
EXECUTIVE SUMMARY

With this document the Delaware Department of Transportation has developed a Statewide Rail-to-Trail & Rail-with-Trail Facility Master Plan. DeIDOT previously conducted a cursory study of all railroad corridors for potential bicycle and pedestrian use. Eleven (11) railroad corridors from that study were identified to be evaluated in further detail within this Plan.

The purpose of this Plan is to review the eleven (11) selected railroad corridors to identify abandoned, inactive, and publicly owned active rail corridor segments that are potentially suitable for re-use as shared use off-road rail-to-trail and/or rail-with-trail facilities. Additionally, this Plan evaluates the interconnectivity of these potential rail-trail corridors with the existing and proposed statewide trail systems, greenways, and pedestrian/bicycle networks.

The *First Goal* of this plan is to identify potential railroad corridors with suitable Transportation Enhancements Program characteristics such as new inter/intra-community transportation alternatives and regional recreational use for multiple user groups.

The *Second Goal* is to work in partnership with local jurisdictions, agencies, advocacy groups, citizens, adjacent residential and commercial property owners, and the community as a whole to develop this Plan.

The *Third Goal* is to provide a practical and prioritized strategy to pursue the successful development and implementation of suitable rail corridors into rail-to-trail and/or rail-with-trail facilities that are consistent with the 2004 Delaware Strategies for State Policies and Spending and the Livable Delaware Initiatives- Safe Routes to Schools program.

It is recommended that the following railroad corridors be considered for more advanced evaluations and planning studies, ultimately, for inclusion in the prioritization process for Capital Improvements Program projects within the Statewide Long Range Transportation Plan.

New Castle County:

1. Brandywine Industrial Track (2.3 miles)
2. New Castle Industrial Track (1.8 miles)

Kent County:

1. Clayton-Easton Line (14.4 miles)

Sussex County:

1. Georgetown-Lewes Running Track (16.7 miles)
2. Completion of the Junction & Breakwater Trail (1.7 miles)
3. Ellendale-Milton Industrial Track (6.8 miles)

Implementation of these rail-trail corridors would provide an additional 44 miles of off-road trail facilities to the existing 150+ miles of trails within state parkland and the 150+ miles of trails within other municipal/county parks and state/federal wildlife refuges.

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1.0 INTRODUCTION:

DelDOT initiated the Master Plan development in response to much public interest in developing off-road facilities for bicyclists and pedestrians for both transportation and recreational uses. The existing railroad corridors have much potential as non-motorized facilities. In most cases the allocated right-of-way needed for the facility already exists, they connect points of interest, typically have intrinsic historic value, and/or connect historic sites.

Within this document the Delaware Department of Transportation has developed a Statewide Rail-to-Trail & Rail-with-Trail Facility Master Plan. DelDOT previously conducted a cursory study of all railroad corridors for potential bicycle and pedestrian use called the Phase I Study of Abandoned Rail Lines for Bicycle and Pedestrian Use. Eleven (11) railroad corridors from the Phase I study were selected to be included in this Plan for further evaluation, see Figure 1.1.

Currently, there are approximately 150+ miles of trail facilities within state parkland and an additional 150+ miles of trail facilities within other municipal/county parks and state/federal wildlife refuges. This Plan studies a potential of approximately 60 additional miles of off-road trails in the form of RTT and RWT facilities.

Four (4) railroad corridors that are not included in this Plan are: Pigeon Point, Frenchtown Line, Pomeroy Branch, and the Georgetown-Lewes Line. The Pomeroy Branch is currently in the project design phase, and the Georgetown-Lewes Line has been accelerated into a project planning study.

Figure 1.2 is a historic illustration of the 1899 Delaware Railroad Network Map obtained from the Library of Congress. The map was originally produced for the Mercantile Guide and Bureau Company, Publishers of Railway, Express and Postal Shipping Guides (copyright, 1899, by the Matthews-Northrup Co., Buffalo, N.Y.).

Senator Harris B. McDowell, III submitted a letter of endorsement for Delaware's statewide rail-to-trail and rail-with-trail program, see Figure 1.3. This letter was included in the information that was presented/displayed at the public workshops discussed in Section 2.4.6. The letter also emphasizes that the impetus for the ability to create rail-trail facilities is the underlying necessity to preserve the original rail corridor right-of-way for potential future re-use as a transportation rail facility.

INSERT STATEWIDE VICINITY MAP

INSERT 1899 HISTORIC RAILROAD MAP

HARRIS B. MCDOWELL, III
Majority Leader
STATE SENATOR
First District



SENATE
STATE OF DELAWARE
LEGISLATIVE HALL
DOVER, DELAWARE 19901

COMMITTEES
Children, Youth & Families, Chair
Energy & Transit, Chair
Ethics
Executive
Health & Social Services
Insurance & Elections
Judiciary
Legislative Council
Permanent Rules
Veterans Affairs

April 4, 2005

Terry Petrucci
Director of Public Relations
DelDOT
P.O. Box 778
Dover, DE 19903

Dear Terry:

I have been a strong supporter of the Greenways and Rail to Trails project for a long time. As you might know I have worked hard to pass legislations that is beneficial to the environment, and in my opinion the trails have been a great addition to the environment.

I believe that it is important to keep in mind what the intended purpose of the Rails to Trails program really is. The program was originally set up as a way for states to hold on to rail lines in the event that they might be used again as a rail/mono-rail system in the future. The idea of future rail development in the state hinges on our ability to use this land, because having to re-purchase land would make future rail/mono-rail development virtually impossible.

It is important to keep in mind the original intention of the Rail to Trail program so that we keep our options open for future transportation needs.

Sincerely,

Handwritten signature of Harris B. McDowell, III, with the initials (SF) written below it.

Harris B. McDowell, III
State Senator

2311 Baynard Boulevard, Wilmington, DE 19802
Home: 302-656-2921 Senate Offices: Dover: 302-744-4147 Fax: 302-739-6890
Wilmington: 302-577-8744 E-Mail: Harris.Mcdowell@state.de.us

PRINTED ON RECYCLED PAPER

Figure 1.3 Senator McDowell Railbanking Letter

2.0 MASTER PLAN PURPOSE & BACKGROUND

2.1 PURPOSE

The purpose of this Plan is to review the eleven (11) selected railroad corridors to identify abandoned, inactive, and publicly owned active rail corridor segments that are potentially suitable for re-use as shared use Rail-to-Trail (RTT) and/or Rail-with-Trail (RWT) facilities. Additionally, this Plan evaluates the interconnectivity of these potential rail-trail corridors with the existing and proposed statewide trail systems, greenways, and pedestrian/bicycle networks in conjunction with the existing state policies, programs, and guidelines illustrated in Figure 2.2.

The intent of the review and evaluation of the railroad corridors discussed within this document is to remain consistent with the 2004 Delaware Strategies for State Policies and Spending and the programs and policies within its Livable Delaware Initiatives. As a result, a prioritization is assigned to each rail corridor for potential recommendations, or exclusion, to be considered for more advanced evaluations and planning studies and ultimately, for inclusion in the prioritization process for Capital Improvements Program projects within the Statewide Long Range Transportation Plan.

To identify and assess the public supply and demand of outdoor recreation resources and facilities within the state, the 2003-2008 Statewide Comprehensive Outdoor Recreation Plan (SCORP) was developed and administered by the Park Resource Office, Division of Parks and Recreation, Department of Natural Resources & Environmental Control (DNREC).

The SCORP, which parallels many of the Livable Delaware initiatives, identified and prioritized more than 24 different outdoor recreation facilities. The SCORP has identified walking/jogging paths and bike paths as the top two High Priority facility needs throughout the state (see Figure 2.1). The plan was developed through input from citizens, interest groups, local, county and state agencies and is instrumental in directing and obtaining grant funding from the federal Land and Water Conservation Fund, the Delaware Land and Water Conservation Trust Fund (DTF), and other funding sources. Grant assistance is available to municipalities, counties, and park districts from the DTF. Park and conservation land acquisition as well as construction of outdoor recreation facilities (including trails and paved pathways) are eligible for DTF assistance.

High Priorities	Moderate Priorities	Low Priorities
Walking or Jogging Paths	Hiking Trails	Volleyball Courts
Bike Paths	Swimming Pools	Tennis Courts
Picnic Areas	Fishing Areas	Football Fields
Playgrounds	Skate Facilities	Lacrosse Fields
	Baseball/Softball Fields	Golf Courses
	Campgrounds	Power Boat Access
	Soccer Fields	ATV Trails
	Basketball Courts	Mountain Bike Trails
	Canoe/Kayak Access	Equestrian Trails
		Hunting Areas
		Disc Golf

Figure 2.1 Statewide Facility Needs

Source: Table 5.1 in the 2003-2008 SCORP

The development of rail-trail facilities also provides better land use and transportation connections, which in turn, encourage more non-motorized trips, improve access to transit, improve access to adjacent land uses and communities, conserve energy, and enhance the Department's vision for multi-modal and inter-modal transportation systems. In addition, by providing this transportation

alternative, the installation of RTT/RWT facilities can be an effective means in reducing automobile dependence and use. Additionally, it will assist in achieving the goal of cleaner air under the requirements of the Clean Air Act Amendments of 1990.

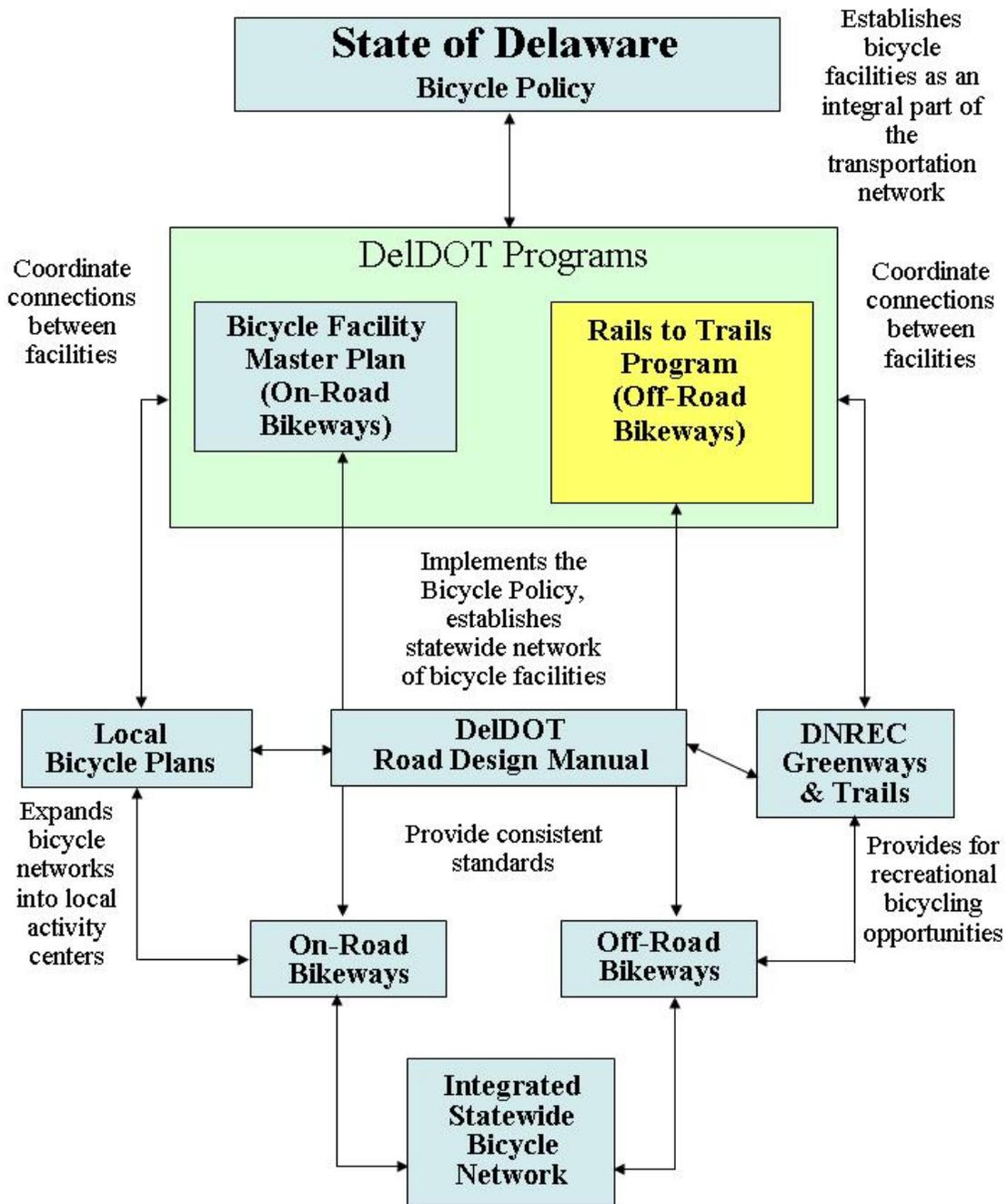


Figure 2.2 DeIDOT's Comprehensive Approach to Establishment of the Bicycle Network
 Source: Delaware Bicycle Facility Master Plan (modified)

2.2 GOALS & OBJECTIVES

GOALS:

- To identify potential rail-trail corridors with eligible Transportation Enhancements Program criteria. Primarily within the TEP categories of bicycle/pedestrian facilities and preservation of railway corridors.
- To work in partnership with local jurisdictions, agencies, advocacy groups, citizens, adjacent residential and commercial property owners, and the community as a whole to develop this Plan.
- To provide a practical and prioritized strategy to pursue the successful development and implementation of suitable rail corridors into RTT and/or RWT facilities that are consistent with the 2004 Delaware Strategies for State Policies and Spending and the Livable Delaware Initiatives-Safe Routes to Schools program.

OBJECTIVES:

- Conduct research and investigations to identify and evaluate opportunities and constraints for each corridor.
- Identify and address the needs of multiple user groups by soliciting and obtaining feedback from all agencies/parties involved: interested advocacy groups, key stakeholders, and residential and commercial property owners adjacent to the RTT/RWT study corridors.
- To research, analyze, and evaluate findings to provide recommendations for the direction of trail implementation and management.
- Establish design criteria/standards and operational, maintenance, and safety guidelines for multi-use RTT/RWT facilities that encourage economic, environmental, and social development.

2.3 SCOPE

The scope of this document is to further DelDOT's original RTT/RWT vision in the form of a Master Plan. This was accomplished by conducting the following tasks:

The following tasks were conducted to obtain information about each rail corridor and additional information necessary to complete this Plan:

- Data Collection and Mapping
- Site Inventory and Analysis
- Preliminary Environmental Identification
- Preliminary Rights-of-Way Research
- Preliminary Structural Evaluations
- Public Outreach

- Agency Role Assessment and Program Inventory
- Create RTT/RWT Network Mapping and Corridor TIP Sheets
- Demand Potential and Connectivity Assessment

2.4 METHODOLOGY

Following is a description of the approach used to conduct the tasks identified above:

2.4.1 Data Collection and Mapping: 2002 aerial imagery and GIS data were obtained in digital format to generate a statewide base map and individual maps for each rail corridor. The GIS data sets were superimposed over the aerial images to best illustrate the correlation of the geographic data to the surface elements of the state and the vicinity of each rail corridor.

The GIS data sets, digital and hard copy, that were obtained and incorporated into the mapping were:

Agricultural	Libraries
Activity Centers	Municipal/Jurisdiction Boundaries
Bicycle LOS	Parcels
Bicycle Network	Parking
Bridges	Park-n-Ride Facilities
Cemeteries	Parks (all levels)
Census Population Data	Railroads (abandoned/active)
Drainage	RTE Species
Environ. Sensitive Dev. Areas	Roads & Centerlines
Floodplains FEMA	Schools
Floodplains D-FIRM	State Restricted Areas
Green Infrastructure of Delaware	State Spending Policies
Greenway Conservation Corridors and Trails (exist./planned)	Superfund/Hazardous Waste Sites
Historic Sites	Trail Network
Hydrological	Transit Networks
Investment Strategy Levels	Watersheds
Land Use	Wetlands NWI
	Wetlands DNREC

2.4.2 Site Inventory and Analysis: Site visits were conducted to create a site inventory for each rail corridor, to visually inspect and photo-document the existing conditions of each site, and to provide a foundation for the site analysis values used as part of the determination process for assigning a priority to each rail corridor. Experienced personnel conducted preliminary studies related to three of the major elements in the planning process. These are design development, environmental, and structural evaluations. See Appendix I for the rail corridor existing conditions data and viewshed photographs. Summaries of the inventory and analysis for each rail corridor are provided in various sections of the Appendices.

2.4.3 Preliminary Environmental

Identification: The environmental GIS data sets that were obtained were used to identify environmental resources that are adjacent to, or encroaching upon, the rail corridors such as wetlands, waters of the US, floodplains, and known Superfund or hazardous waste facilities. A review of mapping provided by DNREC was conducted for each proposed trail, which included the National Wetland Inventory (NWI), the Delaware Statewide Wetland Mapping Project (SWMP), State Resource Areas (SRA), the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map, and aerial photography. The information provided by DNREC was compared to the most recent information available from the previously mentioned agencies.



The environmental base mapping was generated using this information, and site visits were conducted by experienced environmental scientists to verify the mapping and to visually inspect the existing conditions to identify potential environmental issues not provided in the GIS mapping. The results of these studies are provided in the preliminary environmental identification summary located in Appendix H. The preliminary environmental studies conducted to complete this Plan do not constitute a Phase I Environmental Site Assessment. It is recommended that a Phase I assessment be conducted for any rail corridor that progresses into a more advanced planning study.

2.4.4 Preliminary Rights-of-Way Research: It was assumed that some of the rail corridors may require right of way investigations to more accurately determine the feasibility of placing a trail on the existing or former rail rights-of-way. GIS parcel data was obtained and superimposed over the aerial images to provide a better understanding of the rights-of-way and any potential issues that may exist. Known ownership data was obtained by interview only. Deeds, titles and property tax data were not obtained. Data collected for this research were preliminary only and did not utilize the services of a title company. It is recommended that all applicable parcel and ownership data be obtained for any rail corridor that progresses into a more advanced planning study. Data collected should pertain to the rail corridor, potential trailhead locations, potential trail alignment easement locations, and potential locations for environmental and drainage facilities.

2.4.5 Preliminary Structural Evaluations: Several of the rail corridors contain existing or former bridge structures that may need to be modified, rehabilitated and/or reconstructed to accommodate a rail-trail system. Evaluations of the bridge structures were conducted by experienced structural engineers to determine the feasibility of using existing bridge decks and/or



foundations as part of a rail-trail facility. These studies are cursory only, and did not involve field-testing of materials in foundations or decks. The structural engineers rendered their best professional opinion regarding the feasibility and cost of re-using the structures that were evaluated. Appendix G contains the preliminary structural evaluations and order of magnitude cost estimates. Structural evaluations were not conducted for structures within the Wilmington & Northern corridor and the Milton-Lewes Line rail corridor.

2.4.6 Public Outreach: DelDOT held a series of three public workshops regarding the Delaware RTT/RWT Facility Master Plan to present to the public the rail corridors investigated and to solicit information and opinions from the public and interested groups. The public was informed of the workshops through a series of public notices and advertisements and was also informed that the workshop display boards are available on DelDOT's project website for public review and comment.

The intent of each public workshop was to: update and inform the public on the project background, goals, and status; present the railroad corridors that are being studied; graphically display the information collected and the existing conditions of each rail corridor; discuss potential opportunities and constraints; inform the public of the next steps for completion of the Plan; and to obtain vital feedback from the public on the corridor studies. A copy of the questionnaire that was distributed is provided in Appendix A.

Identical information and displays were presented at each of the three (3) workshops listed below. The workshops did not contain a formal presentation, but consisted of an open forum to present and discuss the items listed above.

The three (3) public workshops were conducted as follows:

- Monday, March 21, 2005 (4-7 P.M.)
Georgetown Train Station
140 Layton Avenue
Georgetown, DE
- Monday, March 28, 2005 (4-7 P.M.)
Brandywine High School Lobby
1400 Foulk Road
Wilmington, DE
- Monday, April 4, 2005 (4-7 P.M.)
DelDOT Main Administration Building
Felton/Farmington Rooms
800 Bay Road, Dover, DE



The public was invited to discuss this Plan with project staff during these public workshops and to submit written comments. The comments that were received were summarized, and

consideration of those comments provided by the public and various interest groups played a great role in developing the prioritized list for potential rail-trail corridors in this Plan.

In general, the most concern regarding rail-trail development was received on the Rockland Track, Kentmere Track, Milton-Lewes Line, and the Smyrna Track. These four rail corridors have been abandoned for a significant period of time and have a higher density of adjacent property owners relative to the other rail corridors. Additionally, preliminary right-of-way research of these corridors indicated that the rail corridor ownership is unknown, and in some cases, appears to have reverted back to private ownership. Most of the comments received on these four corridors are related to the safety, security, and liability of adjacent property owners, trail security patrolling, property ownership, easements, and property takings.

Additionally, the Master Plan development status and updates are maintained on DelDOT's worldwide web "Projects" page to increase the coverage of public involvement and awareness of the Plan. The web page contains information regarding the project purpose and background, digital copies of the public workshop displays and questionnaires, points of contact for the Plan, rail corridor photographs, and an electronic forum for the public to submit their comments about the Plan.

2.4.7 Agency Role Assessment and Program Inventory: Interviews with agency representatives were conducted to collect information to better understand the roles and coordination requirements, among various state agencies and DelDOT, to facilitate the implementation of rail-trail facility development. Additionally, relevant information already compiled by DelDOT and/or others regarding the current agency roles, programs, and policies was incorporated into this Plan in lieu of an interview.

These interviews and previously compiled information provide a comprehensive inventory and review of the roles that each agency plays in the planning or providing for of rail-trail facilities in Delaware. This information was used to create prioritization and implementation guideline recommendations for rail-trail development within this Plan.

Information relative to rail-trail development was obtained on the following agencies. Those agencies include, but were not limited to:

- DelDOT Departments (Planning and Development Coordination)
- Delaware Transit Corporation (DTC)
- Department of Education
- State Police
- Department of Health and Mental Hygiene
- Department of Natural Resources and Environmental Control (DNREC), Division of Parks and Recreation
- Local Governments (county, municipal)
- WILMAPCO (MPO)
- Dover/Kent MPO
- Delaware Bicycle Council

- Delaware Greenways
- Delaware Office of Highway Safety & Homeland Security

2.4.8 Create RTT/RWT Network Mapping and Transportation Improvement Program (TIP) Reference Sheets: In addition to the information obtained in the previous tasks, all existing and proposed statewide transit and bicycle networks, trail networks, and greenways were identified to prepare a statewide map and individual corridor maps to illustrate their connectivity to the existing and proposed RTT/RWT corridors. This mapping was used to cross-reference the proposed rail-trail corridors with DeIDOT's current implementation plan for meeting the goals of the Livable Delaware Initiatives. The Strategies for State Policies and Spending in Investment Areas and the statewide mapping served as a basis for the review and prioritization of the potential rail-trail development recommended in this plan.

Additionally, the various evaluations of each rail corridor were summarized in a one-page document for each corridor, and these are provided in a prioritized order in Appendix B. These corridor summaries are referred to as TIP sheets. The intent of the corridor TIP sheets is to provide a one-page document on each corridor, which can be submitted for review and consideration of the potential rail-trail corridor for inclusion in the Transportation Improvement Program (TIP) and ultimately forwarded toward implementation. The TIP sheet summaries identify the rail corridor, corridor length, connectivity, condition of the rail bed, suitability of trail, opportunities and constraints for implementation, and order of magnitude costs estimates to develop the rail corridor into a rail-trail facility.

The TIP sheet order of magnitude costs were derived using historical data on the industry average for construction costs of rail-trail facilities. Order of magnitude type cost estimates were provided due to the commonly "dated" cost information available for construction materials and widely fluctuating regional material/labor costs. The order of magnitude costs include the following costs: 10% preliminary engineering fee, 15% construction engineering fee, 5% for land acquisition and easements, preliminary structure improvement costs, and a remainder of contingency costs for typical rail-trail construction. A breakdown of the preliminary structural improvement evaluations and cost estimates are described and provided in Appendix G.

Following are rail-trail construction items that are represented in the contingency costs but greatly fluctuate between the development of one facility and another and are *NOT* included in the TIP order of magnitude costs as specific line items. These are: trail design elements and amenities, parking facilities and service structures, environmental impact/permitting, signage/markings, drainage facility installation/rehabilitation, and erosion/sediment control. As a potential rail-trail corridor progresses in the preliminary planning phase the associated construction cost items will be developed in greater detail and accuracy.

2.4.9 Demand Potential and Connectivity Assessment: Demand estimations were established using the designations provided in the 2004 State Strategies for Policies and

Spending Maps and the Investment Level Area descriptions. Additionally, basic demand measure was determined from feedback provided by the public and major stakeholders. This information was used to generate evaluation criteria that were applied to the prioritization for recommended rail-trail facilities to be implemented by 2010.

Connectivity assessments for each rail corridor were made using the same information above and GIS data obtained in previous tasks, such as trail networks, bicycle facilities, greenways, and other major activity centers.

It is recommended to conduct demand estimation comparison studies, at a minimum, if it is determined during the project development of any of these rail corridors that more detailed estimates of non-motorized travel are required. Comparison studies are the least costly and time consuming and primarily consist of obtaining user counts of facilities similar in length, design, and geographic characteristics.

3.0 RTT/RWT FACILITY REQUIREMENTS & RECOMMENDATIONS

3.1 USER CHARACTERISTICS

3.1.1 Definitions:

- Pedestrian—a person afoot, in a wheelchair, on skates, or on a skateboard.
- Bicycle—a pedal-powered vehicle upon which the human operator sits.

3.1.2 Travel Times and Operator Space: Below are the various traveling speeds and operator space requirements for the various types of rail-trail user modes. The following is a compilation of information obtained from AASHTO, the ITE Traffic Handbook, and the Transportation Research Record:

	Avg. Recreational Travel Speed (mph)	Minimum Oper. Space (ft.)	Recommended Oper. Space (ft.)
Bike	13.1	4'	5'
Skate	10.5	5'	6'
Jog	7.0	3'-4'	4'
Walk	3.1	4'	5'
Wheelchair	2.4	4'	5'



The figure to the right shows that bicyclists require at least 40 inches (40") of essential operating space based solely on their profile. An operating space of 4 feet (4') wide is assumed as the minimum traveling width for one direction. On rail-trails with two-way travel of other facility users and bicyclists, a more comfortable operating space of 5 feet (5') in each direction is recommended. The average eye height of the bicyclist is 4.5 feet (4.5')

The AASHTO *Guide for the Development of Bicycle Facilities* recommends a minimum width of 10 feet (10') for rail-trails. As noted above, this width would accommodate two inline skaters passing in opposite directions but a 12 foot (12') width would be more desirable as two skaters traveling abreast have a combined sweep width of almost exactly 10 feet (10').

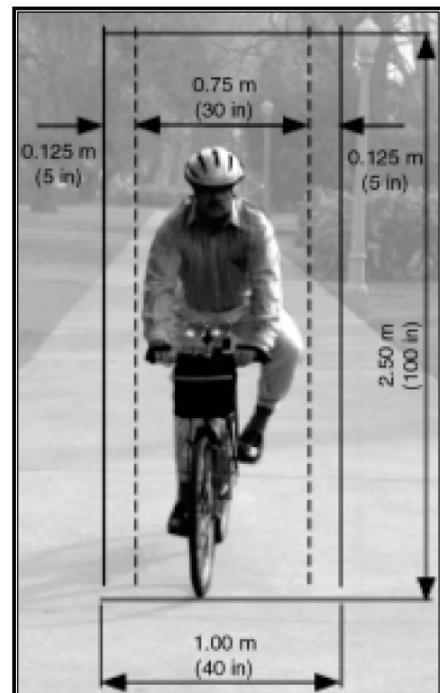


Figure 3.1 Operating Space
Source: AASHTO, Figure 1

3.2 FACILITY CHARACTERISTICS

3.2.1 Definitions:

- Access Trail (spur trail)- any trail that connects the main trail to a road, points of interest, overlooks, adjacent communities, activity centers, and trailheads.
- Bicycle Facility- any road, street, or path, that in some way is designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.
- Bicycle Lane- a portion of a roadway that is designated by signs and pavement markings for preferential or exclusive use by bicyclists.
- Designated Bicycle Route- a system of bikeways designated by the jurisdiction having authority with appropriate directional and informational route signs, with or without specific bicycle route numbers. Bicycle routes, which might be a combination of various types of bikeways, should establish a continuous routing.
- Easement- grants a nonowner the right to use a specific portion of land for a specific purpose. An easement agreement survives transfer of landownership and is generally binding upon future owners until it expires on its own terms. There are three types of easements: (1) temporary, (2) permanent, and (3) utility easements.
- Multi-Use Trail- a linear trail that permits more than one user group at a time for recreational or transportation purposes. Permitted uses can include motorized and nonmotorized user groups such as horse riding, hikers, mountain bikes, motorcycles ATVs, etc.
- Pedestrian Facilities- a general term denoting improvements and provisions made to accommodate or encourage walking.
- Right-of-Way- a strip of land held in fee simple title, or an easement over another's land, for use as a public utility for a public purpose. Usually includes a designated amount of land on either side of a railroad corridor or trail that serves as a buffer for adjacent land uses.
- Shared-Use Path- a trail outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment and right-of-way. Shared-use paths have a transportation and/or recreation function for nonmotorized users such as pedestrians, inline skaters, users of manual and motorized wheelchairs, joggers, and bicyclists.

- **Trailhead**- the start, access point, or end of a trail, often accompanied by various public facilities such as parking areas, restrooms, water, directional and informational signs and information.
- **Train Dynamic Envelope**- the clearance required for the train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure. The distance between rail and dynamic envelope pavement marking should be 6 feet (6'), unless otherwise advised by the operating railroad. Rail width is typically 5 feet 2 inches (5'2") from the outside of rail to outside of rail, and the ties are typically 8 feet (8') long.

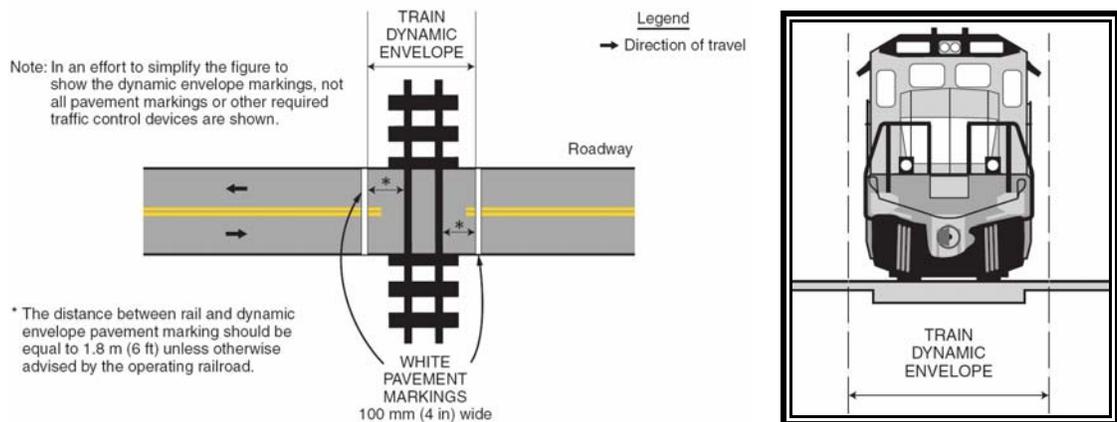


Figure 3.2 Train Dynamic Envelope & Pavement Markings
Source: MUTCD, Figure 8B-8 (left), Figure 8A-1 (right)

3.2.2 Rail-to-Trail (RTT) Facility: are public path/trail facilities that are developed from the conversion of inactive and abandoned rail corridors into public shared-use or multi-use trail systems. Figure 3.3 illustrates the a typical RTT cross section design, drainage, and safety features such as a split rail fence at areas with steep slopes adjacent to the facility.

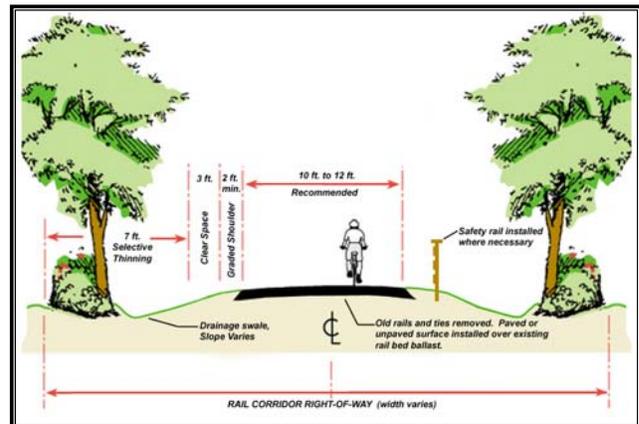


Figure 3.3 Typical RTT Cross Section
Source: Rail-to-Trail Conservancy (modified)

Figure 3.4 illustrates example techniques for RTT surfaces, selective thinning and clearing, shoulder and drainage treatments, safety railings, and the use of wood guide rails to serve as barriers between the trail facility, adjacent properties, and paralleling roadways.



Figure 3.4 Example RTT Design Elements
Source: Western Maryland Rail Trail Web Site

3.2.3 Rail-with-Trail (RWT) Facility: is a public shared-use path/trail facility that has been developed adjacent to active railroad lines and shares the same right-of-way corridor. Successful RWT facilities are separated from active rail lines by a minimum distance of 10 feet (10') and/or with a physical barrier such as grade separation, vegetation, drainage ditches, or fencing. Each type of barrier is selected based on the train's type, frequency, and speed. An 8 foot (8') separation is the absolute minimum and should only be applied at pinch points or for very short distances. At these locations it is recommended that a grade separation be provided in addition to a vertical barrier. Figures 3.5, 3.6, and 3.7 illustrate the typical RWT cross-section design, drainage, and safety features.

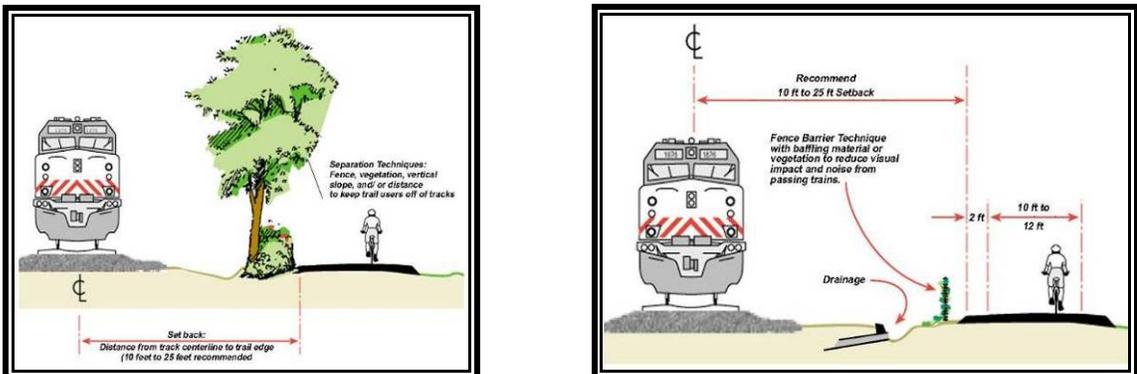


Figure 3.5 Typical RWT Cross Sections
Source: Rail-to-Trail Conservancy (modified)

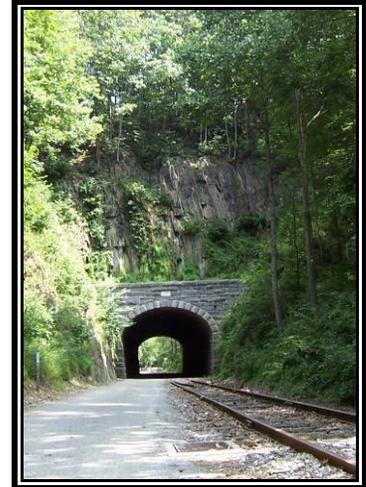
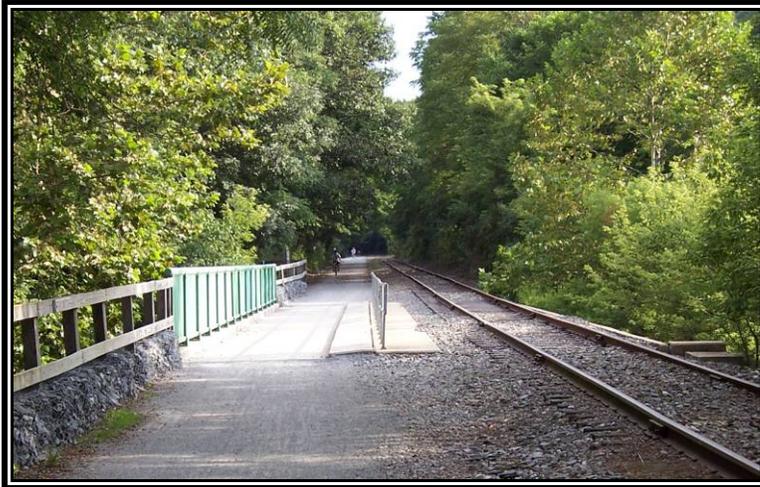


Figure 3.6 Example RWT without continuous barriers
 Source: Heritage Rail Trail County Park, York, PA



Figure 3.7 Example RWT with separation barriers
 Source: (left, unknown RWT in Ohio, right, Springwater Corridor in Portland, OR)

3.3 RTT/RWT FACILITY COMPONENTS

The three primary RTT/RWT design features that combine to create the total trail experience, are:

- The trailhead
- The trail corridor
- Trail elements

3.3.1 Facility Trailheads:

3.3.1.1 Accessibility: A trailhead is the trail facility where trail users can enter or exit from a rail-trail facility or a recreation trail. Trailheads typically include elements such as parking, bicycle racks, restrooms, informational kiosks, trash

receptacles, benches, drinking fountains, picnic tables, fee boxes, emergency phones, and in some cases, such amenities as changing rooms.



Figure 3.8 Typical Trailhead Parking Facility

Source: Junction & Breakwater Trail, Cape Henlopen State Park- Wolfe Neck Area

An attempt should be made to locate trailheads in areas where it is easier to take advantage of existing facilities and infrastructure such as parks and other activity centers. Another typical trailhead location that provides easy access to the trail is at or near trail-roadway intersections. Providing trailheads at locations along the trail where there is a concentration of special features, including natural and cultural resources, have proven successful.

Creating a RTT/RWT facility that provides access for people with disabilities involves more than the trail itself. Consideration must be given to ensure that an accessible route, as well as parking, is maintained throughout the trailhead and the access trail to the RTT/RWT facility itself meets the Americans with Disabilities Act Accessibility Guidelines (ADAAG). This includes spur trails from adjacent land uses, communities, and other activity centers. Furthermore, the facilities and amenities along and connected to the trail should also be designed for access.

The State Architectural Accessibility Board represents the interests of the disabled, on state and federally funded projects. This board adopts standards and criteria to address service and accessibility for the disabled and handicapped and is the regulatory agency for ensuring compliance with all applicable standards and criteria during design and in construction. The Department applies accessibility standards during the RTT/RWT design and construction based on project initiation, scope, and funding authorization. The Project Design Checklist provides guidance for the submission of plans to the Architectural Accessibility Board for review.

The appropriate guides to ensure conformance include: the current **10-28 Miscellaneous Design July 2004 Delaware Architectural Accessibility Standards**; Part II of the *Federal Register's Architectural and Transportation Barriers and Compliance Board- 36 CFR (Part 1191)* - dated July 26, 1991; and Part IV of the *Federal Register's Department of Transportation- 49 CFR (Parts 27, 37, 38)* - dated September 6, 1991.

3.3.1.2 Sidewalks and Access Trails: Because railroad beds have gradual turns and grades, typically less than 4 percent (4%), relatively few barriers exist in making this type of trail accessible. The greatest challenge is typically designing an accessible pathway to the RTT/RWT facility. If the rail bed is raised high above the surrounding areas, providing access for people with mobility impairments may involve changes in design, such as reducing grade through the use of switchbacks or building ramped surfaces. See Section 3.4.7 for grade tolerances.



Figure 3.9 Trailhead Access Trail

Source: Junction & Breakwater Trail, Cape Henlopen State Park- Wolfe Neck Area

Any sidewalks within the trailhead or incorporated within a RTT/RWT facility shall be designed with the guidance of the DelDOT *Road Design Manual (RDM)*. Additionally, access trails and spur trails associated with a RTT/RWT facility shall meet the Shared-Use Path design standards of the RDM.

With the development of RTT/RWT facilities, communities will be able to safely link to other land uses and transportation modes, resulting in better and more desirable neighborhoods and land development practices. A very important element of successful rail-trail facilities is incorporating logical and ample connections to adjacent land uses by providing access and spur trails. During the design process, every effort should be made to connect the rail-trail facility to various land uses such as: local business centers, corporate centers, shopping centers, malls, schools, medical centers, religious centers, hotels and residential communities.

Typically, the user volumes on access trails and spur trails are significantly lower than the main trail facility. Although these connector trails must maintain the same standard of accessibility as the main-line trail, the required trail width may be reduced to 8 feet (8') and potentially 6 feet (6') if very low volumes are anticipated.

3.3.1.3 Facilities & Amenities at the Trailheads: The needs of all potential user groups should be addressed during the planning, design, and construction of the trailhead area to ensure that adequate amenities are available. Different types of users have distinct needs for trailhead amenities whether or not they have a disability. For example, bicyclists may need bicycle racks that are easy to use and secure. DeIDOT and/or DNREC shall review bicycle rack style and location selection on a case-by-case basis. See Appendix C for examples of bicycle racks that DNREC has installed at the Junction & Breakwater Trail trailhead facilities. People with and without disabilities may be included in each of the trail user groups, and therefore amenities should be designed for the needs of all users.



Figure 3.10 Trailhead Information Kiosk, Collapsible Bollards, Restrooms, and ADA Parking
Source: Junction & Breakwater Trail, Cape Henlopen State Park- Wolfe Neck Area

It is important during the design process to acknowledge that people with disabilities participate in all types of trail activities at a wide range of skill levels, and may be a member of any user group. For example, a person with a mobility impairment may ride a hand-powered or tandem bicycle. Therefore, it is recommended that the built facilities and amenities, such as restrooms and parking lots, at all trailheads and along all trails be constructed using accessible designs for all user groups of disabled persons.

3.3.1.4 Information at the Trailhead: Objective information about the condition of the trail should be available to trail users before they embark on the trail. Usually, the information is conveyed at designated trailheads through signage. However, other information formats (e.g., maps, guidebooks, or large print, or Braille trail descriptions) may be preferred.

The information provided at the trailhead is an extremely important factor in trail access. Each trail user is unique and has different abilities depending on personal fitness, endurance, and the suitability of any adaptive equipment being used to access the trail. It is essential that all trail users have accurate information about the conditions that they will encounter on the trail in order to identify trails that best suit their needs.

Information provided at the trailhead should be representative of the rail-trail conditions including the facilities and amenities provided along the trail. When the conditions on the trail have the potential to change or have a history of changing (e.g. due to seasonal change and/or severe weather) it becomes even more important to provide accurate and updated information about the on-trail conditions, through signs or other direct information sources, at the trailhead.

Signage at the trailhead and along the trail should conform to ADAAG requirements for font size, type, and contrast.



Figure 3.11 Information Kiosk Maps and Other Regulatory Information
Source: Junction & Breakwater Trail, Cape Henlopen State Park- Wolfe Neck Area

3.3.2 Rail-Trail Corridor: The trail corridor is defined as the entire design width and height of the trail right-of-way. It extends from the trail entrance to the destination. The key to providing access within the trail corridor is to remember that it is not defined only by the trail surface. Accessibility within the entire area on, over, or beside the trail surface must be planned with the needs of all potential users in mind. Although many factors impact the accessibility of the rail-trail corridor, the following characteristics are most directly related to access for people with disabilities:

- Surface
- Grade
- Cross slope
- Clear tread width
- Protruding objects
- Vertical clearance

3.3.3 Rail-Trail Elements & Amenities: The accessibility of the rail-trail depends not only on the conditions encountered on the trail itself but also the accessibility and availability of trail elements. Trail elements are the facilities and features that are found along a rail-trail, in addition to the rail-trail itself. Examples of design elements include:

- Destinations such as lakes, ponds, sports facilities, parks, and historic sites
- Scenic viewpoints
- Interpretive information displays
- Built facilities, such as restrooms, shelters, picnic tables, and bicycle racks
- Water access or supply points

The overall trail experience may be compromised if the accessibility of the trail elements does not match the accessibility provided by the trail itself. The lack of accessible elements such as picnic and toilet facilities can be especially frustrating to users who have invested time and energy in reaching a particular destination. ADAAG provides design standards for numerous elements normally found along a rail-trail, such as drinking fountains, restrooms, and parking areas.

In addition to ADAAG standards, the FHWA *Designing Sidewalks and Trails for Access Part 2*, provides valuable guidance for the development of the following rail-trail elements:

- Picnic tables and grills
- Trash and recycling containers
- Overlooks and viewing areas
- Telescopes and periscopes
- Benches
- Restroom facilities

When designing elements that are not specifically addressed in ADAAG standards for outdoor recreation, use the best available information for similar elements that have outdoor recreation guidelines or obtain guidelines for the same or similar element within a built environment and then adapt the design guidelines accordingly.

3.4 DESIGN GUIDELINES

RTT and RWT facilities have the potential to offer a much wider range of opportunities to multiple user groups than those provided by the roadway and sidewalk systems. These facilities can provide a recreational opportunity and alternative transportation options, unlike many other off-road recreational trails that may be isolated or only connect community to community and a limited amount of additional destinations. Whereas, many towns were built and located as a result of the railroad system, RTT and RWT facilities on these same corridors inherently provide a strong transportation and commuting function while connecting communities, recreational destinations, and other activity centers along the way.

Various design circumstances and/or physical barriers may require that the RTT/RWT alignment be diverted from the original or existing railroad ROW and potentially be collocated within a roadway ROW. In the event that this situation is required, in order to continue the trail facility, consideration must be given to maintaining the continuity of a “shared-use” facility along the roadway. Pedestrians and bicyclists should not just be diverted onto sidewalks and dedicated or shared roadway facilities until they are rejoined with the shared-use facility. Not only is there a high potential for pedestrians with strollers, joggers, inline skaters, skate boarders, and dog walkers, but all bicyclists that may use a rail-trail facility should not be “expected” to have the skill and comfort level required by an on-road type of bicycle facility. Any RTT/RWT facility that falls under this condition should maintain the AASHTO guidance provided for the development of shared-use paths.

RTT and RWT facilities are to be designed in accordance with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for shared transportation paths. Maximum slope, cross slope, and the rate of change in grade should be carefully examined during the design process.

The design criteria categories that apply to rail-trail facilities are based on those used for shared-use paths including horizontal/vertical alignment, horizontal/vertical clearances, sight distance, grades, and pavement structures. Although rail corridors typically have gradual slopes and curves, the need to acknowledge horizontal and vertical alignment design criteria is more applicable to accessing the rail-trail facility and for the rail-trail facility itself in a RWT condition. For example, with a RWT facility, it is not uncommon for the adjacent rail-trail to be diverted away from the rails to negotiate an obstacle, environmental feature, or the approach to a roadway intersection. In these instances it may be necessary to drastically change grades or horizontal alignment.

Even when providing a RTT or RWT facility and appropriate trailheads, street improvements to address this mode of transportation should not be overlooked in the vicinity of trail-roadway intersections as many local users may access these trail facilities via their local roadway network. Many users will still use the local street system, perceiving it to be more convenient than accessing the trail from a designated trailhead.

3.4.1 Context Sensitive Design: Context sensitive design is a term used to identify a design process that balances the design features of a project with:

- User safety
- Transportation system needs
- Accessibility and mobility
- Preservation of historic sites and districts
- Natural and man-made environmental concerns
- State and local economic needs
- Preservation of community values

Context sensitive design recognizes that the application of uniform design standards to specific rail-trail projects is not always possible. Rail-trail facilities are not constructed through consistent, uniform settings. This Plan, with guidance from AASHTO and the DelDOT Road Design Manual, attempts to address these issues by developing specific

RTT/RWT design standards to apply to the most typical situations encountered in developing a railroad corridor for these types of facilities.

The context sensitive design approach is used to develop projects that achieve protection of community, historic, and environmental values while utilizing scientifically developed engineering standards that will result in a safe facility for the user. This process allows the designer to address community concerns while meeting the intended transportation or recreational needs, minimizing adverse impacts and enhancing the project area. Context sensitive design requires careful listening and understanding of the values placed on the project area by citizens, agencies, special interest groups, and local governments. Additionally, it requires thoughtful and often creative design solutions.

Each project should begin with determining the applicable design standards as published by AASHTO, ADAAG, DelDOT, and guidance provided by the Rails-to-Trails Conservancy and this Plan. Additionally, familiarization with the Universal Trail Assessment Process (UTAP) is a valuable resource when establishing the various project parameters, during the design process, which will provide a safe, flexible, and accessible set of design elements that meet project requirements.

Due to the unique characteristics of each rail corridor and their potentially unique set of design solutions, it is likely that it will not be feasible to meet all of the applicable design standards. One design approach that should remain constant throughout the development of all rail-trail projects is to provide design and operational consistency to the maximum extent feasible. Ensuring the continuity of various rail-trail designs means that a rail-trail user can travel to any state, city or town and, depending upon the situation encountered, react in the same user manner, e.g. all crossings are signed and marked uniformly. The need to apply flexibility in the design should not compromise the user's safety. Each project is unique and has its own community values, social, economic, and environmental constraints. Context sensitive designs recognize and address those unique elements that preserve or enhance community values. The most successful rail-trail projects have applied the context sensitive design process.

3.4.2 *Universal Trail Assessment Process (UTAP):* Signs that clearly describe the RTT/RWT facility conditions are an essential component to enhance pedestrian access. Signs should be provided in an easy to understand format with limited text and graphics that are understood by all users. Providing accurate, objective information about actual rail-trail conditions will allow people to assess their own interests, experience, and skills in order to determine whether a particular rail-trail is appropriate or provides access to them with their assistive devices such as wheelchairs, crutches, and walkers. Providing information about the condition of the rail-trail to users is strongly recommended for the following reasons:

- Users are less likely to find themselves in unsafe situations if they understand the demands of the RTT/RWT facility before beginning
- Frustration is reduced and people are less likely to have to turn around because they can identify impassible situations, such as steep grades, before they begin
- Users can select rail-trails that meet their skill level and desired experience

Objective information about the rail-trail conditions (e.g., grade, cross slope, surface, width, obstacles) is preferable to subjective difficulty ratings (e.g., easy, moderate, very difficult). Individuals with respiratory or heart conditions, as well as individuals with mobility impairments, are more likely to have different interpretations of difficulty than other users. Figure 3.12 illustrates an example of a trail access information strip that provides important trail user data such as grade, width, and surface type.



Figure 3.12 Example of a Trail Access Information Strip (UTAP)

Source: Junction & Breakwater Trail, Cape Henlopen State Park- Wolfe Neck Area

A variety of information formats may be used to convey objective rail-trail information. The type of format should conform to the policy of the management agency. Written information should also be provided in alternative formats, such as Braille, large print, or an audible format. The type and extent of the information provided will vary depending on the rail-trail, environmental conditions, and expected users. It is recommended that the following information be objectively measured and conveyed to the user through appropriate formats:

- Rail-trail name
- Permitted users
- Path length
- Change in elevation over the total length and maximum elevation obtained
- Average running grade and maximum grades that will be encountered
- Average and maximum cross slopes
- Average tread width and minimum clear width
- Type of surface
- Firmness, stability, and slip resistance of surface

3.4.3 Width & Clearance: The paved width and the operating width required for a rail-trail facility are primary design considerations. Figure 3.13 below depicts the recommended design cross section of a two-way Rail-to-Trail facility. The width of the rail-trail tread not only affects pedestrian usability but also determines the types of users who can use the path. Factors, such as the movement patterns of designated user groups, should be considered. For example, inline skaters use a more lateral foot motion for propulsion that is wider than the operating space pedestrians or bicyclists. Under most conditions, a recommended paved width for a two-way rail-trail facility is 10 feet (10') wide. In other instances, a reduced width of 8 feet (8') can be adequate only where the following conditions prevail: (1) bicycle traffic is expected to be low, even on peak days or during peak hours, (2) pedestrian use of the facility is not expected to be more than occasional, (3) there will be good horizontal and vertical alignment providing safe and frequent passing opportunities, and (4) during normal maintenance activities the path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage. Under certain conditions it may be necessary or desirable to increase the width of a rail-trail tread to 12 feet (12'), or even 14 feet (14'), due to substantial use by bicycles, joggers, skaters and pedestrians, use by large maintenance vehicles, and/or steep grades.

The minimum width of a one-way facility, access trail, or spur trail is 6 feet (6'). It should be recognized, however, that one-way paths often will be used as two-way facilities unless effective measures are taken to assure one-way operation. Without such enforcement, it should be assumed that shared use paths will be used as two-way facilities by both pedestrians and bicyclists and should be designed accordingly. A minimum 2 foot (2') wide graded area (shoulder) with a maximum 1:6 slope should be maintained adjacent to both sides of the rail-trail; however, 3 feet (3') or more is desirable to provide clearance from trees, poles, walls, fences, guardrails, or other lateral obstructions.

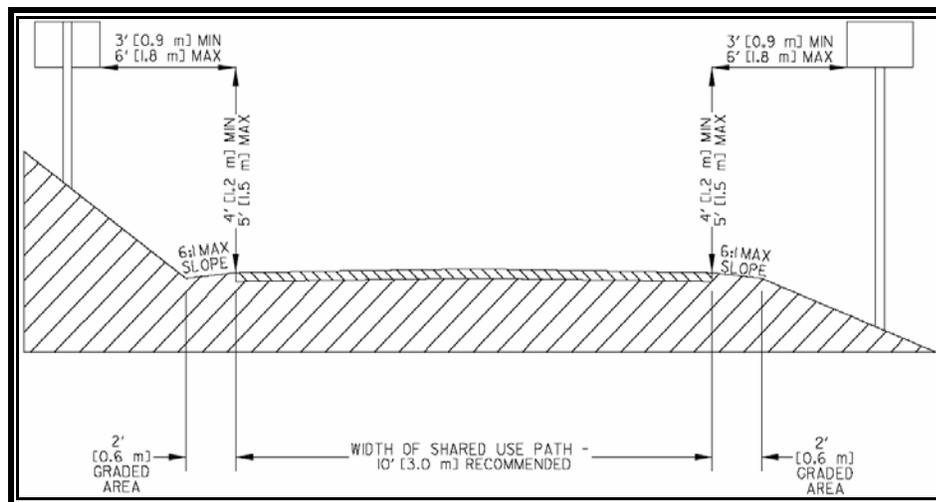


Figure 3.13 Cross Section of Two-Way Rail-to-Trail Design and Sign Placement
Source: DelDOT Roadway Design Manual, Figure 10-7

Where the path is adjacent to canals, ditches or down slopes steeper than 1:3, a wider graded shoulder should be considered. A minimum of 5 feet (5') separation from the edge

of the path pavement to the top of the slope is desirable. Depending on the height of embankment and condition at the bottom, a physical barrier, such as dense shrubbery, railing or chain link fence, may need to be provided (see Figure 3.6.). The vertical clearance to obstructions should be a minimum of 8 feet (8'). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In under-crossings and tunnels, 10 feet (10') is desirable for adequate vertical clear distance.

Figure 3.13 illustrates the horizontal and vertical placement of signage along RTT/RWT facilities. The typical recommended sign mounting height is 5 feet (5') high from the bottom of the sign to the trail surface, and if supplemental signs are used the bottom of that should be 4 feet (4') from the bottom of the sign to the trail surface. In the event that an overhead sign is used or required, the mounting height should be 8 feet (8') minimum from the bottom of the sign to the trail surface. The total width of the trail and clear space should be maintained through any tunnels, underpasses, bridges, or overpasses.

Protruding objects are anything that overhangs or protrudes into the rail-trail tread whether or not the object touches the surface. Examples of protruding objects include lighting posts, poorly maintained vegetation, and signs. It is recommended that vegetation be cleared to a minimum of 5 feet (5') from the edge of the rail-trail tread. Additionally, it is recommended that selective thinning be conducted for an additional 7 feet (7') from the 5 foot (5') clear zone. The clear zone and selective thinning zone should periodically be inspected and maintained to these standards.

Ideally, objects should not protrude into any portion of the clear tread width of a shared-use path. If an object must protrude into the travel space (e.g. fencing and handrails), it should not extend into the travel space more than 4 inches (4"). Although pedestrians only require 80 inches (80") of vertical clearance, an 8 foot (8') vertical clearance shall be provided and maintained for bicycle users. On rail-trail facilities where there is the potential for emergency or maintenance vehicles to gain access to areas, it may be necessary to increase the vertical clearance. In addition, when an underpass such as a tunnel is used, 10 feet (10') of vertical clearance is recommended. Coordination with maintenance and emergency services is critical in determining the height, width, and weight requirements for accommodating their vehicles along the RTT/RWT facility.

3.4.4 Surface & Materials: The condition of the surface is a significant factor in determining how easily users, especially a person with a disability, can travel along a rail-trail facility and ultimately affects which user groups will be capable of enjoying the rail-trail facility. Rail-trails that have been built using crushed aggregate generally are unusable by inline skaters and slow down the speed of bicyclists. The accessibility of the rail-trail surface is determined by a variety of factors including:

- Surface material
- Surface firmness and stability
- Slip-resistance
- Changes in level
- Size and design of surface openings

The preferred pavement surface is a good quality all weather surface. The controlling load of the design is that of motorized maintenance and patrol vehicles. Frost damage potential, skid resistance, surface quality, edge support, and surface and subsurface drainage influence the pavement selection.

There are various surface materials that can be used in rail-trail facilities. Rail-trail facilities are generally paved with asphalt or concrete, but may also use prepared surfaces such as crushed stone or soil stabilizing agents mixed with native soils or aggregates. Paved surfaces should be provided in areas that are subject to flooding, drainage problems, in areas with steep terrain, and in environmentally sensitive areas. Providing a paved surface in these areas will maximize the longevity of the rail-trail surface by reducing the effects of erosion and run-off.

RTT/RWT facilities shall have a firm and stable surface and be designed with a surface that is slip resistant during typical weather conditions. The firmness, stability, and slip resistance of the rail-trail surface affects all users but is particularly important for people using mobility devices such as canes, crutches, wheelchairs, or walkers.

- Firmness is the degree to which a surface resists deformation by indentation when a person walks or wheels across it. A firm surface would not compress significantly under the forces exerted as a person walks or wheels on it.
- Stability is the degree to which a surface remains unchanged by contaminants or applied force so that when the contaminant or force is removed, the surface returns to its original condition. A stable surface would not be significantly altered by a person walking or maneuvering a wheelchair on it.
- Slip resistance is based on the frictional force necessary to permit a person to ambulate without slipping. A slip-resistant surface does not allow a shoe heel, wheelchair tires, or a crutch tip to slip when ambulating on the surface.

Asphalt and concrete are firm and stable in all conditions. Other materials, such as crushed limestone or sandstone are also firm and stable when compacted properly during construction. Under dry conditions, most asphalt and concrete surfaces are fairly slip resistant. The *U.S. Access Board Technical Bulletin #4* addresses slip resistance in further detail (U.S. Access Board, 1994).

Changes in level are defined as the maximum vertical change between two adjacent surfaces. This situation will be most common at trailhead sidewalk and ramp transitions to the trail, at trail to bridge transitions, around drainage grates and manholes, and at roadway and railroad crossings. Other examples of changes in level that may occur on rail-trails include cracks caused by freezing and thawing or a sudden change in the natural ground level due to erosion or drainage problems.

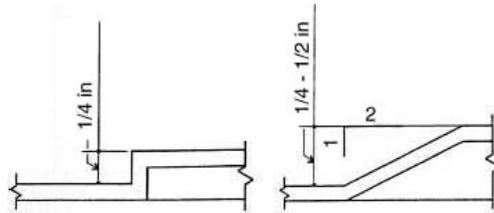


Figure 3.14 Cross Section of ADAAG Vertical Change Standards

Source: FHWA, Designing Sidewalks and Trails for Access, Part 2, Figure 14-8

Although changes in level are not desirable for people with mobility impairments, they are most harmful to bicyclists and inline skaters and can cause pedestrians to trip and fall. Minimizing or eliminating changes in level will greatly improve the rail-trail safety for all users.

For RTT/RWT facilities, the following recommendations should be followed concerning changes in level:

- Vertical changes in level should not be incorporated in new construction
- If unavoidable, small changes in level up to ¼ inch (¼”) may remain vertical and without edge treatment
- A beveled surface with a maximum slope of 50 percent (50%) should be added to small level changes in levels between ¼ inch (¼”) and ½ inch (½”)
- Changes in level such as curbs that exceed ½ inch (½”) should be ramped or removed

3.4.5 Horizontal/Vertical Alignment & Sight Distance: Refer to the AASHTO *Guide for the Development of Bicycle Facilities* and the DelDOT *Road Design Manual* for “shared-use path” design guidance relating to rail-trail horizontal/vertical alignment and sight distance design issues. As previously stated due to the flat and straight nature of most rail corridors typical rail-trail alignments do not present many challenging design issues related sight distance or horizontal and vertical alignment. Although, the rail-trail’s associated access trails and spur trails may require special attention to these design factors. Sections 10.9.6.5 and 10.9.6.6 of the DelDOT RDM are an excellent resource for addressing shared-use path issues related to horizontal/vertical alignment and sight distance.

3.4.6 Design Speed: Rail-trails should be designed for a selected bicycle speed that is at least as high as the preferred speed of the faster bicyclist. In general, a minimum design speed of 20 mph should be used; however, when the grade exceeds 4 percent (4%) a design speed of 30 mph is advisable. For most bicycle path applications the superelevation rate will vary from a minimum of 2 percent (2%) to a maximum of approximately 3 percent (3%). For a superelevation rate of 2 percent (2%), the minimum radii of curvature is 80 feet (80’) for a design speed of 20 mph and 260 feet (260’) for a design speed of 30 mph. When substandard radius curves must be used on rail-trails due to right-of-way restrictions, topographical or other considerations, standard curve warning signs and supplemental pavement markings should be installed in accordance with the MUTCD. The negative

effects of substandard curves can also be partially offset by widening the pavement through the curves.

3.4.7 Grades: Grades on rail-trails should be kept to a minimum, especially on long inclines. This section is intended to address typical issues related to grades for connector, access, and spur trails as the main line of most, if not all, rail-trails provide gradual curves and inclines that typically do not exceed 4 percent (4%). Grades greater than 5 percent (5%) are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent or comfortable. On some rail-trails and their connector trails, where terrain dictates, it may be necessary to exceed the 5 percent (5%) grade recommended for bicycles for short distances. As a general guide, the following grade restrictions and grade lengths are suggested:

- 5-6% for up to 800 feet (AASHTO)
- 7% for up to 400 feet (AASHTO)
- 8% for up to 200 feet (ADAAG)
- 9% for up to 100 feet (recommended)
- 10% for up to 30 feet (ADAAG)
- 12.5% for up to 10 feet (ADAAG)

As the ADAAG standards are continuously updated, newly recommended maximum distances for given grade percentages have been provided in the criteria above and noted as such.

Steep running grades are particularly difficult for users with mobility impairments when resting opportunities are not provided. If steeper segments are incorporated into the rail-trail, the total running grade that exceeds 8.3 percent (8.3%) should be less than 30 percent (30%) of the total trail length. In addition, it is essential that the lengths of the steep sections are minimized and are free of other access barriers. Users should not be required to exert additional energy to simultaneously deal with other factors, such as steep cross slopes and change in vertical levels.

Near the top and bottom of the maximum grade segments, the grade should gradually transition to less than 5 percent (5%). In addition, rest intervals should be provided within 25 feet (25') of the top and bottom of a maximum grade segment. Regardless of grade, rest intervals may be located on the rail-trail for disabled persons but should ideally be located adjacent to the path for the safety of all users. Rest areas may be located at an interval not only convenient to disabled persons but they equally serve the elderly, younger user groups, and most user groups in general. Well-designed rest intervals should have the following characteristics:

- Grades that do not exceed 5 percent (5%)
- Cross slopes on paved surfaces that do not exceed 2 percent (2%) and cross slopes on non-paved surfaces that do not exceed 5 percent (5%)
- A firm, stable, and slip-resistant surface

- A width equal to or greater than the width of the path segment leading to and from the rest interval
- A minimum length of 5 feet (5')
- A minimum change of grade and cross slope on the segment connecting the rest interval with the rail-trail

3.4.8 Cross Slope & Drainage: Severe cross slopes can make it difficult for wheelchair users and other pedestrians to maintain their lateral balance. Cross slopes can cause wheelchairs to veer downhill and create problems for individuals using crutches who cannot compensate for the height differential that cross slopes create. The impacts of cross slopes are compounded when combined with steep grades or surfaces that are not firm and stable.

Cross slope can be a barrier to all rail-trail users especially people with mobility impairments. However, some cross slope is necessary to drain water quickly off of the tread surface. For asphalt and concrete, a maximum cross slope of 2 percent (2%) should be used and for non-paved surfaces, such as crushed aggregate, the maximum recommended cross slope is 5 percent (5%).

Care must be taken to ensure that drainage grates are bicycle-safe. If not, a bicycle or wheelchair wheel may fall into a slot in the grate, causing the user to fall. Replacing existing grates (see A and B in Figure 3.15, preferred methods) or welding thin metal straps across an existing grate perpendicular to the direction of travel (C, alternate method) is required. These should be checked periodically to ensure that the straps remain in place.

The most effective way to avoid drainage grate conflicts is to eliminate them entirely with the use of a 'curb face' style drainage inlet. If a trail-surface grate is required for drainage, care must be taken to ensure that the grate is flush with the trail surface. Inlets should be raised after a pavement overlay to within 1/4 inch (1/4") of the new surface. If this is not possible or practical, the pavement must taper into drainage inlets so they do not cause an abrupt edge at the inlet.

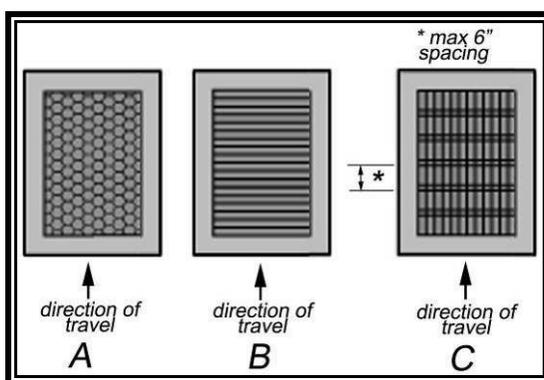


Figure 3.15 User Safe Drainage Grates

Source: Oregon Bicycle Pedestrian Plan, Figure 21

3.4.9 Structures: Many rail-trails take advantage of bridges and tunnels that were built to accommodate trains, and are therefore strong enough to support bicycle and pedestrian use. However, some bridges have to be replaced or restored. See Appendix G for the evaluation and photographs of existing structures along the rail corridors in this Plan. The AASHTO Guide recommends:

- The recommended clear width of the bridge should be the same as the trail width. This provides clearance from tunnel walls or bridge railings and allows clearance from users who may have stopped on the bridge
- Railings, fences, or barriers should be a minimum of 42 inches (42”) high
- Bridges should be designed for the live loads and dead loads of pedestrians, maintenance vehicles, and emergency vehicles



Figure 3.16 Railroad Bridge Modifications for a RTT Facility

Source: Mon River Rail Trail South and the Caperton Trail, Morgantown, West Virginia



Figure 3.17 Example New Bridge Styles for RTT Facilities

Source: Steadfast Bridge Manf. (left), Wheeler Bridge Manf. (right)

Figure 3.16 shows examples of unique railing and decking modifications made to existing railroad bridges to accommodate a rail-trail facility. The left photo shows the use of galvanized corrugated metal (“Q-decking”) and concrete for the bridge trail surface. Figure

3.17 shows examples of new bridge types that are adequate for RTT/RWT facility design. Note the “rub-rail” attached to the side railings of the left bridge photo in Figure 3.17.

Consideration needs to be given to the orientation of the bridge decking planks. The orientation of the planks is usually determined by the superstructure design of the existing or new bridge. Typically the deck planks should be fastened perpendicular to the beams of the superstructure. On existing railroad bridges where the crossties will remain the bridge decking should be oriented on a 45 degree (45°) angle to the direction of travel as shown in the right photo of Figure 3.16. The angled decking is the preferred method because it provides a smoother ride for wheeled rail-trail users as opposed to a perpendicular orientation and it also avoids “tracking” of wheeled users as opposed to a parallel orientation to the direction of travel. The tolerance of the gap between the deck planks should be 1/8 inch (1/8”) to 1/4 inch (1/4”) maximum. Engineering judgment should determine the deck board orientation and recommended board thickness.

3.4.10 Utility Adjustments: Refer to the DelDOT Road Design Manual, chapters 10 and 11, and the DelDOT Utilities Design Manual, which defines the policies and procedures regarding the relationships among the Department, the public, and private utilities in Delaware. In storm drain design, it is often possible to avoid conflicts with underground utilities by making minor adjustments in the line or grade of the storm drains, lines, and culverts. Consideration must be given to identify conflicts with any utility facilities during the design process to minimize costly relocations and conflicts. Additionally, utility relocations frequently delay the progress of construction and so should be avoided where possible.

3.4.11 Easements: Design solutions may determine that it is more beneficial to obtain an easement rather than to purchase additional right-of-way. A temporary easement should be obtained where it is not necessary to obtain permanent possession of the land or permanent right of access to the land. Temporary easements are appropriate:

- For any areas where the Department will not have any maintenance responsibility after the completion of the proposed project construction
- Where relatively flat cut or fill slopes extend beyond the right-of-way line and the lateral clear zone or for grading purposes that may benefit the property
- To obtain proper grade on private driveways and approaches
- For channel changes and inlet and outlet ditches at drainage structures where future maintenance is not anticipated
- For construction working areas

A permanent easement should be obtained where it is not necessary that the State own the land, but where perpetual interest is necessary. Examples are where the Department needs to access the property for future maintenance, repair, or replacement of the rail-trail facility, its drainage systems or appurtenances and as provided for in a project's right of way or railroad agreement.

A utility easement may be necessary when the sole purpose of the acquired property is to provide an area for the relocation of public or municipal utility facilities that must be relocated from the existing highway and/or railroad corridor as a direct result of the proposed project. A utility easement should be proposed only after consultation with design support personnel. This type of easement is primarily used in urban or highly developed areas where such an easement will minimize negative impact to adjoining privately owned properties and substantially decrease urban right-of-way costs.

3.4.12 RTT/RWT Facility Specifications Summary: Following is a summary of the specification recommendations made within this Plan from the guidance of AASHTO, MUTCD, DeDOT, DNREC, other FHWA resources, and the Rails-to-Trails Conservancy:

Pavement Thickness	Asphalt	4" (2 ½" base, 1 ½" surface)
	Concrete	4"
	Screenings	2"
Sub-Base Course		6" graded aggregate
Width (two-way shared-use)		8' min. 10'-12' preferred
Shoulders		2'-3'
Lateral Clearance		3'-5'
Selective Thinning		12' from edge of trail surface
Vertical Clearance		8' min. 10'-12' preferred
Striping (Centerline or Edge)		4", See Appendix F and MUTCD
Signing		See Appendix F and MUTCD
Cross Slope		2%
Separation from Roadway		5' (barrier required if less)
Design Speed		20-30 mph
Super-elevation		5% max.
Grades		5% (see section 3.4.7 for exceptions)
Barrier Posts (Bollards)		32"-36" high 5' max. on center
Railing/Fence Height		42"-48"
Bridge Decking	Width	Same as facility surface width
	Thickness	4"
	Orientation	90° or 45° (recommended)

3.5 SIGNAGE & MARKINGS

Adequate regulatory and warning signs and markings are essential on rail-trails, especially to alert bicyclists to potential conflicts and to convey regulatory messages to both bicyclists and motorists at trail-roadway intersections. Additionally, guide signs should be used in the same manner as on shared-use trails to indicate directions, destinations, distances, route numbers, and names of intersecting streets.

3.5.1 General: Appendix F is intended to be a compilation and summary of the general guidelines and standards provided by the Federal Highway Administration (FHWA) and the American Association of State Highway Transportation Officials (AASHTO) for typical RTT/RWT conditions. It is recommended that the following resources and this Plan be referred to in detail for the determination of the proper signage and use for the unique and specific design circumstances that commonly occur during RTT/RWT development. The following guidance and figures provided within Appendix F are from the MUTCD, 2003 Edition, Part 9, *Traffic Controls for Bicycle Facilities* and the AASHTO, *Guide for the Development of Bicycle Facilities*, 1999.

RTT/RWT signage not only occurs along the rail corridor itself, but also will include additional roadway signage for specified distances to provide advanced warning at the termination and/or intersection of the RTT/RWT corridor and any roadway that the facility may intersect. Refer to Part 2 of MUTCD for the mounting height and placement of on-road signage that is to serve both bicyclists and other road users. These instances are also identified in great detail within the Delaware Bicycle Facility Master Plan, 2005.

All bicycle facility roadway and rail-trail signage shall be retroreflectorized and meet the standard size, shape, legend, and color as specified in Table 9B-1 of MUTCD and the MUTCD *Standard Highway Signs manual*, 2004 (SHS Book).

The dimensions of RTT/RWT facility signs are typically smaller than roadway signs. It is authorized and recommended to use the larger roadway signs on rail-trails where the engineering judgment determines that added emphasis is warranted.

In the event that an overhead sign is to be used on a rail-trail, the clearance from the bottom edge of the sign to the path surface directly under the sign shall be a minimum of eight feet (8'). Ten feet (10') is recommended to accommodate a wider range of maintenance and emergency vehicles.

Following are the MUTCD definitions of the three (3) primary sign types that may be installed along or in conjunction with a RTT/RWT facility:

- **Regulatory Signs-** give notice to users of traffic laws or regulations.
- **Warning Signs-** give notice to users of a situation that might not be readily apparent.

- **Guide Signs-** show users route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information.

Figure 3.13 illustrates the horizontal and vertical placement of signage along rail-trail facilities. The use and location of these three sign types are described in detail in Appendix F of this Plan.

The following are a few examples of additional types of signage that may be useful to rail-trail users. It is recommended that during the RTT/RWT design development process the use of these signs be evaluated. Additionally, the need for installing or updating these types of signs should be periodically reevaluated as user volumes may increase on a particular constructed RTT/RWT or as new development occurs adjacent to the RTT/RWT facilities. These types of custom signing can also be helpful to encourage different user types to share the facility and to follow rail-trail user etiquette.

3.5.2 Tourist-Oriented Directional Signs: RTT/RWT facilities not only serve the local and regional population of users but as these facilities have continued to increase in popularity they are now inter/intra-national tourist attractions. Signs such as the one shown in Figure 3.18 inform the rail-trail user of local attractions, services, and facilities located along and within a reasonable distance from the RTT or RWT facility. Tourist-oriented directional signs are guide signs with one or more panels that display the business identification of and directional information for business, service, and activity facilities. DNREC has developed and installed similar signage along paved trails within the Bellevue State Park and Cape Henlopen State Park which provide directions to primary destinations and facilities within and adjacent to these parks.



Figure 3.18 Example Tourist-Oriented Directional Sign
Source: MUTCD, Figure 2G-1

3.5.3 Recreational and Cultural Interest Area Signs: Recreational or cultural interest areas are attractions or traffic generators that are open to the general public for the purpose of play, amusement, or relaxation. Recreational attractions include such facilities as parks,

campgrounds, and gaming facilities. Museums, art galleries, and historical buildings and sites are good examples of cultural attractions.

The purpose of recreation and cultural interest area signs (see Figure 3.19) is to guide rail-trail users to a general area and then to specific facilities or activities within the area.



Figure 3.19 Example Recreational and Cultural Interest Area Signs
Source: MUTCD, Figure 2H-5

3.5.4 Emergency Notification Signage: Emergency notification signs (see Figure 3.20) should be installed at areas where there is a potential for an incident to occur such as the signs shown in Figure 3.20 that are typically installed at all highway-rail grade crossings to provide for emergency notification. Other locations along a rail-trail facility that may potentially require this type of sign are ponds, lakes, and stream crossings. The sign should have a white message on blue background. The Department and the public or private landowners on whom the potential hazard is located should decide the location and placement cooperatively. These signs are typically located within the rail-trail right-of-way. These signs should convey a clear and simple message that is visible and understandable to all user groups.

DNREC currently posts emergency contact information at its trailheads. In addition to trailheads, location of these types of signs may be warranted, along the rail-trail facility, in the vicinity of intersecting connector trails or where the trail may be accessed by other intersecting bicycle facilities such as on-road bike routes. Development of rail-trail facilities presents many unique circumstances and installation of these sign types should be considered on a case-by-case basis.



Figure 3.20 Example Emergency Notification Signs
Source: MUTCD, Figure 8B-4

3.5.5 Trail Branding & Logos: A signage system with a prominent trail name and logo can raise a trail’s identity and visibility in the community. These can be placed at the trail access points and crossings. At access points and trailheads these logo signs can incorporate trail rules and regulations as shown in Figure 3.21.



Figure 3.21 Example Trail Logos
Source: Trails for the 21st Century, Figure 3.60

Additional benefits of developing a trail identity or logo are the marketing and revenue benefits that can be realized from increased tourism and product sales. These types of additional revenue have proven vital to the maintenance, general upkeep, and improvements of other rail-trails.

3.5.6 Markings: RTT/RWT facility markings and associated roadway markings should follow the guidance of AASHTO, MUTCD Part 9, and Appendix F of this Plan. If conditions make it desirable to separate two directions of travel on rail-trail facilities at particular locations, a solid yellow line should be used to indicate no passing and no traveling to the left of the line. It is not anticipated that the RTT/RWT facilities described in this Plan will require continuous striping but engineering judgment should determine if paved surfaces and striping would be beneficial in the following circumstances: (1) at trailheads, activity centers, and built-up areas where high volumes of bicycles and/or other users are anticipated, (2) at approaches and on curves with restricted sight distance (see Appendix F, Figure F.8.1), (3) on unlighted paths where nighttime riding is expected such as in more urban areas and resort and tourist areas, and (4) at the trail approach to railroad and high volume roadway crossings.

Striping should be broken where adequate passing sight distance exists, and solid in other locations such as through curves where passing by bicycles should be discouraged and sight distances may be limited. The Oregon Bicycle Pedestrian Plan states that attempts to separate pedestrians from cyclists with an additional painted lane have not proven successful and are not recommended. The use of the regulatory sign R9-7 and awareness of user etiquette alone can be successful.

Pavement markings at a trail-roadway crossings should accomplish two things: channel rail-trail users to cross at a clearly defined location and provide a clear message to motorists that this particular section of the road must be shared with other users. See Appendix F of this Plan for signing and marking standards for trail-roadway crossings. See Figures 3.31 and 3.32 for alternative marking and separation examples at trail-roadway

crossings that provide additional safety and increased visibility of rail-trail users to motorists.

Rail-trail facility stop bar markings and other pavement markings on paved facilities, including other devices should be used as applicable. Stop bar markings on a paved rail-trail facility shall be 8 inches (8") wide and half the width of the trail surface. Additionally, a clear message must be presented in a location where the motorist will see it as well. Traditional pavement marking treatments have included the pedestrian crosswalk lines, double 6 inch (6") lines spaced not less than the trail facility surface width, or flashing yellow lights at the crossings in limited visibility locations.

Engineering judgment should be used in determining the use of wider markings and/or alternative crossing treatments such as "traffic calming" elements at high volume trail-roadway intersections. These alternative crossing treatments are far more visible and effective of raising motorist awareness of the crossings. The trail facility crossing and markings on RWT facilities shall not interfere with the train dynamic envelope and/or markings see Figure 3.2.

3.6 FACILITY INTERSECTION ALIGNMENTS

3.6.1 Roadway Intersections: Intersections between paths and roadways are often the most critical issue in shared use path design and require considerable care. Although every intersection is a little different from the next, the AASHTO Guide identifies three basic categories of path-roadway intersection:

- mid-block crossings- where the rail-trail crosses a roadway away from existing intersections
- adjacent path- where the rail-trail crosses a roadway at an existing intersection
- complex- where other configurations exist

During rail-trail design there is usually not an option to select the most appropriate intersect type due to the fact that rail-trails are developed within the existing railroad corridor right-of-way and intersection design alternatives are limited. However, there may be circumstances or opportunities that will provide alternatives in selecting an intersection type through easements or other methods. If alternate locations or approach methods are available, the one with the most favorable intersection conditions should be selected. Although most trail-roadway intersections occur in more rural areas, there are instances where rail-roadway crossings occur within close proximity to other roadway intersections. Every effort should be made to locate the trail-roadway crossing a minimum distance of 100 feet (100') from other roadway intersections.

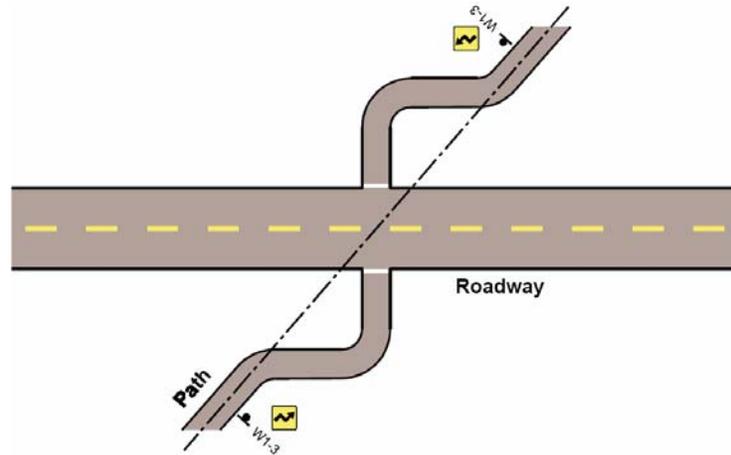


Figure 3.22 Example Rail-Trail Mid-Block Intersection

Source: AASHTO Guide for the Development of Bicycle Facilities, Figure 21

Another important consideration for mid-block crossings is the treatment for a skewed crossing. Figure 3.22 depicts a rail-trail realignment to achieve a 90 degree (90°) crossing. A minimum 45 degree (45°) crossing angle may be acceptable to minimize right-of-way requirements.

There are other elements that need to be considered in this type of crossing, including right of way assignment, appropriate traffic control devices, sight distance, refuge islands, and pavement markings.

Adjacent path intersections occur when the path is parallel to a roadway and it crosses a driveway or other intersecting roadway such as a T-intersection or a simple four-legged intersection. In designing this type of crossing it is important to keep the location close to the intersection. This allows the motorist and path user to recognize they are a part of the traffic mix and to be prepared to react accordingly. In this situation, it is important to clearly definite rights of way and the appropriate traffic control devices adjusted to reflect the addition of the rail-trail component in the intersection flow.

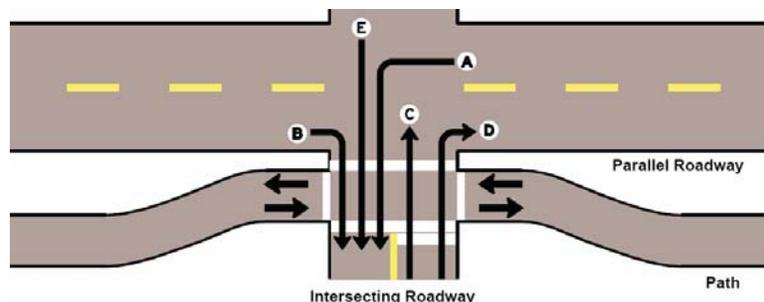


Figure 3.23 Example Adjacent Rail-Trail Intersection

Source: AASHTO Guide for the Development of Bicycle Facilities, Figure 21

With this configuration (see in Figure 3.23) the path user is faced with potential conflicts with motor vehicles turning left (A) and right (B) from the parallel roadway, and on the crossed roadway (C, D, and E). The major road may be either the parallel or crossed

roadway. Clear sight lines across corners are especially important. In a Type A turning movement, it may be advisable to prohibit permissive left turns on a high-volume parallel roadway and high use path crossings. For turning movement Type B, as small as practical corner turning radius may be required to reduce the speeds of motor vehicles. For Type C and D movements, it may be advisable to prohibit right-turns-on-red and place a stop bar in advance of the path crossing. To account for vehicle movement E, it may require an all-red phase to protect the path users.

Complex intersections are defined as all other types of intersections of rail-trails with roadways. These intersections are unique and must be developed with site specific design. Several alternative treatments are available such as moving the crossing, installing a traffic or warning signal, or providing a refuge island. Designers should insure that adequate signing is in place to alert both motorists and rail-trail users of their design intent. Figure 3.24 is a good example of how the RWT-roadway crossing has been relocated away from the limited visibility of the existing rail-roadway intersection in a very sharp turn.



Figure 3.24 Example Complex Rail-Trail Intersection

Source: Heritage Rail Trail County Park, York, PA

When intersections occur at grade, a major consideration is the establishment of right-of-way. The type of traffic control to be used (signal, stop sign, yield sign, etc.), and location, should be provided in accordance with the MUTCD. Care should be taken to ensure that rail-trail signs are located in such a manner that motorists are not confused by them and that roadway signs are placed so that they do not confuse rail-trail users. At crossings of high-volume, multi-lane arterial highways where signals are not warranted, consideration should be given to providing a median refuge area for the rail-trail user (see Appendix F, Figure F.8.6). Stopping sight distances at intersections should be checked and adequate warning should be given to permit bicyclists to stop before reaching the intersection, especially on downgrades.

When a rail-trail facility terminates at existing roads, it is important to integrate the rail-trail into the existing system of roadways and sidewalks, separating the different user groups accordingly. In the event that the rail-trail crosses a roadway with adjacent sidewalks, curb ramps at these intersections should be the same width as the rail-trail facility.

3.6.2 Rail Intersections: Special care must be taken wherever a rail-trail facility intersects railroad tracks. The most important design considerations at rail crossings for wheeled rail-trail users are smoothness, angle of crossing, and flange opening.

Concrete performs best under wet conditions and, when laid with precision, provides a smooth ride. Rubberized crossings (see Figure 3.28) provide a durable, smooth crossing, although they tend to become slippery when wet. If asphalt pavement is used, it must be maintained in order to prevent a ridge buildup next to the rails (see Figure 3.28). Timber crossings wear down rapidly and are slippery when wet.

The risk is kept to a minimum where the rail-trail crosses the tracks at a 90 degree (90°) angle. If the skew angle is less than 45 degrees (45°), special attention should be given to the rail-trail alignment to improve the angle of the approach, preferably to 60 degrees (60°) or greater, so cyclists can avoid catching their wheels in the flange opening and losing their balance (see Figure 3.25).

Trails that cross railroads pose potential hazards to all trail users, but particularly those who rely on wheeled forms of mobility because the size of the open flangeway area of typically 2 inches (2") exceeds the recommended width of ½ inch (½") for openings. The open flangeway gap should be kept to a minimum. Getting a wheel caught in the flangeway gap is a safety hazard and can cause the wheeled user to lose balance and fall.

To minimize the impact of the flangeway gap, it is important that trails should intersect the tracks at a right angle. Additionally, the following design strategies should be used:

- Approaches to the track and the area between the tracks should be raised to the level of the top of the rail because rail ties that are not flush with the travel surface create a tripping hazard, in addition to the gap hazard. A surface material that will not buckle, expand, or contract significantly (e.g., textured rubber railroad crossing pads) should be used
- Approaches to the track should be ramped with minimal grades and should be flat for a distance of 5 feet (5') on either side of the tracks, free of obstacles, and have a firm and stable surface

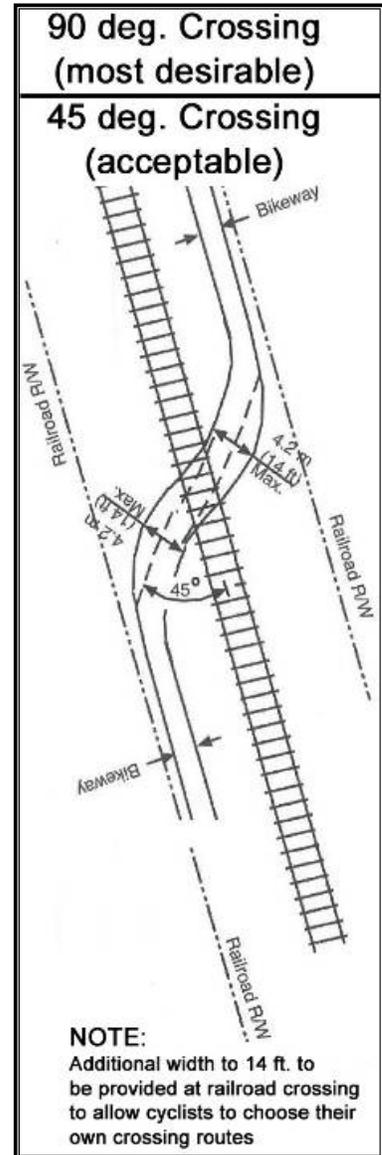


Figure 3.25
Example Trail-Railroad Crossing
 Source: AASHTO (modified)

- For recreation trails, the trail surface should be hardened to reduce the debris that scatters over the tracks as users pass
- Sight lines and signage should ensure that all users, and particularly those with disabilities affecting hearing, vision, or mobility impairments, have adequate warning about the intersection
- Signals and/or gates should be considered to warn trail users of the rail crossing

Currently there are no design strategies that can completely eliminate the flangway gap for high speed, regulation size trains. The flangway gaps can be closed for low speed and light rail tracks with the use of a “flangway filler” as shown in Figure 3.26. The flangway fillers provide a level surface for rail-trail users and deflect downward with the weight of the train and do not affect low speed rail function. The combination of smoothness, angle, and flange opening create conditions that affect the wheeled user. By improving smoothness and flange opening, the angle becomes less critical.

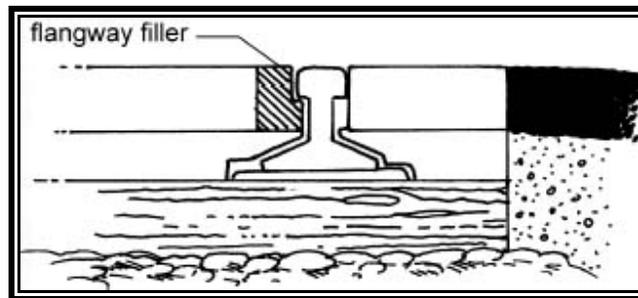


Figure 3.26 Example Open Flangway Filler

Source: FHWA, Designing Sidewalks and Trails for Access, Part 2, Figure 16-14



Figure 3.27 Example RWT Railroad Crossing Alignment

Source: FHWA, Designing Sidewalks and Trails for Access, Part 2

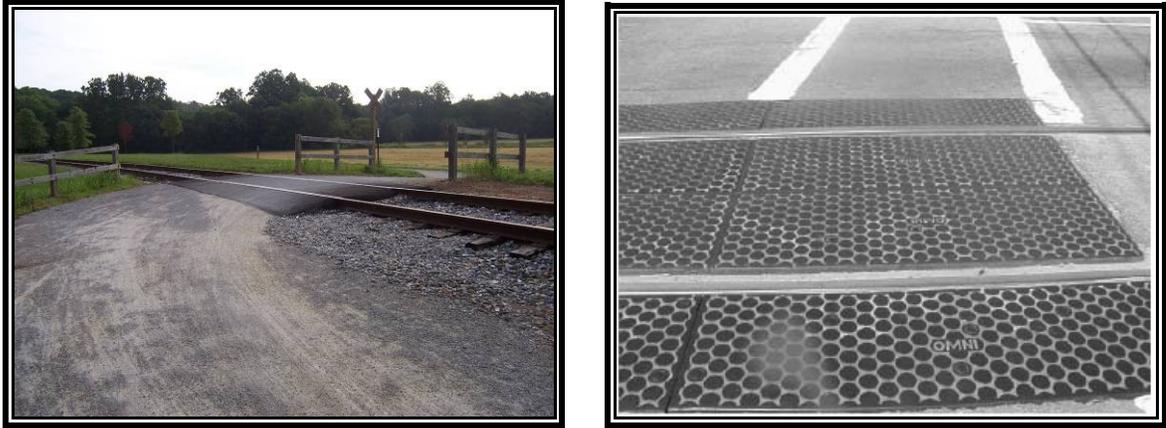


Figure 3.28 Example RWT Railroad Crossing Materials

Source: Heritage Rail Trail County Park, York, PA (left), and FHWA, Designing Sidewalks and Trails for Access, Part 2, Figure 16-1 (right)

3.7 SAFETY & SECURITY

Safety concerns should be at the forefront of the design process by applying well thought out and previously established risk management strategies. Just as important as safety in design is safety through proper and routine maintenance practices. In addition to the safety and security issues previously discussing in this Plan, following are some other safety and security related topics.

3.7.1 Mileage Markers: Mileage markers such as those shown in Figure 3.29 provide the user the ability to gage the distance of their travel as well as assist in determining their location along the RTT/RWT facility. But most importantly, as on highways, the mileage markers provide the user the ability to identify and report their location in the event of an emergency. Mileage markers have been installed using a wide range of materials from concrete and granite to treated lumber. Installation of mileage markers have in the past been a relatively simple way to get the community involved which in turn not only gives the community a sense of contribution but it helps instill a sense of ownership which can provide a great payoff relative to the security and monitoring of the rail-trail facility. Some case studies have shown that great savings have been realized on the cost of material and labor by involving the volunteer efforts of community organizations such as the Boy Scouts and Girl Scouts of America.



Figure 3.29 Example RTT/RWT Mileage Markers

Source: Genesee Transportation Council Regional Trails Initiative Action Plan

3.7.2 Railings: Low forms of edge protection, such as curbs, are not recommended on rail-trails because of the risks that they pose to bicyclists and other wheeled users. If edge protection is required, then it should be in the form of a railing. The minimum railing height on a rail-trail facility should be 42 inches (42”) to 48 inches (48”). See DelDOT Standard Detail M-5 (2004) for the wood rail fence detail. In some situations, it may also be beneficial to provide a gripping surface for pedestrian use in addition to the protective railing. If a handrail is included as part of the railing design, it should meet the specifications in ADAAG 4.26.

Good examples of proper railing applications on rail-trail facilities are illustrated in Figures 3.4, 3.6, 3.16, and 3.17.

3.7.3 Fencing: Fences should normally be considered under one or more of the following conditions:

- Where access restrictions to adjacent property have been identified through community and stakeholder input obtained during the planning process
- Replacement fence where an existing fence was removed because of right-of-way widening or for trail construction purposes
- For locations where there is a need for rail-trail user safety for locations such as at culverts, bridge approaches, other hazards, and for RWT train-user separation barriers

Fence height should be a minimum of 42 inches (42”) to prevent bicyclist from flipping over the fence. The location of fencing typically depends on who will assume the ownership and maintenance responsibility, 1 foot (1’) inside the right of way for DelDOT and 1 foot (1’) outside if by others. The responsibility for installing and maintaining fencing varies and shall be determined during the planning process. It is recommended that fencing installation and maintenance agreements follow the guidance of the DelDOT Road Design Manual. The type of fencing will depend on the characteristics and use of the adjacent property while ensuring to meet the safety requirements for all users.

3.7.4 Restricting Vehicular Access: Rail-trail facilities need some form of physical barrier at roadway intersections to prevent unauthorized motor vehicles from accessing the facilities. Provisions can be made for a break-away, lockable, or removable bollard to permit entrance by authorized vehicles. The bollard should be permanently reflectorized for nighttime visibility and painted a bright color for improved daytime visibility.

Bollards should be between 32 inches (32”) and 36 inches (36”) tall and placed 5 feet (5’) on center in a 3-bollard arrangement (see Fig.3.30). Wider spacing can allow entry to motor vehicles, while narrower spacing might prevent entry by adult tricycles and bicycles with trailers. DelDOT and/or DNREC shall review the bollard style, color, and location selection on a case-by-case basis. See Appendix C for photographs of collapsible bollards that DNREC has installed on the Junction & Breakwater Trail. Also, see Appendix A for bollard installation details developed by DNREC. An alternative method of restricting entry of motor vehicles is to split the entryway into two 5 foot (5’) sections separated by

low landscaping. Emergency vehicles can still enter if necessary by straddling the landscaping (see Figure 3.31). The higher maintenance costs associated with landscaping should be considered.

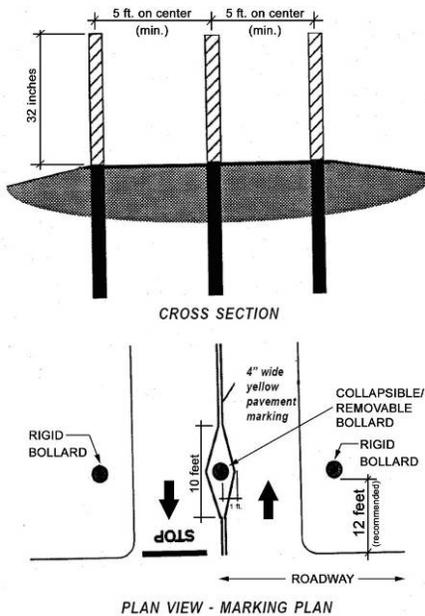


Figure 3.30 Bollard Placement and Markings

Source: California Highway Design Manual, 1987 (modified)

Appendix F, Figure F.8.3 illustrates bollard placement and markings at trail-roadway intersections. The bollards are recommended to be placed 12 feet (12') from the edge of road to allow emergency and maintenance vehicles to park off of the roadway while unlocking or removing the necessary bollards to access the trail facility. Where arrows are needed on rail-trails to clearly indicate the proper direction of travel, half-size layouts of the arrows may be used (see MUTCD, Section 3B.19). Centerline pavement striping should be used to increase the visibility of bollards located in the center of the trail (see Figure 3.30 and Appendix F for proper markings).

The ability for unauthorized vehicular access to the trail adjacent to the location of the outside bollards should also be evaluated during the design process. In many cases the areas adjacent to the outside bollards provide the opportunity to incorporate more attractive access barriers through the use landscape beds with trees, boulders and ornamental lighting. These barrier methods not only beautify the access point but also provide a vehicular barrier and can potentially increase the visibility of the access point, which are roadway crossings in many cases.

3.7.5 Refuge Areas & Traffic Calming Devices: Some of the alternative traffic calming treatments that could be incorporated into a rail-trail/roadway intersection to increase user safety and visibility include: raised platform crossings, neck-downs, two lane chokers, and center islands with refuges. The use of these alternatives should be considered on a case-by-case basis and should always be evaluated with regard to the safest overall method for

accommodating both the rail-trail users and roadway users. See the DeIDOT *Traffic Calming Manual* for guidance on potential applications and treatments.

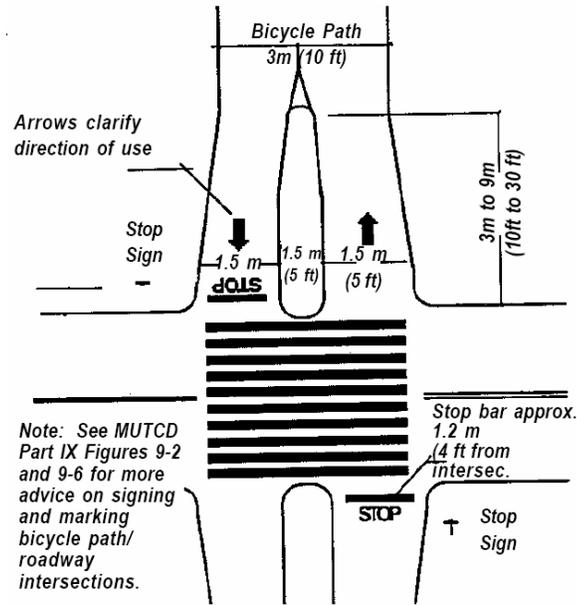


Figure 3.31 Alternative Approach to Trail-Roadway Crossings
Source: FHWA Bike/Ped Transportation Course & NCDOT

Figures 3.31 and 3.32 illustrates the installation of increased striping at the roadway crossing and split islands on the rail-trail facility that deter motor vehicle access, increase visibility, and clearly delineate the rail-trail user direction of travel which help to eliminate user conflicts within the roadway or shoulder.



Figure 3.32 Example Trail-Roadway Crossing Improvements
Source: FHWA Bike/Ped Transportation Course

3.7.6 Security: Many security problems on rail-trails occur at the trailhead itself. To increase security, consideration should be given to providing adequate lighting in the parking lot areas or eliminate night time access to the trailhead by installing gates at the entrance.

Installation of emergency telephones or call box systems should be considered for measured points along the rail-trail, especially in remote areas. Landscaping is also a factor in user safety; vegetation adjacent to the trail can easily serve to hide potential offenders. Proper selective thinning can address this issue as well as good design and maintenance of new planting areas.

The rail-trail corridor should be able to accommodate security, safety, and other emergency equipment, including fire trucks and ambulances. If trail security turns out to be a problem or is perceived as a problem, then consideration should be given to arranging a trail patrol. Although most rail-trails, multi-use trails, and other shared-use trails do not have organized patrols, regular patrols can serve some useful functions. A trail patrol's primary function is to provide assistance and information, not to actually apprehend criminals. If a serious crime or incident does occur, members of the patrol can contact emergency services. Successful trail patrols have been comprised of managing agency staff, local police, volunteers, or a combination of these.

According to the most comprehensive study conducted to date, "The Impacts of Rail-Trails", no negative effect on property values has been found, and in some cases property values have increased. The findings indicate that typically homes adjacent to a trail showed no increase or decrease, but those located a block from the trail realized a 6 percent (6%) increase in property values according to the local real estate agents that were interviewed. Furthermore, the residents and landowners that were interviewed consistently stated that they believe the trails either increased or had no effect on their property values. In many locations, the home-sale advertisements promote the properties' proximity to trails as a selling point.

Another common concern by landowners adjacent to a trail is their liability. They typically fear that a trail user will wander onto their property, get injured, and then sue the landowner for liability. Case studies have indicated that liability has not been much of a problem on multi-use trails. This is primarily due to the fact that that a person entering an adjacent landowner's property is considered a trespasser, and the landowner owes limited duty of care to a trespasser.

3.8 MAINTENANCE & MANAGEMENT

Designing for maintenance up front, completing regular maintenance tasks, planning for liability protection, and undertaking measures to maximize user safety will ensure a safe, well-used RTT/RWT facility. *Trails for the 21st Century* points out that the lesson is that maintenance costs are best addressed through prevention- by spending money during the design phase to avoid management problems later. For example, the single biggest cause of maintenance-related safety

problems is drainage, and fixing damage caused by drainage is often the biggest line item in a maintenance budget. The solution is to solve drainage problems before a rail-trail is built by including proper drainage facilities in the rail-trail design. In the long run, it will be money well spent.

Following is a typical list of rail-trail items that require routine maintenance:

- Inspect and replace signage
- Repaint pavement markings
- Sight distance vegetation trimming
- Vegetation selective thinning
- Trail surface repair of holes and cracks
- Clean out drainage systems
- Debris removal (leaves, gravel, limbs, trees, etc.)
- Rail-trail shoulder mowing and other areas
- Trash receptacle pick up
- Site furniture cleaning and repair
- Restroom and drinking fountain cleaning and repair
- Graffiti removal
- Structure inspections and repair
- Lighting cleaning and replacement
- Weed control spraying
- Snow and ice removal
- Emergency telephone inspection and repair

The two most important safety related maintenance tasks are typically sign and marking upkeep and sight distance and clearance maintenance.

For shared use paths, attention should be given to maintaining the full paved width and not allowing the edges to ravel. Trees, shrubs and other vegetation should be controlled to provide adequate clearances and sight distances. Trash receptacles should be placed and maintained at convenient locations. Seeded and sodded areas in the vicinity of shared use paths should be mowed regularly. Snow plowing should be used to remove snow from bikeways because de-icing agents and abrasives can damage bicycles. Also, enforcement is often necessary to prevent unauthorized motor vehicles from using a shared use path.

4.0 AGENCY ROLE & PROGRAM INVENTORY

4.1 RELATED PROGRAMS, POLICIES, & FUNDING MECHANISMS

4.1.1 DelDOT's Role:

- **Planning-** Staff awareness of the planning status of the RTT/RWT facilities identified in this plan allows them to begin to evaluate their integration into existing and proposed bicycle facility projects, roadway projects, and right-of-way requirements. This Plan will also improve developer awareness by informing them of facility improvements required for access and spur trail development and allowing DelDOT to provide developers with important information affecting their property.
- **Design.** This Plan is developed to provide design details and standards for the development of RTT/RWT facilities within the state of Delaware, to provide a Master Plan that meets the requirements for funding sources/programs, and to provide a document that can be integrated and referred to during the development of other bicycle facility and roadway projects. If it is determined during the planning process of a RTT/RWT, bicycle facility, or roadway project that the design guidelines/standards provided or referenced in this Plan cannot be achieved, then a design waiver is to be obtained (see Section 4.2)
- **Construction.** As stated in the Bicycle Master Plan, interviews with the construction staff of the DelDOT Transportation Solutions section revealed that the ability to implement RTT/RWT facilities properly is contingent on the design plans. By making construction staff aware of RTT/RWT facilities planned for construction, they should have a better understanding of the significance of site-specific facility improvements/requirements. This, in turn, should assist them when it is necessary to make facility modifications to adapt to conditions in the field.

4.1.2 Funding Facility Improvements: There are a number of funding sources available for RTT/RWT facility design, construction, and improvements. See the Delaware Bicycle Facility Master Plan, Table 5.1 for descriptions of federal funding programs available for bicycle facilities, which include RTT/RWT facilities. The following descriptions of primary funding sources/programs are from the Bicycle Facility Master Plan:

- **Federal transportation funds:** Bicycle projects are broadly eligible for funding from a large number of federal highway, transit, safety, and other programs. Bicycle projects funded through federal transportation programs must be "principally for transportation, rather than recreation, purposes" and must be designed and located pursuant to the transportation plans required of states and Metropolitan Planning Organizations (MPO). Table 5.2 of the Bicycle Master Plan shows how federal funding sources may be applied to specific bicycle facility improvements. In general, and with a few exceptions, the federal share of the costs for transportation projects is 80% with a 20% state or local match.

- **Transportation Enhancement funds:** DelDOT has a Transportation Enhancement (TE) program which builds off of the federal funded program. DelDOT's TE program has been used extensively to implement shared-use path improvements throughout the state. Projects up to \$1,000,000 are eligible for funding under this program, provided that the sponsors (local or private) are able to match 20% of the funds. (For every \$100,000 less than \$1,000,000, the sponsor's required match decreases by 2%.)
- **Developer easements and in-kind donations:** Developers with projects adjoining designated bikeways may be able to provide an alternative funding source for bicycle facility improvements. For example, developers may be requested to provide right-of-way for bikeways fronting their properties. Alternatively, developments that include shared use trails may be requested to provide connector trails to on-street bikeways and RTT/RWT facilities. Coordination between DelDOT and developers may provide other opportunities for improving on-road and off-road bicycle facilities while sharing costs among DelDOT, developers, and local municipalities.

4.1.3 Municipality's Role: DNREC has been coordinating with several municipalities within Delaware to begin development of their RTT facility segments. These potential facilities are located on some of the corridors discussed in this Plan. This will help provide a jump-start for the design development process of these facilities using the **Delaware Land and Water Conservation Trust Fund (DTF) program**. The DTF program was established to provide an annual source of funding for the acquisition of open space and development of outdoor recreation facilities for municipal and county governments. Currently, \$750,000 is generated annually to provide matching grants for the Greenway and Trail Grant Program. As established in the Trust Fund legislation all county and municipal governments and park districts are eligible to receive financial assistance.

4.1.4 Department of Natural Resources and Environmental Control (DNREC): As the caretaker of Delaware's state parks, wildlife refuges, and natural areas, DNREC is responsible for the majority of the shared-use trails in the State of Delaware. Coordination between DNREC and DelDOT will ensure that appropriate connections are made between recreational trails and the statewide bicycle routes, regional bicycle routes, recreational connectors of this Plan, and subdivision developments. The Council on Greenways and Trails serves to advise the DNREC Secretary on the protection of greenway conservation corridors and trail development. DelDOT is represented on this Council.

4.1.5 Delaware Bicycle Council: The stated role of the Delaware Bicycle Council is to advise state agencies regarding bicycle issues. DelDOT is represented on the Council, and will keep its members informed of the progress being made in implementing this Plan. As the Delaware Bicycle Council receives feedback from bicycle groups around the state, it will be able to advise DelDOT on issues associated with on-road bikeways and their associated facilities.

4.1.6 Metropolitan Planning Organizations (MPOs): The two Metropolitan Planning Organizations located in Delaware are WILMAPCO and the Dover-Kent MPO. Both of these agencies conduct area and corridor studies regarding pedestrian and bicycle needs. In addition, WILMAPCO maintains a Nonmotorized Working Group to advise WILMAPCO on pedestrian and bicycle issues associated with its Long Range Transportation Plan and Transportation Improvement Program (TIP). All projects selected by the MPOs for inclusion in the TIP are coordinated with the DelDOT Capital Transportation Program. This Master Plan will assist the MPOs by letting them know where RTT/RWT facilities have been studied and their recommended prioritization for inclusion as part of the overall list of TIP projects.

4.1.7 Delaware Transit Corporation: The Delaware Transit Corporation (DTC) currently has two programs that facilitate inter-modal connections between bicycles and transit facilities. First, DTC provides bicycle lockers and bicycle racks at park and ride facilities and rail stations. Second, some DTC buses are equipped with bicycle racks, allowing transit patrons to ride their bicycles at both ends of their journey. By including RTT/RWT facilities along with designated on-street bicycle routes, this Plan should help DTC determine which of their transit stations should be equipped with bicycle storage facilities. Coordination with DTC will also make it possible to identify, fund, and implement improved bicycle connections to transit stations. The Bicycle Master Plan recommends that DTC provide bicycle racks on more of its bus fleet, especially in New Castle County. This would be of great utility to less experienced cyclists, who may use transit to bypass on-road facilities with more challenging cycling conditions to provide connections between different RTT facilities. DTC manages the following State-owned railroad corridors: New Castle Industrial Track, Georgetown-Lewes Running Track, and the Ellendale-Milton Industrial Track.

4.1.8 Department of Education: The Bicycle Master Plan states that the Department of Education is currently working with DelDOT to implement the Delaware Safe Routes to School (SR2S) Pilot Project. As part of this project, DelDOT, the Department of Education, and members of the Safe Routes Committee will select six pilot school sites where SR2S programs will be implemented. Grants of \$10,000 to \$15,000 will be provided to pilot schools for Safe Routes activities (community meetings, etc.) and physical improvements. DelDOT will also coordinate with the Department of Education to ensure it is aware of all existing and proposed schools served by Statewide Bicycle Routes, Regional Bicycle Routes, and Recreational Connectors. The presence of schools will be one consideration when prioritizing RTT/RWT implementation.

4.2 DESIGN WAIVER IMPLEMENTATION

The following information was obtained during the development of the Bicycle Master Plan. The design guidelines proposed for Statewide Bicycle Routes, Regional Bicycle Routes, Recreational Connectors and RTT/RWT facilities can typically be accommodated within the recommended right-of-way; however, there may be instances where site specific conditions would make the

application of these standards difficult (if not impossible). In such instances, a design waiver from the guidelines is required.

4.2.1 Purpose: In order for this plan to be successful, it is important that the RTT/RWT facilities are held to the intended design guidelines of this Plan. However, it is recognized that instances may arise where it is not possible to meet the design guidelines of the RTT/RWT Facility Master Plan. Where constraints occur, rather than eliminating the development of the facility, there is an expectation that DelDOT planning and design staff will coordinate to propose mitigation that allows for RTT/RWT and other bicycle facility development and connectivity. Where the Plan recommendation cannot be met, it will be necessary for the Project Engineer to request/obtain a waiver from the design guidelines. This section documents the procedure for obtaining approval for a waiver as developed in the Bicycle Master Plan.

4.2.2 Determining Factors: Efforts are to be made to comply with these design guidelines of this Plan, however, if they cannot be met, the justification to seek a waiver will need to be prepared by the DelDOT Project Engineer. The first step is for the Project Engineer to prepare written documentation of the project and the setting in which the waiver is sought. The documentation should explain:

- Existing corridor characteristics including the planned or existing bike facility and roadway characteristics connecting to or intersecting the project
- Information on the implementation status of RTT/RWT facility affected
- Cross section comparing existing and proposed conditions
- Effect on right-of-way
- Environmental constraints
- Other pertinent factors

4.2.3 Mitigation Plan: Where the design guidelines of this Plan cannot be met, Design Staff must still provide alternative facility improvements for the affected area. Information on the proposed alternative facility improvement for the area of the waiver must be provided.

The second step is for the Design Engineer to submit a mitigation plan to support the proposed request for a Design Waiver. The mitigation plan must explain what will be done to improve design conditions in lieu of meeting the Facility Plan design guidelines for the RTT/RWT facility that is planned.

The third step is for the Project Engineer to submit the application for waiver and proposed mitigation plan to the DelDOT Bicycle and Pedestrian Coordinator for his/her reviews and input. Any comments from the Bicycle and Pedestrian Coordinator on the waiver and the mitigation plan are to be considered by the Project Engineer.

When the Project Engineer and the Bike/Pedestrian Coordinator are in agreement, the waiver and mitigation plan are to be added and become part of the project documentation for design.

If needed, a fourth step applies when there is not agreement regarding the need for the waiver or the proposed mitigation. The documentation for the waiver and the mitigation plan with Coordinator comments are to be submitted to the Director of Planning and the Chief Engineer for resolution. The matter is to be referred to the Secretary of Transportation for final disposition if the Director and Chief Engineer cannot reach concurrence.