburban communities serve as the arterials of the bicycle and pedestrian transportation system. They serve as a complement to and extension of onstreet facilities (not as alternatives to them) and offer the protection from motor vehicle traffic that many Americans seek when looking to leave their car behind in favor of a bike, walk, or skate.

The popularity of many urban paths has shown that large volumes of pathway traffic, with a diverse user mix, can create congested and conflictive path conditions similar to that on urban highways. Therefore, planning and design of shared-use paths must be done with the same care and attention to recognized guidelines and user needs as the design of on-roadway bikeways and other transportation facilities.

The following discussion addresses planning and design issues common to most shared-use path facilities, including how to accommodate various user types, address different right-of-way settings, and achieve various safety standards and guidelines. More detail on shared-use path design and engineering is provided in national guidelines established by the Federal Highway Administration (FHWA), the U.S. Architectural and Transportation Barriers Compliance Board (the Access Board), and the American Association of State Highway and Transportation Officials (AASHTO). See specific resources listed in section 19.11. The major sections of this lesson are as follows:

- 19.1 Introduction.
- 19.2 Shared-Use Path Definition.
- 19.3 Shared-Use Path Users.
- 19.4 User Conflict.
- 19.5 Shared-Use Path Types and Settings.
- 19.6 Planning.
- 19.7 Rail-Trails, Rails-with-Trails, and Towpaths.
- 19.8 Greenway Paths.
- 19.9 Paths Adjacent to Roadways.
- 19.10 Path Design.
- 19.11 Student Exercise.
- 19.12 References and Additional Resources.

19.2 Shared-Use Path Definition

The term shared-use path is defined by AASHTO as "a bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared-use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other nonmotorized users."[(1)] These facilities are most commonly designed for two-way travel. In many communities, shared-use paths may also be referred to as trails, multiuse trails, bike paths, hiker/biker trails, or other similar terms.

19.3 Shared-Use Path Users

Shared-use paths are typically used by a diverse set of users representing different travel modes, using different types of equipment and traveling at different speeds (see figure 19-1). It is important to understand, even within the basic user categories of bicyclists, pedestrians, and skaters, how diverse path users can be. A recent study, *Characteristics of Emerging Road and Trail Users and Their Safety*, begins to document the various characteristics of these users and their equipment.[(2)]

Figure 19-1. Photo. To minimize user conflicts, adequate trail width is critical on paths having high volumes and diverse user mixes (Santa Barbara, CA).

- **Bicyclists** include adults using traditional bicycles, but also child bicyclists, cyclists pulling trailers or trail-a-bikes, and riders of tandem bicycles, recumbent bicycles, hand cycles, tricycles, and a variety of four-wheeled human-powered vehicles.

- **Pedestrians** include joggers, runners, and people walking dogs and pushing strollers, as well as disabled people. Today, disabled and injured people have a wide variety of assistive devices available to aid in travel or enable participation in trail activities, including powered and manual wheelchairs, powered scooters, tricycles, hand cycles, and racing wheelchairs, as well as the more traditional, crutches, walkers, and canes.

- **Skaters** include users as diverse as in-line skaters, kick scooters, skateboarders, and people using roller-skis.

In some communities, multiuse trails are designed and managed to accommodate equestrians, cross-country skiers, mountain bikers, and other users of specialized recreational activities. In general, the present discussion of shared-use paths does not specifically address the needs and issues of these more specialized user groups.

Shared-use paths do not typically allow use by motorized vehicles such as cars, motor scooters, motorcycles, go-carts, or recreational all-terrain vehicles (ATVs); however, there are important exceptions to consider in planning and design:

- Access for emergency, police, and maintenance vehicles.
- Use of electric wheelchairs, scooters, or other devices by disabled persons.
- Use of electric bicycles, electric push scooters, or other means of electric locomotion (if permitted by Federal-aid program regulations), at the discretion of local or State government.
- In rural areas, use of snowmobiles in winter.

Some shared-use paths may be appropriate for equestrian use. Some States claim that Federal law or regulation prohibits equestrian use on shared-use paths that use transportation funds. This is not true: there is no such Federal law or regulation. While the projects must serve a transportation function, nothing prohibits recreational use, and nothing requires a prohibition of equestrian use. There are various design options to allow equestrian use, such as providing both a paved path and an unpaved path within the same right-of-way.

In addition to diverse users and a variety of equipment used, shared-use paths serve a wide variety of trip purposes. User behavior, such as travel speed and willingness to make stops, varies considerably with different trip purposes. Especially in urban and suburban areas, paths are routinely used for commuting to work or school, running errands, visiting friends, getting exercise, observing nature, and seeking recreation and enjoyment of the outdoors.

Moreover, people of all ages and abilities use and enjoy shared-use paths—from the very young to the very old, from the novice cyclist to the marathon trainer. Accommodating and balancing the various needs created by this diverse user market is a central challenge for today's shared-use path planners and designers.

19.4 User Conflict

User conflicts can emerge when user goals differ. In *Conflicts on Multiple-Use Trails*, Moore urges trail planners, designers, and managers "not to treat conflict as an inherent incompatibility among different trail activities, but as goal interference attributed to another's behavior."[(3)] In addition to following good trail planning and design principals, Moore describes how user conflicts can be successfully minimized through effective path management.

Understanding the diverse social and operational needs of expected users and designing trails to accommodate projected volumes and mode mixes is critical to building successful trail systems—trails that will serve multiple roles in a community's transportation and recreation network.

19.5 Shared-Use Path Types and Settings

Shared-use paths can be developed on a variety of rights-of-way and exist in many types of settings, including urban, suburban, exurban, and rural. Increasingly long paths use a variety of rights-of-way and pass through many diverse environments. The following is a list of the most common shared-use path types:

- **Rail-trails**—Paths created on abandoned railroad corridors.

- **Rails-with-trails**—Paths created adjacent to active rail lines (see figure 19-2), such as freight railroads, commuter rail lines, light rail, or other rail transit facilities.

Figure 19-2. Photo. Shared-use paths can be adjacent to railroad lines (Libba Cotton Trail, Carrboro, NC).

- **Greenway trails**—Paths incorporated into linear natural areas such as parks or conservation areas, along stream or river corridors, along waterfronts (see figure 19-3) including beaches and shorelines, or along flood control levees, etc.

- **Paths adjacent to highways, roads, and parkways**—Sometimes referred to as *sidepaths*.

- **Towpaths**—Paths created along abandoned canals by using the towpath or canal bed.

- **Paths using utility corridors**—Such as power lines, water supply, or sewer corridors, irrigation canals, or other utility lines.

- **Other paths**—Such as those developed within university campuses, on other institutional properties, or within large residential and/or commercial developments.

A wide variety of other facilities are often referred to by the terms path, pathway, or trail. They may share similarities with shared-use paths, but they are not addressed in this course. These include nature and interpretive trails, primitive and backcountry hiking trails, historic trails, heritage trails and touring routes, and walking paths.

Figure 19-3. Photo. Shared-use paths can be integrated into urban waterfronts and parks, providing direct access to central business districts (East Bay Bicycle Path, Providence, RI).

19.6 Planning

Greenways: A Guide to Planning, Design and Development and *Trails for the Twenty-First Century* are two well-researched resources on the subject of planning that both emphasize its importance in the process of creating a shared-use path.[4,5] Three key objectives that should be addressed during the planning phase comprise communicating a clear vision, goals, and concept for the facility; building community support; and developing a comprehensive corridor assessment. Other plan components may include: documentation of community benefits and opportunities, environmental impact assessments, preliminary cost estimates, funding and phasing options, and implementation plans. Public involvement, interagency coordination, and interjurisdictional coordination should also be considered during early planning activities.

Trails for the Twenty-First Century offers a helpful guide to planning process terminology and includes four key steps in the pathway planning process:[5]

1. Trail vision or concept
2. The master plan
3. Preliminary design
4. Construction drawings and documents

Too often, agencies charged with creating a shared-use path fail to understand or adopt a crucial pathway planning principal—that by definition, shared-use paths serve both transportation and recreation functions. As such, they must be planned and designed to be a part of two systems of community infrastructure: parks and recreation, and transportation.

19.7 Rail-Trails, Rails-with-Trails, and Towpaths

More than 20,117 kilometers (km) (12,500 miles (mi)) and 1,200 rail and canal trails are now in place nationwide. More than 61 rails-with-trails and 25 towpaths are included in these totals. Unused rail and canal corridors offer many benefits as trail conversions, including gentle grades, existing base and sub-base for path construction, access to the center of communities, historic preservation and revitalization opportunities, scenic and natural resource preservation, and creation of social linkages from the past to the future. These types of pathways also present unique planning and design challenges. The following issues are especially important, since many of them have received extensive study and best-practice analysis (see "References" in section 19.11):

- Right-of-way acquisition and landownership issues.
- Liability issues.
- Bridge, tunnel, stonewall, and other structure reuse and rehabilitation issues.
- Potential historic resource impacts.
- Potential environmental contamination.

19.8 Greenway Paths

> The most common feature of many greenways is a trail…with so many types of users in the United States, there are many types of trails, and elementary though it may seem, it is important to distinguish among them. All greenway trails should be compatible with the natural landscape and its functions.[4]

What distinguishes the typical greenway path from other types of shared-use paths is that the path is only one component of a larger corridor, which is primarily defined by its environmental features or functions, including waterways, forests, wetlands, shorelines, or other natural or restored landscapes. Moreover, the reason that the corridor exists may not be primarily to create a context for a path, but for larger environmental purposes such as habitat preservation, to absorb and accommodate floodwaters, or to provide parkland and recreation resources for human communities.

Greenway paths may be incorporated into built natural areas such as linear urban parks or parkways, along flood control levees or along urban waterfronts. Greenway paths can also be created in natural areas such as along beaches and shorelines, in conservation areas, or along stream or river corridors.

Greenway paths present unique planning and design challenges. The following issues are especially significant, as many of them have received extensive study and best-practice analysis:

- Positioning the pathway within the greenway corridor.
- Minimizing and managing environmental disturbance and impact, both during path construction and as the path sustains ongoing use.
- Reducing stormwater runoff and protecting against erosion.
- Incorporating environmental restoration such as bioengineering and low-impact stormwater management techniques.

- Designing the trail to be compatible with or even reinforce the larger goals and purposes of the corridor.

19.9 Paths Adjacent to Roadways

In select circumstances, locating shared-use paths adjacent to roads may be the best or only option available. In settings such as parkways or roadways with little or no access on one side and sufficient space to provide a path and buffer, locating paths adjacent to roads may be preferable to other options. Roads or streets that have low motor-vehicle traffic volumes and/or low traffic speeds can also be viable candidates for accommodating sidepaths, especially to provide continuity for a path that is otherwise on an independent right-of-way, but has critical gaps.

However, in typical cases, if a two-way shared-use path is located immediately adjacent to a roadway, some operational problems are likely to occur. The extent of these problems will depend on the context and layout of the roadway, number and nature of cross-streets, driveways and access ramps, and adjacent motor vehicle travel speeds. The AASHTO *Guide for the Development of Bicycle Facilities* enumerates nine potential problems and safety issues that need to be given serious consideration when planning or designing a shared-use path adjacent to a roadway, as for example:[1]

- When the bicycle path ends, bicyclists going against traffic will tend to continue traveling on the wrong side of the street. Likewise, bicyclists approaching a bicycle path often travel on the wrong side of the street in getting to the path. Wrong-way travel by bicyclists is a major cause of bicycle/automobile crashes and should be discouraged at every opportunity.

- At intersections, motorists entering or crossing the roadway often will not notice bicyclists coming from their right, as they are not expecting contraflow vehicles. Even bicyclists coming from the left often go unnoticed, especially when sight distances are poor.

- Although the shared-use path should be given the same priority through intersections as the parallel highway, motorists falsely expect bicyclists to stop or yield at all cross-streets and driveways. Efforts to require or encourage bicyclists to yield or stop at each cross-street and driveway are inappropriate and frequently ignored by bicyclists.

19.10 Path Design

AASHTO's updated (1999) *Guide for the Development of Bicycle Facilities* remains the primary design guide for shared-use paths. The *Manual on Uniform Traffic Control Devices* (MUTCD) 2003 edition, "Part 9: Traffic Controls for Bicycle Facilities," is the primary source for guidance regarding signing and striping of shared-use paths.[6]

A number of new publications provide supplementary information, including:

- *Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities* (ADAAG).[7]
- *Accessible Rights-of-way: Sidewalks, Street Crossings, and Other Pedestrian Facilities: A Design Guide*.[8]
- *Characteristics of Emerging Road and Trail Users and Their Safety*.[2]
- *Designing Sidewalks and Trails for Access: Parts 1 & 2*.[9]
- *Draft Guidelines for Accessible Public Rights-of-Way*.[10]

- *Evaluation of Safety Design and Operation of Shared Use Paths: Users Guide and Final Report.*[11]
- *Recommendations for Accessibility Guidelines: Outdoor Developed Areas, Final Report.*[12]
- *Trail Intersection Design Guidelines.*[13]
- *Trails for the Twenty-First Century.*[5]

The following highlights address important trail design issues using references from the texts listed above. The AASHTO *Guide* should be used as a companion text for this module.

Accessible Path Design

Because shared-use paths provide a transportation function, all newly constructed shared-use paths should be built to provide access for people with disabilities. In addition, existing shared-use paths should be improved to enhance access whenever possible. Key issues for accessibility include trail access points, grade, cross-slope, street crossings, curb ramp design, railings, and signage. A single source of access guidance for shared-use trails has not been compiled; however, taken together, the sources above address the essential topics.

- Surfaces can be paved (asphalt or concrete) or unpaved (crushed stone or aggregate), but should be firm, stable, and slip-resistant.
- Grades should generally be less than 5 percent, but can be up to 12.5 percent for short distances, such as 3 meters (m) (10 feet (ft)). Level landings or rest areas should be provided at appropriate intervals on grades steeper than five percent.
- Cross-slopes for drainage or superelevated curves should be no greater than two percent.

Trail Width and Striping

Under most conditions, the recommended paved width for two-directional trails is 3 m (10 ft); however 3.7- to 4.3-m (12- to 14-ft) widths are preferred where heavy traffic is expected (see figure 19-4). In select instances, a reduced width of 2.4 m (8 ft) can be adequate, especially if one or the other of the bicycle or pedestrian modes has a small percentage of overall use. A recent study, *Evaluation of Safety Design and Operation of Shared Use Paths*, found that from 3 to 4.9 m (10 to 16 ft), every additional foot in width significantly improves the level of service for bicyclists using shared-use paths.[11]

This study also found that centerline stripes have a significant impact on how bicyclists tend to operate on shared-use paths: [11]

> A striped centerline has a strong impact on the bicyclist's perception of freedom to maneuver. This finding appears to support the intent of trail designers in providing a centerline, which is to clearly delineate two opposing travel lanes. A centerline reinforces the idea that to pass a slower moving user, the cyclist may need to use the travel lane of opposing trail users, and should pass only when the opposing lane is open…there may be valid safety reasons for providing a centerline stripe, particularly on crowded trails, on curves with limited sight distance, and in other appropriate circumstances.

Additional details regarding striping and marking of paths are found in MUTCD.

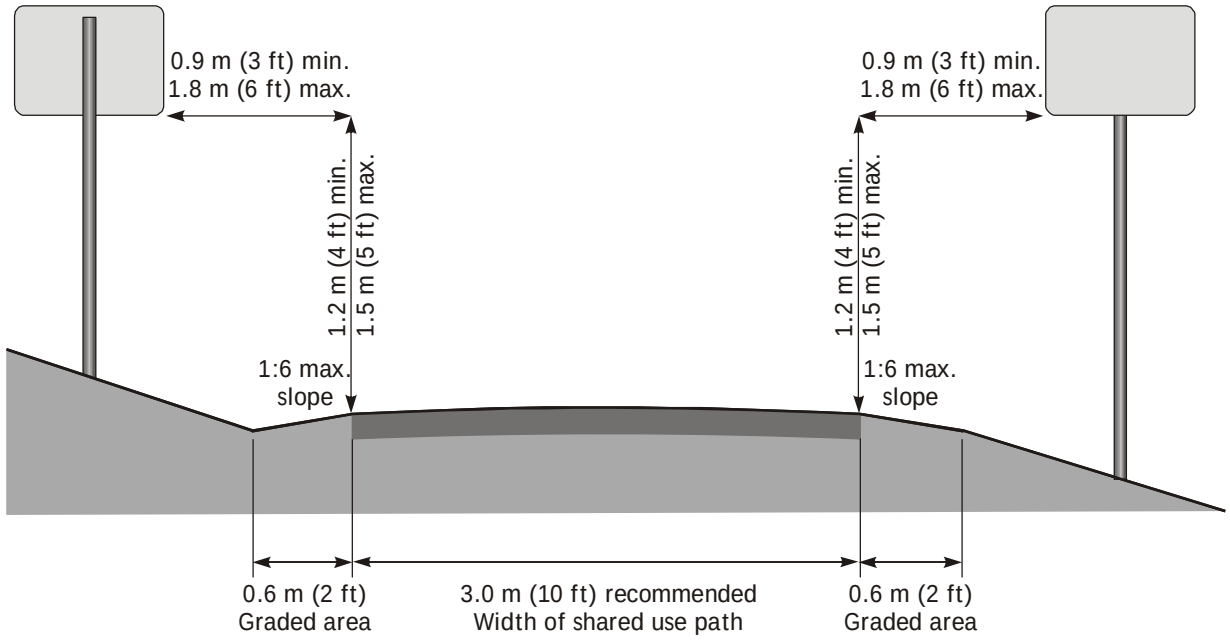

Figure 19-4. Illustration. Typical cross section for multiuse trails.
Source: American Association of State Highway and Transportation Officials[(1)]

Trail/Roadway Intersection Design

According to page 46 of AASHTO's *Guide for the Development of Bicycle Facilities*:[(1)]

> Intersections between paths and roadways are often the most critical issue in shared-use path design. Due to the potential conflicts at these junctions, careful design is of paramount important to the safety of path users and motorists alike. The solutions provided in this chapter should be considered guidelines, not absolutes. Each intersection is unique and will require sound engineering judgment on the part of the designer as to the appropriate solution.

The following are principles of intersection design taken from *Trail Intersection Design,* AASHTO, and other sources:[(13,1)]

- Design for the full spectrum of trail users—young and old, slow and fast, bicyclists, skaters, and walkers, etc.
- Site the crossing area at a logical and visible location.
- When assigning right-of-way, give trail users at least the same rights as the motoring public, and provide clear right-of-way assignment.
- Provide positive guidance for trail users and motorists to ensure full awareness of the intersection. Warning signs and pavement markings (see figure 19-5) that alert motorists of the upcoming trail crossing should be used in accordance with MUTCD.

(This picture shows bicyclists not wearing helmets.
FHWA strongly recommends that all bicyclists wear helmets.)

Figure 19-5. Photo. Signs, bollards, and trail and crosswalk markings alert both motorists and bicyclists to this midblock trail crossing.

Source: Pedestrian and Bicycle Information Center (PBIC)
Image Library, http://www.pedbikeimages.org

- Minimize conflicts and channelize the intersection to separate conflicting movements.
- Design unavoidable conflicts to occur at right angles.
- Optimize sight triangles, thereby ensuring proper stopping, intersection crossing, and decision sight distances. Conflicts should be clearly visible.
- Reduce motor-vehicle speed through traffic-calming techniques, as appropriate.
- Use design to ensure appropriate trail user speeds approaching and through the intersection. Wherever possible, intersections and approaches should be on relatively flat grades.
- Minimize trail user crossing distance with a median refuge area or by narrowing the roadway as appropriate.
- Provide adequate staging and refuge areas for trail users; use trail edge railings or posts to give stopped bicyclists a handhold that allows them to stop and maintain a ready posture for crossing without taking their feet off the pedals.
- Discourage unwanted motor vehicle intrusion onto the trail while enabling emergency and maintenance vehicle entry.

- Avoid unnecessary obstacles and barriers, and visibly highlight necessary obstacles. At signalized intersections:

    - Minimize trail user delay by minimizing traffic signal cycle time.
    - Provide adequate signal crossing time for design pedestrians.
    - Provide tactile/audible pushbuttons that are easily accessible for all types of trail users.

- Design to assist the trail user in looking in the direction of the potential hazard. Use signs and pavement markings on the trail to provide advance warning of upcoming intersections, especially in areas where the intersection is not clearly visible 75 m (250 ft) in advance.

- Consider the potential for sun blinding and lighting needs.

- Consider landscaping and other gateway treatments to draw motorists' and trail users' attention to intersections and to encourage slowing; however, take care to use designs that do not limit visibility and sight distances or demand trail users to make difficult maneuvers.

Other Design Issues

Quality shared-use path design requires a melding of skills from the fields of transportation engineering and landscape architecture. Guidance about basic engineering such as pavement structure, bridge loading, geometric design, and traffic safety must be combined with aesthetic, environmental, and cultural considerations such as attention to diverse human needs and the surrounding environmental and climatic conditions and integration with a community's identity and history. The following list of additional design issues is addressed in one or more of the design resources provided in section 19.11; these issues can also be researched on the Internet for case examples and guidance from documents developed by regional, State, or local agencies.

- Path surface and treadway design:

    - Hard and soft surfaces.
    - Boardwalks and bridge decks.
    - Separate treadways for wheels and heels.
    - Soils, subgrade, and geotechnical design.

- Geometric design issues:

    - Sight distance.
    - Slopes, grades, and cross-slopes.
    - Horizontal alignment.

- Providing access:

    - Stairs with bicycle rolling troughs for grade-separated crossings (see figure 19-6).
    - Access to abutting and cross-streets.
    - Controlled and uncontrolled access to adjacent properties.
    - Spur paths and trails.

Figure 19-6. Photo. Stairway with bicycle rolling troughs (Capital Crescent Trail, Bethesda, MD).

- Restricting access and separation from adjacent activities:
  - Restricting motor vehicle access.
  - Restricting path side access.
  - Paths adjacent to active railroads.
  - Fence, bollard, railing, and barrier design.
- Adjacent to roadway design issues:
  - Curbs.
  - Buffers.
  - Trail edge railings.
  - Roadway guide rails.
- Environmental controls and impacts:
  - Providing appropriate drainage.
  - Minimizing erosion.
  - Porous paving.
  - Trees and root systems.
  - Crossing wetlands.
  - Use of recycled materials and green building practices.

- Aesthetic issues:

    - Materials and use of color.
    - Landscaping.
    - Signs.
    - Public art.
    - Lighting.

- Amenities—location, citing, and design:

    - Bicycle parking.
    - Benches and rest areas.
    - Drinking water.
    - Restrooms.
    - Historic and cultural interpretation.

- Signing (see figure 19-7):

    - Wayfinding.
    - Identity.
    - Etiquette.
    - Regulatory.
    - Interpretive.
    - Informational.

Figure 19-7. Photo. Trailheads with parking and wayfinding signs assist shared-use path users (Rock Creek Trail, Montgomery County, MD).

- Structures and special crossings (see figure 19-8):
    - Bridges.
    - Tunnels.
    - Underpasses.
    - Retaining walls.
    - Culverts and drainage structures.
    - Railroad/trail crossings.
    - Bicycle/pedestrian ferries.

Figure 19-8. Photo. Bridges and floating sections allow paths to cross water and maintain continuity (Eastside Esplanade, Portland, OR).

- Lighting:
    - Safety and security.
    - Wildlife impacts.

- Trailheads and parking:
    - ADA accessibility.

19.11 Student Exercise

Visit and evaluate a trail facility in your area. Determine the positive elements and some of the issues of the facility, while paying close attention to the connection with on-street facilities, trail design, etc. Why might have the decision been made to build the facility in that manner, and what might be done to correct the issue?

19.12 References and Additional Resources

The references for this lesson are:

1. *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials (AASHTO), Washington, DC, 1999.

2. *Characteristics of Emerging Road and Trail Users and Their Safety*, Federal Highway Administration, 2004, available online at http://www.tfhrc.gov/safety/pubs/04104/index.htm.

3. Moore, R., *Conflicts on Multiple-Use Trails*, Federal Highway Administration, Publication No. FHWA-PD-94-031, available online at http://www.fhwa.dot.gov/environment/conflicts/, 1994, accessed November 22, 2004.

4. Flink, C., L. Schwarz, and R. Searns, *Greenways: A Guide to Planning, Design, and Development*, The Conservation Fund, 1993.

5. Flink, C., K. Olka, R. Searns, *Trails for the Twenty-First Century—Planning, Design, and Management Manual for Multi-Use Trails*, Second Edition, Island Press, Washington, DC, 2000, p. 30.

6. "Part 9—Traffic Controls for Bicycle Facilities," *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 2003, most recent edition available online at http://mutcd.fhwa.dot.gov.

7. *ADA and ABA Accessibility Guidelines for Buildings and Facilities* (ADAAG), Access Board, 2004, available online at http://www.access-board.gov/ada-aba/final.htm.

8. *Accessible Rights-of-Way: Sidewalks, Street Crossings and Other Pedestrian Facilities: A Design Guide*, Access Board, 1999, available online at http://www.access-board.gov/prowac/guide/PROWGuide.htm.

9. *Designing Sidewalks and Trails for Access: Parts 1 & 2*, Federal Highway Administration, Publication No.'s FHWA-HEP-99-006 and FHWA-EP-01-027, 1999 and 2001, available online at http://www.fhwa.dot.gov/environment/bikeped/publications.htm.

10. *Draft Guidelines for Accessible Public Rights-of-Way*, Access Board, 2002, available online at http://www.access-board.gov/rowdraft.htm.

11. *Evaluation of Safety, Design, and Operation of Shared-Use Paths*, Federal Highway Administration, Washington, DC, 2005.

12. *Regulatory Negotiation Committee on Accessibility Guidelines for Outdoor Developed Areas, Final Report*, Access Board, 1999, available online at http://www.access-board.gov.

13. Pein, W., *Trail Intersection Design Guidelines,* Florida Department of Transportation, 1996, pp. 2–11, available online at http://www.dot.state.fl.us/Safety/ped_bike/handbooks_and_research/TRAILINT.PDF

Additional resources for this lesson include:

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