



## Appendix D: Design Guidelines

### Chapter Outline:

1. Overview
2. Trail Guidelines
3. Ancillary Facilities
4. Crossings and Intersections
5. Over Passes and Under Passes
6. Ancillary Trail Features
7. Trailheads
8. Public Art

### 1. Overview

This chapter provides guidelines to both public and private entities for the future development of various types of trails in Carrboro. The guidelines noted herein are based on the best practices in use throughout the United States, as well as accepted national standards for greenway facilities.

#### *Guidelines for Best Management Practices*

The guidelines should be used with the understanding that each trail project is unique and that design adjustments will be necessary in certain situations in order to achieve the best results. Each segment should be evaluated on a case-by-case basis, in consultation with local or state bicycle and pedestrian coordinators, a qualified engineer and a landscape architect. Should these national standards be revised in the future and result in discrepancies with this chapter, the national standards should prevail for all design decisions.

Facility design is a broad topic that covers many issues. This section provides guidelines for typical greenway facilities and is not a substitute for more thorough design and engineering work. For more in-depth information and design development standards, the following publications should be consulted:

- Greenways: A Guide to Planning, Design and Development. Island Press, 1993. Authors: Charles A. Flink and Robert Searns
- Trails for the Twenty-First Century. Island Press, 2nd ed. 2001. Authors: Charles A. Flink, Robert Searns, Kristine Olka
- Guide to the Development of Bicycle Facilities. American Association of State Highway Transportation Officials (AASHTO), 1999.
- Manual on Uniform Traffic Control Devices (MUTCD). U. S. Department of Transportation, Washington, DC, 2004.
- Universal Access to Outdoor Recreation: A Design Guide. PLAE, Inc., Berkeley, CA, 1993.
- North Carolina Bicycle Facilities Planning and Design Guidelines. NCDOT Office of Bicycle and Pedestrian Transportation, Raleigh, NC, 1994

Other useful web sites for information include:

- Rails-to-Trails Conservancy - [www.railtrails.org](http://www.railtrails.org) (Note: the Trails and Greenways Clearinghouse is now a part of this website)
- National Park Service - [www.nps.org](http://www.nps.org)
- U.S. Department of Transportation - [www.walkinginfo.org](http://www.walkinginfo.org) and [www.bicyclinginfo.org](http://www.bicyclinginfo.org)
- U.S. Department of Transportation - Federal Highway Administration - Bicycles and Pedestrian Program - [www.fhwa.dot.gov/environment/bikeped/index.html](http://www.fhwa.dot.gov/environment/bikeped/index.html)
- Pedestrian and Bicycle Information Center - [www.pedbikeinfo.org](http://www.pedbikeinfo.org)

### ***ADA Requirements***

The Americans with Disabilities Act requires that portions of Carrboro greenways be accessible to persons with varying motor skills and abilities. Perhaps the best way to comprehend the importance of ADA is to understand that most of us, at some time in our life, will experience a temporary disability which will affect the way in which we make use of outdoor resources. ADA benefits all Americans by making the outdoor environment more accessible.

### ***Sustainable Design***

The consultant recommends the use of recycled materials and products in the construction of trails and trail facilities. Recycled materials offer design versatility, often have a long life span, and require less long-term maintenance than similar products constructed from natural materials. Recycled plastic lumber and or concrete can be used for the construction of posts and poles, and recycled aluminum can be used for signs. Whenever possible, local materials should be used for construction.

### ***Trail Details & Standards***

The graphics on the following pages depict greenway trail details, on-road guidelines, and typical trail amenities. They are provided as examples only, and are not intended as substitutes for professional, site-specific design and engineering work.



## 2. Trail Construction Guidelines

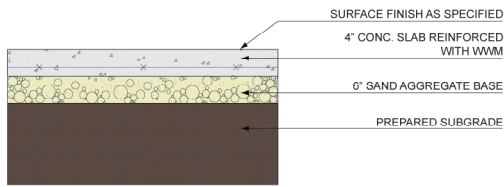
### 10' WIDE CONCRETE TRAIL

#### *Purpose*

This trail type is recommended for the majority of the trail corridor and accommodates multiple modes of travel along the trail within the floodplain.

#### *Guidelines/Considerations*

- Subject to infrequent, periodic flooding.
- Require paved surfaces of either asphalt or concrete depending on frequency of flooding and expected velocity of flow.
- Proper trail foundation (see detail) will increase the longevity of the trail.
- No soft shoulder should be constructed due to flood considerations.
- A vegetative buffer between the stream and trail should be left intact.



CONCRETE PAVING ON AGGREGATE

### 10' WIDE ASPHALT WITH RUBBERIZED LANE

#### *Purpose*

Due to the high cost of installation, this trail type is recommended for premier areas only.

#### *Guidelines/Considerations*

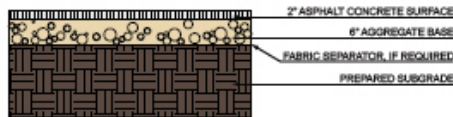
- Same installation as for 10' wide asphalt, except the edge of asphalt must be sawcut, the rubberized lane installed and the edge between the two surfaces sealed.



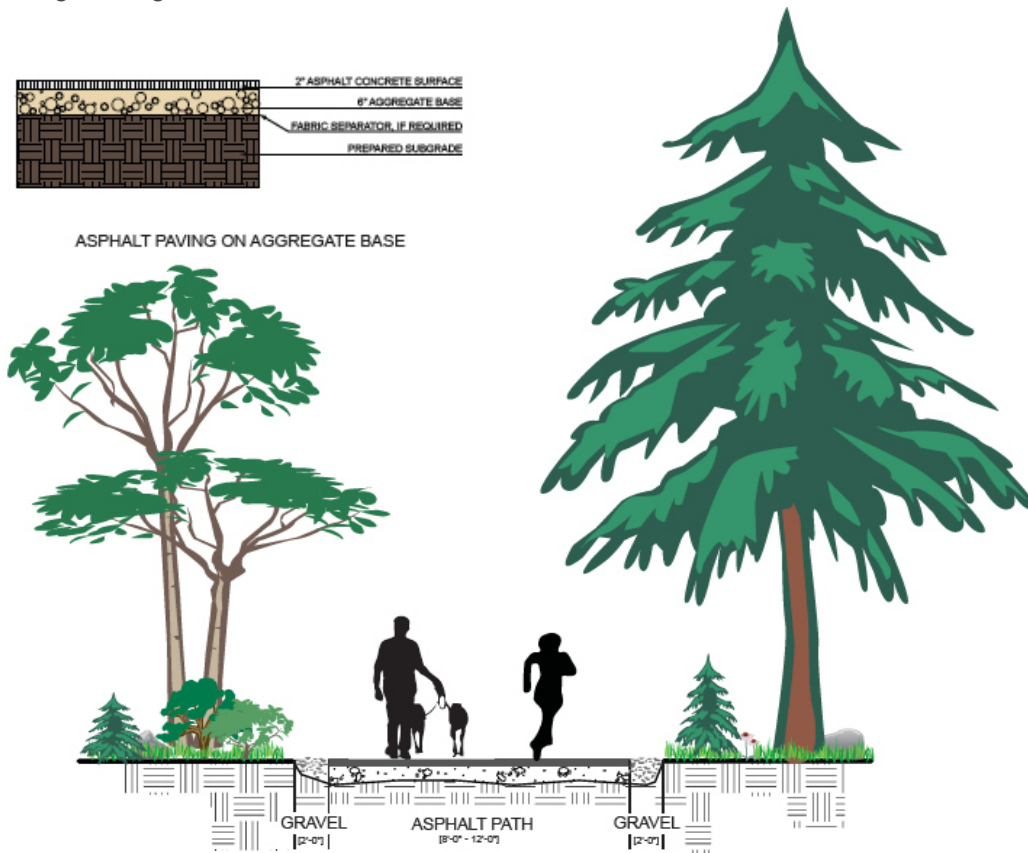
Asphalt trail with rubberized lane Greenville, SC.

## 10" WIDE TRAIL WITH GRAVEL SHOULDER

- Typically composed of asphalt or concrete, paved multi-use trails should be designed to withstand the loading requirements of occasional maintenance and emergency vehicles.
- In areas prone to frequent flooding, it is recommended that concrete be used for its excellent durability.
- As a flexible pavement, asphalt should be considered when installing a paved multi-use trail on slopes.
- A concern for the use of asphalt is the deterioration of trail edges. Installation of geotextile fabric beneath a layer of aggregate base course (ABC) can help to maintain the edge of the trail. It is also important to provide a 2 foot wide graded shoulder to prevent edges from crumbling.
- Most often, concrete is used for intensive urban applications. It is the strongest surface type and has the lowest maintenance requirement if it is installed properly.
- In floodplain areas, using a gravel shoulder can be a maintenance issue during flooding events. If a shoulder is used in the floodplain, the trail should be inspected after every flood event.
- Centerline stripes should be considered for trails that generate substantial amounts of traffic. Centerline stripes are particularly useful along curving sections of trail.



ASPHALT PAVING ON AGGREGATE BASE







Boardwalks with guardrail (above) and curb rail (below) can add interest to the greenway trail as well as span wetlands and low areas. (Photos courtesy of York Bridge Concepts).

### 3. Bridges and Boardwalks

#### BOARDWALK

##### *Purpose*

For use in areas with poor soils and wetland areas to reduce traffic impact to the wetland. Also used create a unique trail experience.

##### *Guidelines/Considerations*

- Boardwalks are typically located when crossing wetlands or poorly-drained areas.
- Boardwalk width will vary according to the connecting trail (see individual trail segments). A minimum width of 10' clear (inside of guardrails/curb rails) is recommended.
- Boardwalk shall be constructed of real wood or recycled plastic.
- Consult a structural engineer for wood member sizing and post footing design.
- A 6" curb rail is recommended, however, a 42" guardrail is required at locations where there is a 30" or greater difference in the boardwalk elevation and the ground elevation below. A 54" railing is recommended for bicycle trails.
- Additional seating and signage can be included into the design of a boardwalk for a specific overlook or wildlife viewing area.
- Permitting within wetlands and water crossings is a consideration.

## LOW WATER BRIDGE

### *Purpose*

Provides access to the user over certain natural (i.e. streams, rivers, creeks) features with the use of a low impact bridge.

### *Guidelines/Considerations*

- Low water bridges are typically located when crossing wetlands or poorly-drained areas.
- Low water bridge width will vary according to the connecting trail see individual trail segments). A minimum width of 10' clear (inside of guardrails/ curb rails) is recommended.
- Consult a structural engineer for member sizing and post footing design.
- A 6" curb rail is recommended, however, a 42" guardrail is required at locations where there is a 30" or greater difference in the low water bridge elevation and the ground elevation below.
- Permitting within wetlands and water crossings is a consideration.



## 4. Crossings and intersections

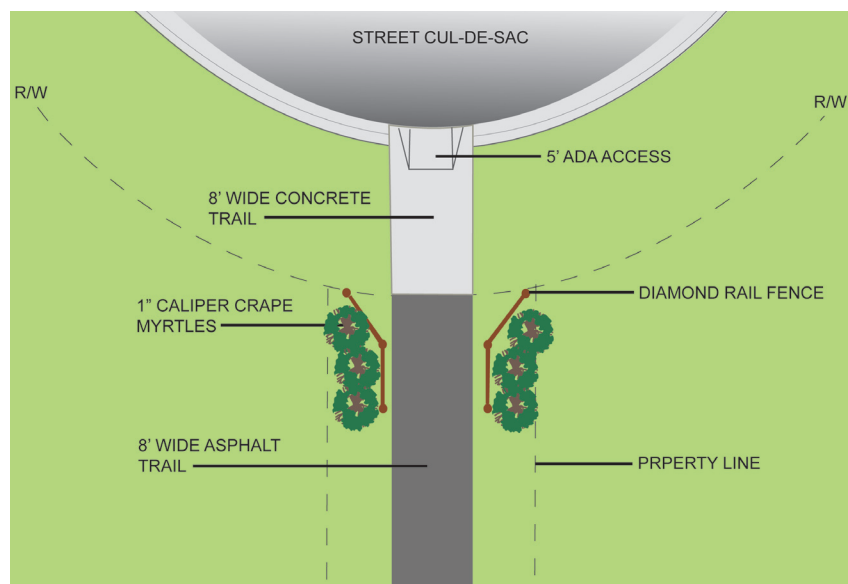
### NEIGHBORHOOD ENTRANCE TRAIL

#### *Purpose*

An access trail is developed in a residential area to link to a greenway.

#### *Guidelines/Considerations*

- Trail pavement shall be 8' wide to accommodate emergency and maintenance vehicles, meet ADA requirements and be considered suitable for multi-use.
- Trail widths should be designed to be less than 8' wide only when necessary to protect large mature native trees over 18" in caliper, wetlands or other ecologically sensitive areas.
- Trail pavement shall not encroach within the sideyard set back to a distance equal to the sideyard setback of the adjacent property.
- No access trail shall be less than 5' wide.
- Access trails should meander whenever possible.
- All landscape materials shall be installed during the appropriate planting season for the particular species.
- Other ornamental landscape shall be included at the street frontage of the access trail based upon input from the residents of the cul-de-sac. If the access is not in a cul-de-sac the adjacent property owners and property owners directly across from the access trail will be invited to provide landscape design input.
- Annuals may be provided when there is a commitment from at least 3 neighbors or a Home Owners Association to install and maintain these plants.
- Two sections of diamond rail fencing shall be included on each side of the trail near the street frontage. Diamond rail will not be included if the respective neighbor hood deeds and covenants do not permit it.



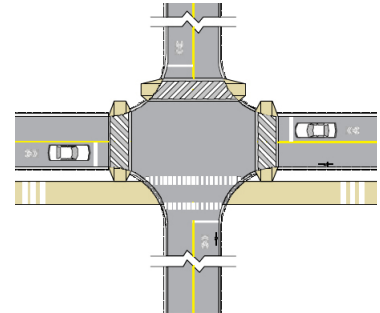
## TRAIL INTERSECTIONS

### Purpose

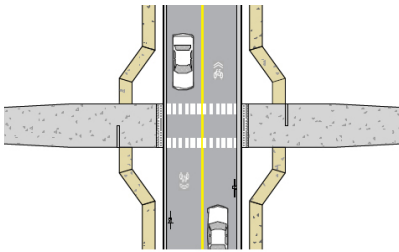
Provides safe and convenient cross to trail users

### Guidelines/Considerations

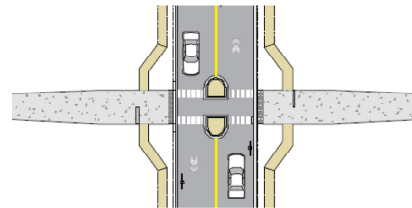
- Site the crossing area at a logical and visible location.
- Warn motorists of the upcoming trail crossing and trail users of the upcoming intersections.
- Maintain visibility between trail users and motorists.
- Intersection approaches should be made at relatively flat grades so that cyclists are not riding downhill into intersections.
- If the intersection is more than 75 feet from curb to curb, it is preferable to provide a center median refuge area



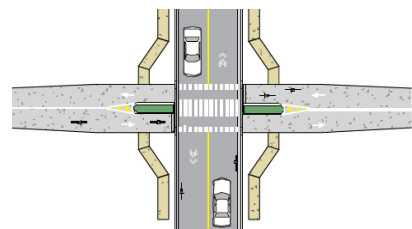
4-WAY INTERSECTION CROSSING  
Shared Use Path



MID-BLOCK INTERSECTION  
Shared Use Path with Sidewalks



MEDIAN REFUGE  
Shared Use Path with Sidewalks



MIDBLOCK CROSSING  
Shared Use Path with Sidewalks and Medians



## RAILROAD INTERSECTIONS

### Purpose

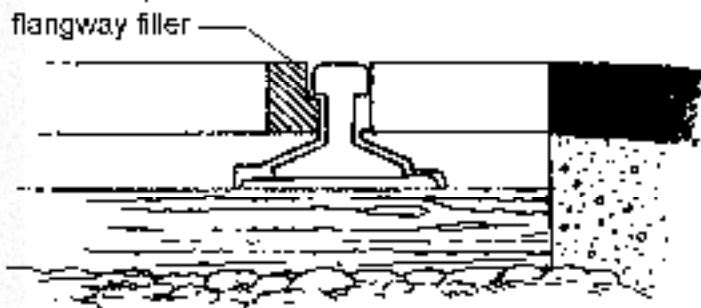
Provides safe and convenient mean for trail users to cross railroad corridors.

### Guidelines/Considerations

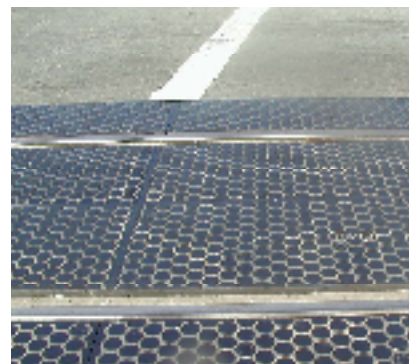
- Make the Crossing Level: Raise approaches to the tracks and the area between the tracks to the level of the top of the rail.
- Bikes Should Cross RR at right angle
- When bikeways or roadways cross railroad tracks at grade, the roadway should ideally be at a right angle to the rails. When the angle of the roadway to the rails is increasingly severe, the approach recommended by Caltrans (Highway Design Manual, Section 1003.6) and AASHTO (Guide for the Development of Bicycle Facilities, 1999, p.60) is to widen the approach roadway shoulder or bicycle facility, allowing bicycles to cross the tracks at a right angle without veering into the path of passing motor vehicle traffic.
- Use Multiple Forms of Warning: Provide railroad crossing information in multiple formats, including signs, flashing lights, and audible sounds.
- Clear Debris Regularly: Perform regular maintenance to clear debris from shoulder areas at railroad crossings.
- Fill Flangeway with Rubberized Material or Concrete Slab: Normal use of rail facilities causes buckling of paved-and-timbered rail crossings. Pavement buckling can be reduced or eliminated by filling the flangeway with rubberized material, concrete slab, or other treatments. A beneficial effect of this is a decrease in long-term maintenance costs.



Railroad crossing signage.



The "flangeway filler" eliminates the gap in the path of travel for pedestrians crossing railroad tracks. The filler, consisting of a rubber insert, will deflect downward with the weight of a train and does not affect railway function.



Installing a rubber surface rather than asphalt around railroad flangeways reduces changes in level and other maintenance problems.

## 5. Trail Overpass and Underpasses

### TRAIL OVERPASS

#### *Purpose*

Provides safe means for users to cross over vehicular thoroughfare

#### *Guidelines/Considerations*

- Safety should be the primary consideration in bridge/overpass design.
- Specific design and construction specifications will vary for each bridge and can be determined only after all site-specific criteria are known.
- Always consult a structural engineer before completing bridge design plans, before making alterations or additions to an existing bridge, and prior to installing a new bridge.
- A 'signature' bridge should be considered in areas of high visibility, such as over major roadways. While often more expensive, a more artistic overpass will draw more attention to the trail system in general, and could serve as a regional land mark.





## TRAIL UNDERPASS

### *Purpose*

Provides safe means for trail users to cross under roadway

### *Guidelines/Considerations*

- Vertical clearance of the underpass should be at least 10-feet.
- Width of the underpass must be at least 12-feet
- Proper drainage must be established to avoid pooling of stormwater.
- Lighting is recommended for safety.



## 6. Ancillary Trail Features

### TRAIL IDENTITY SIGNAGE

#### Purpose

To provide and reinforce a trail's identity

#### Guidelines/Considerations

- The logo should be simple, direct and easy to identify.
- A skilled graphic designer/sign consultant should be consulted when generating the design. It should be used as a consistent element throughout the length of the greenway and trails.



The Colorado Trail  
Trail logo examples.

### INFORMATIVE SIGNS

#### Purpose

To inform trail users the rules of the trails and associated amenities and distances along the trail. These include regulatory and warning signs, maps and directional signs, mileage markers and location identities for emergency services.

#### Guidelines/Considerations

- Locate regulatory signs at trailheads, parking lots and public gathering spaces along the greenway.
- Locate warning signs appropriately at the specific hazards that they refer to such as at road crossings, steep terrain, trail narrowing and stop signs.
- Locate maps and directional signage at trailheads, public gathering spaces and key trail access points to help people entering the trail to determine their next destination and to identify their locations should they need emergency assistance.
- Locate specific identification signs at trailheads
- Locate mile markers 3' from the edge of the trail and at approximately one mile intervals beginning at the north and south ends of the trail system. (Note: Mile marker should be cumulatively labeled as follows: mile 1, mile 2, mile 3, etc so that each mile is unique for identification purposes).



Lake Brandt Marina map, Greensboro, NC



Trail mile marker examples.



Regulatory sign examples



## INTERPRETIVE SIGNS

### *Purpose*

To provide greenway and trail users with information about the Bolin Creek, wild-life, vegetation, history and significance of elements along the greenway.

### *Guidelines/Considerations*

- There is a wide variety of interpretive signage styles and amount/type of information they can provide.
- Consider the character of the greenway trail and surrounding elements when designing these signs.
- A professional graphic designer/sign consultant should be consulted for sign design.
- Locate interpretive signage 3' from the edge of the trail.



Examples of interpretive signs - historical (left) and environmental education (right).

## KIOSKS

### *Purpose*

To provide visitors with information to orient themselves, learn of site opportunities, read the rules and regulations of the site, find the hours of operation and read about local events such as activities programmed for the greenway or seasonal festivals.

### *Guidelines/Considerations*

- Install kiosks at each trailhead
- Kiosk design should be coordinated with the character of the entire greenway trail sign system.
- Keep the style of the kiosk simple and readily identifiable by trail users as an information contact station.
- Bulletin boards, regional trail maps, rules and regulations and accessibility advisories should be designed as part of the kiosk.

- When locating kiosks next to parking facilities, set the units back far enough from traffic and protect the support posts or structure with appropriately sized bollards.



Kiosks along a greenway in Maine (above) and Durham, NC (right) provide information for trail visitors.

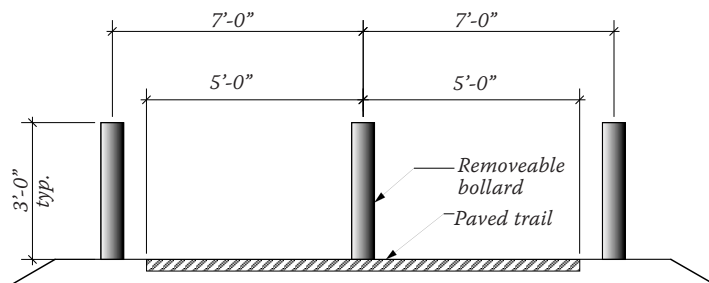
## BOLLARDS (REMOVABLE AND PERMANENT)

### Purpose

To increase trail safety by providing separation between motorized vehicles and trail users. Installing removable bollards allows emergency and maintenance vehicles to access the trail.

### Guidelines/Considerations

- Coordinate bollard locations with street crossing and trail access points.
- Bollards are available in a variety of shapes, sizes and colors and come with a variety of features.



Typical bollard placement



Unlighted metal bollard by Fairweather



Lighted metal bollard by Selux

- Bollards are typically constructed of painted steel or aluminum. Some have halogen or metal halide lights in weather tight casings for pedestrian lighting.
- Bollards should be chosen according to the specific needs of the site and should be similar in style to the surrounding site furniture.
- Lighted bollards are intended to provide trail users with minimum levels of safety and security along the trails that are open after dark.

## EMERGENCY PHONES

### *Purpose*

To provide a means of contacting emergency personnel while using trail facilities and for convenience of trail users.

### *Guidelines/Considerations*

- Locate emergency phones at all trail heads, major intersections, areas of potential conflict along the trail.
- Locate emergency phones approximately every 1/2 mile along the trail.
- When locating the emergency phones, provide reference information on the location, such as mile markers so that a caller can be located.
- Emergency phones have options for cellular and arrangements may be possible with local cell phone providers for reduced service fees.
- Emergency phones also have options for power. If phones are located in a remote area, it may be feasible to use solar power to avoid electric wiring installation and service costs.



*"Wide-Area Emergency Broadcast"*



*Electric powered*



*Solar powered*

## SECURITY FENCING

### *Purpose*

To provide a safe and secure boundary between the trail and adjacent property.

### *Guidelines/Considerations*

- 12' height (typical)
- Chainlink or similar if there is a need to see through the fence. Otherwise, the fence can be a solid material such as wood.
- Fence posts should be driven to refusal or set in concrete depending on local codes.
- Consider gate locations per the adjacent property owner's needs.



*Ornamental iron fencing by Long Fence.*

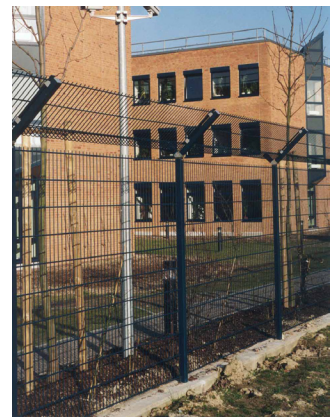
## PERIMETER/NON-SECURITY FENCING/BOUNDARY (LANDSCAPING)

### *Purpose*

To decoratively define an edge or boundary to the greenway such as in a Natural Heritage Area or historical interpretive site.

### *Guidelines/Considerations*

- There are many varieties of decorative fences, low walls and landscaping that can be used to define a boundary. When determining the appropriate edge treatment, consider the character of the specific site and surrounding design elements. Is the area more suburban or naturalized, in an open field or wooded area, along the river's edge or inland.
- A low wall can also serve as a seat wall if it is between 18" and 24" tall.



*Welded wire fencing (an alternative to chain link) by APPS Inc.*



*Boundary fencing along the Levels Creek Greenway Mount Airy, NC.*





## LANDSCAPE SCREENING

### *Purpose*

To provide visual screening between the trail and adjacent property.

### *Guidelines/Considerations*

- Consider the dimensions of a mature plant when determining appropriate plant species and locations. A common mistake is to install plant material too close together and not allow adequate room for the plants to grow resulting in unhealthy plants that may need replacing.
- Determine the level of screening, i.e., total visual screen or merely filtering views.
- Try to utilize native, low maintenance plant material wherever possible.
- Consider temporary irrigation (drip irrigation or Tregator bags) to establish plants versus a traditional irrigation system.



## LIGHTING

### *Purpose*

Allows certain areas of the greenway trail to be used in the nighttime and provides safety for trail users.

### *Guidelines/Considerations*

- There is a great variety of lighting fixtures available including solar light fixtures. Consider the character of the specific site to determine appropriate lighting fixtures. A lighting professional can also help in determining lighting options such as appropriate light level, sports lighting and security lighting.
- Locate lighting at the following locations at a minimum:
  - a. Trailheads and parking lots
  - b. Restroom facilities
  - c. Entrances and exits of bridges
  - d. Street crossings
  - e. Public gathering spaces along the greenway
- Design lighting levels appropriate to each situation.
- Avoid light fixtures at eye level that could impair visibility.
- Only use lighting along a trail if:
  - a. Night usage is desired



*Solar lighting is an option for remote areas where utility connections are difficult. (Photos courtesy of Sonne by Se'lux).*

b. It is acceptable to neighboring land uses

**c. The area is not a wildlife area**

## PICNIC TABLES

### *Purpose*

To provide places for trail users to congregate for meals or to just sit and relax.

### *Guidelines/Considerations*

- Locate picnic tables far enough back from the trail to avoid interfering with circulation along the trail (min. 3')
- Wheelchair access should be possible at some picnic tables.
- Wheelchair-accessible tables should be connected to the trail by a firm surface path such as asphalt or concrete.
- Locate picnic tables in areas that provide interesting views, are close to an educational or historical trail element, shade or shelter from seasonal winds.
- Install (1) trash/recycle receptacle for every (1) picnic table.



*Example of 8' side accessible picnic table manufactured by Pilot Rock.*



*Example of 8' universal accessible picnic table manufactured by Pilot Rock.*



Bench placement along the Levels Creek Greenway Mount Airy, NC (top) and with interpretive signage in Greensboro, NC (above).



Welded wire Prestige Bench by Wabash Valley.

## BENCHES

### *Purpose*

To provide places to trail users to rest, congregate, or contemplate along trails and throughout the greenway. Benches can be designed to create identity in a place or along the greenway or be strictly utilitarian.

### *Guidelines/Considerations*

- Locate benches (and other site furniture) a minimum of 3' from the edge of the trail.
- Locate benches at all trailheads, picnic areas and at regular intervals along the trail.
- Locate benches in areas that provide interesting views are close to an educational or historical trail element, shade or shelter from seasonal winds.
- Drainage should slope away from the bench and trail.
- Wheelchair access should be provided alongside benches with firm surface to match the trail.
- Locate benches a minimum of 4' from restrooms, phone booths and drinking fountains and a minimum of 2' from trash receptacles, light poles and sign posts.
- Benches should be securely anchored to the ground.
- Install one trash/recycle receptacle per every (2) benches.

## BIKE RACKS

### *Purpose*

To provide a safe place to secure bicycles while trail users may walk and explore destinations along the greenway.

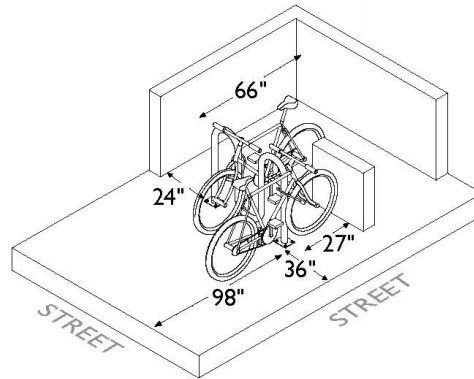
### *Guidelines/Considerations*

- Install bicycle racks at trailheads, public gathering areas, public transit stations, picnic areas and periodically along the greenway.
- Bicycle racks should be installed in public areas within easy viewing distance from a main pedestrian walkway, but without interfering with pedestrians.
- Bicycle racks should be located within 50' of building entrances (where bicyclists would naturally transition into pedestrian mode).

- Bike Racks should be installed with 24" clearance from a parallel wall and 6' clearance from a vertical wall (see illustration).



"Rolling" bike rack manufactured by Dero.



Typical "rolling" bike rack dimensions and clearances (Details courtesy of Dero).

## DRINKING FOUNTAINS

### *Purpose*

To provide a more enjoyable greenway experience and to protect the health of two and four-legged trail users.

### *Guidelines/Considerations*

- Locate drinking fountains at least 5' from trail edge.
- Locate drinking fountains near restrooms, at trailheads, parks and other public gathering places along the greenway trail.
- Standard, accessible and dog height bowls should be installed to accommodate all trail users.
- Drinking fountains should be placed on a well-drained surface (ie. 2% sloped concrete slab)
- Include hose bib connections for maintenance purposes.



Dual Barrier Free Fountain & Pet Fountain manufactured by Stern-Williams.





32-gallon recycled plastic trash receptacle by Belson Outdoors.

## TRASH/RECYCLING RECEPTACLES

### *Purpose*

To provide for proper maintenance and appearance of the greenway and trail system.

### *Guidelines/Considerations*

- Locate receptacles at each trailhead and each seating area (1 per every 1 picnic table, 1 per every 2 benches).
- Placement of other receptacles will depend upon the location of concessions, facilities and areas of group activities.
- Receptacles should be selected using the following criteria:
  - a. Expected trash amount
  - b. Maintenance program requirements
  - c. Types of trail users
  - d. Durability
- Receptacles need to be accessible to maintenance personnel and trail users.
- Receptacles should be set back a minimum of 3' from the edge of the trail.
- Consider selecting trash receptacles that are made of recycled materials and that are appropriate for flood prone areas.



## RESTROOMS

### *Purpose*

Public sanitary facilities.

### *Guidelines/Considerations*

- Local ordinance codes for health issues and accessibility.
- Locate restrooms at each trailhead.
- Restroom structures should be located adjacent to vehicular access points for security, maintenance, and access to utility hookups.
- Restrooms should also make use of natural light and ventilation as much as possible.



Composting restroom facilities are an option where connecting to utilities is difficult. (Photo courtesy of BioSun).

## 7. Trailhead and Support Facilities

### TRAILHEADS

#### *Purpose*

Trailheads provide access for the surrounding community to the trail.

#### *Guidelines/Considerations*

- Locate trailheads near commercial developments and transportation nodes.
- Trailhead should be accessible to the surrounding communities.
- Trailhead facilities often include parking, water fountains, benches, bike racks, trash receptacles, information kiosk, emergency phones, shelters, and picnic areas
- Locate trailheads near commercial developments and transportation nodes.



## 8. Public Art

### PUBLIC ART

#### *Purpose*

Public art engages community through artists' work creating a memorable experience to trail users.

#### *Guidelines/Considerations*

- Strengthen emotional connection between users and trail.
- Memorable installation may prove to be a valuable wayfinding tool.
- Public art can be a device used for telling a trail's history and provide a compelling and memorable story.

